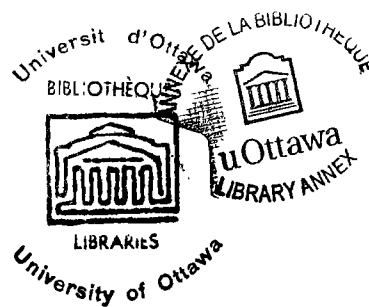


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INTROVERSION-EXTRAVERSION AND THE ROLE OF THE
ORIENTING REACTION HABITUATION RATE AND
RECOGNITION SENSITIVITY TO NEUTRAL
AND AFFECTIVE WORDS

by Joseph Y. C. Chien

Thesis presented to the School of
Graduate Studies of the University
of Ottawa as partial fulfillment of
the requirements for the degree of
Doctor of Philosophy



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CURRICULUM STUDIORUM

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INTRODUCTION

It is well known that perception of certain aspects of the environment is a function not only of the properties of external stimulation, but also of certain dispositions within the perceiver. The concept of the Orienting Reaction, first advanced by Russian workers, has been implicated in individual differences of stimulus reception and learning, and has prompted attempts to explicate the interrelationships between personality variables, stimulus qualities, and differential psychological and perceptual modes of response.

Within this context, the present research considers the following general questions: (a) Do introverts and extraverts differ in terms of their Orienting Reaction Habituation Rates to Neutral and Affective words? (b) Do introverts and extraverts differ in terms of their recognition sensitivity to Neutral and Affective words?

Eysenck postulates that introverts, because of their greater degree of cortical excitability, should have longer Orienting Reaction Habituation Rates. Experimental evidence, however, is still inconclusive. One possible explanation of the conflicting results reported in the literature is that different researchers have used stimuli differing in signal value. The Orienting Reaction may reflect a complex interaction of attentional, cognitive and motivational personality

characteristics, in addition to its function as a sensory facilitator.

In order to explore this possibility, Neutral and Affective words will be used to elicit the Orienting Reaction. It is well known that these stimuli elicit individual differences in recognition behavior and are presumed to reflect complex cognitive and affective signal values.

Eysenck further postulates that introverts, because of their greater degree of cortical arousal, should display greater recognition sensitivity. Only a few studies have been conducted to explore the relationship between extraversion and recognition sensitivity. Furthermore, tests of this hypothesis have generally employed traditional psychophysical measures which confound sensory and nonsensory factors. Since it is important that recognition sensitivity be separate from personal response factors, the present study proposes to explore this hypothesis with the Signal Detection Method of Recognition data analysis.

The basic strategy of the research involves classifying individuals into groups of low, middle, and high extraversion. The Orienting Reaction Habituation Rates to Affective and Neutral words for these groups are compared.

The first chapter presents a review of the various theories and relevant studies which led to the development

of the problem. The chapter ends with a statement of the hypotheses. The second chapter gives a description of the sample, procedure, and statistical design. The third chapter presents the results. The fourth and final chapter discusses the implications of the results.

CHAPTER I

REVIEW OF THE LITERATURE

Previous studies have employed the rate of habituation of the Orienting Reaction to test Eysenck's hypothesis that introverts have greater cortical excitability than extraverts. Conflicting results have been reported in studies that used auditory or visual stimuli. Since it has also been shown that different stimuli, such as simple and complex, have differential effects on the elicitation of the Orienting Reaction, it is possible that differences in the signal value of the stimulus may contribute to the inconsistency of the results. The Orienting Reaction Habituation Rate may reflect a complex situation of attentional, cognitive and motivational personality characteristics, as well as the facilitation of sensory reception.

In this context it can also be argued that the differences in perceptual sensitivity between introverts and extraverts reported in the literature may be attributable to differences in response bias rather than specific sensory sensitivity. The argument hinges on the fact that the measures of sensory sensitivity have been derived by traditional psychophysical procedures which are well known to confound sensitivity and response bias.

The problem which this study attempts to elucidate is whether introverts indeed have greater cortical excitability as reflected by longer Orienting Reaction Habituation Rate and/or greater recognition sensitivity.

This chapter presents a review of the theories and relevant research which led to the formulation of the problem. Section 1 reviews the literature on the properties and functions of the Orienting Reaction. Section 2 reviews studies that attempted to link the Eysenckian dimension of Extraversion to the elicitation of the Orienting Reaction and perceptual sensitivity. Section 3 examines the possibility of the Orienting Reaction as a complex response, the elicitation of which depends on the interplay of personality and stimulus variables. Section 4 describes the theory of Signal Detection, and discusses its advantages over the classical approaches to psychophysics in terms of its value in clarifying the role of sensory and nonsensory determinants in the perceptual recognition task. Section 5 discusses the choice of the stimuli used in the present study. In the final section of this chapter, the problems posed for investigation are formulated in the light of the theoretical background, and the null hypotheses employed to treat the problems are presented.

1. The Orienting Reaction.

The OR¹ was first introduced into modern psychophysiology in 1910 by Pavlov² as the "what-is-it" reaction, an initial arousal phase of the conditioning process which brings about attention and investigatory responses in man and animals to the slightest changes in their environments. Experiments indicated that the Orienting Reaction occurred when the organism was presented with stimuli which were novel,³ or had meaning or signal quality.⁴

According to Sokolov⁵ and Anokhin⁶ the OR is a holistic physiological response of an organism to novel

1 OR in this study is the abbreviation for Orienting Reaction(s), and is used interchangeably.

2 I. P. Pavlov, Conditioned Reflexes: An Investigation of the Physiological Activity of the Cerebral Cortex, London, Oxford University, 1927, p. 12.

3 M. Rheinberger and H. H. Jasper, "The Electrical Activity of the Cerebral Cortex in the Unanesthetized Cat," American Journal of Physiology, Vol. 119, 1937, p. 186-196.

4 H. H. Jasper and R. M. Cruikshank, "Electroencephalography II: Visual Stimulation and the After Image as Affecting the Occipital Alpha Rhythm," Journal of General Psychology, Vol. 17, 1937, p. 29-48.

5 E. N. Sokolov, Perception and the Conditioned Reflex, New York, Macmillan, 1963, ix-309 p. (e.g., p. 132 and 285).

6 P. K. Anokhin, "The Role of the Orienting-Exploratory Reaction in the Formation of the Conditioned Reflex," in D. B. Lindsley (ed.), Orienting Reflex and Exploratory Behavior, Washington, American Institute of Biological Sciences, 1965, p. 3.

stimulation. It sensitizes the organism's analyzers or sense organs involved in stimulus detection and precedes perception of the stimulus by bringing the organism into favorable position with the source of stimulation. Sokolov⁷ considers the OR as a general unspecific reaction evoked by any qualitative, intensive or temporal change in stimulation. Such a change in stimulation is thought to appear to the organism as novel, to acquire signal quality, or produce surprise and/or conflict, regardless of the sense modality stimulated. The second significant characteristic is that the OR is subject to habituation or extinction. Habituation is the diminution of the magnitude of the response and its final disappearance when a stimulus is repeated. The rate and pattern of habituation, however, may differ with individual organisms.

A number of theoretical models have been proposed in the literature to explain the elicitation of the OR and to account for its habituation. This study adopts the most widely accepted theory: Sokolov's two-stage neuronal model.⁸ According to the theory, novel stimuli reach the cortex via specific sensory pathways. In the cortex, the characteristics

⁷ E. N. Sokolov, "Neuronal Models and the Orienting Reflex," in M.A. Brazier (ed.), The Central Nervous System and Behavior, New York, Moon, 1960, p. 189-190.

⁸ Ibid., p. 216.

of the stimuli are analyzed, compared to pre-existing neuronal models, and stored as memory traces or 'neuronal models.' If the incoming stimulus is novel, its characteristics cannot be matched with any consolidated cortical neuronal models since a replica of the stimulus has not yet been formed in the cortex. The cortex then activates the reticular formation by sending excitatory impulses to it, resulting in heightened cortical arousal and EEG desynchronization. Full tuning of the analyzers occurs, in preparation for the further elaboration, exploration and processing of the stimulus information. Thus the central component (via the Diffuse Thalamic Projection System) and the autonomic component (via posterior hypothalamus reticular formation) of the OR are produced. When the stimulus is appraised by the cortex as not being novel or relevant, or when habituation sets in after repeated stimulation resulting in a neuronal model of the particular stimulus, matching takes place. The cortex sends down inhibitory impulses "somewhere between the collaterals from the specific pathway and the reticular formation [...] probably by hyperpolarization of synaptic connections."⁹ Thus stimulus enhancement by the reticular formation is inhibited, and both central and autonomic OR components disappear. The less novel or the

⁹ Sokolov, Perception and the Conditioned Reflex, p. 212.

less relevant information the incoming stimulus contains, the sooner the OR will habituate. An illustration of this process is given in Figure 1.

Sokolov's theory advances the following main ideas: First, similar to Hebbian Cell Assembly theory,¹⁰ he considers the nervous system as a mechanism which models the external world by specific changes occurring in its internal structure. These changes in the cortex mirror the external world by becoming isomorphic with the external stimulus agents. The internal neuronal models have the important function of modifying the organism's subsequent behaviors and allowing him to predict future events and adapt to a new environment.¹¹ Second, the purpose of habituation of the OR is to filter, block or attenuate unimportant stimuli peripherally, implying that "a selective prevention of transmission of impulses from certain kinds of stimulation must take place,"¹² to free the cortex for the processing of more relevant information. Third, Sokolov considers the OR as a central mechanism involving intricate interrelationship

10 D. O. Hebb, The Organization of Behavior, New York, Wiley, 1949, xix-335 p.

11 E. N. Sokolov, "The Modeling Properties of the Nervous System," in M. Cole and I. Maltzman (eds.), A Handbook of Contemporary Soviet Psychology, New York, Basic Books, 1969, p. 671-704.

12 -----, Perception and the Conditioned Reflex, p. 208.

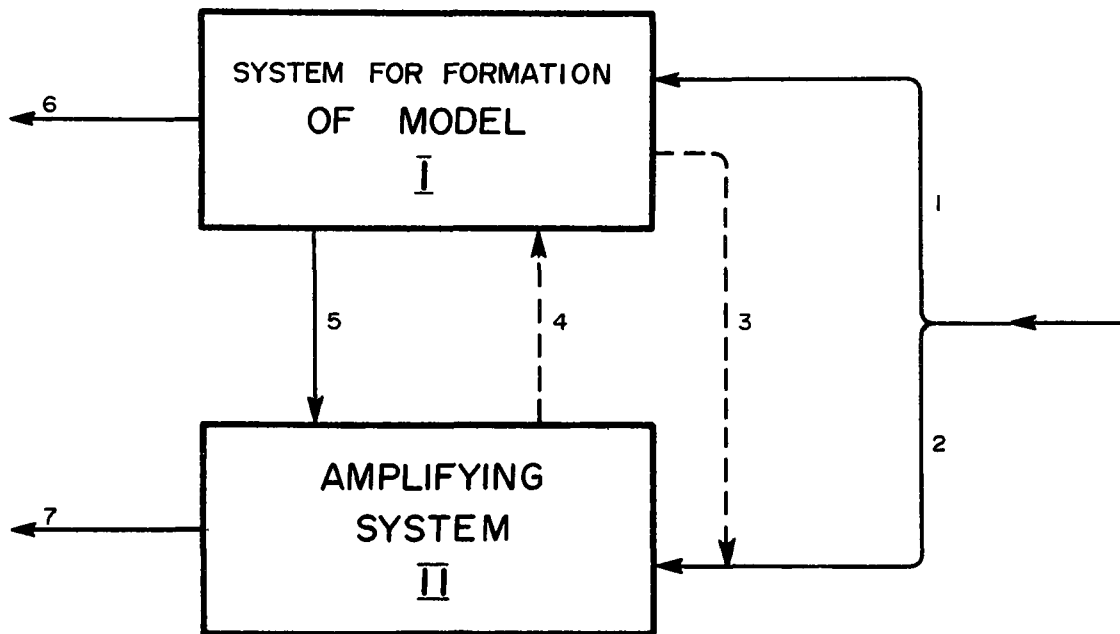


Figure 1.- Schema for the Orienting Reflex.

I. Modeling system. II. Amplifying system. 1 = specific pathway from sense organs to cortical level of modeling system; 2 = collateral to reticular formation (represented here as an amplifying device); 3 = negative feedback from modeling system to synaptic connection between collaterals from specific pathway and R.F.; 4 = ascending activating influences from the amplifier (R.F.) upon modeling system (cortex); 5 = pathway from modeling system to amplifying system (this is the pathway through which the impulses signifying concordance are transmitted from the modeling system to the amplifying system); 6 = to the specific responses caused by coincidence between the external stimulation and the neuronal model elaborated in the cortex; and 7 = to the vegetative and somatic components arising from the stimulation of amplifying system (R.F.).*

* E.N. Sokolov, "Neuronal Models and the Orienting Reflex," in M.A.B. Brazier (ed.), The Central Nervous System and Behaviour, New York, J. Moon, 1960, p. 216.

between the cortex and the reticular formation. His claim has received neuroanatomical support. Brazier¹³ provided evidence that the central-median nucleus of the nonspecific thalamus was responsible for detecting signal novelty and habituation upon monotonous repetition of an unchanging stimulus. The nucleus is known to be the relay station for visual and auditory sensory fibres. Other authors^{14,15} have also provided evidence that the midbrain reticular formation was responsible for generalized alpha blocking typically observed after the first few presentations of the stimulus, whereas the thalamic reticular formation was responsible for differentiated attention states of localized, modality specific sensory projection areas. The inhibitory influence was least apparent when the stimulus was novel, sudden, intense, or had acquired a special signal or cue value. Furthermore the authors have suggested that, on the regulation and monitoring of information by the cortex, the reticular formation is in a complex, dynamic, constantly

13 M. A. B. Brazier, "Novelty and Information Theory: Brain Potential Signs of Informational Control," in I. Ruttky-Nedecky *et al.* (eds.), Mechanisms of Orienting Reaction in Man, Bratislava, Slovak Academy of Sciences, 1967, p. 339-347.

14 I. Samuel, "Reticular Mechanisms and Behavior," Psychological Bulletin, Vol. 56, 1959, p. 1-25.

15 S. Sharpless and H. H. Jasper, "Habituation of the Arousal Reaction," Brain, Vol. 79, 1956, p. 655.

fluctuating state of excitation-inhibition that affects the sensitivity of specific sensory modalities. Hence the OR and perceptual sensitivity are probably concomitantly related. Fourth, since the OR occurs to novel stimulation, previous experience and personal relevance are important determinants of the OR. The OR is not bound to external stimulation alone, but also to individual differences in memory schema.

The components of the OR as described by Sokolov,¹⁶ Maltzman and Raskin,¹⁷ and Lynn¹⁸ comprise skeletal (movement of the body and receptors towards the source of stimulation), sensory (lowering of sensory thresholds thereby increasing the sensitivity of the sense organs involved in stimulus reception), autonomic (change in the heart rate, vascular content and volume in peripheral blood vessels, momentary cessation of respiratory movement, changes in the electrical potential and conductance of the skin), central (electroencephalographic desynchronization in

16 Sokolov, "Neuronal Models and the Orienting Reflex," p. 191.

17 I. Maltzman and D. Raskin, "Effects of Individual Differences in the Orienting Reflex on the Conditioning and Complex Processes," Journal of Experimental Research in Personality, Vol. 1, 1965, p. 1-2.

18 R. Lynn, Attention, Arousal and the Orienting Reaction, London, Pergamon Press, 1966, p. 2-3.

cortical areas with waves of high frequency and low amplitude indicating general arousal or excitation of the cortex). These physiological indices correspond to a general state of arousal in the organism and prepares him for adaptation to changes within his immediate environment.

2. Extraversion, Orienting Reaction and Perceptual Sensitivity.

In this section, the resemblance between Sokolov's theory of the Orienting Reaction and Eysenck's theory of Extraversion is first discussed. The second part of this section is devoted to the review of experimental studies that were conducted to investigate the relationship between extraversion and perceptual sensitivity, the relationship between extraversion and OR reactivity, and the relationship between OR reactivity and perceptual sensitivity.

(a) The Relationship between Sokolov's Theory of the Orienting Reaction and Eysenck's Theory of Extraversion.- There has been little research by Russian investigators on individual differences in the magnitude and habituation rate of the OR. Based on the work of

Pavlov and Teplov, Gray^{19,20,21} suggested that the Pavlovian dimension of Strong and Weak Nervous System and the Eysenckian dimension of Introversion-Extraversion were congruent. He argued that individuals characterized by a "weak nervous system" were similar to introverts in that they appeared more sensitive, had lower sensory thresholds, were more excitable and amplified stimulation more than "strong nervous system" individuals or extraverts.

Eysenck²² has postulated that Introversion and Extraversion may be distinguished in terms of sensitivity of stimulus intake and the speed of conditioning. This difference was explained by Eysenck with the use of a hypothetical construct known as "the excitation-inhibition balance." According to Eysenck, extraverts are centrally inhibited and are expected to suppress sensory input because of more easily triggered cortical activity of the thalamo-cortical inhibitory system. On the other hand, introverts

19 J. A. Gray, Pavlov's Typology, New York, Pergamon, 1964, p. 248-260.

20 -----, "Strength of the Nervous System, Introversion-Extraversion, Conditionability and Arousal," Behavior Research and Therapy, Vol. 5, 1967, p. 151-169.

21 -----, "The Psychophysiological Basis of Introversion-Extraversion," Behavior Research and Therapy, Vol. 8, 1970, p. 249-266.

22 H. J. Eysenck, The Biological Basis of Personality, Springfield, C. Thomas, 1967, p. 226-262.

are more tonically aroused because of lower sensory and reticular formation (brain stem) threshold which enhances the efficiency of the sensory receptors. Eysenck²³ sees a similarity between his postulate of excitation-inhibition balance to explain observed differences in the performance of introverts and extraverts and the Sokolovian neuronal model of cortico-reticular loop with its excitation-inhibition balance in the processing of information.

Experimental studies have shown that introverts tend to be more sensitive perceptually, and more easily aroused than extraverts. Studies have also shown that the OR is related to attention arousal and perceptual intake. Some of these studies are discussed in the following part of this section.

(b) Experimental Studies Relating Extraversion, OR Reactivity, and Perceptual Sensitivity.- Concerning the relationship between the OR reactivity and perceptual sensitivity, a number of studies^{24,25,26} have shown that the OR

23 Ibid., p. 231-242.

24 J. Germana, "Response Characteristics and the Orienting Reflex," Journal of Experimental Psychology, Vol. 78, 1968, p. 610-616.

25 D. C. Raskin, "Semantic Conditioning and Generalization of Autonomic Responses," Journal of Experimental Psychology, Vol. 79, 1969, p. 69-76.

26 P. E. Baer and M. J. Fuhere, "Cognitive Processes in the Differential Trace Conditioning of Electrodermal and Vasomotor Activity," Journal of Experimental Psychology, Vol. 84, 1970, p. 178.

was related to a lowering of sensory thresholds, accentuation of attention, and increase in the ability to discriminate between stimuli. A recent experiment by Maltzman and Raskin²⁷ provides a good example: the subject was first presented with a light of subthreshold intensity, followed by a loud tone which evoked an OR. During the evocation of the OR, it was found that the subject was able to detect the subthreshold light both behaviorally and physiologically, indicating greater perceptual sensitivity and physiological arousal. On repeated presentations of the auditory tone, however, it was found that the OR soon habituated and the subject's visual threshold was raised to its previous level, indicating decreased perceptual sensitivity and physiological arousal during the extinguishing of the OR. The authors also showed that the subjects who gave a large initial OR response, such as the vasoconstriction response in the finger, to a novel stimulus, were better at discriminating tasks and conditioning than subjects who gave low initial OR responses. They concluded that the findings supported the Sokolovian theory in that the OR reactivity was directly related to arousal, attention and perceptual discrimination.

27 I. Maltzman and D. C. Raskin, "Effects of Individual Differences in the Orienting Reflex on Conditioning and Complex Processes," Journal of Experimental Research in Personality, Vol. 1, 1965, p. 1-16.

Concerning the relationship between the Eysenckian dimension of Introversion-Extraversion and physiological OR reactivity, an early study by Bakan²⁸ indicates that, in an auditory vigilance situation, introverts maintained a greater level of arousal than extraverts and persisted in listening for signals even though they occurred infrequently. The results seem to show that extinction of listening responses took place earlier for extraverts than for introverts. More recent studies by Mangan and O'Gorman²⁹ and by Sadler et al.³⁰ have also shown that introverts made more OR responses to auditory stimuli than extraverts. These differences in the physiological OR reactivity between the introverts and the extraverts were interpreted in terms of cortical arousal, in the light of the findings by Ross et al.³¹ and Coles and Gale.³² The former found that the greater the

28 P. Bakan, "Extraversion-Introversion and Improvement in an Auditory Vigilance Task," British Journal of Psychology, Vol. 50, 1959, p. 325-332.

29 G. L. Mangan and J. G. O'Gorman, "Initial Amplitude and Rate of Habituation of OR in Relation to Extraversion and Neuroticism," Journal of Experimental Research in Personality, Vol. 3, 1969, p. 275-282.

30 T. G. Sadler, R. B. Mefferd and R. L. Houck, "The Interaction of Extraversion and Neuroticism in Orienting Response Habituation," Psychophysiology, Vol. 8, 1971, p. 314.

31 S. Ross, J. Dardano, R. C. Hackman, "Conductance Levels During Vigilance Task Performance," Journal of Applied Psychology, Vol. 43, 1959, p. 69.

32 M. G. H. Coles and A. Gale, "Physiological Reactivity as a Predictor of Performance in a Vigilance Task," Psychophysiology, Vol. 8, 1971, p. 598.

magnitude of the physiological reactivity measured during the performance on a vigilance task, the greater was the perceptual efficiency, indicating higher cortical arousal. The latter found that the longer the habituation rate of the OR-GSR, the better was the signal detection efficiency in a discrimination task. Thus, the Orienting Reaction has been employed as a physiological tool in experimental research to support Eysenck's theory that introverts have greater cortical excitability.

