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Personality And Experimental Variables Affecting Size Estimation

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PERSONALITY AND EXPERIMENTAL VARIABLES AFFECTING SIZE ESTIMATION

by

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ABSTRACT

This research was comprised of three studies directed at explicating relations among several possible determinants of individual differences of size estimation performance. The first study examined the relationship between natural and altered levels of eye movements and size estimates. In addition, personality correlates of the size estimation process were sought. An experimental manipulation relevant to the trait of impulsivity was applied by means of speeding subjects' performances so as to cause them to act more impulsively. Both eye movement levels and performance time were altered by verbal sets, the latter as an analogue of change of impulsivity. The major findings were significant alterations of performance time and eye movement levels with the verbal sets, and reduction of eye movement frequencies with speeded performance. However, size estimates were not affected by these manipulations as the groups with differing sets for eye movements differed initially in size estimation performance. Results indicated that impulsivity was a significant correlate of size estimates, and may have been responsible for the initial group differences noted above.

The second study employed essentially the same apparatus and procedure as the first experiment in order to further appraise the

role of personality variables as determinants of size estimates. Subjects were divided into high and low trait-level groups on the basis of their personality scale scores. The traits assessed included Impulsivity, Defendence, Obsessiveness, Preparanoid Tendencies and Shallow Affect. Size estimation performance was analyzed in relation to eye movement and performance-speeding sets, and to personality trait levels. Impulsivity was found to be an important correlate of size estimates as the varying of performance time and the separation of subjects into high and low impulsive groups produced the same effect of greater overestimation with higher impulsivity. Also, separating each of the two impulsivity groups into high and low performance time subgroups resulted in the location of groups concerned respectively with accuracy and with rapid completion of estimates. Suggestive findings indicated that the scan set conditions may have affected size estimates as the low obsessive subjects under the scan set maintained a relatively stable level of overestimation over repeated trials, unlike the progressive increase of overestimation shown by other low obsessive subjects.

The third experiment involved an attempted replication of the findings of the second study, but with a sample of subjects expected to exhibit a greater range of personality scale scores, thus maximizing the chance of establishing relations with size estimates. The apparatus and procedure were identical to those of the second study. The third sample was found in general to show greater variability and higher mean scores on the more pathological personality scales. The variables of defendence and obsessiveness were significantly related to size estimates such that low trait scores were associated with greater overestimations. The different pattern of findings of the third study was attributed to processes related to the markedly faster performance times of the third sample. Increases of accuracy of the third sample with speeding were interpreted in the context of a rapid, careless performance style as fortuitous.

It was concluded that changes of the frequency of comparisons of stimuli bore little relation to size estimates and that photographic eye movement indicators may serve as better measures of scanning style. The implications of the present findings were discussed in terms of a multidimensional view of scanning which incorporates the concept of cognitive styles. Finally, the ramifications of the present findings were considered for the process interpretation and treatment of groups with deviant attentive styles.

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CHAPTER I

ATTENTION STYLES AND SIZE ESTIMATION PERFORMANCE

Introduction

Consider the following experimental situation: a subject is seated before a ground glass screen on which a circle of white light is projected. By turning a control knob, he can change the size of the circle. His task is to reduce the circle's size until it is exactly equal in size to a grey metal disc mounted to his left at the same height and distance as the variable circle. The task does not appear to be difficult, and in fact, over a series of such judgments, subjects are found to be highly accurate in matching the disc's size. Although the range of error is small, subjects are consistent in the magnitude of error they make and its direction (over- or underestimation of the disc), so that a person who overestimates a relatively large amount on one judgment will tend to continue overestimating on repeated judgments. Similarly, underestimations on one judgment will be associated with underestimations on further judgments.

The present series of experimental studies was directed at understanding some of the reasons why people differ in size estimation performance. It is hoped that such an understanding will bear on the psychological bases for an interpretation of some rather interesting group differences observed in performance on this task. Patients hospitalized for mental disorders, for example, tend to show extremes of under- or overestimation; the average performance of normals falls within these extremes. Differences among patients are related to their diagnostic category, the severity and rapidity of onset of their disorder, and duration of hospitalization.

What processes can account for these group differences? Hypotheses can be formed by considering some of the other ways groups showing differences in size estimation are dissimilar. The suggestion has been made that the groups mentioned above differ in the degree to which they attend to stimuli--that is, in the degree to which they deploy their attention to all parts of a stimulus. According to this viewpoint, differences of attention deployment serve a defensive function. For example, the chronic exposure to unpleasant and perhaps threatening stimuli may lead to a reduction of attention deployment so that such stimuli will more likely be avoided, much as an individual might reduce the impact of a threatening film by turning away from it and attending only to a limited range of the stimuli before him. In the case of more extreme threat, such as patient groups might experience, this defensive function could become sufficiently developed so that it operates irrespective of the content of stimuli as a highly developed habitual mode of perception. A style of attention deployment could thus develop which is applied to many stimulus situations, even those which are objectively nonthreatening. Such pervasive differences in attentive style could then be maintained even in the relatively innocuous size estimation task, where it is thought that differences in style of attention contribute to the group differences of size estimation noted above.

The present research was concerned with assessing relationships in a normal population between size estimation performance and a specific group of personality traits. The traits of interest were carefully selected so as to be relevant to aspects of pathology and/or size estimation. It was hoped that by going beyond global differences between pathological and nonpathological groups, to an examination of specific dimensions of difference in terms of personality traits, that the functional significance of processes underlying size estimation performance will be clarified. In addition, experimental manipulations were utilized to produce momentary alterations of subject's behaviour relevant to these traits, so that size estimation performance can be related to both the enduring trait-moderated behaviour of the subjects and to experimentally produced changes of this behaviour.

The basic expectation is that different habitual modes of attending to stimuli are responsible for consistent differences of size estimation performance. Modes of attending are seen as linked to personality trait levels, and patterns of traits.

Review of relevant literature

The general review of the literature involves the development of the concept of cognitive controls, a detailed consideration of those controls involving attentive processes with emphasis on breadth of attention, the postulated defensive significance of individual attentive differences and a discussion of possible personality traits underlying such differences.

Development of the cognitive control concept

Perceptual theory has traditionally emphasized the immediate effects of stimuli on sensory receptors and the relaying of this stimulation to sensory cortical areas. As such, it has been concerned with physiological effects on a system largely given at birth. Appropriate measures have been taken to use subjects in a manner which prevented the intrusion of higher processes such as memory or learning. Individual differences in such processes were minimized as possible contaminants of the experimental situation.

In the fifties work by Bruner and Krech (1959), Klein (1951, 1954), and others led to the realization that higher-level processes played a significant role in the perceptual event which a fully adequate theory of perception would have to accommodate. In addition, the perceptual experiment could be used to clarify the nature of the subjects' higher processes. Thus, laws of perceivers were sought, as well as laws of perception (Allport, 1955).

Many experiments were performed to show the influence of central higher states on perception. In a variety of experiments typical of the precursers of cognitive style research, bodily needs (Levine, Chein and Murphy, 1943), personal values (Postman, Bruner and McGinnies, 1948), and defenses and emotions of the subject (McGinnies, 1949) were shown to alter perceptual reports. Bruner and Krech (1959) postulated that taken together these various processes formed a central directive state which was inextricably involved in perception. Bruner (1957) also proposed that such a state formed the basis of a general information processing system for the organism by means of which the multitude of stimuli confronting it can be filtered into elements which are meaningful to the organism. Since the central processor was viewed as being programmed by the past experience, needs and defenses of the individual, it thus served an adaptive function in the person's relations with his environment.

Work by Gardner, Holzman, Klein and others involved in the perception project at the Menninger Foundation integrated the concept of a central directive state operating in the adaptive interests of the particular organism's genetic and experiential background with current developments in ego psychology (cf. Hartmann, 1951; Rapaport, 1957). They found evidence in simple tasks of consistent individual styles or strategies of perceiving, remembering and thinking (Holzman and Klein, 1954; Klein, 1950, 1954; Klein and Schlesinger, 1949). It was proposed that such consistencies of approach to tasks of varying demands which required different higher processes reflected consistent structural aspects of ego organization; these were named cognitive controls or cognitive systems principles (Holzman and Klein, 1956).

Cognitive controls were viewed as relatively stable, developmentally produced ego structures which "mediate between purposes, intentions and need states on the one hand, and adaptive requirements of a stimulus situation on the other (Holzman and Gardner, 1959, p. 1)." While drive level was seen as providing the energizer for behaviour, cognitive controls provide the direction (Holzman and Klein, 1956).

Although initially referred to as perceptual attitudes or styles, cognitive controls were thought to be apparent in cognitive processes in general, including learning and recall. A given cognitive control referred therefore to stylistic consistencies in approach to tasks involving memory, learning and the various perceptual modalities. It was a common style of approach to a variety of tasks, manifested in a variety of higher processes which monitored activities of subordinate processes such as learning, memory and perception, adaptively co-ordinating the organisms' capabilities to the demands of the environment.

Several cognitive controls have been isolated. Two of these are directly relevant to attention processes and will be discussed in subsequent sections. Others will be briefly mentioned at this point to indicate the types of consistencies included under the rubric of cognitive control.

Typical cognitive controls

Leveling-sharpening. The leveling-sharpening principle refers to the degree to which individuals "merge new experiences and memories of related earlier experiences (Gardner and Lohrenz, 1960, p. 1)." The degree of leveling or sharpening a subject customarily uses is reliable over a variety of measurement situations, appearing in serial learning (Gardner and Long, 1960), serial reproduction of stories (Gardner and Lohrenz, 1960) and memory organization (Holzman and Gardner, 1960). The defining measure is essentially a serial judgment task in which the memory of earlier judgments interferes to varying degrees among subjects with present judgments (Holzman, 1954; Holzman and Klein, 1954).

Several scoring systems are used to evaluate performance on this task. There is evidence that the construct of leveling-sharpening is in need of tighter definition, as the different scoring systems are not highly related (Vick and Jackson, 1967).

Holzman and Gardner (1959) verified their hypothesis that cognitive controls act as preconditions for defenses--that is, that different cognitive controls predispose individuals to different psychological defenses--by linking leveling to repression. The defense of repression is thus thought more likely to be prominent for the individual who easily blurs new experiences with the memories of earlier experiences. Holzman and Gardner (1959) viewed their results as confirming and extending the theoretical positions of Freud (1937) and Hartmann (1939), who felt that the control function of the ego links adaptive and defensive processes in the service of the organism.

Equivalence range. Basically, equivalence range refers to the range or span of objects an individual will judge as the same. Subjects with low equivalence range require a large number of categories to account for the variety of objects facing them in the object sorting task used as the defining measure of this control principle. High equivalence range individuals, on the other hand, require relatively few categories (Fillenbaum, 1959; Gardner, 1953). It has been implied that individual differences of categorizing style reflect different preferred modes of compartmentalizing experience. The individual using broad categories is presumed to be aware of finer differences among objects categorized, but not to act upon these differences. Further research has extended the range of situations and tasks over which equivalence range may be demonstrated (Clayton and Jackson, 1961; Gardner and Schoen, 1962) and suggests that as with leveling-sharpening, the construct of equivalence range is in need of further refinement (Sloan, Gorlow and Jackson, 1963).

Tolerance for unrealistic experiences. This cognitive control has produced relatively little research. Individual differences of performance on tasks which generate experiences contrary to the subjects' usual impressions of reality were used as defining measures, e.g., apparent movement phenomena, and distortions of the visual field with aniseikonic lenses (Klein, Gardner and Schelsinger, 1962).

Patterns of cognitive controls

It should be noted that a given individual is expected to possess a cluster of cognitive controls, as indicated by his varying score levels on a variety of defining measures, one for each control. The overall consistency of the subject's adaptive behaviour is considered due to the joint operation of the whole conglomerate of cognitive control structures, referred to as the individual's cognitive style (Klein, 1951). Research has been largely directed, however, at the level of individual cognitive controls rather than their joint operation as a cognitive style.

Cognitive controls and selectivity of attention

The present section will examine two cognitive controls of direct relevance to the attention process. The first of these has emerged from the research program of H. A. Witkin, whose early work indicated that individuals differed in their ability to perform visual tasks emphasizing active analysis of the visual field versus passive, non-analytical acceptance of the field (Witkin, Lewis, Hertzman, Machover, Meissner and Wapner, 1954). At this stage of historical development, the dimension of differences was referred to as perceptual dependence-independence and had the same status as Klein's (1951) perceptual attitudes.

Further research led to the postulation of more general consistent individual differences along a dimension known as field articulation. This change was due to the realization that active, analytical functioning (or its converse) were not limited either to the visual sense modality or to the perception of simple inanimate stimuli. A subject's manner of dealing with simple, physical stimuli (dependent or independent) was thought to be paralleled by a similar style of dealing with social stimuli. Field dependent people were found to rely more on others for guidance and support, to have less ability to resist conformity pressures and to have a less stable self-concept such that their self-perception depended more on the particular social situation they were in; that is, they depended more on others for self-definition (Witkin, Dyk, Faterson, Goodenough and Karp, 1962). The generalization suggested by Witkin et al. (1954) is that developmentally-produced individual differences in the personality trait of dependency lead to differences in the degree of analytical perception of both people and objects.

Evidence emerged from Witkin's research program for the existence of relatively stable cognitive structures of developmental origin, with perceptual, intellectual and personality components; such structures were obviously akin to the concept of cognitive control principles discussed above. The field articulation concept therefore evolved to one of global versus articulated cognitive functioning (Witkin et al., 1962). Its relation to intellectual functioning emphasized the cognitive nature of these structures; nonverbal intelligence subtests measuring an analytical aspect of intelligence have been found to be significantly related to an active analytical style of attention (Gardner, Jackson and Messick, 1960). As Witkin (1965) states, "it is because these stylistic tendencies extend across both perception, where we are dealing with an immediately present stimulus configuration, and intellectual functioning, where we are dealing with symbolic representations, that we refer to them as cognitive styles (p. 319)." The influence of this field articulation control principle also extends to memory processes where active analyses and selectivity must be exercised over past rather than immediate perceptions (Gardner and Long, 1961, 1962).

The explicit connection between the variable variously described as perceptual independence, field articulation or articulated cognitive style, and selectivity of attention deployment was made in a study by Gardner, Holzman, Klein, Linton and Spence (1959). Measures of the various cognitive controls were administered and the scores intercorrelated and factor analyzed. The measures used by Witkin's group largely defined a separate factor which Gardner et al. (1959) termed constricted versus flexible control. These results and those of Gardner and Long (1962b) and Karp (1963) led to the redefinition of this cognitive control as consistent individual differences in the degree of selectivity of attention. Selectivity of attention was indicated by the ability to attend to particular stimulus elements in internal or external fields (memory or perception) despite the influence of compelling but irrelevant stimulus elements.

Differences in field articulation have been found between normals and various pathological groups, including alcoholics (Karp, Poster and Goodman, 1963; Karp, Witkin and Goodenough, 1965a, 1965b), asthmatics (Fishbein, 1963), obese individuals (Pardes and Karp, 1965), schizophrenics (Powell, 1964) and those with functional cardiac disorder (Soll, 1963). Witkin (1965) has suggested that individual differences in the selectivity of perception, with their correlates in intellectual functioning and personality traits, may be of significance for the etiology of such disorders.

The relation of psychopathology to field articulation as formulated by Witkin (1965) is that either extremes of articulation result in characteristic diagnostic outcomes and the use of particular types of defenses. For example, Witkin (1965) considered that the articulated extreme results in specialized defenses such as isolation while individuals at the other extreme tend to use more general, primitive defenses, such as repression and denial. Also, as Taylor (1956) has shown, delusional individuals are more field independent or articulated than hallucinatory subjects.

The significance of group and individual differences of field articulation has been enriched by an understanding of some of the developmental antecedents of a particular style of attention selectivity (Dyk and Witkin, 1965; Witkin et al., 1962). The importance given the mother's interaction with the child emphasizes the role of past experience in the production of this attentive style.

Cognitive controls and extensiveness of attention

Although the control principle of field articulation is highly relevant to attention processes, it is not thought to be the cognitive control of greatest importance for size estimation performance. In the case of the size estimation task, extensiveness of attention deployment appears critical. The cognitive control of "scanning" takes into consideration extensiveness of attention deployment, rather than selectivity.

The scanning control is not as well elaborated a construct as field articulation, but it is of primary importance for the present series of studies, and will be discussed in detail in the following section. It was preceded by a discussion of field articulation because it is hoped that the present studies and others to follow will lead through similar stages of experimentation to the degree of understanding of the scanning control that is now available for field articulation.

Knowledge of field articulation proceeded from the discovery of individual differences in normal subjects, to personality and intellectual correlates of such differences, resulting in their formulation as a cognitive control. The discovery of differences between and among normal and abnormal groups with differing psychological defenses led to process interpretations of these group differences in terms of a developmentally produced attentive style.

At present, our knowledge of the scanning process is at the level of demonstrations of differences among normal and pathological groups. Process interpretations of differences have not been sufficiently outlined or tested. The present research sought in a series of related studies to explicate relations between personality traits and scanning behaviour, utilizing group differences in personality traits and experimental manipulations relevant to traits of interest.

Scanning measures. The scanning control, first identified by Schlesinger (1954), concerns the degree or extensiveness of attention deployment over a stimulus field, either external (perceptual) or internal (memory), (Gardner et al., 1959).

A number of diverse procedures are potentially available to measure degree of scanning. As scanning involves differences in breadth of attention, having subjects monitor displays with central and peripheral elements allows assessment of the range of peripheral elements the subject is using or can recognize (e.g., Wachtel, 1968). Scanning could also be indicated by searching through complex visual or memory fields for particular elements (Egeth, 1967; Messick, 1966).

In practice, two basic procedures have emerged for the measurement of scanning. The first procedure involves the direct measurement of deliberate eye movements (Gardner and Long, 1962a; Thomas and Stasiak, 1964). The degree of looking about the visual stimulus field--that is, scanning--is reflected in changes of the point of fixation of the eyeballs on the stimulus. This change is either directly photographed or eye muscle potentials are recorded.

The second basic measurement method relies on the size estimation task in which subjects are required to vary the size of a circle of light on a ground glass screen until it is perceived to match in size an equidistant hand-held metal disc (Gardner et al., 1959; Silverman, 1964b). Judgments are made over ascending and descending trials while the size, weight and color of the standard disc are varied. The mean error of estimation of the standard stimuli is taken as an index of scanning.

The rationale for a size estimation measure of scanning is provided by Piaget's perceptual centration hypothesis (Piaget, 1961). According to this hypothesis, there is an innate tendency to overestimate stimuli in the center of a stimulus field. This is due to restricting most "looks" (centrations) to the center of the field. Developmentally, decentration strategies are thought to emerge by which people compensate for such natural overestimation by looking more extensively about the stimulus field. This decentration process results in more accurate perception of size of objects in the center of the field (Gardner, 1959).

Gardner (1961) suggests that in the size estimation situation, extensive, balanced looking between standard and variable stimuli should lead to minimal overestimation or even underestimation of the standard. On the other hand, a limited number of looks, with a major portion of judgment time spent inspecting the standard stimulus should lead to extensive errors of overestimation of the standard stimulus. This interpretation is consistent with Piaget's law of relative centrations, by which the relative apparent magnitude of two stimuli being compared is in part a function of the durations of looks upon each of the stimuli (Piaget, 1961). "Thus errors of the standard are conceived of as products of the relatively long periods during which subjects attend to standard stimuli in the course of making judgments in experimental situations" (Gardner and Long, 1960a, p. 1). According to

Piaget, most subjects tend to overestimate the standard stimulus, instead of the variable, because they spend more time attending to the standard.

Scanning is therefore measured primarily by either amount of eye movement or by constant errors in a size estimation task. High scanning is assumed to be reflected by a high degree of eye movement about the stimulus field, or by low errors of overestimation of the standard (and even underestimation) in the size estimation paradigm.

Silverman (1964a), in an extensive review of the attention literature, suggested that the scanning control can also be inferred from other perceptual tasks such as reversible figures, the autokinetic illusion, and perceptual constancy situations. However, the present study will be primarily directed at uncovering processes contributing to differences with the size estimation measure.

Individual differences and scanning measures. It is important to ascertain the stability and generality of individual differences in scanning measures. This will be done separately with respect to eye movements and size estimation performance, the former first.

Gardner and Long (1962a) employed three different size estimation tests together with electro-oculographic eye movement records. In these tests such parameters of size estimation stimuli as the size of the standard, and the nature of the light source for the variable stimulus, were varied. Consistency of eye movement scores across the three tests was indicated by a mean intercorrelation of .75 among "looks" in the different tasks. Gardner and Long (1962b) used five tasks involving modified concentric-circles illusions of Delboeuf as inferred measures of scanning style, again recording gross eye movements. The mean intercorrelation among the five tasks for the eye movement measure of "number of looks" was .70; a further indication of consistency of eye movement behaviour across tasks.

Gardner and Long (1962b) also obtained a large number of significant correlations among different indices used included number of separate looks at the standard, total time looking at the standard, per cent time looking at the standard, and mean time per look at the standard.

Luborsky, Blinder and Schimek (1965) photographically recorded eye movements during the exposure of subjects to a series of pictures of variable content. Eye movement indices included time spent looking at the background rather than the figure, per cent time looking at central areas of pictures, number of areas fixated at least once, distance from one fixation point to the next and duration per fixation. Some significant intercorrelations among these indices (for N = 16) provides evidence for the consistency of deliberate eye movement measures. The results reported above were primarily directed at consistencies of eye movements. Although size estimation tests were used, they were simply a vehicle for the assessment of eye movements; consistencies of size estimation performance as an inferred measure of scanning were not considered. In the following section, these latter consistencies are evaluated.

Considering constant errors of size estimation, Gardner and Long (1962a) failed to find significant correlations among size estimation scores for three different tasks with varied parameters of the standard and comparison stimuli. These variations apparently prevented consistent size estimation responding across tasks. This inconsistency cannot be attributed to a lack of reliability of size estimation scores; Gardner and Long (1962a) reported a test-retest reliability coefficient of .60 over 60 days, and Gardner and Long (1960) provided such reliabilities for a three-year period, ranging from .57 to .68.

Gardner and Long (1962b) did obtain significant correlations among size estimation scores from the five concentric-circles illusion tasks; the mean intercorrelation was .47 with a range from .25 to .74. The status of these tasks as scanning measures is ambiguous, however, as only two of the five tasks showed a significant correlation between size estimations and actual eye movements, both of which are supposedly measures of the same construct, scanning. Gardner (1961) using two versions of the standard size estimation task and two forms of an inverted _T_ illusion, obtained significant correlations between errors of estimation of the standard stimulus in these tasks; the mean correlation was .33, $p < .02$. Subjects therefore made consistent degrees of errors of estimation in the two situations.

There is therefore some evidence for individual differences in scanning styles as measured by eye movements and size estimation performance, although it is more compelling for eye movements. If these two variables are both measures of scanning, they should themselves be related. In two studies employing a total of seven measures of eye movement over eight size estimation tasks, significant correlations between size estimation performance and eye movements were found for four measures of eye movements over three size estimation tasks (Gardner and

Long, 1962a, 1962b).

The studies reviewed do not provide sufficient evidence to regard differences in natural eye movements as the sole or even a major source of variation in size estimation scores. Significant correlations between these variables, when obtained, were relatively small. Also, Neale and Cromwell (1968) found significant differences of size estimation performance among paranoid and nonparanoid schizophrenic groups using a 100 millisecond presentation of the standard stimulus--too short a time for differences of eye movements to be important. However, the size estimation measure in this experiment was not the standard task, as used by Gardner and Silverman. Line drawings of various scenes were presented photographically with subjects selecting an equal-sized picture from among six alternatives.

The present research was concerned with clarifying some major determinants of differences in size estimation performance by examining personality characteristics of subjects, using both correlational and experimental methods. Although Gardner and Long (1962a, 1962b) demonstrated a degree of relation between size estimation and eye movements, they did not deliberately alter the level of eye movement. Silverman, Berg and Kantor (1966) report an unpublished study in which a verbal set was used in an attempt to alter scanning. The results were equivocal, however, as the scanning measure used was an illusion task not clearly related to the usual size estimation apparatus, and the significant results reported were in terms of the numbers of subjects showing changes in the predicted direction, rather than a mean difference of illusion effect. The results above suggest that the relation of eye movements to size estimation scores should be examined by experimentally altering eye movement levels and noting the effect on estimations.

Scanning differences and their defensive significance. The section below reviews some of the group differences obtained with scanning measures and examines a functional interpretation of such differences involving psychological defenses.

Thomas and Stasiak (1964), using an eye marker camera to measure eye movements, found that psychiatric groups exhibited either very high or very low eye movement, with normals falling within these extremes. Davis, Cromwell and Held (1967), Harris (1957), and Silverman (1964a), using size estimation procedures, found differences in performance between paranoid and nonparanoid schizophrenics. Paranoids were found to underestimate the standard stimuli, indicating high scanning, while nonparanoids made overestimations, indicating low scanning. In addition, Silverman (1964a, 1967) found that the factors of premorbid adjustment and chronicity interact in a complex fashion with diagnostic category in relation to size estimation scores. Extremes on the scanning dimension can be defined by two schizophrenic groups; highest scanners are early-term good premorbid adjustment paranoids, and lowest scanners are early-term poor premorbid nonparanoids.

How are these group differences to be interpreted? Silverman (1964a) suggests that developmental factors in the lives of schizophrenics (cf. Singer and Wynne, 1963; Wynne and Singer, 1963) result in the differential reinforcement of particular scanning behaviours, thus gradually modifying their scanning, culminating in the extremes noted in schizophrenia. Scanning is thus seen as a basic means of altering attention, with approach-avoidance utility. Precedents for this concept of the learning of particular attentive styles can be found in the theories of Guthrie (1959) and Solly and Murphy (1960). Empirical documentation is also available (e.g., Farrow and Santos, 1962; Santos, Farrow and Haines, 1963; Solly and Santos, 1959; Silverman, 1963a).

