1961

Discrimination without awareness in a psychophysical task

BOSTON UNIVERSITY

GRADUATE SCHOOL

Dissertation

DISCRIMINATION WITHOUT AWARENESS IN A PSYCHOPHYSICAL TASK

Preston Davis, Jr.

(B.A., Wesleyan University, 1941;
A.M., Boston University, 1955)

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

1961

Approved by the Committee:

Chairman Austin W. Berkeley
Professor of Psychology

Henry Weinberg
Associate Professor of Psychology

John D. Sullivan
Associate Professor of Psychology

TABLE OF CONTENTS

		Page
I	INTRODUCTION	1
II	HISTORY AND BACKGROUND	5
	Subjective-Introspective Studies	5
	Objective-Behaviorist Studies	9
	Dynamic-Psychoanalytic Studies	16
	Discussion: Restrictions of the Situation .	17
III	RATIONALE AND GENERAL METHOD	27
	The Psychophysical Task	31
IV	PRELIMINARY TEST	
	Apparatus	35
	Subjects	37
	Procedure	37
	Results	38
	Summary	39
V	EXPERIMENT I	40
	Apparatus	40
	Subjects	46
	Procedure	47
	Results	52
	Discussion	55
	Summary	59
VI	EXPERIMENT II	60
	Apparatus	63
	Subjects	65
	Procedure	66
	Results	70
	Discussion	80
	Summary	87
VII	CONCLUSIONS	89
	The Assumptions Reviewed	90
	A View of the Process	93

Page

VIII SUMMARY 105

APPENDICES

A. Experiment I: Sample Order of Stimulus Presentations 110

B. Experiment I: Frequency of Correct Judgments 111

C. Experiment I: Analysis of Variance 112

D. Experiment II: Table of Data 115

E. Experiment II: Analysis of Variance 117

F. Latencies of Thirteen "Influenced" Subjects 118

BIBLIOGRAPHY 120

ABSTRACT 126

AUTOBIOGRAPHY 129

LIST OF TABLES

		Page
I	Classification of Studies	21
II	Agreement with Each of Two Incidental Stimuli for Male and Female Groups Judging Mid-Stimulus	75
III	Judgments of Stimuli Larger and Smaller than Standard in Presence of Appropriate and Control Incidental Stimuli	76
IV	Judgments of Stimuli Larger and Smaller than Standard in Presence of Appropriate and Control Incidental Stimuli among Influenced and Non-Influenced Subjects	78
V	Mean Latencies of Judging Mid-Stimulus in Agreement or Disagreement with Two Incidental Stimuli among Influenced and Non-Influenced Subjects	80

LIST OF FIGURES

FIGURE		Page
1.	The Apparatus	41
2.	Tachistoscope Timer: Circuit Diagram	42
3.	General Control Circuit	43
4.	Sample Stimulus Slides	45
5.	Experiment I. Group Psychometric Function: Three Subjects	54
6.	Tachistoscope as Used in Experiment II	64
7.	Experiment II. Stimulus No. 6. Subjects' Frequencies of Agreement with Flashed "greater"	72
8.	Experiment II. Stimulus No. 6. Subjects' Frequencies of Agreement with Flashed "smaller"	73
9.	Experiment II. Stimulus No. 6. Subjects' Frequencies of Agreement with Both Flashed Stimuli	74

CHAPTER I

INTRODUCTION

Human beings are observed to respond to stimulation of whose presence they are unaware. Indeed, if responses are considered to include even the most trifling and inconsequential kinds, and if stimulation is considered to include both interoceptive and exteroceptive varieties, individuals are aware of only a small number of the stimulus-response relationships in their own behavior.[1,2] Yet laboratory research upon unnoticed, incidental stimulation is still at a comparatively primitive stage.

In classifying laboratory studies of behavior without awareness, Adams[3] points out that the lack of awareness may be with respect to any of a number of aspects of behavior which we usually assume to be present in awareness. S may be unaware of his own actions, as in unconscious whispering. He may be unaware of a systematic relationship which exists or is being formed between his behavior and

---

[1] "We recognize a face without noting the specific features; we throw and catch balls when their trajectories are far too complex for a physicist to predict." (G. S. Klein, On subliminal activation, J. Nerv. Ment. Dis., 128, 1959, p. 296.)

[2] "Even most complex, ordered thought processes take place without the participation of consciousness." (D. Rapaport, Toward a theory of thinking, in D. Rapaport, Ed., Organization and Pathology of Thought, 1951, p. 718.)

[3] J. K. Adams, Laboratory studies of behavior without awareness, Psychol. Bull., 54, 1957, 383-405.

some environmental events, as through reinforcement of a verbal response.[1] He may be trying to discriminate stimuli, but have no confidence that his discriminations are successful, as in fact they are. Finally, he may fail to have the sensory experiences that usually accompany a given kind of stimulation. It is with the last of these cases that the present paper is concerned.

The quest for "subliminal" effects, defined as a correlation of response with stimulus characteristics which S intends to discriminate but is totally unable to discriminate consciously, seems likely to fail.[2,3,4] More promising, and also more relevant to life outside the perceptual laboratory, is the investigation of responses to stimuli which are meaningful to S, but of whose existence (in a form in which they may carry cue value) he never becomes aware.

It should be pointed out that such stimulation is frequently supraliminal[5] in the sense that it is quite strong

---

[1] See L. Krasner, Studies of the conditioning of verbal behavior, Psychol. Bull., 55, 1958, 148-170.

[2] C. W. Eriksen, Subception: fact or artifact? Psychol. Rev., 63, 1956, 74-80.

[3] I. Goldiamond, Indicators of perception: I. Subliminal perception, subception, unconscious perception: an analysis in terms of psychophysical indicator methodology, Psychol. Bull., 55, 1958, 373-411.

[4] G. S. Klein, op. cit.

[5] "Certain stimuli may be well above the threshold and yet be 'subliminal' in the sense that they cannot be reported on under certain experimental conditions." (J. V. McCon-

enough for S, if he were fully attending to it, to report its presence accurately and perhaps to discriminate its cue-significance as well.

Stimulation which impinges upon S's receptors, but on which he does not focus his intention to discriminate, will be called (following Klein[1]) incidental stimulation. It may be noticed or unnoticed, as defined by S's ability or inability to report its occurrence under appropriate instructions.

The present research was undertaken in order to study further the conditions under which behavior may be influenced through unnoticed incidental stimulation. The classes of stimulation employed form one variable under study. The classes of behavior which may show the influence form another. A further aim was to differentiate degrees of such influence, thus pointing the way toward more satisfactory quantification in this field.

The area of this study was further narrowed down to include situations where (1) S is attending effortfully

---

nell, R. L. Cutler, and E. B. McNeil, Subliminal stimulation: an overview, Amer. Psychologist, 13, 1958, 229-242.) The present writer prefers not to use "subliminal" with such a referent. For situations in which incidental stimulation has also been truly subliminal, see the following reports, which will be discussed in Chapter II below: N. F. Dixon, The effect of subliminal stimulation upon autonomic and verbal behavior, J. Abn. Soc. Psychol., 57, 1958, 29-36; F. H. Goldberg, H. Fiss, and G. S. Klein, Effects of an undiscriminated stimulus on imagery (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

[1] Op. cit., p. 299.

and objectively to a concurrent task of discrimination; (2) S responds immediately and in a constrained fashion to that task; (3) the unnoticed incidental stimulation constitutes a cue of a class to which S is not consciously prepared to respond; (4) this cue is such as to present or dictate a response to the task; and (5) the stimuli in use are not known to be systematically affect-related. These points will be considered in greater detail in the last section of Chapter II below (pages 17-26).

CHAPTER II

HISTORY AND BACKGROUND

The chief interest of this review is in studies bearing on response to stimulation of which S is unaware. Some other closely related material will also be cited. The general field is divided, for convenience, into three groups reflecting the subjective-introspective, the objective-behaviorist, and the dynamic-psychoanalytic approaches.

Subjective-Introspective Studies

Pillsbury[1] examined in detail the responses made by sophisticated observers to tachistoscopic presentations of words. He recognized that active apperception[2] is the controlling factor in recognition. Wundt's view of mental processes as associations of elements was inadequate, for the perception of individual letters depended on the perception of the word. When the percept "arrives," there occurs a sense of relief or cessation of strain. The percept is unified with the rest of our experience, often in a faulty or illogical way. Finally, and perhaps more to the

---

[1] W. B. Pillsbury, A study in apperception, Amer. J. Psychol., 8, 1897, 315-393.

[2] "Apperception: n. 1. The final stage of attentive perception in which something is clearly apprehended and thus is relatively prominent in awareness. ...Apperception is defined in terms of the outmoded psychology of mental content, but the facts referred to are important and deserve restatement in terms of behavior or performance." (H. B. English and A. C. English, A Comprehensive Dictionary of Psychological and Psychoanalytical Terms, 1958, pp. 37-38.)

present purpose:

> "It seems...we can have a sensation of so little interest in itself, and with associations of such great interest, that it comes to consciousness only in and through the complex process that it excites."[1]

In a paper on the primary awareness of stimulation (pre-sensation), Bichowsky[2] reported several points of interest to the present study. The pre-sensation is a sort of feeling on the basis of which perception develops. It may give rise to a range of perceptual or imaginal contents, depending on other processes current in the organism. It may fail to give rise to its normally corresponding sensation, when the latter is inhibited by the "higher" activities of consciousness. In particular, this may occur when the chief conscious perceptual activity is especially susceptible to stimulation, so that (the energy of) the low-level stimulation is drained off into that activity and not <u>via</u> its normal path into conscious sensation. But even when its sensation is thus inhibited, the pre-sensation still exists and, at least sometimes, has an evident effect upon the general affective tone. Thus, an observer who is attending to the sight of an apple reports it more pleasant when in the presence of a slight, unreportable fruity odor than when in the presence of a slight unreportable putrid

---

[1] Pillsbury, <u>op. cit.</u>, pp. 379-380.

[2] F. R. Bichowsky, The mechanism of consciousness: the pre-sensation, <u>Amer. J. Psychol.</u>, 36, 1925, 588-596.

odor.[1] When two incongruous stimuli occur, the first effect on consciousness is not that of two stimuli but of a single fused pre-sensation partaking of the quality of both modalities; it is accompanied by a decided emotional tone, normally unpleasant.

Cattell[2] presented a more controlled and detailed study of much the same ground, together with the objective measure of psychogalvanic response. He drew a continuum of states of consciousness from the highly objective to the completely subjective; in the latter, nothing is conscious but pure sensation. The possible relevance for perception without awareness is apparent in two of his conclusions:

> "(e) In highly subjective states there is a tendency for remote memories to appear spontaneously and in completely subjective states there is absence of memory. Afterwards there is great difficulty in recalling the nature of the experience lived in the subjective state.
>
> "(f) In highly subjective conditions there is an absence of normal will control and both the feeling and conation which may be aroused tend to develop inordinately."[3]

Cattell directed attention in particular to experience which is not contemplated or cognised objectively. Where

---

[1] Presumably Bichowsky's S would be aware that odors were being or could be presented; hence, the specific criteria for the present study would not be met.

[2] R. B. Cattell, The subjective character of cognition and the pre-sensational development of perception. Brit. J. Psychol. Monogr. Suppl., XIV, 1930.

[3] Ibid., p. 88.

experience has this characteristic, the organism seems to respond in a reflex or instinctive manner. The failure of such experience to be registered in memory, thought Cattell, may account for much of what is called repression.

(This observation suggests a problem related to the area under review. If S responds to a stimulus and, under questioning, reports unawareness of it, was he perhaps momentarily aware of it, then immediately repressing any memory of the awareness? If the memory proves absolutely non-recoverable, then the question is patently unanswerable. The memory may yet, however, prove to be recoverable by some means. If this were the case, the focus of investigation would probably shift from perception as such to a combination of perception and the means of recovery.)

These authors, then, testified to a sort of pre-sensational process which normally leads to a percept but which, under some conditions, may lead to illogical associations; may enter consciousness only through its effects upon another percept; and may be associated with marked affect.

Also to be listed with the subjective-introspective group is Perky's classic study[1] in which 35 Ss fixated a ground-glass screen under the instructions to "imagine a colored object; for instance, a tomato," etc. The appropriate projected image was increased in intensity until S began

---

[1] C. W. Perky, An experimental study of imagination, Amer. J. Psychol., 21, 1910, 422-452.

to report his imagined image, when it was removed. Generally, Ss believed themselves to be reporting pure unassisted images at levels of illumination at which, when enlightened as to the technique employed, they could easily see the stimuli. Many reported that, although they had expected the image of a banana to be horizontal or that of a leaf to be a maple leaf, imagination presented an upright banana or an elm leaf (corresponding to the projected image).

It must be recognized that the subjective-introspective group of studies has in general the limitations pointed out by Maier.[1] In problem-solving and other activities, people undoubtedly use certain stimuli and follow certain programs of registration and organization[2] that are absolutely unavailable to introspection. Nevertheless, the views that the authors cited above drew from introspective studies are remarkably congruent with conclusions reached by students of the objective-behaviorist and dynamic-psychoanalytic groups.

Objective-Behaviorist Studies

This segment of psychology has, of course, contributed many studies bearing on behavior without awareness. The

---

[1] N. R. F. Maier, Reasoning in humans: II. The solution of a problem and its appearance in consciousness, J. Comp. Psychol., 12, 1931, 181-194.

[2] J. S. Bruner and G. S. Klein use these terms to emphasize the programmatic character of perception (Constraints in perception, presented at A.P.A. convention, 1959; ref., Amer. Psychologist, 14, 1959, 379).

present review is restricted, for the most part, to cases in which there was a discrimination task to which S's attention was directed; an incidental cue was afforded, designed to influence that task; and S was unaware of the existence of such a cue.

A sort of transition from the subjective-introspective studies is provided by the early experiments of Miller.[1,2] His Ss believed that they were engaged in an experiment on clairvoyance. They were to look at a screen and passively allow the image of any of the ESP-card designs to come to mind, in an attempt to match an unseen deck. To a significant degree, their choices matched the cards whose images were being dimly projected on the screen.

One avenue of approach has involved the use of standard optical illusions, with the illusion-producing stimuli at subliminal intensity or duration. Dunlap[3] employed a form of the Muller-Lyer illusion with "wings" so dim that sophisticated observers only rarely reported seeing them. The effect of the illusion was very slight, although Dunlap considered its presence to be successfully demonstrated.

---

[1] J.G. Miller, Discrimination without awareness, Amer. J. Psychol., 52, 1939, 562-578.

[2] J.G. Miller, The role of motivation in learning without awareness, Amer. J. Psychol., 53, 1940, 229-239.

[3] K. Dunlap, The effect of imperceptible shadows on the judgments of distance, Psychol. Rev., 7, 1900, 435-453.

Two later replications[1,2] yielded no support; the observers involved either were clearly sophisticated or had some suggestion of the nature of the experiment. Bressler[3] worked with naive Ss and obtained convincing positive results.

Smith and Henriksson[4], also, measured the illusory shift in the shape of a trapezoid when fan-shaped lines were flashed across it. Using naive Ss and gradually raising the flash duration, they found a significant effect upon judgments of shape prior to recognition. Klein,[5] however, has been unable to confirm such an effect.

It is questionable, in any case, whether the study of illusions may be expected to contribute much to the understanding of our problem. What occurs in the kind of discrimination task under consideration may be thought of as the addition of information in an unexpected mode. Eriksen and Hake[6] have shown that supplying information in two or

---

[1] E.B. Titchener and W.H. Pyle, Effect of imperceptible shadows on the judgment of distance, Proc. Amer. Phil. Soc., 46, 1907, 94-109.

[2] H.M. Manro and M.F. Washburn, Effect of imperceptible lines on judgment of distance, Amer. J. Psychol., 19, 1908, 242-243.

[3] J. Bressler, Illusion in the case of subliminal visual stimulation, J. Gen. Psychol., 5, 1931, 244-250.

[4] G.J.W. Smith and M. Henriksson, The effect on an established percept of a perceptual process beyond awareness, Acta Psychol., 11, 1955, 346-355.

[5] G.S. Klein, personal communication, 1959.

[6] C.W. Eriksen and H.W. Hake, Multidimensional stimulus differences and accuracy of discrimination, J. Exp. Psychol., 50, 1955, 153-160.

three modes rather than in one alone increases the accuracy of discriminations, at least where all such modes or stimulus qualities are known and expected by S.

One way of supplying information in an unexpected mode is through a different sensory modality. Information designed to influence a visual task could be supplied through audition, or the reverse. No study is known which fits the paradigm being considered here; that is, with S remaining ignorant as regards the existence of the incidental stimulation.[1]

Using a single sensory modality, experiments have been reported in which Ss were indeed unaware of the incidental stimulation. In the experiment of Klein, Spence, Holt, and Gourevitch,[2] Ss were looking for clues regarding the personality characteristics of projected drawings of faces. In two subsequent studies,[3,4] they were looking for and

---

[1] For a somewhat related study, however, see H. Ohms, Untersuchung unterwertigen Assoziationen mittels des Worterkennungsvorganges, Z. Psychol., 56, 1910, 1-84.

[2] G.S. Klein, D.P. Spence, R.R. Holt, and S. Gourevitch, Cognition without awareness: subliminal influence upon conscious thought, J. Abn. Soc. Psychol., 57, 1958, 255-266.

[3] S. Bach and G.S. Klein, Conscious effects of prolonged subliminal exposures of words (paper presented at A.P.A. convention, 1957; abstract, Amer. Psychologist, 12, 1957, 397.)

[4] G.J.W. Smith, D.P. Spence, and G.S. Klein, Subliminal effects of verbal stimuli, J. Abn. Soc. Psychol., 59, 1959, 167-176.

usually imagining that they discriminated slight (fictitious) changes in a face. Ss responded in open-ended fashion, and the response categories were broad. In each of these cases, responding was shown to be influenced by flashed or otherwise unnoticed stimulation.

Kolers[1,2] has used unnoticed stimulation as an influence upon varyingly complex perceptual-cognitive tasks. In his Part II the recognized stimulus, briefly presented to S, consisted of three lines of four small figures each. The task was to report which figure (e.g., square, circle, triangle) appeared in all three lines. There were, in fact, two right answers, one of which had been presented as an unnoticed flash. Control Ss received a blank flash.[3] The stimulus sequence--unnoticed flash followed by the complex figure, which lasted 0.3 second--was repeated to a criterion of ten repetitions of the same response, or to a total of 25 sequences. The unnoticed flash was indeed found to influence the choice of a right answer.

---

[1] P. A. Kolers, Subliminal stimulation in simple and complex cognitive processes, (Unpublished doctoral dissertation, New York Univer., 1956).

[2] P. A. Kolers, Subliminal stimulation in problem-solving, Amer. J. Psychol., 70, 1957, 437-441. In this published article, Parts II and III of the dissertation were renumbered I and II, while the original Part I was omitted. As used herein, part numbers refer to the dissertation.

[3] Kolers' overall design required the use of a blank flash here rather than a flash of the other right answer for half of the Ss.

In his Part III, designed to tap a more complex level of cognitive functioning, Kolers' Ss had the problem of finding the hidden element which was common to a series of complex figures. Again there were repeated trials to a criterion; again the correct element was presented to half the Ss as an unnoticed flash briefly preceding the problem stimulus (which again lasted 0.3 second). These Ss required fewer trials to reach the criterion of ten consecutive correct responses than did Ss who received a blank flash.

Kolers' experiment was designed to test whether information given to S without awareness can affect his behavior at all points in a series of tasks including both higher and lower levels of cognitive functioning. It included a procedure (Part I, somewhat similar to the experiments of the Klein group referred to just above) testing the effect of unnoticed flashed figures on impressions of a face. This task was thought to involve only a low level of cognitive function, appealing primarily to "egocentric attitudes and feelings." In this procedure also, an effect of the unrecognized stimulation was apparent. In fine, Kolers was able to draw the inference that many levels of cognitive functioning may be affected through unnoticed incidental stimulation.

In Kolers' "low-level" task just described, Ss were instructed not to look carefully and analytically, but to relax and to be "imaginative and impressionistic." Similar

instructions were employed by Eagle.[1] Using a somewhat different method of tachistoscopic presentation, he obtained differential effects from the use of unperceived stimuli depicting aggressive and benevolent actions. It appears, therefore, that an effortful perceptual task is not necessary for the occurrence of effects related to unnoticed incidental stimulation.