Conflicting results have been reported by Quirion.³³ The author found that introverts showed a shorter OR habituation rate to an auditory tone than extraverts. The differences in the OR habituation rate between the introverts and the extraverts were interpreted in terms of the speed of conditioning, in the light of Razran's³⁴ review of Russian studies that the OR may be related to the manifestation and speed of conditioning. Thus the shorter OR habituation rate of the introverts was interpreted as indicating greater

33 N. Quirion, Extraversion, Neuroticism and Habituation of the Orienting Reaction, unpublished doctoral dissertation presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1970, vii-77 p.

34 G. Razran, "The Observable Unconscious and the Inferable Conscious in Current Social Psychophysiology: Interoceptive Conditioning, Semantic Conditioning and the Orienting Reflex," Psychological Review, Vol. 68, 1961, p. 109-119.

speed of conditioning and greater cognitive efficiency, in support of Eysenck's theory that introverts have greater cortical excitability.

In the following section of this chapter, the complex nature of the Orienting Reaction will be further discussed.

Concerning the relationship between the Eysenckian dimension of Introversiion-Extraversiion and perceptual sensitivity, Eysenck³⁵ has provided research evidence in support of his hypothesis that introverts have greater perceptual sensitivity. Further recent evidence that introverts are perceptually more sensitive, indicating higher arousal, than the extraverts has been provided by Smith³⁶ and Siddle et al.³⁷ who found that introverts had lower sensory thresholds than extraverts. Thus, the Eysenckian prediction that introverts are more physiologically aroused and more perceptually sensitive than extraverts has been supported by experimental studies. Only a few studies, however, have been conducted to investigate the relationship between

³⁵ Eysenck, The Biological Basis of Personality, p. 226-262.

³⁶ S. L. Smith, "Extraversiion and Sensory Threshold," Psychophysiology, Vol. 5, 1968, p. 296-297.

³⁷ D. A. T. Siddle, R. B. Morrish, K. D. White, and G. L. Mangan, "Relation of Visual Sensitivity to Extraversiion," Journal of Experimental Research in Personality, Vol. 3, 1969, p. 264-267.

extraversion and recognition sensitivity, and their findings are conflicting.

Recognition sensitivity and recognition threshold are operationally defined concepts in studies that deal with the perceptual defense paradigm. An early article on perceptual defense or perceptual adaptation to threat was co-authored by Bruner and Postman.³⁸ The basic assumption underlying the 'New Look' approach was stated as follows:

Perception is a form of adaptive behavior. Its operation reflects not only the characteristics of sensorineural processes, but also the dominant needs, attitudes and values of the organism. For perception involves a selection by the organism of a relatively small fraction of the multiplicity of potential stimuli to which it is exposed at any moment in time. In perception, moreover, certain stimuli are accentuated and vivified at the expense of others. Finally, what is "habitually seen" in any given perceptual situation is a function of the fixation of past perceptual responses in similar situations. Through these three processes--selection, accentuation, and fixation--the adoptive needs of the organism find expression in perception.³⁹

Individual differences in perceptual adaptation to threat were soon found by the same authors in studies conducted at the Laboratory of Social Relations at Harvard. In one of the studies, Bruner and Postman⁴⁰ used nineteen

38 J. S. Bruner and L. Postman, "Tension and Tension Release as Organizing Factors in Perception," Journal of Personality, Vol. 15, 1947, p. 300-308.

39 Ibid., p. 300.

40 -----, "Emotional Selectivity in Perception and Reaction," Journal of Personality, Vol. 16, 1947, p. 69-77.

subjects and obtained their associative reaction times for each of ninety-nine words including 'threatening' words such as raped, penis, death, etc. On a later date, each subject was presented with eighteen stimulus words tachistoscopically, at increasingly slower exposure times until correct recognition was obtained. A significant relationship was found between reaction time and recognition exposure speed. Of primary interest in the present study was the finding that there were two distinct patterns of response among the subjects. To explain these two response patterns, the authors suggested that some individuals revealed a defense process in which the recognition threshold was a monotonic increasing function of associative reaction time; while some other individuals developed a sensitizing process in which recognition time was faster for anxiety-provoking words than non-threatening words.

In an investigation attempting to relate perceptual defense and extraversion, Dodwell⁴¹ found that introverts at low levels of stress showed suppression and extraverts sensitization, while at high levels of stress this relation was reversed. In one experiment, the author presented two words simultaneously to the right and left ear; both words

⁴¹ P. C. Dodwell, "Some Factors Affecting the Hearing of Words Presented Dichotically," Canadian Journal of Psychology, Vol. 18, 1964, p. 72-91.

had to be repeated by the subject, and the score was the number of correct recognitions of experimental words as compared with control words. "Good" words such as happy, truth were paired with neutral words such as lofty. "Bad" words such as grief, nasty were likewise paired with neutral words. Introverts were found to "defend," i.e., not to hear bad words. In another experiment involving dichotic listening, the bad words were replaced by "taboo" words such as vagina. Attempt was also made to manipulate stress by means of instructions. Again it was found that the introverts defended more than the extraverts, especially at low levels of stress. Eysenck, in agreement with Dodwell's discussion of the Inglis-Brown model,⁴² stated that introverts tend to show response suppression at low levels of stress and response sensitization at high levels of stress, while the extraverts tend to show the reverse relation.

Ehlers⁴³ also found that introverts, when compared with extraverts, showed a higher recognition time for shock stimuli, which were nonsense syllables paired with shock, over nonshock stimuli. This again supported the Eysenckian position that introverts tend to display greater perceptual defense to affective stimuli than the extraverts.

⁴² Ibid., p. 72-91.

⁴³ B. Ehlers (1963), quoted by Eysenck, The Biological Basis of Personality, p. 141-151.

On the basis of research involving the dimension of personality characterized as Repression-Sensitization, Byrne⁴⁴ described sensitizers as more introverted and better able to perceive threatening words in an ambiguous perceptual situation than repressors who were more extraverted. His conclusion, that extraverts tend to display greater perceptual defense to affective stimuli than introverts, clearly contradicts Eysenck's position.

The lack of experimental controls, the variety of terminology used, and the variety of methods of investigation may account for the conflicting findings on the relationship between extraversion and recognition sensitivity. Furthermore, the majority of such studies have employed classical recognition thresholds which are now known to confound sensory and nonsensory response bias factors.^{45,46,47,48,49}

⁴⁴ D. Byrne, "Repression-Sensitization as a Dimension of Personality," in B. A. Maher (ed.), Progress in Experimental Personality Research, Vol. 1, New York, Academic Press, 1964, p. 169-220.

⁴⁵ D. E. Broadbent, "Word-Frequency Effect and Response Bias," Psychological Review, Vol. 74, 1967, p. 1-15.

⁴⁶ R. H. Haber, "Effect of Prior Knowledge of the Stimulus on Word-Recognition Processes," Journal of Experimental Psychology, Vol. 69, 1965, p. 282-286.

⁴⁷ E. Tulving and C. Gold, "Stimulus Information and Contextual Information as Determinants of Tachistoscopic Recognition of Words," Journal of Experimental Psychology, Vol. 66, 1963, p. 319-327.

⁴⁸ A. Paivio and B. J. O'Neill, "Visual Recognition Thresholds and Dimensions of Word Meaning," Perception and Psychophysics, Vol. 8, 1970, p. 273-275.

⁴⁹ G. W. Lange, "Perceptual Defense and Manifest Anxiety," Proceedings of the West Virginia Academy of Science, No. 37, 1965, p. 278-282.

The present study proposes to explore the relationship between extraversion and recognition sensitivity with the Signal Detection Method of analysis which statistically separates recognition sensitivity from personal, response bias factors. The method of Signal Detection will be discussed in a later section of this chapter.

3. Orienting Reaction as a Complex Response.

Eysenck regards perceptual defense as a kind of "early warning system"⁵⁰ to protect the organism against unwanted or dangerous stimuli, the same term which Sokolov used to describe the Orienting Reaction. Indeed, as noted in the previous section of this chapter, the OR and perceptual defense have many common features: both deal with perceptual sensitivity, both are affected by the characteristics of the stimuli, their informational or signal value and specific salience to the observer. Hypotheses have also been formulated that, similar to perceptual defense, the elicitation of the OR is influenced by a complex interaction of cognitive,⁵¹ motivational,⁵² and attitudinal⁵³ personality

50 Eysenck, op. cit., p. 148.

51 Razran, op. cit., p. 119.

52 A. S. Bernstein, "To What Does the Orienting Reaction Respond?" Psychophysiology, Vol. 6, 1969, p. 349.

53 E. Duffy, "The Psychological Significance of the Concept of 'Arousal' or 'Activation'," Psychological Review, Vol. 64, 1957, p. 273.

characteristics. Evidence supporting such hypotheses is provided by studies that showed significant relationships between individual differences in OR reactivity and differences in perceptual-cognitive organization and functioning. Israel⁵⁴ found that the cognitive control dimension of leveling-sharpening was related to OR habituation rate. Cognitive control principles have been described by Klein⁵⁵ as relatively enduring, regulative and adaptive features of cognitive organization which determine an individual's perception: his attention deployment and stimulus selection. In a more recent book, Klein⁵⁶ compared cognitive attitude and perceptual defense, but considered the term 'perceptual defense' as an operational definition poorly used by many investigators. Klein⁵⁷ also hypothesized that personality types, with their stabilized perceptual-cognitive dispositions, may display qualitative and quantitative differences in their physiological, perceptual, and cognitive functioning.

⁵⁴ N. Israel, "Individual Differences in GSR Orienting Response and Cognitive Control," Journal of Experimental Research in Personality, Vol. 1, 1966, p. 244-248.

⁵⁵ G. S. Klein, "Cognitive Control and Motivation," in M. G. Lindzley (ed.), Assessment of Human Motives, New York, Holt, 1958, p. 87-118.

⁵⁶ -----, Perception, Motives and Personality, New York, Knopf, 1970, p. 197-200.

⁵⁷ Ibid., p. 5-10.

Luborsky,⁵⁸ in another recent experiment, concluded that OR reactivity was dependent on an individual's motives, his perceptual-cognitive style, and his typical way of selecting information from the stimulus environment.

It may be noted, at this point, that the Eysenckian and Sokolovian theories bear some resemblance to other theories of attention, vigilance and learning. For example, Broadbent⁵⁹ proposed a filter theory which assumes that an organism has a limited capacity channel for perception and storage, and consequently is selecting from the environment stimuli which are novel, physically intense, personally relevant, or biologically important for admission into the limited capacity channel. Deutsh and Deutsh⁶⁰ proposed a similar theory that the selection of a particular stimulus from the environmental array of possible stimuli depends on the general level of arousal of the organism as well as the level of importance of each individual stimulus to the organism.

⁵⁸ L. Luborsky, "Individual Differences in Cognitive Style as a Determinant of Vasoconstriction Orienting Responses," Mechanisms of Orienting Reaction in Man, Bratislava, Slavic Academy of Sciences, 1967, p. 73-81.

⁵⁹ D. E. Broadbent, Perception and Communication, Oxford, Pergamon, 1958, p. 1-338.

⁶⁰ J. A. Deutsh and D. Deutsh, "Attention: Some Theoretical Considerations," Psychological Review, Vol. 70, 1963, p. 5-15.

In the light of the above discussion, the signal value of the stimulus to the observer may be an influential factor in the OR reactivity and habituation rate. Rosenberg⁶¹ reports that the rate of habituation of the OR to 'salient' stimuli was longer than to stimuli that had less salience to the subject.

As discussed in the previous section, conflicting results on the relationship between extraversion and the elicitation of the OR have been reported. Quirion⁶² found that introverts showed shorter OR habituation rates to simple auditory tones than extraverts. The results appear to be contradictory to the findings of other studies where more complex stimuli were employed. Therefore, it may be of interest to study the effect of stimulus value, such as stimulus affectivity, on OR reactivity and recognition sensitivity. In a later section, the choice of stimuli will be further discussed.

In addition, the initial state of arousal of the observer may influence the elicitation of the OR. Sokolov⁶³

61 G. Rosenberg, Self Concept Certainty Reporting and Orienting Reaction Habituation Rate, unpublished doctoral dissertation presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1971.

62 Quirion, op. cit.

63 Sokolov, Perception and the Conditioned Reflex, p. 190-203.

differentiated the OR into a generalized form and a localized form, the former being independent of the modality of stimulation, the latter being related to the activation of a specific analyzer. He attributed the two forms of OR manifestation to different states of cortical arousal during stimulation. Generalized OR was elicited when the subject was drowsy or asleep and was resistant to extinction. Localized OR was evoked in alert subjects and was selective and precise with a short habituation rate.⁶⁴ Sokolov's observation was supported by McDonald et al.,⁶⁵ and implied that the initial state of arousal of the subject may influence the rate of OR habituation.

Another factor that may contribute to the conflicting results and needs to be further investigated is the OR parameter measurement itself. Although the OR is traditionally recognized as a general or non-specific response, there is evidence pointing to response specificity of the

⁶⁴ E. N. Sokolov and N. P. Paramavona, "Progressive Changes in the Orienting Reflex in Man During Development of Sleep Inhibition," Journal of Higher Nervous Activity, Vol. 2, 1961, p. 206-215.

⁶⁵ D. G. McDonald, L. C. Johnson, and D. J. Hord, "Habituation of the Orienting Response in Alert and Drowsy Subjects," Psychophysiology, Vol. 1, 1964, p. 163-173.

OR.^{66,67,68,69,70} Several explanations for the lack of high intercorrelations between various autonomic components of the OR recorded simultaneously from the same subject have been put forward. One explanation, proposed by Duffy,⁷¹ is that a particular subject may demonstrate a response preference for one response modality and not another, and that for each individual there may be a patterning in the excitation of physiological responses, depending on specific external stimulus situations and internal organic factors. Another explanation, proposed by Raskin et al.,⁷² is that different autonomic responses are recorded by different

66 Raskin, op. cit., p. 69-76.

67 R. Edelberg, "The Relationship between GSR, Vasoconstriction and Tactile Sensitivity," Journal of Experimental Psychology, Vol. 62, 1961, p. 187-195.

68 J. J. Furedy, "Human Orienting Reaction as a Function of Electrodermal Versus Plethysmographic Response Modes and Single Versus Alternating Stimulus Series," Journal of Experimental Psychology, Vol. 77, 1968, p. 78.

69 R. Uno and W. W. Grings, "Autonomic Components of Orienting Behavior," Psychophysiology, Vol. 1, 1965, p. 311-321.

70 M. J. Cohen and H. J. Johnson, "Effects of Intensity and the Signal Value of Stimuli on the Orienting and Defensive Responses," Journal of Experimental Psychology, Vol. 88, 1971, p. 286.

71 Duffy, op. cit., p. 266.

72 D. C. Raskin, H. Kotses and J. Bever, "Cephalic Vasomotor and Heart Rate Measure of Orienting and Defensive Reflexes," Psychophysiology, Vol. 6, 1969, p. 149-159.

methods and tools. The vasomotor activity, recorded by means of photoelectric plethysmographs attached to the surface of the skin, is difficult to quantify accurately, because the pressure applied to the pickup and movement artifacts are difficult to control. On the other hand, the heart rate component and the Galvanic Skin Response of the OR are more easily quantifiable by the use of electrodes which are less affected by differential pressure applied to the site of recording. In the present study, this difficulty in measuring separate OR responses has been taken into consideration, and the problem of response specificity has been solved by the use of the three most commonly employed OR components: the vasomotor, the heart rate and the Galvanic Skin Response, in order that significant differences in a particular response modality of the OR would not go undetected.

4. The Signal Detection Analysis.

Reviews by Natsoulas⁷³ and Goldiamond⁷⁴ have suggested that it has been very difficult to separate sensory from

⁷³ T. Natsoulas, "Converging Operations for Perceptual Defense," Psychological Bulletin, Vol. 64, 1965, p. 393-401.

⁷⁴ I. Goldiamond, "Indicators of Perception: I. Subliminal Perception, Subception, Unconscious Perception: An Analysis in Terms of Psychophysical Indicator Methodology," Psychological Bulletin, Vol. 55, 1958, p. 373-411.

non-sensory factors in perceptual defense research using classical psychophysical methods, where recognition sensitivity is typically inferred from the data derived from the ability of an individual to recognize a printed word shown tachistoscopically, and often assumes the form of a sensory threshold estimate. There have been criticisms^{75,76} about the classical threshold as an indicator of sensitivity or sensory capacity because it may be confounded by nonsensory or personal factors such as motives, attitudes or sets which have been found to influence psychophysical judgments. The advantages of the method of Signal Detection are:⁷⁷ (a) it provides a measure of sensitivity which is purported to be relatively independent of a separate measure referred to as the decision or response criterion; (b) the measure of sensitivity is influenced only by the individual's sensory capacity, whereas the measure of decision criterion is influenced by the interplay of the individual's various non-sensory factors such as his experiential background, caution, perceptual style, and other personality variables.

75 E. G. Boring, "The Control of Attitude in Psychophysical Experiments," Psychological Review, Vol. 27, 1920, p. 440-452.

76 J. P. Guilford, "Fluctuations of Attention with Weak Visual Stimuli," American Journal of Psychology, Vol. 38, 1927, p. 534-583.

77 J. A. Swets, W. P. Tanner, Jr., and T. G. Birdsell, "Decision Processes in Perception," Psychological Review, Vol. 68, 1961, p. 301-340.

A common experimental procedure used for the Signal Detection method of analysis involves the presentation of two classes of stimulus events varying in one dimension and having fixed a priori probabilities of occurrence. In the present study, the two classes of stimuli are paired neutral and affective words, presented at variable exposure duration speeds, and having equal a priori probabilities of occurrence. The subject is asked to make a forced-choice response stating to which of the two classes a particular stimulus event appears to belong. If the subject reports that the stimulus is a neutral word (N) when in fact it is neutral, a hit is recorded. However, if the subject reports that the stimulus is a neutral word when in fact it is affective (A), a false alarm is recorded. The measure of sensitivity (d') is defined as the ratio of the probability of hits to the probability of false alarms, and estimated as the False Alarm Rate intercept of the Receiver-Operating-Characteristics curve (ROC curve), plotted with the hit rate as the ordinate and the false alarm rate as the abscissa. On the other hand, an estimate of the variation in the subject's subjective decision criteria is provided by obtaining a sample of the various confidence levels and other personal states under which the recognition-selection observations are made.

The relationship of the subject's internal recognition criterion and the traditional threshold measure is such

that excessive caution raises the thresholds.⁷⁸ Subjects' tendencies to be cautious toward affective words alone may account for the higher classical thresholds for affective words compared with neutral words found in many experiments,^{79,80} without having to attribute the higher thresholds to a result of decreased sensitivity. As Price⁸¹ has indicated, the traditional threshold measure is a global indicator of the observer's hit rate and does not reflect all the information concerning the stimulus-response contingencies in an experimental situation by not taking into consideration the false alarm rate which provides information about the subject's decision strategies and cognitive controls. Hence, the differences in classical absolute sensory threshold measures might pertain more to the decision-making habits and risk-taking propensities of the subject than to his sensory capacity.

78 M. Smith and E. Wilson, "A Model of the Auditory Threshold and Its Application to the Problem of the Multiple Observer," Psychological Monographs, Vol. 67, 1953, p. 8.

79 A. Mathews and M. Wertheimer, "A 'Pure' Measure of Perceptual Defense Uncontaminated by Response Suppression," Journal of Abnormal and Social Psychology, Vol. 57, 1958, p. 373-376.

80 R. R. Bootzin and T. Natsoulas, "Evidence for Perceptual Defense Uncontaminated by Response Bias," Journal of Personality and Social Psychology, Vol. 1, 1965, p. 461-468.

81 R. H. Price, "Signal-Detection Methods in Personality and Perception," Psychological Bulletin, Vol. 66, 1966, p. 50-60.

Egeren⁸² applied the decision theory of signal detection to the recognition behavior of nineteen repressor and nineteen sensitizer subjects in a perceptual defense experiment. The author found that the repressors and sensitizers did not differ significantly in sensitivity (d') or recognition decision criteria (β); in addition, affective and neutral words were very similar in recognizability; and finally, more conservative decision criteria were adopted by all the subjects for recognition of affective words and in situations when the subject had to choose between an affective word and a neutral word for a recognition response. The author discussed the importance of the Signal Detection Theory in a perceptual defense research setup in order to obtain the observer's recognition criterion, as well as a measure of his recognition sensitivity.

In the present experiment, perceptual recognition of neutral or affective word stimuli is viewed as involving a complex decision-making process. On each trial the subject is assumed to combine sensory and nonsensory information to make a decision about which stimulus of a pair of word stimuli has in fact occurred. Through the use of the Signal

⁸² L. V. Egeren, "Repression and Sensitization: Sensitivity and Recognition Criteria," Journal of Experimental Research in Personality, Vol. 3, 1968, p. 1-8.

Detection Method of analysis,⁸³ two main parameters of this decision process, one sensory and one nonsensory, can be made explicit and measurable. In this experiment, recognition sensitivity is derived from the signal detection estimate of the effect of sensory processes, and decision criterion is derived from the signal detection estimate of the effect of nonsensory factors, such as caution, response bias, set, motivation, attitude, etc. The observer's decision criterion may have a critical role in the recognition task, since it is conceivable that in a decision-making stimulus situation when the subject is less confident of a recognition response, she may rely more on nonsensory strategies and less on sensory information.

5. Choice of Stimuli.

As seen in previous sections of this chapter, the Orienting Reaction has been described as a complex response. Studies have shown that the elicitation of the OR is related not only to perceptual sensitivity,⁸⁴ but also to cognitive^{85,86}

⁸³ J. C. Ogilvie and D. Creelman, "Maximum Likelihood Estimation of Receiver Operating Characteristic Curve Parameters," Journal of Mathematical Psychology, Vol. 5, 1968, p. 377-378.

⁸⁴ Maltzman and Raskin, op. cit.

⁸⁵ Razran, op. cit.

⁸⁶ Israel, op. cit.

and attitudinal⁸⁷ variables of the observer, and to the characteristics of the stimuli.⁸⁸ It has been suggested that differences in the signal value of the stimuli may account in part for the inconsistent results of experiments attempting to explore the relationship between extraversion and OR reactivity. For the purposes of this study, stimuli which differ in terms of signal value, specifically affect value, have been employed.