Silverman (1964a, 1964b, 1967) has thus proposed that scanning serves a defensive function which is utilized to some degree by normals, but is exaggerated in pathological groups such as schizophrenics. High scanning paranoids are viewed as hyper-alert to cues in the environment which may signify threat. Anxiety is reduced not by avoiding stimuli but by seeking it and reinterpreting its significance. "The defensive manoeuvres of the preparanoid thus dispose him to constantly scan environmental input for possible threat to self-esteem and to deal with such threat by selectively examining and translating their meanings (Silverman, 1964a, p. 370)."

By contrast, low scanning nonparanoids are thought to avoid anxiety by encountering as little threatening stimuli as possible, and by directing their attention to internal processes such as hallucinations. Just as normals may reduce the threat potential of stimuli by averting their eyes, the nonparanoid schizophrenic is considered to reduce threat by chronically having a very low level of eye movement, thereby lowering the probability of processing disturbing stimuli. Furthermore, if such stimuli are encountered, his attention is restricted by low scanning to such a small portion of the stimulus that its overall significance is minimized. This severe defensive scanning posture has been termed "sensory input processing-ideational gating" by Silverman (1964a).

Silverman (1967) cites evidence for such a process in studies by De Vault (1955) and Draguns (1963). Draguns found experimentally that chronic nonparanoids often respond to diffuse, undifferentiated aspects of stimuli rather than to their connotative attributes.

> It was found in De Vault's study that heart rate deceleration, a response usually associated with simple sensory stimuli such as light or sound, was emitted by process chronic schizophrenics to pictorial stimuli connoting themes of hostility, dependency, sex, and to a verbal warning preceding a loud sound. In clear contrast to this reaction, the accelerated heart rate responsiveness of reactive chronic schizophrenics and of nonschizophrenics corresponded to that normally observed when subjects are presented with ideational stimuli such as meaningful pictures (Silverman, 1967, p. 39).

The interpretation of a defensive potential of scanning behaviour is not limited to pathological groups. In other studies cardiac deceleration to threatening stimuli was noted for a substantial number of nonclinical subjects (Lacey, Kagan and Moss, 1963; Luborsky, Blinder and Mackworth, 1963, 1964; Luborsky, Blinder and Schimek, 1965; Speisman, Lazarus, Mordkoff and Davidson, 1964). These results have been interpreted by Silverman (1967) as indicating a mild form of "ideational gating" in normals. Therefore for normals as well as for pathological subjects scanning behaviour has been given a functional significance.

These findings suggested that it would be profitable to explore relations among size estimation performance and personality traits of relevance to defensive processes. The use of normal groups for such exploratory work is advisable as differences of size estimations among schizophrenic groups could be related to spurious variables such as medication effects (cf. Goldberg, Klerman and Cole, 1965). In addition, nonspecific institutionalization factors have been shown to be important for scanning behaviour (Silverman, et al., 1966). The point is that hospitalized psychiatric patients differ from normal individuals in various ways besides their psychopathology (Kety, 1960), which may influence the size estimation process.

Size estimation and affectivity. Silverman (1964a, 1967) has hypothesized that arousal level may play a significant role in size estimations. Schizophrenic groups varying in chronicity and premorbid adjustment are seen as also varying in degree of anxiety, with consequences for their accuracy of estimation. Other studies indicate the importance of a variable variously named anxiety, arousal, emotionality, or affectivity in a variety of experimental situations involving attentional processes (cf. Agnew and Agnew, 1963; Callaway, 1959; Callaway and Brand, 1958; Callaway and Dembo, 1958; Callaway and Thompson, 1953; Carlson, 1961; Easterbrook, 1959; Illanit, 1961; Oltman, 1964, 1965; Tecce and Happ, 1964; Tecce and Tarnell, 1965; Zahn, 1960). The general finding is a narrowing of attention with increased affectivity (Wachtel, 1967). These results suggested that affectivity should be considered in relation to size estimation performance.

Some studies are available linking scanning differences to measures of affectivity. Luborsky, Blinder and Mackworth (1963, 1964) and Luborsky, Blinder and Schimek (1965) found high scanning of neutral, aggressive and sexual stimuli, as measured by eye movements, associated with Rorschach measures of isolation of affect. High scanning was related to Rorschach measures of isolation by Gardner and Long (1962b). Schlesinger (1954) found that a majority of subjects who made use of the defense of isolation exhibited minimal overestimation of the standard in a size estimation task. Isolation in this latter case was measured by the frequency of unclassified stimuli in a task which required subjects to classify pictures as to their emotional content.

Accordingly, relations between size estimation and a shallow effect scale (Jackson and Payne, 1963) were assessed in the present studies.

Size estimation and obsessiveness. The selection of further personality traits to consider in relation to size estimation was guided by the theoretical work of Shapiro (1965), which integrates the concept of cognitive control with a view of neurotic processes. Basically, Shapiro proposes that different types of neuroses can be thought of as neurotic "styles" each with an adaptive significance for the individual and each being manifested in a variety of the individuals' processes, such as perception, thinking, affective experience and behaviour.

> By 'style,' I mean a form or mode of functioning--the way or manner of a given area of behavior--that is identifiable, in an individual, through a range of his specific acts. By 'neurotic styles,' I mean those modes of functioning that seem characteristic, respectively, of the various neurotic conditions. I shall consider here, particularly, ways of thinking and perceiving, ways of experiencing emotion, modes of subjective experience in general, and modes of activity that are associated with various pathologies (Shapiro, 1965, p. 1).

Shapiro's book represents an application of the concept of cognitive controls to neurotic behaviour. Of particular interest and relevance to the present reseach is Shapiro's analysis of different attention processes in the neurotic styles discussed.

The attentive style of obsessive-compulsives is characterized by an intense, sharp focus on detail.

> The obsessive-compulsive's attention, although sharp, is in certain respects markedly limited in both mobility and range. These people not only concentrate; they seem always to be concentrating. And some aspects of the world are simply not to be apprehended by a sharply focussed and concentrated attention. Specifically, this is a mode of attention that seems unequipped for the casual or immediate impression.... These people seem unable to allow their attention to simply wander or passively permit it to be captured (Shapiro, 1965, pp. 27-28).

This sort of individual is seen as unable to naturally and easily activate and relax his focussed attention; he is always sharply but narrowly attentive. The obsessive-compulsive individual is very poorly suited for decision making.

> What distinguishes obsessional people in the face of a decision is not their mixed feelings, but rather the fact that those feelings are always so marvelously and perfectly balanced. In fact, it is easy to observe that just at the moment when an obsessional person seems to be approaching a decision, just when the balance is at last tipping decisively in one direction, he will discover some new item that reestablishes that perfect balance. The obsessive-compulsive person, in other words, shrinks from the act of decision (Shapiro, 1965, p. 46).

As the size estimation task involves careful attention to detail and requires decision making as the variable circle approaches accuracy, the variable of obsessiveness was included for evaluation in the present series of studies by comparing high and low obsessive groups.

Size estimation and preparanoid tendencies. Shapiro is also concerned with what he terms the paranoid style. The paranoid's attentive style is considered an exaggeration of that of obsessives, with a continuously acute, extremely narrow focus. This style of attention is never casual or passive; rather, it is "rigidly intentional" and biased.

> On the one hand, the paranoid person searches intensely for confirmation of his anticipations. On the other hand, those same rigid anticipations of what he will find allow him to feel entitled to discredit and disregard apparent contradiction. Between these two attitudes, he is bound to 'find' what he is looking

> for. In this process, intellectual capacity, keeness, and acuteness of attention become not guarantees of realistic judgment, but, on the contrary, instruments of bias. This keeness enables suspicious people to make, as they often do, brilliantly perceptive mistakes. Acuteness and intensity of attention, when it is this rigid, becomes exceedingly narrow in its focus; and the ultimate object of the suspicious person's intense, narrowly focused, and biased search is what we commonly call a 'clue.' The clue is the confirming evidence, perhaps insignificant to anyone else, that the suspicious person seizes on while at the same time disregarding all modifying and corrective facts that may surround it (Shapiro, 1965, p. 60).

The individual of paranoid style is thus seen as hypersensitive and hypervigilant, with exceptionally sharp perception guided by faulty judgment as to the significance of what is being perceived.

In the present studies, because of the characteristics attentive style of paranoid-style neurotics noted by Shapiro, and the findings of scanning style differences between paranoid schizophrenics and both normals and other schizophrenics, one of the personality scales included as relevant to size estimation was a measure of <u>pre</u>paranoid tendencies. The importance of this attentive style in the etiology of paranoid-based abnormalities would be enhanced by a finding of its relation to differences of paranoidal tendencies in a relatively normal group not subject to the influence of institutionalization and the prolonged treatment by others as abnormal.

<u>Size estimation and defendence</u>. Because of the functional significance attributed to scanning in terms of a broad defensive and vigilant posture, a scale of general defensiveness was included for the purpose of relating defensiveness scores to scanning style.

<u>Size estimation and impulsivity</u>. Shapiro (1965) extended his discussion of neurotic styles to include a style that does not exactly

coincide with any one category of psychiatric diagnosis--the impulsive style. The impulsive style is characterized by actions which are performed quickly, in the sense of a short period between thought and execution. An impulse, should it occur, is gratified quickly with little of the deliberation that less impulsive people would bring to bear. For the less impulsive person, an act may have its basis in a momentary impulse or whim, but the difference is that once the whim occurs it must pass cognitive hurdles of practicality and adequacy, and if of some significance, must be integrated into the individual's long-range plans before it is translated into action. It is not that the highly impulsive person is thought to have more impulses, but rather that they are more readily given expression. Shapiro suggests that the impulsive mode stems partially from a lack of stable interests, values and goals with which new short-range impulsive acts need to be integrated. If little such integration is required, there are few criteria to determine the advisability of acting on a new idea which has just occurred.

Again, what is of most interest is an understanding of the attentive process of impulsive individuals. Shapiro feels the attentive style of impulsive people can be characterized as relatively impressionistic, passive and concrete.

> If we say that the impulsive person's attention does not search actively and analytically, we may add that his attention is quite easily and completely captured; he sees what strikes him, and what strikes him is not only the starting point of a cognitive integrative process, but also, substantially, it is its conclusion. In this sense, his cognition may be called <u>passive</u>. Second, if he does not search--critically examine this aspect and that aspect--he does not perceive things in their potential and logical significance, but sees them only in their

> most obvious, immediately personally relevant qualities. In this sense, the impulsive mode of cognition is relatively concrete (Shapiro, 1965, pp. 150-151).

The general attentive style of impulsive individuals is therefore poorly focussed without sustained direction. Aside from these theoretical considerations, there is an empirical basis for linking impulsivity and style of attention. For example, Gardner and Long (1962b) found a relationship between scanning measure scores and scores from a color word interference test (r = -.38). This finding was considered important because adept performance on the color-word test has been related to inhibition of impulse expression, (Holt, 1960; Klein, 1954, 1964; Levine and Springle, 1959). The direction of the relationship is such that high scanners show a relatively low level of impulse expression.

Various results with time measures also indicate that impulsivity is relevant to size estimation. High scanning has been found to be related to longer reading times on the color-word test, to longer times scanning inkblots before giving initial responses, and to a Rorschach measure of generalized delay (Gardner et al., 1959; Gardner and Long, 1962b). "It appears possible that extensive deployment of attention has the secondary consequence of slowing down the selection of relevant details. The availability of several alternatives can prevent speedy appraisal and choice of one only, (Gardner et al., 1959, p. 85)." Presumably, longer decision times in experimental situations reflect low impulsivity and shorter times reflect higher impulsivity. Further evidence that extensive scanning slows decision making is provided by Gardner and Long (1962a). They found that high scanning was related to longer judgment times in size estimation tasks, and to longer periods spent checking the final setting of the variable stimulus before deciding that this final setting was accurate.

The studies reviewed suggested that impulse regulation may have an important bearing on size estimation performance, and that degree of impulsivity should be of relevance to the individual's habitual scanning disposition. Therefore, a scale assessing degree of impulsivity was incorporated in the present studies.

In summary, the present research was concerned with clarifying the bases for reliable individual and group differences of the cognitive control of scanning, as inferred from size estimation performance. The literature reviewed indicated that scanning differences may in part be due to differences in the personality traits of shallow affect, obsessiveness, preparanoid tendencies, defendence and impulsivity. Accordingly, both group differences on these variables and experimental manipulations of behaviours relevant to the above traits were related to size estimation performance. Finally, the significance of eye movement levels for the size estimation process was assessed by affecting deliberate alterations of degree of subjects' eye movements.

CHAPTER II

PERSONALITY TRAITS AND EYE MOVEMENTS AS DETERMINANTS OF SIZE ESTIMATES

Introduction

The present research sought in a series of studies to explicate relations between personality traits, and scanning behaviour as measured by a size estimation task. To this end, group differences were utilized in the carefully selected traits of affectivity, obsessiveness, preparanoid tendencies, defendence and impulsivity. It was thought that the relevance of such traits to scanning could be more clearly indicated by experimental manipulations of behaviour moderated by the traits of interest. The demonstration of correlations between these traits and size estimation would alone be significant, because of the lack of common method variance, which frequently elevates intercorrelations (cf. Campbell and Fiske, 1959). However, if manipulations of subject behaviour relevant to personality traits produces changes of scanning in the manner and direction anticipated from our knowledge of scanning styles, the result will be an enrichment of the theoretical construct of scanning.

Accordingly, various possible experimental manipulations were considered. It was decided that impulsive behaviour could be readily manipulated by restricting the amount of time available to perform size estimation. Thus, differences of estimation anticipated between high and low impulsive subjects under natural unspeeded conditions could be minimized by forcing low impulsive subjects to perform more quickly. Their performance should then be similar to high impulsive subjects.

In view of the past use of both size estimation and eye movement levels as indicators of scanning, it was considered important to show that changes of eye movement level are related to changes of size estimation. The use of an instructional set to alter degree of eye movement would have the additional advantage of providing a manipulation for behaviour relevant to the more pathologically oriented traits of obsessiveness, preparanoia and defendence. From the literature review, it would be expected that higher levels of these traits would result in a higher level of scanning, reflected both in group differences of eye movements and size estimation performance. Experimentally increasing the level of eye movements is equivalent to raising the defendence, preparanoia and obsessiveness of the subjects with low initial levels of these traits, and should cause them to perform size estimates more in the manner of the high trait groups.

The following hypotheses are relevant to the first experiment. Additional hypotheses appear in the appropriate sections of following experiments:

(a) An instructional set will be effective in reliably increasing the frequency of eye movements utilized by subjects in the size estimation task.

(b) Experimentally increased eye movement levels will be associated with reduced overestimation of the standard circle in the size estimation task. This expectation was based on the finding of a relation between size estimation scores and subject's preferred, natural level of eye movements, such that high eye movements were related to low overestimation.

(c) An instructional set to decrease the time subjects utilize to make their size estimations will result in a greater degree of overestimation. This prediction was suggested by the relevance of impulsivity to size estimation. Forcing subjects to take less time is in effect an experimental increase of impulsivity. It is expected that a higher induced level of impulsivity will result in higher overestimation, and a reduced frequency of eye movements.

(d) Degree of size overestimation will be negatively associated with the subjects' levels of defensiveness, preparanoia, and obsessiveness and positively associated with shallow affect. These expectations were based on the defensive functional significance attributed to scanning differences, as outlined in Chapter I.

Method

Individual Differences Measures

Personality assessment scales were selected from available measures to form a 180-item questionnaire. The final group of five scales included in the questionnaire were selected on the basis of their relevance to personality traits hypothesized to be of significance for the size estimation process. Two additional scales were used to assess the validity of subjects' responses to the questionnaire items. The complete personality questionnaire with the subscale and direction of keying of each item appears in Appendix A. For each scale half the items were keyed in the true direction and half were keyed false.

A brief description of all the individual differences measures, including the scanning measure, follows:

1. Infrequency: This 20-item scale (Personality Research Form AA, Jackson, 1967) was used to evaluate the purposefulness of subjects' responding. This scale was composed of items with a low probability of endorsement, for example, "I am over 90 years old." A high infrequency score may be due to carelessness, confusion or a lack of cooperation by the subject and suggests that scores obtained from other scales should be interpreted cautiously.

2. Desirability: The 20-item desirability scale (Personality Research Form AA, Jackson, 1967) indicated the degree to which subjects focused on the desirability of the content of items rather than relating their responses to their own behaviour. A typical item is, "I always try to be considerate of the feelings of my friends." A high desirability score may be due to an attempt to present an excessively good impression, unusually high self-regard or some combination of the two, and also indicates a need for caution in accepting the other scale scores as valid.

3. Impulsivity: Degree of impulsiveity was measured with a 40-item scale (Personality Research Forms AA and BB, Jackson, 1967). A high score on this scale is indicative of spontaneity in speech and

action and a lack of deliberation, as reflected in items such as "I have, at times, hurt someone unintentionally because I didn't think before speaking."

4. Defendence: The endorsement of statements in this 20-item scale (Personality Research Form AA, Jackson, 1967) is indicative of an unwillingness to admit even minor common faults or failures, for example, "I try never to allow anyone to get the upper hand with me."

5. Obsessiveness: A 30-item scale (unpublished Jackson, 1967) was used to measure the extent of obsessiveness, as reflected by items such as "Certain questions go through my mind over and over again." High obsessiveness scores indicate an above average interest in the control and detailed organization of thoughts and behaviour.

6. Preparanoia: High scores on the preparanoia scale (unpublished, Jackson, 1967) indicated the presence of paranoid-like thought processes and behaviours. A typical item is "I hesitate to tell others how I feel about certain things." The item content reflects withdrawal with an unwillingness to trust others or confide thoughts or emotions.

7. Shallow Affect: This 20-item scale (Jackson and Payne, 1963) was included to assess the customary breadth and depth of emotional experience of the subjects, as indicated by items such as, "It wouldn't bother me to see someone die." Shallow affect is indicated by a high scale score.

8. Size Estimation task: This measure was used as an indicator of individual differences of scanning strategies among subjects. The apparatus and procedure were adapted from the scanning-control task reported by Silverman (1964).

Size estimation apparatus

A variable-size stimulus was formed by directing the beam of a 10-watt concentrated arc lamp (Sylvania C10 DC) through a circular iris diaphragm onto a 5-inch square double diamond glass screen, sandblasted on both sides. A smooth-edged circular patch of light of uniform brightness resulted. The light source and glass screen were located at opposite ends of a 45-inch x 10-inch x 16-inch rectangular box which isolated the light beam from external influences (see Figure 1). An internal baffle and flat black paint were used to minimize light reflection within the apparatus, thereby reducing the brightness of the circle's surroundings on the screen and enhancing the definition of the circle's edge. Normal room illumination was used throughout the experiment, allowing a clear view of the variable circle.

The circle's size was varied by turning a control knob which drove a pulley system attached to the variable iris diaphragm. Connecting the control knob shaft and the pulley system was a gearbox such that one complete turn of the control knob resulted in .125 revolutions being transmitted from the gearbox to the pulley, which in turn produced a .138-inch change in the circle's diameter. The circle could be varied through its entire size range of 3.59 inches to .75 inches in diameter by 20 complete rotations of the control knob.

Onset and offset of the light circle was controlled by a hand-bulb-operated camera shutter placed in the light beam between the iris and the lamp. Movement of the shutter arm depressed a microswitch which through a relay operated a timer for recording the length of time subjects took to make their size judgments.

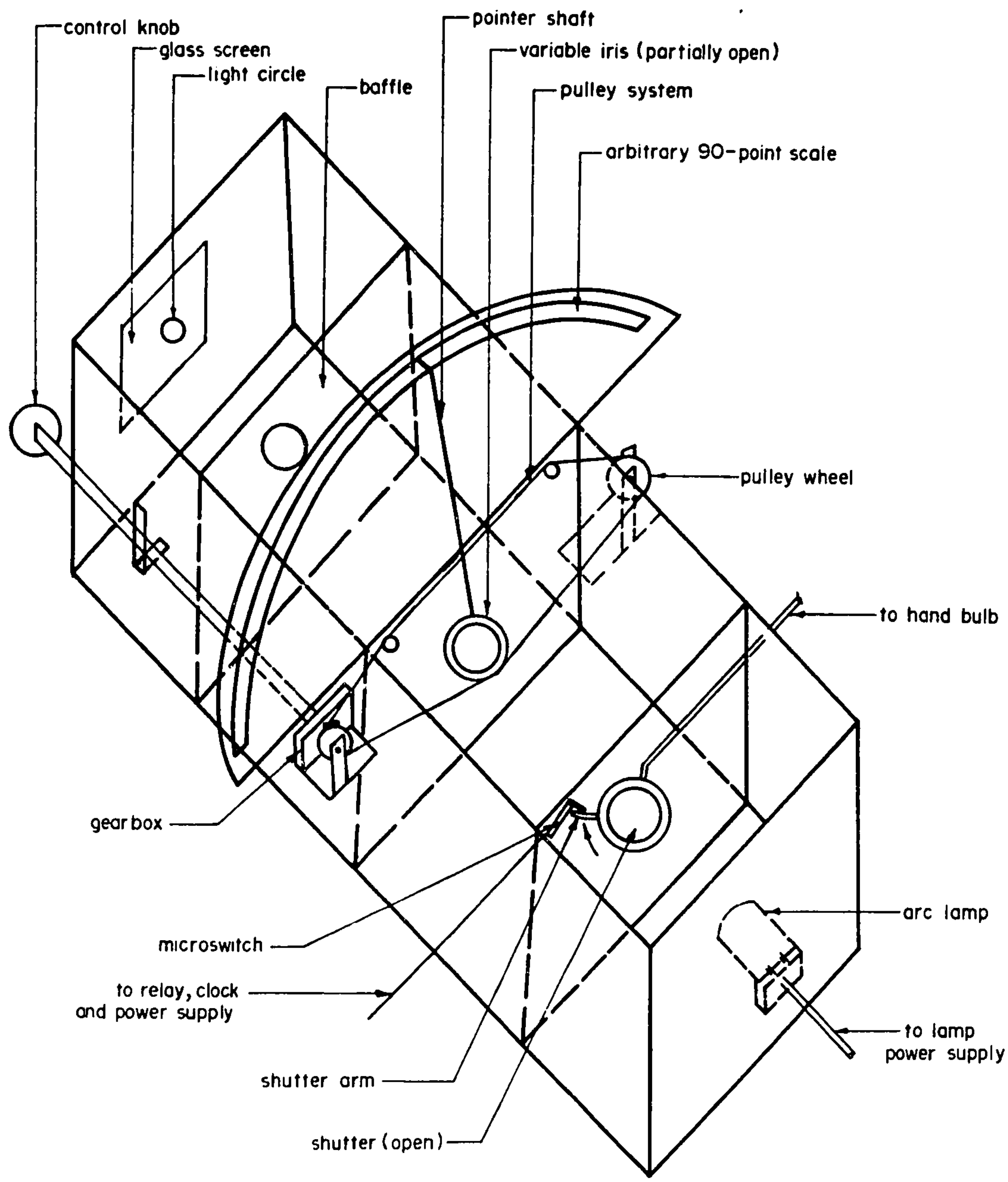


Figure I Size Estimation Apparatus

Accuracy of size matching was measured by a pointer fastened to an 8-inch vertical shaft mounted on the moving portion of the iris. Full travel of the iris moved the pointer through 90 degrees over an arbitrary scale of 180 intervals.

The standard circle, the size of which was to be matched consisted of a circular grey aluminum disc 1.93 inches in diameter, of .93 inches thickness. This disc was glued to a 4.5-inch x 7.5-inch dull white cardboard backing which was mounted vertically 15.5 inches from the subject with the disc's flat surface presented, at the same height as the variable circle but at an angle of 45 degrees to the left of the variable circle.

Subjects

The subjects in this study were 14 male undergraduate students enrolled in introductory psychology at The University of Western Ontario.

Procedure

Subjects for the first and second studies were obtained by soliciting male volunteers from introductory psychology classes. A total of 126 males were administered the personality scales in group testing sessions of approximately 40 minutes duration (one session per subject). At that time, 14 subjects for the first study were randomly selected and scheduled for further individual experimental sessions of 30 minutes duration.

Upon entering the individual experimental session, the subject was seated before the size estimation apparatus and his head placed in a chin rest 15.5 inches from standard and variable stimuli, so that he was directly facing the variable circle. Provisions were made for the recording of gross eye movements by placing two recording electrodes at the horizontal margins of the subject's left eye, with a third ground electrode placed behind the left ear. The electrode leads terminated in a Grass 5P3 input cable which was connected to a Grass 5P1 low level DC preamplifier. The output from a Grass 5P4 amplifier drove an ink-writing oscillograph.

Subjects were instructed concerning the size estimation task, with emphasis placed on accuracy and holding the head stationary so that only the eyes moved during comparisons (for complete instructions for all experimental conditions, see Appendix B). By preventing head movements during the task, a possible artifact was suppressed in the eye movement records.

Each subject performed 12 size estimation trials. Two trials were used for each of six experimental conditions to allow the assessment of reliability within conditions. The six conditions utilized in experiment 1 in chronological order (see Figure 2) were as below:

1. Subjects were allowed to perform the size estimation at their individual preferred levels of speed and eye movement.

2. Subjects were alternatively assigned to one of SCAN SET and NO SCAN SET conditions, resulting in two groups of seven subjects each. The SCAN SET subjects received instructions to look back and forth as much as possible between the two circles while making their size judgments for all remaining trials in the experiment. They were told that they were not necessarily to perform at a different speed or take a

Group	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
SCAN SET GROUP	preferred speed	preferred speed	moderate speed set	high speed set	return to preferred speed	preferred speed
	preferred level of eye movement	high scan set	high scan set	high scan set	high scan set	low scan set
NO SCAN SET GROUP	preferred speed	preferred speed	moderate speed set	high speed set	return to preferred speed	preferred speed
	preferred level of eye movement	preferred level of eye movement	preferred level of eye movement	preferred level of eye movement	preferred level of eye movement	preferred level of eye movement

BLOCKS

Figure 2 Experimental Conditions in Chronological Order different amount of time than before, but they were to look back and forth as much as possible in the length of time they did take. The NO SCAN SET subjects received no instructions regarding eye movements; they were simply required to perform two more trials at their preferred speed and eye movement levels as in the first condition. This allowed them to act as a control group to assess the effects of the scan set instructions on size estimation. In this condition, all subjects were still allowed to perform at their individual preferred speeds. If they inquired about time limits in conditions one or two they were told that none existed.