It is suggested, indeed, by Goldberg, Fiss, and Klein[2] that the effortful perceptual task militates against any appearance of such effects. These authors carefully reduced the amount of stimulation to a level where S could no longer discriminate with even partial accuracy among three figures. They then instructed S to relax while a new stimulus figure was exposed at a still briefer duration. These well-trained Ss reported only a quick flicker. Yet, when asked to let their minds wander and "invite" images, their descriptions and drawings of the images were found to be related to the content of the very briefly exposed stimuli. In a final procedure, Ss were shown the two stimulus figures used and tried to discriminate them at the same duration used in the

---

[1] M. Eagle, The effects of subliminal stimuli of aggressive content upon conscious cognition, J. Pers., 27, 1959, 578-600.

[2] F. H. Goldberg, H. Fiss, and G. S. Klein, Effects of an undiscriminated stimulus on imagery (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

relaxed condition; they could do so only at a chance level.

In a similar procedure, Dixon[1] instructed Ss to maintain a relaxed, passive attitude while observing a continuous but very dimly projected image of a word. (Of 12 stimuli, six were emotionally loaded words.) They then guessed what the word might be, and later gave an association to each of the guesses. A week later, being shown a list of the stimulus words, they tried to match it to a list of their responses, not in a logical fashion but in terms of their personal, even autistic associations. In general, these Ss did not guess the stimulus word accurately, but their guesses and associations were judged to be related to that word, and were significantly matched to it in the later test. Also recorded were the latency of each response and the galvanic skin response accompanying it. Both of these were greater in the case of the emotionally loaded words than for the others, the latter measure significantly so.

Dynamic-Psychoanalytic Studies

Within the dynamic-psychoanalytic group, the experiments of Pötzl[2] and his successors are the only series immediately

---

[1] N.F. Dixon, The effect of subliminal stimulation upon autonomic and verbal behavior, J. Abn. Soc. Psychol., 57, 1958, 29-36.

[2] O. Pötzl, Experimentell erregte Traumbilder in ihren Beziehungen zum indirekten Sehen, Z. Neurol. Psychiat., 37, 1917, 278-349.

related to the present specific field. Pötzl, whose interest had been directed to visual anomalies of various kinds, used a tachistoscopic presentation of pictures--landscapes and street scenes--to study modes of handling stimulation that was presented in peripheral vision, perceived but not apperceived and not immediately reportable. The "motoric barrier" thus created was thought of as equivalent to repression. Pötzl found that images reported from dreams subsequent to the exposure were symbolically related to the unreportable features of the pictures.

This general method has been used with variations and refinements by others.[1,2] Although not always performed according to rigid standards, these experiments apparently have demonstrated effects due to unperceived stimulation. The effects have appeared not only in dream reports but in word associations and freely wandering imagery.

Discussion: Restrictions of the Situation

A review of three groups of studies, insofar as they relate to the interest of the present paper, has been given above. Some of the findings of these studies can now be considered in connection with the five restrictions of the

---

[1] R. Allers and J. Teler, Über die Verwertung unbemerkter Eindrücke bei Assoziationen, Z. ges. Neurol. Psychiat., 1924, 89, 492-513.

[2] H. Shevrin and L. Luborsky, The measurement of preconscious perception in dreams and images: an investigation of the Pötzl phenomenon, J. Abn. Soc. Psychol., 56, 1958, 285-294.

experimental situation which have been adopted in narrowing the area of the present interest. These restrictions were stated without amplification in Chapter I (pp. 3-4). They specify that (1) S is attending effortfully and objectively to a concurrent discrimination task; (2) S responds immediately and in a constrained fashion to that task; (3) the unnoticed incidental stimulation constitutes a cue of a class to which S is not consciously prepared to respond; (4) this cue is such as to present or dictate a response to the task; and (5) affective factors are not intentionally induced.

These restrictions will be discussed, and assumptions which the writer has made in order to proceed to an experimental test will be stated.

"Objective" vs. "subjective" attitudes. The words are used in Cattell's[1] sense: Is S required to pay effortful attention to an objective task, or is he instructed to relax and disregard the precision of his perceptions?

It should be noted that in neither case is attention being directed to the stimulation which is of interest to the experimenter; that is, the incidental stimulation. In the "objective" case, S is paying effortful attention to some other stimulation, being engaged in some task related to it. In the "subjective" case, S withholds altogether his analytical attention.

---

[1] R.B. Cattell, The Subjective Character of Cognition and the Pre-sensational Development of Perception, 1930. See p. 7 above.

In this connection, it is worth while to repeat the comment made on page 2 above. If S is aware of and is trying to discriminate a given stimulus, and if the latter is so weak that he is quite unable to do so, then it appears that no characteristic of that stimulus will modify S's behavior.

> "The evidence seems to indicate that where S's intention is to discriminate, he cannot do so successfully until some critical, minimal segment of the field is consciously apprehendable."[1]

Reference was made above (page 7) to Cattell's interest in experience which is not contemplated or cognised objectively, and which may not be registered in memory. Ordinarily, such experience accompanies the subjective attitude. But Cattell also suggested[2] that stimuli might be experienced in this mode without awareness while S was attending to another task. That they often are seems indisputable. An individual may begin to whistle a tune shortly after the tune has been played, although, having had his attention directed elsewhere at the time, he cannot remember hearing it.

Goldberg, Fiss, and Klein[3] state that the S in a discrimination task, being

---

[1] F.H. Goldberg and H. Fiss, Partial cues and the phenomenon of "discrimination without awareness," Percep. Mot. Skills, 9, 1959, 243-251.

[2] Op. cit., p. 158.

[3] F.H. Goldberg, H. Fiss, and G.S. Klein, Effects of an undiscriminated stimulus on imagery, p. 3 (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359). Emphasis by the original authors.

> "geared to one end only--to achieve identity of the stimulus...gives priority to perceivable information in his decisions... For discrimination, the consequence of this behavior is that the task samples only a very narrow segment of the activated cognitive field..."

(Within the activated field they include the effects of any stimulation that may be responded to.) Hence, as regards incidental stimulation, they expect to find its effects only or chiefly

> "in states of consciousness where it is not obscured by the S's need to represent reality effectively and accurately in his response."[1]

A classification of the relevant studies is presented below in Table I. It is apparent that at least four studies may be cited to illustrate that effects due to incidental stimulation do occur when S is effortfully trying for accurate perception. It appears, therefore, that Goldberg, Fiss, and Klein have overstated the extent to which such a state of consciousness prevents the registration and use of incidental stimulation. The assumption is made that incidental stimulation can affect effortful, attended behavior as well as relaxed, unattended behavior.

---

[1] Ibid., p. 3.

TABLE I

CLASSIFICATION OF STUDIES

Response	Attitude induced in S:	
	Objective, effortful; S is trying for accurate perception	Subjective, relaxed; not trying for accurate perception
Open-ended, may be delayed	Klein, Spence, Holt and Gourevitch Bach and Klein Smith, Spence, and Klein	Kolers, Part I Goldberg, Fiss, and Klein Dixon* Eagle*
Constrained, immediate	Kolers, Parts II and III	Perky Miller

*Partly constrained responding

Immediate, constrained vs. open responding. Is S restricted to a rather small choice of responses in the task which is set him? Must he respond almost at once?

None of the cited authors has dealt specifically with this question. Klein,[1] however, indicates that any effects of incidental stimulation are likely to

> "be delayed, and show themselves on levels of behavior and in states of consciousness bearing little similarity to the original contents of stimulation and report."

This is thought especially likely to be the case where

[1] G.S. Klein, On subliminal activation, J. Nerv. Ment. Disease, 128, 1959, p. 299.

S is attending fully to a discrimination task. In such a state of controlled consciousness, incidental activations are expected to be almost completely excluded from the task behavior. Then:

> "As reality contact and reality requirements are minimized, so the prospects of incidentally registered material emerging to awareness in passive imagery may increase."

Table I, however, shows that three experimenters[1,2,3] did obtain effects from incidental stimulation when responding was constrained and immediate. It appears to the writer that Klein tends to overestimate the degree to which controlled states of consciousness actually exclude incidental activations. The difference of viewpoint is relative, not absolute. In a given experimental situation, however, the difference might amount to an absolute. That is, in the state of consciousness employed, incidental activations might be excluded to such a degree that their predicted effect would fail to appear. This risk was run in the experiments of the present study.

---

[1] C.W. Perky, An experimental study of imagination, Amer. J. Psychol., 21, 1910, 422-452.

[2] J.G. Miller, Discrimination without awareness, Amer. J. Psychol., 52, 1939, 562-578.

[3] P.A. Kolers, Subliminal stimulation in problem-solving, Amer. J. Psychol., 70, 1957, 437-441.

Novel class of cue; response dictation. Is the incidentally supplied cue of such a nature that S, if he were aware of it, could readily assimilate it into the conduct of his main task?

The answer must be a matter of degree, related to the strength of the associative linkages involved. Suppose that S is trying to detect slight changes in the expression of a projected face. Presumably he could more readily assimilate a briefly exposed frowning face than the word ANGRY. Again, imagine S trying to receive by clairvoyance one of the ESP-card designs. Presumably he could more readily assimilate into his behavior a star design than the printed word STAR, and could assimilate STAR more readily than ETOILE (assuming that French is less familiar to him than is English).

Of interest here is the analysis of Kolers' experiment, Parts II and III, in these terms. Here the incidentally supplied cues were exactly what S was looking for in his examination of the inspection figures--i.e., an element which met the specifications of the task. This places Kolers' work in contrast to that of other experimenters who used quite unlooked-for types of cue. It also creates some doubt whether his results would have been obtained if the incidental cue had been less closely associated with the material of the task, and hence presumably less assimilable into task performance.

A closely related question arises in the cases where

there is an objective task and where the responding to it is constrained. It is this: Can changes in responding be evoked by presenting an unnoticed stimulus representing the goal response itself, as directly as possible, as contrasted with a stimulus which merely suggests a line of procedure in the task?

Again we may analyze the Kolers experiment,[1] in almost but not quite the same terms. His incidentally presented clues operated as a suggestion or hint to S in his task of finding the common element among the supraliminal figures. He might, however, have presented (a symbol of) the response category, the choice of which was the goal of that task. Thus he might have presented FIGURE 2, where that was to have been the spoken response. This would have constituted response dictation, circumventing S's attended processes of judgment. It would also have been a novel class of cue, as described just above.

In both these dimensions of the experimental situation, the differences are subtle and are matters of degree. In general, as they apply to cases where there is an objective task and constrained responding, there is no evidence that either the novel class of cue or response dictation would prevent the appearance of the experimental effect. The following assumption is made for present purposes: If the objective judgments of Ss can be influenced by suggestions of

---

[1] Ibid.

a readily assimilable class, they can also be influenced by dictations of a novel class.

The affective element. Experimenters identified with the "New Look"[1] have shown an early and continuing interest in variations in perception as correlated with affective elements. Thus, of the objective-behaviorist studies cited in a preceding section, affect-related incidental stimuli were used in six,[2,3,4,5,6,7] while four others used stimuli

---

[1] J. S. Bruner and G. S. Klein, Constraints in perception (paper presented at A.P.A. convention, 1959; ref., Amer. Psychologist, 14, 1959, 379).

[2] G. S. Klein, D. P. Spence, R. R. Holt, and S. Gourevitch, Cognition without awareness: subliminal influence upon conscious thought, J. Abn. Soc. Psychol., 57, 1958, 255-266.

[3] S. Bach and G. S. Klein, Conscious effects of prolonged subliminal exposures of words (paper presented at A.P.A. convention, 1957; abstract, Amer. Psychologist, 12, 1957, 397).

[4] G. J. W. Smith, D. P. Spence, and G. S. Klein, Subliminal effects of verbal stimuli, J. Abn. Soc. Psychol., 59, 1959, 167-176.

[5] P. A. Kolers, Subliminal stimulation in simple and complex cognitive processes (Unpublished doctoral dissertation, New York Univer., 1956), Part I.

[6] M. Eagle, Effects of subliminal stimuli of aggressive content upon conscious cognition, J. Pers., 27, 1959, 578-600.

[7] N. F. Dixon, The effect of subliminal stimulation upon autonomic and verbal behavior, J. Abn. Soc. Psychol., 57, 1958, 29-36.

which were not intentionally affect-related.[1,2,3,4]

It appears, therefore, that unnoticed stimuli may be the means of altering perceptions and discriminations, whether or not they are affect-related. In the present experiments, the stimuli used were not known to be systematically affect-related.

---

[1] C. W. Perky, An experimental study of imagination, Amer. J. Psychol., 21, 1910, 422-452.

[2] J. G. Miller, Discrimination without awareness, Amer. J. Psychol., 52, 1939, 562-578.

[3] P. A. Kolers, Subliminal stimulation in problem-solving, Amer. J. Psychol., 70, 1957, 437-441.

[4] F. H. Goldberg, H. Fiss, and G. S. Klein, Effects of an undiscriminated stimulus on imagery (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

a greater effect than one which is less closely relevant.

Ideally, there would be available two clearly defined theoretical positions from which, at some point, contradictory predictions could be derived. A crucial experiment would then allow one of the positions to be confirmed, the other infirmed, and understanding of the field to proceed with a bound. No such clear theoretical positions have been found with significant applications to the present area of research. The search for the limits of the kind of effect under study, however, can be guided by a general view of the nature of perception and thought.

A view of percept-development. The view adopted here is that both percept-development and thought-development pass

> "through a phase of symbolic and symbol-like presentations. These presentations are in part irrelevant to the thought concerned; fleeting and easily suppressed, they soon vanish, while what they lead to--the thought--remains. Thus, from the point of view of thought, images are transitory stages. These images are very frequently symbolic. One might be inclined to consider even verbal images as transitory stages, since they too are only mediators of meaning."[1]

The present writer would expand this passage to include percepts as well as thoughts. Both are implied by Klein's phrase, "cognitive behavior."

As it applies to percepts, the view may be stated as follows: Transitory stages occur in the process from which a percept or a perceptual judgment develops. In such stages,

---

[1] P. Schilder, On the development of thoughts, p. 505 (in D. Rapaport, Ed., Organization and Pathology of Thought, 1951).

weak as well as strong sensations and memories, especially those with meanings related to S's conscious and unconscious purposes, affect the development of percepts and perceptual judgments.

The content of these transitory states and their mode of development may or may not be in accord with the real or consciously expected relations among things. They are usually not available to later recall.

The percept or perceptual judgment, as a final product of this process, has a unitary quality and does not reflect the variety of sensations and memories which contributed to its development.[1]

A set of propositions. From this general conception of perceptual process, a set of propositions relative to perceptual judgment may be set forth:

(Condition 1) If a normal mature S is required to perform a perceptual judgment (choice of a response class in accordance with the assignment of a stimulus situation to its appropriate class);

(Condition 2) If sense data of classes a,b,c provide S with information relevant to the judgment, relevant in ways which S considers to be in accord with reality;

(Condition 3) If sense data of classes d,e,f provide S with information relevant to the judgment, but relevant in ways which S considers not in accord with reality;

---

[1] Where the same percept or judgment would be arrived at through rational conscious examination of the sources of the transitory stages--sensations and memories--we say that the perceptual process has been integrative. Where it would be rejected through such conscious examination, we term the process syncretic.

Then: (Derivative 1) The probability of occurrence of a given response class will be chiefly increased or decreased in accordance with the (absolute and relative) availability to S of data of classes a,b,c;

(Hypothesis 1) The probability of occurrence of a given response class will also be increased or decreased in accordance with the (absolute and relative) availability to S of data of classes d,e,f.

(Postulate 1) The mature S has learned to minimize probability shifts of the kind referred to in Hypothesis 1. His minimization, or rejection of the associated information, is a part-function of his awareness of the existence of sense-data providing that information.

Then: (Derivative 2) Where S is unaware of the existence of sense data of classes d,e,f, he is less likely to minimize their effect; their availability will exert a greater increase or decrease upon the probability of occurrence of response classes than it does where he is aware of their existence.[1]

(Definition) The more a class of information is found to increase or decrease the probability of a given response, the more "relevant" it is said to be to that response.

(Postulate 2) For the mature S, classes of sense data can be reliably ordered along gradients of relevancy of their information to a given perceptual judgment.

(Postulate 3) Gradients of relevancy among data of classes d,e,f will be the same as the gradients of relevancy among precisely comparable data of classes a,b,c.

Then: (Hypothesis 2) The increase or decrease of probability of occurrence of response classes due to data of classes d,e,f, which data are judged more relevant to the task, will be greater than that due to similar data which are judged less relevant.

In less formal terms: If we use the kind of incidental

---

[1] "We would suggest, tentatively, that because they did not reach awareness, they [incidental stimulations] were relatively effective in influencing reactions to the face." G.J.W. Smith, D.P. Spence, and G.S. Klein, Subliminal effects of verbal stimuli, J. Abn. Soc. Psychol., 59, 1959, p. 175. Emphasis by original authors.

stimuli under discussion, but if we make some of them comparatively task-irrelevant, we expect to find these less effective in altering task responses. For example, a flashed word might be altered so as to become less legible.

The Psychophysical Task

The present experiment undertakes to test Hypothesis 1 and Hypothesis 2 within the setting of a psychophysical task.

In a psychophysical task, S is required to perform a strictly perceptual judgment (Condition 1). The sense data associated with the perceptual task provide information relevant to his judgments in ways he considers to be in accord with reality (Condition 2). It is possible to provide additional information relevant to the judgment, but relevant in ways which S will consider not to be in accord with reality (Condition 3). Such additional information can be provided while S is unaware of its existence; he should then be comparatively unlikely to minimize his response to it (Derivative 2).

Then it is predicted that response to the psychophysical task will vary in accordance with the additional information supplied (Hypothesis 1).

The additional information itself can be made more or less relevant to the psychophysical task (Postulate 2), in ways which are predictable from other data (Postulate 3). Then the effect predicted in Hypothesis 1 will be expected

to vary in accordance with the relevancy of the additional information (Hypothesis 2).

As a psychophysical task the visual comparison of sizes of stimulus patches was selected. Incidental stimulation was by means of a brief flash immediately preceding the appearance of the variable stimulus to be judged. The flash consisted of a printed form of the words to be spoken by S as response: greater or smaller; or of a control (nonsense) flash.

The prediction afforded by Hypothesis 1 then takes the form: Flashes of greater will be more frequently followed by judgments of "greater," and flashes of smaller will be more frequently followed by judgments of "smaller," than in the respective control conditions.

It may be noted that this predicted effect will be most evident where the discrimination task is most difficult. The most difficult case, by definition, occurs at the point of the physical scale where judgments are evenly divided. This defines the point of subjective equality (PSE) or point of maximum ambiguity.[1] At this point, none of the variance of responding is accounted for by genuine difference in the size of the patches. At the points where responding is always correct, all of the variance of responding is thus accounted for. Thus the magnitude of effects upon responding

---

[1] J. Hochberg, Perception: toward the recovery of a definition, Psychol. Rev., 63, 1956, 400-405.

due to any other factors to be studied is unequally limited at different points of the scale. In general, it is assumed that the magnitude of such effects will be roughly proportional to the percentage of variance not accounted for by genuine patch size.

As incidental stimuli which would be comparatively task-irrelevant, misspelled versions of the words "greater" and "smaller" were chosen. Then the prediction afforded by Hypothesis 2 takes the form: Flashes of greater (correctly spelled) will be more frequently followed by judgments of "greater" than will flashes of a misspelled version of greater; and similarly for smaller.

In all cases, Ss were to be unaware of the existence of the incidental information carried by the flashes. Instructions were such as to induce the set appropriate to a well-defined laboratory discrimination task, together with openness to any related but different stimulation which might appear.

The measure used in testing these hypotheses was the frequency of responses of "greater" and "smaller" under each set of conditions of stimulus patch and incidental stimulation. In Experiment II (Chapter VI below), response latencies were also examined in relation to agreement or disagreement of response with incidental flash. The observation of latencies was considered merely exploratory, not requiring a structure of hypotheses and predictions.

CHAPTER IV

PRELIMINARY TEST

In order to test Hypothesis 2 (Chapter III above), it was necessary to provide data of two classes, judged more and less relevant to the perceptual task being performed by S. The more relevant data were to take the form of the printed words greater and smaller. As less relevant data, it was proposed to use misspelled forms of these words. The forms graeter and samller were chosen after preliminary exploration.

It was necessary, however, to establish that these forms were indeed, in the sense of the hypothesis, less relevant to the responses than the correctly spelled forms. By the definition given in the series of propositions in Chapter III, this means that the stimulus graeter, for example, must be found to effect an increase in the probability of occurrence of the response "greater;" but that increase must be smaller than the similar increase effected by the stimulus greater.

For the purpose of testing this statement by tachistoscopic means, it is translated as follows: The stimulus graeter must be found to evoke the response "greater," but to do so at a higher physical threshold than does the stimulus greater.