Conflicting reports on the differences between introverts and extraverts in their recognition thresholds for neutral and affective words have also been reviewed in an earlier section of this chapter. It has been suggested that, since differences in traditional recognition thresholds may be a function of either perceptual sensitivity or personal response bias factors, the failure to separate these two factors may account in part for the inconsistent experimental results.^{89,90} The theory of Signal Detection offers a method of obtaining independent values of sensory and nonsensory factors, and permits one to distinguish whether the differences between introverts and extraverts in

87 Luborsky, op. cit.

88 Rosenberg, op. cit.

89 Quirion, op. cit.

90 Edelberg, op. cit.

recognition threshold are a function of recognition sensitivity or of response bias.

The stimuli chosen for the present study appear to be appropriate for the testing of these problems.

6. Summary and Statement of the Hypotheses.

This chapter has reviewed various theoretical models and relevant studies designed to investigate the concept of the Orienting Reaction, the Eysenckian dimension of Extraversion, perceptual sensitivity, and their interrelationships. The application of the method of signal detection analysis to recognition judgment data, and the choice of stimuli for the present investigation have also been presented.

The Orienting Reaction, according to Sokolov and other Soviet scientists, is a nonspecific alerting response to novel stimulation. Its functions are to facilitate stimulus reception and conditioning, integrate the operation of perceptual and cognitive processes, and help the observer to recognize and model the external world. In the present study, the Orienting Reaction is an operationally defined concept. Its antecedent condition is a change in stimulation by the presentations of novel word stimuli, while its objective measures include the vasomotor response of cephalic

vasodilatation and peripheral vasoconstriction, the heart rate, and the galvanic skin response.

The quantification of individual differences in the various behavioral and physiological manifestations of the OR has been noted by Pavlov and Teplov in the Strong versus the Weak Nervous System. The Weak Nervous System individual was characterized by greater sensitivity, lower absolute sensory thresholds in perceptual tasks, and a higher level of arousal than Strong Nervous System individuals. This Russian observation has provided ground for Western personality theorists, headed by Eysenck and Gray, to postulate that the concept of Strong and Weak Nervous Systems is similar to the Eysenckian theory of Introversion-Extraversion, the Weak Nervous System individuals being the more highly aroused introverts. According to Eysenck, introverts, because of their greater degree of cortical excitability, should give greater OR reactivity to novel stimuli. Experimental evidence, however, is still inconclusive. One possible explanation of the conflicting results is that different researchers have used stimuli differing in signal value. According to Sokolov and Razran, the reactivity of the OR not only parallels perceptual sensitivity, but also reflects the cognitive characteristics of the observer. It is therefore possible that the OR reactivity is influenced by the signal value of the stimulus, its content and salience to the

observer, as well as by the personality dimension of Extraversion. The present study attempts to explore this possibility by employing neutral and affective word stimuli in the elicitation of the OR.

Eysenck further postulates that introverts, because of their greater degree of cortical arousal, should display greater perceptual and recognition sensitivity. The linkage of Introversion-Extraversion with perceptual sensitivity has received some empirical support. However, only a few studies have been conducted to explore the relationship between Extraversion and recognition sensitivity. Furthermore, tests of this hypothesis have generally employed traditional psychophysical measures which confound sensory and nonsensory factors. The present study proposes to explore this hypothesis with the Signal Detection Method of analysis which statistically separates recognition sensitivity from personal response bias factors.

Eysenck has also suggested, based on Dodwell's study, that, although introverts would display greater perceptual sensitivity to neutral stimuli, at low levels of stress introverts would display perceptual defense to affective stimuli while extraverts would display perceptual sensitization. The differences between Eysenckian introverts and extraverts on recognition sensitivity to neutral and affective word stimuli, without the application of stress, is therefore worthy of investigation.

The basic strategy of the present study involves classifying subjects into groups of low, middle, and high extraversion. The Orienting Reaction habituation rates to neutral and affective words for these groups are compared. In a subsequent experimental phase, the signal detection estimates of recognition sensitivity and decision criterion are compared.

Briefly, the independent variables employed in this study are: Extraversion (three groups of Introverted, Middle, and Extraverted subjects), and Affectivity (two classes of Neutral and Affective word stimuli). The dependent variables are: three Orienting Reaction habituation rates to the word stimuli, i.e., the vasomotor component, the heart rate component, and the galvanic skin response component; and two independent estimates of perceptual recognition behavior derived from the Signal Detection Theory, i.e., sensitivity (or sensory capacity) and decision criterion values (or response biases influenced by nonsensory and personal factors).

With these variables in mind, the problems posed for investigation are specifically defined by the following questions:

1. Do groups of Introverted, Middle, and Extraverted subjects vary in their OR habituation rate to neutral and affective word stimuli, as measured by the Vasomotor, Heart Rate, and Galvanic Skin response?

2. Do neutral and affective word stimuli, when matched for brightness and length, vary in their influence on the OR habituation rate as indicated by the Vasomotor, Heart Rate, and Galvanic Skin response?
3. Do groups of Introverted, Middle, and Extraverted subjects vary in their recognition sensitivity (a signal detection estimate of sensory capacity independent of nonsensory and personal factors contributed by response bias) of neutral and affective stimuli?
4. Do specific stimulus conditions of neutral word paired with neutral word, neutral word paired with affective word, and affective word paired with affective word, vary in their influence on recognition sensitivity (a signal detection estimate of sensory capacity independent of nonsensory and personal factors which influence the observer's judgment)?
5. Do groups of Introverted, Middle, and Extraverted subjects vary in their decision criterion (a signal detection estimate of response bias independent of the observer's sensory capacity) on a word recognition task?
6. Do specific stimulus conditions of neutral word paired with neutral word, neutral word paired with affective word, and affective word pair with affective word, vary in their influence on decision criterion (a signal detection estimate of response bias independent of the observer's sensory capacity)?

From these questions the following null hypotheses are formulated:

1. There are no significant differences between groups of Introverted, Middle, and Extraverted subjects in the OR habituation rate to neutral and affective word stimuli, as measured by the Vasomotor, Heart Rate, and Galvanic Skin response.
2. There is no significant difference between neutral and affective word stimuli in their influence on the OR habituation rate for the entire sample of subjects, as measured by the Vasomotor, Heart Rate, and Galvanic Skin response.

3. There is no significant difference between groups of Introverted, Middle, and Extraverted subjects in their recognition sensitivity (a signal detection estimate of sensory capacity independent of non-sensory and personal factors contributed by response bias) of neutral and affective word stimuli.
4. There is no significant difference between the three stimulus conditions of neutral word paired with neutral word, neutral word paired with affective word, and affective word paired with affective word, in their influence on recognition sensitivity (a signal detection estimate of sensory capacity independent of nonsensory and personal factors which influence the observer's judgment).
5. There is no significant difference between groups of Introverted, Middle, and Extraverted subjects in their decision criterion (a signal detection estimate of response bias independent of the observer's sensory capacity) on a word recognition task.
6. There is no significant difference between the three stimulus conditions of neutral word paired with neutral word, neutral word paired with affective word, and affective word paired with affective word, in their influence on decision criterion (a signal detection estimate of response bias independent of the observer's sensory capacity).

The methods employed to treat the above hypotheses are presented in the following chapter.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter gives a detailed description of the experimental design by means of which the hypotheses stated in the first chapter are tested. It describes the sample, the tools used, the experimental procedure, and the statistics employed in the analysis of the data.

1. The Sample.

The sample consisted of thirty female student nurses enrolled in first or second year at the Ottawa Civic Hospital School of Nursing, and who ranged from seventeen to twenty years of age. They were selected from a population of fifty-six female student nurses who volunteered to take the Eysenck Personality Inventory, Form A.¹ The ten subjects obtaining the highest scores on the Extraversion dimension (E ranging from 17 to 22) were designated as the Extraverted group, the ten subjects obtaining Extraversion scores closest to the mean of the over-all sample of fifty-six volunteers were designated as the Middle group (E ranging from 11 to 16), and the ten subjects who scored lowest on the Extraversion

¹ H. J. Eysenck and Sybil B. G. Eysenck, Manual for the Eysenck Personality Inventory, San Diego, Educational and Industrial Testing Service, 1968, 5-27 p.

scale (E ranging from 5 to 11) were designated as the Introverted group. The subjects were paid for their attendance which included two three-hour sessions of experimentation.

2. The Apparatus.

This section describes the tools used in this study. The psychological tests will be described first, followed by a description of the physiological electronic apparatus for the recording of the orienting reaction to two neutral and two affective words. Finally, the projection tachistoscope used to present the stimulus targets for both the Orienting Reaction and the word selection-recognition experimental phases.

(a) Psychological Tests.- The Eysenck Personality Inventory (EPI) purports to measure two pervasive and independent personality dimensions² which are identified as extraversion-introversion (E) and neuroticism-stability (N). The theoretical background and experimental validation of the concepts of extraversion and neuroticism have been presented in detail elsewhere.³ Briefly, extraversion refers

² Ibid., p. 5.

³ H. J. Eysenck, The Biological Basis of Personality, Springfield, Thomas, 1967

to the outgoing, impulsive, uninhibited and sociable inclinations of a person, and neuroticism refers to the general emotional overresponsiveness and predispositions to develop disagreeable emotional feelings. Evidence for the independence of the two personality dimensions has been provided by Farley.⁴ The EPI consists of two parallel forms (Form A and Form B), thus retesting after experimental treatment for the estimation of test-retest reliability can be made with little interference from memory or practice factors. Each form consists of fifty-seven items, selected on the basis of item and factor analyses, to which the subject answers true or false. A Lie scale is included to identify subjects showing "desirability response set." The reliability⁵ and validity⁶ of the scales have been demonstrated to be adequate for the present study. The EPI (Form A) is reproduced in Appendix 1.

(b) Electronic Apparatus for the Recording of Physiological Data.- A Nihon Kohden Multipurpose Polygraph model RM-85 was used to record the ongoing physiological activities of the subject when she was presented with regular

⁴ F. H. Farley, "On the Independence of Extraversion and Neuroticism," Journal of Clinical Psychology, Vol. 2, 1967, p. 154-156.

⁵ Eysenck and Eysenck, op. cit., p. 14.

⁶ Ibid., p. 16-19.

flashes of word stimuli on the screen. Such recordings of physiological data were later given to raters for the identification of the Orienting Reaction. The polygraph was equipped with an 8-channel monitor CRT oscilloscope model VC-85, whose sweep speed was preset at 2.5 divisions per second, enabling constant monitoring of the ongoing physiological activities of all eight recording channels throughout the experiment. Physiological data were recorded on paper by an ink-writing oscillograph using Nihon Kohden chart number FS 380-10 paper and Nihon Kohden ink, with paper speed set at 3mm. per second. A Crown International Pro-700 Series 8-channel tape recorder Model AR, manufactured by the Vetter Company of Elkhart, Indiana, was used to store on Charter Magnetic Tapes all ongoing physiological data for possible further analyses. The input channels of the tape recorder were calibrated at one volt at the start of the experiment, a suitable voltage for computer analysis, with sensitivity at $5 \text{ db} \pm 0.5 \text{ db}$.

To obtain the pulse and the heart rate changes that occur during the experiment, three ECG electrodes manufactured by Nihon Kohden were placed on the subject, one on the inner surface of each wrist and a ground electrode on the subject's right leg just above the ankle and midway between the shin and the calf. The electrodes and recording sites of the subject's skin were first cleansed with isopropyl

alcohol and applied with an even thin layer of Beckman Offner conductance paste before the attachment of the electrodes. The electrode leads were plugged into an input box model RBL-85, which was in turn connected to the AC input of the Biophysical input selector of the polygraph, set at Channel 1. The ECG signals fed to Channel 1 of the polygraph were then amplified and filtered to give the pulse rate of the subject by a Biophysical Preamplifier model RB-5, sensitivity set at 38.5 db and filter at 2-30 Hz. The output of Channel 1 was in turn connected to the input of Channel 2, which consisted of a pulse rate Instantaneous Tachometer model RT-5, with the range set at 1/2 (15 to 100 beats per minute) and the alarm set at off. The pulse rate tachometer measures the time from pulse to pulse and converts it into heart rate per minute at each pulsation of the heart. The output of Channel 2 was then connected to the input of Channel 3, which consisted of a pulse rate Average Tachometer model RTM-5, with the range set at 20 to 220 beats per minute and the alarm set at off. This second pulse rate tachometer (Average) is designed to present a mean value of time intervals of trains of input ECG pulse signals. The output of Channel 3 was fed to the tape recorder for storage. Although both Channels 2 and 3 readouts were plots of heart rate changes of the subject throughout the experiment, only the beat-by-beat heart rate analysis of the Channel 2

printout was used for the identification of the Orienting Reaction for the Heart Rate (HR) component.

To measure the Galvanic Skin Response (GSR) changes that occur during the experiment, Nihon Kohden silver plated electrodes were placed on each palm of the hand. As with ECG electrodes, the two GSR electrodes were first cleansed with isopropyl alcohol and adequate Beckman Offner paste was applied. These electrodes were connected to a Nihon Kohden Galvanic Skin Reflexograph Bridge Box model GSR-2, with the voltage level set at one and the balance set at 0 initially. The balance was periodically readjusted as required due to changing contact resistances between the electrodes and recording sites of the subject during the experiment. The electrical resistance between the two GSR electrodes changes according to variations of the activities of the sweat glands situated in the palms and is converted into GSR signals. Hence, the measure of GSR changes is believed to reflect changes in the amount of sweat gland secretions produced by emotional activities of the subject. The GSR bridge box was in turn connected to the Nihon Kohden input box model RBL-85 leading to the AC input of the polygraph. The GSR signals were amplified and filtered in Channel 6 of the polygraph by a Biophysical Preamplifier model RB-5, with sensitivity set at 6 db and filter set at 2-30 Hz band-pass. The output of Channel 6 was recorded on tape.

The plethysmograph was obtained by placing a photoelectric transducer of the reflection type model MPP-3A on the subject's forehead, above the eyebrow, at a point where a slight pulse was detectable, and by placing a second photoelectric transducer of the cap type model MPP-3B on the distal end of the subject's tight index finger. The two transducers can detect small changes in the blood flow volume of the peripheral blood vessels in the forehead and finger tip through variations of light reflection from the recording sites back to the transducers producing variations of electrical current. Because the photoelectric transducers are extremely sensitive to light intensity variations, a light-shielding strap and metal cap were used to exclude external sources of light from the forehead and finger pickup transducers respectively. Recording sites of the forehead and finger were also cleansed with alcohol to remove any substance that might reduce the sensitivity of the transducers to light reflections. Each transducer was in turn connected to a photoelectric plethysmograph box model MPP-35 with a 2.5 volt nickel-cadmium alkali rechargeable battery as the power source. The plethysmograph leads were again connected to the Nihon Kohden input box model RBL-85 which fed the AC input of the polygraph. The forehead blood volume signals were amplified and filtered in Channel 4 of the polygraph by a Biophysical Preamplifier model RB-5, with

a sensitivity set at 3 db and filter set at 2-30 Hz band-pass. The outputs of Channels 4 and 5 were connected to the taperecorder for storage of the information. The ink recordings of the forehead and finger blood volume were used for the identification of the vasomotor component of the Orienting Reaction.

A third photoelectric transducer of the earpiece type was clipped onto the left ear-lobe of the subject. Similarly, the transducer was connected to a photoelectric plethysmograph box model MPP-35, which was in turn connected to the input box model RBL-85, leading to the AC input of the polygraph. The ear blood volume signals were amplified and filtered in Channel 7 of the polygraph by a Biophysical Preamplifier model RB-5, with sensitivity set at 14.5 db and filter at 2-30 Hz band-pass. This information was also stored on tape. The ink tracings of the ear blood volume data were used only as supplementary reference to that of the forehead blood volume data for the identification of the vasomotor component of the Orienting Reaction.

Channel 8 was devoted to the trigger information by marking the onset and offset of the stimuli. As will be described below, the stimulus source consisted of two projection tachistoscopes controlled by a Lafayette VIII Bank Timer model 5050B set at 'repeat.' The timer was connected to a dry cell battery-operated transducer, which was in turn

connected to the DC input of a Biophysical Preamplifier model RB-5 at Channel 8 of the polygraph, which was set at DC for the low cut, 'off' for the high cut and sensitivity at 12 db. The trigger information was stored on tape.

The Input Selector Panel of the polygraph was set on ECG for Channel 1 and on External for Channels 2 to 8. The electrodes resistance meter was set at 0, and the calibration at 2 mv.

Briefly, the eight channels of the polygraph give, respectively, measures of pulse, change in the heart rate (beat-by-beat), change in the heart rate (averaged), forehead plethysmograph, finger plethysmograph, Galvanic Skin Response, ear plethysmograph and trigger input.

(c) Projection Tachistoscopes.- In the experiment to obtain the Orienting Reaction to verbal stimuli, two transparency slide projectors, Argus Holiday model 505, were used to present the words in black on a white screen directly in front of the subject. One projector presented only the stimulus slides, the other presented only blank slides which were made of the same transparency material. Both projectors used the Lumray 4 inches anastigmat lens, F set at 3.5, and D.A.K. 500 watt lamps. The anastigmat lens were able to form approximately point stimulus targets on the screen. The projectors were modified by breaking the AC supply to the projection lamps, and connected to a

Lafayette VIII Bank Timer model 5431A which was used to open and close the circuit of the projection tachistoscopes. Channel 1 of the timer, set at 4 seconds, was connected to the projector that presented the stimulus slides, and Channel 2 was connected to the projector that presented the blank slides, set at 25 seconds. Thus, when the timer was set at one cycle (repeat), it was possible to present accurately a 4-second stimulus duration with a 25-second interstimulus interval, automatically repeated until manually stopped. The blank projector was used simply to maintain light adaptation between stimulus presentations. The positioning and focusing of the two projectors were adjusted so that the two visual fields would coincide on the screen. The viewing distance from the subject to the stimulus was 98 inches, and the level of illumination on the visual fields for both stimulus and blank presentations was 37 foot-lamberts, as measured by a Spectra Pritchard Photometer, model 1970-PR.

In the psychophysical experiment phase, a Kodak Carousel KT-800 Automatic Projection Tachistoscope was used for the perceptual selection task. The projector was equipped with a 35 mm Lafayette lens, five variable shutter speeds of 8, 17, 33, 67 and 125 msec., a carousel slide tray, remote control for the changing of slides and a timer set at manual. The viewing distance from the subject to the stimulus

target on the screen was maintained at 98 inches, and the level of illuminance on the visual field for all stimulus presentations was 39 foot-lamberts, as measured by a Spectra Pritchard Photometer, model 1970-PR.

The stimulus targets were printed words mounted on transparent slides by the Communications Center of the University of Ottawa. The stimulus words were selected by pairing each affective word with another word of the same frequency of usage, same length and number of letters, but neutral or nonthreatening in meaning. The principal references for the choice of words were: Thorndike and Lorge,⁷ McGinnies,⁸ Hershenson and Haber,⁹ Taylor,¹⁰ Riegel and Riegel,¹¹ Paivio et al.,¹² McGinnies

7 E. L. Thorndike and I. Lorge, The Teacher's Word Book of 30,000 Words, New York, Bureau of Publications, Teachers College, 1944.

8 E. McGinnies, "Emotionality and Perceptual Defense," Psychological Review, Vol. 56, 1949, p. 224-251.

9 M. Hershenson and R. N. Haber, "The Role of Meaning on the Perception of Briefly Presented Words," Canadian Journal of Psychology, Vol. 19, 1965, p. 42-46.

10 J. A. Taylor, "Meaning, Frequency, and Visual Duration Threshold," Journal of Experimental Psychology, Vol. 55, 1958, p. 329-334.

11 K. F. Riegel and R. M. Riegel, "Prediction of Word-Recognition Thresholds on the Basis of Stimulus-Parameters," Language and Speech, Vol. 4, 1961, p. 157-170.

12 A. Paivio, J. C. Yuille, and S. Madigan, "Concreteness, Imagery, and Meaningfulness Values for 925 Nouns," Journal of Experimental Psychology Monograph Supplement, Vol. 76, No. 1, Part 2, 1968, p. 1-25.

et al.,¹³ and Berquist et al.¹⁴ The words presented during the physiological recording phase were two neutral words "where" and "cinch" and two affective words "whore" and "bitch" as their paired counterparts. In the psychophysical phase of the experiment, eight more neutral words and their counterparts such as "ounce" and "penis," "alert" and "screw," etc. were used, to give a total of ten neutral and ten affective words. All the words were understood by all the subjects. The 24mm by 36mm transparencies were contained in 2 in. by 2 in. thin plastic mounts of less than 1/16 in. thick. Since the projecting distance between the tachistoscopes and the screen was 148 inches, and the viewing distance of the subject from the screen was 98 inches, the stimulus targets appeared to the subjects as large and clear 5-lettered words in black bold prints.

3. The Experimental Procedure.

Apart from the testing session for the selection of the sample, the actual experiment consisted of two separate

13 E. McGinnies, P. B. Comer, and O. L. Lacey, "Visual Recognition Threshold as a Function of Word Length and Word Frequency," Journal of Experimental Psychology, Vol. 44, 1952, p. 65-69.

14 W. H. Berquist, P. M. Lewinsohn, D. W. Sue, and J. R. Flippo, "Short and Long Term Memory for Various Types of Stimuli as a Function of Repression-Sensitization," Journal of Experimental Research in Personality, Vol. 3, 1968, p. 28-38.

experimental phases. Briefly, the first phase was concerned with the recordings of physiological data for the identification of the OR; the second phase was concerned with the collection of psychophysical judgment data on a perceptual selection task.

(a) The First Testing Session.- This session started about two weeks after the administration of the EPI (Form A) for the selection of the sample. Each subject was taken individually to the Department of General-Experimental Psychology laboratory at the University of Ottawa for this and subsequent testing sessions. She was administered the Eysenck Personality Inventory (EPI), Form B, for determining test-retest reliability of the EPI, and the Otis Higher Examination, Form A (thirty minutes) as a measure of intelligence. She was then tested for visual acuity with a Baush and Lomb Orthorater (50 watts, max. lamp 25 watts) Catalogue Number 71 21-31. The orthorater was also used to screen subjects for stereopsis and other visual abnormalities. Since no non-correctable visual abnormalities were found, the selected sample of thirty subjects was retained.