3. In this condition, all subjects were further instructed that there was now a time limit of 30 to 40 seconds in which to complete each size estimation. This time period was determined after an examination of pilot data as sufficient to induce a set for speeded performance on the part of most subjects, while not being so short as to cause them to abandon accuracy. A variable period of time was suggested so as to minimize the value of subjects counting the time to themselves and thus attending more to time estimation than size estimation. Regardless of how long subjects took in this condition, they were allowed to complete their judgments. This moderate speed set condition was included in the event that extreme speeding resulted in unreliable performance.

4. All subjects were required to perform as quickly as possible, while not entirely neglecting accuracy. Comparisons among this high speed set condition, the moderate speed set trials, and the nonspeeded initial condition allowed an assessment of the effects of varying degrees of speeding of performance on accuracy of size estimation.

5. All subjects were told that they were to revert to working at their preferred speed with the emphasis on accuracy. This condition provided a new baseline level of performance for further experimental manipulations of eye movements. The SCAN SET subjects were still required to look back and forth as much as possible. In conditions two to five the SCAN SET subjects were repeatedly reminded before each trial of the need to continue a high level of eye movement. In addition, all subjects were reminded of the time limitations of particular trials, for example, 30 to 40 seconds.

6. Again, all subjects were told they were to work at their preferred speeds. For the NO SCAN SET subjects, this constituted another normal condition similar to the first two conditions for them, and to the previous one. They utilized a preferred time period and level of eye movement. However, the SCAN SET subjects had their set changed at this point to a low rather than a high frequency of comparisons. They were instructed to deliberately reduce the number of comparisons they made, while still striving for accuracy. This condition was included because it was felt that the influence of eye movements on size estimation would be more powerfully indicated if it could be effective for both experimentally increased and decreased levels of eye movement.

The experimental design seen in Figure 2 allowed an evaluation of the effects of scan and speed sets on size estimation, both alone and in interaction.

The effect of differing degrees of eye movement on size estimation was evaluated by contrasting the performance of SCAN SET and NO

SCAN SET groups. It was predicted that the SCAN SET group would have a lower degree of overestimation of the standard circle in all conditions except the first and last: in the first condition before introduction of the scan set, there would be no difference, and in the last condition the SCAN SET group should overestimate more than the NO SCAN SET group. In addition, the SCAN SET subjects were expected to differ from their own performance in the first condition, in the direction of less overestimation, with an increase of overestimation in the final low scan set condition.

The speed set manipulation was investigated by comparing the size estimation performance of subjects during moderate and high speed trials with their performance on preferred speed trials. The expectation was that speeding would result in greater overestimation because of a reduction in the time taken, and hence less opportunity for scanning.

In order to attribute differences in size estimation performance among experimental conditions to the verbal set, manipulations of performance speed and eye movement level, the operation of these sets must be validated. The efficacy of the scan set instructions was determined by comparing the frequency of gross eye movements obtained from the oscillograph records among high, low and no scan set conditions of the design in Figure 2. The speed set conditions' effectiveness were evaluated by comparing moderate and preferred speed set conditions.

A typical size estimation trial proceeded as follows: the subject was given the verbal instructions for the condition, or a brief resume if the second trial of that condition. After a warning "ready" from the experimenter, the shutter bulb was operated to expose the variable circle and start the timer. Simultaneously, the oscillograph pen was switched on to record gross eye movements during the trial. After the subject verbally indicated completion of his judgment, the shutter bulb was again depressed, turning off the variable circle and stopping the timer. The oscillograph pen was switched off simultaneously to indicate the end of the trial in the eye movement records. The experimenter then recorded the time taken and reset the clock. Accuracy of size estimation was read from the arbitrary scale and the variable circle size reset for the next trial. Two starting sizes were used for the variable circle throughout the 12 trials; 3.5 inches and 3.0 inches in diameter. The larger size was used for the first trial of each experimental condition, and the smaller for the second trial.

Although two trials were used in each experimental condition to allow assessment of the reliability of performance within conditions, all analyses made use of subjects' average scores for the two trials of each speed set condition resulting in six scores per subject. This averaging was applied to size estimation, time taken, and eye movement scores.

All analyses using size estimation scores were expressed in the arbitrary scores obtained from the size estimation apparatus scale. A conversion table expressing these units in inches of diameter of the variable circle is provided in Appendix C.

Eye movement data for each subject consisted of the average frequency with which he looked between variable and standard circles for the two trials of each experimental condition. One "look" was defined as one such change in the direction of attention. Frequency of looks was obtained from the raw oscillograph records by counting the number of large magnitude deflections which a pilot study indicated were due to changing the direction of gaze from one stimulus to another. As a check, at the end of each subject's individual experimental session, he was required to look back and forth between standard and variable stimuli to the count of ten, one count per second, while the experimenter directly observed changes of direction of the subjects' attention. The average magnitude of deflection in the eye movement records produced by these ten observed deliberate eye movements (the head being stationary), was used as the criterion of a large magnitude deflection for scoring purposes for that subject. A typical eye movement record in raw oscillograph form together with its scoring are presented in Appendix D.

The method of scoring of eye movement records did not allow positive identification of discrete looks about one stimulus only (for example, the thoroughness with which a subject inspected the circumference of the standard stimulus), but did result in a detection of changes in the stimulus being viewed by the subject, that is, the standard or variable stimulus.

Results and Discussion

The present section first presents the effects on gross eye movements of verbal sets for increased eye movement and reduced size estimation time. The influence of these sets on size estimation performance is then considered. Finally, tentative conclusions are drawn concerning personality correlates of the size estimation process.

Frequency of looks

The results of the scan and speed sets on looking behaviour appear in Figure 3. (Experimental conditions underlying the blocks referred to in Figure 3 and all following figures are listed in detail in Figure 2.) The figure presents the average frequencies of looks obtained by SCAN SET and NO SCAN SET groups over the different speed conditions. These data were analyzed by means of a 2 x 6 repeated measures analysis of variance with scan set and speed set as independent variables (see Tables 1a and 1b).

The anticipated effect of the scan set manipulation was an interaction between SCAN SET groups and the repeated trials of the speed set condition. As the instructional set to change the level of eye movements of the SCAN SET group was not introduced until both SCAN SET and NO SCAN SET groups performed two size estimation trials at their preferred eye movement levels and speeds, no difference of size estimation performance was expected between these groups until the second trial block (see Figure 2). The significant main effect for the scan set variable indicates that the SCAN SET subjects exhibited a higher average frequency of looks across all the repeated size estimation trial blocks than the NO SCAN SET subjects.

The main effect for the speed set conditions was also significant, suggesting that reducing the time available for subjects to make

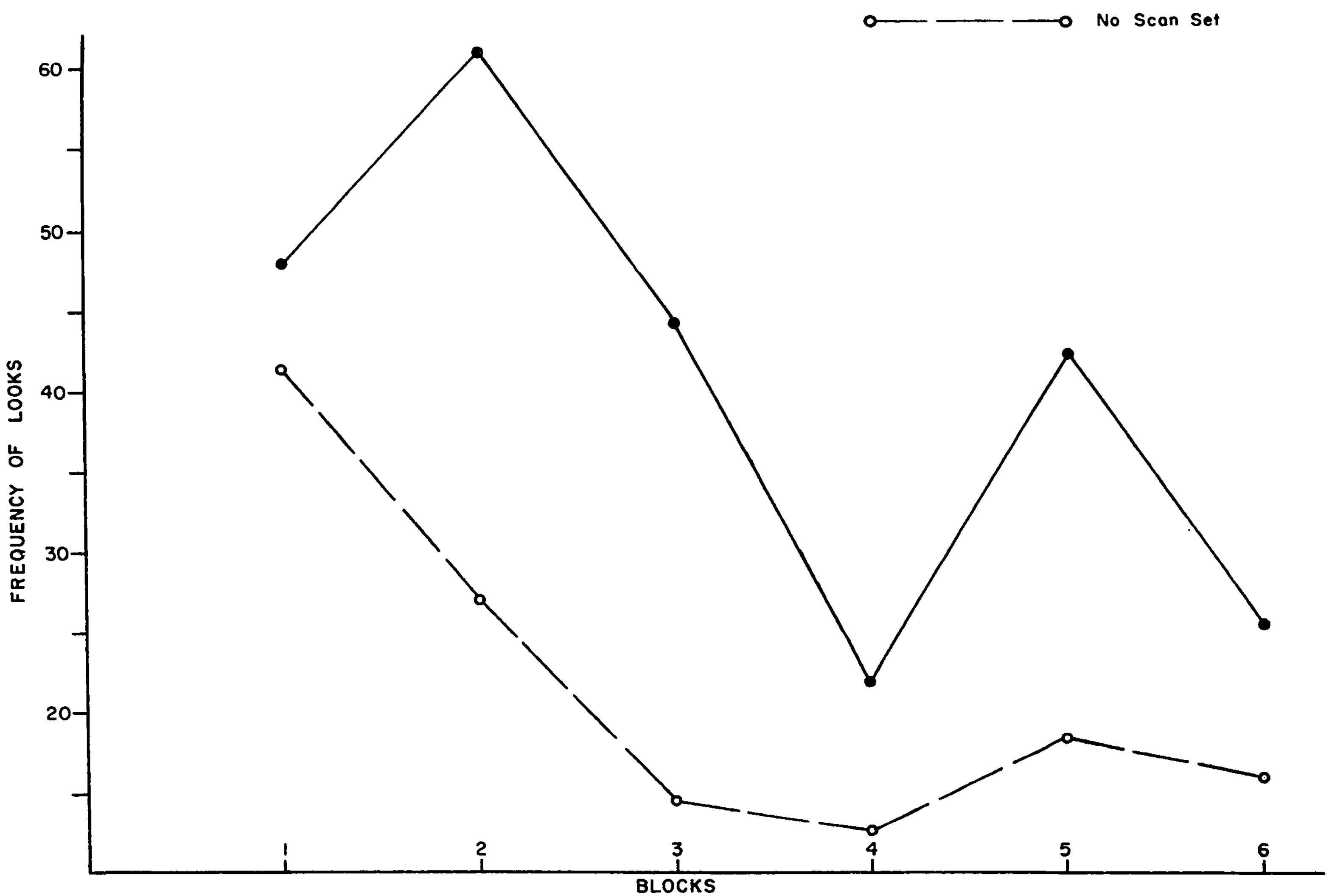


Figure 3 Mean Frequencies of Looks for All Subjects Under Scan Set and Speed Set Instructions

TABLE 1a

Mean frequencies of looks over speed set blocks as a function of scan set instructions

	B1	B2	B3	B4	B5	B6
A1	47.00	60.14	43.36	22.07	41.57	25.64
A2	40.43	27.29	14.43	12.79	18.43	15.93

TABLE 1b

Summary of analysis of variance of mean frequencies of looks as a function of scan set and speed instructions

Source		Sums of Squares	df	Mean Squares	F
Between S's		19005.788	13		
A	Scan Set	7122.646	1	7122.646	7.19**
	Error	11883.143	12	990.262	
Within S's		15234.459	70		
B	Speed Set	8636.657	5	1727.331	23.80****
	A X B	2242.730	5	448.546	6.18****
	B X S's	4355.072	60	72.585	
Total		34240.247	83		

** $p < .05$
****$p < .001$

their size judgments influenced looking behaviour. The total group of subjects showed a decline in the frequency of looking across speed set conditions, particularly under the high speed set trials.

The hypothesized effects of both set conditions on looking behaviour were obtained in their significant interaction, as seen in Figure 3. The SCAN SET group did not initially differ from the NO SCAN SET group. After introduction of the scan set instructions in trial block two, the SCAN SET group had a significantly higher frequency of looks over all other trial blocks except those of the fourth and last conditions, representing respectively, the high speed set and the low scan set conditions. Speeding apparently reduced the amount of time available for SCAN SET subjects to compare stimuli, so that they were not able to look back and forth more than NO SCAN SET subjects in the fast speed set condition.

In the final condition, the SCAN SET group had instructions to deliberately lower their frequency of eye movements. This reduction returned them to the level of eye movement of the NO SCAN SET group. Both groups had a decline of frequency of looks with repeated trials, as indicated by their level of eye movement in the fifth block, when they were to return to a preferred speed of performance. Subjects increased their level of eye movement in this condition to that exhibited in the moderate speed set condition rather than that obtained in the initial preferred speed conditions (trial blocks one and two). These results suggest that subjects relatively quickly learn approximately how much the variable circle must be reduced in size, so that the majority of looks for a given trial tend increasingly to occur in the period when the circles are approaching equality.

It is clear from these analyses that gross looking behaviour was influenced by verbal instructions, and that therefore the scan set was an effective manipulation. In addition, a set for speed had the result of reducing the frequency of looks. Low scanning instructions and high speed instructions produce comparable outcomes regarding frequency of looks.

As Gardner and Long (1962a) regard individual differences of eye movements to be a measure of scanning, the present results have implications for the scanning construct. In the speeded trial blocks, subjects reduced their frequency of looks, that is, scanned less. As reducing the time available to make size estimations was considered an experimental analogue of increased impulsivity, the present results indicate that impulsivity level may be of significance for degree of scanning, as defined by eye movements. This conclusion is based on the assumption that higher impulsivity levels are reflected in shorter judgment and performance times. Thus, forcing subjects to take less time was thought to be equivalent to using a group of subjects with a higher level of impulsivity.

Speed set and size estimation time

To verify that the speed set conditions altered not only the time perceived to be available but also the actual time taken, an analysis of the average time taken to make size judgments for SCAN SET and NO SCAN SET subjects was performed over the speed set conditions. A 2 x 6 repeated measures analysis of variance (see Tables 2a and 2b) revealed a significant main effect for speed set. As can be seen in Figure 4, there was a decline in amount of time taken with speeding instructions, and an increase in time taken in the later normal speed block. These results indicate that the speed set instructions were effective and thus the changes in frequency of looks with speed set trial blocks already cited can be attributed to changes in the amount of time taken to make size estimations. Therefore, the total sample can be considered to have acted more impulsively because of the speeding instructions.

Size estimation and verbal sets

The influence of scan and speed set conditions on size estimation scores was assessed by a 2 x 6 repeated measures analysis of variance with scan and speed set conditions as independent variables (Tables 3a and 3b). As can be seen in Figure 5, the SCAN SET subjects overestimated significantly more over all speed set blocks including the initial trial block, before the scan set was introduced.

Therefore, the difference found between these two groups cannot be attributed to the scan set manipulation, and the predicted relation of a reduction of size overestimation with the increase of eye movements was not obtained.

In order to clarify the cause of the initial difference of size estimation performance found between SCAN SET and NO SCAN SET groups, personality correlates of the size estimation task were sought.

TABLE 2a

Mean times taken over speed set blocks
as a function of scan set instructions

	B1	B2	B3	B4	B5	B6
A1	50.71	45.47	30.79	14.49	32.02	26.98
A2	51.79	31.37	19.21	12.12	23.41	21.54

TABLE 2b

Summary of analysis of variance of
mean times taken as a function of
scan set and speed set instructions

Source		Sums of Squares	df	Mean Squares	F
Between S's		5522.722	11		
A	Scan Set	841.300	1	841.300	1.80
	Error	4681.422	10	468.142	
Within S's		14749.307	60		
B	Speed Set	10371.833	5	2074.367	26.68****
	A X B	489.191	5	97.838	1.26
	B X S's	3888.282	50	77.766	
Total		20272.028	71		

**** $p < .001$

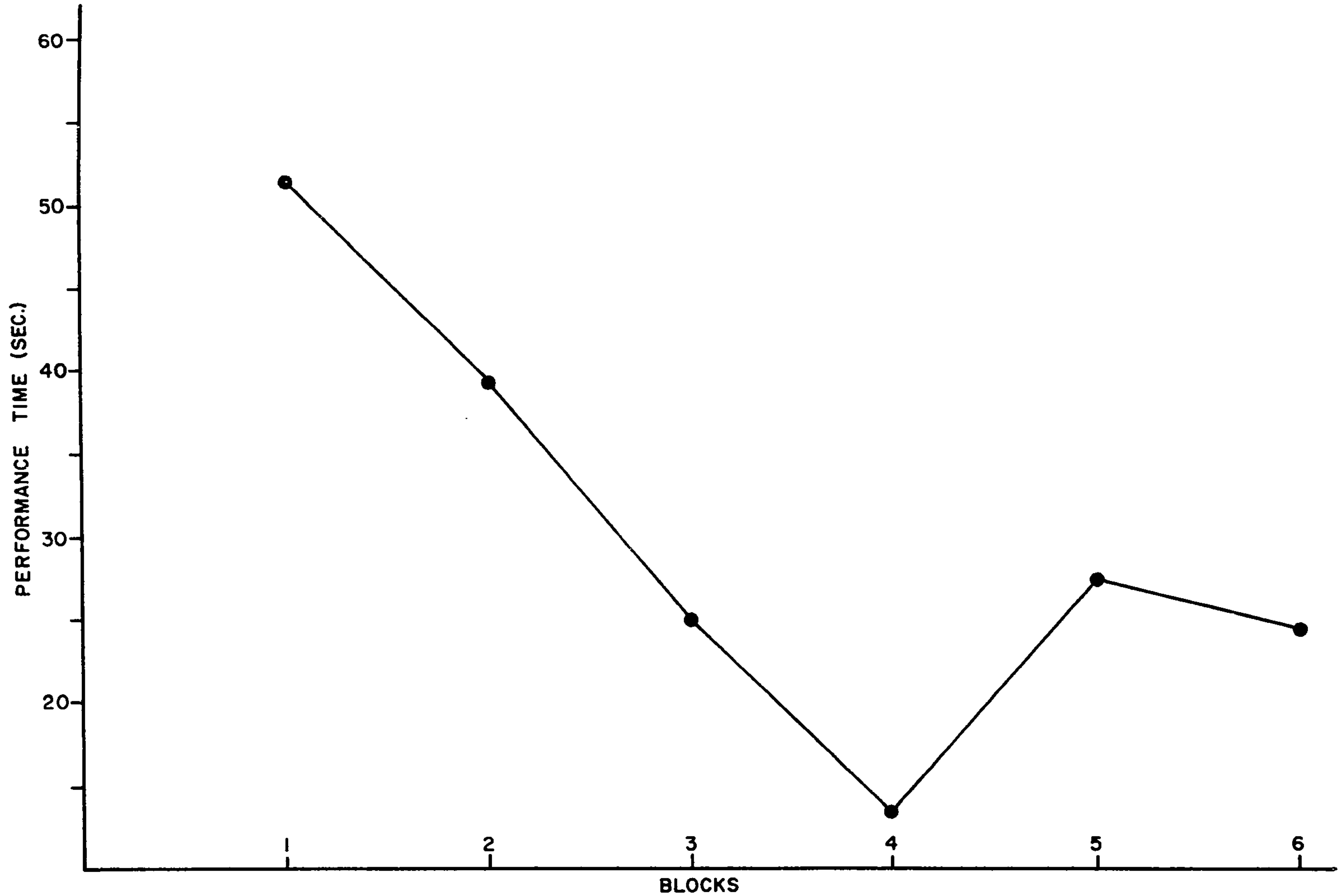


Figure 4 Mean Times Taken for All Subjects Under Scan and Speed Set Instructions

TABLE 3a

Mean size estimates over speed set blocks as a function of scan set instructions

	B1	B2	B3	B4	B5	B6
A1	37.85	38.15	37.40	38.55	37.77	37.25
B2	34.39	35.20	34.98	35.34	35.20	34.38

TABLE 3b

Summary of analysis of variance of mean size estimates as a function of scan set and speed set instructions

Source	Sums of Squares	df	Mean Squares	F
<u>Between S's</u>	254.442	11		
A Scan Set	152.779	1	152.779	15.03***
Error	101.663	10	10.166	
<u>Within S's</u>	86.666	60		
B Speed Set	10.023	5	2.005	1.35
A X B	2.236	5	0.447	0.30
B X S's	74.407	50	1.488	
Total	341.108	71		

*** $p < .01$

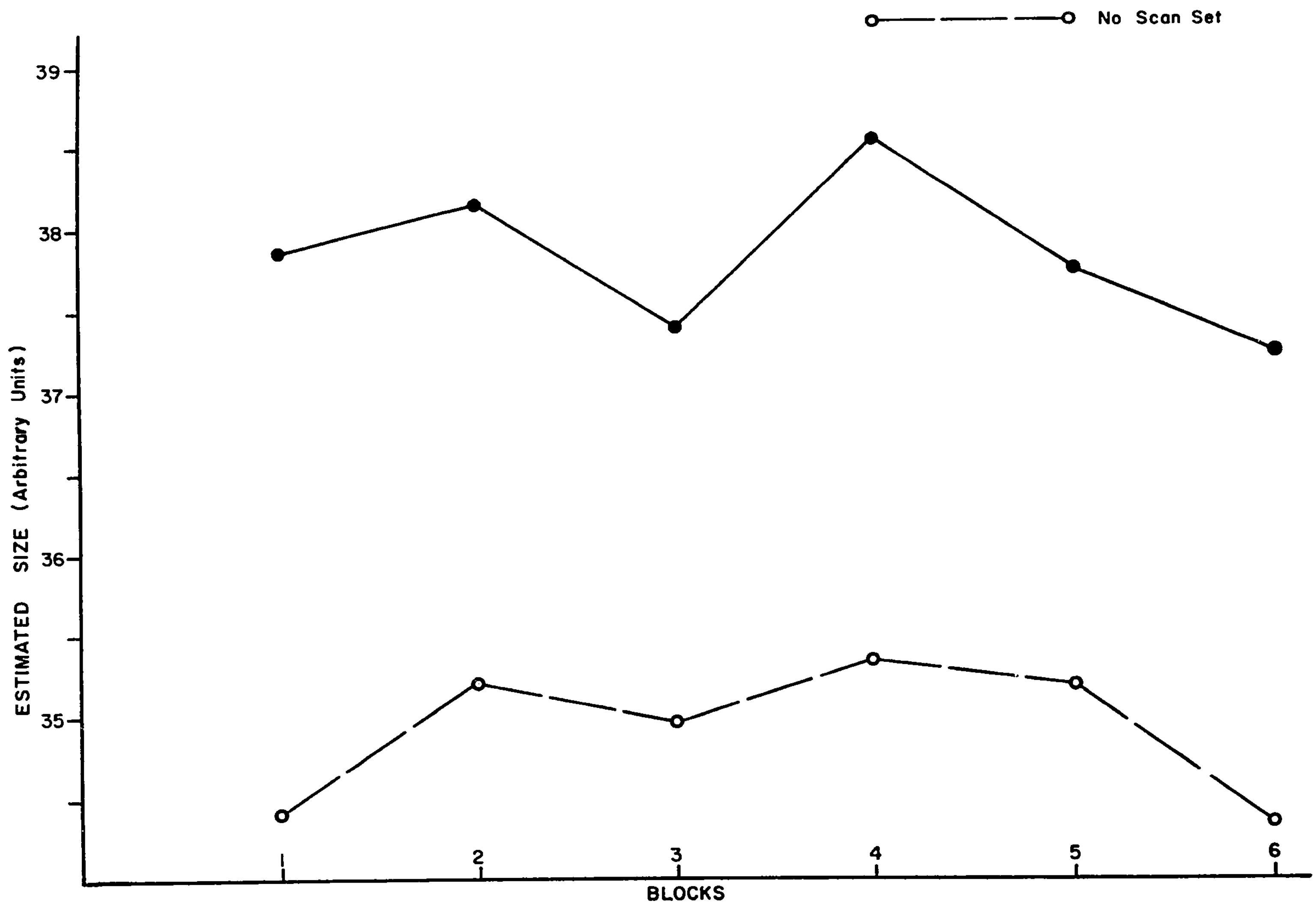


Figure 5 Mean Size Estimates for All Subjects Under Scan Set and Speed Set Instructions

It was hypothesized that a chance difference of personality scale scores between the above groups on one or more traits correlated with the size estimation process accounted for their initial differences of size estimation. An examination of personality correlates of size estimation in the next section provides some suggestions as to the nature of these traits. These suggestions must be viewed as tentative, because of the small group of subjects involved in this initial pilot study.

Size estimation and personality variables

The present study, designated Experiment 1, was frankly exploratory. Its inclusion in the report of this series of three studies was justified by some promising but at the time not conclusive results, which generated further hypotheses regarding determinants of difference of size estimation performance. Some of the more interesting results obtained in Experiment 1 dealt with relations between the personality characteristics of subjects and their size estimation performance.

Impulsivity. Intercorrelation of the personality scale variables with size estimation scores and frequency of looks over the six conditions of Experiment 1 are presented in Table 4. (Summary statistics for the scored personality scales appear in Table 5 in connection with Experiment 2.) Despite the small sample size, there were a few statistically significant correlations appearing in the context of other correlations of the same sign, implying a degree of consistency. Impulsivity had a consistent negative relation to size estimation such that greater impulsivity was associated with lower overestimation.

TABLE 4

Correlations between personality scales and size estimates over experimental conditions: Experiment 1

Size Estimation Trials	Personality Traits* a	b	c	d	e
1				.22	
2				.33	.21
3		-.24			
4	-.44	-.22		.28	
5	-.51	-.28		.31	
6	-.32			.21	
7				.32	
8			.20	.49	.33
9	-.42	-.26	-.39		
10	-.38	-.43	-.41		
11	-.29		-.26		
12		.34			

* a Impulsivity
b Defendence
c Preparanoia
d Obsessiveness
e Shallow Affect

df = 12 p.10 = .46 p.05 = .53

Only those correlations with an absolute value of .20 or greater are reported.