The first part of the statement seemed adequately supported by generalization from past research dealing with the

misrecognition of altered stimuli.[1,2,3,4,5,6] But that such misrecognition would occur at a higher threshold than recognition of the corresponding correctly spelled word was less clearly attested.[7,8] Hence it was thought necessary to use a direct empirical test.

A standard procedure for threshold measurement (ascending series only) was employed.

Apparatus

A Dodge mirror-type tachistoscope was used, with a constantly illuminated background and with the word stimuli illuminated for pre-set periods. These stimuli were prepared

---

[1] H. Münsterberg, Beiträge zur experimentellen Psychologie, 1892, iv, 22.

[2] W. B. Pillsbury, A study in apperception, Amer. J. Psychol., 8, 1897, 315-393.

[3] M. C. Wilkins, A Tachistoscope Experiment in Reading (thesis), 1917, Columbia Univ. Grad. School.

[4] M. D. Vernon, The Experimental Study of Reading, 1931.

[5] E. M. Siipola, A group study of some effects of preparatory set, Psychol. Monog., 46, No. 6, 1935, 27-38.

[6] D. F. Wyatt and D. T. Campbell, On the liability of stereotype or hypothesis, J. Abn. Soc. Psychol., 46, 1951, 496-500.

[7] L. Postman, J. S. Bruner, and R. D. Walk, The perception of error, Brit. J. Psychol., 42, 1951, 1-10.

[8] J. S. Bruner and L. Postman, On the perception of incongruity: a paradigm, J. Pers., 18, 1949, 206-223.

in the form of photographic transparencies mounted in 3-1/4 inch by 4-inch slides, evenly transilluminated by the timed lamps.

In order that the correctly spelled words might be highly recognizable, the use of a fairly legible type face was indicated.[1] Throughout the series of experiments, a boldface Roman lower-case display type with square serifs was used.[2] Words made up from this type were photographed so as to produce a negative with highly opaque ground and transparent letters. A strip of acetate fastened to each slide formed a handle for inserting it into the appropriate slot in the tachistoscope.

The correct and misspelled forms of greater and smaller have been mentioned. In order to make up a longer list and also to remind Ss that they might or might not be seeing English dictionary words, five more six-letter words were added as follows: become, steers, mossia, terval, and ksojwu. Mossia and terval are "fourth-order approximations of English" adapted from Miller, Bruner, and Postman.[3]

---

[1] In contrast, the majority of experiments in this field have used typewritten capitals, which are comparatively illegible. (See D. G. Paterson and M. A. Tinker, How to Make Type Readable, 1940.)

[2] Para-Tipe #85; Para-Tone, Inc., Chicago, Ill., (obtainable at commercial art supply stores).

[3] G. A. Miller, J. S. Bruner, and L. Postman, Familiarity of letter sequences and tachistoscopic identification, J. Gen. Psychol., 50, 1954, 129-139.

Subjects

The Ss were 15 male volunteers, ranging in age from 19 to 32. All but one were students at Boston University summer sessions. The median age was 25. All had approximately normal visual acuity, in some cases by the use of corrective lenses. They were paid for their services.

Procedure

After dark-adaptation, S was told that E was interested in measuring the legibility of certain stimulus slides. S was to watch for the group of letters which would appear for a brief fraction of a second after the warning signal, and was to report whatever he saw or thought he saw. It was emphasized that any group of letters might or might not be the correct spelling of an English word.

For each S an individual sequence of the nine stimulus words had been obtained from a table of random numbers. Each slide was exposed three times at a given duration. The duration of exposure began at six milliseconds and was increased by three milliseconds after each series of slides was shown. When S reported a slide accurately for each of the three exposures at a given duration, the slide was removed from the series. Testing was continued until this criterion was met for each word, except that where the word ksojwu was the last to be recognized, the procedure was terminated without obtaining its recognition threshold.

Results

The nine stimulus words employed are shown below, with their mean thresholds (in milliseconds) for a single correct call:

smaller	13.6	greater	16.2	become	15.8	steers	15.4
samller	52.9	graeter	32.2	mossia	27.0	terval	19.8

ksojwu 40.6 (not comparable to other thresholds)

For a single "predicted miscall," thresholds were as follows:

samller miscalled as "smaller:" 21.2

graeter miscalled as "greater:" 18.8

Can we affirm that the misspelled words evoke the responses of "smaller" and "greater" but at higher thresholds than do the correctly spelled words? Every S made these predicted miscalls at least twice before correctly reading the misspelled words. No S made the predicted miscall of graeter at a lower duration than his correct report of greater. Only two Ss made the predicted miscall of samller at lower durations than their correct reports of smaller. According to Wilcoxon's non-parametric test for paired replicates,[1] all of the predicted threshold differences are significant at well beyond the one per cent level.

---

[1] S. Siegel, Non-Parametric Statistics for the Behavioral Sciences, 1956, pp. 75-83.

Summary

In a standard procedure for threshold measurement, the stimuli graeter and samller were found to evoke the responses "greater" and "smaller," but to do so at higher physical threshold values than do the correctly spelled stimuli. The misspelled stimulus words, therefore, are concluded to be relevant to a task with responses "greater" and "smaller," but relevant in a lesser degree than the correctly spelled stimulus words.

CHAPTER V

EXPERIMENT I

The purpose of the experiment was to study performance in a visual size comparison task as a function of the meanings of words presented as unnoticed incidental stimuli. These stimulus words included both more and less recognizable impressions of the prescribed response words "greater" and "smaller."

Apparatus

The Boston University Tachistoscope #2 (Dodge type) was employed. Its associated electronic timer was modified so that, when the trigger circuit was actuated, the A-stimulus field[1] was illuminated for a pre-set timed period; at the end of this period, the A-stimulus lamps were extinguished and the B-stimulus field was immediately illuminated (monostable multi-vibrator action).

A motor-driven switching timer and relays were used to control the over-all sequence of a trial, which was as follows:

1. Warning buzzer
2. Standard-size rectangle illuminated--three seconds
3. Blank--four seconds

---

[1] It is customary to letter the stimuli in the order of their appearance in a cycle or trial. Here the A-stimulus was the incidental stimulus; the B-stimulus was the patch whose size was to be judged.

1-A

1-B

FIGURE 1. THE APPARATUS

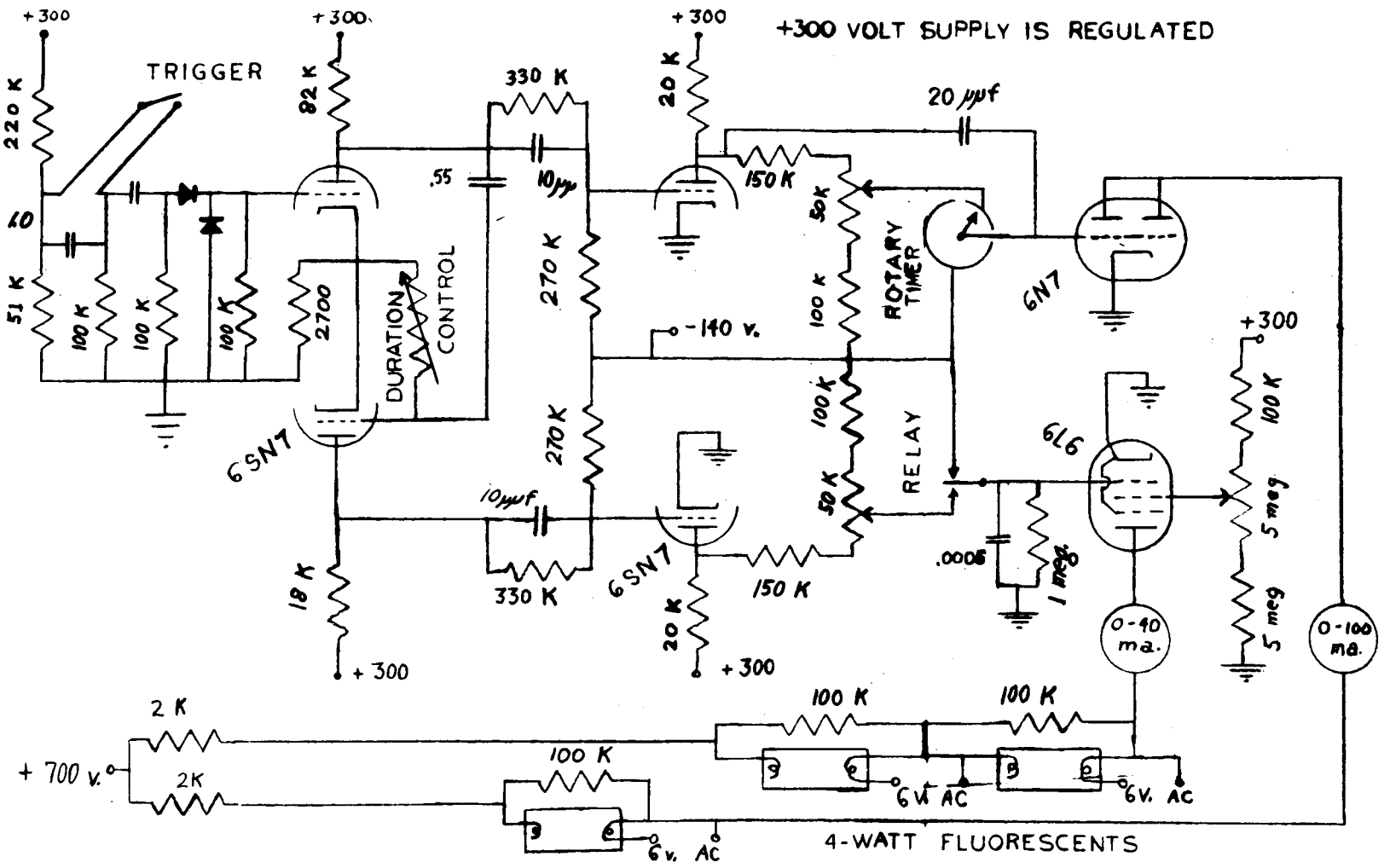


FIGURE 2. TACHISTOSCOPE TIMER - CIRCUIT DIAGRAM

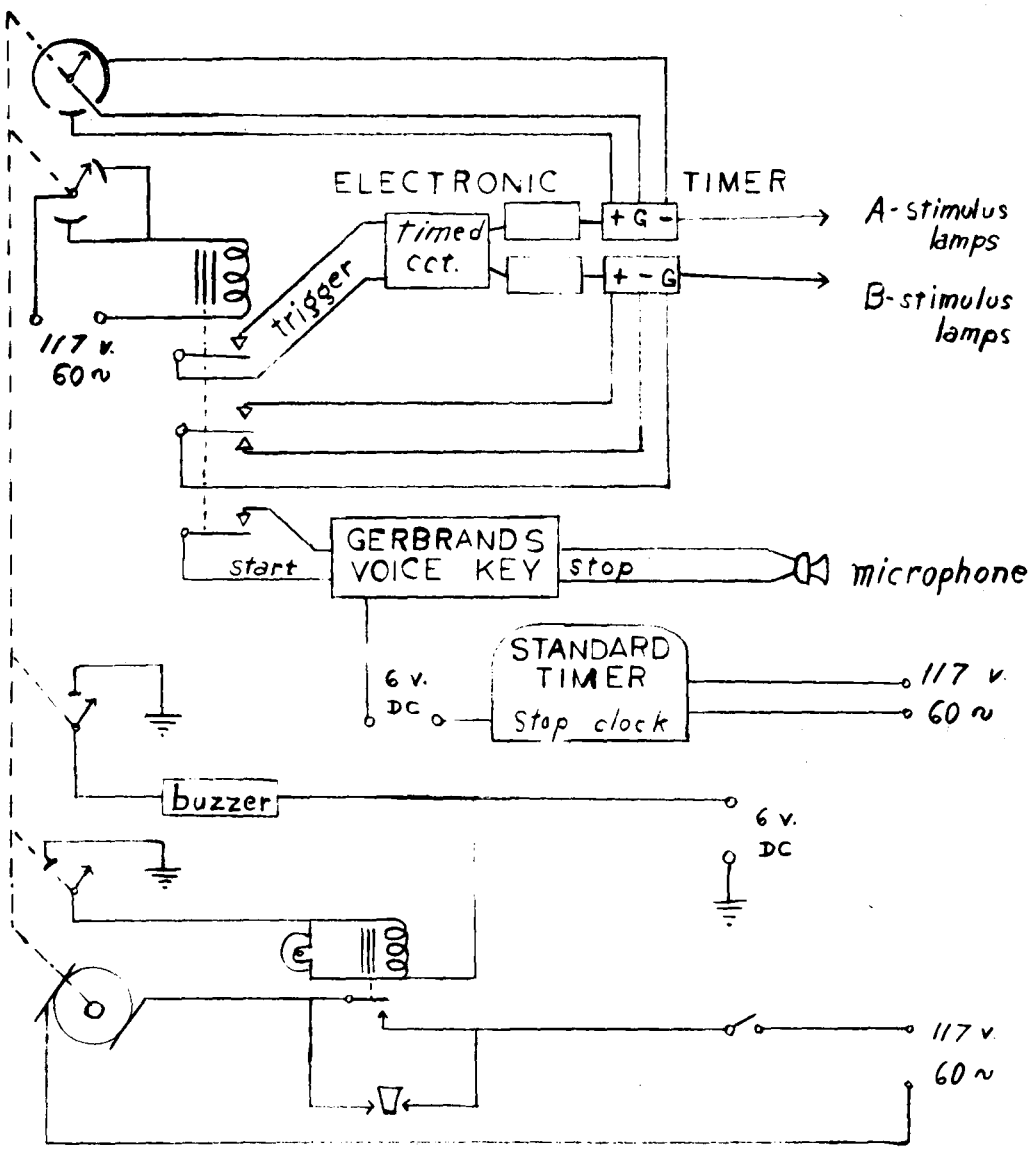


FIGURE 3

GENERAL CONTROL CIRCUIT

4. Incidental stimulus illuminated--11 to 16 millisec.

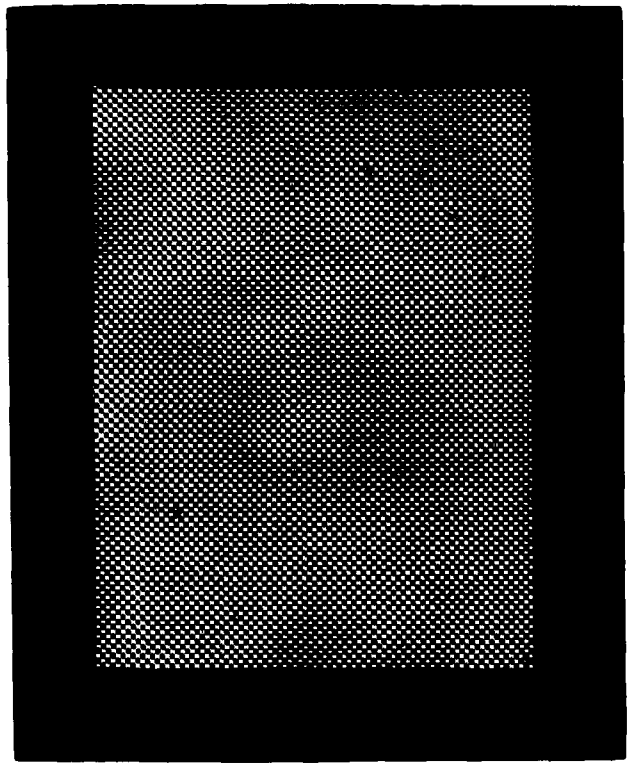
5. Variable rectangle illuminated--3-1/2 seconds

6. Blank--15 to 30 seconds

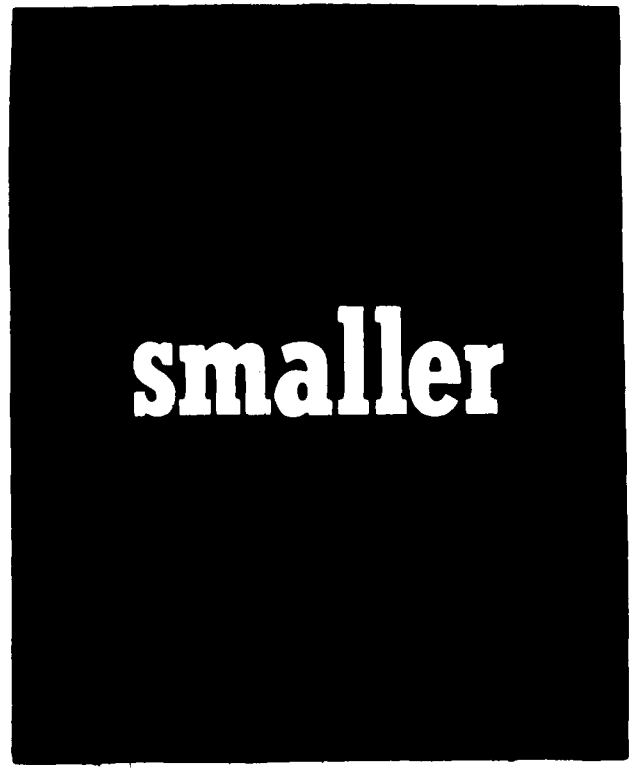
Modification of the timer permitted E to vary not only the duration of the incidental stimulus but the current, hence the brightness, of both stimuli. The probability of the incidental stimulus being noticed had been found to increase, not only as its own duration and brightness were increased, but also as the brightness of the succeeding stimulus (variable rectangle) was decreased. It was planned to make the incidental stimulation gradually more noticeable during the course of the experiment. This was done because it appeared from preliminary data that many Ss, after a period of observing in the task, could work with a higher relative level of flash stimulation without noticing it. For this purpose, occasional slight reductions of brightness of the rectangle were made.

During the blank periods, the field was totally dark.

The stimuli for visual comparison were presented by means of 3-1/4-inch by 4-inch slides, with the fields opaque and the figures transparent so as to allow transillumination from an evenly backlighted ground-glass surface. The standard or comparison stimulus figure was a rectangle or patch of a fine checkerboard pattern, 59 by 77.5 mm., with the longer dimension vertical. The eleven slides used to present the variable stimulus were identical, except that the



STANDARD RECTANGLE



INCIDENTAL WORD

FIGURE 4. SAMPLE STIMULUS SLIDES

size of the rectangle ranged in equal steps from 57 by 75 mm. to 60.5 by 80 mm. Research[1] had indicated that with such a stimulus the constant error or time error should approximate zero with the timing to be employed.

The unnoticed incidental stimuli were likewise presented by means of transparencies. They consisted of the words greater, smaller, graeter, samller, and a nonsense figure approximately equal in size and shape to the words (about 50 by 15 mm. over-all). Any one of these could be inserted into the A (flash) field of the tachistoscope; any of the slides bearing rectangular patches could be inserted into the B field. If both fields were illuminated, the word appeared plainly written across the middle of the patch.

The viewing distance was 60 cm.; hence the visual angle subtended by the standard stimulus was about 6° by 7°.

E inserted and removed all slides by hand. In the event of a delay in changing slides or in recording data, the next trial sequence did not begin until E triggered it by means of a pedal.

Subjects

Subjects were four male undergraduates with normal vision, their ages ranging from 19 to 24. None of them was generally sophisticated in the field of psychology;

---

[1] E. Nowlan, The time-error in visual perception (Unpublished doctoral dissertation, Harvard Univer., 1948).

none suspected the purpose of the experiment. They were paid for their services.

Such a small number of Ss is unusual in research on unnoticed incidental stimulation. The present experiment, however, was considered as a study of an effect in psychophysics, with rather detailed examination of the data provided by individual Ss; in such a setting, the use of few Ss is appropriate. It was supposed that the effect sought, like most known psychophysical effects, could be elicited in some degree from any normal individual.

A further discussion of this point will be undertaken below in the discussion of results (page 57).

Procedure

A formal approach to S with minimal contact and with verbatim reading of instructions appears to heighten anxiety in some Ss and to prevent such subtle influences as are here sought.[1,2] Accordingly, E attempted to put S at ease before and during the experiment. He chatted informally, clarified to S that the latter was not in any sense being tested, and liberally paraphrased the instructions.

A preliminary technique was used to estimate S's threshold for the incidental stimulation. This employed the

---

[1] P. A. Kolers, Subliminal stimulation in simple and complex cognitive processes (Unpublished doctoral dissertation, New York Univer., 1956).

[2] C. M. Solley and J. Long, When is "uh-huh" reinforcing?, Percept. Mot. Skills, 8, 1958, 277.

metacontrast effect, a sort of variant of apparent movement.[1] A solid circle of light was the main stimulus, remaining on for several seconds at each presentation; it was preceded very briefly by a broad ring which surrounded the circle. The duration of the ring and the intensity of the circle were varied so as to obtain values at which the ring seemed to shrink into the circle. These values were then used initially in the main procedure.