A quiet ventilated room was used as the laboratory for the recording of physiological data. The subject was seated upright in a comfortable chair with adjustable arm-rests, and was asked to relax and refrain from moving and

talking during the experiment. She was also instructed to look at the screen where the target words would be shown, and was told that no noxious stimuli would be presented. The electrodes and transducers described in a previous section of this chapter were then placed on the subject. In order to mask any unwarranted external stimuli that might disturb the subject, a Philips Sonalgenic model CP 9100, set at intensity 7, was used to generate white noise through a pair of K 60, 600 ohms earphones placed on both ears of the subject. The room was also darkened, and the polygraph turned on. The physiological tracings were monitored and any necessary adjustments of electrode or transducer placings were made at this stage. Sufficient time (about 10 minutes) was allotted for the baseline of the physiological tracings to become stabilized, after which the tape recorder, the timer, and the tachistoscope were activated. A stimulus word would appear on the screen for a four-second duration, followed immediately by a blank (interstimulus interval) for twenty-five seconds. This alternating sequence of stimulus and blank presentation was repeated until the physiological tracings of vasomotor, heart rate, and Galvanic Skin Response components of the Orienting Reaction indicated that OR habituation had taken place, i.e., the OR to the particular stimulus being investigated (e.g., the neutral word "cinch") no longer

appeared. The criteria used in determining the disappearance of the three OR components will be described in detail in the next section of this chapter. The subject was given sufficient rest and freedom to move and talk before the next recording to a new word took place. The same method of presenting the stimulus and blank trials was followed for all the four word stimuli (two neutral and two affective) employed in this first phase of the experiment, and each time the recording was terminated when the OR to the stimulus was judged to have habituated, followed by a brief rest period. Each subject, therefore, received all four stimulus presentations, but not necessarily in the same order. Although literature seems to justify the contention that the Orienting Reaction to a new stimulus is not related to the amount of repetition of a previous but different stimulus, counter-balancing was still performed in order to eliminate any possible effect due to the order of word stimulus presentation. Thus, to each of the three experimental groups, each word stimulus was presented an equal number of times in the first, second, third and fourth position of a four-position order of presentation.

(b) The Second Testing Session.- About ten days after the first testing session, the subject was taken to the same laboratory and administered the word recognition task. The psychophysical testing began by seating the

subject in a comfortable chair, and handing her a list of ten neutral and ten affective words, including the four stimulus words used in the first testing session. Each subject was allowed ten minutes to familiarize herself with the words and their codes (e.g., "whore" A1, "where" A2; "bitch" B1, "cinch" B2; etc.). It can be seen that each pair of words was coded with a different letter, and the numbers "1" and "2" were always designated as the first or second word of each pair as they appeared on the list. The coding was used as a substitute for the actual words in this perceptual selection task in order to reduce any embarrassment on the subject's part in pronouncing some of the affective words. The subject was then asked to pay attention to the screen where the stimulus targets would be flashed, and read the following instructions adapted from Egeren:¹⁵

This is a study dealing with word recognition and selection. You will be shown the words you have just learned, one at a time, every seven seconds in a random order on the screen. After the word is flashed, you will be told two codes, for example, A1 or A2. Your task is to decide, on the basis of what you saw on the screen, which of the two words represented by the two codes was actually shown. Tell me the code of the word which you think was shown. After you have indicated your choice, I want you to tell me how certain you were of your judgment. Tell me whether you were positive, fairly sure or whether

¹⁵ L. V. Egeren, "Repression and Sensitization: Sensitivity and Recognition Criteria," Journal of Experimental Research in Personality, Vol. 3, 1968, p. 1-8.

it was a guess. For example, if you are fairly sure that the word flashed was A1, you would say A1, fairly sure. Try to use all three of the ratings, positive, fairly sure and guess. All of the words on the list will be shown an equal number of times. Some of the words will be easy to see and some will be more difficult. No one is able to judge them all correctly, so just do your best.

Thus, the instructions required the subject to judge whether the word flashed was the first or the second of a pair of words whose codes were given after each flash, as well as to give a confidence rating of positive, fairly sure, or guess. The confidence rating scale can be expressed as follows: (1) Code 1, for example A1, positive; (2) Code 1, fairly sure; (3) Code 1, guess; (4) Code 2, for example A2, guess; (5) Code 2, fairly sure; (6) Code 2, positive.

After the instructions were read, the subject was tested for learning of the list of words and their codes. To facilitate response, the full list of words with their codes was also written in large bold prints on a white cardboard fixed beside the screen in front of the subject. A series of twenty practice trials was given to the subject using word stimuli not shown on the list presented at 250 msec. tachistoscopic duration time. When the experimenter was satisfied that the subject had learned the list of words and the instructions, the actual experimental trials began.

The two variable stimulus treatment (neutral and affective) was classified into three separate conditions:

Neutral-Neutral (N-N) where neutral words were paired with neutral words to give altogether five pairs; Neutral-Affective (N-A) where five neutral words were paired with five affective words to give a total of five pairs; and Affective-Affective (A-A) where affective words were paired with affective words to give a total of five pairs. Each stimulus word was presented fifteen times under each stimulus condition, thus yielding a total number of 150 times per stimulus condition. Each subject thus made a total of 450 word recognition and selection judgments, regarded as a bare minimum for signal detection analysis.¹⁶ The five tachistoscopic duration times of 8, 17, 33, 67 and 125 msec., determined through a pilot study, were presented thirty times for each of the three stimulus conditions at a predetermined random order. Each stimulus word was presented three times, also at a predetermined random order, for each of the five tachistoscopic duration times, which represents blocks of thirty random experimental trials each. The subject was required to respond within four seconds after each flash, and the interstimulus interval was approximately seven seconds. Three 5-minute rest periods were held during the experimentation.

¹⁶ D. M. Green and J. H. Swets, Signal Detection Theory and Psychophysics, New York, Wiley, 1966, p. 393.

4. Analysis of the Data.

In this section, the method of scoring the Orienting Reaction, the signal detection method of analyzing the psychophysical judgment data, and the statistical procedures employed for the testing of the null hypotheses stated in the previous chapter will be described.

(a) Methods of Analysis of Physiological Data to Obtain the Orienting Reaction Habituation Rates.- The dependent variables being investigated in the first phase of the experiment were the OR habituation rates to the neutral and affective words of three OR parameters: the vasomotor, heart rate and Galvanic Skin Response. The operational definition of OR habituation rate for all three OR components is the total number of stimulus trials presented to the subject before three consecutive stimulations failed to evoke the orienting response. The decision to adopt this criterion came from several sources, such as previous research in the Soviet Union,¹⁷ research conducted

¹⁷ O. S. Vinogradova and E. N. Sokolov, Journal of Higher Nervous Activity, Vol. 5, 1955, quoted by E. N. Sokolov, Perception and the Conditioned Reflex, New York, Macmillan, 1963, p. 119.

at the University of Ottawa by Quirion¹⁸ and Rosenberg,¹⁹ and current research conducted at other laboratories using the vasomotor components,^{20,21} heart rate components,^{22,23,24} and Galvanic Skin Response component.^{25,26}

18 N. F. Quirion, Extraversion, Neuroticism and Habituation of the Orienting Reaction, unpublished doctoral dissertation presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1970, p. 44.

19 G. Rosenberg, Self Concept Certainty Reporting and Orienting Reaction Habituation Rate, unpublished doctoral dissertation presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1971, p. 78.

20 F. L. Royer, "Cutaneous Vasomotor Components of the Orienting Reflex," Behavior Research and Therapy, Vol. 3, 1965, p. 161.

21 S. M. Unger, "Habituation of the Vasoconstrictive Orienting Reaction," Journal of Experimental Psychology, Vol. 67, 1964, p. 11-18.

22 R. C. Davis, A. M. Buchwald and R. W. Frankmann, "Autonomic and Muscular Responses, and their Relation to Simple Stimuli," Psychological Monographs, Vol. 69, No. 20, Whole No. 405, 1955

23 P. J. Lang and M. Hnatiow, "Stimulus Reception and the Heart Rate Response," Journal of Comparative and Physiological Psychology, Vol. 55, 1962, p. 781-785.

24 T. Uno and W. W. Grings, "Autonomic Components of Orienting Behavior," Psychophysiology, Vol. 1, No. 4, 1965, p. 315.

25 E. S. Katkin and R. J. McCubbin, "Habituation of the Orienting Response as a Function of Individual Differences in Anxiety and Autonomic Lability," Journal of Abnormal Psychology, Vol. 74, 1969, p. 54-60.

26 J. G. O'Gorman, G. L. Mangan and J. A. Gowen, "Selective Habituation of Galvanic Skin Response Component of the Orienting Reaction to an Auditory Stimulus," Psychophysiology, Vol. 6, 1970, p. 718.

The three Orienting Reaction parameters: vasomotor, heart rate and GSR will be individually discussed below.

The vasomotor orienting reaction (VM-OR) has been defined by Soviet investigators^{27,28} as simultaneous cephalic vasodilatation and finger vasoconstriction. In keeping with the view that the OR occurs in response to stimulus change or novelty and that it produces heightened perceptual sensitivity which serves to increase intake and processing of information, the OR is assumed to be accompanied by increase in blood supply to the brain and decreases in blood supply to the extremities and internal viscera. This property of the OR has been cited by Sokolov²⁹ as a distinguishable feature from the Defensive Reaction (DR) which is accompanied by vasoconstriction in the forehead skin. In contrast to the OR, the DR occurs to intense or noxious stimulation, and is said to produce decreased perceptual sensitivity. Although much research has been based on the distinction between the

27 E. N. Sokolov, "Higher Nervous Functions: The Orienting Reflex," Annual Review of Physiology, Vol. 22, 1963, p. 546.

28 G. Razran, "The Observable Unconscious and the Inferable Conscious in Current Soviet Psychophysiology: Interoceptive Conditioning, Semantic Conditioning, and the Orienting Reflex," Psychological Review, Vol. 68, 1961, p. 112.

29 E. N. Sokolov, Perception and the Conditioned Reflex, New York, Macmillan, 1963, p. 39-40.

OR and the DR, the literature on the whole is still inconclusive. For example, Hertzman³⁰ concluded that there was no vasoconstrictor effector in the forehead skin, a view contradicted by other investigators^{31,32} who reported vasoconstriction in the forehead; while Lader³³ reported that the vasomotor control of cutaneous blood flow was solely constrictive. Raskin et al.,³⁴ by repeated presentations of white noise ranging from 40 db to 120 db, found clear differences in heart rate and GSR as a function of stimulus intensity, but no forehead vasoconstriction even at high intensities when DRs were supposed to be evoked. In view of the conflicting evidence regarding the relationships between cephalic vasomotor responses and the OR or DR, and the fact that the DR has been studied solely with high intensity

30 A. B. Hertzman, "Vasomotor Regulation of Cutaneous Circulation," Physiological Review, Vol. 39, 1959, p. 280-306.

31 O. S. Vinogradova and E. N. Sokolov, "The Relationship between Reaction of Blood Vessels of Head and Hand in Some Unconditioned Responses in Man," Sechenov Journal of Physiology of the USSR, Vol. 42, 1957, p. 47-53.

32 Royer, op. cit., p. 161-170.

33 M. H. Lader, "Pneumatic Plethysmography," in P. H. Venables and I. Martin (eds.), A Manual of Psychophysiological Methods, New York, Wiley, 1967, p. 159-184.

34 D. C. Raskin, H. Kotses and J. Bever, "Autonomic Indicators of Orienting and Defensive Reflexes," Journal of Experimental Psychology, Vol. 80, 1969, p. 423-433.

or noxious stimulation, the present study does not attempt to clarify the nature of the relation between cephalic vasoconstriction and the DR. Hence, only cephalic vasodilatation will be considered in the scoring of the OR. On the other hand, there has been strong evidence pointing to a relationship between emotionality and vasoconstriction in the finger, as reviewed by Ackner.³⁵ Since the present investigation employed emotional words, vasoconstriction of the finger, as a partial indicator of the OR proposed by Sokolov³⁶ was therefore used.

On the polygraph ink recordings of the plethysmograph tracings, dilatation of the forehead skin vessels was indicated by an upward deflection from its baseline, which was given to become stabilized at the start of the experiment, due to increased blood volume in the forehead; while constriction of the vessels in the finger tip was indicated by a downward displacement from its baseline, due to decreased blood volume. A near simultaneous deflection of 0.1 inch of both plethysmograph tracings, upward from the baseline for the cephalic component and downward from the baseline for the digital component, was the minimum magnitude

³⁵ B. Ackner, "Emotions and the Peripheral Vasomotor System," Journal of Psychosomatic Research, Vol. 1, 1956, p. 3-20.

³⁶Sokolov, Perception and the Conditioned Reflex, p. 39.

requirement for the scoring of an orienting response. The arbitrary criterion of deflection magnitude for the scoring of VM-OR was adopted from Quirion.³⁷

Since the OR is evoked by the stimulus, it is therefore related to the stimulus in terms of time elapsed after the onset of the stimulus. Sokolov³⁸ found that the OR latency range was from 2.5 to 5 seconds following stimulus presentation, and that the maximum deflection or the peak of the OR was in the range of 7 seconds latency. For an alert individual, according to Sokolov:

[...] the latency is the same in spite of the number of presentations. After four presentations, when the subject was awake and in a state of excitation the Orienting Reflex was inhibited.³⁹

Because the latency range of the OR differs from one individual to another, in the present research the latency range criterion was extended from one to ten seconds following stimulus onset to prevent mis-scoring of the OR that might occur beyond the range Sokolov suggested. Anticipatory responses, as found by Gale and Ax,⁴⁰ that occurred later

37 Quirion, op. cit., p. 46.

38 Vinogradova and Sokolov, op. cit., quoted by Sokolov, Perception and the Conditioned Reflex, p. 39.

39 E. N. Sokolov, "Neuronal Models and the Orienting Reflex," in M. A. Brazier (ed.), The Central Nervous System and Behavior, New York, Moon, 1960, p. 211.

40 E. N. Gale and A. F. Ax, "Long Term Conditioning of Orienting Responses," Psychophysiology, Vol. 5, No. 3, 1968, p. 307-315.

than the ten-second latency but before the presentation of the next stimulus, were not scored as OR.

The second OR parameter investigated in this study is the Heart Rate (HR-OR) change elicited by presenting a stimulus to the subject. Although investigators generally agree that the HR response is a part of the general OR system, there still exists a lack of agreement on the form and direction the HR change upon stimulation in man and how it is to be interpreted in terms of the Sokolovian distinctions between orienting, adaptive and defensive responses. According to the Russian investigators, as described in the previous chapter, sensitivity of peripheral receptors can be either reduced by negative or enhanced by positive feedback from central mechanisms. In general, increased sympathetic activity appears to have an excitatory or facilitatory effect, and the OR is accompanied by an increase in heart rate. However, Lacey and Lacey⁴¹ cited evidence suggesting that increased HR and blood pressure lead, via the carotid sinus and aortic baroreceptors, to inhibition of cortical activity. The authors proposed that HR acceleration should be associated with stimulus 'rejection' occurring when stimulation was

⁴¹ J. I. Lacey and B. C. Lacey, "The Law of Initial Value in the Longitudinal Study of Autonomic Constitution," Annals of the New York Academy of Science, Vol. 98, 1962, p. 1257-1290.

painful or unpleasant, while HR deceleration should be associated with stimulus enhancement occurring in situations that require 'attention'. The Laceys' findings were replicated by Obrist.⁴² In the writer's opinion, this inconsistency in the reported direction of HR changes may be explained by the fact that while Sokolov^{43,44} used simple stimuli such as tones, the Laceys used, among others, fluctuating white noise, and a series of arithmetic problems. Graham and Clifton,⁴⁵ however, after reviewing studies using simple nonsignal stimuli, suggested that HR deceleration was a major component of the Orienting Reaction, and HR acceleration probably reflected a "defensive," "startle" or "acoustic-cardiac" response. The authors provided evidence that showed HR decreased on the initial presentations of a stimulus to the adult human subjects, and habituated on repeated stimulation. A similar view was expressed by Smith

⁴² P. A. Obrist, "Cardiovascular Differentiation of Sensory Stimuli," Psychosomatic Medicine, Vol. 25, 1963, p. 450-459.

⁴³ Sokolov, in Brazier (ed.), The Central Nervous System and Behavior, p. 235.

⁴⁴ -----, "Higher Nervous Functions: The Orienting Reflex," Annual Review of Physiology, Vol. 25, 1963, p. 546.

⁴⁵ F. K. Graham and R. K. Clifton, "Heart-Rate Change as a Component of the Orienting Response," Psychological Bulletin, Vol. 65, No. 5, 1966, p. 305-320.

and Strawbridge,⁴⁶ who used tones and light flashes of moderate intensity and concluded that HR deceleration is a component of the OR and that HR acceleration is neither an orienting, defensive, nor adaptive response but is largely secondary to respiratory changes. Other researchers^{47,48} who also used weak or moderate stimuli made similar conclusions: the OR is best indicated by HR deceleration. Still others,^{49,50} who used complex visual stimuli which included slides of objects, complex reading texts and materials with sexual content, also found that the HR decelerated upon stimulation. The nature of the stimulation, whether it was intense or moderately intense, pleasant or unpleasant, also affected the pattern of the response. Raskin et al.⁵¹ found that moderately intense stimulation

⁴⁶ D. B. D. Smith and P. J. Strawbridge, "The Heart Rate Response to a Brief Auditory and Visual Stimulus," Psychophysiology, Vol. 6, 1969, p. 317.

⁴⁷ T. Uno and W. W. Grings, "Autonomic Components of Orienting Behavior," Psychophysiology, Vol. 1, 1965, p. 311-321.

⁴⁸ J. Germana and S. B. Klein, "The Cardiac Component of the Orienting Response," Psychophysiology, Vol. 4, 1968, p. 324-328.

⁴⁹ R. C. Davis and A. M. Buchwald, "An Exploration of Somatic Response Patterns: Stimulus and Sex Differences," Journal of Comparative and Physiological Psychology, Vol. 50, 1957, p. 44-52.

⁵⁰ M. A. Wenger, J. R. Averill and D. B. D. Smith, "Autonomic Activity during Sexual Arousal," Psychophysiology, Vol. 4, 1968, p. 468-478.

⁵¹ Raskin et al., op. cit., p. 427.

(80 db) evoked a short latency OR while an intense stimulus (120 db) evoked a DR, defining OR as characterized by HR deceleration and DR characterized by HR acceleration.

Recent studies by Edwards and Alsip⁵² and Deane⁵³ supported the Lacey's' position that the cardiac deceleration was related to environmental intake of pleasant stimuli, or in anticipation of stimulation, while cardiac acceleration was related to environmental rejection of unpleasant stimuli, or experimentally induced anxiety. Thus, the majority of recent findings indicated that only the cardiac deceleration component should be referred to as the OR whose major function is facilitation of sensory intake. However, a few investigators reported^{54,55,56} a diphasic HR pattern, where the whole HR response was said to be comprised of two

52 D. C. Edwards and J. E. Alsip, "Intake-Rejection Verbalization, and Affect: Effects on Heart Rate and Skin Conductance," Psychophysiology, Vol. 6, 1969, p. 6-7.

53 G. E. Deane, "Cardiac Activity During Experimentally Induced Anxiety," Psychophysiology, Vol. 6, 1969, p. 17.

54 R. C. Davis, A. M. Buchwald and R. W. Frankman, "Autonomic and Muscular Responses and Their Relation to Simple Stimuli," Psychological Monographs, Vol. 69, No. 20, (Whole No. 405), 1955.

55 Lang and Hnatiow, op. cit., p. 782-784.

56 W. J. Meyers and G. R. Gullickson, "The Evoked Heart Rate Response: The Influence of Auditory Stimulus Repetition, Pattern Reversal and Autonomic Arousal Level," Psychophysiology, Vol. 4, 1967, p. 55-66.

components that occurred one after the other, HR acceleration initially followed by HR deceleration. Thus, the controversy over the form and direction of the HR response remains to be solved, and poses a methodological problem to the present study, since two types of complex stimuli were employed, neutral words and affective words, which might have different effects on the HR configuration. However, through a small pilot study, it was found that HR deceleration occurred to both neutral and affective word presentations. Hence, in the present study, only HR deceleration was used in the definition of an OR, whose minimal requirement was a heart rate deceleration of nine beats per minute occurring up to the twelfth post-stimulus beat as compared to the mean of three prestimulus beats. This criterion was adopted from Raskin et al.⁵⁷

The third OR parameter to be measured in the present study was Galvanic Skin Response (GSR), which is the most widely studied of the three. It is well known⁵⁸ that the sweat glands in the skin of the palms are unique in that they do not participate in thermoregulation but respond to psychological excitation. When the psychological status of

⁵⁷ Raskin, Kotses and Bever, op. cit., p. 425.

⁵⁸ D. T. Lykken, "Neuropsychology and Psychophysiology in Personality Research," p. 463.

the subject changes as a result of stimulus excitations, palmar sweat glands will be activated effecting a drop in the skin resistance, or conversely an increase in the skin conductance. The sensitivity of the measure has been demonstrated.⁵⁹ The validity of GSR as an autonomic indicator of orienting and emotional responses has also been demonstrated: O'Gorman⁶⁰ reported that resistance of GSR habituation increased linearly with the amount of informational value; Lovibond⁶¹ found that GSR habituation rate was a function of the uncertainty of the reinforcement schedule; Cohen and Johnson⁶² reported greater number of GSR responding for signal than for non-signal stimuli; Grim and White⁶³ reported augmentation of GSR responses with increase

59 T. S. Ball, M. Gabriel and V. Ackerland, "The Orienting Response as a Nonverbal Measure of Body Awareness," in J. Hellmuth (ed.), Deficits in Cognition, Cognitive Studies, New York, Mazel, Vol. 2, 1971, p. 352.

60 J. G. O'Gorman, "Habituation of the Orienting Reaction as a Function of Stimulus Information," Psychonomic Science, Vol. 22, 1971, p. 331-332.

61 S. H. Lovibond, "Habituation of the Orienting Response to Multiple Stimulus Sequences," Psychophysiology, Vol. 5, 1969, p. 435-439.

62 M. J. Cohen and H. J. Johnson, "The Effects of Signal and Nonsignal Stimuli on the Orienting and Defensive Responses," SPR Abstracts, Vol. 6, No. 5, 1969, p. 626.

