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THE UNIVERSITY OF ALBERTA

A STUDY OF THE RELATIONSHIP BETWEEN DISCRIMINATION RESPONSE STYLES AND THE ORIENTING RESPONSE

BY

© DONALD ROY CAMPBELL

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled A Study of the Relationship Between Discrimination Response Styles and the Orienting Response submitted by Donald Roy Campbell in partial fulfilment of the requirements for the degree of Doctor of Philosophy (or Doctor of Education).

Supervisor

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ABSTRACT

The present investigation studied some of the intrinsic variables associated with reflective and impulsive styles of responding. When the performance of these two groups of children is compared on visual discrimination tasks, reflective children characteristically show a greater frequency of head-eye movements, take longer to respond and reveal fewer errors than do impulsive children. The origin of these response styles is still obscure and there seems to be difficulty in relating them to the mainstream of psychological theory.

However, a review of the related literature revealed that reflective and impulsive styles could be fitted into the framework of the Soviet orientation reaction--a system of autonomic and motor responses that facilitate the reception of stimuli and enhance learning. A number of hypotheses emerged when these response styles were viewed from the Soviet theoretical frame of reference:

1. That reflective subjects manifest a higher level of autonomic orienting response (OR) than do impulsive subjects.

2. That the size of the autonomic OR is related to the frequency of the motor OR.

3. That reflective subjects require more trials to extinguish the autonomic OR than do impulsive subjects.

4. That reflective subjects show a greater degree of conditioning than do impulsive subjects.

These hypotheses were tested in a series of four studies.

An initial sample of 136 boys, at the grade six level, was selected from five elementary schools and administered Kagan's Matching Familiar Figures test. On the basis of their latency and error scores, the sample was classified into reflective and impulsive categories. Only subjects from the upper and lower ends of the reflective-impulsive distribution (N = 30 for each group) were used in testing the hypotheses. There was no difference in the age or intelligence quotients of the two groups of subjects selected for the study.

When the results of the four studies were analyzed, no support was found for the first three hypotheses. The fourth hypothesis, however, was supported: reflective subjects reveal a significantly greater degree of conditioning than do impulsive subjects.

A number of non-hypothesized considerations were discussed, the most notable of which were: (1) the discovery that reflective and impulsive subjects reveal no significant difference in performance on a school type task (the Iowa Achievement Battery), (2) that different scanning strategies seemed to accompany the varied response styles on discrimination tasks, and (3) the suggestion that social status is a variable which is related to reflective and impulsive response styles.

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CHAPTER I

THE PROBLEM

Since the early sixties, Kagan and his co-workers have been studying a disposition or style of behavior which they have labelled reflection-impulsivity (Kagan, Rosman, Day, and Phillips, 1964). This disposition, described as "the tendency to consider alternative solution hypotheses when many alternatives are available simultaneously" (Kagan *et al*, 1964), seems to be different from other cognitive styles in the current literature of psychology.

The existence of a reflection variable was first observed in the behavior of individuals on a classification task (Kagan, Moss, and Sigel, 1963). When children were asked to pick out a pair of pictures (from sets of three pictures) that were alike or went together in some way, their choices were observed to fall into two widely different categories: analytical-categorical and relational. The analytic category included concepts that were based on a similarity among elements that were a differentiated part of the total stimulus whereas concepts in the relational category were based on a functional relation among stimuli. Relational responses, based on stimuli as whole units, were generally more concrete in nature. Analytic concepts, on the other hand, involved a more differentiated analysis of stimuli and tended to be more abstract (Kagan, Moss, and Sigel, 1963).

In a search for variables that might underlie the production of analytic versus non-analytic responses, Kagan *et al*, (1964) hypothesized that differences in the evaluative and visual analysis responses of the subject seemed likely variables. Both of these hypotheses held up under test: a tendency to "reflect over alternative choices in a stimulus array" and a tendency to "analyze stimuli visually" contributed significant variance to the production of analytic concepts. Thus Kagan progressed from an initial concern with conceptual styles of classifying stimuli to an intensive study of the variables associated with these styles--principally the reflection-impulsivity variable.

Reflection-Impulsivity

Operational index. As already suggested, Kagan defines the disposition of reflection-impulsivity as the tendency to reflect over alternative solution possibilities in problems with high response uncertainty. The chief operational index of this variable is response latency in visual discrimination tasks requiring the subject to match a standard stimulus with an identical stimulus located in an array of highly similar variants. Scores on any of three related tests serve as measures of reflection-impulsivity. These tests are: the Design Recall Test (DRT), the Matching Familiar Figures test (MFF) and a Haptic Visual Matching test (HVM). The Haptic Visual Matching test differs slightly from the others in that it involves two sense modalities--touch and vision.

Developmental trends. Performance on tests of reflection-impulsivity, administered to large numbers of elementary school children, indicated a gradual decrease in errors and an increase in response latency with age (Kagan, 1965a). Kagan (1966a) suggested that the habit of reflection grows rapidly between the ages of five and ten and is of central importance to cognition. He believes that evaluation (that is, a tendency to reflect) touches the problem solving process at three vital points: (1) in considering the validity of the initial coding, (2) in assessing the validity of hypotheses that are competing for expression, and (3) in assessing the appropriateness of the hypothesis selected.

The stability of the evaluative disposition is demonstrated in studies with school children extending over a year, and the generality of the dimension is revealed by reflective and impulsive tendencies in situations other than discrimination tasks (Kagan, 1965a).

Correlates of reflection. Kagan (1965a) reported a connection between reflection-impulsivity in ten-year-olds and the early behavior patterns of these children. The life histories of a number of ten-year-old reflective and impulsive children revealed that children who were rated impulsive at age ten were also more hyperactive, impulsive, and had lower standards of task mastery at four years of age than did a comparable group of reflectives.

The tendency to show fast or slow decision times on tests of reflection-impulsivity did not seem to be related to verbal ability as measured by verbal subtests of the WISC (Kagan _et al_, 1964). Children rated impulsive, however, were observed to make more errors in word recognition tasks and in reading tasks than did reflectives (Kagan, 1965b). Primary grade children who were rated impulsive from scores obtained on the MFF test made more errors while reading aloud from selected passages than did a comparable group of reflectives. Moreover, reading errors at the end of grade two were still significantly related to the index of reflection obtained in grade one (Kagan, 1965b). One of the more common errors made in reading was the tendency to insert words of similar structure for the words actually present. Kagan believes that one reason for the more numerous errors of impulsives is insufficient reflection on the validity of their hypotheses.

Origins of reflection-impulsivity. Some correlates of the reflection dimension are present so early that it is difficult to relate differences in decision speed to any particular early experiences of the child (Kagan, 1966b). Kagan's speculations as to the origin of the dimension have ranged variously from subtle cerebral insult (Kagan _et al_, 1964) to differences in risk orientation (Kagan, 1965a) to his current view of a conflict between cultural values (Kagan, 1966b). He believes that a child's tendency to be reflective or impulsive (in tasks having response uncertainty) is a function of the balance between two cultural standards: "get the answer quickly" versus "don't make a mistake." The interaction between the positive value of quick success and the anxiety generated by the possibility of making errors determines the child's decision time. If a child's anxiety over making errors is stronger than his desire for quick success, he will be reflective. If, on the other hand, his anxiety over making errors is low in comparison with his desire for quick success, then he will be an impulsive child (Kagan, 1966b).

Whatever the origin of the dimension, the educational process confronts children with a large number of tasks that involve evaluation before responding, hence it is important to have more knowledge of the origins and characteristics of the reflection-impulsivity variable introduced by Kagan and his co-workers.

The present study. Before beginning to talk of changing the child's evaluative style (Kagan, 1966c) or trying to relate this style to physical, physiological, or personality characteristics (Kagan, 1965a; Kagan, 1966a; Kagan, 1966b), Witkin's (1963) advice should be borne in mind. He cautioned against the prevalent tendency to establish individual differences in performance in one situation and then attempt to link a wide array of other characteristics to these individual differences. The nature of the reflection-impulsivity variable is not yet sufficiently explored to permit a clear interpretation of individual differences in performance. The present study focuses on some of the variables associated with reflection-impulsivity.

CHAPTER II

REVIEW OF RELATED LITERATURE

Kagan and his co-workers deserve credit for reasserting the notion that much can be discovered about the learning process from a careful examination of a subject's responses in place of merely recording responses as correct or incorrect. The reflection-impulsivity dimension was discovered through a careful analysis of response latency, mainly working with children. The dimension seemed so different from other response styles current in the literature that Kagan *et al*, (1964) could not relate it to the mainstream of psychological theory.

Vicarious Trial and Error

A close look at the psychological literature, however, reveals a variable that bears many similarities to Kagan's reflection-impulsivity variable. According to Woodworth and Schlosberg (1954), Lashley, as early as 1912, observed that a response to a problem involving a decision--made after hesitation--was more likely to be correct. Other early experimenters made similar observations and concluded that hesitation seemed to play a part in finding a dependable cue (Woodworth and Schlosberg, 1954). Accordingly, Muenzinger (1938) named this hesitant behavior "vicarious trial and error" or VTE for short. Throughout this paper a number of terms are used synonymously with VTE. These terms are: VTE behavior, VTEs, and VTEing.

VTE behavior refers to the vacillatory behavior of subjects in situations requiring a choice between alternatives. Initially, the VTE label was used to identify the choice point behavior of rats in discrimination boxes, mazes, and in visual discrimination studies employing jumping stands. Later, the label was extended to hesitant behavior in a wide variety of situations--including conditioning, reasoning, conflict, and even non-choice situations. Subjects other than rats were included in the studies: dogs, monkeys, children, and adults (Goss and Wischner, 1956).

VTE behavior has been variously described as "looking to the right and left before making a choice," "head movements," "looking and preparing to move" and the like. By counting the shifts in each trial before the moment of decision, and by counting the trials showing shifts, Muenzinger made vicarious trial and error into a definite response variable for the experimenter's use (Woodworth and Schlosberg, 1954).

Goss and Wischner (1956) reported that, on a theoretical level, VTE has been variously interpreted as: a behavioral definition of consciousness, a catalytic process which aids learning, a form of symbolic exploration, overt thinking, a behavioral index of conflict and a preparatory response. Berlyne (1960) believes that VTE qualifies as orienting behavior and is evoked by a situation that can be expected to induce conflict (competing responses).

Criteria of VTE behavior. No standard set of criteria have been developed and used consistently with VTE. This situation limits any attempt to evaluate and interpret empirical findings (Goss and Wischner, 1956). The most common scoring criteria used can be designated as VTE units and VTE trials. The VTE unit is defined as behavior which involves either, (1) looking at one side or card and then turning toward and looking at the other side or card before making a choice, or (2) looking at one card, then looking at the other card, and finally returning to the first card before making a choice. The former pattern is designated as the AB unit; the latter as the ABA unit. The VTE trial is defined as any trial during which one or more VTE units were recorded (Goss and Wischner, 1956, p. 36).

VTE and errors in learning. Tolman was one of the most persistent and systematic investigators of VTE behavior. Part of his interest in the area seems to have stemmed from his belief that VTEing leads to greater learning efficiency. Tolman (1938) advanced the generalization that there was a negative relationship between VTEing and errors in discrimination learning, but a positive relationship between VTEing and errors in maze learning. Goss and Wischner (1956), in a review of the literature, suggested that there were data which contradicted or were not completely consistent with Tolman's generalizations. They believed that the nature of the VTE-error relationship in discrimination tasks depended upon experimental conditions to a greater extent than Tolman seemed aware of.

Variables influencing VTE. A number of variables have been observed to influence VTEing in various learning situations. One of the more extensively investigated of these is the similarity of stimuli-to-be-discriminated. On the basis of animal studies, Tolman (1939) concluded that the less similar the stimuli-to-be-discriminated the more frequent the VTEing. Tolman (1941), however, referred to unpublished observations that similarity had the opposite effect in humans; the greater the similarity of stimuli the more frequent the VTEing. These observations of Tolman have been confirmed by Phillips (1957). The suggested reason for the apparent species difference is that animals first had to learn what to do, or to "discover the instructions" that can be readily communicated to humans before commencing the task. There is some evidence to support this suggestion in that after the animals learn what to do in the task, the relationship between VTE frequency and similarity of the stimuli assumes the direct relationship observed with humans (Goss and Wischner, 1956).

The effect of absolutely indiscriminable stimuli on VTE frequency has not been clearly established. One investigator found that for absolutely indiscriminable stimuli the animal seemed to lessen its efforts to discriminate and tended to respond without hesitation. This would suggest a curvilinear relationship between similarity and VTE frequency, with fewer VTEs for both easy and absolutely impossible discriminations (Goss and Wischner, 1956). Kluver (1933) observed that monkeys did one of two things in a weight discrimination task as the difference between weights was decreased: they either abolished the comparison behavior altogether or they increased the number of comparisons. Phillips (1957), working with humans, observed that weight comparisons increased as judgments became more difficult. The differences in findings probably reflect differences in experimental conditions; for example, the number of very difficult comparisons presented to the subjects. It is understandable that there would be a wide variation in responses as the stimuli to be discriminated were made more alike; this was precisely the technique used by Pavlov to induce "experimental neurosis" in animals.

The angular separation between visual stimuli was a variable that influenced the frequency of VTEs among animals. An angular separation of 30, 80, and 130 degrees was inversely related to VTE frequency in a black-white discrimination task (Tolman, 1951). The longer choice times of the widely separated stimuli were explained on the basis of a tendency for the animals to forget the alternative stimulus.

The particular sensory modality used was found to have a bearing on the frequency of comparisons or VTEs; VTEing was more frequent for visual stimuli than for auditory or weight stimuli (Kluver, 1933; Tolman, 1938). The type of visual form used as stimuli was also related to the frequency of VTEs in monkeys. Greater hesitation and more comparisons were observed with triangles and crosses than with squares, circles, or irregular forms (Kluver, 1933).

Motivation and conflict are also variables that influence VTE. Schlosberg and Solomon (1943) advanced the notion that VTE increases as a function of conditions which strengthen a tendency not to respond. Punishment is such a condition. Muenzinger (1938) and Wischner (1947) found that the VTE frequency of animals given shock for the correct response was higher than that for animals receiving shock for wrong responses and for animals receiving no shock. Moreover, the relationship between VTEs and errors assumed a positive form where shock was present. Only for the no-shock group did the data clearly indicate the inverse relationship between VTEs and errors which has been stressed in Tolman's writings (Goss and Wischner, 1956). Since punishment presumably induces fear or anxiety, it seems reasonable to conclude that VTE frequency changes with variations in drive strength.

How does punishment, in the form of shock, facilitate the learning of a discrimination? Fowler and Wischner (1965) believe that shock operates in two ways: (1) through its cue properties, and (2) through its aversive properties. These investigators suggest that the shock experience may serve to make the stimuli more distinctive thereby providing a cue effect that is very useful when the stimuli to be discriminated are highly similar. The enhanced distinctiveness of the stimuli serves to reduce the generalized tendency to respond to the incorrect stimulus thus reducing errors. When the stimuli to be discriminated are quite dissimilar, the cue effect of shock should be relatively small--perhaps even obscured by the aversive properties of the shock. Soviet investigators introduce the concepts of orienting and defence reflexes to explain variations in discrimination learning that accompany variations in the intensity of aversive stimuli (Sokolov, 1963). There seems to be a scarcity of evidence on the effects of non-aversive drives on VTE.

VTE behavior decreases as the type of conflict shifts from avoidance-avoidance to approach-approach. Barker (1942) studied the preference of children for one of two liquids. He observed that the more equal the preference for any two liquids, the greater the amount of VTE behavior. The VTE frequency tended to be highest when the choice was between pairs of non-preferred liquids. Brown (1942) made a similar observation on animals: more head movements were associated with an avoidance-avoidance conflict than with double approach-avoidance or approach-approach conflicts. The earlier view that conflict, generated by aversive stimuli, was largely responsible for VTE behavior was later enlarged to include uncertainty and competing responses as the principal variables underlying VTE (Woodworth and Schlosberg, 1954; Berlyne, 1960).

Other variables found to influence VTE were cortical lesions and type of pre-experimental experience. Normal animals made fewer errors and more VTEs in learning to run a simple maze than animals with a moderate amount of cortical lesion (Tolman, 1938). Cage-rearing was observed to be one kind of previous experience that governed hesitation, freezing and VTEing at the choice points in animals learning to run a maze (Christie, 1951).

VTE and learning efficiency. The hypothesized relationship between VTE and learning efficiency (Tolman, 1938; Muenzinger, 1938) received most of its support from the observation that as the learning criterion was approached VTEs increased and errors decreased. Supplementary evidence from the same studies suggested that groups of animals which VTEed more frequently also learned more rapidly (Goss and Wischner, 1956). The latter investigators, however, reported inconsistencies in the empirical data and the possibility of different interpretations of the evidence. They questioned the general hypothesis that VTEing *per se* aids learning, even in discrimination situations. Instead, they preferred to interpret the various VTE and error relationships, observed in animal studies, as dependent on a combination of conflict and position preferences. The suggestion was that any conditions such as jumping stand, hard discriminations, or large angles between the discriminanda, which are likely to induce strong position preferences, will also be marked by initial periods of infrequent VTEing. Then, as animals begin to respond to the positive stimulus with greater than chance frequency, VTEs become probable when the negative stimulus is on the preferred-position side (Goss and Wischner, 1956, p. 51).

Tolman (1959), however, reasserted his belief that VTE behavior involves an exploratory scanning performance that facilitates discrimination. He reported that exploratory scanning, which accompanies VTEing, reduced a relatively grossly perceived immediate stimulus to the same stimulus perceived and discriminated more precisely. He noted that shortly after VTEs have begun, the organism was able to make better than chance responses to the correct visual stimulus. Support for Tolman's hypothesis comes from evidence that more difficult discriminations occasion more numerous and more prolonged orienting responses. Phillips (1957) observed that when subjects were permitted to lift weights as often as they wished in a weight discrimination task, they lifted the weights more often when they were more nearly equal. Berlyne (1960) cited further evidence from Ving Bang to the effect that when subjects were asked to state which of two lines were longer, the time taken by filmed eye movements was greater when the difference between the lines was smaller. Moreover, Soviet investigators have demonstrated that when stimuli are given signal value through verbal instructions, the sensitivity of the receptors is increased and orienting responses (head-eye movements) commence in order to facilitate maximum information input from the stimuli (Sokolov, 1963).