The purpose and procedure of a psychophysical experiment according to the method of constant stimulus differences were explained to S. On each trial, following the warning buzzer, he would be shown first the standard and then one of the variable patches. At any time after the appearance of the variable, he was to report his judgment as to its size compared with the standard, using the word "greater" or "smaller."[2] No judgments of "equal" were to be used. It would not be possible to distinguish the patches by their shapes or patterns. The task was difficult; much of the time S would be very uncertain, but he was to do his best and not to worry about his accuracy.

E added that the electronic equipment might accidentally

---

[1] M. Alpern, Metacontrast, Opt. Soc. Amer. J., 43, 1953, 648-657.

[2] Although the instructions specified use of the words "greater" and "smaller," and these were used at all times by E, S was not corrected if he used different words. Some Ss used "larger" part of the time.

become erratic, in which case some additional stimulation would be visible. If this should occur, S was to report it to E. S was reminded of this request, in a casual manner, at some time during every experimental hour.

Prior to the beginning of every session, S was dark-adapted for 10 to 20 minutes.

Order of stimuli. The variable stimuli or patches were numbered from one (smallest) to 11 (largest); No. 6 was identical in size to the standard. The experiment was designed to measure the effect of the unrecognized words smaller and samller upon judgments of Nos. 1-5, the effect of greater and graeter upon Nos. 7-11, and the effect of both upon No. 6. Each presentation of a word as unrecognized flash stimulus was to be matched by a similar presentation of the nonsense flash stimulus as control. A full series, therefore, included 12 presentations of the variable stimuli with the correctly spelled flash stimuli; 12 presentations with the misspelled flash stimuli; and 24 presentations with the nonsense flash stimulus.

Some previous experimentation[1] had indicated that, under some conditions, only the third or fourth consecutive presentation of the same unrecognized stimulus might be effective; i.e., a positive recency effect obtained. Accordingly,

---

[1] G. J. W. Smith, D. P. Spence, and G. S. Klein, Subliminal effects of verbal stimuli, J. Abn. Soc. Psychol., 59, 1959, 167-176.

the order of presentation was built of blocks of three greater or three smaller than standard. Each of the patches of a single block was preceded by the same flash stimulus. To avoid following an unvarying pattern of three-greater-three-smaller, there was a run of six either greater or smaller in the middle of each series of 24 trials. Within these limitations, the order was randomly drawn. (See Appendix A for a typical series.)

A brief rest period was afforded after each series of 24 trials. Ninety-six trials normally constituted an hour's session. The intensity of the visible stimulus patches was gradually decreased from hour to hour, so that the flash stimuli became relatively more recognizable. The procedure was continued to a total of 1,536 trials with each S, except for one who reported seeing the flash stimulus after completing 1,152 judgments.

Aural identification of incidental-stimulus slide. As a part of the regular procedure for every trial, one of the five A-stimulus slides bearing the incidental stimuli was inserted into and removed from the tachistoscope. The sound of its doing so was audible to S, along with the various other sounds of the apparatus. It is possible that S might learn to associate the characteristic sound of, say, the greater slide with the probability of occurrence of patches easily judged greater than standard.

A priori, it may be pointed out that the timing of a

cycle was such as to make this association unlikely: Insertion of the A-stimulus slide preceded the warning signal, and its sound would probably be experienced as a part of the previous cycle. Moreover, care was taken to reduce the individually identifiable characteristics of these sounds in relation to their over-all variability.

Nevertheless, it was thought desirable to test Ss' ability to recognize the A-stimulus slides by sound alone. A matching test was used, employing the four meaningful A-stimulus slides. After S had finished the entire psychophysical series, he was told that he was to try to distinguish four slides by the characteristic sounds they made in entering and leaving the exposure chamber. He listened to three repetitions of each, identified for him by their designating letters. He then attempted, after each of a series of eight trials, to report which of the slides had been used. This procedure--identified presentations followed by test--was repeated a second and a third time.[1]

Finally, the nature of the experiment was disclosed to S and was further discussed with him.

---

[1]It will be noted that there is some opportunity for learning to occur during this test itself, even though none may have occurred during the psychophysical procedure. Thus the argument from null results here to rejection of aural association as a factor in producing the predicted effect (if any) in the psychophysical procedure is *a fortiori*.

Results

Aural identification. In trying to distinguish the four A-stimulus slides by sound alone, the three Ss achieved 20.3 per cent hits compared with a chance expectation of 25 per cent. Hence no evidence appears that they could successfully associate the sounds of these slides with the probabilities of appearance of larger or smaller patches.

Recency effect. Arranging the stimuli in blocks of three greater and three smaller than standard introduced a non-random source of error describable as recency effect; i.e., the tendency, when S has judged the last one or two or three stimuli as greater, to judge the next as either greater (positive effect) or smaller (negative effect).[1,2]

This effect was not taken into account in establishing the order of stimuli for the first S. There proved to be a marked negative recency effect, which for this S was confounded with the predicted effects so that the data were useless for the intended purpose. For the other three Ss, the series of 24 trials were counterbalanced so as to neutralize this effect.

Group results. With only three Ss and with a large

---

[1] C. I. Howarth and M. G. Bulmer, Non-random sequences in visual threshold experiments, Quart. J. Exp. Psychol., 8, 1956, 163-171.

[2] J. S. Bruner and H. Wechsler, Sequential probability as a determinant of perceptual closure, Amer. J. Psychol., 71, 1958, 604-606.

number of trials apiece, it is appropriate to examine the data from each S individually. However, the psychometric functions pooling data from the three Ss and reflecting a group test of the main hypothesis are also instructive.

In Figure 5, the ordinate represents per cent of judgments at each stimulus size which were correct, rather than the more conventional per cent of judgments of "greater" throughout the scale. Thus, half of the conventional ogive function has been inverted.

The solid line represents all trials with the control flash stimulus. The broken line represents all trials with the experimental word stimuli, both correctly spelled and misspelled. It should be noted that there are four entries for stimulus No. 6 (equal to standard): one for trials with smaller and samller, one for trials with greater and graeter, and one each for the sets of control trials which precisely match the above in terms of sequential location.

The general prediction is that accuracy for experimental stimuli is superior to that for control stimuli. It is apparent in Figure 5 that, across the full range of stimulus sizes, the data do not bear out this prediction.

If we consider only the four stimulus conditions nearest the middle of the range--closest to the point of subjective equality--we note that they do consistently favor the prediction. Since it had been expected that the experimental effect would be most evident where the objective discrimination

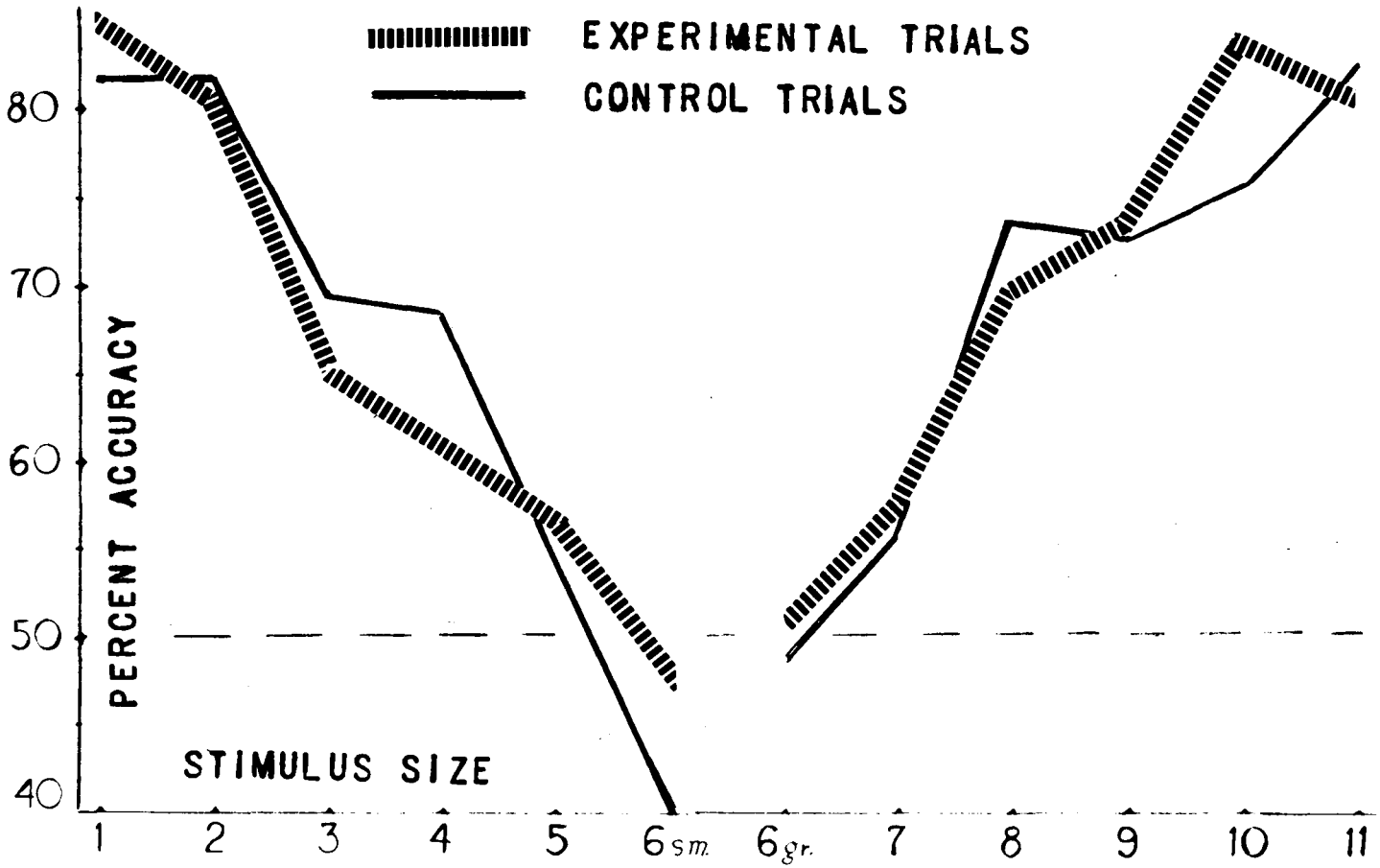


FIGURE 5

EXPERIMENT I. GROUP PSYCHOMETRIC FUNCTION—3 SUBJECTS

task was most difficult, it is appropriate to test the significance of this effect. The test was made by means of an analysis of variance, which is detailed in Appendix C. The magnitude of the predicted effect was found to be such as might have arisen by chance.

Individual results. When the data for the three Ss were examined individually, for none of the three did there appear a consistent increase in accuracy associated with the presence of the meaningful flash stimuli, across all 12 conditions of patch size.

One S (the same who reported seeing the flash after completing three fourths of the planned series of trials) yielded statistically significant agreement with the flash stimulation when it accompanied the stimulus patch of mid-size. However, in view of the large number of such tests which might be made and of the great variability of data from this S, this result can hardly be said to support the psychological hypothesis.

As one would expect from the failure of the combined results to follow the predicted pattern, there was no systematic difference between results obtained with the correctly spelled and the misspelled flash stimuli.

Discussion

Major hypothesis. The major hypothesis of the present study was that, in a psychophysical task of the kind employed,

flashes of greater would be more frequently followed by judgments of "greater," and flashes of smaller more frequently followed by judgments of "smaller," than in the comparable control conditions. For three Ss, tested over a large number of trials each, no such influence was found.

Second hypothesis. It was predicted that the effect of correctly spelled words used as unnoticed incidental stimulation would be greater than would the effect of the same words in misspelled form. Since Experiment I failed to yield any main effect, it could not yield this differential effect.

In reviewing the experiment, possible reasons for the failure to demonstrate the hypothesized influence were considered. First, of course, the influence might be nonexistent. If this were so, it would be difficult to explain why such an influence has appeared in experimental procedures which do not seem radically different from the present one. Thus, on grounds of theoretical parsimony, this explanation of the failure was not immediately accepted.

Second, an inadequate technique was used for predicting the physical value of incidental stimulation at which the individual S will first recognize its existence. The level was set by a rough procedure and was raised only a little[1]

---

[1]Actually, as explained in connection with the description of the apparatus, the brightness of the judgment patches was reduced while the duration and brightness of the incidental stimulation remained the same.

during the series of trials constituting Experiment I. It reached the level of recognition for one of the Ss; for the others, it may have been set far too low.

Whether a method exists which will enable accurate predictions of the recognition level under the conditions of this experiment may be doubted. An improved technique would permit the collection of responses from every S while the incidental stimulus was at a physical level only a little below the level of recognition.

Third, only three Ss were used. The decision to use such a small number was mentioned above (p. 47). It had been assumed that the effect sought, like most known psychophysical effects, could be observed in most normal individuals.

Previous experimentation had, indeed, shown a rather wide range of degree of effect from unnoticed incidental stimulation: some Ss failed to show the predicted effect and some showed a reverse effect. Some authors[1,2,3] have conjectured that there is a meaningful dichotomy between Ss who do and those who do not respond to stimulation without

---

[1] P. A. Kolers, Subliminal stimulation in simple and complex cognitive processes (Unpublished doctoral dissertation, New York Univer., 1956).

[2] S. Bach and G.S. Klein, Conscious effects of prolonged subliminal exposures of words (paper presented at A.P.A. convention, 1957; abstract, Amer. Psychologist, 12, 1957, 397).

[3] D. Spence and I. Paul, Importation above and below awareness (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

awareness. At least one[1] has sought out personality correlates of this dimension of responsiveness. Certain considerations, however, make the existence of such a dichotomy dubious. (A) It has not been shown that Ss who are responsive in a given procedure will continue to be so in retests or in similar subsequent procedures. (B) As suggested above, there seems to be no efficient technique for predicting the physical level of incidental stimulation at which the individual S will first recognize its existence. In practice, E probably uses most of the time a value well below the recognition level. This would account for failure to obtain results from Ss who may actually be responsive. (C) The dichotomy has been announced only on the basis of experimentation with affect-laden incidental stimuli. But with regard to such stimuli, it seems clear from previous work[2] that recognition thresholds vary in accordance with the affective nature of the stimuli. The dichotomy may not hold where affectively neutral stimuli are used.

Fourth, Ss were looking into a totally dark tachistoscope except when one or another stimulus patch was illuminated. Ss reported that this condition was experienced as unpleasant. It may well have caused a greater general

---

[1] M. Eagle, Some personality correlates of responsiveness to unperceived cues (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

[2] C. W. Eriksen, Defense against ego-threat in memory and perception, J. Abn. Soc. Psychol., 47, 1952, 230-235.

variability in judgments of stimulus sizes than would otherwise have obtained. If so, any effects correlated with the nature of the unnoticed incidental stimuli would have been the more likely to go undetected against the large background variation.

It seemed, therefore, that a further test of Hypothesis 1 should be attempted. A revised procedure should permit the collection of responses from each S while the incidental stimulus was at a physical level only a little below the level of recognition; should use an adequate number of Ss to allow for the possibility that many are non-responsive to stimulation without awareness; and should avoid the use of a totally dark background.

Summary

Three Ss judged the sizes of 11 stimulus patches over a lengthy series of trials according to the method of constant stimulus differences. The appearance of each variable patch was preceded by a brief unnoticed flash bearing either the word greater, the word smaller, a misspelling of one of these, or a nonsense stimulus. The same unnoticed stimulus was used for three consecutive trials. Between stimulations, the stimulus field was totally dark.

With the orders of stimuli fully counterbalanced, there was no demonstrable tendency for flashes of greater or smaller or misspelled versions of them to evoke from S the corresponding judgments. Possible reasons for this outcome have been discussed.

CHAPTER VI

EXPERIMENT II

As in Experiment I, the purpose was to study performance in a visual size comparison task as correlated with the meanings of the response words presented as unnoticed incidental stimuli. A further purpose, in the event of such a correlation being found, was to study the relation between latency of response and agreement with such meanings.

The considerations outlined in the discussion of Experiment I (Chapter V), served to indicate certain desirable features of the design of Experiment II. First, the incidental stimuli employed for each S should, ideally, be at a physical level just below that at which recognition would occur. This would avoid the use of a level so low that S might not be able to discriminate among the stimuli, even with full awareness.

No known procedure for estimating the level of recognition in advance was thought to be satisfactory for this purpose. The solution employed was to use a rather conservatively estimated value for the initial level of the incidental stimulation and then to increase the level systematically until recognition occurred. Then the responses to be analyzed were the last of the series, those which preceded by only a few trials the first reported partial recognition. This procedure had the economic disadvantage that the responses

to earlier trials--hundreds, in some cases--had to be disregarded.

Second, the number of Ss to be used should be sufficient to demonstrate the hypothesized effect at a statistically significant level. This effect might occur, according to previous research, in as few as 30 percent of Ss, and was probably only moderately strong in the individuals of that minority. Because these factors could not be more exactly estimated, it was not possible to use operating characteristics of statistical tests to derive precisely an appropriate n. The operating characteristic of the z-test to be used, however, did suggest that there would be little advantage (that is, little reduction in the chance of accepting a false null hypothesis) in using more than about 30 Ss.

Third, it appeared that the viewing field should not be totally dark between the presentations of patches.

The second hypothesis of Experiment I predicted a difference in accuracy from the use of more and less recognizable versions of the unnoticed incidental stimuli. In Experiment II, this difference was not tested. To have tested it would have doubled the length of the procedure, which was already so great with many of the Ss as to raise problems of scheduling. It seemed preferable to test the first hypothesis as directly as possible, while relinquishing the effort to test the second in the same setting.

Also, the major effort in Experiment II was directed toward testing the effect at a point on the stimulus size scale close to the point of subjective equality. As mentioned in Chapter III, this is the point where none of the variance of responding is accounted for by genuine difference in patch size. Hence the predicted variance due to unnoticed incidental stimuli should appear there if anywhere.

In Experiment II, latency of responding was studied in relation to Ss' agreement with the message of the unnoticed incidental stimuli. In psychophysics generally, accurate judgments are found to be made more rapidly than inaccurate judgments. Some experimenters, however, report that judgments agreeing with unnoticed incidental stimulation may be made more slowly than their opposites. An extended analysis of this subject will be deferred to the discussion of results in this chapter.

Finally, Experiment II was designed to test for differences of responding correlated with sex of S. The most closely comparable inquiries have not indicated that either sex is more sensitive than the other to unperceived stimulation.[1] However, in order to test this factor, equal numbers of male and female Ss were employed.

---

[1] In some cases where both male and female Ss were used, published reports have so far dealt only with those of one sex: G. J. W. Smith and U. Kragh, Do microgenetic sequences reflect life history? An illustration, Acta Psychol., 11, 1955, 504-512; M. Eagle, Some personality correlates of responsiveness to unperceived cues (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

Apparatus

The tachistoscope was used in the same fashion as in the first experiment, with the following changes: Brightness of the transilluminated surface behind the rectangular patches was 2.06 foot-lamberts, as seen from the viewing window, on every appearance of these patches. In the other field of the tachistoscope, a sheet of tracing paper ten inches by ten inches was inserted, its front surface illuminated by two shaded 6-volt lamps to a brightness of about 0.001 foot-lamberts as seen from the viewing window. Being visible at all times, this surface provided a frame within which the stimulus patches (about 2-1/3 by 3-1/4 inches) appeared.

It was expected that judgments made with this constantly visible background would be less variable than those made, as in Experiment I, against a totally dark background. Ss could more readily judge the distance of the images, and autokinetic effects would be minimized.