As there was a suggestive, though statistically nonsignificant, difference between the mean impulsivity scores of SCAN SET (13.14) and NO SCAN SET (17.29) groups, it was felt that the impulsivity variable could be partially responsible for their initial difference of size estimation performance, before introduction of the scan set condition. These results suggested that subjects' levels of impulsivity should be considered in relation to size estimations. Also, by taking into account subjects' impulsivity levels, it may be easier to show the effect of scan set instructions on size estimation. This expectation was based on the assumption that impulsivity contributed to the difference found initially between SCAN SET and NO SCAN SET groups. Controlling impulsivity levels by including it as an independent variable may lead to a lack of initial difference of size estimation between the above groups.

Despite the exploratory nature of Experiment 1, the lack of a significant main effect for the speed set conditions (see Tables 3a and 3b) was a further indication for dividing subjects into relatively high and low impulsivity groups. Speeding did not affect accuracy of size estimation, despite subjects taking less time in the speeded condition and thus acting more impulsively (see Figure 4). The effects of reduction of time available for size estimation as a manipulation of impulsivity could be facilitated by using high and low impulsive groups. It could well be that reduction of time available would most affect the performance of low impulsive subjects who can more easily be made to act more impulsively. High impulsive subjects, because they characteristically perform rapidly, should show little or no effect from a speeding of their performance. Thus, the effects of both scan and speed sets would be clarified by the use of high and low impulsive subjects.

Obsessiveness. Tentative evidence was found of a relation between size estimation performance and the personality trait of obsessiveness (see Table 4). High obsessiveness was associated with relatively high overestimation of the standard circle. As the direction of this relationship is contrary to what might be expected, it was considered of importance to replicate this finding with a larger sample. In addition, it was anticipated that obsessiveness might interact with the scan set condition.

High obsessiveness would normally be associated with an inordinate attention to detail, and low obsessiveness with a relative lack of such concern. In the size estimation situation, it would be expected that low obsessive subjects would have a low frequency of comparison of standard and variable stimuli, that is, they would exhibit a low frequency of deliberate eye movements. Therefore, low obsessive subjects should more readily show an increase of eye movement due to scan set instructions than high obsessive subjects who should already possess a relatively high natural level of eye movement.

The other personality variables of affectivity, preparanoia and defendence were not found to be related to size estimations. However, because of the small sample in Experiment 1 and the suggestive theoretical rationale for the original inclusion of these variables, they were retained in Experiment 2.

Experiment 1

Certain results of the first experiment were unequivocal. Verbal sets for speeding size estimation performance and for altering frequencies of eye movements were highly effective. Also, the speeded conditions resulted in a lower frequency of eye movements, suggesting that a higher level of impulsivity (lower time taken) may alter size estimates in the direction of greater overestimation. However, the effect of speed and scan sets, either alone or in interaction, on size estimation performance was not clear because of initial differences of performance of SCAN SET and NO SCAN SET groups, before the introduction of experimental manipulations.

Tentative relations found between size estimates and the personality traits of impulsivity and obsessiveness suggested that these variables should be taken into consideration when assessing the effects of speed and scan sets on size estimation performance.

Two general hypotheses emerged to be evaluated in Experiment 2: (a) Verbal sets for eye movement and for speeding of performance interact with the personality trait of impulsivity in the determination of size estimation scores. (b) A verbal set for eye movement interacts with the personality trait of obsessiveness in determining size estimation scores.

CHAPTER III

PERSONALITY TRAITS AND EYE MOVEMENTS AS DETERMINANTS OF SIZE ESTIMATES: REPLICATION AND EXTENSION OF PERSONALITY FINDINGS

Introduction

This study, to be called Experiment 2, was designed to appraise further the role of personality variables in individual differences of size estimation performance.

The results of Experiment 1 indicated that impulsivity may be related to the size estimation process in the direction of lower size overestimation being associated with greater impulsivity. This tentatively established relationship was further explored in the present study by reducing the amount of time available for subjects to complete their size estimates, thus forcing them to act more impulsively. Because low impulsive subjects were expected to be more amenable to an experimental increase of impulsivity level, the effects of the speed set conditions were evaluated in relation to groups of subjects with relatively high or low impulsivity levels.

In addition, because impulsivity was considered one of several personality variables related to the size estimation process, its incorporation as an independent variable in Experiment 2 could enhance the liklihood of finding a relation between the verbal set for increased eye movement and size estimation performance. Differences of impulsivity in Experiment 1 between SCAN SET and NO SCAN SET groups were coincident with their initial difference of size estimation performance before the introduction of verbal sets to alter looking behaviour. By taking impulsivity into account as a possible determinant of such initial differences of size estimation, it was felt that SCAN SET and NO SCAN SET groups would be made equivalent in size estimation performance before the introduction of experimental manipulations of eye movements, thus allowing a more sensitive test of the effects of such manipulations.

As in Experiment 1, it was anticipated that experimentally increasing the frequency of deliberate eye movements exhibited by subjects would result in a reduced magnitude of size overestimation. In Experiment 2, however, the influence of such scan set instructions was considered in terms of the natural or "background" level of eye movements exhibited by the subjects, as moderated by the personality trait of obsessiveness. Low obsessive subjects were expected to have a low natural level of eye movements, and therefore to be most susceptible to an experimental increase of eye movements through scan set instructions.

The effects of the personality traits of defendence, preparanoia and shallow affect on the size estimation process were not thought to be sufficiently evaluated in the first study. These variables were therefore reconsidered in Experiment 2.

The predictions for Experiment 2 were as follows:

(a) Sets for speeded performance would result in increased overestimation of low impulsive subjects to the level obtained naturally by high impulsive subjects. The latter subjects should either not change in their magnitude of overestimation or increase only slightly with the speeded conditions.

(b) By considering the effects of scan set instructions on groups with impulsivity levels controlled, it was expected that a significant effect of looking behaviour on size estimation could be produced.

(c) The influence of scan set instructions on size estimation performance will most clearly be shown by low obsessive subjects who are most able to increase their level of eye movement.

(d) High scores on measures of defendence, shallow affect, preparanoia and obsessiveness will be associated with low levels of size overestimation.

Method

Individual differences measures

The personality assessment and scanning control measures used in the present study were the same as those used in Experiment 1. Included among the seven personality scales were indicators of infrequent and desirability responding, impulsivity, defendence, obsessiveness, preparanoia, and shallow affect. As in Experiment 1, the subject's level of scanning was indicated by size estimation scores.

Size estimation apparatus

The apparatus was identical to that of Experiment 1, with the exception of removing the chin rest and eye movement recording equipment.

Subjects

Ninety-two male undergraduates enrolled in introductory psychology at The University of Western Ontario served as subjects for this experiment.

Procedure

Several procedural alterations were made from Experiment 1. Because the first experiment showed the effectiveness of scan set instructions in altering eye movement levels, eye movement records were not taken during Experiment 2. As the function of the chin rest had been to prevent head movements which would obscure eye movements in the oscillograph records, it was not used in the second study. The procedure and instructions were the same as those of the first experiment (see Appendix B), with the exception that the final four trials of the size estimation task which involved a return to normal speed and the introduction of a low scan set, were deleted from Experiment 2, as their function had been to determine the influence of such instructions on looking behaviour.

The subjects for this study consisted of those of the 126 volunteers administered the personality scales who did not take part in the first study. Individual appointments for the size estimation procedure were made for these 112 males so that they would not conflict with their class time. Ninety-two subjects individually completed the size estimation task of Experiment 2, the balance not appearing for their appointments.

As in Experiment 1, the size estimation and time taken data for a subject's two trials in each of the four speed set conditions were averaged to provide one score per condition for each of these two variables.

Results and Discussion

The following section emphasizes the role of personality traits as possible determinants of size estimations, both alone and in interaction with sets for increased eye movement and speeding of size estimation performance. Although the traits of impulsivity, obsessiveness, defendence, preparanoia and affectivity are all considered, major emphasis is placed upon impulsivity and obsessiveness.

Mean scores, standard deviations and reliability coefficients for the seven personality assessment and validity scales used in Experiments 1 and 2 are presented in Table 5. Summary statistics are also provided for the size estimation and time measures. The reliability coefficient for these latter two measures consists of the correlations between the two trials of each experimental block.

Impulsivity and speed set instructions

The 92 subjects were divided at their median impulsivity scale score to form high and low impulsive groups of equal size. Because of a notable variability of time taken to perform size estimations within impulsivity groups, it was decided to incorporate time taken as an independent variable. The rationale for this additional variable was the relevance of time taken to the construct of impulsivity; it might be expected that high impulsivity would give rise to short performance

TABLE 5

Summary statistics for size estimation, time and personality measures: University sample

Measure	Mean	Variance	Reliability
Desirability	15.55	6.53	.57
Infrequency	0.55	0.79	.43
Impulsivity	17.75	54.75	.86
Defendence	7.15	8.69	.56
Preparanoia	10.99	18.31	.71
Obsessiveness	12.39	18.47	.71
Shallow Affect	1.83	3.22	.53
Size Estimations			
block 1	36.46	8.16	.73
block 2	36.48	9.91	.79
block 3	36.39	9.11	.86
block 4	36.83	10.20	.86
Times Taken			
block 1	47.45	497.26	.80
block 2	36.36	344.31	.90
block 3	19.48	67.37	.86
block 4	11.53	19.46	.92

times and low impulsivity would give rise to longer times. But the high and low impulsive groups showed little difference in time taken. For example, in trial block three where the moderate speed set was initiated the times taken by high and low impulsive groups were 20 seconds and 19 seconds respectively. Impulsivity groups were therefore split at their median time taken in trial block three. The third trial block was chosen because it was felt that using the time measure from a speeded trial block would allow the contrasting of subjects placing an emphasis on accuracy, versus those either emphasizing meeting time requirements or caring neither about time nor accuracy of size estimation. The fast speed set block was not used because of a reduced variability of time taken, which would limit the potency of this variable.

To test the first prediction concerning the effects on size estimates of speeding the performance of groups varying in impulsivity, a 2 x 4 x 2 repeated measures analysis of variance of size estimation scores (see Table 6a) was performed with impulsivity, speed set and time taken in block three as the independent variables. (Mean times taken in the various experimental conditions are shown in Table 6b.) The results of this analysis appear in Table 7. There was a marginally significant main effect for the speed set condition, such that the subjects showed greater overestimation in the faster speed set condition. However, this overall effect is qualified by a significant interaction of the speed set variable with both time taken in block three and impulsivity level.

The predicted interaction between speed set and impulsivity

TABLE 6a

Mean size estimates over speed set blocks as a function of impulsivity level and time taken

		B1	B2	B3	B4
C1	A1	37.17	37.25	36.53	36.90
	A2	36.05	36.12	35.48	36.73
C2	A1	36.55	36.74	37.13	36.70
	A2	36.06	35.71	36.29	26.90

TABLE 6b

Mean times taken over speed set blocks by groups varying in impulsivity level and time taken

		B1	B2	B3	B4
C1	A1	63.0	52.3	27.7	14.7
	A2	49.6	37.1	24.0	12.8
C2	A1	43.6	26.6	13.1	9.4
	A2	33.7	25.8	13.3	9.1

TABLE 7

Summary of analysis of variance of mean size estimates over speed set blocks as a function of impulsivity level and time taken

Source	Sums of Squares	df	Mean Squares	F
Between S's	2969.358	91		
A Impulsivity	45.585	1	45.585	1.37
C Time Taken	0.025	1	0.025	0.00
A X C	2.446	1	2.446	0.07
Error	2921.302	88	33.197	
Within S's	497.060	276		
B Speed Set	10.726	3	3.575	2.10*
A X B	16.687	3	5.562	3.26**
B X C	18.485	3	6.162	3.61**
A X B X C	0.950	3	0.317	.19
B X S's	450.212	264	1.705	
Total	3466.417	367		

* $p < .10$

** $p < .05$

level was obtained (see Figure 6). Low impulsive subjects, forced to act more impulsively by the high speed set condition, increased their level of overestimation to that shown by the high impulsive group.

The effects of different levels of impulsivity have been attributed to differences of time taken to make size estimations. According to this interpretation, the greater overestimation of high impulsive subjects is due to taking a small amount of time allowing little scanning. It is instructive therefore to consider differences of time taken by these groups varying in impulsivity (see Table 6b).

The high impulsive group, although showing a marked decline of time taken over trial blocks, essentially had no change of size estimation level. By contrast, the low impulsive subjects had their greatest change of size estimation following their smallest reduction of time taken.

For the low impulsive group, the conclusion suggested is that a reduction of time taken to 20 seconds is not important because it is compensated for by a shorter time taken in reducing the circle to within a critical range. Ample time is thus provided for the final judgments of size. It is the reduction of time from 20 to 12 seconds that is assumed critical for the interaction; it is suggested that 11 to 12 seconds was not an undue reduction of the decision time of high impulsive subjects who take relatively little time anyway, but this period imposed restrictions on the judgments of low impulsive subjects. The time restrictions of the fast speed set condition, with its clear emphasis on speed rather than accuracy, resulted in low impulsive subjects taking the same amount of time as the high impulsive groups. However, it is

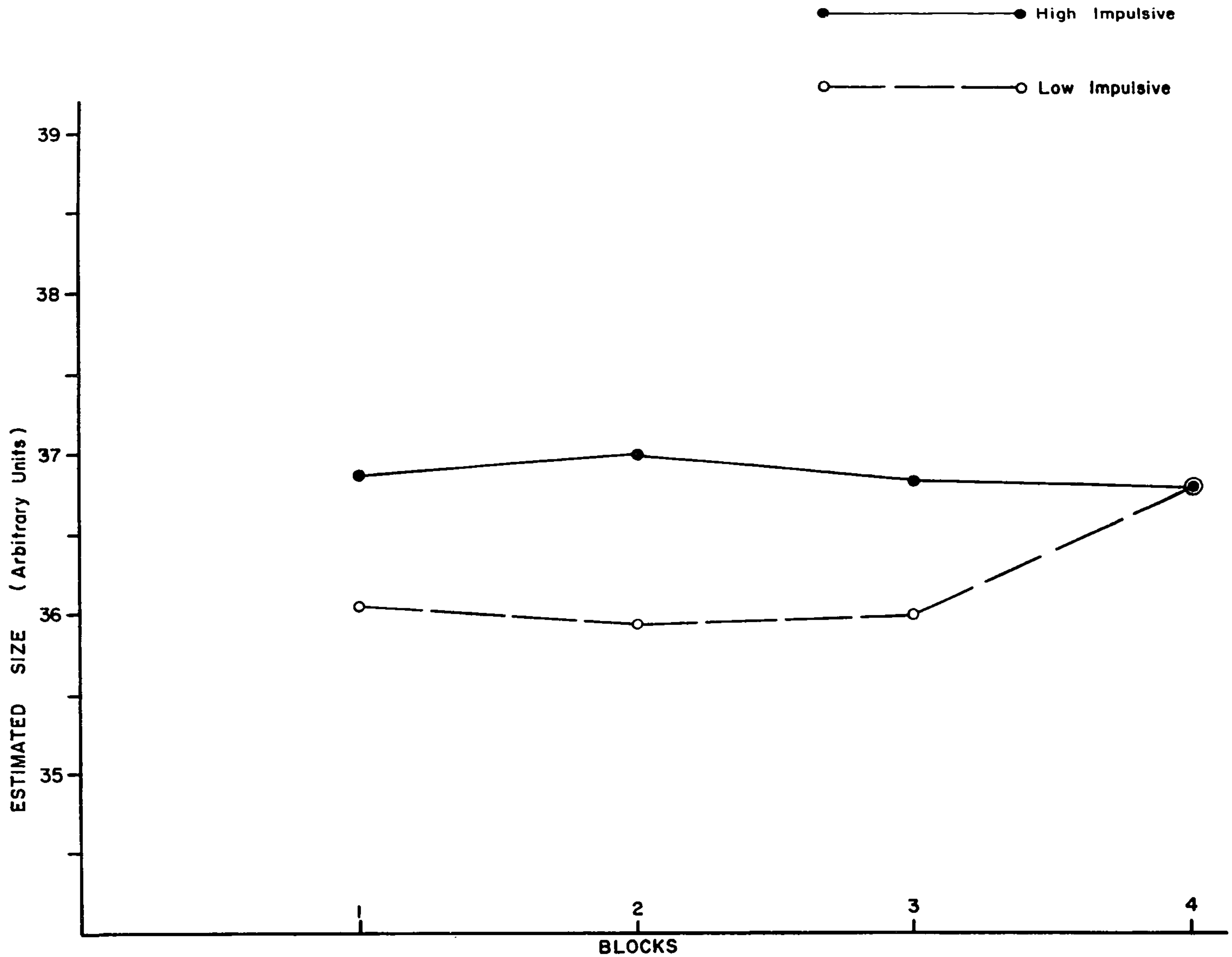


Figure 6 Mean Size Estimates for High and Low Impulsive Groups Under Scan Set and Speed Set Instructions

thought that this restricted amount of time was subtracted from judgment time on the part of low impulsive groups, whereas for the high impulsive subjects, requiring a very small judgment time, the speeding was not sufficient to detract from their customary small judgment time.

A further conclusion suggested by the total lack of change of performance by high impulsive subjects is that they had a very small judgment time through the whole series of trials despite their relatively greater level of time taken on these trials. Their overall higher time taken in the unspeeded trials is difficult to explain, but if this is assumed to not reflect higher judgment times, then it must be due to longer time spent in the actual manual operation of the control knob to reduce the variable circle to the range of diameter where judgment is required. As a possible tentative explanation, the control knob was best operated in long deliberate turns; short, choppy turns could result in a small amount of slippage of the drive pulley, therefore increasing the time taken. Subjects who appeared to be attempting to perform very quickly in the initial trials seemed most prone to such erratic turning, leading to slippage. As the subject whose unspeeded performance was naturally more rapid could well have been more impulsive, it is suggested that such an explanation may account for differences of time taken by high and low impulsive groups in the first two experimental conditions.

Although clearly speculative, the above conclusions could be tested by devising a way to measure the judgment time component of total time taken to make individual size estimations. One possible means would be to obtain continuous oscillograph measures of the variable circle's diameter. With an appropriate constant chart speed, subjects' changes of the circle's diameter would be indicated by oblique line segments, and pauses for comparisons of stimuli by horizontal line segments. The duration of these segments then could be measured.

Alternatively, the size estimation apparatus could be altered to use a constant speed motor drive. Subjects would operate the apparatus by pushing a button to reduce the size of the variable circle, and the total length of time from the start of the trial that the subject does not push the button would indicate total judgment time. This alteration of the apparatus would suppress the effects of idiosyncracies of "turning behaviour", as noted above, and also allow the controlled manipulation of rate of change of circle size, by using different constant speeds for different subjects.

An important possible contribution of a motor-driven apparatus would be to reduce the variability of size estimations due to individual differences in sheer mechanical skill of operation of the control knob. It is entirely possible that the relative difficulty of demonstrating a relation between size estimates and eye movements as measures of scanning is due to certain differences between the two measurement situations. Eye movements are essentially a perceptual process, whereas the size estimation task clearly involves perceptual-<u>motor</u> processes. Such an apparatus would allow a detailed analysis of the components of the impulsive act, as noted by Shapiro (1965); rapid decision time and rapid action. This could be accomplished by using a constant rate of change of the variable circle, thus fixing speed of performance. In this manner, the size estimation task could be broken into perceptual judgment and motor skills components, which could be separately related to personality traits and to direct eye movement recordings.

The significant interaction between speed conditions and time taken in trial block three is presented in Figure 7. The explanation offered of this interaction is in terms of subject differences in concern for accuracy versus concern in meeting time requirements in the moderate speed set condition. Those subjects taking a relatively long time to complete their size judgments in the third trial block will be henceforth referred to as "slow performance subjects." The remaining subjects who used relatively short time periods in trial block three will be termed "rapid performance subjects." Examining rapid performance subjects, their size estimations showed no change before the moderate speed set trials, but coincident with their marked decline of time taken in trial block three (to 13 seconds) was an increase of overestimation. Their performance apparently was speeded sufficiently to impair estimation with the moderate speed set. Their concern seemed to be with meeting the time limitations of the speed set rather than with maintaining accuracy. The high speed set resulted in only a further slight change of time taken by these subjects, with no change of size estimation. They ostensibly operated almost as fast as possible in the moderate speed set blocks. This natural high speeding could be due to either greater concern for time limits than accuracy, or to a desire for rapid completion so as to leave the experimental situation.

The slow performance groups seemed to place a greater emphasis on accuracy of speeded performance. Despite a 19-second decline in time taken in the moderate speed set condition (to 26 seconds), they showed an increase of accuracy of estimation. These results are consistent

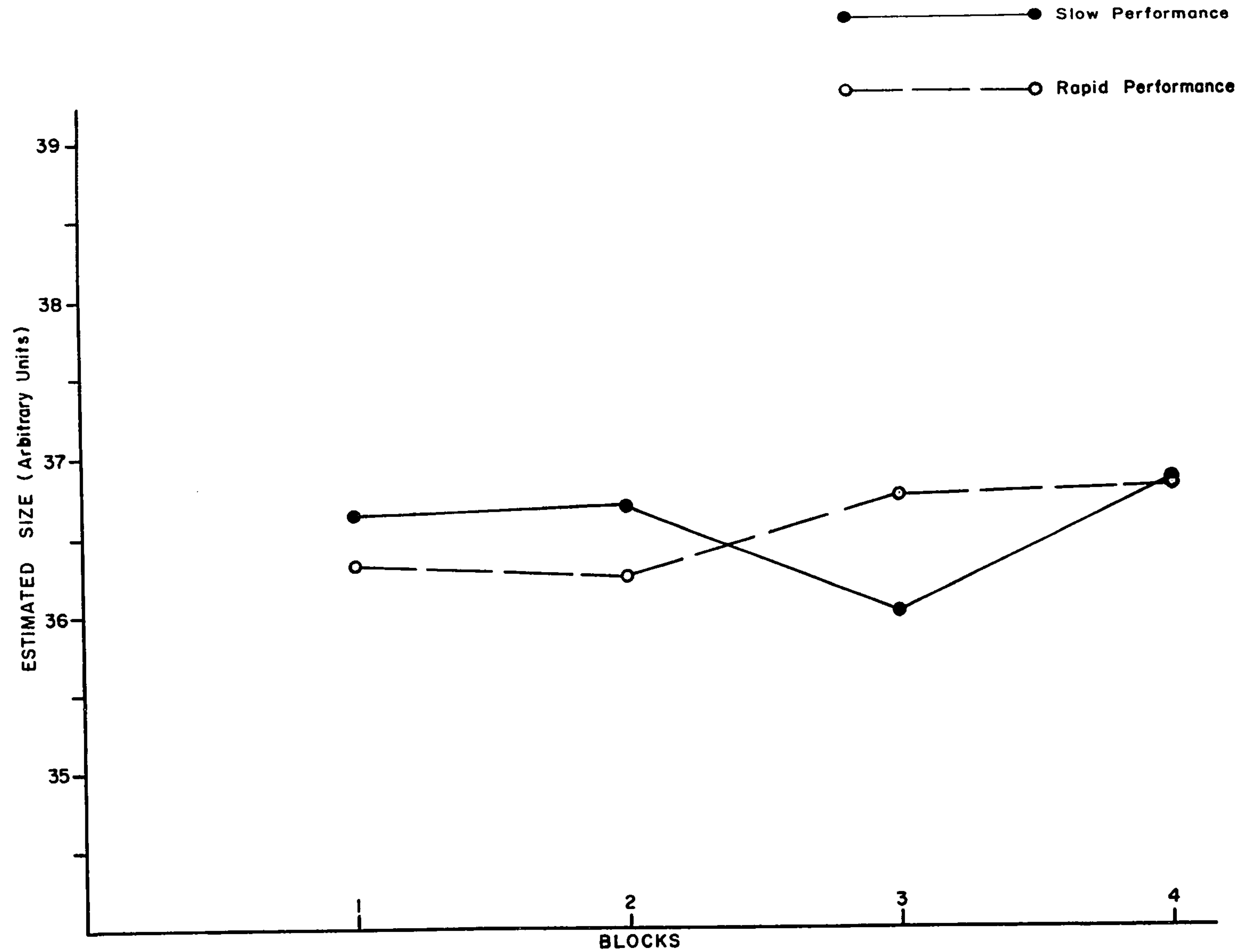


Figure 7 Mean Size Estimates Under Scan Set and Speed Set Instructions for Groups Differing in Performance Time

with the interpretation that moderate speeding enhanced motivation for accuracy, resulting in less overestimation. Following this interpretation, with the high speeding condition instructions, concern for accuracy was reduced because of speed being clearly emphasized. The high time taken subjects speeded their performance to the level where judgment time was apparently being interfered with (14 seconds), resulting in greater overestimation.

The motivational interpretation offered could be moderated by individual differences of confidence in time estimation ability. It could be, for example, that subjects lacking confidence in their time estimates of 30 to 40 seconds were less willing to operate near the limit of available time. Those subjects confident of their time estimation ability could take longer times with the assurance of not exceeding the limit. For that matter, there is reason to believe that confidence in simple judgment tasks is related to ability at these tasks, so that individual differences of time estimation ability may be of importance (cf., League and Jackson, 1964; Siegman, 1961). However, as the present series of studies did not include measures of time estimation ability *per se*, or of confidence in such judgments, the question of the significance of such factors in the present experimental paradigm must be left for future research. A possible means of assessing the significance of the above factors would be to provide subjects with continuous knowledge of either their time taken or time remaining in a given trial.

Because of a possible lack of independence between the variables of time taken and impulsivity, their use as separate independent variables in the same analyses of variance could be questioned. It was decided therefore to combine these two variables into one dependent variable with four levels; that is, all combinations of high and low impulsivity and time taken. Accordingly, a 4 x 4 repeated measures analysis of variance of size estimation scores was performed with impulsivity plus time taken, and speed set conditions as the variables. The mean size estimates for this analysis, and the corresponding mean times taken, appear in Tables 8a and 8b; results of the analysis are presented in Table 9. The two-way interaction between impulsivity plus time taken and speed set conditions was significant. This indicates that the impulsivity plus time taken groups differed in the effects of speed set on their size estimation performance. The nature of these differences can be seen in Figure 8. Two crossovers similar to that of Figure 7 were obtained, the upper one for high impulsive groups, the lower for low impulsive groups. Although alternative explanations are not ruled out, these results are consistent with the interpretation offered for the data in Figure 7; some subjects in each impulsivity group are spurred to greater concern for accuracy by moderate speeding, and some to rapid completion within the time limit with less regard to accuracy. As can be expected from the findings presented in Figure 6, a higher level of impulsivity results in a greater amount of overestimation. Thus the two high impulsive groups have a higher degree of overestimation than the two low impulsive groups, except under the fast speed set conditions.