<u>VTE and reflection-impulsivity</u>. Kagan's dimension bears a close resemblance to VTE behavior. He noted a very high relationship (r = .91) between the number of head-eye fixations of the standard stimulus and mean response time on the MFF test (Kagan, 1965b). The head-eye fixations were observed to follow a cyclical rhythm, averaging three to four seconds, and this rhythm seemed relatively constant for both sexes in grades one, two, three, and four. The upshot of his observation is that the longer response times of reflective subjects are accompanied by a higher VTE frequency and lower error scores, whereas the shorter response latency of impulsive subjects is accompanied by fewer VTEs and more errors. This is precisely the observation made by numerous VTE investigators: VTE frequency is inversely related to the number of errors in tasks that do not involve the use of strong aversive reinforcers (Goss and Wischner, 1956).

Without any theory to guide him, Kagan (1965b) did not pursue the interesting relationship he had observed between head-eye fixations, response latency and error scores. Rather, he interpreted the findings to mean that subjects with long response latencies were actively considering alternative responses during the delay period and not just sitting idle. Evidence accumulated by VTE investigators would indicate that the head-eye fixations (VTEs) observed by Kagan are not as stable and unvarying a response as he seems to believe. For example, VTE studies found that the similarity of the stimuli-to-be-discriminated could alter VTE frequency.

Several advantages could be gained by incorporating the behavior associated with reflection-impulsivity into the VTE model. The first of these is the parsimony that comes from drawing two different experimental strands into a common thread. Kagan et al, (1964) reported an inability to relate their dimension to the mainstream of psychology. The VTE model seems to provide a connecting link. Moreover, the findings in one area suggest, extend, and complement studies in the other. For example, evidence collected by VTE studies suggest that changes can be induced in reflective and impulsive response styles by a number of variables that Kagan has not yet reported. On the other hand, Kagan's discovery of individual differences in evaluative response style is a finding that received little attention in the VTE literature. The usefulness of the VTE model, however, appears to be diminished by developments in Soviet psychology that incorporate the VTE model.

The Orientation Reaction

Orienting behavior has been recognized by Russian experimenters as a worthwhile topic for research ever since Pavlov turned his attention to it (Berlyne, 1960, p. 81). Sokolov (1963) has been one of the principal Soviet investigators in this area; his synthesis of Soviet studies has yielded the major conclusion that outwardly visible orienting behavior--changes in posture and receptor adjustments--forms part of a constellation of physiological processes permeating the entire organism, that can be elicited by the onset, termination, intensification, weakening, or modification in any way of any kind of stimulation (Berlyne, 1960, p. 81). The orientation reaction manifests itself as changes in sense organs, changes in the central nervous system, changes in the muscles that direct sense organs, changes in general muscle tone and vegetative changes. The latter include variations in the size of blood vessels in the limbs and head, an increase in electrical conductivity of the palm (measured by GSR), variations in heart rate and changes in breathing.

The function of the orientation reaction is reported to be that of facilitating the reception of stimuli, and consequently, facilitating learning itself. The numerous physiological changes that accompany the orientation reaction aid in the swift appraisal of events and prepare the organism for a rapid response. The whole receptor equipment of the organism is sensitized. For example, Sokolov (1963) reports experiments in which the absolute threshold for light intensity can be lowered by the introduction of a sound stimulus. Similarly, the auditory threshold falls in response to light stimuli that evoke eye movements. This increase in sensitivity is observed to coincide with the occurrence of the orientation reaction and is characteristic of all sensory receptors. Furthermore, the observing responses (for example, head-eye movements) that accompany the orientation reaction provide access to new sources of information. The turning of the head in the direction of a sound enables the eyes to pick up visual stimuli from the sound source as well as to pinpoint the location of the sound (Berlyne, 1960).

Characteristics of the orientation reaction. Sokolov (1963) makes a distinction between generalized and local orientation reactions. Any perceptible change in a stimulus immediately evokes a generalized orientation reaction which alerts the total sensory equipment of the organism. All of the components, previously mentioned, accompany the generalized orientation reaction: peripheral vasoconstriction, respiratory arrest, inhibition of general movements, dilation of the pupil, variations in EEG and GSR and the like. As the change is repeated, however, the alertness of the total organism diminishes until the initial reaction is localized in specific sensory receptors to which the stimulus applies. The chief feature of local orientation reactions is that they are limited to specific senses and they introduce adjustments in the receptors of these organs as stimulation continues. Local orientation reactions are more commonly known as adaptation responses and can be observed in the contraction of the pupil to light stimulation (Sokolov, 1963).

Habituation is a hallmark of the orientation reaction. The latter gradually extinguishes if the eliciting stimulus is repeated at intervals of a few seconds or minutes. The resistance to extinction is increased if the stimulus has signal value. That is, if the stimulus is a signal for some important event, such as reinforcement, to follow. Stimuli may be given signal significance through association with reinforcers such as food or shock; but with people, verbal instructions are an alternative means of imparting signal value to a stimulus (Sokolov, 1963).

In the initial stages of conditioning, the orientation reaction develops to stimuli similar to the signal stimulus. The greater the difference, the smaller the reaction. As conditioning proceeds, there is a gradual elimination of a number of the components of the orientation reaction and a narrowing of the range of stimuli that evoke it. In the case of coarse differentiation between two stimuli, the orientation reaction extinguishes readily; first to the negative stimulus, then to the positive stimulus. When differentiation is difficult, however, the attempts at discrimination lead to an intensification of the orientation reaction to both stimuli. Associated with the intensified orientation reaction is an increase in the latency of response and an increase in errors in some subjects (Sokolov, 1963). It is interesting to note the parallel between the observations of Sokolov and those of VTE investigators. An increase in discrimination difficulty was accompanied by an increase in the orientation reaction in one case and by an increase in VTE frequency in the other. This is not surprising when one considers that VTE behavior qualifies as orienting behavior (Berlyne, 1960).

An intensification of the orientation reaction during discrimination learning seems to have beneficial effects. The orientation reaction appears during the initial phase of discrimination between similar stimuli and inhibits response. The value of this temporary inhibition lies in the fact that it provides a short interval for more exact evaluation of those stimuli that are difficult to differentiate (Sokolov, 1963).

On the other hand, an intensification of the orientation reaction, after conditioning has commenced, seems to retard the formation of the conditioned response. The usual conditioning pattern involves a progressive extinction of the generalized orientation reaction and a stabilization of the local or adaptive orientation reaction. Any stimulus that reactivates the orientation reaction will interfere with conditioning. Sokolov (1963) indicates that an extraneous stimulus intensifies the orientation reaction and leads to a complete inhibition of the conditioned response; there is also a temporary suspension in responsiveness to the signal stimulus and a decrease in the effectiveness of the conditioned stimulus following the introduction of an extraneous stimulus.

Sokolov (1963) revealed evidence of the facilitating effect of the orientation reaction on learning. He noted that in an experiment where the orientation reaction was present, a conditioned connection was established in two or three pairings of the conditioned stimulus with a verbal reinforcer. When the orientation reaction to the conditioned stimulus had first been extinguished, however, the formation of a conditioned response was interfered with. A conditioned connection was not formed despite more than sixty pairings of conditioned stimulus and reinforcement.

The orientation reaction and arousal. Investigators noted than when a stimulus elicited an orientation reaction, the sensitivity of the receptor lasted well beyond the usual orientation reaction to the stimulus. This observation suggested the existence of a slow orientation reaction in addition to the usual rapid reaction. Sokolov (1963) introduced the terms "tonic" and "phasic" to distinguish the two reactions. The phasic orientation reaction is observed as a number of rapid changes following any modification in the stimulus. The GSR exemplifies the phasic reaction. The tonic orientation reaction, on the other hand, consists of slow changes in arousal that persist for a longer time. The two reactions are intimately related, for the form of the phasic reaction varies with the level of the tonic reaction. Berlyne (1960) suggests that the tonic reaction constitutes a long term shift in the level of arousal whereas the phasic reaction amounts to a fleeting jump. The one is related to the other as the tide is related to a wave.

The orienting reaction and orienting response. The expression "orientation reaction" is currently used in both

Eastern European and Western countries to refer to all the changes that regularly ensue when the prevailing stimulus situation is varied (Berlyne, 1960, p. 95). Some of these changes clearly modify incoming stimulation and augment its yield of transmitted information. But other changes do not seem to be directly concerned with receptivity at all. They seem rather to consist of processes that are useful in quite different ways, for example, by increasing the influx of information from a stimulus that calls for close scrutiny (Berlyne, 1960, p. 95). In keeping with Berlyne, the term "orienting response" is assigned to processes that focus, direct, or sensitize receptor organs and thus have an unmistakable exploratory function. Included in this term are responses that orient receptors by changing posture as well as any vegetative changes that elevate sensitivity.

Whereas some orienting responses, embodied in the orientation reaction, serve to heighten attention, other orienting responses have a stimulus selecting function. The latter responses increase or introduce information from one source at the expense of information from other sources (Berlyne, 1960, p. 95). The head-eye fixations, which are so characteristic of VTE behavior, are equivalent to the orienting responses which have a stimulus selecting function.

The question arises: What factors direct the selective orienting responses toward one stimulus object rather than another? Berlyne (1960) suggests that while the experimental evidence is lamentably inadequate, the following factors seem to be important in orienting the organism toward one stimulus rather than another: intensity, color, novelty, verbal instructions, or other indicating stimuli, surprisingness, complexity, uncertainty, incongruity, and conflict.

Adaptive and Defensive Reactions

Stimuli which elicit the orientation reaction also elicit other reactions in the organism that resemble the orientation reaction in some respects and differ from it in other respects. These reactions are called adaptive and defensive reactions in line with Pavlov's terminology. Whereas the orientation reaction has a sensitizing and excitatory effect on the organism, the adaptive reaction serves to desensitize or diminish the effects of stimulation. Among the more common adaptive reactions are pupil constriction and dilation following changes in light intensity, dilation and constriction of blood vessels with changes in temperature, and chemical changes in the retina accompanying dark adaptation. In contrast with the more general orientation reaction, adaptive responses are confined to the local sense modality stimulated and they do not show extinction which is one of the chief characteristics of the orientation reaction.

Defensive reactions resemble both the orientation and adaptive reactions in some respects. Defensive reactions serve to diminish the effects of a stimulus; in this respect they resemble adaptive reactions. High intensity, generally painful, stimuli elicit the defensive reaction and produce a widespread system of responses in the organism; in this respect the defensive reaction resembles the orientation reaction. Defensive reactions consist of such responses as blinking in response to stimulation of the eye, constriction of blood vessels and intensification of breathing that accompany intense stimuli, and withdrawal reactions from noxious stimuli.

The orientation and defensive reactions interact as stimulus intensity is varied. Stimuli below threshold level evoke neither reaction. With an increase in stimulus intensity above threshold level, orientation reactions are elicited. A further increase in intensity, beyond a given point, leads to orientation reactions during the first few appearances of the stimulus and then the defensive reaction appears. As intensity of stimulation is increased even further, the defensive reaction appears closer and closer to the onset of the stimulus until finally, the defensive reaction is evident on the first presentation--without any evidence of the orientation reaction at all (Sokolov, 1963).

Related to the elicitation of the defensive reaction is increased responsivity to noxious stimuli and reduced responsiveness to neutral stimuli. Maltzman (1967) suggests that differences in the strength of one or the other reaction would result in a great many different effects in normal and pathological behavior.

Startle, Arousal, Drive, and the Orientation Reaction

It might be argued that the orientation reaction is merely another term for the more familiar startle, arousal, and drive reactions. What are the differences? The startle reaction is specific to the appearance of an intensive sudden stimulus. By contrast, the orientation reaction is elicited by any modification in stimulation. The omission of an expected stimulus is sufficient to elicit the orientation reaction. Intensity is not a prerequisite for reaction as is the case with the startle reaction. Moreover, the startle reaction is more likely to elicit a defensive reaction than an orientation reaction (Maltzman, 1967).

The relationship between the orientation reaction and arousal is more complex. Arousal is considered by many to be a drive concept, but Maltzman (1967) reported that groups of subjects, differentiated on the basis of tonic orientation reactions (arousal), do not show differential responsiveness to critical stimuli whereas the same subjects, differentiated on the basis of the phasic orientation reaction (GSR), show differences in responsivity to critical stimuli. The phasic orientation reaction seems to be relatively selective; the tonic orientation is not.

If the orientation reaction is a form of emotionally based drive, Maltzman (1967) reasoned that there should be an interaction between the level of orientation reaction and task difficulty. Taylor and Spence (1952), among others, had demonstrated an interaction between scores on the Manifest Anxiety Test and task difficulty. Maltzman (1967) cited evidence to indicate that males with a high level of orientation reaction did better than males with low reaction levels on both easy and difficult tasks. This would seem to support an interpretation in terms of orientation reaction rather than a drive interpretation. However, females with high and low reaction levels showed no differences on the easy and difficult tasks. There seems to be no adequate explanation for the sex differences at present. Sex may be a main effect, an interaction with the experimenter or both (Maltzman, 1967).

Further evidence indicated that individual differences in the orientation reaction do not function in the same manner as emotionally based drive. By varying the instructions given to two groups of subjects in a semantic conditioning experiment, one experimenter varied the rate of conditioning of the groups. In each group, subjects with high orientation reactions were superior to those with low reactions. There was no interaction between OR level and type of instruction. When these subjects were classified on the basis of scores on the Taylor Manifest Anxiety test (MAS), however, a significant interaction was obtained between anxiety level and type of instruction given. Maltzman (1967) reasoned that if the orientation reaction was a form of emotionally based drive there should be an interaction between level of OR and type of instruction similar to that observed between MAS scores and type of instruction given.

<u>Individual Differences in Orientation Reaction</u>

As Maltzman (1967, p. 97) suggested, a variable such as the orientation reaction which facilitates the reception of stimuli and learning must be of fundamental importance to behavior. Stable individual differences in this variable could have widespread consequences for learning and perception. Maltzman (1967) reported a series of experiments which indicate that there are stable differences in orientation reaction. He presented a list of pre-recorded words by way of earphones to subjects who had become habituated to the testing situation. The first word on the list was presented after a period of silence so that it constituted a radical change in stimulation that elicited the orientation reaction. The latter reaction was then extinguished so that after the presentation of about twenty-five words there was only a barely perceptible reaction to any word. A distribution of GSR's to the first word was drawn up. Subjects scoring above the median on GSR magnitude were classified as high orienters and those scoring below the median were classified as low orienters. The two groups were further assessed on measures of conditioning, generalization, and extinction. Initial difference in orientation reaction to the first word of the list, which formed the basis for classifying the groups, was maintained through all phases of the experiment (Maltzman, 1967).

CHAPTER III

THEORETICAL FORMULATION AND HYPOTHESES

Reflective-Impulsive Response Styles and the Autonomic Orienting Response (OR)

It was noted previously that VTE behavior could be classified as an orienting response (Berlyne, 1960). Furthermore, it was shown that Kagan's reflection-impulsivity dimension could be equated with VTE behavior. It seems reasonable, therefore, to include Kagan's dimension within the framework of the orientation reaction.

Using the orientation reaction frame of reference, VTE behavior can be classified either as an orienting response (Berlyne, 1960) or as an instrumental observing response (Maltzman, 1967). The orientation reaction can be viewed as a composite of physiological and instrumental responses. Much of the Soviet experimentation minimizes the role of orienting responses and stresses the physiological aspects of the orientation reaction. This is partly a result of the stimuli the Soviet investigators select for their experimentation (that is, light and sound). A complete account of the conditions of the organism that influence the reception and discrimination of stimuli requires the consideration of instrumental as well as physiological components of the orientation reaction. In many situations, individual differences in instrumental observing responses assume considerable importance. For example, visual discrimination tasks typically require appropriate head-eye movements for the efficient reception of relevant stimuli (Maltzman, 1967, p. 109).

Kagan and his co-workers have been skirting the orientation reaction in a number of studies, but they have not yet attempted to fit their empirical findings into any theoretical framework. The close relationship observed between head-eye movements, response latency and errors of reflectives and impulsives fits nicely into the orientation reaction framework if head-eye movements are considered as instrumental orienting responses--a component of the more general orientation reaction (Berlyne, 1960; Maltzman, 1967). In other studies, Kagan and his co-workers have used GSR, respiration and heart measures of response that are more appropriately classified as physiological components of the orientation reaction. These latter studies have reported a significant relationship between the analytic responses of men on a figure sorting task and frequency of spontaneous GSR at rest. Also, the production of analytic responses was associated with accurate detection on a perceptual vigilance task (Kagan et al, 1963). Furthermore, analytic boys were reported to show more regularity in their breathing during a task in which they were required to attend to a series of stimuli-interspersed with rest periods. The relationship between analytic concept responses and respiratory variability was highest during the presentation of the first stimulus. The initial differences in variability between analytic and non-analytic boys then gradually receded until they disappeared at about the eighth stimulus presentation. The investigators concluded that the differences in respiratory variability between analytics and non-analytics stemmed from differences in restlessness and attention of the two groups (Kagan and Rosman, 1964).

The accumulated evidence seems to take on a good deal of meaning when it is interpreted within the framework of the orientation reaction. The latter concept can be viewed as a measure of an individual's alertness, sensitivity, or attention (Berlyne, 1960; Maltzman, 1967). Thus reflectives and impulsives, who are reported to differ in attention to stimuli, should also manifest differences in orientation reaction to stimulus change. This hypothesis seems to be reasonable in view of the differences in respiration reported for analytic and non-analytic subjects during a task that required attention to stimulus change (Kagan and Rosman, 1964). Boys who grouped familiar objects together on the basis of an objective attribute that was a differentiated part of the total stimulus (called an analytic concept) showed autonomic patterns characteristic of greater attention than boys who preferred other conceptual categories. The observation becomes even more suggestive when it is noted that analytic subjects are also the more reflective subjects and that a change in respiration is one of the measures of the autonomic orienting response (OR). If the hypothesis is supported, it seems likely that there are further differences on a number of variables basic to the learning process (Maltzman, 1967).

<u>Instrumental Observing Responses and the Autonomic Orienting Response (OR)</u>*

There is general agreement that instrumental observing responses, in the form of VTEs, are overt manifestations of the mobilization of the organism in reaction to stimulus change (Berlyne, 1960). Since there is very little empirical evidence to support this assumed connection, it seems important to determine the nature of the relationship that exists between these overt and covert responses. It is anticipated that reflective subjects, who demonstrate a higher frequency of observing responses on discrimination tasks (Kagan, 1965b), will also reveal a greater sensitivity to stimulus change. That is, there should be a significant correlation between a measure of the overt observing response, in the form of VTEs, and a measure of the covert physiological response, in the form of changes in GSR

*Throughout the remainder of the investigation, the term "orienting Response" is abbreviated to OR.

following stimulus change (that is, the OR).