63 P. F. Grim and S. H. White, "Effects of Stimulus Change upon the GSR and Reaction Time," Journal of Experimental Psychology, Vol. 69, 1965, p. 276-281.

in the amount of stimulus change; Harding and Punzo⁶⁴ found that the rate of GSR habituation increased with increase in the amount of response uncertainty; Germana⁶⁵ reported that GSR habituation increased with larger amounts of informational and associative value of the stimuli; Israel⁶⁶ concluded that GSR rate of habituation was longer for sharpeners than for levelers; and Maltzman and Raskin⁶⁷ demonstrated that individual differences in GSR responsivity was related to, among other things, amount of semantic learning and ability to discriminate complex signals. In the present study, the criterion adopted for the identification of a GSR Orienting Reaction was defined as a drop in the skin resistance of at least 300 ohms occurring within a ten-second period from the time of stimulus onset. This criterion is comparable to that of Germana's study⁶⁸ and others established in the literature.

64 G. Harding and F. Punzo, "Response Uncertainty and Skin Conductance," Journal of Experimental Psychology, Vol. 88, 1971, p. 265-272.

65 J. Germana, "Response Characteristics and the Orienting Reflex," Journal of Experimental Psychology, Vol. 78, No. 4, 1968, p. 610-616.

66 N. R. Israel, "Individual Differences in GSR Orienting Response and Cognitive Control," Journal of Experimental Research in Personality, Vol. 1, 1966, p. 244-248.

67 Irving Maltzman and D. Raskin, "Effects of Individual Differences in the Orienting Reflex on Conditioning and Complex Processes," Journal of Experimental Research in Personality, Vol. 1, 1965, p. 1-16.

68 Germana, op. cit., p. 612.

The scoring of the OR records was done independently by at least two judges. To eliminate experimenter bias, scoring was performed without prior knowledge of the type of stimulation employed or the subject's standing on the Extraversion scale. Two sets of scores on each of the three OR parameters were obtained, from which inter-rater reliability estimates were computed.

(b) Method of Analysis of Psychophysical Judgment Data.- The method of constant stimuli⁶⁹ was used to obtain threshold estimates for each of the three stimulus conditions: Neutral-Neutral (N-N), where five neutral words were paired with another five neutral words, Neutral-Affective (N-A), where five neutral words were paired with five affective words, and Affective-Affective (A-A) where five affective words were paired with another five affective words.

The psychophysical judgment data were then subjected to the signal detection method of analysis. According to the theory of signal detection, two competing stimulus situations were defined corresponding to noise and signal + noise conditions. In the present study, the "noise" condition was the presentation of variable word stimuli targets which were the first words of each pair of words, and

⁶⁹ J. P. Guilford, Psychometric Methods, New York, McGraw-Hill, 1954, p. 101-153.

the signal + noise condition was the presentation of variable stimulus targets which were the second words of each pair of words. For example, in the N-A stimulus condition, presentation of neutral words corresponded to the noise condition, and presentation of affective words which were the paired counterparts of the neutral words corresponded to the signal + noise condition. The assumptions underlying the theory⁷⁰ were: (1) The presentation of Word 1 produced in the subject a sensory datum called "observation." Observations to repeated presentations would form a normal distribution. Similarly, repeated presentations of Word 2 would also form a normal distribution partially overlapping with the distribution for Word 1. (2) Subject was assumed to be able to make a decision about the competing stimulus situations based on an observation by comparing it with some criterion observation. The subject was assumed to establish some "criterion" on the common continuum of observations for Word 1 and Word 2. If subject sets her subjective criterion far to the signal + noise (Word 2) distribution, fewer hits and false alarms will be given, and the subject is described as having a "conservative" or "strict" criterion for reporting recognition of Word 2. Conversely, a "lenient" criterion

⁷⁰ J. A. Swets, W. P. Tanner, Jr., and T. G. Birdsall, "Decision Processes in Perception," Psychological Review, Vol. 68, 1961, p. 301-310.

means the subjective criterion is set to the noise (Word 1) distribution.

On each trial after the presentation of the stimulus, the subject's task was to decide if a given observation was more represented by Word 1 or Word 2, and she would respond either "Word 1" or "Word 2." The two types of stimulus conditions, Word 1 and Word 2 variable stimuli targets, and the two response categories, Word 1 and Word 2, resulted in four stimulus-response alternatives⁷¹ which are illustrated in Figure 2. The hit rate $P(Jw2/Sw2)$, i.e. judged Word 2, stimulus Word 2, is the probability that the subject would judge the variable stimulus was Word 2 when in fact the stimulus was Word 2 of a pair of words. The false alarm rate $P(Jw2/Sw1)$, i.e. judged Word 2, stimulus Word 1, is the probability that the subject would judge the variable stimulus as Word 2 when in fact the stimulus presented was Word 1 of the pair of words. These two response alternatives of hit rate (HR) and false alarm rate (FAR) are sufficient to describe the four-celled matrix because the probabilities of hit and miss, and false alarm and correct rejection, both add up to one.

Classical threshold theory, upon which most research in perceptual defense process has been based, assumes that

⁷¹ Ibid., p. 306.

		Stimulus Alternative	
		Signal + Noise Word 2	Noise Word 1
R E S P O N S E A L T E R N A T I V E	W o r d 2	$P(Jw2/Sw2)$ Judged Word 2, Stimulus Word 2 Hit	$P(Jw2/Sw1)$ Judged Word 2, Stimulus Word 1 False Alarm
	W o r d 1	$P(Jw1/Sw2)$ Judged Word 1, Stimulus Word 2 Miss	$P(Jw1/Sw1)$ Judged Word 1, Stimulus Word 1 Correct Rejection

Figure 2.- Stimulus and Response Alternative Matrix for Signal Detection Analysis.

false alarms are guesses so that the "true" recognition score can be determined by subtracting the percentage of Word 1 stimuli falsely recognized as Word 2 (false alarms) from the percentage of Word 2 stimuli correctly recognized (hits). However, this correction formula is based on the assumption that the relationship between HR and FAR is linear. However, there is evidence that this linear assumption is not justified.^{72,73} The plot of HR and FAR determined at points where the subject has varied her criterion forms a Receiver-Operating-Characteristic (ROC) curve. From the ROC curve, quantitative estimates of the subject's decision criterion or response bias (β) and a relatively independent measure of her sensitivity (d') can be obtained. The classical threshold estimate usually confounds these two relatively independent variables.

72 W. Tanner and J. Swets, "A Decision-Making Theory of Visual Detection," Psychological Review, Vol. 61, 1954, p. 401-409.

73 I. Pollack and R. Decker, "Confidence Ratings, Message Reception and the Receiving Operating Characteristic," in J. Swets (ed.) Signal Detection and Recognition by Human Observers, New York, Wiley, 1964.

Following the confidence rating procedure described by Egan⁷⁴ and Weintraub and Hake,⁷⁵ each decision, i.e. Word 1 or Word 2 response alternative, was taken according to a response criterion (positive, fairly sure, guess) adopted by the subject. By using the two stimulus alternatives, Word 1 or Word 2 presentation, on each trial six joint recognition rating responses are therefore possible.

The frequency of response for the variable duration Word 1 stimulus targets for each of the six response categories was computed as well as the frequency of response for the variable duration Word 2 stimulus targets again for each of the six response categories, for each subject in each of the three stimulus conditions (N-N, N-A, A-A). An example of this procedure is given in Appendix 2. These twelve values for each observer and for each stimulus condition were then entered on an IBM data card for subsequent analysis, using an IBM 7094 Fortran IV computer program developed by Ogilvie and Creelman.⁷⁶ The computer program determined

⁷⁴ J. P. Egan, A. I. Schulman and G. Z. Greenberg, "Operating Characteristics Determined by Binary Decisions and by Ratings," Journal of the Acoustical Society of America, Vol. 31, 1959, p. 768-773.

⁷⁵ D. Weintraub and H. Hake, "Visual Discrimination, an Interpretation in Terms of Detectability Theory," Journal of the Optical Society of America, Vol. 52, 1962, p. 1179-1184.

⁷⁶ J. C. Ogilvie and C. D. Creelman, "Maximum Likelihood Estimation of Receiver Operating Characteristic Curve Parameters," Journal of Mathematical Psychology, Vol. 5, 1968, p. 387.

five different discriminable decision criteria which the subject held subjectively and stated above which criterion each stimulus word was recognized. The program then determines the cumulative Hit Rate and cumulative False Alarm Rate at each criterion point and plots these values to form an ROC curve from which two separate quantitative estimates of the subject's performance, sensitivity d' and the criterion beta values are obtained. The higher the hit proportion and the lower the false alarm proportion, the greater is the sensitivity of the observer to word recognition, and the greater the value of d' . Conversely, the lower the hit proportion and the higher the false alarm proportion, the smaller the sensitivity and d' . The variation in the hit and false alarm proportions along the ROC curve for the five response criteria reflects the influence of nonsensory variables such as set, attitudes or motives on the observer's decisions. Points higher on the ROC curve represent more liberal decision criteria and indicate that the observer is willing to allow more false alarms in order to achieve more hits. By averaging the five beta values which the program yielded, an estimate of the influence of nonsensory factors such as set, attitude or motive on the subject's decisions was therefore obtained. A high averaged beta value indicates a more lenient attitude in the

word recognition-selection task and, conversely, a low averaged beta value indicates a greater degree of caution or a more conservative attitude adopted by the subject in her judgments.

5. Statistical Analysis.

In order to test the hypotheses stated at the end of the first chapter, several statistical techniques were used, the purposes of which were to establish the significance of the differences among the three groups of Introverted, Middle and Extraverted subjects and among the various neutral or affective stimulus conditions on the dependent variables studied, namely, the OR habituation rate and recognition judgment parameters.

A three-way analysis of variance with repeated measures design, as described by Winer,⁷⁷ was used to test the significance of the main effects of Extraversion, Affectivity, and Word, denoted as Factor A, Factor B and Factor C, respectively. Factor C is nested within Factor B. The effects of A and B and of the interaction AB were the main concern of this study, since they were stated in the first hypotheses in the previous chapter. This general

⁷⁷ B. J. Winer, Statistical Principles in Experimental Design, New York, McGraw-Hill, 1962, p. 312-376.

design was employed for each of the three OR parameters. An alternative design similar to the one described above but with a crossed instead of a nested factor was also performed on the same data, and their results included in Appendix 6. . The reason for their inclusion is that, although different word stimuli were used, the two neutral words were matched with the two affective words for structural similarity, for example, the neutral word "where" was structurally similar to its affective counterpart "whore."

To test the third and fourth hypotheses, a two-factor analysis of variance model with repeated measures on one factor⁷⁸ was used. The two factors considered were Extraversion and Stimulus Condition. Repeated measures were taken on the stimulus condition factor consisting of neutral-neutral word pairs, neutral-affective word pairs, and affective-affective word pairs. The two dependent variables were: (a) d' or the sensory capacity estimate of the observer derived from the Signal Detection Method and professed to be independent of nonsensory, personal factors which may influence the recognition judgment behavior; and (b) beta value(s) or the recognition decision criterion values representing Signal Detection estimates of the nonsensory, personal factors independent of sensory capacity.

78 Ibid., p. 302-304.

To exclude chance findings, a conventional level of significance ($p = .05$) was used as the basis for the rejection of null hypotheses. When the over-all test yields a significant F value, post hoc procedures, using the Tukey technique described by Edwards,⁷⁹ were applied to locate the source of difference.

To evaluate the measurement and scoring of the OR habituation rate, inter-rater reliability estimates for each of the OR parameters were calculated with Ebel's formula.⁸⁰

Test-retest reliabilities were estimated for the EPI, using Pearson r ; reliability estimates were also calculated for each of the dependent variables studied from repeated measures analysis of variance design.⁸¹

79 A. L. Edwards, Statistical Methods for the Behavioral Sciences, New York, Rinehart, 1954, p. 330-331.

80 Guilford, op. cit., p. 395-397.

81 Winer, op. cit., p. 125-127.

CHAPTER III

PRESENTATION OF RESULTS

This chapter begins with the selection data for the groups of low, middle and high extraversion. Specific attention is given to the age, the Otis I.Q., and the Eysenck Personality Inventory-Form A score distributions. The main body of this chapter deals with the analysis of the Orienting Reaction habituation rate to neutral and affective word stimuli, and with the analysis of the word recognition data, for the groups of low, middle and high extraversion. For each of these analyses, an attempt is made to clarify the significance of the dependent measures which they provide.

1. Characteristics of the Sample.

The Eysenck Personality Inventory (EPI) - Form A was administered to fifty-six student nurses. The means and the standard deviations of the total sample for both the Extraversion (Mean = 13.93; SD = 4.14) and Neuroticism (Mean = 11.63; SD = 4.27) dimensions were consistent with the norms for student nurses described in the test manual.¹

¹ H. J. Eysenck and S. B. G. Eysenck, Manual for the Eysenck Personality Inventory, San Diego, Educational and Industrial Testing Services, 1968, p. 5-27.

On the basis of the extraversion scores, three groups of ten low extraversion subjects, ten middle extraversion subjects, and ten high extraversion subjects were composed and were defined as Introverted, Middle, and Extraverted groups, respectively.

Tests of significance applied to the extraversion and neuroticism data showed that the three sample groups differed significantly in the Extraversion dimension ($F = 77.82$; $df = 2,27$; $p < .001$) as expected, but did not differ significantly in the Neuroticism dimension ($F = 1.14$; $df = 2,27$; $p > .05$).

Test-retest reliability estimates of the EPI, 0.78 for the Extraversion dimension, and 0.61 for the Neuroticism dimension, are presented in Appendix 5A.

Score distributions of Age, Otis I.Q., Visual Acuity and EPI (Form A) are summarized in Table I. Tests of significance applied to the Age, Otis I.Q., and Visual Acuity scores showed that the three sample groups did not differ significantly in Age ($F = 0.68$; $df = 2,27$; $p > .05$), Otis I.Q. ($F = 0.509$; $df = 2,27$; $p > .05$), and Visual Acuity ($F = 0.04$; $df = 2,27$; $p > .05$), respectively. Hence, the sample groups, selected on the basis of EPI Extraversion dimension, were equated for sex, educational level, age, Otis intelligence, visual acuity, and EPI Neuroticism.

Table I.-

Summary Description of Age, Otis I.Q., Visual Acuity, and EPI (Form A) Score Distribution for Introverted, Middle, and Extraverted Groups.

	Extraversion Groups					
	Introverted		Middle		Extraverted	
	(N-10)		(N-10)		(N-10)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Age	19.10	0.70	18.70	0.78	18.90	0.70
<u>Otis</u> I.Q.	114.10	6.97	116.50	6.35	113.50	7.73
Visual Acuity	11.20	1.03	11.20	0.92	11.10	0.74
Extraversion	9.20	1.69	14.20	1.81	18.40	1.43
Neuroticism	12.70	4.45	12.20	4.56	10.00	3.68

2. Orienting Reaction Habituation Rate Data.

The Orienting Reaction habituation rate of the three sample groups to neutral and affective word stimuli were observed. The word stimuli consisted of two neutral words, "cinch" and "where," and two affective words, "bitch" and "whore." Three components of the OR were recorded: vasomotor (VM), heart rate (HR), and galvanic skin response (GSR).

Mean estimates of rating reliability of OR habituation rates for the vasomotor component, the heart rate component, and the galvanic skin response component are 0.17, 0.93 and 0.87, respectively (see Appendix 5B). The failure to obtain significant rater reliability for the vasomotor OR component reflects the difficulties encountered by other investigators² in the scoring of this OR component.

The habituation rate for each OR component was treated in an independent analysis of variance. In each case the OR habituation rate was the dependent variable. The analysis of variance results for each OR component are presented separately.

2 E. C. Desjardins, The Rater Reliability of a Plethysmograph Scoring Method of the Vasomotor Orienting Reaction Habituation, interim report presented to the Faculty of Psychology of the University of Ottawa for the doctoral degree in psychology, Ottawa, 1972, p. 56.

A. Vasomotor Orienting Reaction

The mean Vasomotor OR habituation rates for the three sample groups are 4.6, 2.2 and 1.5 for Introverted, Middle and Extraverted groups, respectively (see Table II). Analysis of variance results, shown in Table III, showed that the effect of extraversion on OR habituation rate was significant (F for Extraversion factor = 12.99; df = 2,27; $p < .001$). Tukey's test applied to the group means, shown in Table IV, revealed that the over-all significance is due to the significantly longer VM-OR habituation rate obtained by the Introverted subjects than that obtained by the Middle and Extraverted groups (q statistic between Introverted and Middle group means = 5.63; df = 25; $p < .01$; q statistic between Introverted and Extraverted = 7.26; df = 25; $p < .01$).

The results of the analysis of variance did not yield significant differences between the neutral and affective words (F = 0.19; df = 1,27; $p > .05$).

Analysis of variance results showed that the interaction effect due to Extraversion and Affectivity was significant (F = 3.76; df = 2,27; $p < .05$). Analysis of simple main effects showed that the significance of the interaction effect was mainly due to the fact that, during neutral word stimulation, the introverts elicited significantly longer

Table II.-

Mean Rates of Habituation of the Vasomotor Component of the Orienting Reaction for Introverted, Middle and Extraverted Groups.

Group	N	Words				Average
		Neutral		Affective		
		1	3	2	4	
Introverted	10	5.0	5.6	4.2	3.5	4.6
Middle	10	1.0	1.5	2.5	3.8	2.2
Extraverted	10	2.0	0.7	2.2	0.9	1.5
Average	30	2.7	2.6	3.0	2.4	2.7

Note: Neutral words one and three were "cinch" and "where"; affective words two and four were "bitch" and "whore."

Table III.-

Analysis of Variance of Vasomotor Orienting Reaction Habituation Rate Scores to Two Neutral and Two Affective Stimuli for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	434.242	29	14.974	
A (Extraversion)	212.917	2	106.458	12.99 ^a
Subjects within groups	221.325	27	8.197	
Within subjects	606.750	90	6.742	
B (Affectiveness)	1.408	1	1.408	0.19
AB	56.117	2	28.058	3.76 ^b
B X Subjects within groups	201.725	27	7.471	
C : B (Word nested within B)	0.883	2	0.442	0.08
AC:B	29.967	4	7.492	1.28
C:B X Subjects within groups	316.650	54	5.863	

a $p < .001$; $F_{.999}(2,27) = 9.02$

b $p < .05$; $F_{.95}(2,27) = 3.35$

Note: The Vasomotor Orienting Reaction habituation rate scores to neutral and affective words for the sample of Introverted, Middle and Extraverted subjects are given in Appendix 3C.

Table IV.-

Tukey's Test for Significance of Differences Between Pairs of Group Means of Vasomotor Orienting Reaction Habituation Rate Scores for Extraversion Main Effect.

Comparison of Means	Absolute Contrast ^a	q statistic ^b	p ^c
I - M	2.4	5.63	<.01
I - E	3.1	7.26	<.01
M - E	0.7	1.64	n.s.

a Means for Introverted, Middle and Extraverted groups on VM-OR habituation rate = 4.6, 2.2, 1.5, respectively.

b q statistic = HSD or contrast/ 0.4263; refer to Table III for error term.

c $q_{.95,25} = 3.53$; $q_{.99,25} = 4.55$

VM-OR habituation rates than the other two groups ($F = 14.28$; $df = 2,27$; $p < .001$). The differences between the three sample groups were reduced during affective word stimulation, although still significant ($F = 3.71$; $df = 2,27$; $p < .05$).

B. Heart Rate Orienting Reaction

The group means of the Heart Rate OR habituation rate are presented in Table V (Introverted = 5.2; Middle = 4.6; Extraverted = 2.8). Analysis of variance results of the Heart Rate OR data, presented in Table VI, failed to show a significant over-all difference due to the Extraversion main effect ($F = 1.65$; $df = 2,27$; $p > .05$) but showed that the effect due to the neutral and affective word stimuli was significant ($F = 4.83$; $df = 1,27$; $p < .05$). The HR-OR habituation rate to the two affective word stimuli (means = 4.5 and 5.4) was found to be significantly longer than that to the two neutral word stimuli (means = 2.6 and 4.4). The interaction effect between extraversion and word stimulation was not significant ($F = 0.53$; $df = 2,27$; $p > .05$).

Table V.-

Mean Rates of Habituation of the Heart Rate Component of the Orienting Reaction for Introverted, Middle and Extraverted Groups.

Group	N	Words				Average
		Neutral		Affective		
		1	3	2	4	
Introverted	10	4.0	5.5	5.4	5.9	5.2
Middle	10	2.0	4.9	5.5	6.1	4.6
Extraverted	10	1.8	2.8	2.5	4.1	2.8
Average	30	2.6	4.4	4.5	5.4	4.2

Note: Neutral words one and three were "cinch" and "where"; affective words two and four were "bitch" and "whore," respectively.

Table VI.-

Analysis of Variance of Heart Rate Orienting Reaction Habituation Rate Scores to Two Neutral and Two Affective Stimuli for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	1152.542	29	39.743	
A (Extraversion)	125.617	2	62.8083	1.65 ^a
Subjects within groups	1026.925	27	38.0342	
Within subjects	1013.250	90	11.2583	
B (Affectiveness)	60.208	1	60.208	4.83 ^b
AB	13.116	2	6.558	0.53
B X Subjects within groups	336.425	27	12.460	
C : B (Word nested within B)	60.750	2	30.375	3.10
AC:B	13.400	4	3.350	0.34
C:B X Subjects within groups	529.350	54	9.803	

a Not significant; $F_{.95}(2,27) = 3.35$

b $p < .05$ $F_{.95}(1,27) = 4.22$

Note: The Heart Rate Orienting Reaction habituation rate scores to neutral and affective words for the sample of Introverted, Middle and Extraverted subjects are given in Appendix 3D.

C. Galvanic Skin Response Orienting Reaction

The mean Galvanic Skin Response OR habituation rates, presented in Table VII, for the Introverted, Middle, and Extraverted groups were 5.2, 3.3, and 2.2, while those for the neutral words were 2.3 and 3.6, and those for the affective words 3.7 and 4.6. The analysis of variance results of this OR component are presented in Table VIII. The results of the analysis of variance showed that, similar to the Vasomotor OR habituation rate, the main effect due to Extraversion was significant ($F = 5.21$; $df = 2,27$; $p < .05$). The Tukey test for pairs of group means, presented in Table IX, revealed that the significant main effect due to Extraversion was due to the significantly longer habituation rate of the Introverted group when compared with the Extraverted group ($q = 1.67$; $df = 25$; $p < .01$). In addition to the significant main effect due to Extraversion, the interaction effect of Extraversion X Word Stimuli was also found to be significant ($F = 4.71$; $df = 4,54$; $p < .01$). Simple main effects test revealed that the significance of the interaction was due to the irregular OR reactivity by the Introverted subjects to different word stimuli ($F = 9.95$; $df = 2,54$; $p < .001$).

