A more objective method of ordering stimuli on the intake-rejection continuum

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A MORE OBJECTIVE METHOD OF ORDERING STIMULI ON THE INTAKE-REJECTION CONTINUUM

by

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INTRODUCTION

Only recently, since about the mid 1950's, has psychophysiology been delineated as an appropriate subject matter for inter-disciplinary investigation by psychologists, physiologists, psychiatrists, physicians, engineers, and members of other interested disciplines. The advent of this delineation has contributed to the restructuring or perhaps the dissolution of the traditional taxonomy of psychology. For example, Lacey (1956) suggested that due to the ubiquitous growth of psychophysiology, the archaic restricting of the study of the autonomic nervous system (ANS) to a self-contained chapter on "emotions" in our introductory psychology textbooks is an underemphasis or at least a misemphasis. Today the ANS is studied not only in its relationship to emotions; but also, as Lacey (1956) has enumerated, in its relationships to the adequacy of sensory, sensorimotor, and perceptual behavior; to stress; to frustration tolerance; to individual differences in the relative frequency of recall of completed and uncompleted tasks; to injections of drugs as a function of the recovery rate under both psychotherapy and somatotherapies; to combat performance; to the evaluation of the effects of psychotherapy, etc. Of course, the ANS has traditionally been studied by physiologists as an important part of both positive and negative feedback circuits to the cortical cells thus
controlling, modulating, and terminating cortical activity.

Ax (1964), in reviewing the goals and methodology of psychophysiology, suggested that the past and much of the present psychophysiological research has been oversimplified, not because the investigators have been unaware of the complexity of the organism, but because techniques and verified theory have been lacking. An impatient critic might easily assert that these techniques and theory are still lacking. The writer wishes not to engage in the polemics of this issue but only to enumerate some of those problems or troublesome factors which seem to impede progress in the field of psychophysiology.

The writer hopes he is not being too iconoclastic nor unfairly oversimplifying the state of affairs by asserting that research in the traditional areas of psychology seems to entail the accumulation of volumes of data for a large number of subjects (Ss), and then searching for order or some type of lawful relationship which may or may not support the investigator's hypothesis. This procedure has certainly met with success in the areas of learning, perception, personality, etc., but appears less than adequate in psychophysiological research, at least at this time, because of the relative complexity of the ANS coupled with the grossness of the measures employed today in recording the intricacies of that system.

A large number of Ss used in an experiment can lend
little or no support for a hypothesis until the quality of the measure has been improved. Because of the unrefined nature of the measures of the ANS, a reported relationship observed within a small sample is often times only a chance event and consequently is obliterated when the sample size is increased. These inadequacies of the measuring techniques and instruments also make the replication of studies most difficult.

Related to the problem of inadequate measuring techniques and instruments is a second problem, that very crucial methodological consideration of selecting data points from continuous measures of the physiological variables in question. Very generally, this is a two-fold issue: (1) How long are the sampling periods to be, and (2) once the sampling periods are selected, how are the discrete numeric values to be determined from the continuous measures? Since the investigators do not concur on a single best method for the selection of data points, habit seems to prevail. This author, like most other investigators, continues to use the method he first employed.

Briefly, this author's method is to select ten points at one second intervals preceding the stimulus and to select ten points at one second intervals coinciding with the onset of the stimulus, and then determining the mean values of each of these two sets of ten points for the particular physiological variable in question. This procedure is
discussed in greater detail in the Method chapter below.

A number of investigators prefer to use longer sampling periods, sixty seconds or more, upon which to base an estimate of the means of the physiological variable; however, as Venables and Martin (1967) suggested, these longer periods may well mask any temporal changes in the data.

At the time of this writing, the most voguish procedure of selecting data points, at least in the case of heart rate (HR), appears to be some form of the so-called peak to valley difference, i.e., the difference between the highest HR and the lowest HR occurring in some sampling interval following the onset of the stimulus. Although the peak to valley method appears most frequently in the literature today, this writer suggests that popularity is not a substitute for validity. There is yet no evidence that this is the best nor most appropriate method.

A third troublesome factor which must be resolved or at least accounted for in any psychophysiological research is the law of initial values (LIV) first formulated by Wilder (1950, 1957). Very briefly, the law states that an ANS response to stimulation is a function of the prestimulus level. Thus, one can easily foresee the difficulty confronting the investigator who simply quantifies skin conductance (SC) or HR as an algebraic or percentage change. It should be obvious to the reader, for example, that an increase in HR of ten beats per minute (BPM) is much greater
when the initial HR is ninety BPM than when the initial HR is sixty BPM, even though the increase in both cases is ten BPM.

Generally, a high autonomic excitation preceding stimulation is correlated with low autonomic reactivity upon stimulation; and similarly, a low level of autonomic excitation preceding the stimulation is correlated with a high autonomic reactivity upon stimulation. This relationship makes it difficult when comparing individuals or groups to determine whether the differences in reactivity are due to differences in the background or basal level of autonomic activity, to reactivity per se, or perhaps to individual differences in spontaneous or nonspecific activity which is defined as an autonomic displacement of HR, SC, and blood flow due to internal and psychologically induced silent events (Lacey, 1956, 1959).

To permit the comparison of the magnitudes of responses within or between persons, numerous transformations of the raw data have been proposed, most of which belong to the logarithm family. Their intended purpose is to free the difference or change scores from their correlations with the prestimulus levels and to yield a distribution which approximates a normal distribution so that parametric statistical tests may be applied (Sternbach, 1966). Lacey (1956) admitted that these transformations may be statistically sound but they blatently disregard physiological theory.
One crucial theory ignored by these logarithmic transformations is that a principal function of the ANS is to maintain a homeostatic norm and that the recorded autonomic response is a function of not only the magnitude of the autonomic activation, but also of the promptness and vigor of secondarily induced autonomic changes that serve to restrain and limit the effects of the initial response. Any statistical technique of quantifying autonomic responses certainly should not obscure this phenomenon.

An added complication of the LIV is that individual Ss differ greatly in the extent to which the LIV applies. As Sternbach (1966) pointed out, individuals may differ in any number of ways.

(1) Lacey and Lacey (1962) have demonstrated that there seems to be a "stress level constant" which individuals reach with a sufficiently strong stressor regardless of the initial resting level.

(2) An individual may exhibit a "stress level constant" in one ANS measure but variable stress levels in other measures.

(3) One individual may respond to any stimulus in a stereotyped fashion with perhaps a greatest response in HR and lesser responses in other measures. Another individual may respond with almost a random pattern, never showing the same response hierarchy twice.

Lacey (1956) attempted to overcome the shortcomings of
the numerous logarithmic transformations by incorporating the LIV in the determination of the response score. His procedure, which resulted in the autonomic lability score (ALS), is a form of analysis of covariance, and as Benjamin (1963) criticized, does not give adequate representation to the homeostatic process but instead reflects the individual's response to stimulation over and above the LIV effect. According to Sternbach (1966), the greatest limitation of the ALS, and more generally the analysis of covariance procedures, is the assumption that the prestimulus and response levels of activity are linearly related. At the time of this writing, there is no consensus among researchers as to the appropriate transformation.

A fourth troublesome factor which involves the ANS and which must be dealt with by the psychophysiologist is the homeostatic function, or that tendency to maintain internal balance or equilibrium. Although mentioned briefly in the preceding discussion of the LIV, the author feels that homeostasis merits additional consideration. Wenger (1941), in attempting to account for individual differences in homeostasis, hypothesized that because of the differences between the adrenergic branch of the ANS or sympathetic nervous system (SNS) and the cholinergic branch or parasympathetic nervous system (PNS), one branch may predominate in function over the other. This predominance or autonomic imbalance may be continuous or phasic, and either
branch may be the dominant one at any given point in time. When the extent of such autonomic imbalance is measured in an unselected population, the responses should be distributed continuously around some central tendency which could then be defined as autonomic balance.