Reflection-Impulsivity and Habituation of the OR

Maltzman (1967) has shown that there are wide individual differences in OR level and that this level is stable across tasks. There seems to be some difference of opinion, however, as to the relationship between the magnitude of the OR and the speed with which it habituates. Maltzman (1967) suggested that high and low orienters differ only when the initial conditions for an orienting reaction (that is, stimulus change) are present and for a relatively short time thereafter. Although he did not cite experimental evidence to support his suggestion, Maltzman implied that there should be no difference in the rate with which high and low orienters habituate to a novel stimulus. Soviet findings were not consistent on this point. Some studies (Lynn, 1966) reported that the size of the OR correlates well with the number of trials to extinguish the OR, but other studies did not find this relationship to be significant.

Luria and Vinogradova (1963, p. 100) have shown that the appearance of a "good" OR to one stimulus plays a vital role in eliminating interference from other distracting stimuli.

> A child who is concentrating his attention on the solution of a problem ceases to hear incidental stimuli. He does not react to the squeak of the door or to the noise outside the window. Stimuli which are not

> relevant to the problem with which he is occupied do not get through to him.

Other Soviet investigators have attempted to relate the inattention and distractibility of mentally retarded children to abnormalities in the OR (Lynn, 1966). Stimuli which always evoke the OR in normal children are not accompanied by the OR in retarded children. Where ORs do occur, they show a low resistance to extinction.

> If the extinction of the OR begins in normal children after ten to twelve repetitions of the stimulus, it occurs after one or two stimulus presentations in severely retarded children. (Luria and Vinogradova, 1963, p. 103).

Since the OR is frequently equated with attention (Berlyne, 1960; Maltzman, 1967), it seems possible that the differences in distractibility, attention, and concentration observed in reflective and impulsive children (Kagan _et al_, 1964; Kagan and Rosman, 1964), have their origin in different habituation rates of the OR. Thus, it is hypothesized that reflective children require more trials to extinguish the OR to a repeated stimulus than do a comparable group of impulsive children.

Reflection-Impulsivity and Conditioning

Other important variables found to be related to OR level are: conditioning, extinction, and stimulus generalization (Maltzman and Raskin, 1965; Maltzman, 1967; Lynn, 1966). The size of the OR has been found to be related to the speed with which a subject forms conditioned motor responses (Lynn, 1966) and in the speed of semantic conditioning (Maltzman, 1967). When one considers that conditioning forms the basis of several theories of discrimination learning (Skinner, 1954; Spence, 1956), that VTEs and other observing responses are considered to be classically conditioned responses (Perkins, 1955; Wehling and Prokasy, 1962), and that reflective and impulsive children differ widely in VTEing and performance on discrimination tasks, it seemed highly probable that reflective and impulsive children would also differ in the degree of conditioning they manifest.

To those who wonder what such elementary processes as the OR, conditioning, extinction, and habituation have to do with a dimension of behavior that is generally regarded to be a cognitive style, Jensen (1967, p. 147) provides an appropriate defence. He states that:

> When we think of individual differences (IDs) in learning we usually think of such extrinsic IDs as age, intelligence, motivation, personality, and so on. Extrinsic IDs are those which merely represent correlations with some measurable trait which does not bear any direct resemblance to learning, or its inferred processes.
>
> Intrinsic IDs, on the other hand, are those which exist in the processes of learning. In other words, not all variance due to IDs is extrinsic in the sense that the totality of the "between subjects" variance in a learning task can be accounted for in terms of variability in subject characteristics that lies outside the learning domain. Most of the variance in learning is not going to be accountable in terms of psychometric test scores, personality inventories, age, sex,

> and other extrinsic personality characteristics. Therefore we need to study IDs in the intrinsic processes of learning. . . . Even under the best of conditions, considerably less than half of the true ID variance in learning can be accounted for by extrinsic factors. . . . My greatest hope is that some of the main intrinsic factors that might be discovered in the realm of simpler forms of learning might be able to account for much of the variability we find in conceptual learning tasks.

Bearing this in mind, the aim of the present investigation was to examine a number of intrinsic variables that showed promise of being related to the response styles observed by Kagan and his associates.

Hypotheses

The current investigation was organized around a set of hypotheses that emerged from a review of the related research literature. Collected together these hypotheses may be stated as follows:

1. Reflective subjects manifest a higher autonomic orienting response (OR) to stimulus change than do impulsive subjects.

2. The magnitude of a subject's autonomic OR is related to his VTE frequency.

3. Reflective subjects require more trials to habituate the autonomic OR than do impulsive subjects.

4. Reflective subjects show a greater degree of conditioning than do impulsive subjects.

The hypotheses were tested in a series of four studies, one study being devoted to each hypothesis. The classification of the sample into reflective and impulsive categories is outlined in the report of Study One.

TABLE I

NUMBERS AND PROPORTIONS OF SUBJECTS
INCLUDED IN THE SAMPLE

	Pre-Classification Sample		Post-Classification Sample			
			Impulsives		Reflectives	
School	Number	Per Cent of Sample	Number	Per Cent of Sample	Number	Per Cent of Sample
A	24	18.4	3	9.4	5	15.6
B	27	20.4	5	15.6	7*	21.8
C	41	31.0	7*	21.8	12*	37.5
D	22	16.6	6	18.8	6	18.8
E	18	13.6	11*	34.4	2	6.3
Total	132	100.0	32	100.0	32	100.0

*The Post-Classification Sample in Table I has been drawn up on the basis of response latency. When both latency and errors on the MFF are used as the basis of classification (Kagan, 1966b), one subject has been removed from each of the groups noted with an asterisk. This reduces the total N to thirty subjects in each group.

CHAPTER IV

PROCEDURE, RESULTS, AND PRELIMINARY DISCUSSION

STUDY ONE

Selection and Classification of the Sample

The sample of subjects chosen for the study was selected from five Public Schools in Medicine Hat--a city in Southern Alberta with a population of twenty-five thousand (Table I). The Superintendent of Schools permitted a free hand in the selection of schools so that five schools were chosen to constitute a representative cross-section of the city insofar as socio-economic variables were concerned. School E (Table I) was situated in the lowest social status section of the city (on the basis of father's occupation); school D contained a large proportion of rural children who were transported to the city each day by school bus; schools B and C were situated in newer residential areas of the city, and school A was located in an older residential section of the city.

The initial sample consisted of all the grade six boys in the above schools. The sample was restricted to boys because of reported sex differences in GSR responsiveness during habituation trials (Montagu, 1963) and sex differences in conditioning (Spence and Spence, 1966). The only criteria for inclusion in the sample were sex (male) and grade level (six). Four subjects were dropped from the sample because of absence from school when the classification test (MFF) was being given.

Description of the MFF Test

Kagan's Matching Familiar Figures (MFF) test was used to classify the subjects into reflective and impulsive categories. The MFF test is basically a perceptual discrimination task containing fourteen pairs of stimulus cards. The dimensions of each card are $8\frac{1}{2}$ x 11 inches. Two pairs of cards are used for demonstration purposes and the remaining twelve pairs are test cards. Each pair of cards contains familiar stimuli in the form of line drawings (Appendix A). One card in each pair contains a single stimulus (the standard) which must be matched with the correct element in a set of six stimuli on the second card. There is no time limit on the test.

Procedure for Administering the MFF Test

Whereas Kagan (1965b) presented the MFF cards in a vertical fashion--one above the other--the MFF cards were presented in a horizontal manner for the children in this sample. The reason for preferring a horizontal presentation of the stimuli was that it conformed to the manner of presentation used in the VTE studies. The MFF cards were attached to a plywood stand by means of rings (Figure 1). The stand sloped away from the subject at an angle of sixty degrees from the vertical plane. The cards containing the standard stimulus were located on the left side of the board, ten inches from the stimulus card on the right. The centre of the board was located approximately two feet from the subject, a distance which forced him to turn his head as well as his eyes to match the stimuli. The experimenter sat on the left of the subject and slightly behind him in order to count the frequency of head-eye movements (VTEs) used in the process of matching the stimuli. Preliminary trials revealed that subjects were very conscious of being watched if they were observed from the front.

At the beginning of the test, the MFF cards were folded on rings at the rear of the plywood mount, out of the subject's view. When the test commenced, the examiner brought the cards forward for the subject, first the right card, then the left. After the two sample cards were administered, the subject was asked to turn over the next card on his right. The examiner then turned over the left card, containing the standard stimulus, immediately after the subject turned his card. The arrival of the standard stimulus always elicited the subject's attention and was the starting point for determining VTE frequency and the latency of his responses. Each subject was tested individually; the test lasted approximately twenty-five minutes. Instructions for the MFF test appear in Appendix B.

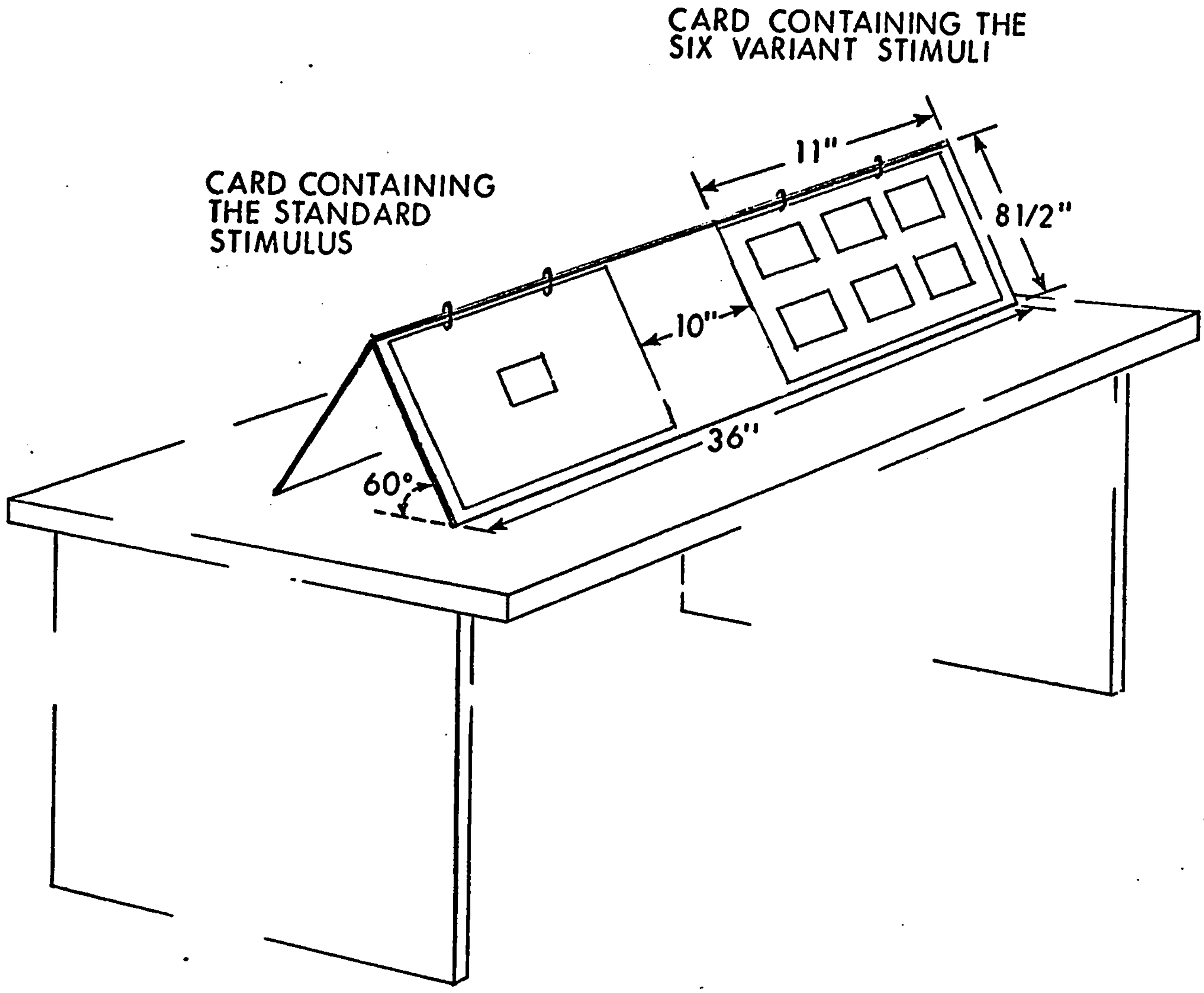


FIG. 1 Diagram of the Board on which the left and right MFF cards were displayed (not to scale).

Other Tests

The Otis (Form EM) test of mental ability and the Iowa Achievement Battery had been administered to all grade six boys in the schools approximately one month before they were tested on the MFF. The purpose of including the intelligence quotient score for each subject was to provide control over possible differences in mental ability between reflective and impulsive children, although Kagan et al (1964) reported there were no differences on this variable in their samples. The purpose of including scores from the Iowa Achievement Battery was to provide a check on the observation of Kagan (1966b). He noted a significant relationship between MFF scores of first grade children and errors in word recognition and reading skill. Since the present study was using older children as subjects, it seemed important to find out whether or not MFF performance was still related to performance on school type tasks at the grade six level.

Criteria for the VTE Response

A VTE response was defined as observing behavior that involved looking at one stimulus card and then turning and looking at the other stimulus card in the process of matching the stimuli. A VTE response occurred each time the subject moved his head and eyes from card A to B or from card B to A. The starting point for the first VTE count was the standard stimulus. The inter-rater reliability for two observers, independently counting VTEs, was determined on a separate sample of children. The reliability coefficient was 0.94, similar to that reported by Kagan (1965b).

<u>Classification of Reflective and Impulsive Subjects</u>

The subjects in the total sample were classified as impulsive or reflective on the basis of their mean latency and error scores on the MFF test (Kagan, 1966b). That is, the time taken for a subject to give his first response to each pair of stimulus cards constituted his latency score for that pair of cards. The mean response time required to react to the twelve pairs of test cards constituted the subject's latency score for the MFF test. A subject's error score included the total number of incorrect responses given during his attempt to match the twelve pairs of MFF stimuli correctly.

Following Kagan's (1966b) procedure, a distribution of the mean latency scores of the first response to each pair of MFF cards (Figure 2) and a distribution of the total error scores on the MFF task (Figure 3) were drawn up for the entire sample. The basis for classifying a subject as reflective or impulsive included both latency and error scores. A subject was classified as reflective if his latency score was <u>above</u> the median of the sample and his error score was <u>below</u> the median. A subject was classified as impulsive if his latency score was <u>below</u> the sample

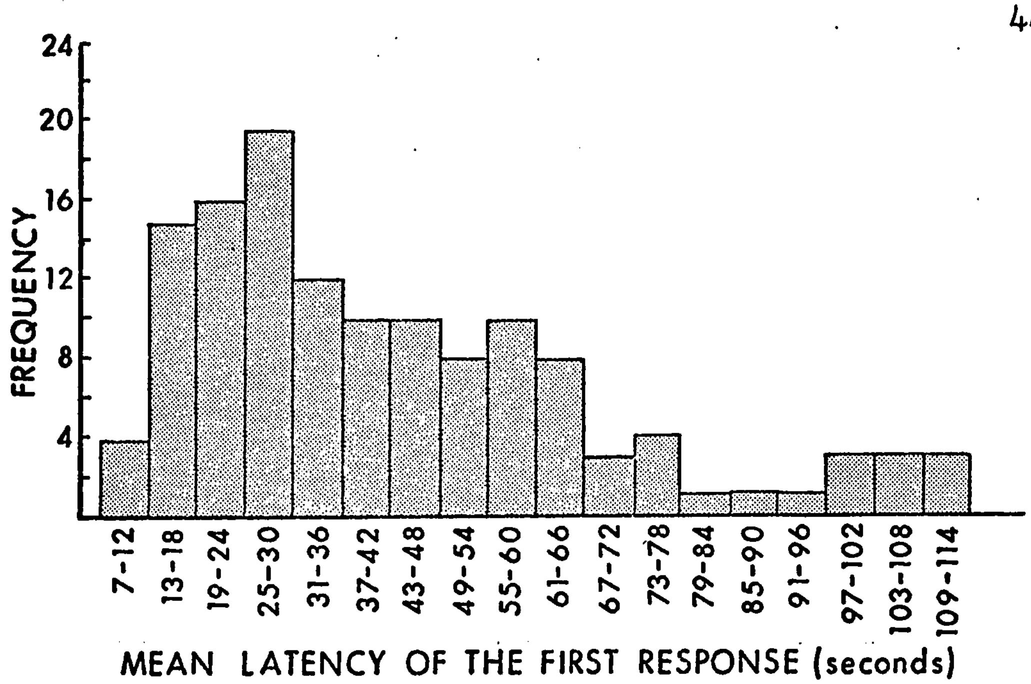


FIG. 2 Distribution of mean latency scores on the MFF test for the total sample (N = 132).

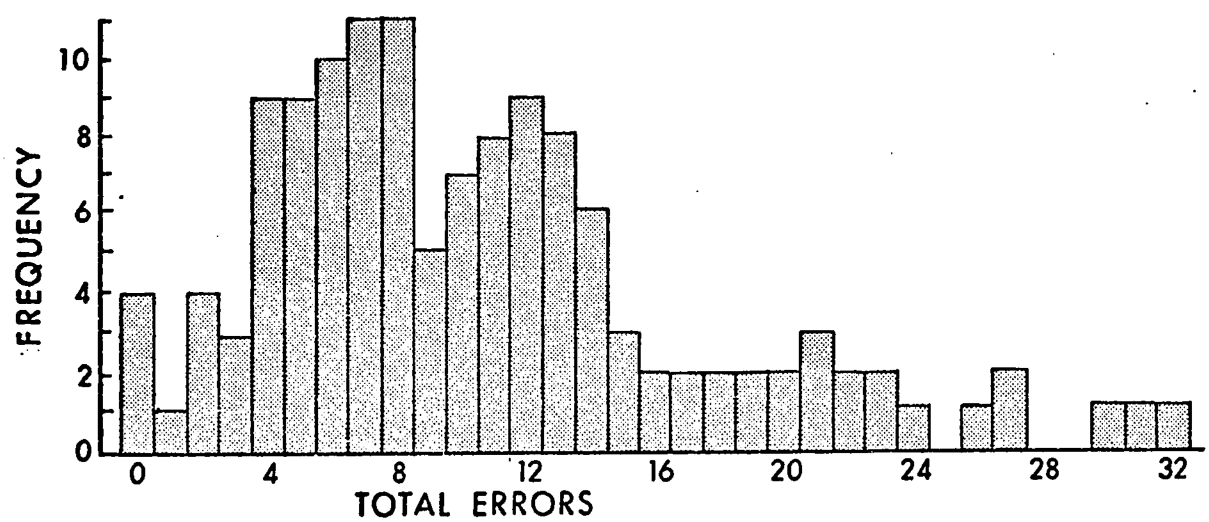


FIG. 3 A distribution of the errors on the MFF test for the complete sample (N = 132).

median and his error score was above the sample median. Subjects of "mixed" type (that is, scoring either high or low on both measures) were excluded from the sample.