It was also possible, however, for S to use the background to try to circumvent the judgment task. While the standard stimulus was in view, he could fixate a spot on the background which coincided with its edge. Then, when the variable appeared, he would make his judgment according to whether the variable overlapped or fell short of this spot. In order to nullify the advantage to S of using such a technique, each patch was centered at a slightly different spot. This was explained to S, and it was emphasized that he could

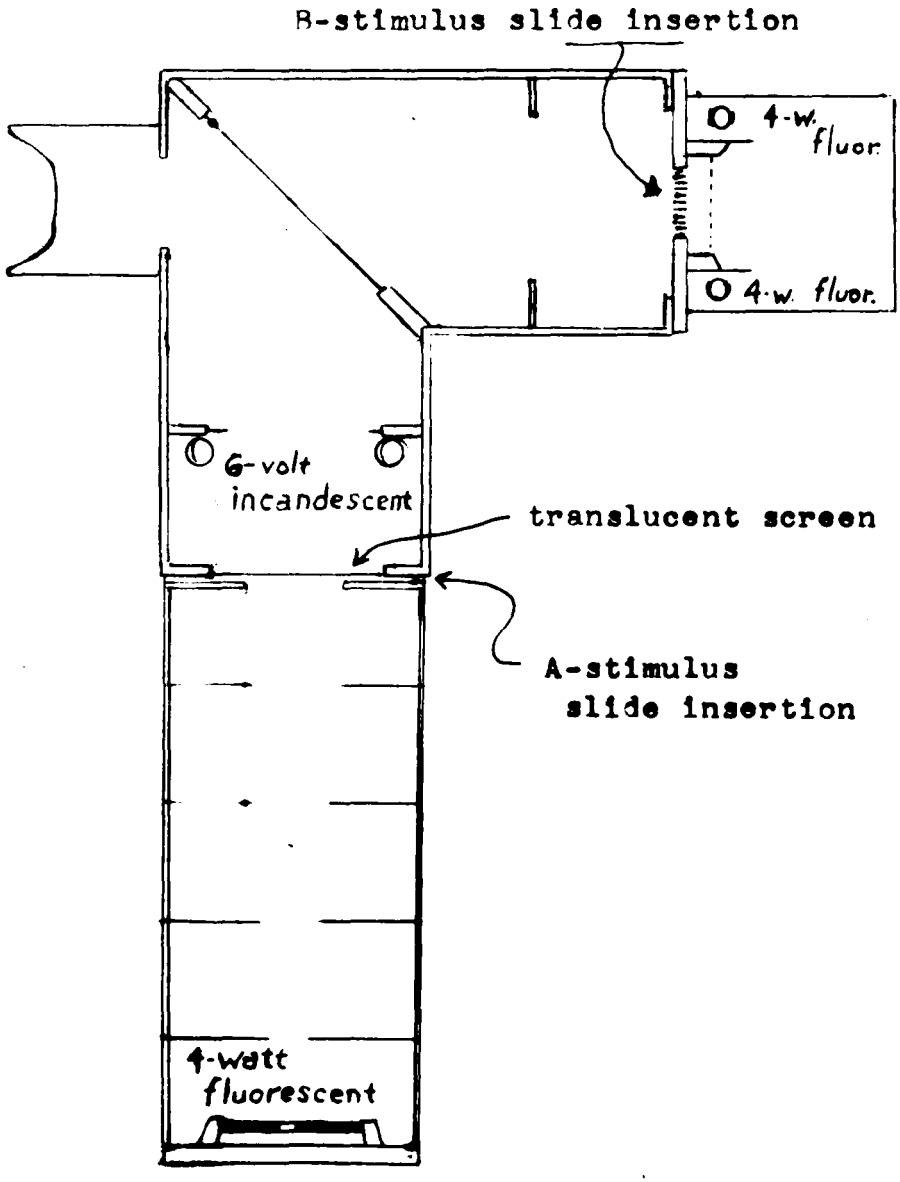


FIGURE 6

TACHISTOSCOPE USED IN EXPERIMENT II

judge with accuracy only by looking at the whole patch and attending to his impression of its total size.

The slides bearing transparencies of the incidental stimulus words could be inserted in a holder immediately behind the sheet of tracing paper. They were transilluminated by light from a 1/3 by 1/3 inch uncovered portion of the surface of a single 4-watt fluorescent lamp, 23 inches behind the sheet, drawing a current of 53 milliamperes from the timed circuit of the timer. This constituted a lensless projector, affording a fairly sharp image of the slide transparency on the tracing paper. Its brightness was 0.014 foot-lamberts as seen from the viewing window.

Latency of response was recorded by means of a Gerbrands electronic voice key. A Standard timer (stop-clock) was started when the incidental stimulus was illuminated, just before the variable patch. When S spoke his response into a microphone attached below the viewing hood, the timer was stopped by means of the voice key.

Subjects

There were 16 male and 16 female Ss, either high school graduates or college graduates; their ages ranged from 17 to 24. Five of them had some degree of sophistication in the field of psychology, but none guessed the purpose of the experiment. All had normal vision. They received pay for their services.

Procedure

Again a preliminary procedure was employed to establish a beginning value for the incidental stimulation. This was a different procedure from that used in Experiment I, seeming (on the basis of some exploratory work) to offer a more sensitive indicator of the level at which S would recognize the flashed words. A broad ring of light was the main stimulus, which remained on for several seconds at each presentation. Preceding it for a brief timed period was a complex pattern located within the ring, and including two bright spots adjacent to the ring on the right and left. The duration of this stimulus was varied so as to obtain ascending and descending thresholds for the appearance of both spots. From these was derived a value for the initial duration of the flash stimulus in the main procedure.

Following this preliminary procedure, S was led to another room where he was asked to produce stories to four TAT cards, recording them by means of a tape recorder.[1]

S then returned to the experimental room for the psychophysical task itself. The instructions he received were essentially the same as those of the first experiment, with the addition noted previously in connection with the lighted background. Also, S was asked to speak his responses clearly

---

[1]These data were collected in order to test hypotheses relating to personality characteristics of Ss influenced by the incidental stimulation. They are to be treated in a separate report.

into the microphone mounted below the viewing aperture, since this would be used to obtain his response time. However, he was told that he need not make any effort to respond either more quickly or more slowly because of the time recording.

Instead of using the buzzer as a warning signal, as in Experiment I, E said the word "ready" about one second before the appearance of the standard patch.

Order of stimuli. The attempt to take advantage of a (possible) positive recency effect by using blocks of three consecutive stimuli greater or smaller than standard (as described in Chapter V) was abandoned in this experiment. A modified random order of stimuli was used instead.

Each series of 20 trials included Stimulus No. 6 (equal in size to the standard) presented six times with the incidental greater and six times with smaller; Stimuli Nos. 2 and 4 presented once each with smaller and once each with the nonsense stimulus; and Stimuli Nos. 8 and 11 presented once each with greater and once each with the nonsense stimulus. These patches were chosen because, on the group psychophysical judgment curve generated in Experiment I, they afforded tasks of two distinct difficulty levels on either side of the point of equality. The latter point appeared to lie quite close to Stimulus No. 6; that is, the constant error or time error was near zero, as had been expected.

Four orders of the 20 trials were drawn from a table of

random numbers; then four more orders were created by substituting No. 6-- smaller for No. 6--greater (and vice versa) throughout the original four orders. The eight orders were presented in rotation to each S.

S was given a brief rest period after each series of 20 trials. Usually about 80 trials were performed in an hour's session.

The duration of the flash stimulus remained at its initial value for the first 40 trials. It was then increased by one millisecond every ten trials for three such increases; thereafter by one millisecond every five trials up to a level of 50 milliseconds; thereafter by one millisecond every three trials. The procedure was discontinued at a level of 100 milliseconds, if recognition had not previously occurred. The selector switches that govern flash duration were muted so as to avoid giving an audible suggestion to S that duration values were being increased (as they had been during the preliminary procedure).

Recognition was judged to have occurred when S reported a localized flash preceding the variable patch, whether or not he perceived it as printed letters; a report of a broad or vague flash covering most of the patch area was not considered recognition. E tried to ascertain as exactly as possible the first trial on which recognition had occurred; usually this was from two to five trials before the report by S.

Aural identification. Again, as in Experiment I, it is possible that Ss might learn to associate the sound of the greater slide entering or leaving its slot with the appearance of patches easily judged greater than standard.

As in Experiment I, a brief procedure was run to test for this kind of association, using six of the 32 Ss. These Ss were selected because they had time to continue with this procedure after finishing the psychophysical task. Their mean combined accuracy score for the main task was 12.5, compared with a mean over all 32 Ss of 13.25.

S was told that he was to try to distinguish two slides by the sounds that they made in entering and leaving the exposure chamber. He listened to four repetitions of the sounds, designated as Number One and Number Two. He then attempted, after each of a series of ten trials, to report which of the two slides had been used. He was given two more identified repetitions of each, and finally another series of ten trials.

Finally, the nature of the experiment was disclosed to each of the Ss and was discussed further with those who showed an interest. Ss almost invariably displayed considerable surprise on finding that the incidental stimulus had been present throughout the psychophysical procedure.

With eight Ss, as time allowed, quick checks were made to determine the thresholds for reading the flash stimuli and for identifying their presence, with S sophisticated as

to their existence.

Results

Aural identification. The six Ss who tried to distinguish two stimulus slides by their sound achieved a total of 62 hits, compared with a chance expectation of 60. Using the appropriate matching test,[1] it was found that such a result might very easily have occurred by chance ($p=0.39$). Thus, Ss who have already frequently heard these slides being inserted do not appear able to distinguish them by their sounds alone, even under favorable conditions for doing so.

Duration levels. The beginning level of duration of the incidental stimuli ranged from 22 to 39 milliseconds. The level at recognition ranged from 31 to about 180 (three Ss who did not report the stimulation at the final level of 100 milliseconds were tested beyond that level, using large duration increments).

The eight Ss whose thresholds were checked in the sophisticated condition were able to detect the presence of the flash stimuli at 20 to 35 milliseconds, and to distinguish one from another at 30 to 60 milliseconds.

The measures. As indicated above, E ascertained as precisely as possible the trial on which recognition had first occurred. All trials at that level of flash duration

---

[1] F. Mosteller and R. R. Bush, Selected quantitative techniques (in G. Lindzey, Ed., Handbook of Social Psychology, 1954, Vol. I, p. 310).

were disregarded, and 40 previous responses were analyzed. These included the last 12 presentations of the mid-stimulus (No. 6) with the smaller flash, its last 12 presentations with greater, and for each of the four other stimuli its last two presentations with a meaningful flash and its last two with the control flash.

Mid-stimulus: accuracy. Each S obtained one score representing his number of calls of "greater" out of 12 trials with this incidental stimulus, and another representing his calls of "smaller" out of the 12 with smaller. In Figures 7 and 8 are plotted the frequency distributions of these two scores, and in Figure 9 the distribution of subjects' total accuracy scores, combining the two.

The extent to which the curves lie to the right of the 50 per cent point is a measure of Ss' agreement with the incidental stimuli. The extent to which the curve of Figure 7 lies to the right of the curve of Figure 8 is a measure of constant error or (negative) time-error; i.e., the tendency to call the variable patch greater than standard.

To test the significance of the degree of agreement with incidental stimuli, the appropriate matching technique[1] was used. The "target deck" has two suits of 12 cards each. The matching deck has the same suits but no restriction as to the number of cards per suit. Variance is computed

---

[1] Ibid.

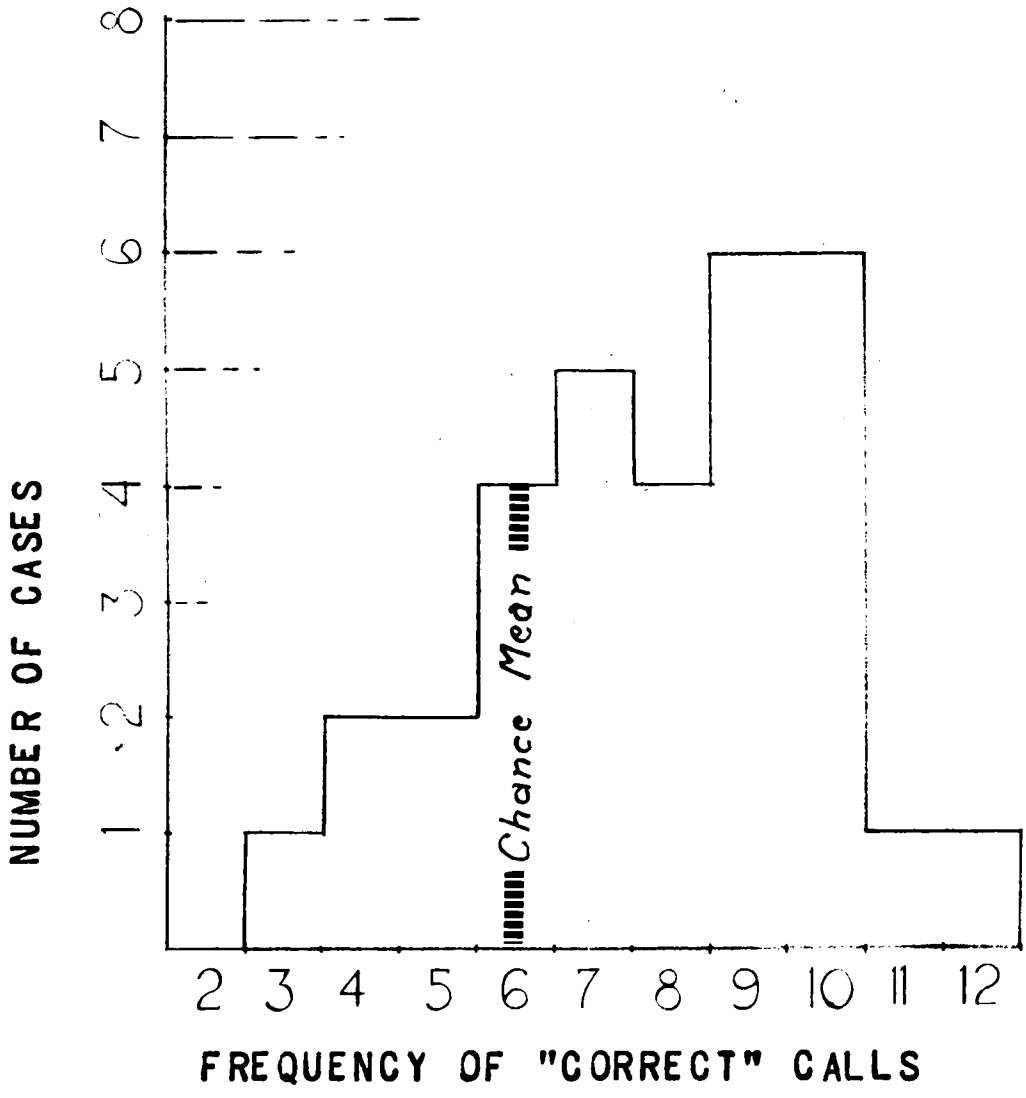


FIGURE 7

EXPERIMENT II. STIMULUS NO. 6

SUBJECTS' FREQUENCIES OF AGREEMENT WITH FLASHED "GREATER"

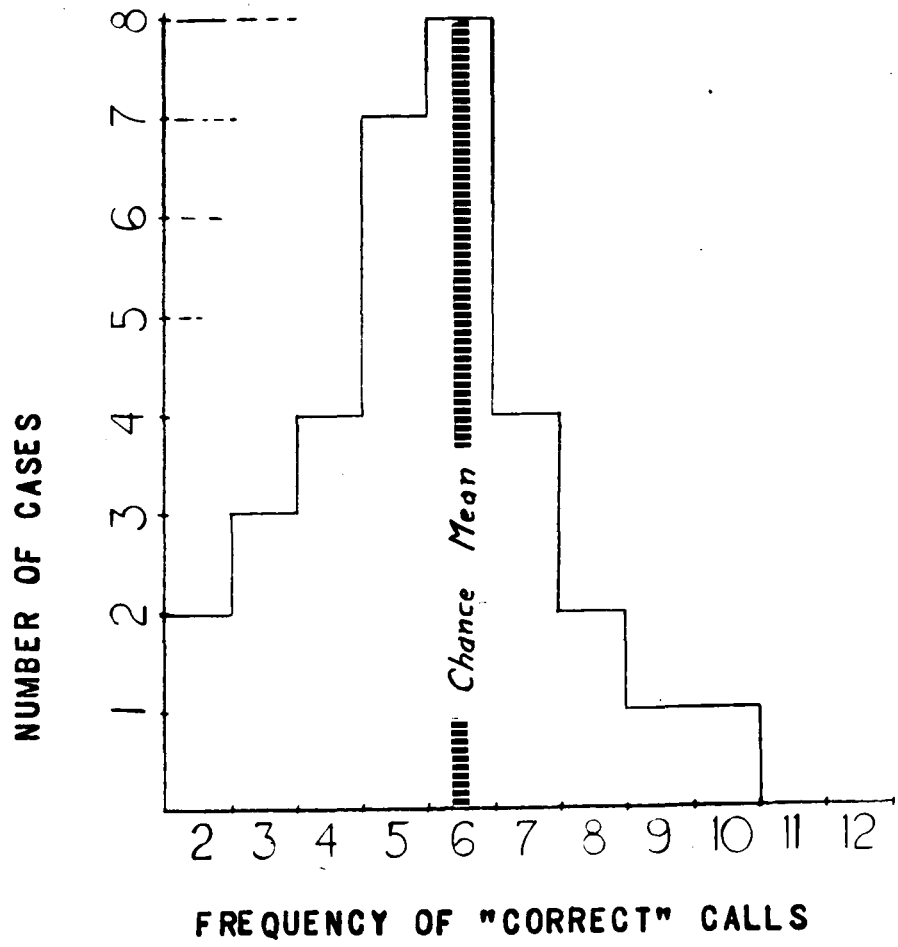


FIGURE 8

EXPERIMENT II. STIMULUS NO. 6

SUBJECTS' FREQUENCIES OF AGREEMENT WITH FLASHED "SMALLER"

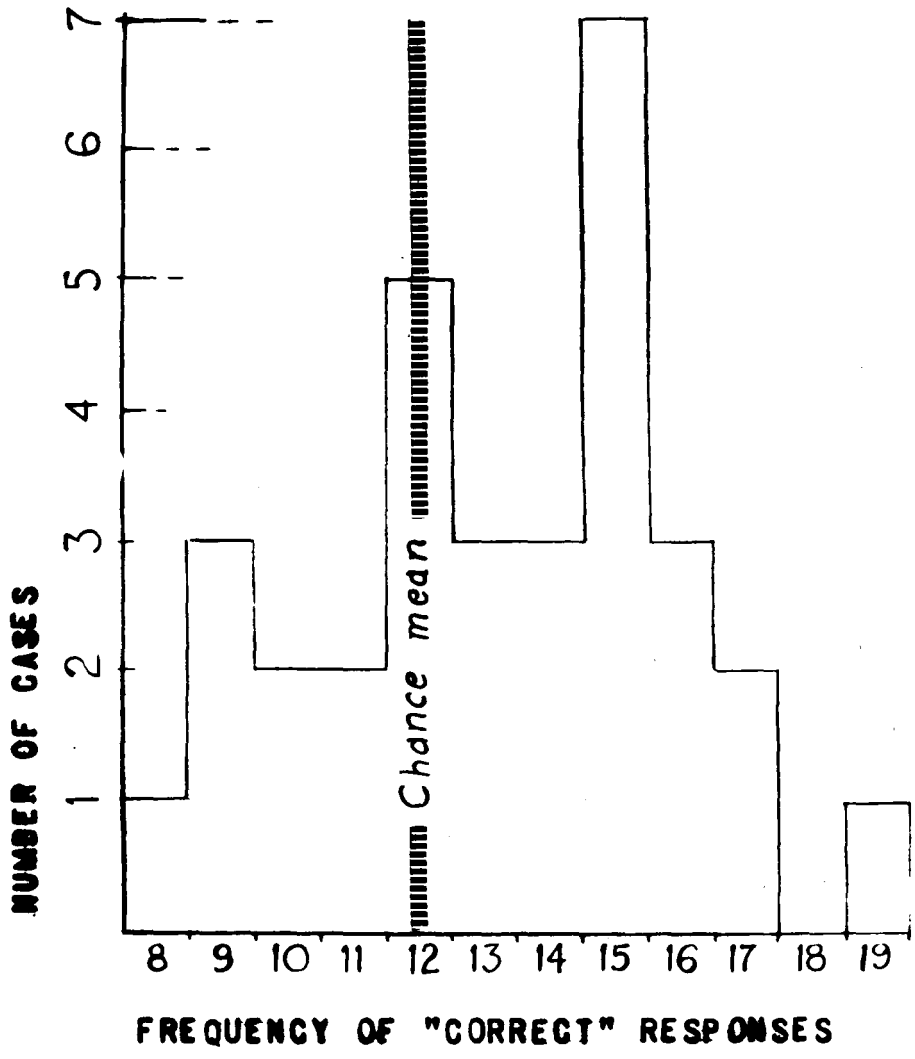


FIGURE 9

EXPERIMENT II. STIMULUS NO. 6
SUBJECTS' FREQUENCIES OF AGREEMENT
WITH BOTH FLASHED STIMULI

separately for each of the 32 Ss; then for the overall test: $z = \frac{\text{total correct matches} - (32 \times 12)}{\sqrt{\Sigma \sigma^2}} = 2.98$. A z-value of 1.65 would be sufficient to reject, at the usual five per cent level, the statistical hypothesis that agreement with the incidental stimuli was no greater than would have occurred by chance.