To better understand the physiological changes underlying homeostasis, a couple of hypothetical illustrations are presented below.

If a resting and quiescent organism maintaining at the moment perfect ANS balance is moderately stimulated, a change toward SNS domination would undoubtedly occur. This SNS domination includes an increase in HR and stroke volume so that greater quantities of blood are circulated, vasoconstriction in the peripheral blood vessels, vasodilation in the blood vessels in the head, an increase in SC, and an increase in the amplitude and a decrease in the frequency of the respiration rate. The changes in blood pressure cause certain pressure sensitive nerve cells, the baroreceptors located in the walls of the aortic arch and carotid sinuses, to change their pattern of firing. When the blood pressure increases in these areas, an increase in the number of impulses occurs in those nerve fibers which terminate in the medulla and the hypothalamus. The increase in impulses sensitizes the hypothalamic cells which in turn influence parasympathetic activity resulting in a decrease in HR and stroke volume and a dilation of the peripheral blood vessels.
Such an effect reduces the blood pressure to normal.

Likewise, if the resting organism maintaining perfect ANS balance is administered a cholinergic drug such as acetylcholine, a shift in the ANS balance toward PNS domination would result. In this case, the HR and stroke volume would decrease accompanied by vasodilation in the peripheral blood vessels and vasoconstriction in the blood vessels of the head. The decrease in impulses going to the medulla and hypothalamus sensitizes the hypothalamic cells which in turn trigger the SNS activity resulting in an increase in HR and stroke volume etc., so that the blood pressure is raised back to normal.

Principles auxiliary to that of homeostasis which must also be considered in any psychophysiological research are the principles of adaptation, habituation, and rebound. If a stimulus is repetitiously applied and maintained with an unchanging constant quality, the receptor organ will discharge initially at a high rate and will progressively be reduced to a lower rate of firing. This process is defined as adaptation. Underlying the process of habituation is a neural or more centrally located mechanism which lends the organism unattentive to repeated presentations of the same stimulus. Thus, the final result of adaptation and habituation is the same, that is, a diminuation of autonomic responses; however, the loci of the underlying mechanisms are quite distant. If, instead of repetitive
stimulation, the organism receives one long or intense stimulation, gradually all variables would return to their prestimulus levels and in many instances overshoot them. Specifically, an excessive response in one direction, apparent SNS, is frequently followed by an excessive response in an opposite direction, apparent PNS, before returning to equilibrium. This rebound effect may also be subject to adaptation in that it will decrease with repetitive stimulation.

A caution that certainly must be heeded by any psychophysiological experimenter (E) is that when several stimuli are to be presented in succession, the E must wait for the response recovery and the rebounding from the previous stimulus to subside before restimulating so that the confounding of responses may be avoided.

The author has not intended that the SNS and PNS be considered as antagonistic systems but rather that they act synergistically; although, on occasion some actions are executed independently. Given a particular response or pattern of responses, it is most difficult and perhaps impossible to determine the degree to which the SNS effect has been masked by the PNS, and vice versa. Separation of the two branches of the ANS may be achieved by ablation or by pharmacological techniques in order to make valid inferences concerning the individual roles of the two systems. However, in the intact organism, it is still the
final resultant reaction that is of importance; and perhaps the interaction, or more correctly the simultaneous operation of the two systems, is very much different than when the systems are operating in isolation. Nevertheless, studies of the two systems operating in isolation have revealed useful information. For example, the SNS has a much greater latency than the PNS. In the case of the SNS, cardiac acceleration does not appear until a minimum of two and one half seconds after the onset of stimulation; and the maximal acceleratory effect doesn't appear until a minimum of seven seconds has elapsed. On the other hand, cardiac deceleration, that is PNS stimulation, appears at the first heart beat following stimulation. Thus, when the direction and magnitude of autonomic responses shed little light on the relative impact of the SNS and PNS, an analysis of the latencies may well provide the information. As an example, it may be determined that a HR acceleration appearing at the moment of stimulation or shortly thereafter is more a function of PNS inhibition than of SNS stimulation.

One final point that must be made before leaving this discussion of homeostasis is that autonomic balance is a ceaseless, interacting, modulating rhythmic or periodic activity. If this activity were plotted over time, there would be long slow undulations over periods of months, superimposed upon which would be diurnal variations, and superimposed on these would be the briefer hour to hour and
minute to minute peaks caused by responses to routine daily events (Lacey, 1956; Lynn, 1966; Noback, 1967; Sternbach, 1966).

A fifth factor or principle that the psychophysiological must recognize and deal with is that of individual response specificity, mentioned only briefly in the discussion of the LIV. Malmo, Shagass, and Davis (1950a, 1950b) first formulated such a principle by stating that for psychiatric patients with somatic symptoms, the physiological mechanism underlying the symptoms is specifically responsive to activation by stressful stimuli. For example, when patients with psychosomatic heart trouble were asked questions about their lives and problems, they responded most actively with circulatory system changes; whereas, the patients with histories of headaches responded most actively with muscle tension in the head and neck regions. Lacey and Lacey (1958) extended the phenomenon of symptom specificity and verified it on Ss from the normal population. They demonstrated that individuals, regardless of the stressor, respond in such a way that maximal activation occurs in the same autonomic variable. All is not orderly, however, since the Laceys (1958) cautioned that individual differences do exist in the extent to which Ss exhibit response stereotypy. At one extreme are those Ss with almost no flexibility in reproducing the same response hierarchy to stressor after stressor; and at the other extreme are those Ss exhibiting almost a random
pattern showing one response hierarchy to one stressor, a second hierarchy to a second stressor, etc.

A sixth factor to be considered is that of stimulus response specificity defined in the following manner: Any set of stimuli evokes its own unique pattern of response. This principle has been well substantiated in a classic study by Ax (1953) who obtained different autonomic responses from the same Ss under induced anger and induced fear, and by Wenger and Cullen (1958) who took measures on nine different autonomic variables in response to fourteen different stimuli and noted fourteen distinct response patterns.

But how can there be both a patterning of responses unique to the individual and at the same time a patterning of responses unique to the stimulus situation? The individual response specificity occurs when the rank order of the magnitudes of physiological measures is the same for a given individual when presented with several different stimuli. To demonstrate individual response stereotypy, a single S is needed to whom a number of stimuli are presented. Stimulus response specificity occurs when the rank order of the magnitudes of the physiological measures is the same for a group of Ss when presented with the same stimulus. In demonstrating stimulus response specificity, a group of Ss are needed to insure that the patterns of response to the single stimulus are typical of the stimulus and not just typical of a single individual. As the number of stimuli
and Ss are increased, both specificities become more and more difficult to demonstrate. In fact, Wenger, Clemens, Coleman, Cullen, and Engel (1961) suggested that one should not overgeneralize the significance and pervasiveness of these phenomena.

A Lacey (1959) proposal, that it might be more productive to analyze autonomic behavior into classes of events corresponding to psychological (e.g., perceptual, motor, cognitive) processes rather than attempting to demonstrate a separate physiological state in each separate emotion, has spawned numerous hypotheses specifying a relationship between assorted stimulus classes and psychophysiological responses. Lacey (1959) and Lacey, Kagan, Lacey, and Moss (1963) suggested that stimuli used to elicit responses may be of two types -- those that demand an "environmental intake" or require a sustained attentiveness by the S to the incoming stimuli (perceptual tasks), and those demanding a "rejection of the environment" or a preoccupation with the mental solution of problems (cognitive tasks). Such problems are frequently accompanied by inaccessibility and unresponsiveness to external stimuli and often by deliberate attempts to reduce environmental inputs. The Fels Research Institute group (Lacey, 1959; Lacey et al., 1963) demonstrated that a coincident cardiac deceleration and increase in SC, termed directional fractionation, accompany the environmental intake tasks and that cardiac acceleration and an increase
in SC accompany the environmental rejection tasks. Lacey et al., (1963) defined directional fractionation as an instance in which the direction of change in one physiological variable is contrary to what might be expected from the still persistent and pervading Cannon-like view of overall sympathetic activation by stress. In the environmental intake task cited above, the deceleration of the HR would be adjudged as an instance of directional fractionation.