Sixty of the most reflective and impulsive subjects (N = 30 for each group) were selected for more detailed study. The rationale for selecting thirty subjects for each group was simply that this number represented the upper and lower 25 per cent of the original sample, after the subjects of "mixed" classification were removed.

Hypothesis

The first hypothesis predicted that reflective subjects would display a higher orienting response (OR) to stimulus change than would a comparable group of impulsive subjects. The OR, which is essentially a ripple of arousal that permeates the organism, is reported to increase the sensitivity of the sensory receptors and heighten attention to stimuli, thereby expanding the inflow of information to central processes. It seemed quite probable, from a review of related studies, that a linkage existed between Kagan's dimension of reflection-impulsivity and the OR.

Selection of Subjects

The reflective and impulsive (N = 30 for each group) used in testing the above hypothesis were selected in the manner just described. Table II reveals that there was no significant difference in either the age or intelligence quotient scores of the two groups. Faults in the equipment led to the elimination of three subjects from one group and two from the other. For statistical purposes one subject was randomly removed from the latter group, leaving a total of twenty-seven subjects in each group.

Apparatus

A pure tone having an intensity of twenty-eight decibels (db) above hearing threshold and a frequency of one thousand cycles per second, served as the source of stimulus change in the study. The tone was pre-recorded on magnetic tape and delivered to the subject by way of head-phones to both ears. The subject's OR to this auditory stimulus was measured by means of a single channel GSR recorder (manufactured by The Lafayette Company).

Electrodes

A monopolar system, employing two single electrodes, was used in recording changes in GSR amplitude. In keeping with Lykken (1959), zinc electrodes were used. The active electrode consisted of a one-quarter inch circle of zinc metal inserted in a lucite holder. The inactive electrode consisted of a three-quarter inch diameter piece of zinc, fitted with a plastic flange that formed a shallow cup into which the electrode was placed (Montagu, 1963).

Both electrodes were kept polished through sanding, for zinc metal has a tendency to tarnish readily in use.

TABLE II

MEANS OF REFLECTIVE AND IMPULSIVE GROUPS ON A NUMBER OF VARIABLES

Variable	Reflective Group	Impulsive Group	df	t	P
MFF latency (seconds-first response)	78.50	17.60	62	7.80	<.001
MFF errors (first response)	4.36	8.22	62	-8.29	<.001
VTE frequency (first response)	14.44	4.89	62	12.91	<.001
Age (months)	138.31	137.75	62	0.335	0.739
Otis (EM) raw score	40.53	36.63	62	1.48	0.145
Interval between VTEs (seconds)	5.58	3.70	62	6.43	<.001
VTEs (total responses)	189.62	94.28	62	8.60	<.001
MFF latency (seconds-total responses)	1095.75	388.31	62	12.15	<.001
MFF errors (total responses)	16.47	5.89	62	-7.81	<.001

The active electrode was attached to the central whorl of the distal phalanx of the right thumb (Lykken, 1959). Lykken's procedure of attaching a corn pad directly on the thumb was not found to be entirely satisfactory with children. The self adhesive pads did not adhere well to their small thumbs. More satisfactory results were obtained by first punching a quarter-inch diameter hole in a strip of three-quarters inch adhesive tape, centering the corn pad over this hole and then applying the tape, with attached pad, directly to the thumb. The resulting connection adhered to the skin better than the pad alone and also had the advantage of the pressure pad between electrode and skin. The active electrode was inserted into the pad (which was filled with electrolyte) and secured to the thumb by means of adhesive tape. The electrolyte consisted of a paste of 0.078 M Zn SO_4 dissolved in a cornstarch base (Edelberg and Birch, 1962).

Preparation of Electrode Sites

The active site was not cleaned or prepared beforehand, unless cleaning seemed necessary; a detergent solution was then gently rubbed on and wiped off with a cotton cloth. The inactive electrode was attached to the right forearm, midway between the wrist and elbow. The area was first rubbed with a pad of steel wool (an SOS pad moistened with water) in order to bring down the resistance of the inactive site to a given level. Some investigators (Malmo and Davis, 1961; Martin, 1963), working with adults, reported that they reduced the resistance of the inactive site to about 5000 ohms, sometimes less, through brisk sanding. In trying out their sanding procedure with children, using the recommended grade of paper, it was found that the amount of sanding required to bring the resistance down to 5000 ohms frequently left inflamed patches on the skin that bothered the child and remained visible for days. When steel wool was used, however, the child's resistance could be safely brought down to about 15000 ohms without much discomfort to the child and without leaving an inflamed mark on his arm. An Eico meter was used to measure the resistance at the inactive site.

Procedure

During the testing session, the subject was seated in a light shielded enclosure made from a wooden screen and heavy black cloth (Figure 4). The equipment and experimenter were outside this space. A 7 watt night light provided a dim source of light within the enclosure.

Since the equipment had to be transported and set up in different schools, complete sound shielding was not possible. The headset and background hum of the recorder served to mask most of the background noise, and the space provided by the schools for testing was relatively quiet when classes were in session. Subjects were scheduled for testing only when classes were in session to avoid the risk of bells and other loud, distracting stimuli.

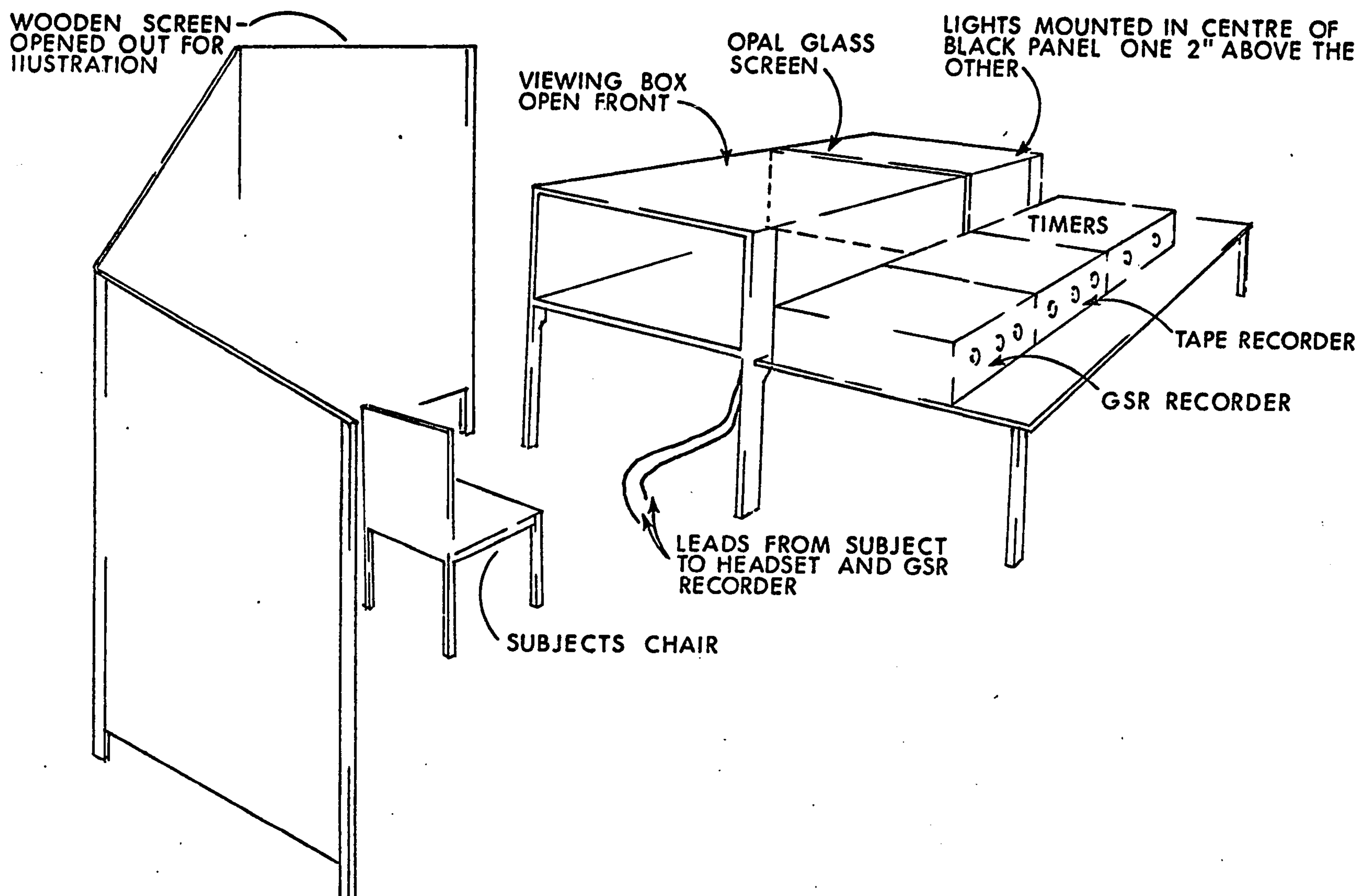


FIG. 4 Schematic diagram of the arrangement of the experimental apparatus for studies one, three and four.

After the electrodes had been attached to the subject for five minutes, and before the headset was placed over his ears, he was told that he would hear some sounds over the headset in a few minutes. He was asked to relax as much as possible with a minimum of movement. The recorder was then turned on and the low background hum provided a masking note until the arrival of the pure tone two minutes later.

Quantification of Results

The subject's response to the pure tone stimulus was defined as a drop in resistance that commenced after a latent period of one to five seconds. The changes in resistance were converted into log conductance units because the latter units have been shown to meet the statistical assumptions underlying the use of parametric statistics (Haggard, 1949; Woodworth and Schlosberg, 1954).

Results and Discussion

The predicted difference in OR level between reflective and impulsive subjects was not supported by the data ($t = 0.55$, $df = 52$, $p > .05$). Even when the ten most reflective subjects were compared with the ten most impulsive, no difference in OR level appeared ($t = 0.18$, $df = 18$, $p = > .05$). Close scrutiny of the data revealed that the highest OR obtained in the study was obtained from an impulsive subject and that the high and low ORs seemed to be scattered randomly throughout both groups.

When one fails to find support for a hypothesis that seemed to be theoretically sound and which received more than a hint of support from the literature, one naturally looks at the experimental techniques for possible deficiences. But no systematic error producing variable was evident here. Further support for the negative findings comes from a second OR measure, obtained on the same subjects during the test of a later hypothesis (Study Three). A change in light stimulation served to elicit the OR in the second case, but again there was no significant difference in the OR level of impulsive and reflective subjects at the level of five per cent.

Furthermore, when subjects with high and low ORs (that is, above and below the mean) were selected out and compared for performance on several variables, no significant correlations were observed. The OR level was not closely related to number of errors on the MFF, latency on the MFF, or performance on the Iowa Achievement Battery. The significance of r was greater than .05 in all cases. These results are not in agreement with Maltzman and Raskin (1965) and Maltzman (1967) who, working with adults, reported differences between high and low "orienters" on several variables usually considered basic to learning: conditioning, extinction, and stimulus generalization. However, the nature of the tasks in the present study differed considerably from those used by the above investigators. First, the OR was elicited by different stimuli, a burst of 110db white noise in one case (Maltzman and Raskin, 1965) and by words in other cases (Maltzman and Raskin, 1965; Maltzman, 1967). A pure tone of relatively low intensity was used in the present study.

According to Sokolov (1963), a stimulus with as high as 110db elicits the defence reaction as well as the OR, so that the OR measure used by Maltzman and Raskin (1965) may have been confounded. Second, the use of words to elicit the OR may also be a questionable procedure. Lynn (1966) indicated that the word alcohol, for example, elicits a much higher OR in alcoholics than in non-alcoholics. Since there was a wide variation in the nature and intensity of the stimuli used to elicit the OR in the studies considered, the results may not be really comparable.

STUDY TWO

Hypothesis

The second hypothesis predicted there would be a significant, positive relationship between the frequency of observing responses (VTEs) of reflectives and impulsives and the size of their ORs. The hypothesized relationship seemed promising. Berlyne (1960) regarded both VTEs and the OR to be manifestations of the more general orientation reaction. Both VTEs and the OR have a stimulus selecting function in that they serve to increase the flow of information from one source at the expense of information from other sources.

Other evidence that supported the hypothesis came from the parallel observations of Tolman (1959) and those of Hess and Polt (1964). Tolman observed that when subjects were working on a discrimination task the frequency of their head-eye movements (VTEs) increased as they neared the solution and then fell to a low level following mastery of the task. Hess and Polt likewise observed that pupil diameter (a measure of OR level) increased as a subject worked on a mental arithmetic task and dropped abruptly when the answer was obtained. These two studies support the notion of a linkage between the overt observing responses (VTEs) of a subject and his OR level.

Procedure

The VTE frequency of each subject was determined during the administration of the MFF test and a measure of his OR level (to an auditory stimulus) was obtained from the data of Study One. Testing the second hypothesis was a matter of correlating the two sets of measures (that is, VTE frequency and OR level) and checking the significance of the correlation coefficient obtained. There were twenty-seven reflective subjects and twenty-seven impulsive subjects in the sample. As indicated in Study One, several subjects were lost from the initial groups--each of which had an N = 30.

Results and Discussion

The results obtained did not support the relationship hypothesized between VTE frequency and OR level in reflective and impulsive children ($r = 0.19$, $p > .05$). Furthermore, when VTE frequency was correlated with a second measure of OR level (that is, a change in GSR following a change in light stimulation), the correlation value obtained failed to reach significance ($r = 0.21$, $p > .05$).

A look at Table II reveals the wide differences that existed between reflective and impulsive subjects on a number of variables. The reflective children revealed a VTE frequency that was more than double that of impulsive children. The response latency of the reflective group was more than four times that of the impulsive group and the numbers of errors made by impulsives was more than double that of reflectives. The interval between VTEs (Table II) refers to the time that elapsed between successive head-eye movements on the MFF test. Although the latter measure has limited value in contributing to the understanding of the nature of the different response styles, it was included in the study because Kagan (1965b) reported some rather curious findings about the rate of head-eye shift of reflective and impulsive children.

The non-significant results obtained in a test of hypothesis two indicates that the wide difference in observing responses manifested by reflective and impulsive subjects is not closely associated with the size of the autonomic OR. The question then arises: What do the observed differences in VTEing between reflective and impulsive children signify? What are the children doing as they demonstrate VTE behavior? To answer this query, a number of children were questioned in detail about the response sequences they used in their attempts to master the MFF task.

In line with Bourne's (1966, p. 46) suggestion that an individual's overt responses are nearly always indicative of his strategy on the problem, there were variations in the plan of attack used by subjects on the MFF task. The superior performers (those making fewest errors) tended to analyze the standard stimulus into manageable segments and then scan the array of variant stimuli for differences on each segment. For example, the standard stimulus for the last pair of cards on the MFF test consists of a pair of overlapping graphs (Figure 5). The X and Y axes have four numbers each. The variant stimuli, with which the standard stimulus is to be matched, are similar in all but minor details. The number on the axes may be out of sequence, new numbers may be inserted, or the slope and origin of the graphs may vary. The most efficient subjects divided this standard stimulus into about four segments. Each axis and each graph line would be selected separately and compared with the corresponding parts of the six variant stimuli until a perfect match was obtained. The high VTE frequency of these subjects seemed to reflect their systematic scanning

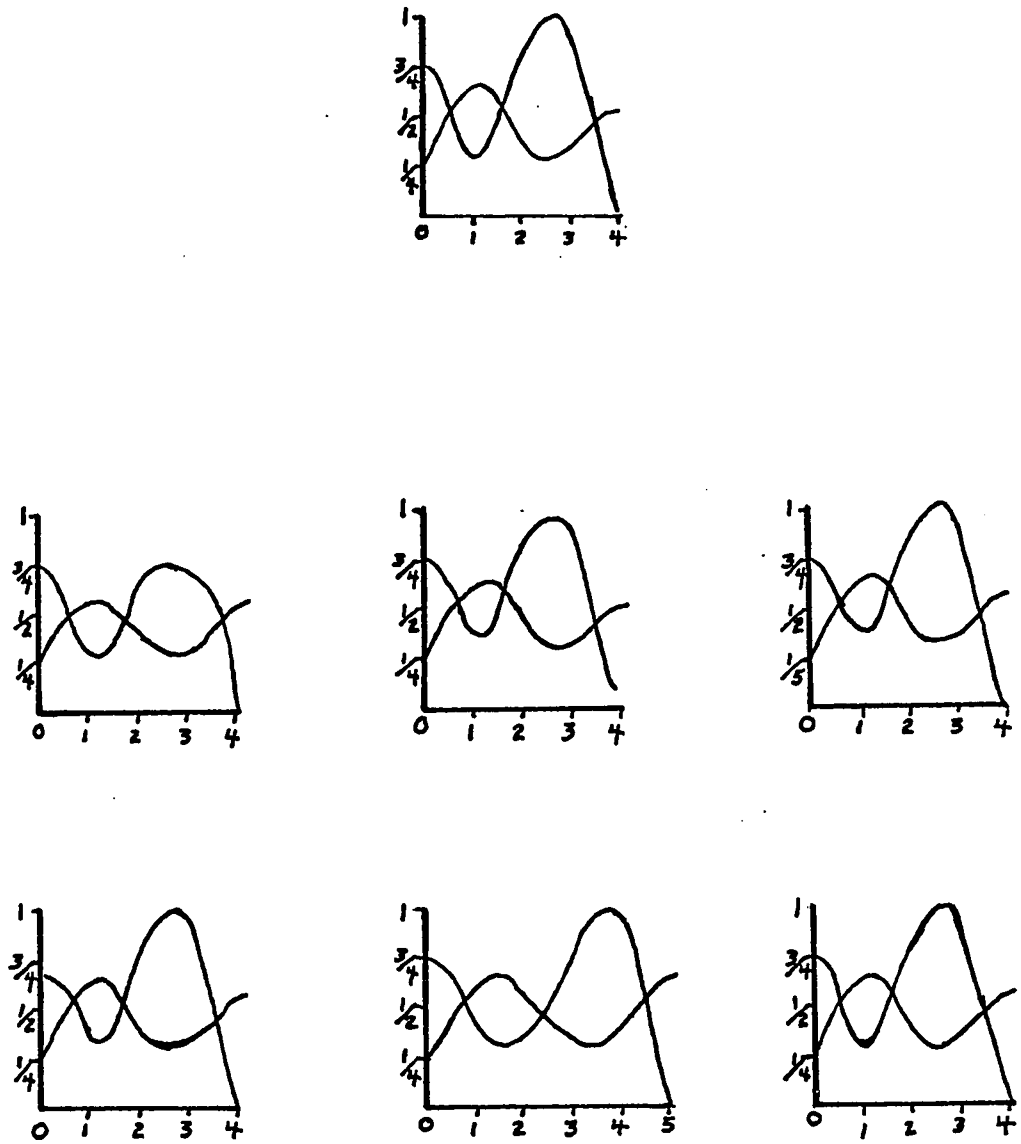


FIG. 5 Stimuli from the last pair of MFF cards (reduced to half size). The standard stimulus appears above and the six variant stimuli are below.

of the stimulus array--trying to match the segments of the standard stimulus with those of the six variants. This systematic strategy is a time consuming one, but it yields low error dividends and involves less cognitive strain than some of the less systematic procedures (Bruner, Goodnow, and Austin, 1956).