The data were next examined with respect to two other questions: Was there a significant tendency to judge the mid-stimulus greater rather than smaller, and did either sex perform more accurately than the other? Each S's proportion of "hits" or agreements with the flashed word was transformed to $\phi = 2 \arcsin \sqrt{p}$, a transformation which tends to normalize the distribution of proportions.[1] Table II lists the group means and standard deviations.

TABLE II

AGREEMENT WITH EACH OF TWO INCIDENTAL STIMULI FOR MALE AND FEMALE GROUPS JUDGING MID-STIMULUS

MEANS AND (STANDARD DEVIATIONS)

	Incidental stimulus greater		Incidental stimulus smaller	
MALE	1.828	(.360)	1.596	(.405)
FEMALE	1.985	(.488)	1.396	(.257)

An analysis of variance is detailed in Appendix E.

[1] H. M. Walker and J. Lev, Statistical Inference, 1953, p. 423.

The results indicate that the response "greater" was indeed more frequently used: that is, a significant constant error (negative time error) existed ($p < .01$). Neither sex outperformed the other at a significant level.

Other stimuli: accuracy. For each S and for each of the four stimuli other than the equal-to-standard mid-stimulus, four trials were to be considered: the last two in which the stimulus was accompanied by the flashed greater or smaller, and the last two in which it was accompanied by the control flash. Thus S might score two hits, one hit, or no hits (agreements with the flash) under each condition.

TABLE III

JUDGMENTS OF STIMULI LARGER AND SMALLER THAN STANDARD IN PRESENCE OF APPROPRIATE AND CONTROL INCIDENTAL STIMULI

Stimulus Size	Number of hits when incidental stimulus was Appropriate			Control		
	0	1	2	0	1	2
No. 2**	0	8	24	2	15	15
No. 4	3	14	15	3	12	17
No. 8	4	17	11	2	16	14
No. 11*	1	5	26	3	8	21
Total	8	44	76	10	51	67

*$p < .05$ **$p < .01$

The distributions of these scores among the 32 Ss are shown in Table III. The control entries in these tables may be taken as expected frequencies. Then the departure from these values of the frequencies observed with meaningful

words may be measured by means of chi-square. (To avoid the use of very small frequencies, the columns for zero and one are combined.) For both Stimulus No. 2 and Stimulus No. 11, the resulting values are sufficient to reject (at the 1 per cent and 5 per cent levels respectively) the hypothesis that the number of hits was not increased by the word stimulus (chi-square: 9.067 and 2.805). For the other two stimuli, the data run (weakly) in the reverse direction to that predicted; and over the entire table, the predicted effect is not significant.

The question may be raised whether Ss who were apparently affected by the incidental stimulus in their judgments of the mid-stimulus were also affected by it in judging the other stimuli. Figure 9 indicates that 13 Ss may be selected whose overall scores on the mid-stimulus were so great (15 or more matches) that a chance distribution would include only two or three of their number. These will be referred to as the influenced group, and the other 19 as non-influenced.

Table IV indicates the distributions of accuracy scores for the two groups. It will be seen that, for non-influenced Ss, the total scores were virtually identical, while influenced Ss did obtain somewhat (not significantly) greater accuracy when the meaningful incidental stimulus was present. When the results for individual patch sizes are analyzed, the influenced Ss showed significantly greater accuracy on Stimuli Nos. 2 and 11; the non-influenced Ss showed signifi-

TABLE IV

JUDGMENTS OF STIMULI LARGER AND SMALLER THAN STANDARD IN PRESENCE OF APPROPRIATE AND CONTROL INCIDENTAL STIMULI AMONG INFLUENCED AND NON-INFLUENCED SUBJECTS

Thirteen "Influenced" Subjects						
Stimulus Size	Number of hits when incidental stimulus was Appropriate			Control		
	0	1	2	0	1	2
No. 2*	0	2	11	1	5	7
No. 4	0	7	6	0	5	8
No. 8	3	6	4	1	9	3
No. 11*	0	1	12	1	3	9
Total	3	16	33	3	22	27
Nineteen "Non-Influenced" Subjects						
	0	1	2	0	1	2
No. 2*	0	6	13	0	11	8
No. 4	3	7	9	3	7	9
No. 8**	2	11	6	1	6	12
No. 11	1	4	14	2	5	12
Total	6	28	42	6	29	41

*$p < .05$ **$p < .01$ (contrary to prediction)

cantly increased accuracy on No. 2 and significantly decreased accuracy on No. 8.

Mid-stimulus: latency. It was desired to test predictions concerning the latencies of judgment of Ss whose responding was influenced by the unnoticed incidental stimuli. Specifically, their speed of response when agreeing with the message of such stimulation was to be compared with the speed

of response when they disagreed with the message.

Latencies had been measured in hundredths of a second; they ranged from about 80 to about 500. In order to normalize the distribution of scores, each latency was transformed according to the commonly accepted logarithmic transformation.[1]

The 32 Ss were again divided into an influenced group of 13 and a non-influenced group of 19. Predictions applied only to data from the former group; the latter is included for comparison. Each S's trials could be divided according to whether the incidental greater or smaller had been exposed, and again according to whether the response was or was not in agreement with that word. For each S, the means of the resulting four sets of latencies were computed. Table V indicates the means and standard deviations of these subject means.

An analysis of variance was carried out upon the data from the 13 influenced Ss. No evidence was found that judgments agreeing with the incidental stimulus were made either more rapidly or more slowly than the opposite judgments. The analysis is summarized in Appendix F.

---

[1] C. G. Mueller, Numerical transformations in the analysis of experimental data, Psychol. Bull., 46, 1949, 198-223.

TABLE V

MEAN LATENCIES OF JUDGING MID-STIMULUS IN AGREEMENT OR DISAGREEMENT WITH TWO INCIDENTAL STIMULI AMONG INFLUENCED AND NON-INFLUENCED SUBJECTS

MEANS AND (STANDARD DEVIATIONS)

	Incidental Stimulus: greater		smaller	
	Agree	Disagree	Agree	Disagree
13 influenced subjects	2.279 (.118)	2.332 (.138)	2.324 (.138)	2.284 (.111)
19 non-influenced subjects	2.270 (.153)	2.359 (.158)	2.373 (.123)	2.307 (.148)

Other Stimuli: latency. If similar tables were to be set up for each of the four other stimulus sizes, many Ss would fail to contribute data to one or more of the cells. Since the variability among subjects is great, it would be misleading to draw conclusions from such tables.

Discussion

Main hypothesis. Results served to support the psychological hypothesis: the choice of responses in a visual size comparison task was indeed affected by presentation of the response words as unnoticed incidental stimuli.

Why did Experiment II show such an effect while Experiment I failed to do so? In the discussion in Chapter V above (pp. 56-59), four possible reasons to account for that

failure were advanced. The first was actual non-existence of the influence being studied; results of the present experiment allow that possibility to be rejected.

The second was that the level of incidental stimulation needed to be raised for each S to a point as near as possible to his recognition level. This was accomplished in Experiment II through raising the duration gradually to that point; responses to only the last 24 trials using the mid-stimulus were tallied. What if responses to still briefer flashes had been used? A check of the preceding set of 24 responses for each S indicates that there would have been no reason to reject the null hypothesis, either for all 32 Ss or for the 13 who attained high scores on the last 24 trials. We may conclude that, where procedures similar to the present are employed, incidental stimulation will exert an appropriate effect only when delivered at a physical level almost high enough for recognition. This underscores the observation made in a review of the field

> "that, in nearly all studies reporting relevant data, the reliability of the Ss' judgments increases directly with the intensity of the stimuli."[1]

The third possibility was that many Ss are, in a given situation, non-responsive to stimulation without awareness. That there is indeed a dichotomy in this respect is indicated

---

[1] J. V. McConnell, R. L. Cutler, and E. B. McNeil, Subliminal stimulation: an overview, Amer. Psychologist, 13, 1958, p. 231.

by the shape of the distribution of total scores (Figure 9, p. 74). About one third of Ss appear to be responsive. The existence of this dichotomy was not clearly supported by the data on responding to stimuli other than the mid-stimulus. Nevertheless, present results do strengthen the assumption (referred to in Chapter V, p. 57) that there are many non-responders. It is clearly unwise to depend on a small number of Ss for the kind of effects sought, as in Experiment I.

The fourth possibility had to do with the assumed extra variation in responding caused by the use of a totally dark field between presentations of patches. This situation was altered in Experiment II. Whether its alteration was a necessary condition for the predicted effect is not known.

Other stimulus sizes. Were the flash stimuli effective in shifting judgments about the size of stimulus patches which were, in fact, greater or smaller than standard? Experiment II was not designed to test this hypothesis efficiently; most of the data were collected on judgments of the mid-stimulus. However, it was also possible to measure the degree to which judgments of each of four other stimulus patches benefited in accuracy from the incidental flash of the appropriate word (Table III). For the two extreme patch sizes, the easiest sizes to judge, there was significant increase; for the two patch sizes closer to the standard and hence more difficult, there was no such increase. For the mid-stimulus itself, as noted above, there was significant

agreement with the incidental flash.

The results clearly fail to demonstrate a consistent relation between the effect of incidental stimuli and the difficulty of judging the variable stimulus patches.

No obvious explanation presents itself. It is noted that the general level of accuracy for Stimulus No. 8 was unpredictably low, reaching an outstandingly low level among the non-influenced Ss when the appropriate incidental stimulus was flashed (Table IV). Now there were, no doubt, slight but consistent differences among the sounds made in inserting the different patch slides. Ss who depended in part on auditory clues would run the risk of thereby depressing their scores; and there may conceivably have been some obscure interaction between such an effect and the flashing of the incidental stimulus word.

Latency. In Experiment II, latency of responding was studied in relation to Ss' agreement with the message of the unnoticed incidental stimuli. It seems to be usually accepted in psychophysics that

> "it takes longer . . . (on the average) to make a false judgment than it does to make a correct one."[1]

But Henmon[2] found that, within a given category of

---

[1] W. N. Kellogg, The time of judgment in psychometric measures, Amer. J. Psychol., 43, 1931, p. 74.

[2] V. A. C. Henmon, The relation of the time of a judgment to its accuracy, Psychol. Rev., 18, 1911, 186-201.

subjective confidence, wrong judgments were made consistently more rapidly than right judgments. It appears that the chief variation of judgment time is its inverse variation with confidence of judgment, which in turn varies inversely with difficulty of the task. The co-variation of time of judgment with accuracy, other conditions remaining constant, is rather slight.

Within the field of unnoticed incidental stimulation, Eagle[1] measured three modes of response to a picture of a boy: trait list ratings, drawings of the boy, and latency of response. Unperceived flash stimuli showed the boy in aggressive or benevolent action. When the flash was of aggressive action, the ratings and drawings indicated more negative and aggressive qualities in the picture than when the flash was of benevolent action. Also, the latency of response to the picture was greater under the aggressive condition. This last effect was not observed at a statistically significant level. However, when Ss were ordered according to the magnitude of this effect, the ranks were found to be significantly related to the corresponding ranks on the other two measures. Thus Ss whose ratings and drawings seemed to be influenced by the presence of an unnoticed aggressively toned flash were also slow to respond.

---

[1] M. Eagle, Effects of subliminal stimulation of aggressive content upon conscious cognition, J. Pers., 27, 1959, 578-600.

Other findings[1] are partly congruent with these. Responses which by their nature were appropriate to the flashed word ANGRY were delayed when compared with responses inappropriate to that word. In both of these cases, by the very design of the experiments, the affective element is central. The more Ss responded to the unnoticed aggressive content, the greater was the latency of responding.

From these experiments it can be assumed that the unnoticed presentation of material related to aggressive (or perhaps generally disturbing) affect, when it is registered by S and affects his responding, will make for an increase in latency. It may be, however, that the affective element is not crucial. Perhaps latency is always increased when an incidentally presented message of any kind is registered and responding is appropriately affected.

On the other hand, one can reason in this fashion: If S is indeed being influenced by incidental messages, he should become more confident of judgments which agree with those messages and less confident of judgments which disagree with them. Then according to the general conclusion above, drawn from psychophysical studies, he should respond more rapidly when in agreement with the flashed stimulation and more slowly when disagreeing with it.

---

[1] G. J. W. Smith, D. P. Spence, and G. S. Klein, Subliminal effects of verbal stimuli, J. Abnorm. Soc. Psychol., 59, 1959, 167-176.

Thus, opposite predictions can be made. If latencies of judgments which apparently are affected by the incidental stimulation are shorter than those of judgments not so affected, it will seem most appropriate to think of the incidental stimulation as additional information which can make S more confident of a judgment. If the reverse is true, it will appear likely that incidental registrations generally are associated with delays in responding.

As reported above (p. 79), neither of the two opposite predicted relationships appeared in the latency data. What did appear was a greater latency for the response "smaller," which was also made less often than the response "greater." This relationship may be traced in Table V as well as in Appendix F, where the analysis of variance is reported.

A further comment is in order on the latency effects reported respectively by Smith, Spence, and Klein[1] and Eagle[2] and referred to above. In the first of these reports, what was observed was a delay in producing a given type of response--generally speaking, an unpleasant or negative response. It was observed at a significant level when the unnoticed stimulus was ANGRY, but was not observed when the latter was HAPPY. But such responses were given infrequently by these Ss (hospitalized neurotics) and hence were comparable to the response "smaller" in the present experiment.

---

[1] Op. cit. [2] Op. cit.

As the authors say, "our Ss gave negative responses only with perceptible reluctance."[1] Such reluctance, it appears, may suffice to account for any generally reliable latency effects in this type of experiment. In general, the same considerations apply to Eagle's observations.

Summary

Sixteen male and 16 female Ss took part in a modified size comparison procedure, using the method of constant stimulus differences. Rectangular patches of a checkerboard pattern were presented in a tachistoscope, first one of standard size followed by one of variable size, the latter to be judged "greater" or "smaller." In reality, 3/5 of the variable patches were identical to the standard.

Immediately before the appearance of the variable patch, an incidental stimulus was flashed, consisting of the word greater, the word smaller, or a nonsense figure. The duration of this flash was increased until S reported seeing it, or until the duration of 100 milliseconds was reached. Responses to the last 24 presentations of the patch equal in size to the standard were then analyzed for agreement with the incidental greater or smaller. Responses to the last four presentations of each of the other four stimuli were analyzed for the effect of the appropriate one of these words as compared with a nonsense flash.

---

[1] p. 173.

Over all Ss, for the stimulus equal in size to the standard, the frequency of agreement with the incidental word was so great as to permit rejection of the hypothesis that such a word causes no difference in responses. There was also a marked tendency for Ss to report this patch as greater than the standard. Thirteen of the 32 Ss achieved a high degree of agreement with the incidental word, while the agreement scores of the other 19 were distributed in a chance fashion. Sex of Ss was not related to the agreement scores.

For the four patches which were greater or smaller than the standard, it was not demonstrated that the accuracy of responses had been increased by the presence of the incidental word naming the correct response. This was true for all 32 Ss, and also for the 13 whose scores on the mid-stimulus were highest. Accuracy on certain of the individual stimuli, however, did appear to be related to the incidental stimulation.

Latency data from the 13 high-scoring Ss, in judgments of the patch equal to standard, did not show any relationship to the agreement of S's judgment with the incidental word.

Some considerations with regard to these results have been advanced.

CHAPTER VII

CONCLUSIONS

The major aim of the present research was to test whether, within the setting of a psychophysical task, stimuli that do not result in conscious percepts may produce an immediate effect upon perceptual judgments. The novelty of this aim appears in the choice of experimental situations with the combined restrictions which were described in the last section of Chapter II above. It was noted that these restrictions imply certain assumptions about the range of experimental situations within which the kind of effect sought may occur.

It was assumed that an unnoticed, incidentally supplied cue can affect effortful, attended behavior as well as unattended, relaxed behavior. It was assumed that the effects of such stimulation can be observed even when S's range of possible responses in the attended task is quite narrow, and when he must respond almost at once. It was assumed that the incidentally supplied cue might be of a novel class, different from the stimulus material of the attended task; and that it might directly present the goal response. It was assumed, finally, that the stimuli in use need not be systematically affect-related.

Two experiments were performed, testing the effect of an unnoticed (flashed) stimulus word--<u>greater</u> or <u>smaller</u>--

on judgments of the size of a rectangular patch. In the second of these, perceptual judgments (near the point of subjective equality) were indeed found to be affected in the predicted manner.

The Assumptions Reviewed

In making some of the assumptions required for the present experiments, positions were taken which were partly at odds with those of other investigators.

One assumption which was proven incorrect was that nearly all Ss would show behavioral effects due to the presence of unnoticed incidental stimuli. The results at hand clearly add to the evidence that many Ss are non-responders under the conditions of laboratory experiments. Eagle[1] has begun to isolate the personality correlates of individual responsiveness. However, no study is known dealing primarily with the constancy of responsiveness as the individual is tested on various procedures involving unnoticed stimuli. Research on this point is clearly in order.

In their experimental designs, some experimenters have allowed for great differences among Ss in the physical level at which effects of unnoticed stimuli may appear. Many have not. The present findings testify to the desirability of making such an allowance. In some cases where results have

---

[1] M. Eagle, Some personality correlates of responsiveness to unperceived cues (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

been null or equivocal, it seems likely that a redesigned experiment taking this factor into account would yeild more intelligible results.

Klein was quoted above (pp. 20, 22) as expecting the effects of incidental stimuli only or chiefly where S is not required to represent reality accurately. This study has proceeded on the contrary assumption that such effects may be obtained where S is required to represent reality accurately. The results obtained do not by any means serve to deny the crucial role which Klein[1] assigns to the state of consciousness in determining the structures of registrations and perceptions. They do, however, present an opportunity for investigation of the range of induced attitudes relative to the task, within which the behavior of Ss may be influenced through unnoticed stimuli. Thus, E's instructions to S might be varied systematically. At one end of the scale, great stress would be laid on attaining maximum accuracy; at the other, S would be encouraged to let himself be influenced by "hunches" or to make sheer guesses.

It may also be possible to investigate the question of dictating versus hinting the response to an attended task through unreportable stimulation. The difference was illustrated in Chapter II above (p. 24), as it might have applied

---

[1] G. S. Klein, Consciousness in psychoanalytic theory: some implications for current research in perception, J. Amer. Psychoanal. Ass., 7, 1959, 5-34.

to Kolers' experiment.[1] Had Kolers flashed before his Ss, not a hint to guide their performance of the task but an arbitrary designation of the desired response, he would have been using response dictation. Presumably he would have been by-passing the judgment process.

In the present experiment, the unreportable flash did indeed consist of a printed form of the response to be spoken. The task was so simple, however, that the same word--greater or smaller--may have operated as a suggestion also. It may have slanted or guided the judgment process, rather than circumventing that process. Moreover, the flash did not at any time make a suggestion contrary to reality. If such a suggestion were made and were systematically accepted by S, it would seem more likely that the judgment process is by-passed.

The results at least suggest that response dictation may be effective with some Ss. A modification of Kolers' experiment along the lines suggested above would be one possible experimental approach to the question.[2]

Klein has asked[3] whether the process aroused by incidental

---

[1] P. A. Kolers, Subliminal stimulation in problem-solving, Amer. J. Psychol., 70, 1957, 437-441.

[2] A recently published report deals with an attempt to induce erroneous solutions through a procedure similar to Kolers'. The method was unsatisfactory, however, and results are equivocal at best. (E.O. Gerard, Subliminal stimulation in problem-solving, Amer. J. Psychol., 73, 1960, 121-126.)

[3] G. S. Klein, On subliminal activation, J. Nerv. Ment. Dis., 128, 1959, p. 296. Original author's emphasis.

stimulation "has an independent status in the sense that its cognitive effects run parallel to, without intruding upon, a concurrent act of discrimination." The answer appears to be that those effects may behave in this fashion, as in Klein's own experiments and others; on the other hand, they may affect concurrent acts of discrimination, as in the present study.

A View of the Process

In the review of the literature in Chapter II above, there was derived from the subjective-introspective studies the concept of a kind of process preceding perception which is not subject either to the rules of logic or to the normal control of the will; which may sometimes enter consciousness only through its effects upon another percept; and which may be associated with marked affective tone. From the objective-behaviorist studies it appeared that this kind of process, when generated by stimulation of which S is unaware, may exert an effect upon a separate objective perceptual task.

In the present writer's view, this area of behavior can be profitably explored using a framework of concepts drawn from psychoanalytic theory.

We use without conscious attention, and sometimes without any awareness of the process, multitudinous slight cues in the course of such automatized activities as driving a car. Moreover, very slight unnoticed cues sometimes serve as signals to draw our attention to a previously unattended

phenomenon. This is, at one level, unconscious integration: i.e., the integration of unnoticed cues into the ongoing purposeful activities.