Table VII.-

Mean Rates of Habituation of the Galvanic Skin Response
Component of the Orienting Reaction for
Groups of Introverted, Middle and
Extraverted Subjects.

Group	N	Words				Average
		Neutral		Affective		
		1	3	2	4	
Introverted	10	2.3	7.7	3.1	7.6	5.2
Middle	10	2.0	2.1	4.9	4.1	3.3
Extraverted	10	2.6	0.9	3.1	2.2	2.2
Average	30	2.3	3.6	3.7	4.6	3.6

Note: Neutral words one and three were "cinch" and "where," respectively; affective words two and four were "bitch" and "whore," respectively.

Table VIII.-

Analysis of Variance of Galvanic Skin Response Orienting Reaction Habituation Rate Scores to Two Neutral and Two Affective Stimuli for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	651.70	29	22.472	
A (Extraversion)	181.55	2	90.775	5.21 ^a
Subject within groups	470.15	27	17.412	
Within subjects	1362.00	90	15.133	
B (Affectiveness)	45.63	1	45.633	3.43 ^b
AB	23.52	2	11.758	0.88
B X Subjects within groups	358.85	27	13.291	
C : B (Word nested within B)	37.13	2	18.567	1.51
AC:B	231.86	4	57.967	4.71 ^c
C:B X Subjects within groups	665.00	54	12.315	

a $p < .05$; $F_{.95}(2,27) = 3.35$

b $p > .05$, not significant; $F_{.95}(1,27) = 4.22$

c $p < .01$; $F_{.99}(4,54) = 3.65$

Note: The Galvanic Skin Response Orienting Reaction habituation rate scores to neutral and affective words for the sample of Introverted, Middle and Extraverted subjects are given in Appendix 3E.

Table IX.-

Tukey's Test for Significance of Differences Between Pairs of Group Means of Galvanic Skin Response OR Habituation Rate Scores for Extraversion Main Effect.

Comparison of Means	Absolute Contrast ^a	q statistic ^b	p ^c
I - M	1.9	2.88	n.s.
I - E	3.0	4.55	.01
M - E	1.1	1.67	n.s.

a Means for Introverted, Middle and Extraverted groups on GSR-OR habituation rate = 5.2, 3.3, 2.2, respectively.

b q statistic = HSD or Contrast/ 0.66

c $q_{.95,25} = 3.53$; $q_{.99,25} = 4.55$

D. Summary of the Analysis of the Orienting Reaction Data

Similar results were also obtained using a crossed factor design for all the three OR parameters. As explained earlier, this crossed factor assumed structural similarity between two pairs of neutral and affective words, and therefore introduced a two-level stimulus structure factor. The results are presented in Appendix 6.

To summarize the OR findings, the results showed the Introverted group produced significantly greater OR reactivity to both neutral and affective word stimuli than the Middle and Extraverted groups, except in the case of the heart rate response. The affectivity of the stimuli also tended to prolong the OR habituation rate.

3. Recognition Judgment Data.

The application of Signal Detection analysis on the recognition judgment data yielded two independent estimates, namely d' or sensory capacity estimate, and beta or an estimate of the influence of nonsensory factors on the observer's recognition judgment. The greater the value of d' means the greater the perceptual sensitivity; and a high value of beta indicates a more cautious decision criterion in word recognition. These two perceptual estimates were treated each as a dependent variable in separate analysis of variance.

The mean d' score for the Introverted, Middle and Extraverted groups (2.54, 2.32 and 2.15, respectively) and for the three stimulus conditions (2.23, 2.41 and 2.37, respectively for N-N, N-A and A-A) are presented in Table X. The analysis of variance test applied to the data showed that the effects due to Extraversion, the Stimulus Conditions, or their interaction on the sensory capacity d' scores were not significant. The analysis of variance results are presented in Table XI.

The mean beta scores for the Introverted, Middle and Extraverted groups (1.30, 1.15 and 1.30, respectively) and for the three stimulus conditions (1.23, 1.26 and 1.27, respectively for N-N, N-A and A-A) are presented in Table XII. As in the case of d' , the analysis of variance test applied to the beta scores (see Table XIII) failed to show significant effects due to Extraversion, the Stimulus Condition, or their interaction.

Similar results were obtained for individual beta values when analysis of variance test was applied to each of the five beta values. The results are presented in Appendix 7.

The analysis of variance results of Recognition-Duration threshold estimates, which is presented in Appendix 8, showed a significant effect due to the stimulus condition

Table X.-

Mean d' Scores Obtained Under Neutral-Neutral(N-N), Neutral Affective(N-A) and Affective-Affective(A-A) Stimulus Treatment for Groups of Introverted, Middle and Extraverted Subjects.

Group	N	N-N	N-A	A-A	Average
Introverted	10	2.494	2.671	2.454	2.539
Middle	10	2.065	2.418	2.463	2.315
Extraverted	10	2.118	2.146	2.197	2.153
Average	30	2.225	2.411	2.371	2.336

Note: Raw d' scores are presented in Appendix 3F.

Table XI.-

Analysis of Variance of d' Scores Obtained Under Neutral-Neutral, Neutral-Affective and Affective-Affective Stimulus Treatment for Groups of Introverted, Middle and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio	p
Between subjects	38.442	29	1.326		
A (Extraversion)	2.258	2	1.129	0.842	n.s.
Subjects within groups	36.184	27	1.340		
Within subjects	13.144	60	0.219		
B (Stimulus condition)	0.575	2	0.288	1.209	n.s.
AB	0.674	4	0.168	0.708	n.s.
B X Subjects within groups	11.895	54	0.238		
Total	51.586	89			

Table XII.-

Mean beta Scores Obtained Under Neutral-Neutral(N-N), Neutral-Affective(N-A) and Affective-Affective(A-A) Stimulus Treatment for Groups of Introverted, Middle and Extraverted Subjects.

Group	N	N-N	N-A	A-A	Average
Introverted	10	1.404	1.336	1.170	1.303
Middle	10	1.020	1.197	1.235	1.151
Extraverted	10	1.260	1.237	1.398	1.298
Average	30	1.228	1.256	1.268	1.251

Note: Raw beta scores for the sample are presented in Appendix 3G.

Table XIII.-

Analysis of Variance of Averaged beta Scores Obtained Under Neutral-Neutral, Neutral-Affective and Affective-Affective Stimulus Treatment for Groups of Introverted, Middle and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio	p
Between subjects	13.143	29	0.453		
A (Extraversion)	0.450	2	0.225	0.479	n.s.
Subjects within groups	12.693	27	0.470		
Within subjects	8.839	60	0.147		
B (Stimulus condition)	0.025	2	0.013	0.083	n.s.
AB	0.680	4	0.170	0.129	n.s.
B X Subjects within groups	8.134	54	0.151		

Note: The above beta scores were averaged from five separate beta values obtained by each subject. Analysis of variance was performed on each of the five beta values and presented in Appendix 7.

($F = 3.61$; $df = 2,54$; $p < .05$). On further analysis by applying Tukey's test on this effect, it was found that the significance of the Stimulus Condition main effect was due to the significance of the difference between the neutral-neutral stimulus condition and the affective-affective stimulus condition, the threshold for the former was significantly higher than for the latter ($q = 3.49$; $df = 54$; $p < .05$). The results are interesting especially since this traditional threshold estimate is reported to confound the sensory and nonsensory factors that influence perceptual recognition and judgment.

4. Correlation Data.

Pearson r correlations for the entire sample of subjects between recognition sensitivity d' , response bias β , and habituation rates of specific OR components were also calculated. Although the selection of extreme groups of introverts and extraverts necessarily destroys the nominality of the sample and limits the value of these statistics, it is, however, interesting to note that significant correlations were obtained between the Heart Rate habituation rate and the Galvanic Skin Response habituation rate ($r = 0.31$; $p < .01$); between the Heart Rate habituation rate and recognition sensitivity ($r = -0.32$; $p < .05$); and

between recognition sensitivity and decision criterion ($r = 0.72$; $p < .01$). The complete correlation matrix is shown in Table XIV.

The following chapter considers the results of the analyses of the Orienting Reaction habituation rate and word recognition data in the light of the hypotheses and problem which guided this investigation.

Table XIV.-

Intercorrelations Between Orienting Reaction Habituation Rates, Averaged d' , and Averaged beta Values.

	Orienting Reaction Component			Recognition Sensitivity d'	Decision Criterion beta
	VM	HR	GSR		
VM	--	0.13 (N=120)	0.08 (N=120)	0.09 (N=60)	0.04 (N=60)
HR		--	0.31 ^b (N=120)	-0.32 ^a (N=60)	-0.21 (N=60)
GSR			--	0.23 (N=60)	0.03 (N=60)
d'				--	0.72 ^b (N=90)
beta					--

a $p < .05$

b $p < .01$

CHAPTER IV

DISCUSSION OF RESULTS

This chapter begins with a summary of the results of the analysis of the Orienting Reaction habituation rate to neutral and affective word stimuli and the analysis of the word recognition data. Following this is an evaluation of the hypotheses which guided the investigation. The critical ratio, used as a guideline for accepting or rejecting each null hypothesis, was set at a five per cent level of confidence. The evaluation of the hypotheses leads into a discussion of the questions formulating the problem which are reconsidered in light of the present results. Specifically questioned is the Eysenckian postulate that introverts, because of their greater degree of cortical excitability than the extraverts, should also have greater perceptual sensitivity. In the final section of this chapter, consideration is given to the implications of the results on the Orienting Reaction and perceptual organization.

1. Summary of Results.

The results of the Orienting Reaction habituation rate data showed that groups of Introverts, Middle, and Extraverts varied significantly in their Vasomotor and

Galvanic Skin Response components of Orienting Reaction habituation rates to neutral and affective word stimuli. In general, the Introverted group produced larger OR habituation rates than the Middle and Extraverted groups. The results of the Orienting Reaction habituation rate data also showed that affective and neutral word stimuli varied significantly in their effect on the habituation rate of the Heart Rate component of the OR. In general, the Orienting Reaction habituation rate of the two affective word stimuli was found to be longer than that of the two neutral word stimuli.

From the signal detection analysis, which provided measures of recognition sensitivity independent of the non-sensory, personal factors which influence the observer's judgment criterion, the results revealed that the effects due to extraversion and to the stimulus condition on the signal detection estimate of recognition sensitivity were insignificant. Likewise, the effects due to extraversion and to the stimulus condition on the averaged decision criterion, which is influenced by nonsensory, personal factors, were also insignificant.

The analysis of variance results of the recognition duration threshold estimate, which is known to confound sensory and personal factors that influence recognition

and judgment, showed that groups of Introverts, Middle and Extraverts did not vary significantly in their recognition duration threshold. It was found, however, that the neutral-neutral and the affective-affective stimulus conditions varied significantly in their effect on this traditional threshold estimate. The recognition duration threshold for the neutral-neutral stimulus condition was significantly higher than that for the affective-affective stimulus condition.

Pearson r correlations revealed that the Heart Rate habituation rate was significantly correlated with the Galvanic Skin Response habituation rate: the longer the HR habituation rate, the longer the GSR habituation rate. The Heart Rate habituation rate was also found to be significantly correlated with the signal detection estimate of recognition sensitivity, d' : the longer the HR habituation rate, the lesser the recognition sensitivity; and conversely, the shorter the HR habituation rate, the greater the recognition sensitivity. Although the theory of signal detection purports to yield independent estimates of sensory capacity (d') and decision criterion (β) in a recognition judgment task, it was found that the signal detection estimate of recognition sensitivity was significantly correlated with the averaged criterion value; the greater the recognition

sensitivity, the more cautious the decision criterion in word recognition; and conversely, the less the recognition sensitivity, the less cautious the decision criterion.

2. Evaluation of the Hypotheses.

It will be recalled that the Eysenckian introverts and extraverts have been demonstrated to vary in their levels of physiological arousal and perceptual sensitivity to environmental stimulation. The concept of the Orienting Reaction habituation rate has also been demonstrated to be influenced by individual differences of stimulus reception and speed of conditioning. Previous studies have employed the OR habituation rate to test Eysenck's hypothesis that introverts have greater physiological arousal than extraverts. In view of the conflicting reports relating the Eysenckian dimension of Extraversion to the rate of OR habituation, an attempt was undertaken to explore the possible influence of the signal value of the stimulus on the habituation rate of the OR. In this framework, significant variations in the effect of the word's affect value on the OR habituation rate would be anticipated. On the other hand, if the Eysenckian dimension of Extraversion is the principal determinant of the observed differences on the OR habituation rate, introverts and extraverts would be expected

to differ in their OR habituation rates to both neutral and affective word stimuli.

It is well known that perceptual sensitivity of the environment is a function not only of the affective value of the environmental stimulation, but also of certain dispositions of the perceiver. Previous studies have employed the traditional recognition threshold to test Eysenck's hypothesis that introverts, because of their greater degree of cortical arousal, should display low recognition threshold. In view of the inconclusive findings relating extraversion to the traditional recognition threshold, an attempt was made to explore this hypothesis with an estimate of recognition sensitivity derived from the theory of Signal Detection, which is an estimate of sensory capacity independent of non-sensory, personal factors contributed by response bias in a perceptual judgment task. In this framework, significant variations in the effect of extraversion on the recognition sensitivity to neutral and affective words would be anticipated.

These considerations may be helpful in evaluating the hypotheses which test the general rule that introverts and extraverts vary significantly in their level of physiological arousal upon stimulation, and also in their level of perceptual sensitivity in a word recognition task.

From the analyses of the Orienting Reaction data, it would appear that introverts and extraverts vary significantly in their OR habituation rates to both neutral and affective word stimulation. The first null hypothesis, which states that there is no significant difference between groups of Introverted, Middle, and Extraverted subjects in the OR habituation rate to neutral and affective word stimuli as measured by the Vasomotor, Heart Rate, and Galvanic Skin Response, was therefore partly rejected. The direction of these differences, with the Introverted group giving longer OR habituation rates than the Middle group and the Middle group giving longer OR habituation rates than the Extraverted group, was consistent with the observations of previous research.^{1,2} In general, then, although differences in experimental conditions and statistical designs make comparisons with previous research difficult, the results of the present study seem to be generally congruent with the findings of studies employing the Orienting Reaction as an index of physiological reactivity to differentiate between

1 G. L. Mangan and J. G. O'Gorman, "Initial Amplitude and Rate of Habituation of OR in Relation to Extraversion and Neuroticism," Journal of Experimental Research in Personality, Vol. 3, 1969, p. 275-282.

2 T. G. Sadler, R. B. Mefferd, and R. L. Houck, "The Interaction of Extraversion and Neuroticism in Orienting Response Habituation," Psychophysiology, Vol. 8, 1971, p. 314.

Eysenckian introverts and extraverts. Insofar as the Orienting Reaction habituation rate is an index of cortical arousal and physiological sensitivity as suggested by Sokolov,³ one may conclude that introverts and extraverts vary in their OR habituation rate to neutral and affective word stimuli.

From the analysis of the OR habituation rate data, it was also found that, in general, the OR habituation rate to affective word stimulation was longer than that to neutral word stimulation. In particular, affective and neutral word stimulation varied significantly in their influence on the heart rate OR habituation. The second null hypothesis was therefore partially rejected. The direction of these differences, with the affective word stimulation giving longer OR habituation rates than the neutral word stimulation, was consistent with the assumption that affective words tend to raise the level of arousal of the observer more than the neutral words, and that the observer subsequently required a greater number of stimulus trials before habituation took place.

From the analysis of the word recognition data, it would appear that, with the traditional psychophysical

³ E. N. Sokolov, Perception and the Conditioned Reflex, New York, Pergamon, 1963, p. 132.

procedure, the three stimulus conditions varied significantly in their influence on the recognition-duration threshold estimate. The direction of these differences, with the recognition threshold appearing higher for the stimulus condition of neutral word paired with neutral word than for affective word paired with affective word, was inconsistent with the observations of earlier research in perceptual defense. McGinnies,⁴ for example, investigated the perceptual defense phenomenon, and his study showed that recognition thresholds for emotionally toned words were higher than that for neutral words. The results, however, were consistent with some more recent research on the perceptual defense paradigm, using more sophisticated experimental controls. Bryant *et al.*,⁵ for example, used two groups of thirteen college students selected on the basis of combined scores from the 16 PF, and exposed them to a list of eighteen tachistoscopically presented words, seven taboo and eleven neutral. The words were matched for frequency from the Thorndike-Lodge count. Personality variables and the word affective value were not significant; only the "familiarity" dimension was found to be significant.

⁴ E. M. McGinnies, "Emotionality and Perceptual Defense," Psychological Review, Vol. 56, 1949, p. 244-251.

⁵ G. P. Bryant, A. J. Turner, and C. V. Lair, "Word Familiarity as a Factor in Perceptual Defense Research," Perceptual and Motor Skills, Vol. 25, 1967, p. 229-234.

Although differences in experimental conditions make comparisons with previous research findings somewhat hazardous, the results of the constant stimuli analysis seem to disagree with the "perceptual defense" concept that emotional words tend to disrupt perception and increase the recognition threshold of the observer. Rather, the opposite was found in this study. One possible explanation is that, when word frequency and structure were controlled, the affective word stimulation, far from inhibiting or disrupting perceptual organization, increased the observer's recognition sensitivity. Insofar as the recognition duration threshold is an index of recognition sensitivity to word stimuli, one may conclude that neutral and affective stimulus values vary in their influence on recognition sensitivity as determined by a classical psychophysical procedure.

This conclusion, that neutral and affective words vary significantly in their influence on the recognition threshold, was challenged, however, when the method of analysis derived from the signal detection theory was applied. These measures of recognition sensitivity, unlike the estimates of sensitivity from the classical psychophysical procedure, are relatively independent of the nonsensory, personal factors which influence the observer's judgments.

Insofar as the Eysenckian concept of extraversion has been regarded in terms of perceptual arousal, the roles of recognition sensitivity and of nonsensory, personal factors as determinants in the word recognition task are explored further with the evaluation of the hypotheses concerning differences between groups of Introverts, Middle, and Extraverts. In this regard, it will be recalled that, within the framework of the Eysenckian concept of extraversion, differences in perceptual and cognitive performance are associated with recognition sensitivity or sensory capacity⁶ rather than personal, nonsensory factors. From this assumption, differences between Introverts, Middle, and Extraverts would not be expected to emerge in estimates of the contribution of nonsensory, personal factors to recognition judgments which are independent of recognition sensitivity. On the other hand, differences between the three groups would be expected to emerge in estimates of recognition sensitivity which are independent of nonsensory, personal factors contributed by response bias.

From the signal detection analysis, the null hypothesis that there is no significant difference between groups of Introverted, Middle, and Extraverted subjects in their

⁶ H. J. Eysenck, The Biological Basis of Personality, Springfield, Ill., Thomas, 1967, p. 226-262.

recognition sensitivity, a signal detection estimate of sensory capacity independent of nonsensory, personal factors which influence the observer's judgments, was accepted, in view of the insignificant over-all effect due to extraversion. The findings of the present study were therefore inconsistent with previous research^{7,8} which found that introverts had lower sensory thresholds than extraverts.

The null hypothesis that there is no significant difference between the three stimulus conditions in their influence on recognition sensitivity, a signal detection estimate of sensory capacity independent of nonsensory, personal factors which influence the observer's judgments, was accepted, because the over-all effect due to the stimulus condition on recognition sensitivity was found to be statistically nonsignificant.

The null hypothesis that there is no significant difference between groups of Introverted, Middle, and Extraverted subjects in their decision criterion, a signal detection estimate of response bias independent of the observer's sensory capacity, was also accepted, owing to the finding

7 S. L. Smith, "Extraversion and Sensory Threshold," Psychophysiology, Vol. 5, 1968, p. 296-297.

8 D. A. T. Siddle, R. B. Morrish, K. D. White and G. L. Mangan, "Relation of Visual Sensitivity to Extraversion," Journal of Experimental Research in Personality, Vol. 3, 1969, p. 264-267.

that the groups did not differ significantly in their averaged decision criterion.

Finally, the null hypothesis that there is no significant difference between the three stimulus conditions in their influence on the decision criterion was also accepted, on the basis of the finding that the over-all effect due to the stimulus condition on the averaged decision criterion was statistically nonsignificant. The findings of this experiment, therefore, were not consistent with previous research⁹ which found that the influence of caution and response bias or response suppression was significant in a psychophysical detection task.

3. Evaluation of the Problem.

The primary aim of the present research was to re-examine the Eysenckian postulate that introverts, because of their greater degree of cortical excitability, should also have greater arousal and sensitivity. The inquiry focused on the differences in the Orienting Reaction habituation rate and recognition sensitivity between groups of high, middle, and low extraversion.

⁹ E. M. Whittaker, J. C. Gilchrist, and J. W. Fisher, "Perceptual Defense or Response Suppression?" Journal of Abnormal and Social Psychology, Vol. 47, 1952, p. 732-733.

Although the evidence is not clear-cut, the Orienting Reaction habituation rate analyses tend to suggest that the introverts display longer OR habituation rates than the extraverts to both neutral and affective word stimuli.

The question of the relative contribution of the affective value of word stimuli to the differences in the Orienting Reaction habituation rate was also explored by comparing the OR habituation rates to neutral and affective word stimuli. Consistent with the assumption that affective stimuli produced greater arousal in the observer than neutral stimuli, a trend emerged which suggested that the physiological reactivity of the observer to affective words was greater than that to neutral words, so that the observer required more stimulus trials for the OR habituation to take place during affective word stimulation than during neutral word stimulation.

The word recognition experiment employed the method of signal detection to derive independent estimates of recognition sensitivity, which is influenced by sensory capacity, and of decision criterion, which is influenced by nonsensory, personal factors contributed by response bias. In evaluating the results of this experiment, differences between the three groups of Introverted, Middle, and Extraverted subjects in recognition sensitivity and decision

criterion did not emerge as statistically significant. These observations were not consistent with the findings of previous research that supported the Eysenckian postulate that introverts tend to have greater perceptual sensitivity than extraverts.

4. Orienting Reaction and Perceptual Organization.

By employing levels of extraversion as a classification criterion in both the Orienting Reaction experiment and the word recognition experiment, an opportunity was provided to explore the differences in physiological arousal and recognition sensitivity between introverts and extraverts.