Obrist (1963), in a replication and extension of the Lacey et al., (1963) study, found cardiac decelerations for additional environmental intake tasks; while Davis and Buchwald (1957) had earlier obtained analogous results with still other environmental intake stimuli.

The physiological responses accompanying these two types of stimuli, intake and rejection, correspond to the physiological responses produced by Darrow's (1929) designated "sensory" and "ideational" stimuli. Darrow (1929) suggested that simple "sensory" stimuli do not require any extensive cognitive activity and result in HR decelerations; whereas, noxious stimuli and activities requiring cognitive processes produce HR accelerations. Also, he found that "sensory" stimuli yield greater peripheral responses, i.e., SC deflections and vasoconstriction, than do the "ideational" stimuli.

Lacey et al., (1963) further suggested that the intake-rejection tasks are not dichotomous, but order themselves
along a continuum. For example, their "Rules" task, which necessitates both intake and rejection, yields psychophysiological measures intermediate to the pure intake and pure rejection tasks.

Related to the intake-rejection variable is a second stimulus variable advanced by Lacey et al., (1963), that of pleasantness-unpleasantness. The authors suggested that psychophysiological evidence supports the notion that pleasant stimuli, those that the organism wants to take in from the environment, produce a cardiac deceleration; and unpleasant stimuli, those that the organism wants to reject, produce cardiac acceleration. Again, stimuli may be ordered along the pleasantness-unpleasantness continuum such that those judged intermediate in pleasantness yield psychophysiological measures which are intermediate in magnitude when compared to the pleasant stimuli and the unpleasant stimuli.

Campos and Johnson (1966, 1967) and Johnson and Campos (1967) have introduced still another characteristic variable of the stimuli, the verbalization factor which they defined as either an overt or covert requirement to speak. The verbalization factor appears to override the other two variables, discussed immediately above, in that any requirement to verbalize accelerates the HR. In fact, Campos and Johnson (1967) stated that without exception, conditions of no verbalization are accompanied by cardiac deceleration and that later verbalization produces cardiac acceleration.
A review of the psychophysiological literature, including the sources cited throughout the text above, reveals a common and perhaps a faulty methodological procedure. That procedure consists of the E, independent of his Ss' judgments or responses, identifying or ordering the selected stimuli along the continuum of the variable of interest. The E's expectation then is that the Ss' psychophysiological responses will correspond with his own judgments of the stimuli. When the E's judgments about the stimuli and the Ss' psychophysiological responses to those stimuli do not in fact coincide, the E resorts to the intellectual exercise of altering his judgments of the stimuli to better fit the Ss' responses. The resultant, of course, is that new explanations are created to justify the E's new judgments.

Another obvious fault with this procedure may well lie with the rather tenuous assumption that the continuums of intake-rejection, pleasantness-unpleasantness, and verbalization-nonverbalization are unidimensional. As Lacey et al., (1963) stated, "We hastily admit the dangers and oversimplifications involved in asserting the existence of a single continuum from 'environmental acceptance' to 'environmental rejection'. Having admitted them, we proceed to attempt to establish in a preliminary way that something like this factor does exist[p. 166]." The same may well be said of the other variables, pleasantness-unpleasantness and
verbalization-nonverbalization.

The purpose then of this paper is to attempt a more objective ordering of the stimuli along the continuum of interest. First of all, no objective operational definition exists for any of the three variables mentioned above. This writer is primarily concerned with the intake-rejection dimension and proposes that viewing time (VT), the length of time spent looking at a stimulus, shall serve as a measure or at least an approximation to the measure of the intake-rejection variable. Thus, the E's subjective judgments of the stimuli, and hence, the former basis for the ordering of the stimuli have been eliminated. The hypothesis to be tested is that the VT will correspond to the psychophysiological responses of the Ss. That is, the longer a S views a stimulus, the greater will be his cardiac deceleration. In like manner, the shorter the time spent viewing the stimulus, the less will be the cardiac deceleration; and, perhaps, no change or a cardiac acceleration will occur. The author, of course, is assuming that VT is a function of the intake-rejection variable. Essentially, the expected result would be a lawful relationship between two responses to the same stimulus such that one, the VT, shall predict the other, the HR response, and vice versa.

The relationship, however, between VT and SC, or in the case of this study, the reciprocal of SC, skin resistance (SR), is not so obvious nor clear-cut. Evidence clearly
indicates that regardless of the type of stimulus, an increase in conductance or a decrease in resistance obtains. This consistent rise in SC is accounted for by the fact that sweat glands are innervated solely by SNS postganglionic fibers, and are, therefore, unlike most of the other autonomically modulated organs which are innervated by both SNS and PNS fibers (Sternbach, 1966). Because of this single innervation of the sweat glands, the author hypothesizes that the greatest deflection, that is, the greatest decrease in resistance, will occur most frequently with those stimuli eliciting an overall SNS domination. Similarly, the smallest deflections will occur with those stimuli eliciting an overall PNS domination. Therefore, long VT's should accompany small decreases in SR, and short VT's should accompany large decreases in SR. A positive correlation is thus hypothesized between VT and decreases in SR.

This proposed procedure should also reduce the amount of speculation and time spent conjuring up alternative justifications for the lack of relationship between the E's judgments of the stimuli and the S's responses -- at least for this writer if not for others.
METHOD

Selection of Stimuli

An assortment of 168 photographic slides was shown to four groups (N = 8, 8, 10, 10) of male undergraduates enrolled in the introductory psychology course at Iowa State University. Each S received course credit for participation. The slides were shown in sets of four accompanied by instructions for the Ss to rank the four slides in descending order according to which slides they would most like to see again for a longer period of time (see Appendix A). Each slide was shown for only five seconds and the fourth slide was followed by a fifteen second rest period to allow the Ss to mark their answer sheets. The 168 slides were completely randomized for each of the four groups.

After all thirty-six Ss ranked the 168 slides, weights were arbitrarily assigned to the slides in the following manner. Those slides which the Ss judged that they would most like to see again for a longer period of time, that is, those placed in the extreme left hand position on the answer sheets, were given a weight of one. Those slides which the Ss felt that they would next most like to see again for a longer period of time, or those in the second position on the answer sheets, were assigned a weight of two. Weights of three and four were similarly assigned. Thus, each slide was assigned a weight by each of the Ss.
The thirty-six weights for each slide were then summed, and the sums were placed in a frequency distribution and partitioned into deciles. The slides assigned to the first decile were those having the smallest sums, or those that the Ss generally agreed upon that they would most like to see again for a longer period of time. Slides in the tenth decile were those with the largest sums, or those that the Ss judged that they would least like to see for a longer period of time. The E next selected eight slides from both the first and tenth deciles and two slides from each of the deciles two through nine. The thirty-two slides selected for the study, their decile rankings, and identification (ID) numbers are shown in Appendix B.

Subjects

Forty male students enrolled at Iowa State University served as Ss for the study, twenty for each of the two experiments. Thirty-one of the Ss were volunteers from numerous undergraduate psychology courses at Iowa State and were given course credit for their participation. The other nine Ss, also undergraduates, were paid for their participation.

Apparatus

Continuous measures of skin resistance (SR), heart rate (HR), and finger pulse volume (FPV) were recorded by a
Beckman Type R Dynograph.

SR was amplified and recorded by Beckman Skin Resistance Couplers, Type 9892A. Beckman Biopotential Skin Electrodes (Ag/AgCl; 19 mm diameter) were placed at the center of each palm, while a third electrode serving as a ground was placed on the dorsal side of the right forearm. An intra palmar measure of SR was recorded to monitor the inter palmar measure. Identical electrodes were placed on the left palm of each S, one near the juncture of the index finger and the other near the juncture of the fourth finger. The ground electrode was also placed on the dorsal side of the right forearm.