The present study is concerned with the class of situation in which S is performing some purposeful activity with attention, with conscious effort, and with emphasis on the accuracy of perception. Can it be expected that unnoticed cues will be integrated into the performance of this sort of activity?

That such integration does not ordinarily occur is thought to be the result of critical, logical, inhibiting processes. In psychoanalytic terms, these are processes of censorship based on the experience of reality and performed by the ego. These censoring or disintegrative processes must, to a great extent, take place without conscious attention. The question why integration without awareness occurs under some circumstances becomes the question why the unconscious censoring processes are not fully effective in those circumstances.

Luborsky and Shevrin, in a study[1] of the Pötzl experiment (which they replicated), present a useful line of thinking. All perception, they assume, is initially physiognomic: that is, the individual perceives the object in terms of its personal meaning for him, in terms of its satisfaction of his needs and wishes. "Initially" means here, first, that

---

[1] L. Luborsky and H. Shevrin, Dreams and day-residues: a study of the Poetzl observation, Bull. Menninger Clin., 20, 1956, 135-148.

this is characteristic of infantile perception and, second, that it remains characteristic of the brief process preceding perception. In maturity we have adaptive modes or defenses which divest the perceptual world of most of its physiognomic impact, so far as we can be consciously aware of it. But it may be assumed that the personal meaning remains, more or less unavailable to conscious awareness because of repression.

The experiment of these authors involved tachistoscopic presentation of a rather complex picture. In the physiognomic pre-perceptual stage, some parts of the picture would become associated with perceptual categories[1] which would ordinarily be excluded from awareness, either because they are conflictual or because they are irrelevant to the present purpose. If sufficient time were available, S's defense or censorship process would function as it normally does in perception. He would arrive at an adapted percept which is appropriate in terms of reality and which is only slightly or not at all influenced by the associated categories of the pre-perceptual stage.

With insufficient time, however, or under other unfavorable conditions, adaptation is incomplete. To put the matter in a somewhat different way:

> "The subliminal stimulus exercises a selective function upon responses hitherto associated with the stimulus material, the occurrence probabilities of

---

[1] J. S. Bruner, On perceptual readiness, Psychol. Rev., 64 1957, 123-152.

> associations being determined by emotional as opposed to logical factors; that is, the subliminal stimulus activates primary thought processes."[1]

It is noteworthy that only in its stress on emotional factors does this concept differ in essence from one propounded 66 years earlier:

> "Zwischen äusserer Reizung and bewusster Erregung liegt eine Zwischenstufe, in welcher nicht bewusst der Komplex disponibler Associationen erregt werden kann, und in welcher diese associativen Miterregungen je nach ihren Beziehungen zu den gegenwärtigen Bewusstseinsinhalt verstärkend oder schwächend, beschleunigend oder verzögend auf die Umsetzung des Reizes in bewusste Erregung einwirken können."[2]

The dynamic aspect. In the set of propositions in Chapter III, it was stated that the mature S minimizes responses based on stimulus information which he considers not in accord with reality. Hence, if he is unaware of the existence of such information, he is more likely to be influenced by it. The suggestion is that incidental stimuli, for example,

> "because they did not reach awareness ... were relatively effective in influencing reactions to

---

[1] N. F. Dixon, The effect of subliminal stimulation upon autonomic and verbal behaviour, J. Abn. Soc. Psychol., 57, 1958, p. 35; original author's emphasis.

[2] "Between external stimulation and conscious excitation lies an intermediate stage, in which the complex of available associations can be excited without awareness, and in which these associative co-excitations can, according to their relation with the present content of consciousness, influence the conversion of the stimulus into conscious excitation by strengthening or weakening, by accelerating or delaying." H. Münsterberg, Beiträge zur experimentellen Psychologie, Heft 4, 1892, pp. 10-11.

the face."[1]

It appears now that this view omitted one essential: the dynamic aspect, or the motivation for accepting the influence. It is to variations in this factor that we may most reasonably ascribe differences in the effects being studied. The quotation might better read: Among the conditions for incidental stimuli to influence reactions were these: (1) they must not reach awareness; (2) they must somehow enlist adequate dynamic (motivational) forces.

In Chapter II above (pp. 18-20), consideration was given to the attitude or state of consciousness of S. In effortful attended tasks, would S's "need to represent reality effectively and accurately in his responses"[2] prevent him from using or from being influenced by unnoticed incidental stimulation? Earlier studies in which such a need had been induced had appeared to demonstrate this kind of influence. It was assumed that effortful attended behavior could indeed be influenced. The motivation for accepting such influence, however, was not analyzed.

Here it will be prudent to note Rapaport's comment[3] that

---

[1] G. J. W. Smith, D. P. Spence, and G. S. Klein, Subliminal effects of verbal stimuli, J. Abn. Soc. Psychol., 59, 1959, p. 175; original authors' emphasis.

[2] F. H. Goldberg, H. Fiss, and G. S. Klein, Effects of an undiscriminated stimulus on imagery, p. 3 (paper presented at A.P.A. convention, 1959; abstract, Amer. Psychologist, 14, 1959, 359).

[3] D. Rapaport, Toward a theory of thinking, p. 702. In D. Rapaport, Ed.: Organization and Pathology of Thought, 1951.

the cathectic dynamics of the variants of conscious experience in reality-testing and judgment remain unexplored. Nevertheless, one may offer as speculation a hypothetical view of the perceptual process based on the outline of Luborsky and Shevrin[1] and on the general view of Fisher.[2]

The concept was sketched above of a pre-perceptual process which, for lack of time, cannot proceed to its normal conclusion in the production of a finished percept. Acting through primary-process relations, the pre-percept will have activated a number of perceptual categories. Some of these would ordinarily be excluded from awareness, either because they are conflictual or because they are irrelevant to the present purpose. For this reason, the half-formed percept is likely to undergo repression.

At this point, personality differences among individuals and fluctuations in mode of response in a single individual become paramount. One S may absolutely, in every case, deny access to consciousness to any ideas or unfinished percepts which are conflict-related. Another may be relatively free in this respect and may admit almost any ideas or perceptual stages. A third may vary markedly from day to day in this respect.

---

[1] Op. cit.

[2] C. Fisher, Studies on the nature of suggestion: Part II. The transference meaning of giving suggestions, J. Amer. Psychoanal. Ass., 1, 1953, 406-437.

Now if unfinished percepts are allowed to influence consciousness, they may be expected to have the characteristics noted by investigators of the subjective-introspective group. Being primitively physiognomic, they are not subject to the rules of logic. Being associated with primitive needs and wishes, they carry marked affective tone;[1] on the other hand, this tone may be repressed while the non-affective influences upon consciousness are admitted. They are most likely to have an observable effect by altering or influencing another percept. Also, their effects seem exempt from normal voluntary control.

These characteristics have, indeed, been found by the series of investigators that includes Urbantschitsch,[2] Allers and Teler,[3] and Fisher.[4] Apparent relationships have been pointed out[5] between the kinds of percepts which an individual can report only indirectly, without awareness of their

---

[1] An unpleasant affect has been reported as attached to the recovery of material in a Pötzl-type procedure. (H. Shevrin and L. Luborsky, The measurement of preconscious perception in dreams and images: an investigation of the Poetzle phenomenon, J. Abn. Soc. Psychol., 56, 1958, 285-294).

[2] V. Urbantschitsch, Über unbewusste Gesichtseindrücke and deren Auftreten in subjectiven optischen Anschauungsbilde, Z. ges. Neurol. Psychiat., 41, 1918, 170-184.

[3] R. Allers and J. Teler, Über die Verwertung unbemerkter Eindrücke bei Assoziationen, Z. ges. Neurol. Psychiat., 89, 1924, 492-513.

[4] C. Fisher, Dreams, images, and perception: a study of unconscious-preconscious relationships, J. Amer. Psychoanal. Assn., 4, 1956, 5-48.

[5] Ibid.

source, and the central neurotic problems of that individual. Fisher comments that

> "primitive phases of the operation of the ego apparatuses of perception and memory can be thought of as permitting the freer discharge of drive energies and (as) entering into drive-organized image and dream formation."[1]

Thus the motivation for accepting unnoticed incidental stimulation may be thought to be related to drives which are central to the personality.

The percepts discussed by these experimenters, however, either were rather complex (parts of a picture or photograph) or were measured in such a fashion as to allow for the introduction of complexity (checklist of elements in the description of a Rubin double profile). In the presently reported experiment, the percepts and the perceptual task were simple; the response was a single binary choice; and the unnoticed incidental stimuli were common words, thought to be not systematically affect-related. In what fashion might drive energies be discharged through acceptance of the suggestions made by such stimuli?

For a highly tentative answer, one may turn to psychoanalytic interpretations of suggestibility and of the highly suggestible condition of hypnosis. Suggestibility is an aspect of regression. Fisher[2] sums up Freud's[3] and his own

---

[1] Ibid., p. 42.

[2] C. Fisher, Studies on the nature of suggestion, Part II, op. cit.

[3] R. White, G. Fox, and W. Harris, Hypnotic hypermnesia for recently learned material, J. Abn. Soc. Psychol., 35, 1940, 88-104.

concept of suggestibility as involving a regression of libido to a more infantile stage, changes in the ego and ego-ideal resulting in a giving up of the reality-testing function, and a regression from object-relations to identification.

Now a well-known concomitant of hypnotic states is the phenomenon of hypermnesia, or ability to recall material that is normally unavailable. This has been credited[1,2] to the regression induced. S is secure in his transference relation to the hypnotist; he feels neither anxiety nor the need to protect himself.

These considerations may well apply to the susceptibility to unnoticed incidental stimulation, whether complex or simple pre-percepts are involved. As with hypnosis, some Ss are susceptible and some are not. Those who are undergo (unconsciously) a temporary regression, in which there is a loosening of both reality-testing and defensive functions while they identify (unconsciously) with the experimenter. As in hypnosis, the motivational force involved is seen as an infantile wish for love, transformed into an identification. As in hypermnesia, S ceases for the time being to maintain his critical, defensive dissociation of certain ideas; he permits them to be combined in either an integrative

---

[1] R. White, G. Fox, and W. Harris, Hypnotic hypermnesia for recently learned material, J. Abn. Soc. Psychol., 35, 1940, 88-104.

[2] B. G. Rosenthal, Hypnotic recall of material learned under anxiety and non-anxiety producing conditions, J. Exp. Psychol., 34, 1944, 369-389.

or a syncretic fashion.

The regression is, of course, a partial and temporary one, probably to be regarded as a regression in the service of the ego: that is, a regression likely to result in a better integration of diverse elements of personality and in more efficient functioning.[1] One notes also Bartemeier's remark[2] that these phenomena implying brief, ego-syntonic regression occur in everyday life and belong to the psychopathology of daily existence. Even the "controlled states of consciousness" which we are warned[3] to expect in the laboratory are not, after all, fully successful in excluding them. But these regressive processes need have nothing of the pathological about them. The evidence suggests, indeed, that it is the healthier Ss who can make use of them.[4,5,6]

---

[1] E. Kris, On preconscious mental processes (in D. Rapaport, Ed., Organization and Pathology of Thought, 1951), 474-493.

[2] L. H. Bartemeier, Discussion (of M. Brenman, M. M. Gill, and F. J. Hacker, Alterations in the state of the ego in hypnosis, Bull. Menninger Clin., 11, 1947), p. 66.

[3] G. S. Klein, Consciousness in psychoanalytic theory, op. cit.

[4] S. Bach and G. S. Klein, Conscious effects of prolonged subliminal exposures of words (paper presented at A.P.A. convention, 1957; abstract, Amer. Psychologist, 1957, 12, 397).

[5] M. Eagle, op. cit.

[6] S. M. Friedman and C. Fisher, Further observations on primary modes of perception: the use of a masking technique for subliminal visual stimulation, J. Amer. Psychoanal. Ass., 8, 1960, 100-129.

Possible further research. The view just stated brings into the foreground questions not only of the personality of subjects but of rapport in the experimental situation. Experimenters have chiefly manipulated the visual (or aural) presentations to S. A few have noted that comfortable rapport between S and E seems to be a necessary condition for the kind of response sought. But it appears that further investigation of this dimension might well prove productive.

Ss who respond to unreportable stimuli in one situation may, quite possibly, fail to respond in an identical procedure with a different experimenter. Some Ss who fail to respond as expected may be exercising an unconscious negativism, like patients who disobey a psychotherapist's instructions to dream.[1] Again, it may be that, if the experimental procedure were fully mechanized, leaving S with a minimum of direct human contact, he would no longer respond to unreportable stimuli. (This does not follow unquestionably from the foregoing discussion. A man-machine contact is still a human contact on the side of the man, and the very strangeness of it might accentuate transference elements.)

A final ambitious suggestion would be for a broadly organized program which would undertake to investigate the effects of unnoticed incidental stimulation in terms of (1)

---

[1] C. Fisher, Studies on the nature of suggestion, Part I. Experimental induction of dreams by direct suggestion, J. Amer. Psychoanal. Ass., 1, 1953, 222-255.

characteristics of the experimental material; (2) experimenter-subject relationship; (3) states of induced regression; (4) characteristic degrees of suggestibility in S; (5) other personality factors. Such a program seems to hold the best promise for shaping our theoretical conceptions of responding to unnoticed stimulation.

CHAPTER VIII

SUMMARY

This study is concerned with the effect upon effortful judgment behavior of unnoticed, unreportable stimulation of such a nature as to specify one of the possible responses to the judgment task.

Subjective-introspective studies have reported a sort of pre-sensational process in perception, which sometimes leads to illogical associations; which may enter consciousness only through its effect upon another percept; and which may be associated with marked affective tone. Objective-behaviorist studies employing incidental stimulation in unreportable fashion have demonstrated its effects in a pseudo-ESP task; on illusions; on judgments of the characteristics of faces; and in rather complex perceptual-cognitive tasks. Studies from the psychoanalytic school have demonstrated the pathways of symbolic relationship through which similar effects can apparently proceed.

In the present design, Ss were to pay effortful attention to a task of visual discrimination, while unaware that they were being exposed to stimulation with a meaning related to that task. Their responses were to be immediate and constrained to a small number of alternatives. The incidental stimulation was to present one of the possible task responses directly, rather than by way of suggestion. Tasks or stimuli with known affective connotations were to be avoided.

The first hypothesis was this: In a standard psychophysical task, designed according to the method of constant stimulus differences, forced discriminations can be influenced by the presence of an unnoticed incidental cue which directly suggests the response to be evoked.

A second hypothesis was this: The more closely related is the incidental cue to the response it evokes, the greater will be its effect.

As a discrimination task the visual comparison of sizes of stimulus patches was selected. Incidental stimulation was by means of a brief flash immediately preceding the variable stimulus to be judged. The flash consisted of a printed form of the words to be spoken as response: greater or smaller. As an incidental stimulus less closely related to the response, the misspelled forms graeter and samller were employed. Instructions were such as to induce the set appropriate to a well-defined laboratory discrimination task, together with openness to any related but different stimulation which might appear.

In Experiment I, three Ss judged the sizes of 11 stimulus patches over a total of 1,152 to 1,563 trials each. The appearance of each variable patch was immediately preceded by a brief unnoticed flash bearing one of the words greater, smaller, graeter, samller, or a nonsense stimulus. The same unnoticed stimulus was used for three consecutive trials. Between stimulations, the visual field was totally dark.

With the orders of stimuli fully counterbalanced, there was no demonstrable tendency for flashes of greater or smaller or misspelled versions of them to evoke from S the corresponding judgments. Failure to obtain the predicted effect was tentatively ascribed to the experimental conditions and to the small number of Ss employed.

In Experiment II, 32 Ss judged the sizes of five stimulus patches over 44 to 337 trials each. The appearance of each variable patch was immediately preceded by a brief unnoticed flash bearing one of the words greater or smaller, or a nonsense stimulus. The duration of this flash was increased until S reported seeing it, or until the duration of 100 milliseconds was reached.

Of every 40 variable patches presented, 24 were equal in size to the standard. The last 24 presentations of this equal-size patch were then analyzed for agreement with the incidental greater or smaller. The last four presentations of each of the other four patches were then analyzed for the effect of the appropriate one of these words compared with the nonsense figure.

Over all Ss, for the patch equal in size to the standard, the frequency of agreement with the incidental word was so great as to permit rejection of the hypothesis that such a word causes no difference in responses. Of the 32

Ss, 13 achieved a high degree of agreement with the incidental word, while the agreement scores of the other 19 were distributed in a chance fashion. Agreement was not significantly influenced by sex of S.

For the four patches which were greater or smaller than the standard, it was not demonstrated that the accuracy of responding had been increased by the presence of the incidental word naming the correct response. The magnitude of the main effect, it was noted, was not great enough to allow of any lesser or attenuated effects being detected as such. The effect of incidental words on responding to patches greater or smaller than standard is thought of as being attenuated by the genuine relationship of patch size.

The minor hypothesis was not tested in Experiment II. It, too, predicted an attenuated effect; hence it could not have been supported at a significant level.

Latency data from the 13 high-scoring Ss, in judgments of the patch equal to standard, did not show any relation to the agreement of the judgments with the incidental word.

It appears from the main result that attended judgments of objective matters are (among some individuals) subject to influence from unreportable stimulation which supplies or dictates the response.

In the normal course of behavior, slight cues are often used without full or even partial awareness. The information which they convey is received, used to signal a modification

of ongoing behavior, and apparently discarded. But where the behavior involves a closely attended task and where the nature of the slight cue is such as to bypass the normal process of this task, we ordinarily assume that conscious awareness and a critical attitude will be directed to the cues before they are allowed to influence the responding.

The behavior of sensitive Ss in this experiment is seen as a failure to bring into play the critical attitude or censorship to which perceptions of this kind are normally subject. As in hypnosis and the minor hypnagogic states, there is a temporary suggestibility. This is tentatively regarded as a manifestation of ego-syntonic regression: reality-testing is not fully performed, for the moment, and the individual, in infantile fashion, accepts and repeats what is told him. Several possibilities for further examination of such phenomena appear from this examination.

APPENDIX A

EXPERIMENT I

SAMPLE ORDER OF STIMULUS PRESENTATIONS

Flashed incidental word; number representing size of stimulus patch.

1. greater-7	2. greater-6	3. greater-10
4. nonsense-5	5. nonsense-6	6. nonsense-3
7. graeter-11	8. graeter-9	9. graeter-8
10. nonsense-4	11. nonsense-1	12. nonsense-2
13. smaller-5	14. smaller-1	15. smaller-6
16. nonsense-8	17. nonsense-7	18. nonsense-9
19. samller-4	20. samller-3	21. samller-2
22. nonsense-10	23. nonsense-6	24. nonsense-11

APPENDIX B

EXPERIMENT I

FREQUENCY OF CORRECT JUDGMENTS

Stimuli Patch No./Incid.		Second Subject (64 trials each)		Third Subject (48 trials each)		Fourth Subject (64 trials each)	
		Exper.	Control	Exper.	Control	Exper.	Control
1	smaller	58	61	29	26	63	57
2	smaller	54	53	27	31	59	60
3	smaller	52	49	16	26	46	46
4	smaller	45	49	20	25	42	46
5	smaller	45	46	15	19	40	31
6	smaller	40	36	18	11	26	23
6	greater	26	26	30	26	34	34
7	greater	31	30	33	25	38	44
8	greater	34	40	40	42	50	49
9	greater	40	46	36	33	55	50
10	greater	49	49	41	35	58	50
11	greater	47	48	36	40	60	58
Total Right		521	533	341	339	571	548
Total Trials		768	768	576	576	768	768

APPENDIX C

EXPERIMENT I -- ANALYSIS OF VARIANCE

Each of three Ss had made a number of judgments--"greater" or "smaller"--on the appearance of each of the possible combinations of incidental flash and stimulus patch. The responses could be designated as accurate or inaccurate, according to whether they agreed with the meaning of the flashed word or, when the control flash had been used, of the word for which the control flash had been substituted. The analysis was to determine whether judgments of the stimulus patches of sizes #5, #6, and #7 were significantly more accurate when the flash consisted of the word (correctly or incorrectly spelled) then when it consisted of the control (nonsense) shape.