First, although the evidence is by no means definitive, a distinct trend emerged which suggested that introverts displayed longer OR habituation rates than extraverts.

The results appear to support Gray's theory¹⁰ that introverts are cortically more aroused for longer periods of time, and display greater physiological reactivity. The results can also be interpreted in the context of Sokolov's neuronal model theory and cognitive style theories. According to the Sokolovian model,¹¹ an OR is elicited when an

10 J. A. Gray, "The Psychophysiological Basis of Introversion-Extraversion," Behavior Research and Therapy, Vol. 8, 1970, p. 249-266.

11 E. N. Sokolov, "Neuronal Models and the Orienting Reflex," in M. A. B. Brazier (ed.), The Central Nervous System and Behavior, New York, Moon, 1960, p. 216.

incoming stimulus fails to match memory traces stored in the cortex, and will be elicited again on further stimulations until habituation takes place when new models of the stimulus are formed in the cortex. Hence, the amount of memory traces stored in the brain, which are of relative congruence with the neutral and affective word stimuli presented to the observer, may determine the length of the OR habituation rate: the greater the number of memory traces, the longer it takes to compare the stimulus with each individual trace and the longer the OR habituation rate. In the context of Klein's model¹² of perceptual organization, the introvert, because of his greater perceptual sensitivity to the social environment, may, in time, develop a greater wealth of associations and physiognomic qualities which may be called into operation during each stimulus presentation. Upon each stimulus presentation, new associations may be aroused and new matching with consolidated models may take place. Hence, it takes the introvert, who is assumed to have more associations, longer to habituate to a given word stimulus than the extravert, who is assumed to have less associations. Again, according to the theory of information processing proposed by Schroder et al.,¹³

12 G. S. Klein, Perception, Motives and Personality, New York, Knopf, 1970, p. 92-98.

13 H. M. Schroder, M. J. Driver, and S. Streufert, Human Information Processing, New York, Holt, 1967, v-224 p.

individuals develop quasi-stable systems of information reflecting their level of perceptual and conceptual complexity. The complex individual tends to generate more rules and alternatives, to search for more information, and to delay final decisions concerning a problem or a stimulus. It appears plausible that the introvert, with his greater perceptual sensitivity and associative elaboration, may be a more "complex" type of individual than the extravert. Hence, the more elaborate information processing of the introvert may be reflected in longer habituation rates of the OR

In conclusion, the results of this study on the differences between introverts and extraverts in their OR habituation rate to word stimuli appear to support Eysenck's theory¹⁴ and Eysenck and Eysenck's findings¹⁵ that the introvert, when compared with the extravert, is characterized by greater cortical arousal and greater physiological responding to sensory stimulation.

A second matter for consideration is the inconsistency of the effect of the extraversion factor on the

¹⁴ Eysenck, op. cit., p. 230-242.

¹⁵ S. B. G. Eysenck and H. J. Eysenck, "Physiological Reactivity to Sensory Stimulation as a Measure of Personality," Psychological Reports, Vol. 20, 1967, p. 45-46.

habituation rates of the three OR components. The extraversion factor was found to be significant in the Vasomotor and Galvanic Skin Response components, but nonsignificant in the Heart Rate component. The results were inconsistent with Sokolov's claim¹⁶ that the OR is a generalized, holistic response, but were consistent with the findings by Raskin et al.¹⁷ and with Duffy's hypothesis¹⁸ of the response specificity of the OR. It is possible that the heart rate Orienting Reaction may be more related to the internal state of "activation," a term used by Eysenck¹⁹ to describe the involvement of the visceral brain such as the hippocampus, the amygdala, and the hypothalamus, due to the affective stimulation; whereas the vasomotor component of the OR may be more related to the state of "arousal" or "attention," a concept also used by Eysenck to describe the cortico-reticular loop similar to that of the Sokolovian model in his theory of Introversion-Extraversion. According to Eysenck, while activation due to aversive stimulation involves

16 Sokolov, Perception and the Conditioned Reflex, p. 132.

17 D. C. Raskin, H. Kotses, and J. Bever, "Cephalic Vasomotor and Heart Rate Measures of Orienting and Defensive Reflexes," Psychophysiology, Vol. 6, 1969, p. 149-159.

18 E. Duffy, "The Psychological Significance of the Concept of 'Arousal' or 'Activation,'" Psychological Review, Vol. 64, 1957, p. 266.

19 Eysenck, op. cit., p. 228-248.

the visceral brain and generates emotional or defensive responses, cortical arousal can be produced by sensory stimulation or problem-solving activity of the brain without the necessary involvement of the visceral brain. It is therefore noteworthy that Raskin et al.²⁰ found that the HR-OR differentiated the Orienting Reaction and the Defensive Reaction, while the VM-OR did not.

The third matter for consideration is the evaluation of the influence of the stimulus affective word on the OR habituation rate. A trend emerged which showed that the OR habituation rates to affective words were longer than that to neutral words. This trend was in the expected direction, in view of the assumption that affective words tend to produce greater arousal in the observer, and in view of the findings by Ross et al.²¹ that physiological reactivity increased with greater attention or arousal. The findings were also consistent with Klein's theory²² that autonomic reactivity is a function of "peripheral motives" and associational value of the stimulus; hence, the greater OR reactivity to affective word stimuli than to neutral word

20 Raskin, Kotses, and Bever, op. cit., p. 149.

21 S. Ross, J. Dardano, and R. C. Hackman, "Conductance Levels During Vigilance Task Performance," Journal of Applied Psychology, Vol. 43, 1959, p. 69.

22 Klein, op. cit.

stimuli may be attributed to greater peripheral motives and associations produced in the observer by the affective stimuli than by the neutral stimuli.

Finally, an attempt was made to evaluate Gray's²³ and Eysenck's²⁴ hypotheses that the introvert is characterized by greater perceptual sensitivity and greater efficiency in processing sensory data than the extravert. If the Orienting Reaction is a mechanism which facilitates perceptual sensitivity, one would expect that introverts who have longer OR habituation rates would also have greater recognition sensitivity which, in this investigation, is a signal detection estimate of sensory capacity independent of non-sensory, personal factors such as set, attitudes, or motives. However, no significant differences were found between introverts and extraverts in their recognition sensitivity to neutral and affective word stimuli. The results, therefore, failed to support Gray's and Eysenck's hypotheses. The link between physiological reactivity and perceptual performance reported elsewhere²⁵ was also not verified in

23 J. A. Gray, "Strength of the Nervous System, Introversion-Extraversion, Conditionability and Arousal," Behavior Research and Therapy, Vol. 5, 1967, p. 151-169.

24 Eysenck, op. cit., p. 226-262.

25 M. G. H. Coles and A. Gale, "Physiological Reactivity as a Predictor of Performance in a Vigilance Task," Psychophysiology, Vol. 8, 1971, p. 598.

this study. The lack of agreement between the OR habituation rate data and the recognition sensitivity data possibly suggests that the Orienting Reaction reflects complex cognitive activities, as proposed by Maltzman and Raskin²⁶ and Razran,²⁷ rather than simple sensory capacity.

In the following pages, a concise summary of the results, conclusions, and recommendations for further research are presented.

26 I. Maltzman and D. C. Raskin, "Effects of Individual Differences in the Orienting Reflex on Conditioning and Complex Processes," Journal of Experimental Research in Personality, Vol. 1, 1965, p. 1-16.

27 G. Razran, "The Observable Unconscious and the Inferable Conscious in Current Social Psychophysiology: Interoceptive Conditioning, Semantic Conditioning and the Orienting Reflex," Psychological Review, Vol. 68, 1961, p. 109-119.

SUMMARY AND CONCLUSIONS

The primary aim of the present research was to re-examine the Eysenckian postulate that introverts, because of their greater degree of cortical excitability, should also display greater physiological arousal and perceptual sensitivity. The inquiry focused on the differences in the Orienting Reaction habituation rate and recognition sensitivity between groups of high, middle, and low extraversion. There were two experimental phases in this investigation. The first phase aimed at testing the differences between introverts and extraverts in their habituation rates of the Orienting Reaction to neutral and affective word stimuli. The second phase aimed at testing the differences between introverts and extraverts in their recognition sensitivity and decision criterion of a psychophysical judgment task. A total of six main hypotheses were evaluated.

Although the evidence is not clear-cut, the Orienting Reaction habituation rate analyses tend to suggest that the introverts display longer OR habituation rates than the extraverts to both neutral and affective word stimuli. The effect of extraversion on both the Vasomotor component and the Galvanic Skin Response component of the OR was found to be statistically significant. The inconsistency of the results of the Heart Rate OR component, which showed that

the effect due to extraversion was nonsignificant, was attributed to the response specificity of this component. The over-all results on the Orienting Reaction habituation rate were interpreted in the light of several conceptual models in the current literature. It was suggested that the Orienting Reaction may have practical use as a physiological tool in studies relating personality variables to differential modes of perceptual and cognitive functioning.

In evaluating the effect of word affective value on the habituation rate of the OR, a trend emerged which showed that the OR habituation rate to affective word stimulation was longer than that to neutral word stimulation. The results suggested that the affective word stimuli had a greater arousal effect on the observer, who subsequently required more stimulus trials for the OR habituation to take place.

The analysis of the word recognition experiment employed the method of signal detection to derive independent estimates of recognition sensitivity (d'), which is influenced by the sensory capacity of the observer, and decision criterion (β), which is influenced by the nonsensory, personal factors contributed by response bias. The results showed that the differences between the three groups of Introverted, Middle, and Extraverted subjects in recognition sensitivity and decision criterion did not emerge as

statistically significant. These observations were not consistent with the findings of previous research that supported the Eysenckian postulate that introverts tend to have greater perceptual sensitivity than extraverts. The results were interpreted in terms of relevant theories and previous research findings.

Several suggestions for future research emerge from this study. First, it remains the task of future research to devise sound methodological designs to relate personality variables with perceptual-cognitive style and physiological OR reactivity. If possible, simultaneous recordings of physiological and perceptual data should be made. Second, the measurement and scoring of the OR habituation rates have yet to be refined before conclusive statements can be made. A minimum criterion for inter-rater reliability should be set, below which the data should only be interpreted as preliminary. Third, correlational rather than factorial studies may be conducted to establish functional relationships between personality and perception. Fourth, if varying levels of stimulus complexity through different sensory modalities and several physiological behavioral response parameters are used in a multivariate design, and the results factor analyzed, it may be possible to identify common personality-perceptual factors and establish relevant principles of this relationship.

Replications of the findings of this experiment are also necessary before they can be generalized with confidence.

SELECTED BIBLIOGRAPHY

Bruner, J. S., "Personality Dynamics and the Process of Perceiving," in R. R. Blake and G. V. Ramsey (eds.), Perception: An Approach to Personality, New York, Ronald, 1951, p. 121-147.

This early article contains an outline of the Hypothesis Theory with the intention of bridging the gap between clinical observations of personality and experimental investigations in perception.

Byrne, D., "Repression-Sensitization as a Dimension of Personality," in B. A. Maher (ed.), Progress in Experimental Personality Research, Vol. 1, 1964, p. 169-220.

This publication summarizes the construction and validation of the Repression-Sensitization Scale, a questionnaire developed from selected items of the MMPI. The author provides evidence linking repression-sensitization to the Eysenckian personality dimension of Introversion-Extraversion and the phenomenon of perceptual defense.

Egeren, L. V., "Repression and Sensitization: Sensitivity and Recognition Criteria," Journal of Experimental Research on Personality, Vol. 3, 1968, p. 1-8.

In this study, the decision theory of signal detection is applied to the recognition behavior of neutral and affective words. The importance of the observer's recognition criterion in a perceptual defense research design is stressed. The method used has also contributed to the development of the actual psychophysical experimental procedures of the present investigation.

Eysenck, H. J., The Biological Basis of Personality, Springfield, Thomas, 1967, p. 148-153; p. 226-262.

The relevant sections of this publication present a critical review of the relationship between Extraversion and perceptual defense. It also discusses a neurophysiological model for extraversion based on empirical evidence, and the conceptual similarities between this model and the Sokolovian model of the Orienting Reaction.

Gray, J. A., "Strength of the Nervous System, Introversion-Extraversion, Conditionability and Arousal," Behavior Research and Therapy, Vol. 5, 1967, p. 151-169.

This article reviews extensively and concisely the experimental findings on arousal and perceptual sensitivity which appear to support the author's claim that the Russian

typology of Strong and Weak Nervous System is conceptually similar to the Eysenckian personality dimension of Extraversion.

Kempler, B. and M. Wiener, "Personality and Perception in the Recognition Threshold Paradigm," Psychological Review, Vol. 70, 1963, p. 349-356.

This publication reviews the experimental findings both supporting and refuting the personality-perception relationship in the recognition threshold paradigm. The authors suggest more experimental controls in research methodologies to investigate the phenomenon of perceptual defense.

Klein, G., Perception, Motives, and Personality, New York, Knopf, 1970, 464 p.

In this publication, the author proposes a theoretical model that links cognitive attitudes and preperceptual motives, stimulus properties and psychophysical perceptual responses. This comprehensive model describes a complex relationship hypothesized to exist between the cognitive aspect of personality organization, the associational value of the stimulus, autonomic reactions and verbal report of the observer during a psychophysical judgment task.

Lynn, R., Attention, Arousal and the Orienting Reaction, Oxford, Pergamon, 1966, viii-118 p.

This publication provides an extensive review of empirical findings related to the measurement, elicitation and habituation of the Orienting Reaction. It also outlines various theoretical models advanced to explain the nature and properties of the Orienting Reaction, including Sokolov's two-stage neuronal model.

Maltzman, I. and D. C. Raskin, "Effects of Individual Differences in the Orienting Reflex on Conditioning and Complex Processes," Journal of Experimental Research in Personality, Vol. 1, 1965, p. 1-16.

This study shows that the elicitation of the Orienting Reaction is related to individual differences in attention and perceptual discrimination. The authors interpret the results as supporting the Sokolovian theory that the Orienting Reaction facilitates perceptual sensitivity.

Razran, G., "The Observable Unconscious and the Inferable Conscious in Current Social Psychophysiology: Interoceptive Conditioning, Semantic Conditioning and the Orienting Reflex," Psychological Review, Vol. 68, 1961, p. 109-119.

Upon reviewing critically numerous Russian studies on the Orienting Reaction, the author proposes a hypothesis that the Orienting Reaction reactivity is closely related to the manifestation and speed of conditioning, and suggests a possible link between the Orienting Reaction and cognition or recognition of external stimuli.

Siddle, D. A. T., R. B. Morrish, K. D. White and G. L. Mangan, "Relation of Visual Sensitivity to Extraversion," Journal of Experimental Research in Personality, Vol. 3, 1969, p. 264-267.

This study confirms earlier studies that perceptual sensitivity, used as a behavioral measure of central arousal, decreases with increase in the Eysenckian Extraversion dimension. The authors interpret the results as supporting Eysenck's excitation-inhibition theory of this personality dimension.

Sokolov, E. N., "Neuronal Models and the Orienting Reflex," in M. A. B. Brazier (ed.), The Central Nervous System and Behavior, New York, Moon, 1960, p. 187-276.

This important publication provides a detailed description of the author's two-stage neuronal model to explain the elicitation and habituation of the Orienting Reaction to novel stimulation.

-----, Perception and the Conditioned Reflex, New York, Macmillan, 1963, v-309 p.

This book is the basic reference used by many investigators of the Orienting Reaction, and from it many research hypotheses have been generated. The author expounds his neuronal model of the Orienting Reaction, and explains in detail the properties and functions of the Orienting Reaction as a distinct phenomenon to be separated from other reflexes such as the adaptive and defensive reactions.

Stelmack, R. M., A Signal Detection and Information Theory Analysis of the Effect of Hue on Apparent Size for Groups of High and Low Analytic Ability, unpublished doctoral thesis presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1970, vii-123 p.

This recent study is important to the present investigation in guiding the development of the problem

concerning personality-perception relationship and the construction of the experimental design.

Swets, J. A., W. P. Tanner, Jr., and T. G. Birdsall, "Decision Processes in Perception," Psychological Review, Vol. 68, 1961, p. 301-340.

In this review, the authors outline the methodological problems in the investigations of the phenomenon of perceptual defense, criticize the traditional method for the evaluation of sensory thresholds, define the decision theory of Signal Detection, and argue for its usefulness as a method of analysis of psychophysical judgment data. Based on several assumptions, the Theory of Signal Detection makes possible the derivation of separate and relatively independent estimates of sensory capacity and nonsensory factors.

APPENDIX 1

EYSENCK PERSONALITY INVENTORY
FORM A

EYSENCK PERSONALITY INVENTORY

FORM A

By **H. J. Eysenck**
and **Sybil B. G. Eysenck**

Name _____ Age _____ Sex _____

Grade or Occupation _____ Date _____

School or Firm _____ Marital Status _____

INSTRUCTIONS

Here are some questions regarding the way you behave, feel and act. After each question is a space for answering "Yes," or "No."

Try and decide whether "Yes," or "No" represents your usual way of acting or feeling. Then blacken in the space under the column headed "Yes" or "No."

Work quickly, and don't spend too much time over any question; we want your first reaction, not a long drawn-out thought process. The whole questionnaire shouldn't take more than a few minutes. Be sure not to omit any questions. Now turn the page over and go ahead. Work quickly, and remember to answer every question. There are no right or wrong answers, and this isn't a test of intelligence or ability, but simply a measure of the way you behave.

Section of Answer Column Correctly Marked	
Yes	No
<input checked="" type="checkbox"/>	<input type="checkbox"/>
Yes	No
<input type="checkbox"/>	<input checked="" type="checkbox"/>

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- | | | | | |
|---|-----|----|--|--------|
| 1. Do you often long for excitement? | Yes | No | | |
| 2. Do you often need understanding friends to cheer you up? | Yes | No | | |
| 3. Are you usually carefree? | Yes | No | | |
| 4. Do you find it very hard to take no for an answer? . . . | Yes | No | | |
| 5. Do you stop and think things over before doing anything? | Yes | No | | |
| 6. If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so? | Yes | No | | |
| 7. Does your mood often go up and down? | Yes | No | | |
| 8. Do you generally do and say things quickly without stopping to think? | Yes | No | | |
| 9. Do you ever feel "just miserable" for no good reason? | Yes | No | | |
| 10. Would you do almost anything for a dare? | Yes | No | | |
| 11. Do you suddenly feel shy when you want to talk to an attractive stranger? | Yes | No | | |
| 12. Once in a while do you lose your temper and get angry? | Yes | No | | |
| 13. Do you often do things on the spur of the moment? . . . | Yes | No | | |
| 14. Do you often worry about things you should not have done or said? | Yes | No | | |
| Generally do you prefer reading to meeting people? . . . | Yes | No | | |
| 16. Are your feelings rather easily hurt? | Yes | No | | |
| 17. Do you like going out a lot? | Yes | No | | |
| 18. Do you occasionally have thoughts and ideas that you would not like other people to know about? | Yes | No | | |
| 19. Are you sometimes bubbling over with energy and sometimes very sluggish? | Yes | No | | |
| 20. Do you prefer to have few but special friends? | Yes | No | | |
| 21. Do you daydream a lot? | Yes | No | | |
| 22. When people shout at you, do you shout back? | Yes | No | | |
| 23. Are you often troubled about feelings of guilt? | Yes | No | | |
| 24. Are all your habits good and desirable ones? | Yes | No | | |
| 25. Can you usually let yourself go and enjoy yourself a lot at a gay party? | Yes | No | | |
| 26. Would you call yourself tense or "highly-strung"? . . . | Yes | No | | |
| 27. Do other people think of you as being very lively? . . . | Yes | No | | |
| 28. After you have done something important, do you often come away feeling you could have done better? | Yes | No | | |
| 29. Are you mostly quiet when you are with other people? | Yes | No | | |
| 30. Do you sometimes gossip? | Yes | No | | |
| | | | 31. Do ideas run through your head so that you cannot sleep? | Yes No |
| | | | 32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it? | Yes No |
| | | | 33. Do you get palpitations or thumping in your heart? . . . | Yes No |
| | | | 34. Do you like the kind of work that you need to pay close attention to? | Yes No |
| | | | 35. Do you get attacks of shaking or trembling? | Yes No |
| | | | 36. Would you always declare everything at the customs, even if you knew that you could never be found out? . . | Yes No |
| | | | 37. Do you hate being with a crowd who play jokes on one another? | Yes No |
| | | | 38. Are you an irritable person? | Yes No |
| | | | 39. Do you like doing things in which you have to act quickly? | Yes No |
| | | | 40. Do you worry about awful things that might happen? . . | Yes No |
| | | | 41. Are you slow and unhurried in the way you move? . . . | Yes No |
| | | | 42. Have you ever been late for an appointment or work? . . | Yes No |
| | | | 43. Do you have many nightmares? | Yes No |
| | | | 44. Do you like talking to people so much that you would never miss a chance of talking to a stranger? | Yes No |
| | | | 45. Are you troubled by aches and pains? | Yes No |
| | | | 46. Would you be very unhappy if you could not see lots of people most of the time? | Yes No |
| | | | 47. Would you call yourself a nervous person? | Yes No |
| | | | 48. Of all the people you know are there some whom you definitely do not like? | Yes No |
| | | | 49. Would you say you were fairly self-confident? | Yes No |
| | | | 50. Are you easily hurt when people find fault with you or your work? | Yes No |
| | | | 51. Do you find it hard to really enjoy yourself at a lively party? | Yes No |
| | | | 52. Are you troubled with feelings of inferiority? | Yes No |
| | | | 53. Can you easily get some life into a rather dull party? . . | Yes No |
| | | | 54. Do you sometimes talk about things you know nothing about? | Yes No |
| | | | 55. Do you worry about your health? | Yes No |
| | | | 56. Do you like playing pranks on others? | Yes No |
| | | | 57. Do you suffer from sleeplessness? | Yes No |

APPENDIX 2

STIMULUS-RESPONSE FREQUENCY MATRIX

APPENDIX 2

Stimulus-Response Frequency Matrix for One Subject on One
Variable Stimulus Duration Treatment for One
Stimulus Condition.