HR was measured by the Beckman Cardiotachometer Coupler, Type 9857. The HR electrodes were placed on the dorsal side of each wrist and at each inner ankle. The ground electrode was attached to the dorsal side of the left forearm. That combination of two electrodes producing the least amount of "noise" was selected for recording the HR. Beckman Sodium Chloride Paste was used as the contact medium for all electrodes.

FPV, used only to monitor the HR, was measured by the Beckman Photocell Coupler, Type 987+. The photocell was attached to the volar surface of the left index finger.

To mask room noises, a constant low level of white noise was presented to the S through Lafayette F-767 Headphones.

Kodak Carousel slide projectors were used to project the slides. The projectors were wired to a bank of Hunter
Decade Interval Timers so that the slides were advanced automatically at the appropriate intervals. The timers were also connected to a channel of the Dynograph so that the instant a slide was advanced the pen deflected giving an accurate measure of elapsed time. In Experiment 1, a foot switch was placed near the S's foot so that he could advance the stimulus slide when he desired. The switch was wired to the timers so that it was operative only when a stimulus slide was projected and then only after the slide had been projected for fifteen seconds. The foot switch was also wired to a channel of the Dynograph so that a pen deflection recorded the precise moment that the switch was engaged.

In Phase 2 of Experiment 2, a Hunter Klockounter was wired to a two way toggle switch which was manually operated by the E to record the number of seconds, accurate to the nearest one tenth of a second, that the S looked at each of the two slides.

Diagrams of the experimental room arrangements for both experiments are shown in Figures 1 and 2.

Procedure

Experiment 1

Upon entering the laboratory, the S was asked to remove his wristwatch and wash his hands with pHisoHex soap. The S was then seated in a padded reclining chair in the experimental room and given a brief explanation of the
Figure 1. Physical arrangement of experimental room for Experiment 1 and Phase 1 of Experiment 2 (overhead view).
size of projected images: 8" x 12"

Figure 2. Physical arrangement of experimental room for Phase 2 of Experiment 2 (overhead view).
apparatus and a preview of what to expect during the experiment. All areas of the skin to which electrodes would be attached were liberally bathed in isopropyl alcohol. After the electrodes and photocell were attached and the headphones fitted comfortably, the S was asked to rest quietly with his eyes closed for fifteen minutes to allow for physiological stabilization. The S was then read the instructions seen in Appendix C.

Each rest slide (see Figure 36, Appendix B) was projected on the screen for twenty seconds, each alert slide (see Figure 37, Appendix B) for ten seconds, and the photographic slides for at least fifteen seconds after which time the S, by engaging the foot switch, could advance the next slide.

From previous experiences of presenting photographic slides and being cognizant of the effects of response recovery and rebounding as well as the latencies of the ANS, the writer has found that about a twenty second resting period is necessary between the presentation of stimuli to prevent the confounding of responses. Because a SR reading almost always stabilizes within the twenty seconds following the termination of the stimulus slide, a stable SR is often used as a criterion for advancing the next slide. That is to say, an E is more assured that following a stable SR, a SR change occurring with the presentation of a new stimulus slide is due to the presentation of that slide than he is when that same change is preceded by an unstable or
fluctuating SR. In the latter case, the E can not determine whether the fluctuation is due to the presentation of that slide, to some previous slide, or to some extraneous stimuli. Of course, it must be remembered that no single physiological variable, including SR, is necessarily a representative measure of the degree of S arousal. Lacey (1959) and Schnore (1959) believe that using a single arbitrarily chosen physiological variable as an index of arousal is extremely risky since the frequency with which one variable completely fails to show any response, while another simultaneously recorded variable shows considerable impact of the stimulating condition, is not so rare as many seem to think.

The function of the alert slide was only to warn the S that another photographic slide was about to appear. The reason for the relatively long, ten second alert period was to allow the autonomic responses to stabilize before presenting the photographic slide thereby insuring that the S's responses occurring during the presentation of the photographic slide were not latent responses to the preceding alert slide.

Each S, as stated in the instructions, had only partial control over the exposure time of the photographic slides. The author felt that at least a fifteen second exposure to the photographic slides was required to obtain an adequate measure of the autonomic responses. Due to the possible latencies of responses, a lesser period of time may not have
encompassed the autonomic changes or responses. In those cases when the S attempted to advance the slide before the fifteen second period had elapsed, that time period from the onset of the stimulus to the instant the S first engaged the foot switch was recorded as the measure of viewing time (VT), even though the S was exposed to the slide for at least fifteen seconds. As soon as the fifteen seconds had elapsed, the S could advance the slide by engaging the foot switch again.

A set of five introductory slides preceded the thirty-two stimuli slides. The purpose of the introductory slides was to allow the S to adapt to the experimental procedure, particularly the operation of the foot switch. To eliminate position effects, the order of the thirty-two slides was completely randomized but not balanced for the twenty Ss.

To deter the S from attempting to race through the experiment in a minimal period of time, additional slides were presented such that no S completed the experiment in less than seventy-five minutes.

Experiment 2 Phase 1

The identical procedure was followed for Phase 1 of Experiment 2 as was followed in Experiment 1 except that the S did not control the length of time that he viewed the slides. Instead, the photographic slides were automated to advance after exactly fifteen seconds of exposure time. The
time intervals for the rest and alert periods remained the same, twenty seconds and ten seconds respectively. The specific instructions read to the S are shown in Appendix D. As soon as the five introductory and the thirty-two stimuli slides had been projected, the experiment was stopped and preparation for Phase 2 commenced.

Experiment 2  Phase 2

As soon as Phase 1 was completed, the S was asked to relax for a few moments while the E readied the apparatus for Phase 2.

In Phase 2, the slides were projected two at a time, one on the left-hand screen, the other on the right-hand screen (see Figure 2). The specific instructions read to the S are shown in Appendix E. The same two slides were presented together for all twenty Ss; however, the sixteen pair were completely randomized for each S. Also, each slide was shown on the left screen for ten Ss and on the right screen for the other ten Ss. The pairings are shown in Appendix B. The pairings were systematically made so that no two stimuli from the same decile were paired, so that the algebraic differences between the deciles of the pair mates ranged from one to nine inclusive, and so that the decile differences of the pair mates ranged across the entire decile dimension. A diagram of the pairings is shown in Figure 3.
Figure 3. Pairings of the slides for Experiment 2, based upon the decile rankings.
Each of the sixteen pair was projected for sixty seconds, and the amount of time spent viewing each member of the pair was determined. The E, by manually operating the toggle switch wired to the Klockounter, recorded the amount of time that the S spent in viewing the right-hand slide. The time spent viewing the left-hand slide was determined by subtracting the right slide VT from sixty seconds. Each pair of slides was preceded by a fifteen second rest period.

The sixteen pair were preceded by two pair of introductory slides to allow the S to become familiar with the experimental procedure.

The reason that the E divided Experiment 2 into two phases was to avoid the confounding of responses which inevitably would have obtained, had the physiological measures been recorded at the same time that the comparative VT measures were taken. With the S viewing one slide of the pair and then the other in rapid and repeated succession, it would have been impossible to determine any sort of physiological measures for each of the individual slides of the pair. Therefore, the physiological measures were obtained in Phase 1 and the VT measures in Phase 2. This procedure, however, is less than ideal in that evidence indicates that a stimulus perceived a second time is not the same as that stimulus when perceived for the first time (Lynn, 1966).
Experiment 2, in its entirety, required approximately seventy-five minutes.