Examining the high impulsive, slow performance and low impulsive slow performance groups, both show a reduction of time taken in the mmoderate speed condition (to 28 and 24 seconds, respectively), accompanied by reduced overestimation. These results are again interpretable

TABLE 8a

Mean size estimates over speed set blocks as a function of combinations of impulsivity level and time taken

	B1	B2	B3	B4
A1	37.17	37.25	36.53	36.90
A2	36.05	36.12	35.48	36.73
A3	35.55	36.74	37.13	36.70
A4	36.06	35.71	36.29	36.90

TABLE 8b

Mean times taken over speed set blocks by groups of varying combinations of impulsivity level and time taken

	B1	B2	B3	B4
A1	63.0	52.3	27.7	14.7
A2	49.6	37.1	24.0	12.8
A3	43.6	26.6	13.1	9.4
A4	33.7	25.8	13.3	9.1

TABLE 9

Summary of analysis of variance of mean size estimates over speed set blocks as a function of combinations of impulsivity level and time taken

Source	Sums of Squares	df	Mean Squares	F
Between S's	2969.358	91		
A Impulsivity plus time taken	48.056	3	16.019	0.48
Error	2921.302	88	33.197	
Within S's	497.060	276		
B Speed Set	10.726	3	3.575	2.10*
A X B	36.122	9	4.014	2.35**
B X S's	450.212	264	1.705	
Total	3466.417	367		

* $p < .10$

** $p < .05$

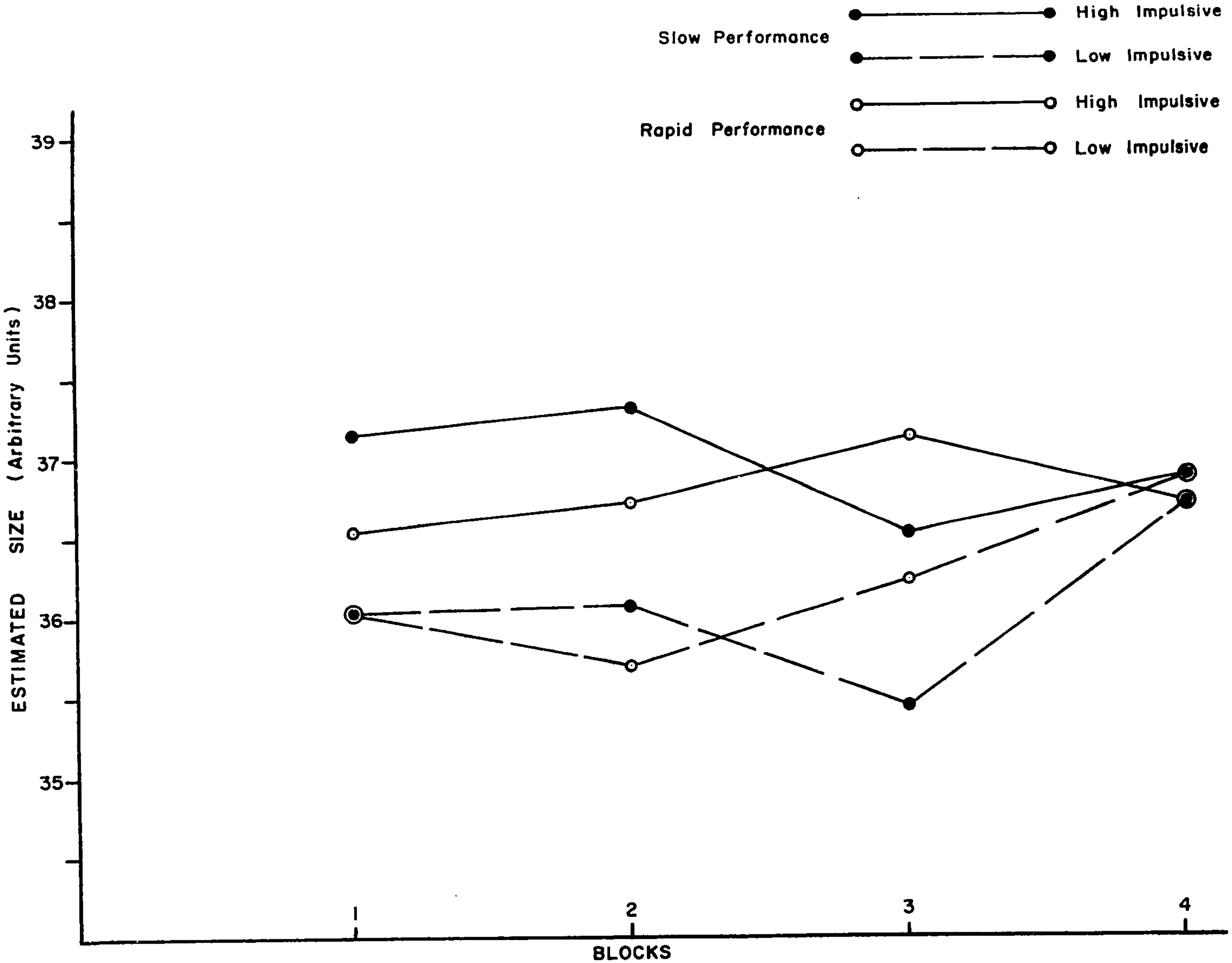


Figure 8 Mean Size Estimates Under Scan Set and Speed Set Instructions for Groups of Different Combinations of Impulsivity Level and Performance Time

as a motivational effect; according to such an interpretation, some subjects in each of the impulsivity groups compensated for anticipated greater error under speeding by increasing scanning, thus reducing their errors of estimation. The effect of high speeding on these groups was to reduce their time taken to a short enough interval to interfere with their judgment period; to 15 and 13 seconds respectively (see Table 8b).

Both rapid performance groups reduced their average time taken to 13 seconds under the moderate speed set instructions. This short amount of time taken seemed to interfere with their judgment period, causing a reduction of scanning and thus increased overestimation. These subjects in each impulsivity group appeared more concerned with very rapid completion than with maintaining accuracy. The final high speed set condition reduced their average time taken to 9 seconds, with little additional change of size estimation performance.

Two of the four subgroups can be considered to represent extremes of impulsivity: the high impulsive, rapid performance and low impulsive, slow performance groups. This consideration is based on the assumption that low impulsive subjects should take longer periods of time than high impulsive subjects. Therefore, those subjects whose time taken is above the mean time for the low impulsive group are relatively less impulsive than those who take a time above average for the low impulsive group. The high impulsive, rapid performance group had an increase of overestimation in the moderate speed trial block, with no change in the fast condition. The effect of speeding was therefore to cause these high impulsive subjects to act in an even more impulsive fashion.

The initial effect of the speed set for low impulsive, slow performance subjects was to produce a decrease in size overestimation. With the high speed set condition, there was an increase of overestimation to the level of the other groups. With moderate speeding, the four groups' size estimation mean scores were in the same order as their suggested impulsivity levels; that is, the highest and lowest overestimation were by high impulsivity, rapid performance and low impulsivity, slow performance groups respectively. Therefore, under the speed set condition impulsivity clearly influenced size estimation performance.

The groups representing extremes of impulsivity thus did not differ initially or under an extremely speeded condition, but did differ with moderate speeding. With extreme speeding in the fast block, there was relatively little emphasis on accuracy, and all subjects tended to perform alike.

Interpretations of the effect of impulsivity on size estimations rely extensively on speculations concerning motivation effects. The role of subject motivation could be clarified in future studies by both direct assessment and various experimental manipulations. A questionnaire could be used to evaluate the overall interest of subjects in the experiment, as an indicator of general motivation. In addition, it could be ascertained whether subjects were concerned more with time limits or accuracy of judgments, and individual confidence in and strategies of time estimation could be revealed.

Motivation for accuracy could be varied by monetary or other rewards for accuracy, false norms in conjunction with negative reinforcement of overestimations, or possibly by more indirect manipulations such as the reported intentions of the experiment and the importance of findings, or the status of the experimenter (Rosenthal, 1966).

Impulsivity and scan set instructions

Despite expectations, a 4 x 4 x 2 analysis of variance with impulsivity plus time taken in trial block three, speed set conditions and scan set groups as variables revealed no effect of scan set instructions on size estimation performance, either alone or in interaction with impulsivity. The scan set instructions therefore were not effective in altering size estimations of either high or low impulsive groups. Thus, increasing the frequency with which subjects looked between standard and variable stimuli in the size estimation task had no consistent effect on degree of overestimation of the standard stimulus. However, it is possible that instructions to increase the frequency of comparison of the standard and variable circles affected subjects differently, leading to improved performance by some and to greater overestimation by others, depending on their natural frequency of comparisons. Scan set instructions should reduce the degree of overestimation of subjects with a low natural scanning level, but could impair the performance of those with a high natural level by increasing their rate of comparison beyond the optimal level. In the following section, incorporation of the variable of obsessiveness allowed a consideration of the effects of scan set instructions on subjects of differing inferred natural scanning levels.

Obsessiveness and speed and scan set instructions

In order to evaluate the joint effects of obsessiveness and speed and scan set instructions on size estimation, subjects were divided at the median obsessiveness scale score of each scan set group into high and low obsessive groups and a 2 x 4 x 2 repeated measures analysis of variance was performed with obsessiveness, speed set and scan set conditions as variables. Mean size estimates associated with this analysis, and corresponding mean times taken, are shown in Tables 10a and 10b. The only effect obtained was a marginally significant interaction between obsessiveness and scan set conditions such that low obsessive subjects had a higher level of overestimation under the no scan condition only (see Table 11).

To further elucidate the above findings, extremes of obsessiveness in set and no scan set groups were selected for further analyses. An identical analysis of variance to that above was performed with 60 subjects (versus 92 above). The size estimation means associated with this analysis appear in Table 12a; corresponding time taken means are presented in Table 12b. The results of the analysis of variance appear in Table 13.

Again, an interaction between the scan set and obsessiveness was obtained, as shown in Figure 9. Superficially, these results suggest that the scan set condition produced enhanced accuracy of estimation for low obsessive subjects and greater overestimation for high obsessive subjects, the reverse being true for the no scan set group. However, the significant 3-way interaction obtained among scan and speed sets and obsessiveness required a re-interpretation of the above

TABLE 10a

Mean size estimates over speed set blocks as a function of obsessiveness level and scan set instructions

		B1	B2	B3	B4
C1	A1	36.51	36.89	36.27	37.22
	A2	36.49	36.48	36.37	36.18
C2	A1	35.79	35.26	35.35	36.04
	A2	36.94	37.26	37.60	37.79

TABLE 10b

Mean times taken over speed set blocks as a function of obsessiveness level and scan set instructions

		B1	B2	B3	B4
C1	A1	45.5	35.9	22.3	12.2
	A2	54.2	45.2	20.3	12.3
C2	A1	43.8	31.5	19.5	11.1
	A2	47.1	29.4	15.9	10.5

TABLE 11

Summary of analysis of variance of mean size estimates over speed set blocks as a function of obsessiveness level and scan set instructions

Source	Sums of Squares	df	Mean Squares	F
Between S's	2977.212	91		
A Obsessiveness	47.967	1	47.967	1.49
C Scan Set	0.222	1	0.222	0.01
A X C	104.221	1	104.221	3.25*
Error	2824.802	88	32.100	
Within S's	496.162	276		
B Speed Set	9.944	3	3.315	1.89
A X B	8.604	3	2.868	1.63
B X C	5.957	3	1.986	1.13
A X B X C	8.303	3	2.768	1.58
B X S's	463.355	264	1.755	
Total	3473.374	367		

* $p < .10$

TABLE 12a

Mean size estimates over speed set blocks as a function of extremes of obsessiveness and scan set instructions

		B1	B2	B3	B4
C1	A1	37.13	37.04	36.67	37.51
	A2	35.70	35.74	35.66	35.07
C2	A1	35.89	35.12	35.21	35.71
	A2	36.67	37.25	37.84	38.32

TABLE 12b

Mean times taken over speed set blocks as a function of extremes of obsessiveness and scan set instructions

		B1	B2	B3	B4
C1	A1	45.7	34.2	21.2	12.6
	A2	48.7	38.8	19.7	11.8
C2	A1	44.4	33.3	19.2	11.5
	A2	49.6	30.9	16.5	10.7

TABLE 13

Summary of analysis of variance of mean size estimates over speed set blocks as a function of extremes of obsessiveness and scan set instructions

Source	Sums of Squares	df	Mean Squares	F
Between S's	1692.207	59		
A Obsessiveness	3.641	1	3.641	0.14
C Scan Set	2.080	1	2.080	0.08
A X C	192.139	1	192.139	7.20***
Error	1494.348	56	26.685	
Within S's	342.009	180		
B Speed Set	4.838	3	1.613	0.90
A X B	10.479	3	3.493	1.94
B X C	8.601	3	2.867	1.59
A X B X C	15.293	3	5.098	2.83**
B X S's	302.798	168	1.802	
Total	2034.216	239		

** $p < .05$

*** $p < .01$

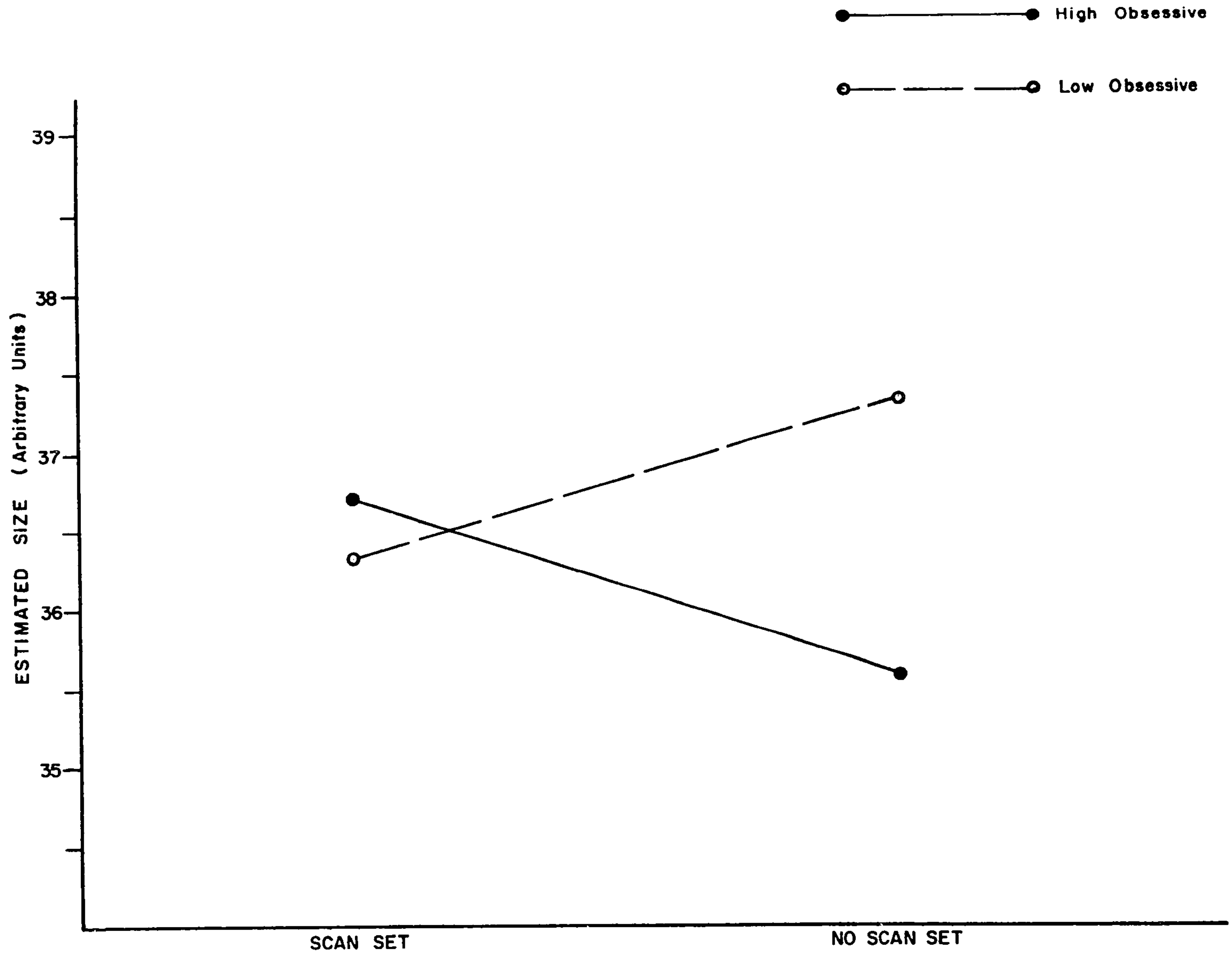


Figure 9 Mean Size Estimates for High and Low Obsessive Groups Under Scan Set Instructions

findings.

For clarity and convenience of discussion, the 3-way interaction is presented in two figures; mean size estimates over the speed set conditions for the high obsessive, SCAN SET and NO SCAN SET groups appear in Figure 10. Similar results for the two low obsessive groups are plotted in Figure 11.

The size estimation difference found between high obsessive, SCAN SET and NO SCAN SET groups cannot be attributed to either scan or speed sets as the difference obtained occurred in the initial trials before either of these sets were introduced (see Figure 10). Both high obsessive groups show a tendency towards greater overestimation with the fast speed set condition, suggesting that reduced time available resulted in high obsessive subjects scanning less and thus overestimating more.

Considering the performance of the low obsessive groups, the SCAN SET subjects were relatively stable in their estimation over trial blocks (see Figure 11). However, the low obsessive, NO SCAN SET group showed a steady increase of overestimation from one trial block to the next. Part of this decline of accuracy could be attributed to reduction of motivation, but the larger portion of the decline occurred after the first speed set condition. Speeding, therefore, resulted in an increase of overestimation for low obsessive, NO SCAN SET subjects.

Differences obtained between low obsessive, SCAN SET and NO SCAN SET groups seemed to be more related to the experimental manipulations as their difference of overestimation was slight in the initial trial block before the sets were introduced but increased with further

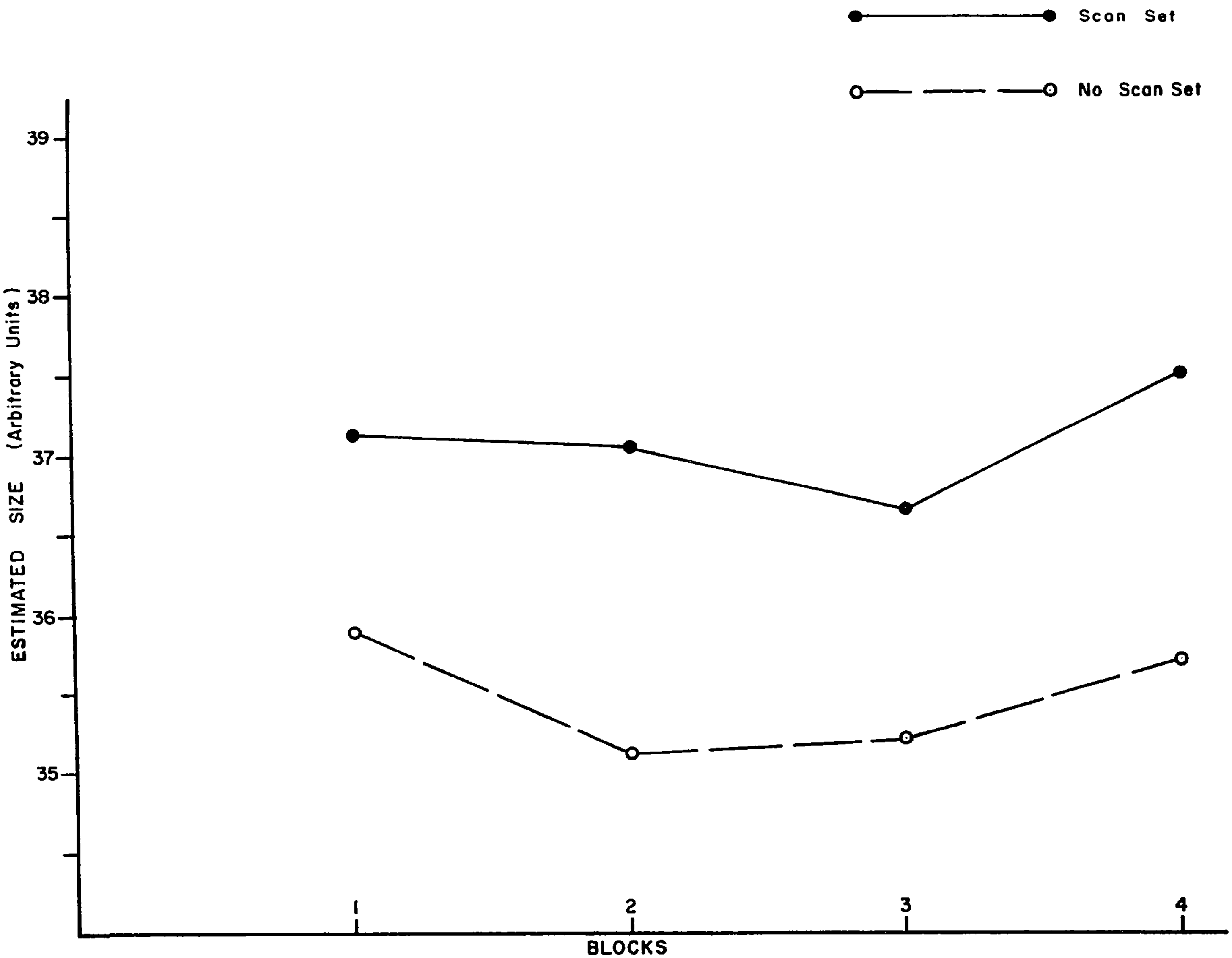


Figure 10 Mean Size Estimates for Extremely High Obsessive Subjects Under Scan Set and Speed Set Instructions

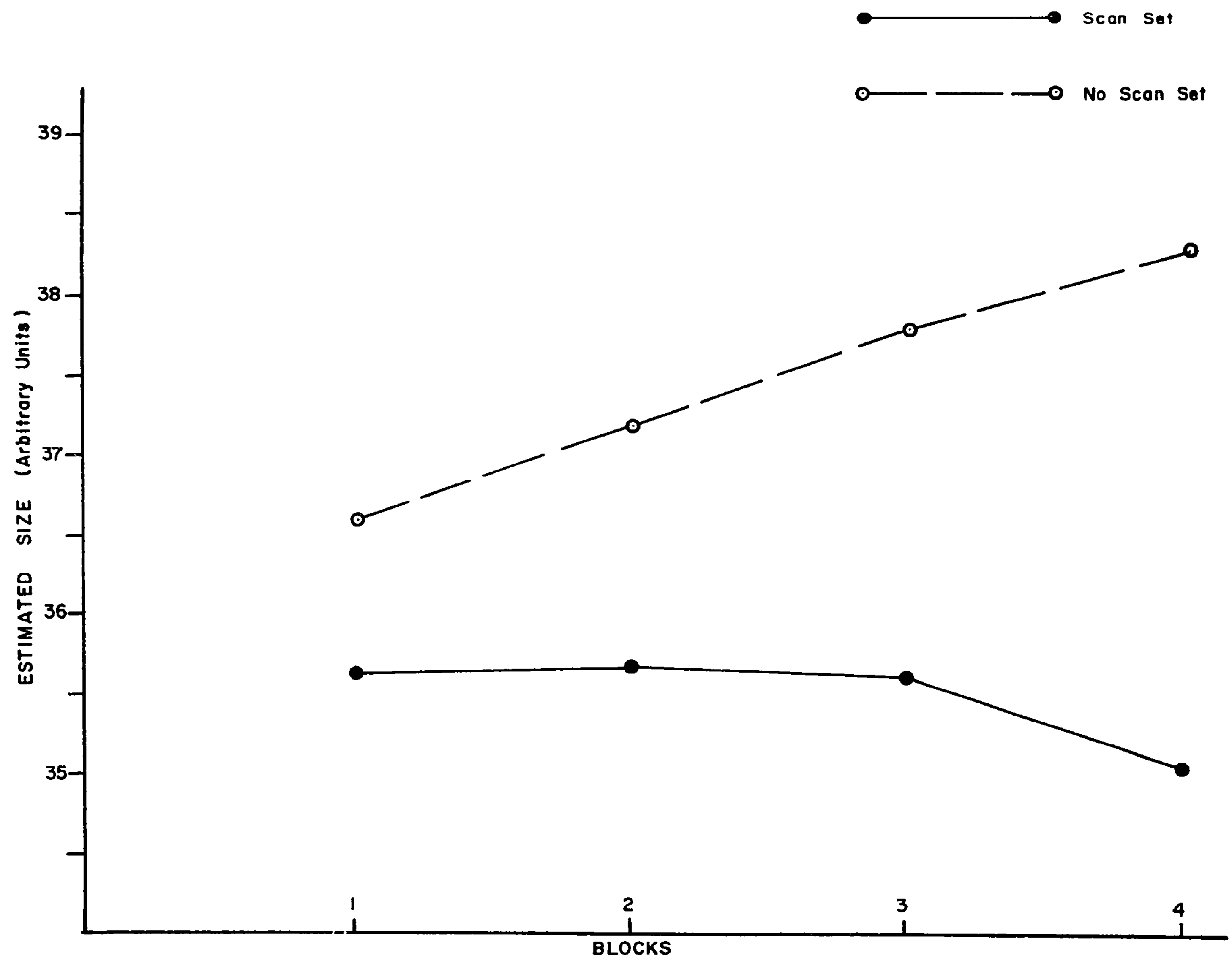


Figure 11 Mean Size Estimates for Extremely Low Obsessive Subjects Under Scan Set and Speed Set Instructions

trials. Examining the low obsessive, SCAN SET groups' performance, it is apparent that these subjects, unlike the comparable NO SCAN SET group, showed no increase of error with further trials. A possible interpretation of the difference between these low obsessive groups is as follows: the low obsessive NO SCAN SET group had a relatively low natural level of scanning. With repeated trials, motivation lagged (hence a decline in accuracy from the first to second trial blocks) and with speeding, opportunity for scanning was reduced. The result was a high final level of overestimation. In the case of low obsessive SCAN SET subjects, the set increased their frequency of inspection of the standard stimulus, leading to a stable level of overestimation, without the increasing overestimation of the NO SCAN SET subjects. Therefore, the predicted effect of the scan set on low obsessive subjects was in part confirmed. The effect, however, was not a decrease of overestimation, as expected, but rather a maintenance of the initial level of overestimation which would otherwise be expected to increase with repeated trial blocks. As with the impulsivity findings, motivational explanations can be tested by means of the assessment of motivation levels, or experimental manipulations of these levels. The explanation above, however, does not rule out competing alternatives. It is possible, for example, that the increasing overestimation of the low obsessive, NO SCAN SET group was a purely perceptual effect. The subjects' motivation levels may not have altered, but rather, perceptual fatigue may have occurred.