The poorer performers on the MFF tended to use a less systematic procedure in their attempts to match the stimuli. These subjects seemed to be trying to extract, and hold in memory, too much information about the standard stimulus. There were too many details in the standard stimulus to cope with it as a single unitary whole. There was certain to be a loss of elements from temporary memory storage as the array of variant stimuli was scanned for a match. Furthermore, uncertainty would arise about the details in storage as the subject encountered stimuli that differed only in some minor detail from the standard stimulus. In short, this strategy placed a very heavy burden on a subject's memory--much more so than the first type of strategy. As the details of the standard stimulus faded from memory, the subject would need to be re-exposed to it. However, the frequency of these returns to the standard was, as would be expected, considerably lower than that which characteristized the first, more systematic strategy. The less systematic strategy observed during MFF performance was reminiscent of the focus gambling observed by Bruner, Goodnow, and Austin (1956) wherein the subject attempted to cope with several attributes of the stimulus at a time.

Subjects having the fewest errors on the MFF tended to use a simpler, more consistent, and more systematic approach to the task than did those having more errors. Moreover, the better performers, using a definite method, were able to verbalize this method more readily. They seemed to "size up" the task more quickly, decide upon the most effective approach and then apply it. They gave the impression they were used to coping with discrimination tasks and that this was merely another variation of a task to which they could readily transfer a set of well practiced skills.

Although only two main strategies of search have been outlined, it should be emphasized that there were more than these two general approaches in evidence during MFF performance. Some subjects spent most of their time scanning the six variant stimuli for similarities and differences, with only periodic glances at the standard stimulus. Others would start off with this procedure and shift to a different one later in the test. Still others had no definite method at all, at least they were unable to verbalize their method.

Differences in scanning strategy then seem to provide a plausible answer for the differences in VTE frequency and MFF errors observed in reflective and impulsive children. Furthermore, the observed relationship between VTE frequency and scanning strategy receives support from Tolman (1959) who contended that the exploratory scanning, which accompanied VTEing, seemed to reduce an undifferentiated stimulus to one that is perceived and discriminated more precisely. The evidence then seems to support an interpretation of VTEs in terms of learned, perceptual scanning strategies rather than in terms of differences in the OR variable as hypothesized initially in this study.

STUDY THREE

Hypothesis

The third study was designed to test the hypothesis that reflective subjects require more trials to extinguish the OR than do impulsive subjects. The need to test this hypothesis arose from a review of the literature wherein habituation of the OR was considered to be a variable of fundamental importance to learning. Luria and Vinogradova (1963) suggested that distractibility and lack of attention were characteristics of children whose ORs extinguished too quickly. Since distractibility and inattention are characteristics that distinguish impulsive from reflective children (Kagan *et al*, 1964), it seemed plausible that differences in rate of extinction of the OR are associated with these characteristics. Moreover, Sokolov (1963) reported that rate of OR habituation varies with the level of discrimination difficulty, a finding that ties in with Tolman's (1959) observation that VTE frequency also varies with discrimination difficulty. Again, support for the hypothesized differences in OR habituation rates would account for variation in VTEing between reflective and impulsive children.

Selection of Subjects

The sample of subjects used in the previous two studies were used to test the third hypothesis (that is, twenty-seven reflective and twenty-seven impulsive boys at the grade six level). The classification of the subjects as reflective or impulsive was, as in the previous studies, based on latency and error scores on the MFF test.

Apparatus

The stimulus used to elicit the OR in this study was a change in the level of light intensity from a constant resting level to a momentary level of greater brilliance. The apparatus used for presenting the light stimuli consisted of a darkened viewing box, made from masonite and painted a flat black (Figure 6). The dimensions of the box were 16 x 20 x 36 inches. An opal glass screen, with a viewing surface 11 x 14 inches was set into the box at a distance of two feet from the viewing end. There were two independent light sources located a distance of ten inches behind the glass screen. One light (a shielded 7 watt a.c. bulb) provided a constant source of light on the screen to prevent dark adaptation. The second light source was a 12 V. d.c. bulb, connected to a variable transformer. A

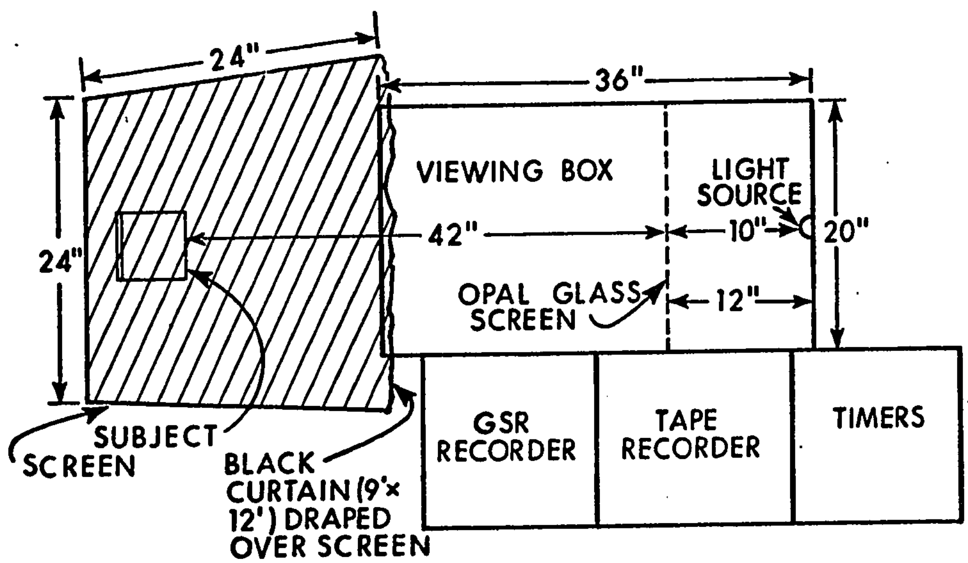


FIG. 6 A diagram of the experimental apparatus - viewed from above.

suitable difference in the two light levels was determined during the pilot trials and this level remained constant throughout the experiment.

The viewing box stood on legs which elevated the front of the box a few inches higher than the rear. The front legs were thirty and one-half inches long, while the rear legs were twenty-six and one-half inches long. The elevation of the box was such that the lighted screen could be viewed comfortably by boys of the age group under study .

The subject was seated in an armchair, three and one-half feet from the lighted panel. A folding screen five feet high, made of black panelling curved behind the subject's chair. Draped over the screen and viewing box was a large sheet of heavy, black cloth to exclude the room light and to keep both apparatus and experimenter out of view of the subject. Within this darkened enclosure only a very low level of diffused light was evident. By contrast, the viewing screen with its constant light source was a natural and compelling point of focus.

Procedure

Each subject was attached to the GSR apparatus in the manner indicated in Study One. The subject was then seated comfortably in the armchair, told to relax as much as possible and to look at the lighted panel in front of him. He was not told what he would see. Earphones (connected to the humming recorder) were then placed over his ears to help keep out any distracting noises. After a pause of two minutes, the viewing panel suddenly lighted up from its resting level for an interval of one second as a control timer delivered current to the 12 V lamp. A change in the subject's GSR amplitude (in log conductance units), following the change in the light stimulus, constituted the subject's OR which was to be habituated.

The change in the light stimulus was repeated at twenty second intervals until the subject showed no observable change in GSR for three consecutive trials. When this point was reached, the subject's OR was said to be habituated. The number of light presentations required to reach the above criterion served as a measure of rate of habituation.

Results and Discussion

Since the distribution of habituation trials was skewed, a non-parametric test (the Mann-Whitney U test) was used to evaluate the significance of the difference between the means of the two groups. This difference in means was not significant ($z = -0.49$, $p > .05$). Thus the hypothesized difference in OR habituation rates for reflective and impulsive subjects was not supported by the data.

The mean number of trials to habituation required for reflective subjects appeared to be considerably larger than that required for impulsive subjects (11.2 vs 8.3);

however, the mean for reflective subjects was spuriously elevated by the presence of a few very large scores. One reflective subject required sixty trials before habituation was complete and two or three others approached forty trials. Although the means did not turn out to be significantly different, there were more reflective subjects at the upper limits of the distribution of habituation trials. Two subjects in each group gave no response at all to the change in light stimulation. Presumably the GSR equipment used was not sufficiently sensitive to register the small autonomic response of these subjects, for the same subjects did register a measurable change to a sound stimulus previously presented (Study One).

The initial OR to a change in the light stimulus constituted a check on the OR to sound obtained in a test of the first hypothesis. As already indicated, in Study One, neither the OR to a change in sound or the OR to a change in light stimulation differentiated reflective from impulsive subjects. As might be expected, the initial OR to the sound stimulus was significantly correlated with the OR to light ($r = 0.39$; $p < 0.001$). The latter correlation is not as high as the values reported in some Soviet studies (Lynn, 1966), and the difference may be attributable to variations in the intensity, duration, and other characteristics of the stimuli used.

Maltzman (1967) implied that there should be no reliable association between OR level and trials to habituate the OR. However, this study found that the number of trials to habituate the OR to a light stimulus was significantly related to the size of the initial OR to the light ($r = 0.39$; $p < 0.001$).

The failure to find support for the predicted difference in trials to habituate the OR rules out yet another potential physiological variable that could have accounted for variations in reflective and impulsive response styles. Thus the source of the differences in attention and distractibility between reflective and impulsive children does not appear to reside in a disparity between their OR habituation rates.

STUDY FOUR

Hypothesis

The fourth hypothesis predicted a difference in the degree of conditioning between reflective and impulsive subjects. Several lines of evidence converged to strengthen the hypothesized relationship between response style and conditionability. First, Maltzman and Raskin (1965) and Lynn (1966) reported a significant relationship between OR level and conditionability. Second, there is evidence from the literature (Wyckoff, 1952; Perkins, 1955; Wehling and Prokasy, 1962) that VTEs and other observing responses are basically classically conditioned responses. Third, conditioning is considered basic to discrimination learning by a number of investigators (skinner, 1954;

Spence, 1956; Bourne and Restle, 1959). And finally, Jensen (1967) considers conditioning to be one of the basic intrinsic variables that should be considered in any attempt to account for the variability observed in conceptual learning.

<u>Design</u>

A three by five factorial analysis of variance design, with repeated measures, was used to test the above hypothesis. There were two assigned variables: response style (reflection-impulsivity) and treatments (extinction trials). The response style variable was divided into three categories consisting of two experimental groups and one control group. The treatment variable was partitioned into five sections containing the five extinction trials. The dependent variable consisted of measures of GSR amplitude (in log conductance units).

<u>Selection of Subjects</u>

Initially thirty reflective and thirty impulsive boys, at the grade six level, were assigned to the experimental groups of the study. The subjects were categorized and selected in the manner described in Study One. After two subjects voluntarily withdrew from the experiment and equipment failures led to the rejection of four more, twenty-six subjects remained in one group and twenty-eight in the other. In order to keep the size of all groups constant for statistical purposes, two subjects were randomly selected and removed from the larger group before the data were analyzed.

The pseudoconditioning control group (with an initial N = 30) was selected from the original reflective-impulsive sample. Fifteen subjects were selected from the reflective category and fifteen from the impulsive category. The chief criterion for selection of the control group subjects was that they have latency and error scores on the MFF test that placed them in that part of the reflection-impulsivity dimension closest to the experimental subjects. Although thirty subjects were initially selected for the control group, four subjects (two reflective and two impulsive) were later randomly removed from the group following a loss of subjects in the experimental groups. The principal reason for wanting equal numbers in the experimental and control groups was that a computer program was not available for this particular experimental design with unequal numbers in the groups.

The purpose of the pseudoconditioning control group was to demonstrate that conditioning, and not some form of sensitization, had occurred. In Beecroft's (1966, p. 19) view, the term pseudoconditioning seems appropriate to describe procedures, other than forward CS-UCS pairing, which result in some display of response strength to the conditioned stimulus. He further adds that since the power of any pseudoconditioning control group should be its ability to detect no conditioning when there is none, the simultaneous procedure appears to be the best pseudoconditioning control.

Apparatus

The experimental set-up employed in the previous study (Figure 6) was used in Study Four--actually Study Four was a direct continuation of Study Three. Conditioning trials followed immediately after habituation of the OR to the light stimulus was complete. The habituated light stimulus of study three served as the conditioned stimulus (CS) in the present study.

The unconditioned stimulus (UCS) was a band of sound (1000 cps), pre-recorded on magnetic tape at maximum recording intensity from a Hewlett-Packard audio oscillator. The volume control knob of the tape recorder was calibrated with the aid of an Eico db meter. Using this arrangement, sound levels varying in intensity from 0-100 db could be delivered to a subject by way of headphones. The duration of the sound and light stimuli was controlled by means of Lafayette timers.

Procedure

Before conditioning trials commenced, the subject was seated alone in the darkened enclosure described in Study Three. The experimenter, timers, and recording equipment were out of the subject's view. The timing equipment was placed in a large wooden box and surrounded with sound absorbing material.

Immediately after habituation to the light stimulus (Study Three), the subject was told that a further recording of his reaction to light and sound was to be made. The subject was told the sounds would be loud, but not unbearable and that he would receive some sample sounds before the experiment started. A sound intensity "work-up" was then introduced for each subject to determine his subjective level of pain tolerance. During the "work-up" the subject was told that he would receive short bursts of sound that started off at a low level and gradually became louder. The subject was instructed to indicate when the sound became unbearably loud. Since the subject was attached to the GSR apparatus during the sound "work-up" the experimenter could follow his autonomic reaction to the sound which provided independent evidence of the effect of the sound. The "work-up" consisted of one-half second bursts of sound delivered every ten seconds, starting at a low level of intensity and building up to higher levels in progressive steps. When the subject signalled that an unbearable level had been reached, the "work-up" ceased and the sound level was stepped down slightly for the conditioning series that followed. The sound intensity was increased during conditioning if adaptation was becoming prominent and decreased if the subject became overly sensitive to it.

The pairing of CS-UCS trials was started after the "work-up" was completed. The CS (described more fully in Study Three) was a one second change in the intensity of a lighted panel of opal glass. The UCS was a loud tone (1000 cps ___ below the subject's pain threshold) delivered through headphones from magnetic tape. The duration of the UCS was 0.5 second. For the experimental groups, the CS-UCS interval was 0.5 second, both stimuli terminating simultaneously. For the pseudoconditioning control group the duration of CS and UCS was the same as that used with the experimental groups, but the onset of the two stimuli was simultaneous whereas an interval of 0.5 second elapsed between CS and UCS for the experimental groups. The intervals between successive presentations of the CS (inter-trial intervals) were the same for both experimental and control groups (that is, 40, 50, or 60 second intervals in random order). Ten acquisition trials were given to each subject followed by five extinction trials at the same inter-trial intervals as the acquisition series.

Measures Obtained

The degree of conditioning was assessed by a resistance to extinction measure. The GSR deflections during acquisition and extinction trials were first converted to log conductance units. Then each GSR deflection that occurred during extinction trials was expressed as a percentage of the subject's mean GSR deflection to the UCS during the last five conditioning trials. This may seem to be a curious measure of extinction, but White and Schlosberg (1952) used an almost identical measure of degree of conditioning in similar circumstances. Basing the amplitude of a subject's GSR deflection during extinction on the amplitude of his deflection to the UCS during acquisition seemed particularly appropriate in the present study where the intensity of the UCS varied from subject to subject.

Results

Table III presents an overall picture of the performance of the reflective, impulsive, and control groups during extinction trials. Wide differences can be readily observed among the groups in resistance to extinction, especially on the first trial. Table IV shows that these differences are significant well beyond the .05 level of confidence ($F = 16.81$; $df = 2$; $p < .001$). A Newman-Keuls comparison between ordered means (Winer, 1962) revealed that both reflective and impulsive groups differ from the control group on all extinction trials ($p < .05$). The latter observation means that conditioning, over and above sensitization or arousal, occurred in the experimental groups. The data of chief importance to the hypothesis under test were the results of the reflective versus the impulsive groups. The Newman-Keuls comparison between ordered means revealed a significant difference in the performance of these two groups on four of the five extinction trials ($p < .05$). Furthermore, there was no significant interaction between response style and extinction performance ($F = 0.34$; $df = 8$; $p = 0.948$).

A frequent measure of degree of conditioning, and perhaps the most straightforward one, is the mean of each group on the first extinction trial. The difference between the means of the reflective and impulsive groups was large and significant on the first trial ($p < .05$). Since the same subjects of the two groups showed no significant difference in OR to a novel stimulus in Study One, it is difficult to attribute the large difference observed on the first extinction trial to an increase in OR level following a change in stimulation.