Quantification and Treatment of Data

In Experiment 1, the records were scored for the last ten seconds of the rest period preceding the photographic slide and for the first ten seconds of the photographic slide presentation. The ten values at one second intervals were averaged to yield a mean value for the basal or rest period and a mean value for the stimulus period. These values were determined for each of the thirty-two stimuli, for all twenty Ss, and for both inter palmar SR and HR. The mean value for the resting period was subtracted from the mean value for the stimulus period for each S on each of the thirty-two slides and for both of the physiological measures. These differences hereafter are called SR change (SRΔ) and HR change (HRΔ). The VT for each S on each stimulus was then correlated with the corresponding scores of HRΔ and SRΔ and with the decile of the photographic slides. The three sets of twenty correlation coefficients were tested for significance by using Fisher's t ratio as described by Guilford (1965). These three sets of correlations were then collapsed about the Ss yielding three coefficients which were also tested for significance in the same manner. These correlations, as well as all others in the study, are Pearson product-moment coefficients.
of correlation. The standard of significance was set at the .05 level for all correlations.

The above analysis yields information about the twenty Ss individually and collectively across all stimuli or slides. The next step in the analysis was to examine the stimuli, singly and collectively, across all Ss. To equate the intra S variability of the twenty Ss or, in other words, to make it possible to compare the SRA and HRA of different Ss, each SRA and HRA was divided by the standard deviation ($s_i$, where $i =$ S number; 1-20) of that S's thirty-two change scores for that particular physiological variable. These transformed scores, $\text{SRA}/s_{\text{SRA}}$ and $\text{HRA}/s_{\text{HRA}}$, were then used in the analysis. Similarly, each VT for a given S was divided by the standard deviation, $s_{\text{VT}}$, of that S's thirty-two scores for VT. The resulting transformed VT is $\text{VT}/s_{\text{VT}}$.

All transformed SRA, HRA, and VT scores, $\text{SRA}/s_{\text{SRA}}$, $\text{HRA}/s_{\text{HRA}}$, and $\text{VT}/s_{\text{VT}}$, were grouped for each of the thirty-two stimuli. The transformed VT was then correlated with the corresponding transformed SRA and HRA. These sixty-four correlation coefficients were tested for significance as described above. The two sets of thirty-two correlations were then collapsed about the slides yielding two coefficients which also were tested for significance.

The identical analysis was performed on the data of Experiment 2 as in Experiment 1 with only a few changes to
accommodate the differences in procedure. The physiological measures obtained from Phase 1 and the VT measures obtained from Phase 2 were treated in the following manner. Since two slides or stimuli were compared, the differences between the difference scores of the pair mates were found
\((SRA_{x_1} - SRA_{x_2}) \text{ and } HRA_{x_1} - HRA_{x_2}\) for each pair for each S.

The corresponding differences in VT were also determined, \(VT_{x_1} - VT_{x_2}\). The subscripts \(x_1\) and \(x_2\) represent the two members of a given pair of slides, \(x\). The toss of a coin determined for each of the sixteen pair of slides which member would be designated \(x_1\). That slide served as \(x_1\) for all twenty Ss. These designations are shown in Appendix B. The VT difference for each S on each of the sixteen stimuli pair was correlated with the corresponding SRA differences and HRA differences. The forty correlation coefficients were each tested for significance by using Fisher's \(t\) ratio. The two sets of twenty correlations were then collapsed about the Ss yielding two correlation coefficients which were also tested for significance.

Again, to gather information about the stimuli pair singly and collectively across the Ss, the following values were determined, \(SRA_{x_1} - SRA_{x_2}, \ HRA_{x_1} - HRA_{x_2}, \text{ and } VT_{x_1} - VT_{x_2}\), for each S for each pair of slides. Each of the difference scores above was divided by the standard deviation
of the appropriate S's sixteen difference scores for that particular variable. These transformed scores,

\[
\frac{(SR\Delta_{x_1} - SR\Delta_{x_2})}{s_1} (SR\Delta_{x_1} - SR\Delta_{x_2}),
\]

\[
\frac{(HRA_{x_1} - HRA_{x_2})}{s_1} (HRA_{x_1} - HRA_{x_2}), \text{ and}
\]

\[
\frac{(VT - VT')}{s_1} (VT_{x_1} - VT_{x_2})
\]

were then grouped according to the sixteen pair of stimuli. The transformed VT was correlated with the corresponding transformed SR\Delta and HRA\Delta. After the resulting thirty-two correlations were tested for significance, the two sets of sixteen correlations were collapsed about all pair yielding two correlations which were also tested for significance.
RESULTS AND DISCUSSION

Undergraduate students were employed and trained to code the necessary data from the forty protocols. A small, 3.1%, random check on the accuracy of the coded data resulted in an error factor of only 0.6% with tolerance allowances of ± 2 beats per minute (BPM) in the case of the heart rate (HR) responses and of ± 4000 ohms in the case of the skin resistance (SR) responses.

As stated previously, the data were summarized by Pearson product-moment correlation coefficients. To determine the values of these correlations, the necessary variables were placed in a correlation matrix; so not only were those correlations of interest determined, but every variable was correlated with every other variable. Most of these additional correlations are meaningless; however, a few are relevant to the study and are discussed below.

Experiment 1

Table 1 presents the correlations between viewing time (VT) and HR change (HRΔ) and between VT and SR change (SRΔ) for the twenty Ss of Experiment 1, both individually and collectively. None of the forty correlations is significant at the .05 level indicating that there is no relationship, or rather that there is no linear relationship between VT and HRΔ and VT and SRΔ. Not only do the
Table 1. Product-moment correlations for Ss of Experiment 1

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</table>

1-20 .0314 -.0614 -.303* -.006 -.078 .019 .097* .117*

*p < .05.*
correlations fail to reach significance, but only about one half of them are in the hypothesized directions. It may be recalled that the author predicted that as the VT increased the HRA should also increase but in the negative direction; or, in other words, as the VT increases HRA should decrease yielding negative correlations.

In the case of the VT-SRA correlations, it was expected that as VT increased the SR' decreases would become smaller. Thus, positive correlations were predicted; but again only about one half are in the predicted direction; and none, as above mentioned, are significant.

When these same correlations, VT-HRA and VT-SRA, were determined for the twenty Ss collectively rather than individually, not only were they found to be insignificant, but both correlations are in the directions opposite to those which were predicted.

Before the author could conclude that there is no relationship between either of the physiological variables and VT, etas were computed collectively for Ss one through ten and for Ss eleven through twenty to determine if nonlinear relationships might exist. F tests, based upon an analysis of variance approach and suggested by Guilford (1965), were performed on the data; and all four obtained F's were found to be insignificant. The results of the F tests are shown in Table 2. It is concluded, therefore, that the differences between the etas and the Pearson product-moment
Table 2. F tests of nonlinearity for the data of Experiment 1

<table>
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<tr>
<th>Relation-</th>
<th>Number of observations</th>
<th>Number of categories</th>
<th>eta</th>
<th>Pearson r</th>
<th>F</th>
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correlations are so small that there is little doubt that a nonlinear relationship does not exist either between VT and HRA or between VT and SRA.

Since eta is particularly sensitive to the number of categories into which the observations are partitioned, great care must be taken in its computation. The minimum number of categories that can show any curvature is three; however, too few categories may give a smoothed and distorted view of the real relationship and consequently an underestimate of the real eta. On the other hand, by increasing the number of categories, the means of the categories become less stable thereby increasing the probability of chance errors which unduly inflate eta. There is no recommended method for correcting eta for the number of categories; however, Guilford (1965) has suggested as a rule of thumb that with samples of at least 100 observations, the number of categories should range between six and twelve.
To insure that there would be at least ten observations per category, the number of categories for the four etas in this study was set at six and at seven.

When VT was correlated with the stimulus decile, it was found that generally, as predicted, stimuli ranked in the lower deciles (one, two, etc.) were accompanied by longer VT's; and likewise, stimuli having higher decile rankings (ten, nine, etc.) generally were viewed for shorter periods of time. That is to say, the S's of Experiment 1 concurred in their actual VT's of the stimuli with the group of thirty-six Ss who only reported their rankings of the stimuli. The results certainly lend a high measure of stability to the rankings in that two independent groups seem to be in general agreement on which slides they wish to see for longer periods of time. For all but one S, the correlations are in the predicted direction; and for ten of the Ss, the correlations reach significance at the .05 level.