The percentage of accurate judgments for each S under each condition was transformed to $\phi = 2 \arcsin \sqrt{p}$, a trans-

TABLE C-1. MEAN ACCURACY AT MID-RANGE

Flash Stimulus:	smaller or samller	greater or graeter	
Patch Size:	5	6	6	7
Experimental				
Mean ϕ	1.666	1.517	1.618	1.748
S. d.	.427	.277	.222	.215
Control				
Mean ϕ	1.635	1.326	1.557	1.694
S. d.	.350	.346	.145	.236

TABLE C-2

ACCURACY AT MID-RANGE: ANALYSIS OF VARIANCE

Source	Sum of Squares	D.f.	Mean Square	F
TOTAL	1.7081	23		
(a) Experimental effect	.0425	1	.0425	
(b) Stimulus patch size	.2946	3	.0982	4.79*
(c) Exper'l x patch size	.0237	3	.0079	
(d) Subjects	.1418	2	.0709	
(e) Ss x Exper'l effect	.0241	2	.0121	
(f) Ss x Patch size	1.0414	6	.1736	7.45**
(g) Ss x Exper'l x size	.1400	6	.0233	

*$p < .05$; error term is (e) pooled with (g).
**$p < .05$; error term is (g).

formation which tends to normalize data representing proportions (Walker and Lev, 1953, p. 423).

Table C-2 indicates the results of an analysis of variance performed on these scores. Although all of the mean differences are in the predicted direction, the main prediction is not supported at a significant level.

The only effects which are of statistically significant magnitude are those associated with patch size (stimulus number) and with the interaction of this dimension and individual Ss. That is, responses to the four different stimulus patch conditions varied according to the patch

being judged and also from S to S. It should be noted that the difference between 6-smaller and 6-greater, apart from the flash stimulus, was a matter of their sequential relationships to other patch sizes. The significant effects are interpreted to mean that Ss respond "greater" more consistently as patch size increases; that this tendency is complicated by a negative recency effect; and that both accuracy and recency effect vary from one S to another.

APPENDIX D

EXPERIMENT II

TABLE OF DATA

S	Age	Sex	Milliseconds Prelim.	Start	Recog.	Frequency of Agreement greater	smaller	Total
1	24	m	65	30	60	7	9	16
2	24	m	40	22	72	6	4	10
3	20	m	49	26	57	4	7	11
4	20	m	40	24	100#	10	2	12
5	17	f	55	24	32	8	6	14
6	19	m	46	25	47	5	7	12
7	31	m	68	35	45	10	5	15
8	21	m	72	36	37	7	4	11
9	17	f	84	50	59	7	6	13
10	24	m	28	22	32	6	3	9
11	23	m	36	25	60	10	5	15
12	24	m	50	29	81	9	10	19
13	18	m	27	25	100#	9	8	17
14	17	m	30	24	44	6	6	12
15	22	f	40	25	100#	12	4	16
16	21	f	68	37	47	10	3	13
17	20	f	41	26	42	8	7	15
18	20	m	69	39	43	9	6	15
19	20	f	32	25	40	6	6	12
20	21	f	35	25	66	9	5	14

Table of Data -- Continued

S	Age	Sex	Milliseconds Prelim.	Start	Recog.	Frequency of Agreement greater	smaller	Total
21	20	f	57	31	51	9	6	15
22	21	f	58	29	92	7	5	12
23	20	f	48	26	98	7	2	9
24	20	f	30	24	57	5	5	10
25	20	f	40	26	31	11	6	17
26	21	f	48	26	58	8	7	15
27	19	f	30	25	41	3	5	8
28	19	f	60	34	92	10	3	13
29	21	m	37	25	77	4	5	9
30	20	m	30	25	96	8	8	16
31	20	f	34	27	42	10	4	14
32	21	m	52	32	100#	9	6	15

APPENDIX E

EXPERIMENT II - ANALYSIS OF VARIANCE

Each of 16 male and 16 female Ss received one score representing the number of times (out of 12 presentations) that his response agreed with the flashed stimulus greater and a second score representing comparable agreements with smaller. The means and standard deviations of these scores (transformed to $\phi = 2 \arcsin \sqrt{p}$) are given in Table II, p.75.

Analysis of variance was employed to determine (1) whether the response "greater" was used more frequently (constant error) and (2) whether either sex responded more in accordance with the flashes than did the other.

TABLE E-1

AGREEMENT WITH FLASH: ANALYSIS OF VARIANCE

Source	Sum of Squares	D.f.	Mean Square	F
TOTAL	12.3022	63		
Constant Error	2.6875	1	2.6875	15.27*
Sex	.0072	1	.0072	
Constant Error x Sex	.5097	1	.5097	
Subjects	4.1507	30	.1384	
Constant Error X Ss	4.9471	30	.1649	

*$P < .01$; error term is pooled interactions

APPENDIX F

LATENCIES OF THIRTEEN "INFLUENCED" SUBJECTS

Mid-Stimulus

Analysis of variance was used to test the relationship of latency of responding to (1) occurrence of greater or smaller as the incidental stimulus, and (2) agreement of Ss' responses with such stimulus. All of the raw latency values had been transformed to their logarithms. Each S's trials were divided into four

TABLE F-1. ANALYSIS OF VARIANCE OF MEAN LATENCIES

Source	Sum of Squares	D.f.	Mean Square	F
TOTAL	0.79315	51		
Incidental stimulus	.00042	1	.00042	
Agreement with incid.	.00002	1	.00002	
Incid'l x Agreement	.01934	1	.01934	7.70*
Subjects	.68295	12	.05691	22.66**
Ss x Incid'l stimulus	.02289	12	.00191	
Ss x Agreement	.01323	12	.00110	
Ss x Incid'l x Agree.	.05430	12	.00453	

*$p < .05$
**$p < .01$

groups, according as the incidental stimulus had been greater or smaller and as the response had been in agreement or disagreement with this incidental stimulus. The mean of the log. latencies was computed for each group; thus each subject yielded four mean log. latencies.

The interaction variances involving Ss may be combined to yield an error term against which the main effects and the interaction of incidental stimulus by agreement of response with such stimulus may be evaluated.

The results indicate: (1) that there is wide variation in the characteristic latencies of Ss; (2) that the constant error which was noted in the relative accuracies is also reflected in the relative latencies—i.e., Ss made the judgment "greater" not only more often but also more rapidly than they made the judgment "smaller." No tendency was found for latency to vary concomitantly with the incidental appearance of the word greater or smaller, or with S's agreement with such word.

BIBLIOGRAPHY

Adams, J. K. Laboratory studies of behavior without awareness. Psychol. Bull., 1957, 54, 383-405.

Allers, R., and J. Teler. Über die Verwertung unbemerkter Eindrücke bei Assoziationen. (On the realization of unnoticed sensations through associations.) Z. ges. Neurol. Psychiat., 1924, 89, 492-513.

Alpern, M. Metacontrast. Opt. Soc. Amer. J., 1953, 43, 648-657.

Bach, S., and G. S. Klein. Conscious effects of prolonged subliminal exposures of words. Presented at American Psychological Association convention, 1957; abstract, Amer. Psychologist, 1957, 12, 397.

Bartemeier, L. H. Discussion (of M. Brenman, M. M. Gill, and F. J. Hacker, Alterations of the state of the ego in hypnosis. Bull. Menninger Clin., 1947, 11, 60-66).

Bichowsky, F. R. The mechanism of consciousness: the presensation. Amer. J. Psychol., 1925, 36, 588-596.

Bressler, J. Illusion in the case of subliminal visual stimulation. J. gen. Psychol., 1931, 5, 244-250.

Bruner, J. S. On perceptual readiness. Psychol. Rev., 1957, 64, 123-152.

Bruner, J. S., and G. S. Klein. Constraints in perception. Presented at American Psychological Association convention, 1959; ref., Amer. Psychologist, 1959, 14, 379. Mimeo. title: New Look retrospect.

Bruner, J. S., and L. Postman. On the perception of incongruity: a paradigm. J. Pers., 1949, 18, 206-223.

Bruner, J. S., and H. Wechsler. Sequential probability as a determinant of perceptual closure. Amer. J. Psychol., 1958, 71, 604-606.

Cattell, R. B. The subjective character of cognition and the pre-sensational development of perception. Brit. J. Psychol. Monogr. Suppl., XIV, 1930.

Dixon, N. F. The effect of subliminal stimulation upon autonomic and verbal behavior. J. abn. soc. Psychol., 1958, 57, 29-36.

Dunlap, K. The effect of imperceptible shadows on the judgments of distance. Psychol. Rev., 1900, 7, 435-453.

Eagle, M. The effects of subliminal stimuli of aggressive content upon conscious cognition. J. Pers., 1959, 27, 578-600.

Eagle, M. Some personality correlates of responsiveness to unperceived cues. Presented at American Psychological Association convention, 1959; abstract, Amer. Psychologist, 1959, 14, 359.

English, H. B., and A. C. English. A comprehensive dictionary of psychological and psychoanalytical terms. New York: Longmans, Green, 1958.

Eriksen, C. W. Defense against ego-threat in memory and perception. J. abn. soc. Psychol., 1952, 47, 230-235.

Eriksen, C. W. Subception: fact or artifact? Psychol. Rev., 1956, 63, 74-80.

Eriksen, C. W., and H. W. Hake. Multidimensional stimulus differences and accuracy of discrimination. J. exp. Psychol., 1955, 50, 153-160.

Fisher, C. Dreams, images, and perception: a study of unconscious-preconscious relationships. J. Amer. psychoanal. Ass., 1956, 4, 5-48.

Fisher, C. Studies on the nature of suggestion: Part II. The transference meaning of giving suggestions. J. Amer. psychoanal. Ass., 1953, 1, 406-437.

Fisher, C. Studies on the nature of suggestion: Part I. Experimental induction of dreams by direct suggestion. J. Amer. psychoanal. Assn., 1953, 1, 222-255.

Freud, S. Group psychology and the analysis of the ego. London: Hogarth, 1922. Trans. from Massenpsychologie und Ich-Analyse, Vienna, 1921.

Friedman, S. M., and C. Fisher. Further observations on primary modes of perception: the use of a masking technique for subliminal visual stimulation. J. Amer. psychoanal. Ass., 1960, 8, 100-129.

Gerard, E. O. Subliminal stimulation in problem-solving. Amer. J. Psychol., 1960, 73, 121-126.

Goldberg, F. H., and H. Fiss. Partial cues and the phenomenon of "discrimination without awareness." Percept. mot. Skills, 1959, 9, 243-251.

Goldberg, F. H., H. Fiss, and G. S. Klein. Effects of an undiscriminated stimulus on imagery. Presented at American Psychological Association convention, 1959; abstract, Amer. Psychologist, 1959, 14, 359.

Goldiamond, I. Indicators of perception: I. Subliminal perception, subception, unconscious perception: an analysis in terms of psychophysical indicator methodology. Psychol. Bull., 1958, 55, 373-411.

Henmon, V. A. C. The relation of the time of a judgment to its accuracy. Psychol. Rev., 1911, 18, 186-201.

Hochberg, J. Perception: toward the recovery of a definition. Psychol. Rev., 1956, 63, 400-405.

Howarth, C. I., and M. G. Bulmer. Non-random sequences in visual threshold experiments. Quart. J. exp. Psychol., 1956, 8, 163-171.

Kellogg, W. N. The time of judgment in psychometric measures. Amer. J. Psychol., 1931, 43, 65-86.

Klein, G. S. Consciousness in psychoanalytic theory: some implications for current research in perception. J. Amer. psychoanal. Ass., 1959, 7, 5-34.

Klein, G. S. On subliminal activation. J. nerv. ment. Dis., 1959, 128, 293-301.

Klein, G. S., D. P. Spence, R. R. Holt, and S. Gourevitch. Cognition without awareness: subliminal influence upon conscious thought. J. abnorm. soc. Psychol., 1958, 57, 255-266.

Kolers, P. A. Subliminal stimulation in simple and complex cognitive processes. Unpublished doctoral dissertation, New York Univer., 1956.

Kolers, P. A. Subliminal stimulation in problem-solving. Amer. J. Psychol., 1957, 70, 437-441.

Krasner, L. Studies of the conditioning of verbal behavior. Psychol. Bull., 1958, 55, 148-170.

Kris, E. On preconscious mental processes. In D. Rapaport, Ed., Organization and pathology of thought. New York: Columbia Univer. Press, 1951, pp. 474-493.

Luborsky, L., and H. Shevrin. Dreams and day-residues: a study of the Poetzl observation. Bull. Menninger Clin., 1956, 20, 135-148.

McConnell, J. V., R. L. Cutler, and E. B. McNeil. Subliminal stimulation: an overview. Amer. Psychologist, 1958, 13, 229-242.

Maier, N. R. F. Reasoning in humans: II. The solution of a problem and its appearance in consciousness. J. comp. Psychol., 1931, 12, 181-194.

Manro, H. M., and M. F. Washburn. Effect of imperceptible lines on judgment of distance. Amer. J. Psychol., 1908, 19, 242-243.

Miller, G. A., J. S. Bruner, and L. Postman. Familiarity of letter sequences and tachistoscopic identification. J. gen. Psychol., 1954, 50, 129-139.

Miller, J. G. Discrimination without awareness. Amer. J. Psychol., 1939, 52, 562-578.

Miller, J. G. The role of motivation in learning without awareness. Amer. J. Psychol., 1940, 53, 229-239.

Mosteller, F., and R. R. Bush. Selected quantitative techniques. In G. Lindzey (Ed.), Handbook of social psychology, Vol. 1, Cambridge, Mass.: Addison-Wesley, 1954, pp. 289-334.

Mueller, C. G. Numerical transformations in the analysis of experimental data. Psychol. Bull., 1949, 46, 198-223.

Münsterberg, H. Beiträge zur experimentellen Psychologie. (Contributions to experimental psychology.) Freiburg: Mohr, 1889-1892. 4 vols.

Nowlan, E. H. The time-error in visual perception. Unpublished doctoral dissertation, Harvard Univer., 1948.

Ohms, H. Untersuchung unterwertigen Assoziationen mittels des Worterkennungsvorganges. (Investigation of subliminal associations by means of the word recognition procedure.) Z. Psychol. Physiol. Sinnesorg., 1910, 56, 1-84.

Paterson, D. G., and M. A. Tinker. How to make type readable: a manual for typographers, printers, and advertisers. New York: Harper & Bros., 1940.

Perky, C. W. An experimental study of imagination. Amer. J. Psychol., 1910, 21, 422-452.

Pillsbury, W. B. A study in apperception. Amer. J. Psychol., 1897, 8, 315-393.

Pötzl, O. Experimentell erregte Traumbilder in ihren Beziehungen zum indirekten Sehen: I. Mitteilung. (Experimentally induced dream-images in their relation to indirect vision: First contribution.) Z. ges. Neurol. Psychiat., 1917, 37, 278-349.

Postman, L., J. S. Bruner, and R. D. Walk. The perception of error. Brit. J. Psychol., 1951, 42, 1-10.

Rapaport, D. Toward a theory of thinking. In D. Rapaport (Ed.), Organization and pathology of thought. New York: Columbia Univer. Press, 1951. Pp. 687-730.

Rosenthal, B. G. Hypnotic recall of material learned under anxiety and non-anxiety producing conditions. J. exp. Psychol., 1944, 34, 369-389.

Schilder, P. On the development of thoughts. (Über Gedankenentwicklung.) In D. Rapaport (Ed.), Organization and pathology of thought. New York: Columbia Univer. Press, 1951, Pp. 497-518.

Shevrin, H., and L. Luborsky. The measurement of preconscious perception in dreams and images: an investigation of the Poetzl phenomenon. J. abn. soc. Psychol., 1958, 56, 285-294.

Siegel, S. Nonparametric statistics for the behavioral sciences. New York: McGraw-Hill, 1956.

Siipola, E. M. A group study of some effects of preparatory set. Psychol. Monogr., 1935, 46, No. 6, 27-38.

Smith, G. J. W., and M. Henriksson. The effect on an established percept of a perceptual process beyond awareness. Acta psychol., 1955, 11, 346-355.

Smith, G. J. W., and U. Kragh. Do microgenetic sequences reflect life history? An illustration. Acta psychol., 1955, 11, 504-512.

Smith, G. J. W., D. P. Spence, and G. S. Klein. Subliminal effects of verbal stimuli. J. abnorm. soc. Psychol., 1959, 59, 167-176.

Solley, C. M., and J. Long. When is "uh-huh" reinforcing? Percept. mot. Skills, 1958, 8, 277.

Spence, D. P., and I. H. Paul. Importation above and below awareness. Presented at American Psychological Association convention, 1959; abstract, Amer. Psychologist, 1959, 14, 359.

Spitz, R. The psychogenic diseases in infancy: an attempt at their etiologic classification. The Psychoanalytic Study of the Child (International Universities Press), 1951, 6, 255-275.

Titchener, E. B., and W. H. Pyle. Effect of imperceptible shadows on the judgment of distance. Proc. Amer. phil. Soc., 1907, 46, 94-109.

Urbantschitsch, V. Über unbewusste Gesichtseindrücke und deren Auftreten in subjektiven optischen Anschauungsbilde. (On unconscious visual sensations and their appearance in subjective optical images.) Z. ges. Neurol. Psychiat., 1918, 41, 170-184.

Vernon, M. D. The experimental study of reading. London: Cambridge Univer. Press, 1931. (Quoted in Gibson, E. J., Improvement in perceptual judgments as a function of controlled practice or training. Psychol. Bull., 1953, 50, p. 412.)

Walker, H. M., and J. Lev. Statistical inference. New York: Holt, 1953.

White, R. W., G. F. Fox, and W. W. Harris. Hypnotic hypermnesia for recently learned material. J. abn. soc. Psychol., 1940, 35, 88-104.

Wilkins, M. C. A tachistoscope experiment in reading. Unpublished master's thesis, Columbia Univer., 1917.

Wyatt, D. F., and D. T. Campbell. On the liability of stereotype or hypothesis. J. abn. soc. Psychol., 1951, 46, 496-500.

DISCRIMINATION WITHOUT AWARENESS IN A PSYCHOPHYSICAL TASK

(Library of Congress No. Mic)

Preston Davis, Jr., Ph.D.
Boston University Graduate School, 1960
Major Professor: Professor Austin W. Berkeley

Discrimination without awareness of the stimuli being responded to has been observed in a number of different experimental situations. In the classic case, the subject is instructed to relax or to engage in what is essentially a task of imagination, while incidental stimulation is presented at a level of intensity or duration such that he remains unaware of its presence. Responses of some comparatively unrestricted type are collected and analyzed for effects attributable to the stimulation.

Present interest is in the case where the subject is effortfully attending to an objective task of discrimination. His range of possible responses to the task is quite narrow, and he is required to respond almost at once. The incidentally supplied stimulation is of a novel class, different from the stimulus material of the attended task; it is such as to present directly one of the possible task responses.

The method used was an adaptation of a psychophysical judgment procedure, with individual subjects viewing the materials in a tachistoscope. A rectangular patch of standard size was presented first, followed in a few seconds by a

test patch of variable size; the subject was required to report whether the latter was greater or smaller than the standard. A brief, unnoticed flash preceding the test patch carried the word greater or smaller or a nonsense control stimulus.

A first experiment, using only three subjects, failed to yield any evidence of influence upon the judgments due to the unnoticed incidental words.

In the second experiment, 32 subjects participated. The duration of the incidental flash was gradually increased until the subject reported noticing its presence. Statistical analysis was restricted to the last 40 responses obtained at duration levels lower than the level at which recognition occurred.

For the test patch of the same size as the standard (which had been presented on 24 of the 40 trials), it was clear that some subjects had indeed been influenced in the direction of agreeing with the unnoticed greater or smaller. The effect was statistically significant over all 32 subjects. About ten achieved a high degree of agreement with the incidental word, while the agreement scores of the others were distributed in approximately a chance fashion. Agreement was not influenced by sex of the subject.

Four other test patches were of sizes greater or smaller than the standard. For two of these patches, subjects responded more accurately following the appropriate flash of greater or smaller than following the nonsense flash.

No consistent relationships were found between latency of responding and agreement with the flashed stimulus.

It is concluded from the main result that attended judgments of objective matters are (among some individuals) subject to influence from unreportable stimulation which directly presents the response to be used. This implies some necessary modification or extension of remarks made by Klein and others relative to this point. While attention usually acts to exclude activations which would be consciously rejected as inappropriate, such activations do (among some individuals) in a significant number of cases influence attended behavior without becoming conscious.

A tentative conceptualization of the process is presented, based on psychoanalytic considerations by Kris and Fisher.

-- --

AUTOBIOGRAPHY

I was born in New York City on 5 December 1919 to Preston Davis and Mary F. (Miller) Davis. I was graduated from Columbus Academy and from Wesleyan University.

From 1941 to 1946 I served in the U. S. Army Air Forces, and thereafter worked in the publishing industry. In 1955 I received from Boston University the degree of Master of Arts in psychology. I have served as a trainee in psychology with the Veterans Administration and with the Newton (Mass.) public schools.