The GSR amplitude of the reflective group dropped rapidly on the second trial, but then declined more slowly over the next three trials (Table III). The same large decrease in amplitude between trials one and two was not evident in the impulsive group. Rather, the decline in response strength showed a more gradual decrease over all trials. The control group revealed a decrease in amplitude over trials that resembles that of the other two groups, but the amplitude throughout all trials was considerably lower than that of the experimental groups. Also, the amplitude of response dropped more (proportionately) between trials one and two in the control group than it did in the two experimental groups.

TABLE III

MEAN VALUES OF TEN RESPONSES ON EXTINCTION TRIALS FOLLOWING CONDITIONING AND PSEUDO-CONDITIONING PROCEDURES

	Extinction Trials					
Groups	1	2	3	4	5	Grand Mean
Reflective	64.5	46.6	47.7	45.0	41.7	49.1
Impulsive	45.6	40.6	39.4	38.2	33.7	39.5
Control	25.8	19.4	16.3	16.2	10.9	17.5

TABLE IV

SUMMARY OF ANALYSIS OF VARIANCES
FOR CONDITIONING DATA

Source of Variation					
Between Subjects	218259.875	77			
'A' Main Effects	67566.000	2	33783.000	16.814	<.001
Subjects Within Groups	150693.875	75	2009.251		
Within Subjects	195118.812	312			
'B' Main Effects	11663.746	4	2915.937	4.812	<.001
'A x B' Interaction	1663.798	8	207.975	0.343	0.95
'B' Subjects Within Groups	181791.375	300	605.971		

Discussion of Results

A difference in the degree of conditioning between reflective and impulsive subjects was demonstrated in the present study, even though the two groups did not differ initially in level of OR to stimulus change (Study One). The anticipated difference in conditioning between reflectives and impulsives was partly predicted on the basis of an expected difference in OR level (Maltzman, 1967). While Maltzman found the "high orienters" conditioned better than "low orienters," the present study found two groups of subjects that were similar in orienting level and yet who showed significant differences in conditionability.

Differences in OR level may be a sufficient, but not necessary, antecedent for differences in conditioning. Closer inspection of the type and intensity of stimuli used to elicit the OR in studies by Maltzman and Raskin (1965) revealed interesting differences from the stimuli used in the present investigation. In the latter instance, relatively neutral stimuli (a pure tone and light) of low intensity were used to elicit the OR, Maltzman and Raskin (1965) used a burst of white noise (110 db) to elicit the OR in one study, and pre-recorded words in a second study. As already indicated (Study One), a stimulus of 110 db is near the pain threshold and must surely have elicited a défence reaction that would confound the usual OR measure. Then again, there is a question of the neutrality of verbal stimuli for all subjects.

An explanation for the observed differences in degree of conditioning, with no differences in initial OR level to stimulus change, may reside in a finding reported by Stern, Stewart, and Winokur (1961, p. 222). These investigators found that measures of activation during rest and measures obtained during conditioning and extinction are poorly related. They suggested that, under most experimental conditions, prediction of responsiveness or conditionability, based on resting measures, is likely to fail. To use a mechanical analogy: a car idling in a garage does not display its true characteristics to a mechanic. It must be observed operating under load before its strength and weaknesses are revealed. Stern _et al_ (1961) seem to be suggesting the same thing holds for measures of human activation. If so, this might account for discrepancies found in the relationship between measures of OR level and conditionability. A tone of low intensity may not impose the same load on the organism that a noise very high in intensity does. Hence, the correlation between an individual's response to a low intensity stimulus (that is, his OR) and his response to the more arousing stimuli used in conditioning, can be expected to differ from the relationship that follows when a high intensity stimulus is used to elicit the OR.

There is some evidence to indicate that the speed with which a subject reaches the criterion of conditioning is related to anxiety in the clinical sense (Woodworth and

Schlosberg, 1954; Spence and Spence, 1966). Is there any evidence that there are differences in anxiety between reflective and impulsive children? Kagan's (1966b) operational definition of reflective and impulsive children is largely based on anxiety or fear of failure. Reflective children supposedly manifest a higher degree of anxiety over making errors and a greater fear of failure than is present in impulsive children. One would expect that anxiety of the kind reported by Kagan might be reflected in the arousal levels of the children during task performance; for any drive, whether it be fear of failure or fear of some other aversive stimulus, tends to raise arousal (Berlyne, 1967). It is interesting to note that when the control group subjects were separated into reflective and impulsive sub-groups, there was a notable difference in their GSR amplitudes during extinction trials. Judging from the residual effects of the UCS during extinction trials, the simultaneous presentation of light and sound seemed to sensitize or arouse the reflective group more than the impulsive group during the pseudoconditioning procedure. While it may be premature to equate measures of autonomic arousal with behavioral indices of arousal, Berlyne (1967) seems to indicate that, with adult organisms at least, the various changes indicative of increased arousal tend to appear in several systems together. Walker and Tarte (1963) believe that high arousal during the associative phase of learning leads to greater ultimate memory because an active perseverative process, which follows arousal, is responsible for consolidation of the memory trace. Ability to capture attention also goes together with properties that induce arousal (Berlyne, 1960). Finally, in classical conditioning where unconditioned stimuli are usually of such a kind as to generate marked increases in activity and excitement, the evidence for a close association between reinforcement and arousal is quite persuasive (Berlyne, 1967).

The demonstrated differences in degree of conditioning between reflective and impulsive children have a good deal of significance in terms of some theories of discrimination learning and theories of how observing responses are acquired. According to Perkins (1955) and Wehling and Prokasy (1962), VTEs and other observing responses are essentially classically conditioned preparatory responses. Such responses afford the organism the opportunity to make optimum preparatory responses in situations where discriminative stimuli are closely associated with reinforcement. Considered from this point of view, differences in discrimination performance observed in reflectives and impulsives, could arise from the presence or absence of the correct differential responses associated with relevant stimulus cues. Reflective children, who show a greater degree of conditioning than do impulsive children, can be expected to form more efficient S-R associations in situations where discriminative stimuli are associated with reinforcement. The result of this difference in S-R association would be manifest in the relative degree of attention that reflective and impulsive children pay to relevant stimulus cues.

While much of the theoretical analysis of discrimination learning assumes that responses are always learned to particular cues and that learning is simply a matter of stimulus response bonds, it should be pointed out that this view is an oversimplication of the problem. There is increasing evidence to show that discrimination learning involves some mediated or central associations. It has been established that when organisms learn to discriminate among cues, they can transfer this discrimination to new situations where entirely different responses are required (Harlow, 1959; Kendler and Kendler, 1962).

At the present time, several concepts are used to explain the behavior of organisms that is associated with their capacity to discriminate: selective attention, mediating behavior and orienting responses. In the future it is possible that these separate terms will be reduced to a common concept. Whether this development comes to pass or not, conditioning will continue to be an important variable, expecially in the early stages of discrimination learning. The most significant development of recent years is not the abandonment of conditioning and S-R bonds from discrimination learning theory, but the realization that S-R bonds are not the only mechanism by which the human organism acquires the capacity to discriminate. More about this point later.

Non-Hypothesized Considerations

Latency and error measures on the MFF test. A number of non-hypothesized considerations, made during the investigation, have a bearing on reflective and impulsive response styles. First, there were observations on the latency and error variables that are used to define reflective and impulsive subjects. Kagan *et al* (1964) reported an inverse relationship between MFF latency scores on the first response to each pair of MFF cards and total errors on the test. These investigators give no reason for using the latency scores of first responses to each pair of cards rather than using the mean latency score of all responses on the test. There is only the suggestion that "the purest measure of the reflection-impulsivity construct is response time to first selection on tests like the MFF" (Kagan *et al*, 1964, p. 17). In order to see if there was some justification for the procedure of Kagan *et al*, the latency, errors, and VTEs of all responses were considered in the present investigation.

The inverse relationship between the latency and error variables on the MFF test, reported by Kagan *et al* (1964), was supported here (Table V). There was very little difference in the size of the correlation values, however, when latency of first response was related to errors on the first response or to total MFF errors ($r = -.47$ versus $r = -.45$).

TABLE V

INTERCORRELATIONS OF THE MAJOR VARIABLES FROM THE MFF

		1	2	3	4	5	6
Latency	(first response)	--					
Latency	(total responses)	.67	--				
VTEs	(first response)	.50	.80	--			
VTEs	(total responses)	.39	.74	.94	--		
Errors	(first response)	-.47	-.59	-.77	-.61	--	
Errors	(total responses)	-.45	-.56	-.73	-.59	.92	--

The small difference in the size of these r values can probably be traced to the high correlation existing between first response errors and total errors ($r = .92$). In this case, it would appear that very little information is gained from Kagan's practice of correlating latency of first responses on the MFF with total errors. Although the use of total MFF latency and total MFF errors increased the size of the inverse relationship from $r = -.47$ to $r = -.59$, this difference was not significant at the level of five per cent.

VTE, error, and frequency measures on the MFF test. When the VTE and error variables on the MFF were considered, measures of first response on these variables showed a higher correlation than did total response measures on the same variables ($r = -.77$ versus $r = -.61$). The inverse nature of the VTE-error relationship supports Tolman (1959) who contended that VTEing served to reduce an undifferentiated stimulus to one that was more clearly defined.

When VTE frequency was related to response latency a positive relationship emerged ($r = .80$ for first response measures and $r = .74$ for total response measures). A positive relationship emerged because VTE frequency is directly related to time. There was also a high degree of correlation between VTE frequency on the first response and total VTE frequency on the MFF test ($r = .94$).

It should also be noted that there was a higher inverse relationship between the VTE and error variables than there was between the latency and error variables. It seems likely that VTEing, which appears to reflect the subject's scanning strategy, is a more fundamental variable than latency. The wide differences in response latency, observed between reflective and impulsive children, can be explained in terms of different scanning strategies rather than in terms of reflection _per se_ as Kagan _et al_ (1964) and Kagan (1966b) contend.

To return to the question of using first response measures versus total response measures in the classification of reflective and impulsive children, there appears to be some justification for Kagan's use of the former measure. Measures of first response on the VTE, latency and error variables correlated well with total response measures on the same variables (Table V). Furthermore, measures of first response accounted for half of the total errors, seventy-five per cent of all VTEs and seventy-three per cent of the total latency. Although scores on the first response represent a sizeable proportion of the total test score, it would seem advisable to use _either_ first response scores or total response scores on _both_ variables. Kagan and his associates seem to persist in using first response scores for the latency variable along with total response scores on the error variable.

Rate of VTE shifts. Kagan (1965b) observed that the average temporal lapse between successive head-eye fixations of the standard stimulus tended to remain relatively constant, hovering between three to four seconds. This value of three to four seconds was observed to hold regardless of the subject's response latency, age, or sex for children of grades one, two, four, and five. The present investigation, using a slightly more difficult version of the MFF with older children, found considerable variability in the successive head-eye fixations of subjects in both reflective and impulsive groups. For reflective subjects, the mean number of seconds elapsing between successive VTE shifts on the first response to MFF stimulus cards was 5.58 and the standard deviation was 1.46. For impulsive subjects, the mean number of seconds per shift was 3.70 and the standard deviation 0.73. The difference in elapsed time between successive shifts was significant beyond the 0.001 level of confidence for the two groups--again revealing differences in the scanning styles of the reflective and impulsive subjects (Table II).

Kagan (1965b) found his invariable results quite surprising and suggested that there might be a more basic rhythm governing the head-eye shift. He believed that the child's respiratory cycle, which was about three seconds for children of the age group he was studying, might be exercising a governing influence on the rate of orientation to the standard stimulus. The present series of studies, on the other hand, point to differences in scanning strategy, rather than to some underlying physiological process, as the important variable governing the rate of orientation to the standard stimulus. Kagan's invariable results might be attributed to some experimental variable of which he was unaware.

The Iowa Achievement Battery

The indices of reflection-impulsivity are reported to be related to reading errors (Kagan, 1965b), restlessness and distractibility (Kagan et al, 1964) and to greater persistence on intellectual tasks (Kagan, 1966b). Since all of these variables are of central importance to successful school performance, one would expect that reflective and impulsive children would show differences in their performance on the Iowa Achievement Battery. This battery samples a wide number of skills that are basic to adequate performance in the classroom: vocabulary and reading comprehension, language skills, work-study skills, and arithmetic skills. Surprisingly, a series of t tests revealed no differences in the means of the reflective and impulsive groups on any of the sub-tests of the Iowa Battery ($p > .05$).

In view of the characteristics attributed to reflective and impulsive children, this finding was unexpected. Various conclusions can be derived from the observation: (1) the construct of reflection-impulsivity may not be as significant a variable in the performance of older children as it is for the younger children observed by Kagan et al (1964). The influence of the reflection variable is believed to be maximal when a subject has learned the rudiments of a skill, but the skill has not yet been learned to the point where it becomes relatively automatic. For example, two individuals may require ten and fifteen hours of instruction respectively before being permitted to fly an aircraft alone, but after one hundred hours of flying, there may be no measurable difference in their flying performance. Similarly, it might be argued that, by grade six, a child has mastered most of the basic performance skills to the point where they have become relatively automatic; (2) a second possibility is that the skills being assessed by the MFF test are not closely related to the skills required for good performance on the Iowa Battery. However, perceptual discrimination is such a basic process in human learning that it is difficult to conceive of individuals performing successfully in school without skill in this area; (3) a third possibility is that the school may not be taxing the discrimination skills of the children to the maximum; the pace may be geared to the less skilled discriminators so that school type tasks fail to differentiate reflective and impulsive subjects. A fuller discussion of this topic will be postponed until another related variable is considered.

Socio-Economic status and reflective-impulsive styles. Although socio-economic status (SES) has not been previously linked with the reflection-impulsivity dimension, there is striking evidence in this study that would seem to support a relationship between these two variables. Reference to Table II reveals that school E, the school in the lowest SES area of the city, represented only fourteen per cent of the original sample, but constituted thirty-four per cent of the impulsive group. Conversely, school E constituted only six per cent of the reflective group. Compared with the proportions of the other schools, these figures seem to represent a significant variation. Is there any evidence in the literature to support a relationship between SES and discrimination performance? A recent study by Scholnick, Osler, and Katzenellenbogan (1968) found that: (1) experience on simple discrimination tasks facilitates performance in concept learning; (2) that low social class status is associated with poorer performance on discrimination tasks; and (3) the puzzling finding that while social class effects were found in discrimination learning, neither social class nor intelligence quotient effects were found in the concept tasks. The parallel between these findings and the observations made in the present investigation is striking. In both cases discrimination was considered basic to a more complex task used in the studies. In both cases there were SES differences, accompanied by differences in discrimination performance, between the groups of subjects used. However, in neither instance were there differences in the performance of the two groups on a more complex task in which discrimination skills seemed to be important.

To quote Scholnick et al (1968, p. 21):

> It appears that lower class children at both ages five and eight start off with a clear disadvantage in discrimination learning. Among the five-year-olds that disadvantage was so great that a substantial proportion of subjects failed to attain criterion, despite a large number of trials. . . . Among the eight-year-old (lower class) children, those subjects who succeeded in learning the discrimination problem made more errors than their middle-class counterparts.

The results were quite unexpected by Scholnick et al who hazarded the guess that the enriched experiences of the middle-class child led to greater familiarity with the stimulus material used in discrimination tasks. The investigators speculated further that the inductive reasoning skills required in solving concept problems might not fall within the realm of experience of children of any social background. Hence, it was possible that all subjects came to the concept tasks equally unprepared (Scholnick et al, 1968, p. 24). The findings of the present study likewise call for an explanation, but the discussion of this point is postponed until the next chapter.

CHAPTER V

SUMMARY, INTERPRETATION, AND IMPLICATIONS

Summary of the Investigation

The principal purpose of the series of studies undertaken in this investigation was to determine whether or not there was a connecting link between the reflection-impulsivity dimension of Kagan et al (1964) and the orienting response (Berlyne, 1960; Sokolov, 1963; Maltzman and Raskin 1965). A review of the literature revealed that Kagan's dimension had much in common with Tolman's (1959) Vicarious Trial and Error (VTE) variable. Since Berlyne (1960) considered observing responses (including VTEs) to be motor components of the more general orientation reaction, parsimony seemed to be achieved by fitting the reflection-impulsivity variable into the framework of the orientation reaction--a variable that has been intensively studied by Soviet investigators. (Sokolov, 1963). Maltzman and Raskin (1965) found that the level of the OR to stimulus change was a variable that was associated with differences in conditioning, extinction, stimulus generalization, and other variables basic to the learning process. There seems to be evidence from the literature which supported the notion that differences in OR level exist between reflective and impulsive children. Thus, on the strength of this evidence, a difference in OR level was predicted between reflective and impulsive groups. A number of other hypotheses seemed promising if one could assume differences in OR level: (1) VTE frequency (a motor component of the general orienting reaction) is related to the level of OR following stimulus change (that is, an autonomic component of the same reaction); (2) there is a difference in the number of trials required to habituate the OR in impulsive subjects; and finally, (3) reflective and impulsive children differ in conditionability.

When the results of the investigation were analyzed, no support was found for the predicted relationship between the OR variable and the reflection-impulsivity construct. Neither OR level nor trials to extinguish the OR were found to be related to measures of reflection-impulsivity. Also, no significant relationship emerged between overt and covert measures of the orienting response. That is, VTE frequency, which is regarded as a motor component of the more general orientation reaction, was not significantly related to the autonomic OR level, measured by GSR amplitude. The only hypothesis receiving positive support in the investigation was the one which predicted a relationship between conditionability and reflection-impulsivity. Reflective subjects demonstrated a greater degree of autonomic conditioning than was evident in impulsive subjects. Following an account of the procedure, results and discussion associated with the above hypotheses, a number of pertinent, non-hypothesized observations were outlined.

Interpretation

A general Discussion of the Results. The results of the investigation seemed to indicate that the nature of the differences between reflective and impulsive response styles is not closely associated with the OR variable. This does not mean, of course, that the OR is not an important variable in learning. The data merely indicated that differences in OR level and trials to extinguish the OR, do not appear to be among the variables contributing to individual differences in response style.