Because of the rather lengthy experiment, the E feared that the Ss might habituate on the latter stimuli in the sequence thereby masking some otherwise significant outcomes. The E's fears were allayed by the resulting correlations of stimulus position with VT for each of the twenty Ss (see Table 1). No relationship appears to exist between these two variables. If habituation had in fact occurred, the expected results would have been high negative correlations, since those slides or stimuli viewed early should have
attracted more attention or have been viewed longer than those stimuli which were viewed much later in the experimental period.

A related relationship that was considered is that of stimulus position and SRA. Darrow (1964) was nonplussed by the large SR deflections or decreases on innocuous first stimuli and insignificant deflections on later, more severe, and disturbing stimuli. The correlations in Table 1 indicate that no such trend appears in these data. In fact only one half of the correlations are in the positive direction. Only four of the correlations reach significance at the .05 level, and one of them is in the direction opposite to what Darrow (1964) might have expected.

Table 1 also shows that the position of the stimulus has little or no effect on HRA as well. The two significant correlations, one in each direction, are perhaps only chance events.

Two other relationships that may shed some light on the hypotheses are those of VT with the range of the SR stimulus period and VT with the range of the HR stimulus period. Range is defined as the arithmetic difference between the high and low SR's and between the high and low HR's in the ten second stimulus period for each stimulus and for each S. As seen in Table 1, only five of the correlations reach the .05 level of significance; however, all five are in the expected positive direction. Also, it may be noted that
twenty-six of the forty correlations are in the positive
direction and that the two summary correlations are both in
the expected direction and significant at the .05 level.
One must be extremely cautious in interpreting the signifi-
cance of these correlations, however. Undoubtedly the two
or three very high positive correlations unduly inflated the
two summary correlations. Rather than suggest that there
are significant relationships between SR stimulus range and
VT and between HR stimulus range and VT, this author prefers
to take a more conservative stance, in light of the individual
correlations, and suggests the possibility of only a trend.
That is, it appears that a greater range or variability in
the SR and HR stimulus ranges is generally accompanied by
a longer VT.

The reason that these two relationships were singled out
for further discussion is that the stimulus ranges of the two
physiological variables approximates the peak to valley
method of selecting data points which is so popular today.

By using the same data, it can be seen that the peak to
valley method of quantifying changes in physiological
variables yields correlations which are closer to significance
than does the method employed by this author. Nevertheless,
the question, "which is the most adequate or appropriate
method?" remains unanswered. Although there are a number of
possible explanations for the difference in the two methods,
two of the most probable explanations follow. One, as
Venables and Martin (1967) pointed out, real changes in the variable may go unnoticed when only means are analyzed. Therefore, the author's method of determining mean rates may well conceal any real changes. Two, since physiological variables, and particularly HR, are constantly in flux regardless of whether a stimulus is presented or not, peak to valley differences exist even during quiescent states of the S and may well be significant without the presentation of a formal stimulus. Thus, the peak to valley method may exaggerate the real change in the variable. A study designed to resolve this issue may be most productive.

Table 3 shows the correlations for the thirty-two stimuli, both individually and collectively across all twenty Ss. As discussed earlier, to permit the comparison of the responses of different Ss to a given stimulus, the responses were divided by that S's standard deviation based upon his thirty-two responses for each physiological variable. The resulting measures, VT/s_{VT}, HRA/s_{HRA}, and SRA/s_{SRA}, for ease in discussion shall hereafter be referred to as transformed VT, HRA, and SRA.

As seen in Table 3, only one of the thirty-two transformed VT-HRA correlations and only two of the transformed VT-SRA correlations are significant at the .05 level, all in the directions opposite to those which were hypothesized. Only thirteen of the correlations between transformed VT and
Table 3. Product-moment correlations for stimuli of Experiment 1

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<th>VT-SRA</th>
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<td>140</td>
<td>-.179</td>
<td>-.611*</td>
<td>.391</td>
<td>-.348</td>
<td>-.404</td>
</tr>
<tr>
<td>143</td>
<td>.036</td>
<td>-.336</td>
<td>-.281</td>
<td>.098</td>
<td>-.217</td>
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<tr>
<td>144</td>
<td>.101</td>
<td>.291</td>
<td>-.168</td>
<td>.131</td>
<td>-.322</td>
</tr>
<tr>
<td>148</td>
<td>.218</td>
<td>.213</td>
<td>0</td>
<td>.454*</td>
<td>-.112</td>
</tr>
<tr>
<td>151</td>
<td>-.079</td>
<td>-.205</td>
<td>-.079</td>
<td>.281</td>
<td>.351</td>
</tr>
<tr>
<td>154</td>
<td>-.122</td>
<td>-.029</td>
<td>-.217</td>
<td>.056</td>
<td>.176</td>
</tr>
</tbody>
</table>

* p < .05.
HRA are in the hypothesized negative direction, and only eleven of the transformed VT-SRA correlations are in the expected positive direction. The fact that the thirty-two stimuli taken together yield a significant transformed VT-SRA correlation is undoubtedly a reflection of those two, highly significant correlations for slides numbered 95 and 140. Again, the author is reluctant to attach much value to the significance of this summary correlation. The results of these two sets of correlations, once more, suggest that no linear relationship exists between VT and HRA nor between VT and SRA.

The correlations between transformed VT and the position of the stimulus indicate that stimulus position does not appear to have any effect on the Ss' VT's. If habituation had occurred, it would have manifest itself in the form of significant negative correlations. Only two of the thirty-two correlations reach significance at the .05 level, and one of those is positive. Twenty of the thirty-two correlations, however, are in the negative direction but not significantly different from zero.

The position of the stimulus also has no effect on the transformed SRA and HRA. In the case of stimulus position and transformed SRA, two of the three significant correlations are in the direction opposite to that which Darrow (1964) might have expected. Only one of the correlations between transformed HRA and stimulus position is
significant providing evidence that stimulus position has no effect on the transformed HRA. Probably that significant correlation for slide number 83 is only a chance event.

The last two sets of correlations to be discussed for these data are the relationships of transformed VT with the range of the SR stimulus period and with the range of the HR stimulus period. As stated before, these ranges approximate the peak to valley method of quantifying changes in physiological variables. Five of the transformed VT-SR stimulus range correlations are significant at the .05 level, and another fifteen are in the expected positive direction. These correlations indicate that the greater the VT the greater is the range of responses or the variability in the SR stimulus period. The summary correlation for all thirty-two stimuli is also significant; but, as before, this correlation may have been unduly weighted by those five significant individual correlations. Thus, the relationship is not so clear-cut, and perhaps only a trend should be inferred.

No such trend is visible in the case of the transformed VT and the range of the HR stimulus period. Only one correlation is significant and in a negative direction indicating that the Ss who viewed that slide, number 31, for longer periods of time exhibited less variability in their ranges of HR responses than did those Ss who viewed it for a shorter period. The direction of this relationship
is not what had been expected.

It appears again that the peak to valley method of selecting data points, at least in the case of SR, yields more significant correlations in support of the hypotheses; but, as discussed earlier, this method may inflate the magnitude of the correlations.

In summary, the results of Experiment 1 indicate that for the twenty Ss and the thirty-two stimuli, there is no relationship between VT and HRA nor between VT and SRA thereby failing to support the author's hypotheses. The only support for the hypotheses occurs in the form of a stability-like measure of reliability. It may be recalled that the actual VT's of the twenty Ss for the thirty-two stimuli correspond very closely with the reported judgments of those thirty-six Ss used in determining the decile rankings.

Experiment 2

The procedure employed in Experiment 2 was to present two stimuli simultaneously to the S with the expectation that that stimulus or slide which commanded the greater portion of the S's attention, would result in a greater decrease in HRA and a lesser decrease in SRA.