The relative merits of perceptual fatigue and decline of motivation with repeated trials as explanations could be assessed by comparing the effects of using the same subjects across experimental conditions (as in the present series of studies), versus using independent groups of subjects in each cell of the design so that a given subject receives only two size estimation trials. In the same experiment, trials could be either massed together (as they are at present) or distributed over time so that recovery from perceptual fatigue could occur. The use of independent groups, however, could introduce difficulties because of the large sample of subjects required.

Preparanoia and speed and scan set instructions

As above, subjects were divided at the median preparanoia score within SCAN SET and NO SCAN SET groups separately to form high and low preparanoid groups. To evaluate the relationship between preparanoia and size estimation performance, a 2 x 4 x 2 repeated measures analysis of variance was performed with preparanoia, speed set trial blocks and scan set as variables. Mean size estimates (and times taken) associated with this analysis are shown in Tables 14a and 14b. A significant interaction was found between speed set blocks and preparanoia level (see Table 15). This indicates that the preparanoia groups performed differently over the speed set conditions. The difference between high and low preparanoid groups was established after introduction of the scan set but before speed set trials (see Figure 12). The latter did not appear to affect groups differentially, as both tended towards an increase of error with speeding. However, the lack of interaction of these variables with the scan set manipulation cautions against interpreting the results as due to the scan set

TABLE 14a

Mean size estimates over speed set blocks as a function of preparanoia level and scan set instructions

		B1	B2	B3	B4
C1	A1	36.27	35.99	35.50	36.04
	A2	36.72	37.38	37.15	37.36
C2	A1	36.62	36.00	36.06	36.47
	A2	36.21	36.41	36.60	37.12

TABLE 14b

Mean times taken over speed set blocks as a function of preparanoia level and scan set instructions

		B1	B2	B3	B4
C1	A1	49.5	44.0	22.2	13.2
	A2	50.2	37.0	20.4	11.3
C2	A1	43.9	29.7	19.3	11.2
	A2	44.6	31.0	16.5	10.6

TABLE 15

Summary of analysis of variance of mean size estimates over speed set blocks as a function of preparanoia level and scan set instructions

Source	Sums of Squares	df	Mean Squares	F
Between S's	2907.468	91		
A Preparanoia	51.743	1	51.743	1.61
C Scan Set	1.216	1	1.216	0.04
A X C	18.969	1	18.969	0.59
Error	2835.541	88	32.222	
Within S's	468.385	276		
B Speed Set	8.853	3	2.951	1.78
A X B	16.798	3	5.599	3.38**
B X C	4.452	3	1.484	.90
A X B X C	0.619	3	0.206	.12
B X S's	437.663	264	1.658	
Total	3375.853	367		

** $p < .05$

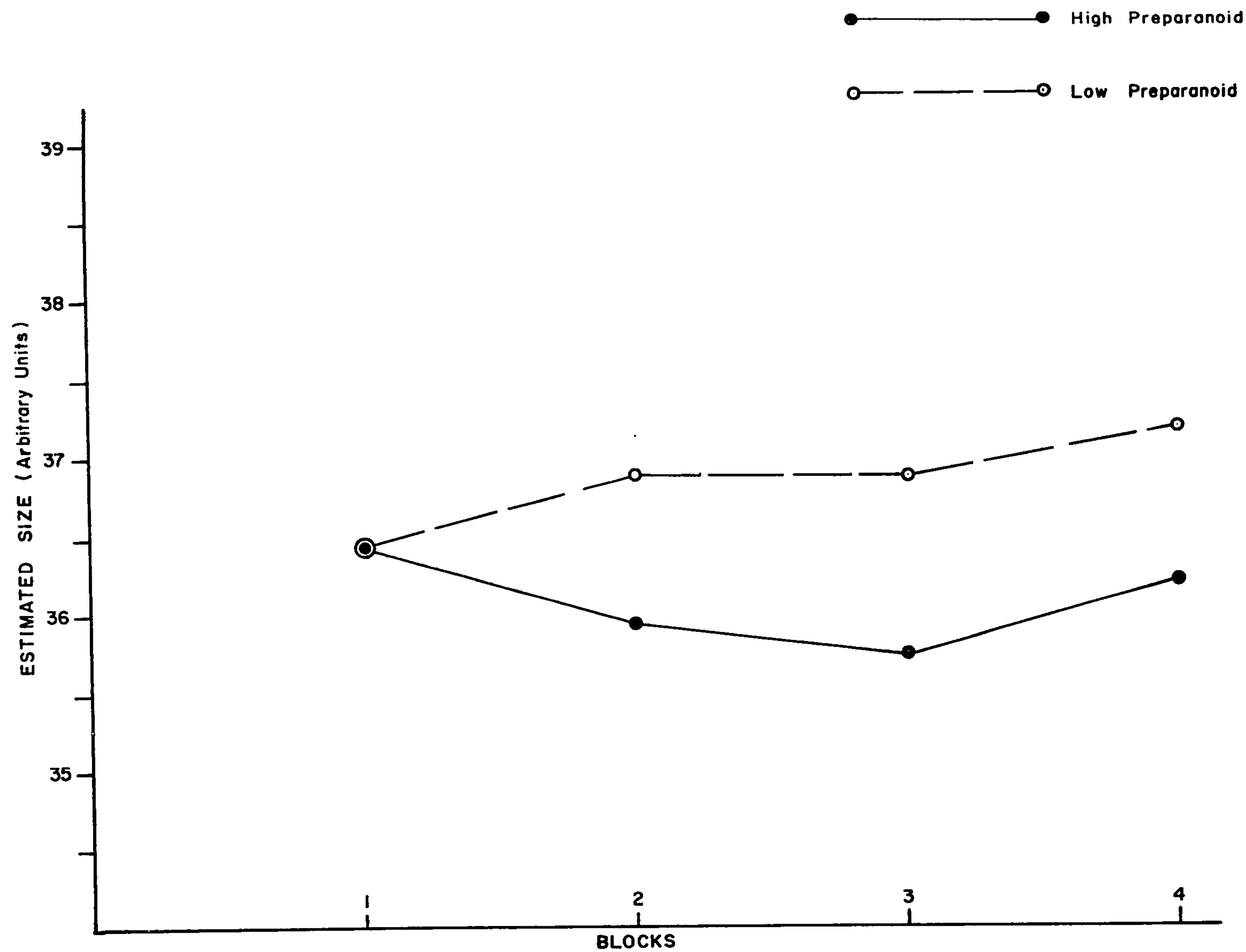


Figure 12 Mean Size Estimates for High and Low Preparanoid Groups Under Scan Set and Speed Set Instructions

instructions. It appears instead that the significant effect obtained was due to the differential effects of repeated performance, again suggesting a motivational interpretation. As can be seen in Figure 12, high preparanoid subjects maintained and increased their initial relative accuracy of performance in the first three trial blocks whereas the low preparanoid group declined in accuracy during these trial blocks. It can be speculated that the lack of progressive increase of the difference between groups in size estimation performance with further trials (which would reinforce a motivational interpretation) could have been due to an incentive effect of moderate speeding for the low preparanoid subjects.

Despite the lack of direct interaction of the variables of scan set groups and preparanoia, the findings obtained with this trait measure are suggestive. The direction of size estimation differences noted by Silverman (1964a, 1967) between paranoid and nonparanoid schizophrenics was also found in the present study using essentially normal groups, but with relatively high and low preparanoid tendencies. These results are consistent with the viewpoint of Shapiro (1965) and Silverman (1964a, 1967) that the low overestimation or even underestimation of the standard stimulus on the part of paranoid schizophrenics is due to an unusually high habitual vigilance for cues signifying threat. The paranoid's high degree of vigilance results in a high level of eye movement, even in objectively non-threatening situations. The outcome is low overestimation or underestimation of the standard circle in the size estimation task.

Other personality variables

Although size estimation performance was found to be linked to the personality traits of impulsivity, obsessiveness and preparanoia, 2 x 4 x 2 repeated measures analyses of variance with personality trait levels, and scan and speed sets as independent variables revealed no significant relationship between size estimation and defendence or shallow affect.

Experiment 2

The finding in Experiment 1 of a relationship between size estimation performance and impulsivity has been confirmed and extended. Low impulsive subjects overestimated less than high impulsive subjects except when they were forced by the speed set condition to perform more quickly. With the inclusion of the variable of performance speed, it was found that some subjects in each impulsivity group responded to the speed set as though it were an incentive to perform more carefully, while others appeared more concerned with rapid completion of size estimates, and consequently had a higher level of overestimation. Extremes of these behaviours were noted in groups which were inferred to represent extremes of impulsivity; the high impulsive, rapid performance group (high overestimation) and low impulsive, slow performance (low overestimation group).

With respect to other personality variables, extreme groups of obsessive subjects in general responded to the speed set condition with increased size overestimation. Evidence for the effects of scan set instructions on size estimation was also provided by subjects varying in obsessiveness. Low obsessive subjects under the scan set condition maintained a relatively stable level of overestimation over repeated trials, whereas the low obsessive group without scan set instructions showed a progressive increase of overestimation with repeated trials.

Although there were some suggestive findings with the variable of preparanoia in the direction of greater overestimation by low preparanoid subjects, no significant relationships were found with the traits of defendence and shallow affect. It was felt that the magnitude of relations between size estimation and some of the more pathologically oriented personality variables, such as preparanoia, defendence, shallow affect and obsessiveness would be enhanced by seeking a group with a greater range of scores on these variables. Accordingly, a third experiment was undertaken, employing the same method, apparatus and variables as Experiment 2, but with a sample of subjects expected to have a greater range of personality scale scores. It was expected that the relations found in Experiment 2 between size estimation performance and impulsivity plus time taken, obsessiveness and preparanoia would be replicated. However, the third experiment was particularly directed at attempting to find relations between the traits of defendence and shallow affect and size estimations.

CHAPTER IV

PERSONALITY TRAITS AND EYE MOVEMENTS AS DETERMINANTS OF SIZE ESTIMATES: ATTEMPTED REPLICATION WITH AN ABERRANT GROUP

Introduction

The present study, to be known as Experiment 3, was concerned in part with replicating the findings of Experiment 2 with an aberrant sample of subjects. With the extended range of personality trait scores that the aberrant group was expected to provide, it was hoped that stronger relationships would be found between size estimation scores and the personality trait variables.

The predictions for Experiment 3 were as follows:

(a) As in Experiment 2, impulsivity plus time taken will interact with the speed set conditions, such that under moderate speeding high impulsive subjects emphasize rapid completion and low impulsive subjects are more concerned with maintaining accuracy of performance. The high speed set should cause low impulsive subjects to increase their overestimations to the level of the high impulsive subjects.

(b) Following the results of Experiment 2, it was also anticipated that a 3-way interaction would be found among obsessiveness, and speed and scan sets, such that the effects of the scan set would be most apparent with the low obsessive subjects. This expectation was based on the assumption that low obsessive subjects have a relatively low natural level of eye movements and thus are most able to increase their eye movement level (after introduction of the scan set condition).

(c) High scores on measures of defendence, preparanoia, and shallow affect will be associated with low levels of size overestimation.

Method

Individual differences measures

The personality questionnaire used in Experiments 1 and 2 was administered to the subjects of the present study, allowing the assessment of infrequent and desirability responding, impulsivity, defendence, obsessiveness, preparanoia and shallow affect. Scanning was again indicated by scores on the size estimation task.

Size estimation apparatus

The apparatus was identical to that of Experiment 2.

Subjects

The subjects for the present study were 68 male volunteers solicited from the London Rescue Mission. The mean age was 42 with a range from 30 to 56 years. The present sample was drawn from a skid row population in which alcoholism, drug addiction and other aspects of psychiatric disorder had a relatively high incidence.

Procedure

Although the equipment for the present study was assembled in a small trailer, the procedure was essentially the same as that used in Experiment 2. All subjects performed a total of eight size estimations, two for each of preferred speed, moderate and high speed set conditions, with alternative subjects assigned to SCAN SET and NO SCAN SET groups (see Figure 2).

To induce potential subjects to enter the experiment, they were offered $2.00 each upon completion of the personality questionnaire and their size estimations. Those agreeing to take part were given the personality questionnaire in small groups. Subjects were carefully monitored during completion of the questionnaire and those who were unable to appropriately use the answer sheet, expressed serious confusion over items or did not appear to have sufficient language and intellectual skills, were rejected from further consideration in the study. Eleven persons were rejected on these bases (resulting in a total sample of 68 subjects).

After completion of the questionnaire, subjects were scheduled for individual sessions in the trailer, 20 minutes per person, to assess size estimation performance. Upon finishing the size estimation apparatus, subjects were debriefed and paid.

The present sample differed from those of Experiments 1 and 2. Aside from generally being older, they were frequently unemployed; many for reasons of intellect, personality or education could obtain only sporadic employment. Relatively low self-confidence appeared common, with reports of exposure to chronic failure in personal and business relations. Included in the sample were a number of alcoholics and/or drug users. The expectation in using such a group was that a higher degree of pathology would generate greater extremes of personality scale scores.

Results and Discussion

Again, the time taken and size estimation scores used in analyses were averages of the two trials of each of the four experimental conditions, yielding four scores per subject for each of the two variables.

The following section first considers the effects of speeding the size estimation performance of high and low impulsive groups. Emphasis is then directed to the influences of the scan and speed sets on groups with varying levels of obsessiveness, defendence, preparanoia and shallow affect.

Impulsivity and speed set instructions

The 68 subjects were split at their median impulsivity scale score, forming high and low impulsive groups of 34 subjects each which were in turn divided into slow and rapid performance groups of equal size on the basis of their performance time in trial block three.

A 2 x 4 x 2 analysis of variance with repeated measures, with impulsivity, speed set conditions and time taken as variables was performed on size estimation scores. Mean size estimation scores associated with this analysis, and the corresponding performance times, are presented in Tables 16a and 16b. A significant main effect was

TABLE 16a

Mean size estimates over speed set blocks as a function of impulsivity level and time taken: Mission sample

		B1	B2	B3	B4
C1	A1	36.95	37.05	36.18	35.92
	A2	37.64	37.82	36.56	36.77
C2	A1	38.58	37.81	37.79	37.10
	A2	37.02	37.20	36.70	37.09

TABLE 16b

Mean times taken over speed set blocks by groups varying in impulsivity level and time taken: Mission sample

		B1	B2	B3	B4
C1	A1	30.9	28.3	20.8	12.6
	A2	34.1	27.2	18.6	13.6
C2	A1	25.0	17.5	9.8	7.9
	A2	22.9	17.3	9.9	7.3

obtained for the speed set variable (see Table 17). The main effect was due to an increased accuracy of performance after introduction of moderate speeding (i.e., reduced overestimation). As can be seen in Table 16b, these subjects initially took a relatively low average amount of time (when compared with the university sample), showing a major reduction of time taken with the moderate speed set. Subjects apparently operated almost as quickly as possible with moderate speeding, as the high speed set produced little further time reduction.

It is possible to interpret these findings in the same manner as the improvement of performance of some of the university samples' subjects during moderately speeded trials. That is, that such speeding acted as an incentive to maintain accuracy despite the difficulties introduced with speeding. However, the apparent lack of motivation for accuracy shown by the Mission sample, and the relatively rapid performance of these subjects even under unspeeded conditions suggest that accuracy was not of the same order of importance to them as to the university subjects. The interpretation offered is that these subjects were on the whole little interested in the accuracy of their performance, being more concerned with rapid completion and obtaining their money. If the mission sample did not exhibit increased concern for accuracy, how can their reduced overestimation during speeded performance be explained? It is hypothesized that moderate speeding resulted in an overall increase of accuracy because these subjects, while operating the apparatus rapidly, were less concerned then they could have been about turning past the perceived point of equal size. A more prudent strategy would be to slow performance near the point of perceived

TABLE 17

Summary of analysis of variance of mean size estimates over speed set blocks as a function of impulsivity level and time taken: Mission sample

Source	Sums of Squares	df	Mean Squares	F
<u>Between S's</u>	2492.543	67		
A Impulsivity	0.332	1	0.332	0.01
C Time Taken	20.460	1	20.460	0.54
A X C	37.742	1	37.742	0.99
Error	2434.009	64	38.031	
<u>Within S's</u>	569.779	204		
B Speed Set	38.262	3	12.754	4.78***
A X B	8.051	3	2.684	1.01
B X C	6.466	3	2.155	0.81
A X B X C	4.209	3	1.403	0.53
B X S's	512.791	142	2.671	
Total	3062.322	271		

*** $p < .01$

equality in order not to reduce the circle past the point of equality, when no further correction would be possible because only descending trials were used. Instead these subjects appeared to show no slowing near equality, rather, turning rapidly and then stopping abruptly when the variable circle appeared clearly too small for them. This interpretation could be tested by using both ascending and descending size estimation trials. If this hypothesis is correct, then these subjects will tend on ascending trials to make increased overestimations of the same magnitude as the increase of accuracy in the present study.

As in the second study, a 4 x 4 repeated measures analysis of variance was performed with impulsivity plus time taken (in trial block three) and speed set conditions as variables. The mean size estimates and corresponding times associated with this analysis appear in Tables 18a and 18b. The main effect for speed set was significant and is subject to the same interpretation as the results above (see Table 19).

The predicted interaction between speed set conditions and impulsivity level was not obtained, as the mean size estimates of high impulsive and low impulsive groups did not differ significantly. Possible explanations for this lack of effect will be considered in a following section.

Obsessiveness and speed and scan set instructions

As in the second experiment, both SCAN SET and NO SCAN SET groups were split at their median obsessiveness scores into high and low obsessive groups. A 2 x 4 x 2 analysis of variance with repeated measures, utilizing obsessiveness, speed set blocks and scan set

TABLE 18a

Mean size estimates over speed set blocks as a function of combinations of impulsivity level and time taken: Mission sample

	B1	B2	B3	B4
A1	36.95	37.05	36.18	35.92
A2	37.64	37.82	36.56	36.77
A3	38.58	37.81	37.79	37.10
A4	37.02	37.20	36.70	37.09

TABLE 18b

Mean times taken over speed set blocks by groups of varying combinations of impulsivity level and time taken: Mission sample

	B1	B2	B3	B4
A1	30.9	28.3	20.8	12.6
A2	34.1	27.2	18.6	13.6
A3	25.0	17.5	9.8	7.9
A4	22.9	17.3	9.9	7.3

TABLE 19

Summary of analysis of variance of mean size estimates over speed set blocks as a function of combinations of impulsivity level and time taken: Mission sample

Source	Sums of Squares	df	Mean Squares	F
Between S's	2492.543	67		
A Impulsivity plus time taken	58.534	3	19.511	0.51
Error	2434.009	64	38.031	
Within S's	569.779	204		
B Speed Set	38.262	3	12.754	4.78***
A X B	18.726	9	2.081	0.78
B X S's	512.791	192	2.671	
Total	3062.322	271		

*** $p < .01$

conditions as independent variables revealed a significant interaction between obsessiveness and speed set variables. The mean size estimates for this analysis and corresponding performance times, are presented in Tables 20a and 20b respectively; the analysis of variance appears in Table 21. The significant interaction, plotted in Figure 13, was due to the difference of size estimation by high and low obsessive groups performing at their preferred levels of eye movement and speed in the initial trial block. As the difference of performance disappeared with onset of the scan set condition, it is tempting to attribute the reduction of size estimation difference between the scan set groups to the effects of scan set conditions. However, the lack of a significant 3-way interaction with the scan set condition suggests caution in accepting such an interpretation. If the scan set condition produced powerful effects, differences should be obtained between scan set groups over trial blocks; in other words, the 3-way interaction should be significant. The effect obtained is attributed to the quality of performance of the present sample of subjects. With declining time taken (see Table 20b), the low obsessive group reduced their overestimations. It is suggested that rather than slowing their turning when approaching the standard's size, they continued to turn until they were certain to have turned far enough. Failure to use more careful turning before the perceived equal-size point was reached led to turning too far, thus stopping when the variable size was clearly seen as smaller than the standard, and no correction in terms of <u>increasing</u> the variable circle's size was possible because of the use of only descending trials.

TABLE 20a

Mean size estimates over speed set blocks
as a function of obsessiveness level
and scan set instructions: Mission sample

		B1	B2	B3	B4
C1	A1	36.67	37.55	36.75	36.93
	A2	37.65	36.64	35.96	35.98
C2	A1	36.38	36.95	36.50	35.77
	A2	38.87	38.12	37.93	37.93

TABLE 20b

Mean times taken over speed set blocks
as a function of obsessiveness level and
scan set instructions: Mission sample

		B1	B2	B3	B4
C1	A1	32.9	28.7	18.7	12.1
	A2	26.8	22.7	14.0	10.7
C2	A1	27.0	19.3	13.5	10.0
	A2	27.2	19.1	12.1	8.9

TABLE 21

Summary of analysis of variance of mean size estimates over speed set blocks as a function of obsessiveness level and scan set instructions: Mission sample

Source	Sums of Squares	df	Mean Squares	F
Between S's	2371.525	67		
A Obsessiveness	33.222	1	33.222	0.95
C Scan Set	19.872	1	19.872	0.57
A X C	84.183	1	84.183	2.41
Error	2234.248	64	34.910	
Within S's	515.277	204		
B Speed Set	28.303	3	9.435	4.00***
A X B	26.449	3	8.816	3.74**
B X C	2.322	3	0.774	0.33
A X B X C	5.565	3	1.855	0.79
B X S's	452.638	192	2.358	
Total	2886.802	271		

** $p < .05$

*** $p < .01$

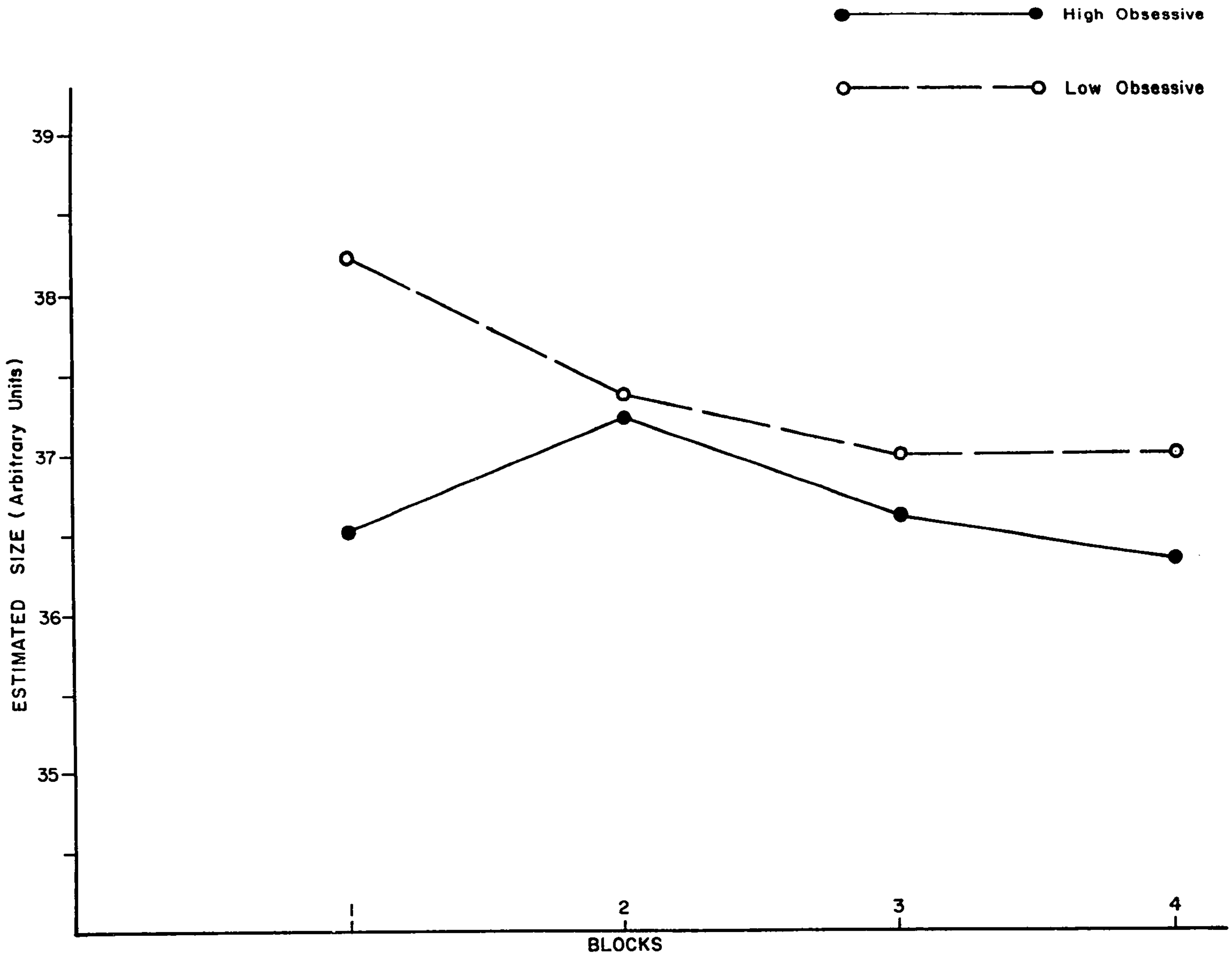


Figure 13 Mean Size Estimates for High and Low Obsessive Groups Under Scan Set and Speed Set Instructions: Mission Sample

The difficulty remains of explaining the reduced accuracy of the high obsessive subjects during the trial block in which the scan set was introduced. The possibility remains that the effect obtained was produced by changes of performance due to the scan set condition. This is a feasible alternative because tests of within-subject effects in analysis of variance are more powerful than tests of between-subject effects (see Winer, 1962, p. 299). It is possible therefore that the influence of the scan set was detected by the relatively powerful within subject repeated trials condition, but was not of sufficient magnitude to effect the between subject scan set group variable.