Differences in the degree of conditioning between reflective and impulsive subjects may be associated with differences in excitation or arousal, for a disparity was noted in the sensitization of these two groups during pseudoconditioning. Impulsive control subjects had a higher frequency of extinction responses near zero than did the reflective control subjects. Furthermore, Kagan et al (1964) and Kagan (1966b) have noted that reflective children seem to be more anxious about making errors, have a greater fear of failure and exhibit more drive to master a task than is evident in impulsive children. Spence and Spence (1966) have also observed differences in the conditioning performance of high and low anxious subjects and interpreted these differences in terms of the construct of generalized drive (D). According to their formulation, the performance differences of high and low anxious subjects reflect a difference in level of D which in turn is assumed to be the result of a difference in the level of emotional reactivity of these two groups to the experimental situation and procedures.

A discrepancy appeared when the current findings were compared with those of Maltzman (1967): there was no difference in the OR variable between the groups used in the current study, yet there were wide differences in conditioning evident in the groups. Soviet studies (Lynn, 1966) have also reported finding groups of subjects who had predominant excitatory and inhibitory processes on a number of measures, but who showed no difference in OR magnitude. Maltzman and Raskin (1965) and Maltzman (1967), on the other hand, found conditionability related to OR level. The variation in results probably stems from the use of different types of conditioning, different kinds of stimuli, and different stimulus intensities in the studies.

Stern, Stewart, and Winokur (1961) have observed that measures of arousal obtained during rest do not always correlate well with measures obtained under load. That is, stimuli of moderate to high intensity may impose a load on the organism which leads to a level of arousal that correlates well with the level of arousal generated by the UCS load during conditioning. Stimuli of low to moderate intensity, on the other hand, may produce more transient levels of arousal that do not correlate well with the more intense level accompanying conditioning. Maltzman and Raskin (1965) reported using a stimulus of very high intensity in contrast with the lower intensities used in the current investigation and in the Soviet studies.

Conditioning and the origin of observing responses (VTEs). An important association arises between the reflection-impulsivity dimension and conditionability when VTEs are viewed as classically conditioned preparatory responses (Perkins, 1955; Wehling and Prokasy, 1962). These investigators believe that observing responses (including VTEs) are molecular--classically conditioned--responses that afford the organism an opportunity to make optimum preparatory responses where discriminative stimuli are correlated with the presence or absence of reinforcement. Their evidence is based on a number of points, the principal one being the variation observed in the frequency of observing responses as motivating conditions are varied. If observing responses are classically conditioned preparatory responses in which discriminative stimuli are associated with reinforcement, then subjects who reveal superior classical conditioning should also reveal differences in observing response behavior. These differences would be chiefly reflected in attention to relevant stimulus cues, a variable on which reflective and impulsive children are observed to differ.

Other views on the origin of observing responses (VTEs). Before attempting to look for the origin of observing responses in classical conditioning, it should be noted that Berlyne (1960) has a different point of view on the origin of these responses. His theoretical rationale for the acquisition of observing responses is based on the principle of uncertainty. He suggests that the information provided by the discriminative stimulus, on perceptual discrimination tasks, reduces uncertainty and that uncertainty reduction is reinforcing. Gibson (1966, p. 282) also believes that discrimination is itself a kind of useful action, an activity reinforced by clarity not be punishments or rewards. Since observing responses (VTEs) aid in reducing an undifferentiated stimulus to one that is discriminated more precisely, they can be said to aid in the reduction of uncertainty and are thereby reinforced.

The need for a reconciliation of the two viewpoints. The two points of view on the origin of VTEs, just expressed, can be reconciled by regarding the observing responses of animals and pre-verbal children as being acquired through direct stimulus-response association. With the advent of language and verbal control over responses, however, the organism begins to operate on a different level. No longer are observing responses dependent on the slow conditioning and extinction procedures that prevailed at the pre-verbal level. Conditioning and extinction of observing responses become possible in one trial when they come under verbal control (Lynn, 1966). Kendler and Kendler (1959) provided a similar explanation, which has stood up very well, in an attempt to reconcile conflicting views on the reversal and non-reversal shift problem. The same kind of reconciliation of views seems to be necessary in resolving the conflicting views of investigators over the origin of observing responses.

The value of verbal mediators in discrimination performance. The addition of internal, and typically unobservable, stimulus-response connections may appear at first to be an unnecessary elaboration of basic S-R theory. The most compelling reason for introducing the notion of mediational processes into theory, of course, comes from experimental data and particularly from studies of conceptual problems which require solution shifts.

On the basis of several experiments showing changes in the relative difficulty of reversal and non-reversal shifts for lower animals and humans of various ages, Kendler and Kendler came to the conclusion that the mediator is probably verbal, and that internal verbalization is a self-generated, cue-producing behavior which guides orientation to the relevant attributes. Pre-verbal children and lower organisms, who perform better on non-reversal shifts, are surely capable of physical orientation, but they cannot verbalize either overtly or covertly. The Kendlers place considerable stress on the role of mediators in a learner's orientation toward key aspects of the stimuli (Bourne, 1966,

p. 32-35).

Zaporozhets (1961, p. 284-285) also attaches importance to verbal mediators in the development of images and observing responses. He believes that the internal representation of external stimuli arises in the child through a number of successive stages. In the first stage, the orientation process is rather chaotic because each individual stimulus evokes a response to itself alone. There are no connections with preceding and succeeding stimuli. During the second stage of development, conditioned orienting responses are formed which anticipate succeeding parts of the stimulus. In the final stage of development, the system of orientation responses is associated with speech and may be directed through verbal instruction or self-instruction.

The distinction just made between the acquisition of observing responses during pre-verbal and verbal stages of development can be related to the observations made in the current investigation. A problem arising from the investigation was how to reconcile the evidence which seemed to implicate both SES and conditioning variables in the origin of response style differences of reflective and impulsive children. To resolve the problem, without violating the evidence implicating both environmental (SES) and physiological (arousal) variables, it appeared necessary to speculate on the origin of observing response styles. No one shows a child directly how to form perceptual and other types of discrimination. No one shows a child which stimulus cues are relevant and which are not, which search patterns are efficient and which are inefficient. How then does a child develop a given response style? There is no question that different response styles exist. For when reflective and impulsive children were compared on MFF performance in this investigation, the former group demonstrated almost three times the number of observing responses (VTEs) and four times the latency that the latter group manifested. What is the origin of these wide differences in response style?

Pre-verbal and verbal influences on observing response style. A number of studies dealing with discrimination responses account for their origin in stimulus-response reinforcement terms. Responses which are reinforced are retained and responses that are not reinforced are extinguished (Skinner, 1954; Perkins, 1955; Spence, 1956). It should be noted that the conclusions of these studies are largely based on animals that characteristically need a number of trials to acquire and extinguish a response, that generalize widely to similar stimuli and that have great difficulty with reversal shift. The same set of observations is made with pre-verbal children (Zaporozhets, 1961). Children of three to four years-of-age are handicapped by their impulsiveness and benefit considerably from instruction in paying attention to the components of a task (Zaporozhets, 1960). The latter investigator further indicated that touch is more important in investigating novel objects than is vision in the child of three or four years of age. Vision, however, comes into its own at about five or six--when the ability to familiarize oneself with objects through visual analysis makes imitation possible. At about this age, the child acquires verbal control of behavior and his responses begin to differ from that of animals and younger children. Numerous trials are no longer required for conditioning and extinction; one trial learning becomes a possibility and the former spread of stimulus generalization is curbed.

Social status and the development of verbal mediators. Both Zaporozhets (1961) and Luria (1961) present evidence to show that verbal control of behavior is sufficiently well entrenched for the child of five years-of-age to attend to a given stimulus on command and to ignore a natural tendency to look at or respond to a second stimulus. Perhaps we have here a possible clue to the origin of differences in observing response style. Perceptual discrimination is not directly taught to the child, either in the home or in school. The child develops his own style and strategy for processing information. The particular style or strategy he develops, however, is not independent of reinforcing contingencies in the environment around him. Observing responses, though influenced by more overt S-R associations at the pre-verbal level, are still dependent on reinforcement at the verbal level. But under verbal control, observing responses are acquired and extinguished faster than formerly and the control or direction of these responses shifts from external to internal stimuli. In Pavlov's terms, the observing responses are being regulated by the "second signalling system."

It is suggested that significant people in the child's life, especially parents, who are in a position to influence his verbal repertoire, are also capable of influencing his observing response style. To quote Gibson (1966, p. 282):

> It is true that the adult who talks to a child can educate his attention to certain differences instead of others. It is true that when a child talks to himself he may enhance the tuning of his perception to certain differences rather than others. The range of possible discriminations is unlimited.

Through critical evaluation of and concern for the products of the child's discrimination process, what he sees in a particular stimulus, the conclusions he draws from his observations and comparisons of stimuli and the general accuracy of his work, parents shape the style of discrimination a child develops. Expressions of praise for results that are detailed and accurate, and expressions of displeasure over carelessness and errors would serve to modify and improve a child's discrimination strategy much as a coach shapes motor skills in various sports. A shaping procedure of this kind would also account for the apparent anxiety that reflective children manifest over making errors on discrimination tasks.

The interaction of social status and conditioning variables. How can differences observed in conditioning between reflective and impulsive children be related to the acquisition of observing response style? While it is difficult to assess the relative contribution of SES and conditioning variables to the development of observing response style, there is evidence that both variables are involved. Recent studies at the Merrill-Palmer Institute indicate that four-year-old children from middle class homes are beginning to shift from a functional-relational organization of stimuli to an analytic one. However, lower-class children of the same age, especially non-white, are still using the functional-relational basis as their preferred category of classification (Kagan, 1966a). When it is considered that a more analytic use of concepts is characteristic of reflective children, it is reasonable to suspect an association between SES and response style variables.

Another source of interaction arises between conditioning and SES variables because--

> . . . the child gets information first by focusing, enhancing, detecting, and extracting it from non-verbal stimulation. Later the extracting and consolidation go together. Perceiving helps talking, and talking fixes the gains of perceiving (Gibson, 1966, p. 282).

It is suggested that conditioning variables are important in extracting information from non-verbal stimuli, and that SES factors influence the verbal mediators which

Gibson believes are important in consolidating the information obtained.

Wyckoff (1952) indicated that increases in the degree of discrimination and increases in observing response frequency were dependent upon one another. The implication of Wyckoff's (1952) work is that basic differences in discriminability lead to different reinforcement contingencies and hence to differences in observing response frequency. Individual differences in conditionability imply a basic difference in the associations formed between relevant stimuli and reinforcement. If Wyckoff is correct, then the differences in the degree of precision with which reflective and impulsive subjects respond to relevant stimulus cues will influence the development of their respective response styles. The greater the degree of discrimination that a subject manifests, the higher his observing response rate. To speculate further, it would appear that SES and conditioning variables, both of which seem capable of influencing the child's degree of discrimination, are also able to influence his observing response style. It seems likely that the best discriminators would be those having both SES and conditioning variables in their favor. Also, the effects of differences in the conditioning variable should be more apparent in the pre-verbal stage of development than in older children.

Assuming that differences in autonomic conditioning reflect basic differences in excitation or arousal, a child with a higher arousal level would not only be more alert to relevant stimuli (Berlyne, 1967), but might also be more prone to develop anxiety. Parents and teachers, who placed a good deal of emphasis on accuracy of performance and quality of responses would, unwittingly, be harnessing the child's proneness to anxiety into improving the quality of his performance. Then too, one would expect an improved ability to handle discrimination problems to emerge from a history of successful experience with discrimination tasks. The different strategies that children manifest on discrimination tasks may be acquired in a fashion similar to the way learning sets are acquired (Harlow, 1959).

<u>The influence of social status on learning</u>. Indeed, Scholnick <u>et al</u> (1968) suggest that one of the factors accounting for the superior performance of middle class children may be their greater familiarity with the task of making perceptual discriminations. They noted further that eight-year-old children of both lower and middle class groups readily develop learning sets which enable them to cope with discrimination tasks. Hence, the initial disadvantage of the lower class eight-year-olds dissipates rapidly with experience. Among the five-year-olds, however, there was no evidence that learning sets developed within the training procedure, except among the brightest children.

Zaporozhets (1961, p. 286) stressed the importance of previous experience in similar terminology. He indicated that although the preliminary orienting responses play a very important part in forming correct patterns of observing responses, these response patterns only reach their optimal functioning efficiency when the subject has already had adequate experience of responding under similar circumstances. If such experience is lacking or insufficient, then the preliminary orientation or scanning of the stimulus array cannot proceed with optimal efficiency.

These observations may account for the puzzling finding that impulsive children show a performance handicap on the MFF discrimination task, but reveal no handicap on the more complex types of school tasks found in the Iowa Achievement Battery. When the low social status child is introduced to a novel discrimination task he has an initial disadvantage; his experience with discrimination tasks is not sufficiently broad or detailed for him to have developed the distinctive observing responses that are essential to flexible hypothesis testing. According to Scholnick *et al* (1968), older children of lower SES background are able to overcome this initial handicap through the rapid development of learning sets. A low SES background imposes a more pronounced handicap on five-year-olds because only the brightest of this group are able to develop useful learning sets.

An explanation for divergent findings. The observation of Scholnick *et al* (1968) on learning sets may explain why Kagan (1965b), using first grade children, found differences between reflectives and impulsives on both discrimination and school related tasks whereas the current investigation, using older children, found only differences on the novel discrimination task. There were no differences in achievement on the Iowa Battery of tests. It is suggested that the performance of the younger children in Kagan's (1965b) study was different on both the MFF and word recognition tasks because these children had not yet developed very effective learning sets for handling either kind of task. Hence, their performance is much more dependent on conditioning variables. And reflective children, who condition more readily than impulsive children, would be expected to show more attention to relevant stimulus cues on any kind of discrimination task. With older children, however, the school provides ample opportunity to develop a pattern of learning sets which can be used to master and render automatic many of the skills that formerly differentiated younger children of different backgrounds who lacked these sets.

While this suggestion accounts for the differences observed in younger versus older children, it does not explain why reflective and impulsive children at the grade six level show differences in performance on the MFF task and no difference in performance on the various tasks that are found in the Iowa Achievement Battery. To account for this paradox, it seemed necessary to postulate that the low social status child has an initial disadvantage when confronted with a novel and difficult discrimination task such as the MFF. The nature of his handicap may well stem from a deficiency in learning sets (Scholnick et al, 1968) or a deficiency in orienting patterns (Zaporozhets, 1961). Both of these constructs are considered to be very dependent upon previous experience on a variety of similar tasks.

After observing wide differences in the efficiency and complexity of the strategies used by older children on the MFF, it seemed likely that the child's past experience was exerting a large influence here. The need for these strategies arises because "In some circumstances we get too much information to work with. . . . In the face of this situation, an expert perceiver develops a highly economical strategy of perception" (Gibson, 1966, p. 30). These strategies are essentially encoding schemes, plans, or hypotheses for information processing and, as such, are known to be influenced by previous experience with similar tasks. As has been suggested, an important element in the child's discrimination experience and the development of learning strategies is interaction with interested adults, especially his parents (Gibson, 1966).

Immediate Implications of the Present Investigation

If the findings of the current investigation are interpreted correctly, and the SES variable is important in the development of a child's discrimination response style, what are the implications? One immediate implication is that the current attempts to modify the child's response style (Kagan, Pearson, and Welch, 1966; Yando, 1968) are on the wrong track. These investigators have been attempting to modify the response style of impulsive children by placing them with reflective models. One study reported no significant change, while the other reported a change in latency of response with no corresponding reduction in errors. These failures to modify the child's style reflect a premature attempt to alter a variable whose nature and origin are still in doubt. In terms of the present interpretation of these response styles, the optimal time to introduce changes in a child's discrimination style might be about five or six years of age, when verbal control over observing responses is being established. But even at this stage, the nature of the verbal code used in the home, whether restricted or elaborated (Bernstein, 1965), may have already introduced a strong disposition in the child to view his world in a manner that reflects varying degrees of differentiation. In Gibson's (1966) theory, language is also accorded a place of considerable importance in the perception of stimuli. For him, words embody stimulus information, especially invariant information about the irregularities of the environment. They consolidate the growing ability of the child to detect and abstract the invariants; they cut across the perceptual systems in that they are capable of providing invariants common to auditory, visual, or tactual stumili. In short, language provides the basis for the encoding, planning, and hypothesis testing that are so essential to efficient information processing.

Future Implications of the Current Findings

One of the advantages of the "Headstart Program," recently initiated for the benefit of culturally disadvantaged children, might well be that of sharpening the child's discrimination and perception of his environment through verbal interaction and information feedback. However, there is a strong possibility that scanning strategies, which appear to be important in complex discrimination tasks, are learning sets acquired from practice on a wide variety of discrimination problems. Thus, if the object is to alter the response style of impulsive children or culturally disadvantaged children, large dividends might be reaped by giving these children extended amounts of practice on a wide variety of discrimination problems. The development of superior strategies for coping with discrimination tasks could be enhanced through verbal instruction to the children, by outlining some superior, alternative ways of extracting information from stimulus arrays. Harlow's (1959) work on learning sets offers the encouragement of more than a fleeting change in discrimination performance if such a training procedure were introduced.

When the various characteristics of reflective and impulsive children were considered, some interesting similarities emerged between Kagan's dimension and Eysenck's (1947) dimension of introversion-extraversion. Eysenck has identified his dimension with the balance of excitatory and inhibitory processes. By and large, excitation refers to the arousal of the cortex and the general facilitation of processes of learning and remembering. Inhibition, in its broadest sense, refers to a process within the central nervous system that interferes with the ongoing perceptual cognitive and motor activities of the organism. It includes aspects of both Hull's reactive inhibition and Pavlov's internal inhibition.

When individuals with predominant excitation (introverts in Eysenck's dimension) are compared with those showing predominant inhibition (extraverts in Eysenck's dimension), they reveal the following characteristics: faster and stronger conditioning, slower extinction, more rapid development of inhibition, superior performance on vigilance tasks, a tendency to show anxiety more readily, a higher level of aspiration, a tendency to be more dissatisfied with their performance, and a higher drive to master a task. Moreover, in tasks which make possible a choice between speed and accuracy, introverts appear to choose high accuracy and slow speed while extraverts appear to prefer high speed and poor accuracy. The parallel between the characteristics assigned to reflective children and to the introverts of Eysenck's dimension is striking. Likewise, the characteristics of impulsive children closely resemble those of Eysenck's extraverts. It seems important to determine whether or not there is a close relationship between these two dimensions, the one largely viewed as being cognitive in nature, the other chiefly a personality construct. The fact that Eysenck's dimension is believed to have strong hereditary components and a physiological basis should, perhaps, temper any premature tendency to dismiss these variables from Kagan's dimension.