The correlation coefficients of the proposed measures are displayed in Tables 4 and 5. Since the stimuli were shown in pairs, one member was randomly designated as $x_1$ and the other as $x_2$. The values, $HRA_{x_1} - HRA_{x_2}$, and $SRA_{x_1} -$
Table 4. Product-moment correlations for Ss of Experiment 2

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Correlations</th>
<th>Subjects</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(VT _VT)</td>
<td></td>
<td>(VT -VT)</td>
</tr>
<tr>
<td>21</td>
<td>-.538*</td>
<td>21-40</td>
<td>-.081</td>
</tr>
<tr>
<td>22</td>
<td>-.022</td>
<td>22</td>
<td>-.074</td>
</tr>
<tr>
<td>23</td>
<td>-.255</td>
<td>23</td>
<td>-.270</td>
</tr>
<tr>
<td>24</td>
<td>-.095</td>
<td>24</td>
<td>.091</td>
</tr>
<tr>
<td>25</td>
<td>-.027</td>
<td>25</td>
<td>.426</td>
</tr>
<tr>
<td>26</td>
<td>-.027</td>
<td>26</td>
<td>-.074</td>
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<td>27</td>
<td>.182</td>
<td>27</td>
<td>.392</td>
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<td>28</td>
<td>-.302</td>
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<td>-.265</td>
</tr>
<tr>
<td>30</td>
<td>-.062</td>
<td>30</td>
<td>-.500*</td>
</tr>
<tr>
<td>31</td>
<td>-.019</td>
<td>31</td>
<td>-.262</td>
</tr>
<tr>
<td>32</td>
<td>-.173</td>
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<td>-.063</td>
</tr>
<tr>
<td>33</td>
<td>-.246</td>
<td>33</td>
<td>-.213</td>
</tr>
<tr>
<td>34</td>
<td>-.303</td>
<td>34</td>
<td>.046</td>
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<tr>
<td>35</td>
<td>.158</td>
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<td>36</td>
<td>-.128</td>
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</tr>
<tr>
<td>37</td>
<td>-.017</td>
<td>37</td>
<td>.012</td>
</tr>
<tr>
<td>38</td>
<td>-.041</td>
<td>38</td>
<td>-.236</td>
</tr>
<tr>
<td>39</td>
<td>.136</td>
<td>39</td>
<td>-.138</td>
</tr>
<tr>
<td>40</td>
<td>.051</td>
<td>40</td>
<td>-.096</td>
</tr>
</tbody>
</table>

\*p < .05.

SRA\_x^2 were each correlated with VT\_x^1 - VT\_x^2 for each of the twenty Ss. From Table 4, it can be seen that only three of the forty correlations are significant, and only two of those are in the predicted directions. Also, neither of the summary correlations is significant. The author, therefore, concluded that there are no linear relationships between these variables.
Table 5. Product-moment correlations for stimuli pair of Experiment 2

<table>
<thead>
<tr>
<th>Stimuli Pair</th>
<th>Correlations</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
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<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
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<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
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<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
<tr>
<td></td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
<td>((\Delta x_1 - \Delta x_2)/s_1)</td>
</tr>
</tbody>
</table>

The correlations for each pair of stimuli are shown in Table 5. Just as in Experiment 1, to permit the comparison of the different Ss' responses to the same stimulus, each S's responses were divided by the standard deviation of his sixteen scores for that given variable. The resulting values which were then used in the computation of the correlation coefficients are \((\Delta x_1 - \Delta x_2)/s_1\), and

\[(\Delta x_1 - \Delta x_2)/s_1(\Delta x_1 - \Delta x_2)\]
\[(SRA_{x_1} - SRA_{x_2})/s_i(SRA_{x_1} - SRA_{x_2})\].

All thirty-two individual correlations as well as the two summary correlations fail to reach significance, and only about one half of them are in the hypothesized directions indicating again that no linear relationships exist between the variables.

Table 5 also shows that the absolute values of the correlation coefficients for those pair mates of the most distant deciles are not greater than the absolute values for those pair mates whose deciles are more closely positioned. Thus, the expectation that the correlations for the pair mates would approach zero as the differences between the deciles of the pair mates approach zero was not confirmed.

In sum, the results of Experiment 2 clearly show, as do the results of Experiment 1, that there is no relationship between VT and HRA and between VT and SRA for these stimuli and Ss.

Composite of the Two Experiments

This study was designed to attempt a more objective ordering of stimuli on the intake-rejection continuum and to provide some evidence, or lack thereof, for the reliability and validity of such ordering.

An approximation to a measure of the reliability of the VT was achieved in Experiment 1 in which the actual VT's of the twenty Ss correlate reasonably well with the reported
rankings of the thirty-six Ss upon whose judgments the thirty-two stimuli were selected.

It was expected, or perhaps stated more accurately it was hoped, that the two different methods employed in measuring the VT might provide an indication of the validity of assessing the positions of the stimuli on the intake-rejection continuum by the time spent viewing the stimuli. The writer wishes to emphasize that this is not a validation study per se and was not designed as such. However, had the two measures of the VT been highly correlated with HRA and/or SRA, a necessary condition for validity, but certainly not a sufficient one, would have been met. If this condition had been met, a next step would have been to correlate the two measures of VT with each other to determine if in fact they were two different measures.

The author wishes not to engage in a lengthy discourse of possible explanations for the results of the study; however, a few comments and suggestions may aid others in avoiding many of the pitfalls of this study.

An assumption underlying this study, as well as most of the work of the Fels Research Institute, is that a unidimensional intake-rejection continuum exists. Before research can progress in this area, the writer feels that an attempt must be made to establish that the continuum does in fact exist and is unidimensional. The possibility that this assumption may well be a faulty one could account for the lack of significant correlations in this study.
A second assumption that this writer makes is that VT is a function of the intake-rejection variable. Again, this may be a faulty assumption. It is suggested, therefore, that once the existence of an intake-rejection variable is established, its relationship with VT must then be determined.

If one will grant for the moment the existence of a unidimensional, intake-rejection continuum, some method must be found to insure that the stimuli tap the entire range of that continuum. The author has nothing more than ordinal information about the thirty-two stimuli used in this study. The fact that the stimuli can be ordered does not preclude the possibility that they might be grouped about the same position on the intake-rejection continuum thereby yielding, as in this study, zero order correlations between VT and HRA and between VT and SRA. Perhaps the continuum encompasses all sense modalities, and the visual stimuli only tap a small segment of that continuum. If one is to tap the entire range of the continuum, stimuli employing the different sense modalities in various combinations may be required. This too is a methodological question that must be answered.

Finally, the most probable explanation of the results of this study, and one which the author thus far has failed to acknowledge despite the evidence, is that there simply is no relationship between the VT of stimuli and the accompanying changes in HR and SR to those stimuli.
The purpose of this study was to advance an objective method for ordering visual stimuli on the intake-rejection continuum. Lacey (1959) and Lacey et al., (1963) proposed that stimuli are of two types: (1) those that require a sustained attentiveness by the S, referred to as intake tasks, and (2) those that demand a rejection of the environment or involve a relatively high level of cognitive functioning, called rejection tasks. These pure intake and pure rejection tasks identify the extremes of a continuum. It was found that heart rate (HR) decreases accompany the intake tasks while HR increases accompany the rejection tasks. Intermediate changes in HR accompany those tasks intermediate to the pure intake and pure rejection tasks.

The usual experimental procedure employed by most Es is to identify stimuli as intake or rejection prior to the experiment; and then when the Ss' physiological responses, particularly HR, fail to support the E's judgments of the stimuli, he seeks new explanations of why the stimuli are or are not intake tasks or rejection tasks.

In lieu of the faulty procedure described above, the author has proposed that viewing time (VT) is a measure of the degree of intake-rejection and that the longer a S views a stimulus, the more he is taking it in; and there-
fore, the greater should be his HR deceleration. Likewise, if a S views a stimulus for only a short period of time, he is perhaps rejecting the stimulus so a HR acceleration would be expected. It was also hypothesized that longer VT's would be associated with smaller skin resistance (SR) decreases and shorter VT's with larger SR decreases.