If it is assumed that the obtained interaction was due to scan set effects, this suggests that the scan set condition increased the accuracy of low obsessive subjects but resulted in greater overestimation for high obsessive subjects. A possible interpretation of these results is that high obsessive subjects scan the standard at a relatively high level, even without a set to scan. This leads to minimal overestimation. With a scan set to look back and forth between stimuli more frequently, scanning about the standard is reduced and more overestimation results. For the scan set, low obsessive subjects, minimal scanning of the standard results in greater overestimation. Under scan set conditions, these subjects are spurred to a greater frequency of scanning of the standard; by increasing looks between the stimuli they are forced to encounter the standard more frequently, leading to reduced overestimation. However, pending replication, the obsessiveness x speed set interaction is more conservatively explained in terms of the effects of qualitative differences of turning behaviour, in which event the decrease of accuracy of the high obsessive group for the present remains unexplained.

Defendence and speed and scan set instructions

SCAN SET and NO SCAN SET groups were divided at their median defendence scores into high and low defendence groups. A 2 x 4 x 2 repeated measures analysis of variance using defendence, speed set and scan set conditions as independent variables resulted in a significant defendence x speed set interaction. The mean size estimates for this analysis, and corresponding times taken, appear in Tables 22a and 22b respectively; the analysis of variance is presented in Table 23. These results, shown in Figure 14, indicate that high and low defensive subjects differed in the effects of speed set conditions on their size estimation scores. As anticipated, high defensive subjects overestimated less than low defensive subjects, but this difference of performance was restricted to the initial trial block. Although the direction of initial differences is maintained over later trial blocks, the main effect for defendence groups was not significant. Unlike high defensive subjects, the low defensive group had an increase of accuracy after the initial trial block. This finding can be interpreted in the same manner as that for the low obsessive group; that is, either scan set instructions resulted in increased accuracy for the low defensive group, or, repeated trials with reduced performance time (see Table 22b) contributed to a higher speed of turning which the subjects maintained until they were past the point of perceived size equality.

TABLE 22a

Mean size estimates over speed set blocks as a function of defendence level and scan set instructions: Mission sample

		B1	B2	B3	B4
C1	A1	36.55	36.95	36.46	36.46
	A2	38.43	37.93	36.90	36.98
C2	A1	37.11	37.27	37.53	36.56
	A2	38.14	37.81	36.90	37.14

TABLE 22b

Mean times taken over speed set blocks as a function of defendence level and scan set instructions: Mission sample

		B1	B2	B3	B4
C1	A1	30.8	23.8	16.9	11.3
	A2	28.9	27.7	16.6	11.4
C2	A1	27.6	20.1	13.4	9.9
	A2	26.7	18.2	12.1	9.0

TABLE 23

Summary of analysis of variance of mean size estimates over speed set blocks as a function of defendence level and scan set instructions: Mission sample

Source	Sums of Squares	df	Mean Squares	F
Between S's	2409.557	67		
A Defendence	30.378	1	30.378	0.82
C Scan Set	3.393	1	3.393	0.09
A X C	5.684	1	5.684	0.15
Error	2370.102	64	37.033	
Within S's	542.767	204		
B Speed Set	30.366	3	10.122	4.00***
A X B	21.070	3	7.024	2.78**
B X C	2.198	3	0.733	0.29
A X B X C	3.142	3	1.047	0.41
B X S's	485.991	192	2.531	
Total	2952.324	271		

** $p < .05$

*** $p < .01$

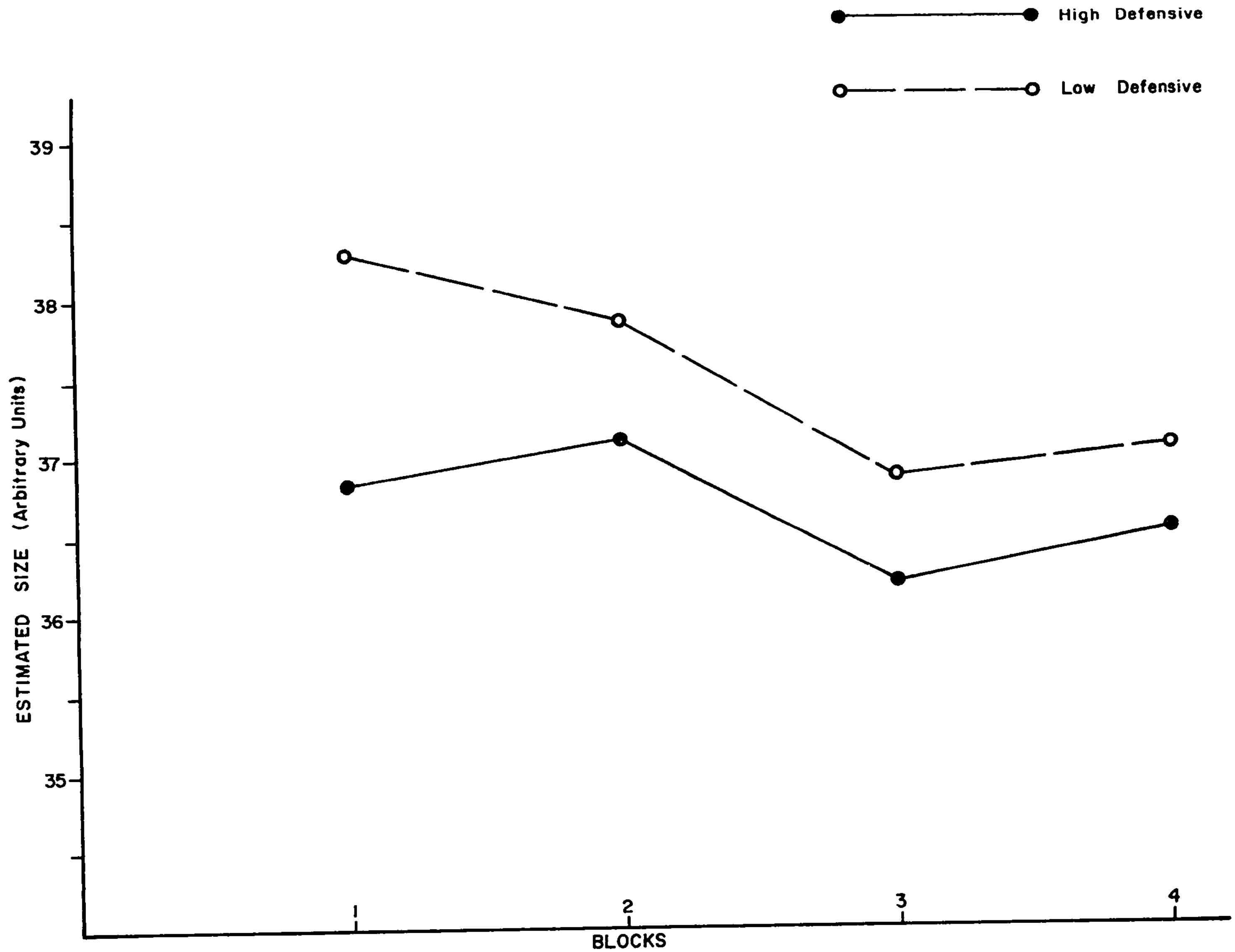


Figure 14 Mean Size Estimates for High and Low Defensive Groups Under Scan Set and Speed Set Instructions: Mission Sample

<u>Other personality variables</u>

In a similar manner to the variables above, subjects were formed into high and low preparanoia and high and low shallow affect groups. Each pair of groups were submitted to 2 x 4 x 2 repeated measure analyses of variance with the personality trait, speed set and scan set as variables. Neither main effects for traits or interactions with traits were found to be significant, indicating a lack of relation between size estimation scores and the personality traits of preparanoia and shallow affect.

<u>Further analysis</u>. It was anticipated that the use of the London Rescue Mission sample in the third study would result in a greater variability of personality scale scores, thus facilitating relations between the traits measured and size estimation scores. The mean scores and standard deviations of all variables for university and mission groups are presented in Tables 5 and 24 respectively. With the exception of impulsivity and obsessiveness, the mission subjects did have a greater variability of personality scale scores, particularly on the shallow affect scale. As the opportunity to find relations between size estimation performance and those traits not significantly related in the second study (preparanoia and shallow affect) was thus increased in Experiment 3, it was concluded that neither of these traits was related to the scanning process.

The mission group was, as anticipated, a somewhat more pathological group than the university subjects. They had higher mean scores on all the personality traits except impulsivity. In terms of validity scales, the mission subjects had a higher mean infrequency

TABLE 24

Summary statistics for size estimation, time and personality measures: Mission sample

Measure	Mean	Variance	Reliability
Desirability	13.21	9.32	.55
Infrequency	0.87	1.52	.47
Impulsivity	17.00	48.45	.82
Defendence	9.59	10.50	.55
Preparanoia	13.62	20.43	.66
Obsessiveness	13.89	17.45	.59
Shallow Affect	2.85	9.15	.77
Size Estimations			
block 1	37.52	13.26	.85
block 2	37.37	10.88	.90
block 3	36.80	9.24	.77
block 4	36.67	9.58	.77
Times Taken			
block 1	28.22	93.32	.53
block 2	22.52	96.40	.85
block 3	14.73	34.30	.86
block 4	10.40	13.00	.90

score, but the university group was higher on the desirability scale.

There is reason to believe, therefore, that the mission group had greater variability and higher mean scores on traits reflecting various pathological tendencies of hypothesized relevance to size estimation performance. The problem remains of explaining the strikingly different pattern of findings in Experiments 2 and 3, which used the same procedure but different samples. A further examination of Tables 5 and 24 suggests an explanation. Examining the performance time results, it was found that the mission subjects had lower mean times taken and lower variability of time scores for all trial blocks except the fast speed set condition ($F = 35.80$, $df = 3/384$, $p < .001$). It was felt that the differences of findings between Experiments 2 and 3 were largely due to the greater speed of performance of the mission sample. The reduced performance time of the mission subjects was considered to reflect a lower level of motivation of these subjects. In the initial trial blocks, this reduced motivation resulted in greater overestimation on the part of mission subjects. Because of the short time period, the opportunity for scanning was reduced, hence the greater overestimation. The speeded trial blocks produced an increase of accuracy for the mission sample, but this increase was felt to be a fortuitous result of a rapid careless operation of the size estimation apparatus.

Experiment 3

The use of an aberrant group in the third study resulted in a different pattern of findings than those obtained in Experiments 1 and 2.

Significant differences of size estimation performance were not found between groups with high and low levels of the traits of impulsivity, preparanoia or shallow affect. Although the speed set manipulation was effective in altering size estimates, the effect was an unexpected general increase of accuracy, without an interaction between impulsivity level and speed set trial blocks.

Considering the traits of defendence and obsessiveness, low trait-level groups in each case were found to have higher levels of overestimation, consistent with the predicted lower scanning of these groups. However, it was not clear whether the interactions of high and low trait groups with the repeated speed set blocks represented an effect of the scan set manipulation, or instead were due to qualitative differences of operation of the size estimation apparatus by the present sample of subjects.

The finding of a change of the pattern of results in the third study was apparently due to the influence of motivational factors, as reflected in significant differences of performance time between samples. Methods for evaluating this motivational hypothesis have been indicated.

CHAPTER V

SUMMARY AND IMPLICATIONS

This research represented an attempt to investigate experimentally in a series of three studies the nature of determinants of individual differences in size estimation performance. The variables given primary consideration were eye movement levels and a carefully selected group of personality traits. The findings obtained bear on the theoretical construct of scanning as a cognitive control, and are relevant to process interpretations ascribed to individual and group differences of scanning control level.

This chapter presents a summary of the findings of the present research. For convenience of presentation, each of the three studies is summarized in a separate section. Each section includes implications of that study for the construct of scanning as well as for interpretations of group and individual differences of size estimation performance. In the final section, some concluding observations are made regarding the broad implications of these findings and those of other investigators for the general phenomena of attention styles.

Personality traits and eye movements as determinants of size estimates

The first study was directed at experimentally assessing the significance of eye movement levels and certain personality traits as possible determinants of individual differences of size estimation performance. Two groups of subjects were required to make repeated size estimations under normal and speeded judgment conditions. The manipulation of time available was undertaken to represent the equivalent of a change of the subject's level of the trait of impulsivity. One group of subjects was allowed to use their normal, preferred level of eye movement in the task. Subjects in the other group were required to alter their level of eye movements in accordance with a verbal set. In this manner, the effect of deliberate alteration of eye movements on subject's size estimates was evaluated.

In addition, size estimation performance was correlated with subject's scores on scales measuring levels of the traits of obsessiveness, preparanoia, defendence, shallow affect, and impulsivity. The results were as follows:

1. Verbal sets for speeding size estimation performance and for altering eye movement levels were highly effective. The speeding sets resulted in a significant reduction of performance time, while the scan set manipulation produced a significant alteration of frequency of eye movements.

2. The speeded conditions resulted in a significant reduction of eye movements. As lowered performance time can be considered an experimental analogue of increase impulsivity, these results suggested

that higher levels of impulsivity may be related to; (a) reduced scanning, and (b) increased overestimation.

3. The effect of speed and scan sets, either alone or in interaction on size estimation performance was not clear because of initial differences of performance of SCAN SET and NO SCAN SET groups, before the introduction of experimental manipulations.

4. Tentative relations established between size estimates and the traits of impulsivity and obsessiveness suggested that these variables should be taken into consideration when assessing the effects of speed and scan sets on the size estimation process.

The results above offered little support for the hypothesized relation between eye movements and size estimates. Neither initial natural levels, nor increases or decreases of eye movement were found conclusively to be related to the size estimation process. However, as the results of Lukorsky et al. (1963, 1964) have indicated even different indices of eye movements taken from the same measurement situation (e.g., eye movement photographs) are not highly intercorrelated. Thus, it is possible that the use of a different eye movement indicator would lead to more substantial relationships. In effect, the present indicator was a counter of frequency of comparisons of variable and standard stimuli; more subtle distinctions such as the amount of inspection of the standard stimulus circumference were lost.

Future research in this area will probably benefit from detailed photographic measurement of eye movements. With such a method, subtle changes of the patterning of attention deployment may be revealed. For example, obsessives may respond to speeding by retaining their quality of inspection over a smaller area of the stimulus field, whereas impulsive subjects could continue to sample the same area as they did without speeding, but with reduced quality. As Wachtel (1967) has suggested, "An overall dimension of scanning may be a useful conceptual tool but...it may nonetheless prove fruitful to explore further whether in particular individuals or in particular circumstances certain components of scanning may be emphasized more than others, (p. 420)."

The viewpoint assumed in this thesis is that personality traits moderate the amount of time taken inspecting the stimuli. Other things being equal, longer times should lead to greater accuracy of estimation. In reality, however, other things are not equal in that quality and patterning of inspection can change to compensate for reduced performance time, so that the same degree of error is maintained, or even greater accuracy results. The examination of detailed eye movement photographs should prove rewarding in this respect.

Personality traits and eye movements as determinants of size estimates: replication and extension of personality findings

The second study was designed to further appraise the role of personality variables in determining individual differences of size estimation performance. The experimental conditions and measures were identical to those of the first study, the only change being the elimination of the gross eye movement measure because of the demonstrated efficacy of scan set instructions.

In the second study the additional variable of performance time was taken into account because of its notable variability, and its theoretical relation to the trait of impulsivity. For purposes of analysis high and low groups on each personality trait were formed by dividing at the median scale scores. Analyses of size estimates were performed in the context of a general factorial design involving levels of the personality trait, scan set groups and repeated speed set trial blocks as independent variables. High and low impulsive groups' size estimates were submitted to further analyses with performance time replacing the independent variable of scan set groups.

The results of the second study were as follows:

1. The finding in Experiment 1 of a relationship between impulsivity and size estimates was confirmed and extended. Low impulsive subjects overestimated less than high impulsive subjects except when they were forced by the speed set condition to perform more quickly. With speeding the two groups' size estimates did not differ significantly.

2. When the variable of performance speed was taken into consideration, it was found that some subjects in each of the two impulsivity groups responded to the speed set as though it were an incentive to perform more carefully, while others appeared more concerned with rapid completion of size estimates, and consequently had higher levels of overestimation.

3. Suggestive evidence for the effects of scan set instructions on size estimates was provided by the low obsessive subject group. Low obsessive subjects under the scan set condition maintained a relatively stable level of overestimation over repeated trial blocks, whereas the low obsessive group without such instructions showed a progressive

increase of overestimation.

4. Although there were some suggestive findings with the variable of preparanoia in the direction of greater overestimation by low preparanoid subjects, no significant relationships were established between size estimates and the traits of defendence and shallow affect.

The results obtained with the trait of impulsivity clearly implicate this variable as a determinant of size estimates. The proposed process involved is one of limiting the degree of time available for scanning, probably because of relaxed criteria of accuracy, resulting in greater overestimations.

The taking of detailed photographic eye movement measures would aid in ascertaining whether low impulsive subjects use the same strategy of inspection as high impulsive subjects but terminate it sooner, or whether qualitative differences in style of comparison are involved.

It is important to determine the relative contributions of impulsivity to the variability of eye movement levels, and to the motor task of operation of the size estimation apparatus. The finding of a high impulsive group which exhibits relatively slow performance and a low impulsive group with rapid performance may be partially explained by such a motor skill factor. The existence of the above groups also suggests that the situational generality of impulsivity be examined. The degree of impulsivity exhibited in a given situation may within limits be dependent on the subjects cognitive evaluation of the importance of the results; such a hypothesis could be explored by varying the perceived significance of task results.

The suggestion of a relationship between scan set instructions and size estimates for the low obsessive group must be qualified by the lack of clear within-subject effect of these instructions. This problem possibly could be alleviated by the use of a design with independent groups of subjects in each condition. The above relationship might more clearly be shown by making some adequate reinforcement contingent upon increased eye movement or more interestingly, upon increased accuracy of estimation with eye movements as the dependent variable. This latter procedure would probably lessen the liklihood of a compliant mechanical increase of eye movement without maintenance of a desire for accuracy.

Considering the general paucity of findings with the more pathologically oriented traits of defendence and preparanoia, it is possible that the relatively innocuous size estimation task did not provide a sufficient threat so as to evoke these processes. In other words, although the personality scale results indicate an individual is predisposed to certain behaviour tendencies of a preparanoid or defensive nature, at the time of performing his size estimates he may not have exhibited such behaviour. The obvious test of this hypothesis would be to stress the individual so as to evoke his habitual defensive processes. Inasmuch as an underlying assumption of the cognitive style literature is that attention styles adopted for their defensive significance generalizes to objectively nonthreatening situations, these results fail to support this assumed generality of styles. However, this assumption is usually made with reference to severely abnormal groups--more aberrant than those used in the present studies.

Regarding shallow affect, it was felt that a greater range of scale scores would be desirable as the liklihood of relating other variables to shallow affect would thus be enhanced.

Personality traits and eye movements as determinants of size estimates: attempted replication with an aberrant group

The third study involved an attempted replication of the finding obtained in Experiment 2 but with a sample of London Rescue Mission subjects expected to exhibit a greater range of personality scale scores. The procedure and measures employed in the third study were identical to those of Experiment 2. The results obtained in Experiment 3 were as follows:

1. The mission sample had higher variances on five of the seven scales used, and obtained higher mean scale scores on all of the more pathologically oriented scales; that is, preparanoia, obsessiveness, defendence and shallow affect.

2. The speed set manipulation resulted in a general decrease of overestimation for this sample. The speed set condition did not, as anticipated from Experiment 2, interact with the trait of impulsivity.

3. Significant differences of size estimation performance were not obtained between groups with varying levels of the traits of preparanoia, impulsivity or shallow affect.

4. Groups with low levels of the traits of defendence and obsessiveness were found to have higher levels of overestimation than corresponding low trait score groups.

5. The mission sample took substantially less time than the

university sample of the second study to perform size estimates under unspeeded conditions. Their rapid performance in the unspeeded trials was paralleled by a lower variability of time taken in these trials.

The results of the third study indicate that the mission sample was, as anticipated, a generally aberrant group relative to the university sample. The extended range of scores did not, however, result in either the replication of relationships between personality traits and size estimates noted in the second study or the extension of such relationships to include other traits such as shallow affect.

Considering the variable of shallow affect, it is possible, as Krause (1961) has noted, that trait measures of affectivity are not sufficiently representative of subject differences of affective state during experiments. A strategy which might overcome such potential difficulties would be to monitor physiological indices of affectivity while administering stress to subjects so as to alter their affective states.

Some suggestive but necessarily tentative evidence was found linking higher overestimation (and thus lower scanning) to low-trait levels of defendence and obsessiveness. These findings are of interest because they support the contention that learned differences of attentive style have a defensive significance for the individual, and are related to general personality and cognitive structures.

The explanation offered of both the lack of replication and the unexpected general increase of accuracy with speeded trial blocks was based on the unusually rapid performance of the mission sample. These subjects apparently performed naturally in a relatively careless manner. In particular, they failed to reduce their rate of reduction of the variable circle as they approached the point of perceived equality to the standard. Because only descending trials were used, these subjects were therefore in danger of turning too far and thus not being able to turn back to the size representing perceived equality as has been mentioned. If the obtained increase of accuracy with speeding was spurious, it should be eliminated by the addition of ascending trials.

Concluding Observations

Although the reliability of size estimates is well established, the narrow range of error apparent in the size estimation task produces serious difficulties for the use of such a measure for differential prediction or categorization regarding attentive styles. It is suggested that for this reason and others to follow that the photographic recording of eye movements may be the method of choice for placing subjects along a dimension of degree of scanning.

Ambiguity exists as to what "scanning" itself clearly implies. It has been noted by Sloan, Gorlow and Jackson (1963) and Vick and Jackson (1967) that the cognitive controls of equivalence range and leveling-sharpening may be too broadly defined; this would appear also to be the case with "scanning." Accompanying the proliferation of measures of scanning appears to be a proliferation of notions of what constitutes scanning; e.g., Messick (1966) has differentiated between scanning for signal detection and scanning for information seeking;

factor analytic results indicated that these are relatively independent processes.

Wachtel (1967) has discussed the complexity of the scanning dimension with a view to emphasizing the inadequacy of an undimensional view of attention deployment. Using the analogy of attention as a beam of light, he suggests that both the degree of patterning of the movement of the beam and the beam's width must be taken into account. For example, obsessives are considered to have widely ranging but narrow attentional "beams."

It is possible that the concept of beam width may be analogous to that of equivalence range. Such a hypothesis is consistent with the results obtained by Silverman (1964) in which combinations of extremes of scanning and category width were found in paranoid and non-paranoid schizophrenic groups. The direction of this research is therefore towards the little explored concept of cognitive styles as combinations of individual controls. The evaluation of different stylistic consistencies of attentive style is also indicated by Shapiro's (1965) analysis of the relation between neurotic processes and attention.

Although the significance of group differences of scanning style has clearly been established the status of competing process interpretations of these differences requires clarification. The study of Dulany (1957) indicates that the effects of experimental arousal of perceptual vigilance and defence on attention deployment may be a fruitful approach to evaluating process interpretations of group differences.

The importance of the relatively nonpathological trait of impulsivity established in the present research indicates that characterological or trait dispositions, as well as defensive processes, are determinants of scanning style. The possibility that impulsivity is more important for the size estimation measure than for eye movement measures should be explored.

Finally, it is possible that the attention deficits noted in schizophrenics, inasmuch as they represent learned styles of coping with threat, may be altered by appropriate reinforcement techniques, thereby providing patients with a degree of control of their attention deployment which will make them more amenable to alterations of other aspects of their behaviour.