Conclusion

The current investigation dealt with some variables that seemed to be associated with reflective and impulsive response styles. An attempt was made to relate these styles of responding to the Soviet "orientation reaction" construct. The data did not support the notion that differences in level of orienting response (measured by the GSR) were closely associated with response style. However, there was evidence that reflective children show a greater degree of conditioning than do impulsive children.

The evidence gathered from the present series of studies would indicate that reflective and impulsive styles of responding are more complex than they were initially believed to be. Observations, peripheral to the main investigation, suggest that (a) the scanning strategy used by the children, and (b) social status are variables associated with reflective and impulsive response styles. In view of the implications of these variables for the development and modification of response styles, it seems important that future research efforts be directed into a more thorough study of patterns of search used by reflective and impulsive children as well as the relevance of the social status variable to discrimination response styles.

R E F E R E N C E S

REFERENCES

Barker, R. An experimental study of the resolution of conflict by children: time elapsing and amount of vicarious trial and error behavior occurring. In Q. McNamar and M. A. Merrill (Eds.), Studies in personality. New York: McGraw-Hill, 1942.

Beecroft, R. S. Classical conditioning. Goleta, California: Psychonomic Press, 1966.

Berlyne, D. E. Conflict and choice time, British Journal of Psychology. 1957, 48, 106-118.

Berlyne, D. E. Conflict arousal and curiosity. New York: McGraw-Hill, 1960.

Berlyne, D. E. Arousal and reinforcement. In D. Levine (Ed.), Nebraska symposium on motivation. Lincoln: University of Nebraska Press, 1967, pp. 1-110.

Bernstein, B. A socio-linguistic approach to social learning. In J. Gould (Ed.), Penguin survey of social sciences, 1965. Middlesex: Penguin Books, 1965, pp. 144-168.

Bourne, L. E. Jr.; Restle, F. Mathematical theory of concept identification, Psychological Review. 1959, 66, 278-296.

Bourne, L. E. Jr. Human conceptual behavior. Boston: Allyn and Bacon, 1966.

Brown, J. S. Factors determining conflict reactions in difficult discriminations, Journal of Experimental Psychology. 1942, 31, 272-292.

Bruner, J. S.; Goodnow, J. J.; Austin, G. A. A study of thinking. New York: Wiley, 1956.

Edelberg, R.; Burch, N. R. Skin resistance and galvanic skin response, Archives of general psychiatry. 1962, 7, 163-169.

Eysenck, H. J. Dimensions of personality. London: Routledge and Kegan Paul, 1947.

Forgus, R. H. Perception. New York: McGraw-Hill, 1966.

Fowler, H.; Wischner, G. J. Discrimination preference as affected by problem difficulty and shock for either the correct or incorrect response, Journal of Experimental Psychology. 1965, 69, 413-418.

Gibson, J. J. The senses considered as perceptual systems. Boston: Houghton-Mifflin, 1966.

Goss, A. E.; Wischner, G. J. Vicarious trial and error and related behavior, Psychological Bulletin. 1956, 53, 35-54.

Haggard, E. A. On the Application of analysis of variance to GSR data: I. The selection of an appropriate measure, Journal of Experimental Psychology. 1949, 39, 378-392.

Harlow, H. F. Learning set and error factor theory. In A. Koch (Ed.) Psychology: a study of a science. Vol. II, New York: McGraw-Hill, 1959, pp. 492-537.

Hebb, D. C. The organization of behavior. New York: Wiley, 1949.

Hess, E. H.; Polt, J. M. Pupil size in relation to mental activity during simple problem solving, Science. 1964, 143, 1190-1192.

Jensen, A. R. Individual differences in concept learning. In H. J. Klausmeier (Ed.), Analysis of concept learning. New York: Academic Press, 1966, pp. 139-154.

Kagan, J.; Moss, H. A.; Sigel, I.F. Psychological significance of styles of conceptualization, Monograph on Social Research in Child Development. 1963, 28, No. 86 (whole No. 2), 73-112.

Kagan, J.; Rosman, B. L.; Day D.; Albert, J.; Phillips, W. Information processing in the child, Psychological Monographs. 1964, 78, No. 1 (whole No. 578).

Kagan, J.; Rosman, B. L. Autonomic correlates of attention and an analytic attitude, Journal of Experimental Child Psychology. 1964.

Kagan, J. Impulsive and reflective children: the significance of conceptual temperament. In J. D. Krumboltz (Ed.), Learning and the educational process. Chicago: Rand McNally, 1965, (a), pp. 133-161.

Kagan, J. Reflection impulsivity and reading ability in primary grade children, Child development, 1965, 36, 609-628, (b).

Kagan, J. Individual differences in the resolution of response uncertainty, Journal of Personality and Social Psychology. 1965, 2, 154-160, (c).

Kagan, J. A developmental approach to conceptual growth. In H. J. Klausmeier (Ed.), Analysis of concept learning. New York: Academic Press, 1966, pp. 97-115, (a).

Kagan, J. Reflection-impulsivity: the generality and dynamics of conceptual temperament, Child development. 1966, 71, 17-24, (b).

Kagan, J.; Pearson, L.; Welch, L. Modifiability of an impulsive tempo, Journal of Educational Psychology 1966, 57, 359-368, (c).

Kendler, H. H.; Kendler, T. S. Vertical and horizontal processes in problem solving, Psychological Review. 1962, 69, 1-16.

Kluver, H. Behavior mechanisms in monkeys. Chicago: Chicago University Press, 1933.

Knowles, D. W. A comparative study of mediational-task performance on Indian children. Unpublished doctoral dissertation, University of Alberta, Edmonton, 1968.

Luria, A. R. The role of language in the formation of temporary connections. In B. Simon (Ed.), Psychology in the Soviet Union. Stanford: Stanford University Press, 1957, pp. 115-129.

Luria, A. R.; Vinogradova, O. S. Peculiarities of the orientation reflexes in child-oligophrenics. In A. R. Luria (Ed.), The mentally retarded child. New York: Pergamon Press, 1963, pp. 97-108.

Lykken, D. T. Properties of electrodes used in electrodermal measurement, Journal of Comparative and Physiological Psychology. 1959, 52, 629-634.

Lynn, R. Attention, arousal, and the orientation reaction. London: Pergamon Press, 1966.

Malmo, R. B.; Davis, J. F. A monopolar method of measureing palmar conductance, American Journal of Psychology. 1961, 74, 106-113.

Maltzman, I.; Raskin, D. C. Effects of individual differences in the orienting reflex on conditioning and complex processes, Journal of Experimental Research in Personality. 1965, 1, 1-16.

Maltzman, I. Individual differences in attention: the orienting reflex. In R. M. Gagne (Ed.), Learning and individual differences. Columbus, Ohio: Merrill Books, 1967, 94-113.

Martin, I. Delayed GSR conditioning and the effect of electrode placement on measurement of skin resistance, Journal of Psychosomatic Research. 1963, 7, 15-22.

Montagu, J. D. Habituation of the psycho-galvanic reflex during serial tests, Journal of Psychosomatic Research. 1963, 7, 199-214.

Montagu, J. D.; Coles, E. M. Mechanism and measurement of the galvanic skin response, Psychological Bulletin. 1966, 65, 261-279.

Muenzinger, K. F. Vicarious trial and error at a point of choice: a general survey of its relation to learning efficiency, Journal of Genetic Psychology. 1938, 53, 75-86.

Osgood, C. E. Method and theory in experimental psychology. Fairlawn, New Jersey: Oxford Press, 1953.

Perkins, C. C. The stimulus conditions which follow learned responses, Psychological Review. 1955, 62, 341-348.

Phillips, L. W. Vicarious trial and error and psychophysical judgment. Unpublished Ph.D. thesis, University of California, Berkeley, California. Cited by D. E. Berlyne, Conflict arousal and curiosity. New York: McGraw-Hill, 1960, p. 219.

Schlosberg, H.; Solomon, R. L. Latency of response in a choice discrimination, Journal of Experimental Psychology. 1943, 33, 22-39.

Scholnick, E. K.; Osler, S. F.; Katzenellenbogan, R. Discrimination learning and concept identification in disadvantaged and middle-class children, Child development. 1968, 39, 15-25.

Skinner, B. F. Science and human behavior. New York: MacMillan, 1953.

Sokolov, E. N. Perception and the conditional reflex. New York: MacMillan, 1963.

Spence, K. W. Behavior theory and conditioning. New Haven: Yale University Press, 1956.

Spence, K. W.; Spence, J. T. Sex and anxiety differences in eyelid conditioning, Psychological Bulletin, 1966, 65, 137-142.

Spence, K. W.; Platt, J. R. UCS intensity and performance, Psychological Bulletin, 1966, 65, 1-10.

Stern, J. A.; Stewart, M. A.; Winokur, G. An investigation of some relationships between various measures of galvanic skin response, Journal of Psychosomatic Research., 1961, 5, 215-223.

Tolman, E. C. The determiners of behavior at a choice point, Psychological Review, 1938, 45, 1-41.

Tolman, E. C. Prediction of vicarious trial and error by means of the schematic sowbug, Psychological Review, 1939, 46, 318-336.

Tolman, E. C. Spatial angles and vicarious trial and error, Journal of Comparative Psychology, 1940, 30, 129-136.

Tolman, E. C. Discrimination versus learning and the schematic sowbug, Psychological Review, 48, 367-382.

Tolman, E. C. Collected papers in psychology. Berkeley: University of California Press, 1951.

Tolman, E. C. Principles of purposive behavior. In S. Koch (Ed.), Psychology: a study of a science. Vol. II., New York: McGraw-Hill, 1959, pp. 92-157.

Underwood, B. J. Experimental psychology. New York: Appleton-Century-Crofts, 1966.

Walker, E. L.; Tarte, R. D. Memory storage as a function of arousal and time with homogeneous and heterogeneous lists, Journal of Verbal Learning and Verbal Behavior, 1963, 2, 113-119.

Wehling, H. E.; Prokasy, W. F. Role of food deprivation in the acquisition of the observing response, Psychological Reports, 1962, 10, 399-407.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.

Wischner, G. J. The effect of punishment on discrimination learning in a non-correction situation, Journal of Experimental Psychology, 1947, 37, 271-284.

Witkin, H. A. Discussion. In J. C. Wright and J. Kagan (Eds.), Basic cognitive processes in children, Monograph on Social Research in Child Development, 1963, 28, No. 86 (whole, No. 2), 118-124.

Woodworth, R. S.; Schlosberg, H. Experimental psychology (revised edition). New York: Rinehart and Winston, 1954.

Wyckoff, L. B. The Role of observing responses in discrimination learning: Part 1. Psychological Review, 1952, 59, 431-442.

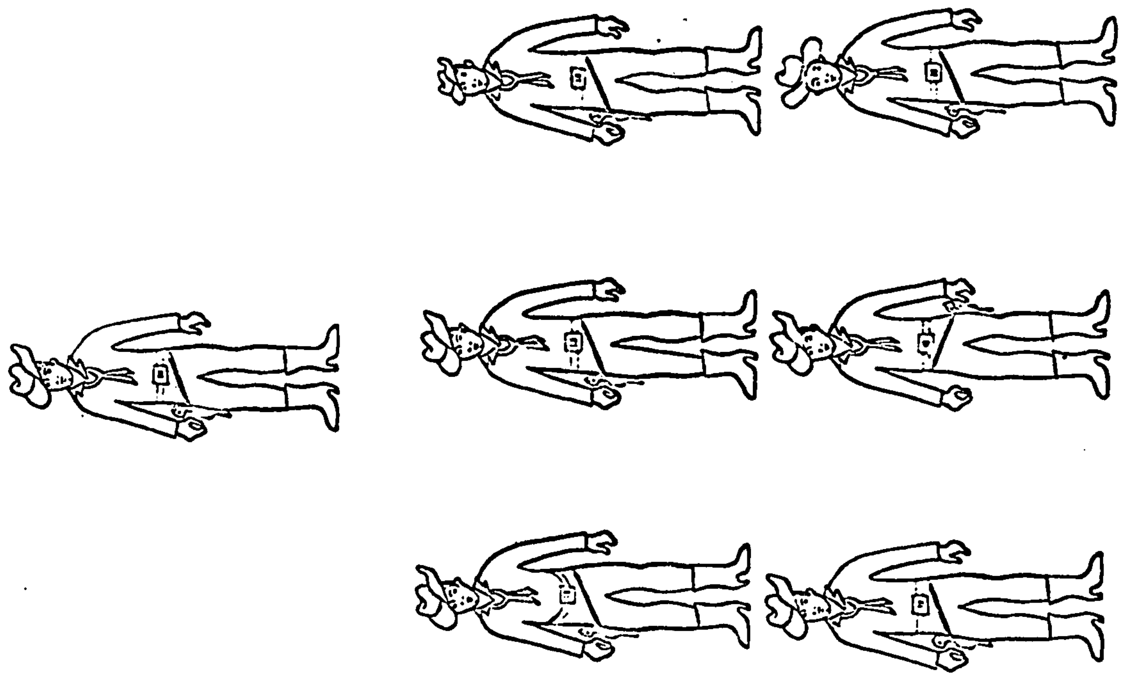
Yando, R. M.; Kagan, J. The effect of teacher tempo on the child, Child development. 1968, 39, 27-34.

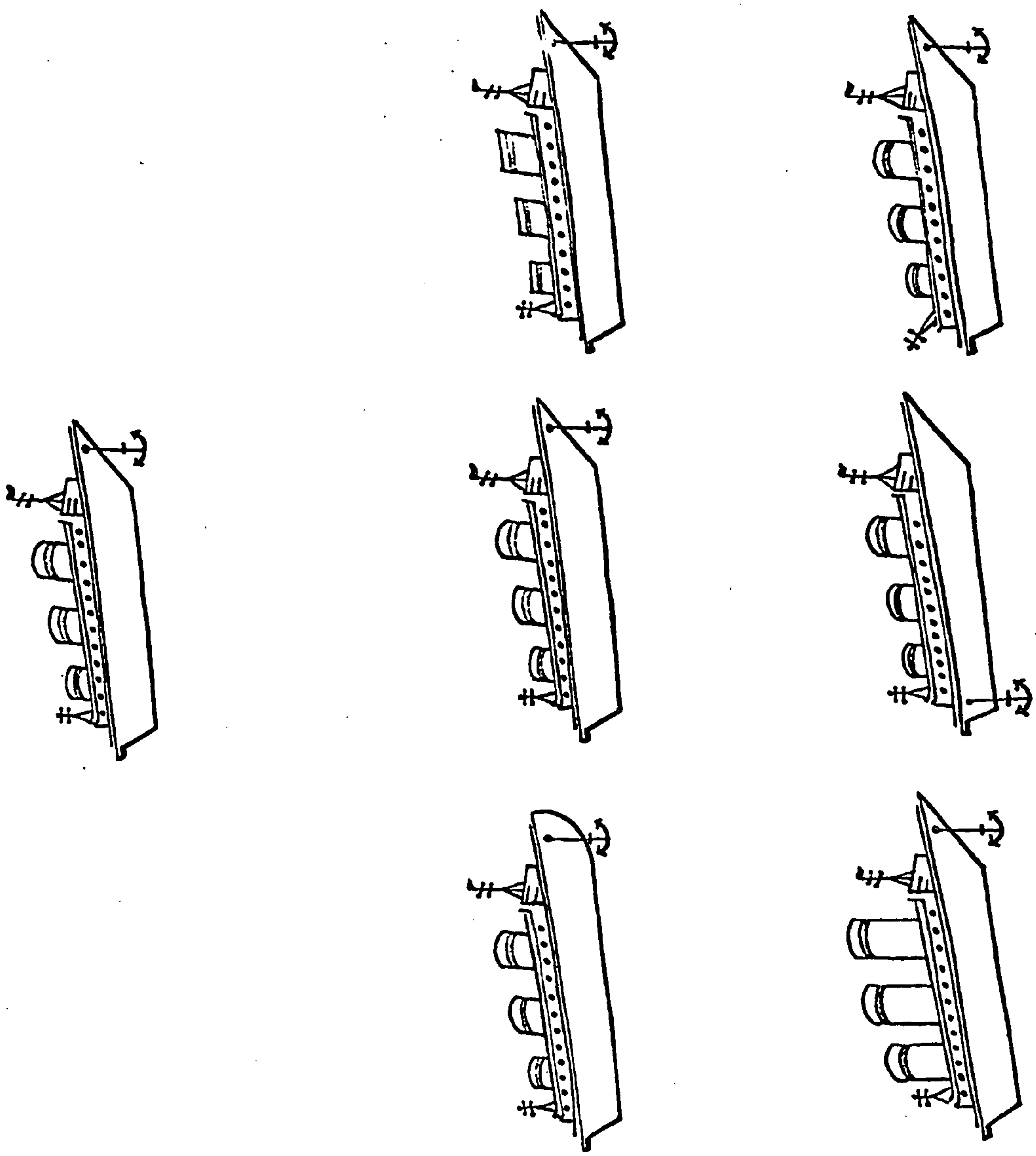
Zaporozhets, A. V. The origin and development of the conscious control of movements in man, In N. O'Connor (Ed.). Recent Soviet psychology. London: Pergamon Press, 1961, pp. 273-289.

APPENDIX A

DEMONSTRATION FIGURES FROM THE MATCHING FAMILIAR FIGURES TEST (REDUCED IN SIZE).

THE STANDARD STIMULUS APPEARS ABOVE AND THE SIX VARIANTS BELOW





A P P E N D I X B

INSTRUCTIONS FOR THE MATCHING FAMILIAR FIGURES TEST

APPENDIX B

INSTRUCTIONS FOR THE MATCHING FAMILIAR FIGURES TEST

"I am going to show you a picture of something you know and then some pictures that look like it. For example, I have a picture of a ship here on the left (point) and pictures of six ships here on the right (point). Only one of these ships on the right is just like the ship on the left. See if you can find the ship that is just like the one over here (point to the left picture)". If the subject is wrong say, "no, see if you can find the one that is just like the one on the left." Continue the latter procedure until the subject finds the correct matching picture. The latency of each response is recorded to the nearest second. The first two pairs of cards are for demonstration purposes and the remaining twelve pairs of cards constitute the test proper.

Although Kagan records only the latency of the subject's first response, in the present investigation the latency of all responses given by the subject was recorded. Likewise, the total number of errors for each pair of Matching Familiar Figures (MFF) test cards was recorded during the test.