Twenty Ss were shown thirty-two photographic slides for as long a period as they desired, and measures of VT, HR change (HRA), and SR change (SRA) were recorded. These measures were then correlated for each S and for each stimulus. Zero order correlations resulted, indicating that there is no relationship between VT and HRA nor between VT and SRA.

In a related experiment, twenty different Ss were shown the thirty-two slides in pairs. It was hypothesized that that slide of a given pair which commanded more attention, i.e., greater VT, would be accompanied by a greater HR decrease and a smaller SR decrease than the other slide. Correlations between the VT differences of the two members of a pair of slides and the corresponding HRA and SRA differences again yielded nonsignificant correlations. The author concluded that no relationship exists between VT and the two physiological variables.
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APPENDIX A. INSTRUCTIONS FOR SELECTING STIMULI

I am going to present to you several groups of slides, four slides in each group; and I want you to rank these four slides in the following manner.

In the extreme left-hand position of your answer sheet, place the number of that slide which you would most like to see again for a longer period. In the second position from the left, place the number of the slide which you would next most like to see again for a longer period of time. Continue this procedure until you have the four slides ranked. In the fourth position, on the extreme right, you should place the number of the slide which you would least like to see again for a longer period.

The number of each slide corresponds to the order in which it will be presented. That is, the slide shown first shall be number one, the slide shown second will be number two, etc.

In addition, I want you to circle the numbers of those slides which you feel you might like to look at for extended periods of time.

Each slide will be projected on the screen for only five seconds, so please pay close attention. After the fourth slide in each set has been shown, a fifteen second rest period will allow you to mark your answer sheet.

Please work carefully and rapidly.
For practice, I will now show you a set of four slides. Indicate the ranks of the four slides in the "practice spaces" provided on your answer sheet.

Are there any questions?

I will now present the first set of four slides.
Plate 1. Prints of slides

Figure 4.
Slide #7($x_2$)
10th decile
member Pair A

Figure 5.
Slide #143($x_1$)
8th decile
member Pair A

Figure 6.
Slide #39($x_1$)
8th decile
member Pair B

Figure 7.
Slide #148 ($x_2$)
3rd decile
member Pair B
Plate 2. Prints of slides

Figure 8.
Slide #95(x_2)
1st decile
member Pair C

Figure 9.
Slide #154(x_1)
7th decile
member Pair C

Figure 10.
Slide #29(x_1)
10th decile
member Pair D

Figure 11.
Slide #140(x_2)
1st decile
member Pair D
Plate 3. Prints of slides

Figure 12. Slide #56($x_1$)
2nd decile
member Pair E

Figure 13. Slide #151($x_2$)
9th decile
member Pair E

Figure 14. Slide #4($x_2$)
10th decile
member Pair F

Figure 15. Slide #84($x_1$)
6th decile
member Pair F
Plate 4. Prints of slides

Figure 16.
Slide #25\(x_2\)
4th decile
member Pair G

Figure 17.
Slide #144\(x_1\)
10th decile
member Pair G

Figure 18.
Slide #2\(x_1\)
10th decile
member Pair H

Figure 19.
Slide #90\(x_2\)
1st decile
member Pair H
Plate 5. Prints of Slides

Figure 20. Slide #71($x_2$)
1st decile
member Pair I

Figure 21. Slide #98($x_1$)
5th decile
member Pair I

Figure 22. Slide #31($x_2$)
10th decile
member Pair J

Figure 23. Slide #92($x_1$)
2nd decile
member Pair J
Plate 6. Prints of slides

Figure 24. Slide #83\(x_2\)
1st decile
member Pair K

Figure 25. Slide #113\(x_1\)
10th decile
member Pair K

Figure 26. Slide #59\(x_1\)
1st decile
member Pair L

Figure 27. Slide #79\(x_2\)
10th decile
member Pair L
Plate 7. Prints of slides

Figure 28. Slide #64(x_2)
7th decile
member Pair M

Figure 29. Slide #76(x_1)
4th decile
member Pair M

Figure 30. Slide #40(x_2)
3rd decile
member Pair N

Figure 31. Slide #60(x_1)
1st decile
member Pair N
Plate 8. Prints of slides

Figure 32.
Slide #24\(x_1\)
9th decile
member Pair 0

Figure 33.
Slide #70\(x_2\)
1st decile
member Pair 0

Figure 34.
Slide #1\(x_1\)
6th decile
member Pair P

Figure 35.
Slide #73\(x_2\)
5th decile
member Pair P
Plate 9. Prints of slides

Figure 36. Rest Slide
Figure 37. Alert Slide
APPENDIX C. INSTRUCTIONS FOR EXPERIMENT 1

For the remainder of the period, I am going to show you a number of photographic slides; each will be followed by a rest period in which I want you to relax by closing your eyes. Following the rest period, will be a bright alerting slide which will warn you of the next photographic slide. Open your eyes when the alerting slide appears.

You may control the length of time that each of the photographic slides appears on the screen. I want you to look at each slide for as long a period as you like and advance it at your own volition by pressing the foot switch on the floor in front of you.

To obtain an adequate measure of your psychophysiological responses, each photographic slide must be shown for a minimal period of time. Therefore, if you press the switch before that minimal period has elapsed, the slide will not advance; however, each press of the foot switch will be recorded on the polygraph, and I will thus have a measure of the length of time that you wanted to look at the slide even though you were forced to look at it for a longer period of time. This measure, the length of time that you want to look at a given slide, is of most importance to me; so when you no longer want to look at a given slide and you're relatively certain that a press of the foot switch will not advance that slide, or in other words, you know that the
minimal period of time for that slide has not yet elapsed, please press the switch anyway to signal to me that you no longer want to look at the slide.

Please do not press the foot switch during the rest and alert slides. They will advance automatically.

Here then is the sequence of events: the photographic slide will appear on the screen until you advance it by pressing the foot switch. Look at the slide for as long a period as you like. When you advance the slide, a rest slide will appear. Please close your eyes and relax during this short period. Also, do not press the foot switch. The rest slide will be followed by a very bright alert slide. Even though your eyes will be closed during the rest slide, you'll still be able to tell when the bright alert slide appears. Again, do not press the foot switch during this period. The alert slide will then be followed by another photographic slide, and the same procedure will be repeated.

The sequence will begin with the rest slide, followed by the alert slide, the photographic slide, rest, alert, photographic, etc.

There are far too many slides for you to view during this period, so please do not try to rush through. Advance the photographic slide only when you are ready.

Do you have any questions?

I will take a couple of minutes now to insure that the equipment is still operating properly. As soon as I have done that, we will begin.
APPENDIX D. INSTRUCTIONS FOR EXPERIMENT 2 PHASE 1

For the first part of the experiment, I am going to show you a number of photographic slides, and your task will simply be to look at them. Each slide will be followed by a rest period in which I want you to relax and close your eyes. Following the rest period will be a bright alerting slide which will warn you of the next photographic slide. Open your eyes when the alerting slide appears on the screen. Even though your eyes will be closed during the rest period, you'll still be able to tell when the bright alert slide appears.

The sequence will begin with the alert slide first, followed by the photographic slide, the rest slide, alert, photographic, rest, etc.

Again, do not forget to close your eyes and relax during the rest period.

Do you have any questions?

I will take a couple of minutes now to insure that the equipment is still operating properly. As soon as I have done that, we will begin.
For the second part of the experiment, I am going to show you many of the same photographic slides; however, this time the slides will appear in pairs. One slide will be projected on the screen on your left, and the other will be projected on the screen on your right. Again, your task will simply be to look at the slides.

Please do not attempt to view both slides simultaneously, but turn your head so that you may comfortably view each slide. Although you have already seen the slides once, please cooperate by looking at them as long as they are projected on the screens rather than closing your eyes, staring into space, or looking at something other than the slides.

Each pair of slides will be followed by a short rest period in which I want you to relax. You need not close your eyes, however.

Do you have any questions?