APPENDIX A

List of Personality Research Questionnaire Items with Subscale and Direction of Keying Indicated

1	PR	F	37	IMP	T	73	OB	F	109	IF	T	145	SA	F
2	IMP	T	38	IMP	F	74	PR	T	110	DEF	F	146	PR	F
3	OB	F	39	IF	T	75	DEF	T	111	IMP	F	147	PR	F
4	PR	T	40	DEF	F	76	DY	F	112	DY	T	148	SA	T
5	DEF	T	41	IMP	F	77	OB	T	113	PR	F	149	OB	T
6	DY	F	42	DY	T	78	IF	F	114	IMP	T	150	PR	T
7	OB	T	43	PR	F	79	IMP	T	115	OB	F	151	OB	F
8	IF	F	44	IMP	T	80	IMP	F	116	PR	T	152	SA	F
9	IMP	T	45	OB	F	81	IF	T	117	DEF	T	153	PR	F
10	IMP	F	46	PR	T	82	DEF	F	118	DY	F	154	PR	F
11	IF	T	47	DEF	T	83	IMP	F	119	OB	T	155	SA	T
12	DEF	F	48	DY	F	84	DY	T	120	IF	F	156	OB	T
13	IMP	F	49	OB	T	85	PR	F	121	IMP	T	157	PR	T
14	DY	T	50	IF	F	86	IMP	T	122	IMP	F	158	OB	F
15	PR	F	51	IMP	T	87	OB	F	123	IF	T	159	SA	F
16	IMP	T	52	IMP	F	88	PR	T	124	DEF	F	160	PR	F
17	OB	F	53	IF	T	89	DEF	T	125	IMP	F	161	SA	T
18	PR	T	54	DEF	F	90	DY	F	126	DY	T	162	OB	T
19	DEF	T	55	IMP	F	91	OB	T	127	PR	F	163	PR	T
20	DY	F	56	DY	T	92	IF	F	128	IMP	T	164	OB	F
21	OB	T	57	PR	F	93	IMP	T	129	OB	F	165	SA	F
22	IF	F	58	IMP	T	94	IMP	F	130	PR	T	166	SA	T
23	IMP	T	59	OB	F	95	IF	T	131	DEF	T	167	OB	T
24	IMP	F	60	PR	T	96	DEF	F	132	DY	F	168	PR	T
25	IF	T	61	DEF	T	97	IMP	F	133	OB	T	169	OB	F
26	DEF	F	62	DY	F	98	DY	T	134	IF	F	170	SA	F
27	IMP	F	63	OB	T	99	PR	F	135	IMP	T	171	SA	T
28	DY	T	64	IF	F	100	IMP	T	136	IMP	F	172	SA	F
29	PR	F	65	IMP	T	101	OB	F	137	IF	T	173	SA	F
30	IMP	T	66	IMP	F	102	PR	T	138	DEF	F	174	SA	F
31	OB	F	67	IF	T	103	DEF	T	139	IMP	F	175	SA	T
32	PR	T	68	DEF	F	104	DY	F	140	DY	T	176	SA	F
33	DEF	T	69	IMP	F	105	OB	T	141	SA	T	177	SA	T
34	DY	F	70	DY	T	106	IF	F	142	OB	T	178	SA	F
35	OB	T	71	PR	F	107	IMP	T	143	PR	T	179	SA	T
36	IF	F	72	IMP	T	108	IMP	F	144	OB	F	180	SA	T

KEY:

T	True-keyed
F	False-keyed
DY	Desirability scale item
IF	Infrequency scale item
IMP	Impulsivity scale item
OB	Obsessiveness scale item
DEF	Defendence scale item
PR	Preparanoid scale item
SA	Shallow Affect scale item

Numbers are item numbers in Questionnaire order.

APPENDIX A (cont'd)

1. I never hesitate to tell people how I feel about things.
2. I admire free, spontaneous people.
3. I don't keep track of my money to the exact cent.
4. I hesitate to tell others how I feel about certain things.
5. When someone opposes me on an issue, I usually find myself taking an even stronger stand than I did at first.
6. Nothing that happens to me makes much difference one way or the other.
7. Certain questions go through my mind over and over again.
8. I try to get at least some sleep every night.
9. I have, at times, hurt someone unintentionally because I didn't think before speaking.
10. I have a reserved and cautious attitude toward life.
11. I was born over 90 years ago.
12. When someone presents me with strong arguments, I usually try to settle on some middle ground.
13. Emotion seldom causes me to act impulsively.
14. I always try to be considerate of the feelings of my friends.
15. I seldom feel that people are finding fault with me.
16. I find that I sometimes forget to "look before I leap."
17. I usually ignore the errors I see when reading the newspaper.
18. I am usually careful about what I say.
19. I don't like people to joke about what they feel are my shortcomings.
20. I have a number of health problems.
21. There are certain songs which I am unable to get out of my mind.
22. I have attended school at some time during my life.

APPENDIX A (cont'd)

23. I get a kick out of doing something just "for the heck of it."

24. Rarely, if ever, do I do anything reckless.

25. I have a number of outfits of clothing, each of which costs several thousand dollars.

26. If someone finds fault with me I either listen quietly or just ignore the whole thing.

27. I am careful to consider all pros and cons before taking action.

28. I often take some responsibility for looking out for newcomers in a group.

29. When something goes wrong, I like to talk it over with another person.

30. The people I know who say the first thing they think of are some of my most interesting acquaintances.

31. I do not weigh myself regularly.

32. I seldom tell my friends or family how I feel.

33. I try never to allow anyone to get the upper hand with me.

34. I often have the feeling that I am doing something evil.

35. I always know to the exact penny how much money I have.

36. I could easily count from one to twenty-five.

37. My thoughts often get ahead of me.

38. I am not an "impulse-buyer."

39. I make all my own clothes and shoes.

40. I usually let unkind things someone might say about me pass without making any return comment.

41. I am considered rather reserved in thought and action.

42. In the long run, humanity will owe a lot more to the teacher than to the salesman.

43. I seldom have the feeling that someone is trying to get the best of me.

APPENDIX A (cont'd)

44. I have often broken things because of carelessness.

45. Nothing that happens to me makes much difference one way or the other.

46. When something goes wrong, I prefer to keep it to myself.

47. I tend to react strongly to remarks which find fault with my personal appearance.

48. I almost always feel sleepy and lazy.

49. I always make note of the errors in everything I read.

50. Sometimes I feel thirsty or hungry.

51. When I go to the store, I often come home with things I had not intended to buy.

52. I make certain that I speak softly when I am in a public place.

53. I rarely use food or drink of any kind.

54. Most people are honest enough that I would let them work in my home without close supervision.

55. Life is a serious matter which should be lived with caution and a cool head.

56. I am seldom ill.

57. I am not afraid that anyone will take advantage of my ideas.

58. I enjoy arguments that require good quick thinking more than knowledge.

59. I don't go over conversations in my mind, thinking about what else I could have said.

60. When people whisper, I feel they might be talking about me.

61. I would get into a long discussion rather than admit I am wrong.

62. I am not willing to give up my own privacy or pleasure in order to help other people.

63. I always keep track of exactly how much I weigh.

64. I usually wear something warm when I go outside on a cold day.

APPENDIX A (cont'd)

65. Sometimes I get several projects started at once because I don't think ahead.

66. I am not one of those people who blurt things without thinking.

67. I have never ridden in an automobile.

68. I don't get angry when people laugh at my errors.

69. If I want to buy something, I make certain that it will be just what I want before purchasing it.

70. My memory is as good as other peoples'.

71. People rarely have hidden motives for the nice things they do for me.

72. I often get bored at having to concentrate on one thing at a time.

73. I don't follow a precise schedule.

74. People usually try to get the best of me.

75. Since people are always looking for a person's weak spots, I am careful never to talk about mine.

76. We ought to let the rest of the world solve their own problems and just look out for ourselves.

77. I can't stop thinking about mistakes I have made.

78. If someone pricked me with a pin, it would hurt.

79. I often say the first thing that comes into my head.

80. I always try to be fully prepared before I begin working on anything.

81. I have never seen an apple.

82. I am only very rarely in a position where I feel a need to actively argue for a point of view I hold.

83. If I start one activity, I stay with it until it is finished.

84. Most of my teachers were helpful.

85. I have not noticed anybody gossiping about me.

APPENDIX A (cont'd)

86. It seems that emotion has more influence over me than does calm meditation.

87. I don't try to control what I think about.

88. If I had a good idea, I would not discuss it with anyone who might take advantage of it.

89. People find it very difficult to convince me that I am wrong on a point no matter how hard they try.

90. I often question whether life is worthwhile.

91. After I have been in a conversation, I keep thinking about what I should have said.

92. If I were exploring a strange place at night, I would want to carry a light.

93. I often do daring things on the spur of the moment.

94. I generally rely on careful reasoning in making up my mind.

95. I think the world would be a much better place if no one ever went to school.

96. If faced by a good argument, I am usually willing to change my position even on important issues.

97. Statements I make are usually well thought out.

98. My life is full of interesting activities.

99. I don't mind talking about my background and personal life to my friends.

100. Often I stop in the middle of one activity in order to start something else.

101. I usually talk without first mentally considering each word.

102. Whenever I can, I sit where others can't easily see me.

103. I am always ready to defend myself against remarks people might make about me or my friends.

104. I believe people tell lies any time it is to their advantage.

105. I have a great desire to completely organize my thoughts.

APPENDIX A (cont'd)

106. I wear clothes when I am around other people.

107. Many of my actions seem to be impulsive.

108. If I am playing a game of skill, I attempt to plan each move thoroughly before acting.

109. I have no sense of touch in my fingers.

110. Most of the people with whom I am in contact ignore any minor errors I make.

111. I am pretty cautious.

112. I am able to make correct decisions on difficult questions.

113. I often confide in other people.

114. Most people feel that I act spontaneously.

115. My thoughts are not organized in any special way.

116. People often tell me that I imagine all my troubles.

117. I deliberately keep people from getting to know me too well.

118. I find it very difficult to concentrate.

119. I repeatedly have thoughts about the death of people I know.

120. I would have a hard time keeping my mind a complete blank.

121. I find that thinking things over very carefully often destroys half the fun of doing them.

122. I think that people who fall in love impulsively are quite immature.

123. I can't believe that wood really burns.

124. I don't mind answering questions about my family or friends when applying for a job.

125. My thinking is usually careful and purposeful.

126. Rarely, if ever, has the sight of food made me ill.

127. I don't take what people say about me very seriously.

APPENDIX A (cont'd)

128. Life is no fun unless it is lived in a carefree way.

129. I am not overly annoyed or upset by forgetting someone's name.

130. People often return my kindness with hateful thoughts.

131. If someone accused me of making a mistake, I would call his attention to a few mistakes of his own.

132. Many things make me feel uneasy.

133. I can't seem to keep my mind off certain gloomy topics.

134. I am able to breathe.

135. Outlining a paper or talk has always struck me as a waste of time.

136. I like to take care of things one at a time.

137. I can run a mile in less than four minutes.

138. Most of the criticism I receive can be used to my advantage by helping me to improve myself.

139. If I have to give a talk, I like to have plenty of time to plan it.

140. I am always prepared to do what is expected of me.

141. I very seldom look forward to anything.

142. Much of my time is spent thinking about poems and sayings that I learned as a child.

143. I think that people gossip about me too much.

144. My thoughts are seldom frightening.

145. Some things cause me to become quite excited.

146. I rarely stop to analyze the motives of the people around me.

147. Most people like me.

148. I usually do not have any feelings or concern over the people I know.

149. When I try to remember someone's name, I always follow the same patterns in my thinking.

APPENDIX A (cont'd)

150. I feel uncomfortable when I don't know what is going on behind my back.

151. I don't have any dreams that repeat over and over again.

152. It bothers me to see someone hurt in an accident.

153. I have several friends whom I can really trust.

154. People seldom laugh at me or make fun of me.

155. I am basically rather heartless.

156. When I think of a project for myself, I can't think of another thing until I have finished that project.

157. I have stopped associating with certain people because I realize what their motives were.

158. I have never noticed in myself a tendency to think of touching some particular object.

169. I enjoy children.

160. Most of the people with whom I am in contact ignore any minor errors I make.

161. Seldom, if ever, have I been embarrassed.

162. I am frequently concerned with thoughts of the Eternal.

163. I seldom, if ever, confide in other people.

164. Eternity is a concept which does not enter my thinking very often.

165. There are some things in my life which I feel are very important.

166. I don't care whether I have friends or not.

167. I always think about the concept of Guilt.

168. I think a good deal about what people's actions really mean.

169. I spend very little time pondering the meaning of Truth.

170. I usually form opinions about the things that I see or hear.

171. It wouldn't bother me to see someone die.

APPENDIX A (cont'd)

172. I don't think I could watch an animal suffer without becoming upset.

173. There have been times when I have been ashamed of something I have done.

174. There are some people I like and some I dislike.

175. It doesn't matter to me what style or color clothes I wear.

176. There are times when I would enjoy having a pet.

177. It doesn't matter whether people are kind or unkind to me.

178. I find some things quite humorous.

179. I have never liked anyone very much.

180. Watching an animal suffer wouldn't bother me.

APPENDIX B

Instructions to Subjects

The instructions are divided into several sections, beginning with the initial instructions common to all experimental conditions and continuing with those relevant to each particular experimental block (as depicted in Figure 2).

Initial and Block 1. This is a size estimation apparatus. (Turn on variable circle.) You will notice a circle of light on the screen in front of you. By turning the knob on your right, you can reduce the size of the circle. (Demonstrate and turn off light circle.) Your task is to make the light circle exactly equal in size to the metal disc on your left by turning the knob in one direction only--to the left. If you make the circle too small, you cannot turn the knob in the other direction to make the circle larger; turn only to the left. You are to start each time when the light circle appears. There is no time limit, so just work at your own speed. When you complete each comparison, say "finished" so I can turn off the light circle and prepare the next trial. While you are making your judgments, I want you to keep your head at the same distance as it is now from both circles. Try not to change this distance. To help you maintain this distance, I want you to keep your chin in this chin rest and move only your eyes while making your comparisons.* Okay, now we are ready to begin.

Block 2; high scan set. People generally show their highest level of accuracy in this situation by looking back and forth between disc and circle as much as possible. That is, the more times you compare them, the more accurate your judgment is likely to be. Therefore, on each trial from now on, I want you to look back and forth as much as possible between the disc and the light circle. As before, work at your own speed and tell me when you are finished.

Block 3; moderate speeding. This time you will do exactly the same task as before except that there will be a variable time limit of 30 to 40 seconds to complete your comparisons. After this time is over, the light circle will be turned off. The idea then is to finish your comparison in 30 to 40 seconds. As before, tell me when you finish your comparison.

Block 4; extreme speeding. This time you are to make your comparison as fast as possible while not entirely neglecting accuracy. I will be timing how long you take so make your comparisons as fast as you can. As before, tell me when you are finished.

Block 5; return to preferred speed. Now you are to make your comparison at your normal comfortable speed. The emphasis is again on accuracy and there is no time limit. Again, tell me when you finish.

APPENDIX B (cont'd)

<u>Block 6; low scan set</u>. Now you are to deliberately look less often between the two circles. Accuracy is important but try to deliberately look less frequently back and forth between circles. As before, tell me when you finish.

Blocks 5 and 6 were not included in Experiments 2 and 3.

*This instruction is relevant only to Experiment 1.

APPENDIX C

Conversion Table Expressing Arbitrary Size Estimation Scale Values in Inches of Diameter of the Variable Stimulus

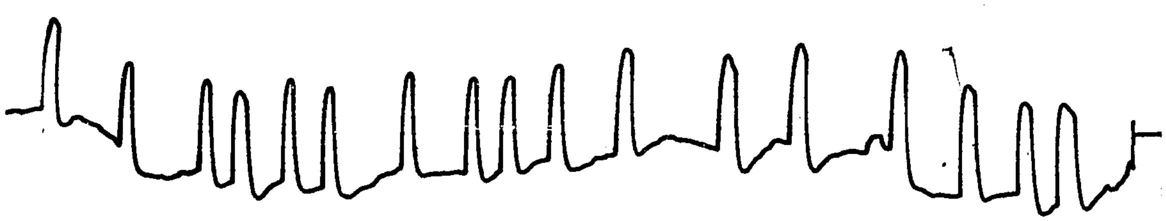
Arbitrary Scale Value	Variable Stimulus Diameter*
75	3.500
70	3.250
65	3.063
60	2.844
55	2.625
50	2.438
45	2.250
40	2.063
35	1.875
30	1.688
25	1.500
20	1.313
15	1.125
10	0.875
5	0.750

* Exact equality of standard and variable stimuli occurs at an arbitrary scale value of 36.1.

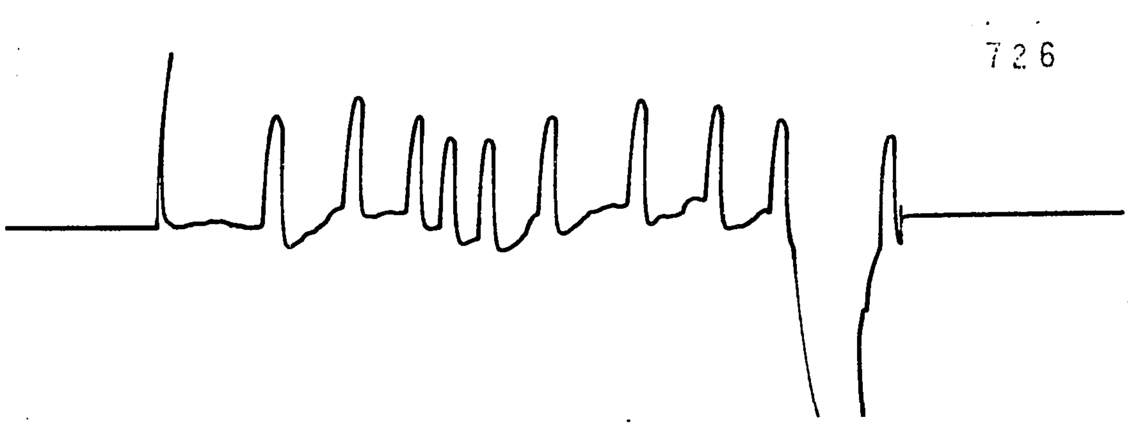
APPENDIX D

Typical Oscillographic Eye Movement Record with

Frequency of Eye Movements Scored

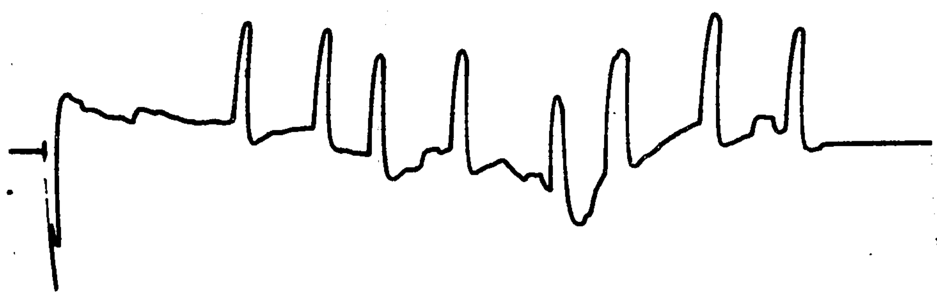


Block 1, Trial 1 Preferred Speed 34 Looks

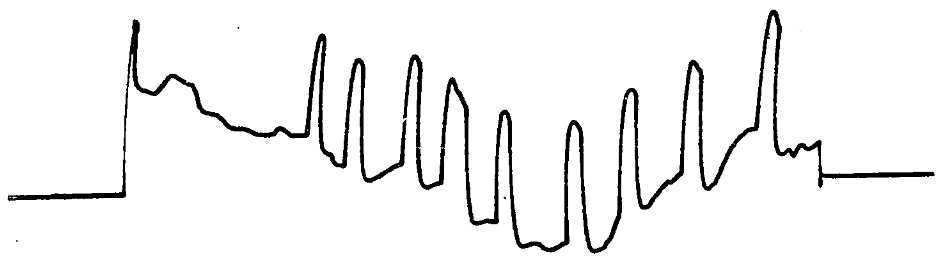


Block 1, Trial 2 Preferred Speed 20 Looks

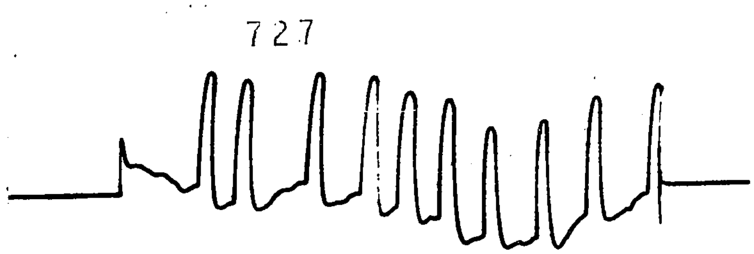
APPENDIX D (Cont'd)



Block 2, Trial 1 Preferred Speed 16 Looks

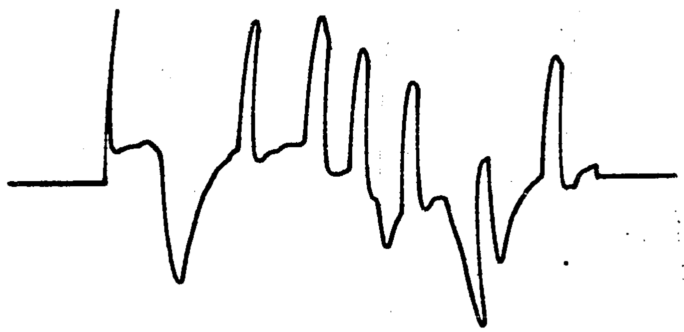


Block 2, Trial 2 Preferred Speed 18 Looks

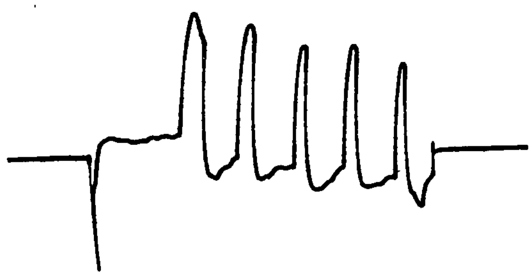


Block 3, Trial 1 Moderate Speed Set 20 Looks

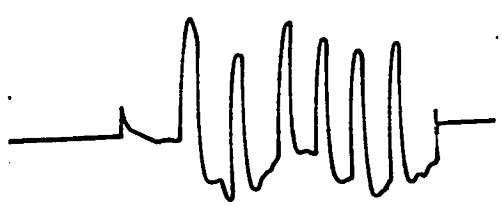
APPENDIX D (Cont'd)



Block 3, Trial 2 Moderate Speed Set 12 Looks

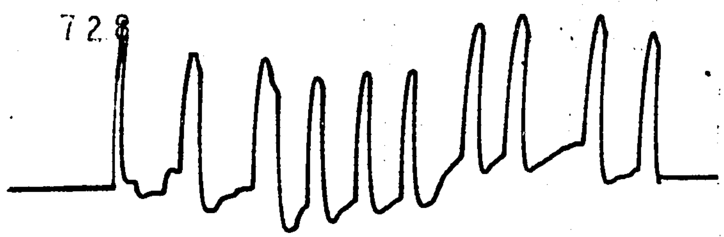


Block 4, Trial 1 High Speed Set 10 Looks

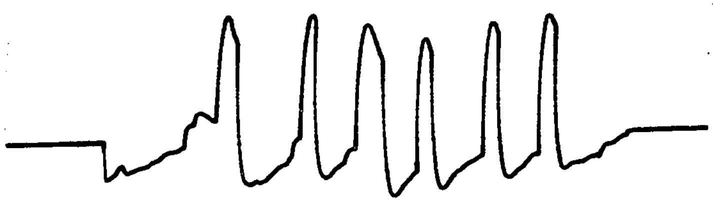


Block 4, Trial 2 High Speed Set 12 Looks

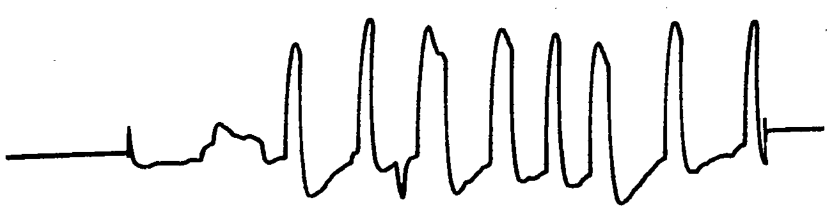
APPENDIX D (Cont'd)



Block 5, Trial 1 Return to Preferred Speed 18 Looks

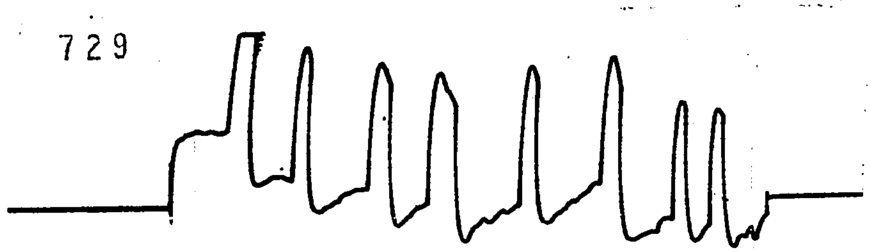


Block 5, Trial 2 Preferred Speed 12 Looks

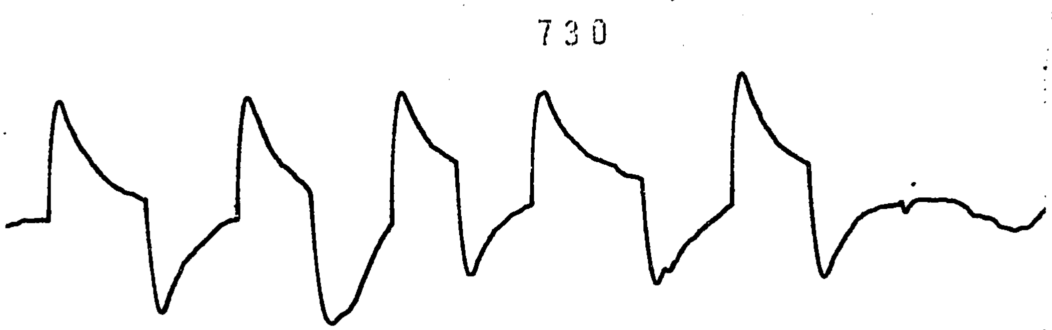


Block 6, Trial 1 Preferred Speed 16 Looks

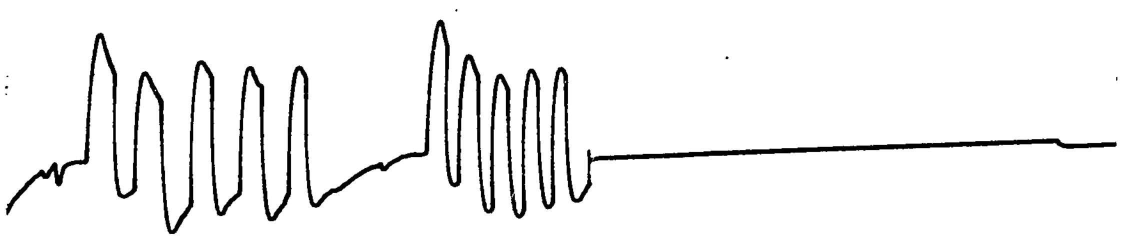
APPENDIX D (Cont'd)



Block 6, Trial 2 Preferred Speed 16 Looks



Calibration Trials Slow Count 10 Looks



Calibration Trials Moderate Speed and Fast Counts 20 Looks

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