Response Category	Word 2 Signal	Stimulus Duration(in msec.)					Word 1 Noise
		8	17	33	67	125	
Word 2 Positive	36	-	2	7	13	14	2
		-	-	-	1	1	
Word 2 Fairly Sure	10	1	1	5	2	1	5
		3	2	-	-	-	
Word 2 Guess	12	8	2	2	-	-	12
		7	4	1	-	-	
Word 1 Guess	9	6	2	1	-	-	11
		4	6	1	-	-	
Word 1 Fairly Sure	5	-	5	-	-	-	10
		1	2	5	2	-	
Word 1 Positive	3	-	3	-	-	-	35
		-	1	8	12	14	

Note: Word 2 (Signal+Noise) stimuli and Word 1 (Noise) stimuli were each presented 75 times or 15 times per variable stimulus duration, thus yielding a total number of 150 trials per stimulus condition.

APPENDIX 3

RAW DATA FOR AGE, VISUAL ACUITY, OTIS IQ, EPI,
OR HABITUATION RATES, d' , beta,
AND RECOGNITION DURATION THRESHOLD

APPENDIX 3A

Age, Orthorater Visual Acuity Scores, and Otis Higher Examination (Form A) Intelligence Quotient (I.Q.) Scores for Groups of Introverted, Middle and Extraverted Subjects.

Subject	Age	Visual Acuity	Otis I.Q.
Introverted			
25	19	10	124
19	20	12	122
8	19	12	116
11	19	11	111
16	19	11	111
59	18	12	115
35	20	12	111
44	18	9	120
56	20	12	111
34	19	11	100
Middle			
57	19	12	120
47	19	12	122
27	19	12	107
51	20	11	120
33	18	12	113
2	19	11	121
53	18	9	119
43	17	11	106
42	19	11	124
12	19	11	113
Extraverted			
22	18	11	110
58	19	12	122
54	20	11	102
38	19	11	118
24	20	11	107
30	18	11	111
32	18	10	122
13	19	12	125
28	19	12	107
40	19	10	111

Eysenck Personality Inventory (EPI) Scores on Form A and
Form B for Extraversion (E) and Neuroticism (N) by
Groups of Introverted, Middle and
Extraverted Subjects.

Subject	EPI (Form A)		EPI (Form B)	
	E	N	E	N
Introverted				
25	10	14	15	14
19	10	9	14	14
8	9	10	9	11
11	5	14	9	9
16	11	18	17	17
59	9	18	12	16
35	10	13	15	11
44	8	3	11	8
56	10	14	15	16
34	10	14	12	14
Middle				
57	15	8	19	16
47	15	10	16	10
27	12	16	14	17
51	16	11	17	16
33	15	10	18	11
2	13	10	15	13
53	11	11	7	16
43	13	18	15	17
42	16	7	18	8
12	16	21	15	23
Extraverted				
22	19	11	21	12
58	17	13	18	15
54	18	15	20	17
38	22	8	18	15
24	18	10	18	12
30	18	9	19	15
32	18	3	22	9
13	19	14	19	14
28	17	6	16	14
40	18	11	14	4

Habituation Rates of the Vasomotor Component of the Orienting
Reaction for Groups of Introverted, Middle and
Extraverted Subjects by Two Judges.

Subject	Judge	Neutral				Affective			
		Word 1N		Word 2N		Word 1A		Word 2A	
		1	2	1	2	1	2	1	2
Introverted									
25		3	6	11	5	3	2	4	0
19		4	3	1	0	3	0	3	3
8		14	17	5	12	7	11	1	4
11		3	0	11	6	3	3	3	0
16		4	4	9	9	2	3	3	4
59		10	5	10	0	10	4	0	0
35		0	1	1	2	3	5	5	4
44		0	0	1	0	2	0	2	0
56		6	0	2	2	7	3	9	2
34		6	0	5	0	2	0	5	5
Middle									
57		1	0	1	15	3	12	5	18
47		0	0	0	0	1	7	0	7
27		0	0	2	0	3	0	5	0
51		0	0	0	0	2	0	10	0
33		5	0	2	0	2	2	5	0
2		0	0	6	1	1	0	4	0
53		2	11	1	15	1	5	1	5
43		1	0	0	0	1	0	0	0
42		0	4	2	5	10	15	6	6
12		1	2	1	0	1	4	2	6
Extraverted									
22		3	9	0	10	1	7	0	1
58		4	9	2	0	2	7	1	0
54		2	13	1	10	0	11	1	4
38		1	7	0	12	1	3	0	14
24		0	2	1	1	2	2	2	3
30		5	20	0	5	3	9	0	9
32		1	10	0	2	3	12	4	11
13		0	8	3	4	2	11	0	3
28		2	1	0	0	2	2	1	8
40		2	8	0	0	6	12	0	3

Habituation Rates of the Heart Rate Component of the Orienting
Reaction for Groups of Introverted, Middle
and Extraverted Subjects by Two Judges.

Subject	Judge	Neutral				Affective			
		Word 1N	Word 2N	Word 1A	Word 2A	Word 1N	Word 2N	Word 1A	Word 2A
Introverted									
25		11	14	6	6	2	4	3	3
19		0	0	3	3	3	1	0	0
8		5	3	2	4	9	4	13	11
11		3	5	2	2	0	0	6	6
16		5	5	7	8	4	5	3	3
59		12	9	12	15	15	18	11	13
35		0	0	1	0	2	1	8	5
44		4	3	18	18	7	7	10	10
56		0	0	4	4	10	11	0	0
34		0	0	0	0	2	2	5	5
Middle									
57		0	3	1	1	3	5	4	7
47		3	6	7	10	0	3	3	4
27		2	3	14	20	11	15	12	14
51		0	2	3	3	0	0	6	6
33		0	0	2	2	1	1	2	2
2		0	0	1	1	0	0	0	0
53		3	3	9	13	17	20	13	17
43		3	3	3	3	5	5	4	4
42		4	4	4	6	5	11	7	12
12		5	5	5	5	13	17	10	12
Extraverted									
22		0	1	0	0	3	3	10	13
58		1	2	7	7	1	4	3	4
54		3	3	8	8	10	12	0	0
38		5	5	3	3	0	0	10	10
24		0	0	0	0	3	3	6	9
30		0	0	8	10	2	2	2	2
32		1	3	0	0	3	2	6	7
13		2	2	0	2	0	0	1	2
28		0	0	0	0	2	2	1	5
40		6	10	2	4	1	2	2	5

Habituation Rates of the Galvanic Skin Response (GSR) Component
of the Orienting Reaction for Groups of Introverted,
Middle and Extraverted Subjects by Two Judges.

Subject	Neutral				Affective			
	Word 1N		Word 2N		Word 1A		Word 2A	
	Judge 1	2	1	2	1	2	1	2
Introverted								
25	2	2	2	2	2	2	3	2
19	0	1	12	15	7	9	1	1
8	1	1	6	5	7	6	8	5
11	0	6	4	4	1	1	18	20
16	2	2	4	6	2	2	7	9
59	1	1	2	2	0	0	0	0
35	3	3	3	1	1	1	18	14
44	4	3	20	16	1	1	5	8
56	9	6	11	10	6	2	8	5
34	1	0	13	12	4	1	8	16
Middle								
57	1	1	5	4	3	3	4	5
47	4	4	1	2	3	3	2	2
27	0	0	0	0	10	8	2	4
51	3	3	1	1	5	0	4	4
33	0	0	0	0	0	0	1	1
2	5	6	0	0	2	2	1	1
53	2	2	10	9	10	19	11	14
43	3	5	3	1	0	0	0	0
42	1	1	0	0	11	6	3	2
12	1	1	1	1	5	2	13	16
Extraverted								
22	2	2	0	0	5	4	4	4
58	1	1	5	5	3	3	4	3
54	7	10	1	0	6	8	1	0
38	9	12	0	0	9	18	4	6
24	0	0	3	2	0	0	2	2
30	1	1	0	0	0	0	0	0
32	2	2	0	0	0	0	4	6
13	1	1	0	0	0	0	1	1
28	2	0	0	0	0	0	1	0
40	2	0	0	0	0	0	1	0

Sensitivity (d') Values of Introverted, Middle and
Extraverted Subjects Obtained Under Neutral-
Neutral (N-N), Neutral-Affective (N-A) and
Affective-Affective (A-A) Stimulus
Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	1.666	1.810	1.992
19	3.405	3.208	3.253
8	3.329	2.141	3.564
11	2.506	2.232	3.293
16	2.727	3.240	1.196
59	1.856	2.046	0.942
35	2.402	3.923	2.706
44	1.912	2.281	2.464
56	2.397	3.211	3.114
34	2.739	3.211	3.114
Middle			
57	2.296	2.481	3.331
47	0.756	2.003	2.297
27	1.189	1.635	1.771
51	2.246	2.027	2.145
33	1.935	2.425	2.588
2	2.190	2.826	2.665
53	1.821	1.237	1.956
43	3.327	3.855	3.224
42	2.141	3.459	2.485
12	2.749	2.231	2.168
Extraverted			
22	2.366	1.891	2.499
58	3.491	3.847	4.024
54	2.951	1.510	2.383
38	2.195	2.396	2.154
24	1.662	1.739	2.074
30	0.484	0.998	0.550
32	1.901	2.569	2.539
13	2.628	2.974	2.921
28	1.688	1.519	1.028
40	1.809	2.014	1.798

Decision Criterion (beta) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	0.884	0.882	1.100
19	1.598	1.968	1.824
8	2.122	1.092	1.632
11	1.186	0.990	1.478
16	1.954	1.452	-0.665
59	1.548	1.064	0.750
35	1.066	1.912	1.726
44	0.946	1.190	1.244
56	1.058	1.428	1.236
34	1.678	1.378	1.372
Middle			
57	1.192	1.356	1.410
47	0.324	1.064	1.270
27	0.400	0.850	1.108
51	1.250	1.058	0.706
33	1.142	1.040	1.318
2	1.088	1.336	1.142
53	0.778	0.802	1.106
43	1.884	1.822	1.844
42	1.186	1.656	1.686
12	0.958	0.986	0.758
Extraverted			
22	1.310	0.930	1.652
58	1.624	2.066	1.856
54	1.832	0.600	1.292
38	1.240	1.216	1.196
24	0.946	0.738	1.390
30	0.212	0.270	0.866
32	1.094	1.576	1.482
13	1.530	2.060	1.344
28	0.706	0.750	0.562
40	2.101	2.162	2.340

The First Decision Criterion (beta 1) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	3.19	2.65	2.96
19	2.98	3.20	3.32
8	3.49	3.31	3.49
11	2.75	2.93	3.24
16	3.01	3.45	1.40
59	3.34	2.78	2.34
35	2.33	3.45	3.92
44	2.94	3.35	3.13
56	3.13	2.51	2.46
34	3.13	3.26	3.38
Middle			
57	2.11	2.66	2.62
47	2.71	3.53	2.86
27	1.86	2.85	2.88
51	3.76	2.91	2.67
33	2.76	2.67	2.53
2	3.43	4.06	3.55
53	3.76	3.86	4.23
43	3.02	3.49	3.54
42	2.96	3.60	3.29
12	3.32	3.10	2.82
Extraverted			
22	2.42	2.21	2.70
58	2.98	3.47	3.10
54	3.56	2.58	2.77
38	3.48	3.21	3.00
24	2.45	2.33	2.68
30	2.61	2.38	2.84
32	2.82	3.43	3.23
13	2.76	4.30	3.02
28	2.88	2.63	2.46
40	3.52	3.61	3.80

The Second Decision Criterion (beta 2) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	2.55	2.08	2.70
19	2.36	2.53	2.40
8	3.29	2.85	3.24
11	1.74	2.11	2.53
16	2.67	3.16	1.22
59	2.78	1.89	1.90
35	1.69	3.05	2.13
44	2.36	2.43	2.35
56	2.49	2.38	2.11
34	2.73	2.50	2.35
Middle			
57	1.95	2.54	1.98
47	1.81	2.43	2.09
27	1.27	1.64	2.09
51	2.94	1.96	1.84
33	1.93	1.92	2.31
2	2.12	2.46	2.50
53	2.59	2.95	3.29
43	2.72	2.58	2.76
42	2.14	3.49	2.97
12	1.89	1.82	1.76
Extraverted			
22	2.08	1.59	2.26
58	2.82	3.01	2.50
54	2.85	1.67	2.19
38	2.99	2.27	2.59
24	2.10	1.64	2.53
30	2.01	1.97	2.50
32	2.42	2.90	2.96
13	2.23	3.19	2.06
28	2.20	2.01	1.62
40	3.00	3.04	3.12

The Third Decision Criterion (beta 3) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	1.06	0.75	1.29
19	1.48	1.98	1.93
8	2.06	0.94	1.57
11	0.95	0.94	1.47
16	2.13	1.34	-0.12
59	1.89	0.78	0.75
35	1.28	2.29	1.31
44	1.06	1.01	1.11
56	1.29	1.41	1.16
34	1.75	1.15	1.10
Middle			
57	1.36	1.10	1.53
47	0.44	0.42	1.12
27	0.28	0.74	1.32
51	1.04	1.02	0.60
33	0.97	0.92	1.07
2	1.28	1.62	1.52
53	0.92	0.99	1.03
43	1.88	1.69	1.81
42	1.16	1.83	1.75
12	0.69	0.81	0.71
Extraverted			
22	1.38	0.93	1.63
58	1.84	1.97	1.75
54	1.75	0.42	1.39
38	1.68	1.37	1.13
24	0.99	0.85	1.51
30	0.16	0.26	1.07
32	1.28	1.33	1.29
13	1.39	1.98	1.30
28	0.94	0.73	0.58
40	2.30	2.70	2.98

The Fourth Decision Criterion (beta 4) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	-0.72	-0.23	-0.54
19	0.77	0.90	0.98
8	0.68	-0.44	0.28
11	0.42	0.00	0.46
16	0.81	-0.01	(-2.64) ^a
59	0.18	-0.04	-0.21
35	0.38	1.10	1.02
44	-0.09	0.00	0.24
56	-0.30	0.46	0.36
34	0.61	0.23	0.47
Middle			
57	0.47	0.39	1.07
47	-1.38	-0.36	0.17
27	-0.27	0.11	0.14
51	-0.05	0.37	-0.10
33	0.43	0.14	0.27
2	-0.15	0.08	0.01
53	-1.23	-1.40	-1.27
43	1.08	0.66	0.64
42	0.21	-0.09	0.42
12	-0.03	0.29	-0.02
Extraverted			
22	0.49	0.22	1.01
58	0.50	1.19	1.07
54	0.68	-0.49	0.56
38	-0.64	0.07	-0.54
24	0.14	-0.31	0.45
30	-1.48	-1.28	-0.61
32	-0.32	0.17	0.02
13	0.89	0.79	0.47
28	-0.76	-0.57	-0.61
40	1.48	1.40	1.65

^a This value is interpolated between the third and the fifth decision criteria adopted by the same subject because this category has been collapsed by the computer.

The Fifth Decision Criterion (beta 5) Values of Introverted, Middle and Extraverted Subjects Obtained Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	-1.08	-0.84	-1.10
19	0.42	0.58	0.59
8	-0.01	-0.85	-0.18
11	-0.37	-0.84	-0.17
16	0.35	-0.36	-5.16
59	-0.68	-0.79	-1.42
35	-0.01	0.63	0.25
44	-1.27	-1.08	-0.63
56	-0.71	0.16	-0.39
34	-0.46	-0.42	-0.11
Middle			
57	-0.23	0.31	0.16
47	-1.88	-1.06	-0.44
27	-1.11	-0.99	-0.80
51	-1.28	-0.57	-1.09
33	-0.33	-0.18	0.06
2	-1.45	-1.02	-1.47
53	-2.60	-2.39	-1.91
43	0.40	0.25	-0.15
42	-0.67	-0.51	-0.50
12	-1.08	-1.09	-1.48
Extraverted			
22	0.01	-0.23	0.24
58	-0.11	0.91	0.46
54	-0.17	-1.18	-0.53
38	-1.22	-0.55	-1.00
24	-0.86	-0.75	-0.47
30	-2.31	-2.13	-1.30
32	-0.83	-0.42	-0.34
13	0.02	0.04	-0.03
28	-1.59	-1.37	-1.37
40	0.20	0.06	0.15

Recognition Threshold Estimates in milliseconds of Introverted, Middle and Extraverted Subjects Under Neutral-Neutral (N-N), Neutral-Affective (N-A) and Affective-Affective (A-A) Stimulus Treatment.

Subject	N-N	N-A	A-A
Introverted			
25	12	9	10
19	2	8	8
8	4	12	3
11	9	10	5
16	4	4	6
59	8	6	15
35	10	4	7
44	13	10	8
56	10	6	11
34	8	5	6
Middle			
57	9	6	4
47	23	12	10
27	16	12	10
51	16	14	15
33	10	7	7
2	10	8	9
53	13	14	10
43	5	3	6
42	10	6	6
12	7	9	10
Extraverted			
22	9	10	9
58	7	3	1
54	6	12	7
38	9	10	10
24	14	12	9
30	22	16	20
32	15	12	10
13	10	8	8
28	12	12	11
40	11	10	13

APPENDIX 4

F MAX TEST FOR HOMOGENEITY OF VARIANCE
APPLIED TO EXPERIMENTAL DATA

APPENDIX 4A

F max Test for Homogeneity of Variance Applied to the Pooled
 Between (Subject within Groups) and Within (B X Subject
 within Groups) and (C:B X Subject within Groups)
 Error Terms in the Three Factor with Nested
 Factor C Repeated Measures Design for the
 Analysis of Orienting Reaction
 Habituation.

Measure	Between Error		Within Errors			
	Subj.w.G.		B Subj.w.G.		C:B Subj.w.G.	
	F	p	F	p	F	p
Vasomotor	12.019	<.01	5.496	<.01	5.094	<.01
Heart Rate	6.664	<.05	1.612	n.s.	3.195	<.01
GSR	2.002	n.s.	8.069	<.01	2.323	<.01

Note:

$$F \max_{.95}(3,9) = 5.34$$

$$F \max_{.95}(3,18) = 3.00$$

$$F \max_{.95}(3,54) = 1.90$$

$$F \max_{.99}(3,9) = 8.50$$

$$F \max_{.99}(3,18) = 3.90$$

$$F \max_{.99}(3,54) = 2.30$$

F max Test for Homogeneity of Variance Applied to the Pooled Between (Subjects within Groups) and Within (B X Subjects within Groups) Error Terms of the Recognition Judgment Data.

Measure	Between Error		Within Error	
	F	p	F	p
d'	2.196	n.s.	2.766	n.s.
Averaged beta	3.094	n.s.	5.236	<.01
beta 1	2.420	n.s.	2.099	n.s.
beta 2	2.397	n.s.	1.634	n.s.
beta 3	5.099	n.s.	4.267	<.01
beta 4	2.567	n.s.	4.190	<.01
beta 5	1.265	n.s.	10.692	<.01
Threshold	3.954	n.s.	2.370	n.s.

Note:

$$F_{\max, .95}(3,9) = 5.34$$

$$F_{\max, .95}(3,18) = 3.0$$

$$F_{\max, .99}(3,9) = 8.50$$

$$F_{\max, .99}(3,18) = 3.9$$

APPENDIX 5

TEST-RETEST RELIABILITY OF EPI, ESTIMATES
OF RATING RELIABILITY OF OR HABITUATION
RATES, AND ESTIMATES OF RELIABILITY
FROM REPEATED MEASURES EXPERIMENT

APPENDIX 5A

Test-Retest Reliability of Eysenck Personality Inventory
(Form A and Form B) for the Over-all Sample of
Introverted, Middle and Extraverted
Subjects (N=30).

Test	<u>Mean</u> Occasion One	<u>Mean</u> Occasion Two	<u>Reliability</u> Pearson r
<u>EPI:-</u>			
a) Extraversion Dimension	13.933	15.600	0.7780
b) Neuroticism Dimension	11.633	13.467	0.6140

Note: The two testing sessions were approximately three weeks apart. Subjects were tested with EPI (Form A) on the first occasion and EPI (Form B) on the second occasion.

Estimates of Rating Reliability of Orienting Reaction
Habituation Rates for the Vasomotor, Heart Rate and
Galvanic Skin Response Components.

Reliability	Vasomotor	Heart Rate	Galvanic Skin Response
\bar{r}_{11} for one rater	.1731	.9308	.8688
r_{22} for two raters combined	.2951	.9642	.9298

Estimates of Reliability from Repeated Measures Obtained
Under Four Stimulus Conditions for the Vasomotor, Heart
Rate and Galvanic Skin Response Components of the
Orienting Reaction.

	Vasomotor	Heart Rate	Galvanic Skin Response
\bar{r}_1 for one measurement	.2380	.3874	.1081
r_4 for four measurements	.5497	.7167	.3265

Note: The four stimuli used were "cinch,"
"bitch," "where" and "whore."

Estimates of Reliability from Repeated Measures Obtained
Under Three Stimulus Conditions for Sensitivity (d'),
Averaged Decision Criterion (β), and Threshold
Estimates.

	d'	β	Threshold
\bar{r} for one measurement	.6274	.4091	.5516
r_3 for three measurements	.8347	.6750	.7869

Note: The three stimulus conditions were
Neutral-Neutral, Neutral-Affective and Affective-
Affective.

APPENDIX 6

CROSSED FACTOR ANALYSIS OF VARIANCE APPLIED
TO OR HABITUATION RATE DATA

APPENDIX 6A

Analysis of Variance of Vasomotor Orienting Reaction
Habituation Rate Scores to Neutral and Affective
Words Matched for Stimulus Structural Similarity
Obtained from a Sample of Introverted, Middle
and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio
Between subjects	434.242	29	14.974	
A (Extraversion)	212.917	2	106.458	12.99 ^a
Subjects within groups	221.325	27	8.197	
Within subjects	606.750	90	6.742	
B (Affectiveness)	1.408	1	1.408	0.19
AB	56.117	2	28.058	3.76 ^b
B X Subjects within groups	201.725	27	7.471	
C (Word Structure)	0.675	1	0.675	0.09
AC	24.350	2	12.180	1.69
C X Subjects within groups	194.225	27	7.194	
BC	0.208	1	0.208	0.05
ABC	5.617	2	2.808	0.62
BC X Subjects within groups	122.425	27	4.534	

a $p < .001$; $F_{.999}(2,27) = 9.02$

b $p < .05$; $F_{.95}(2,27) = 3.35$

Note: This crossed factor design with the introduction of the stimulus structure factor is an alternative method of analysis of variance to the nested factor design given in Table III.

Analysis of Variance of Heart Rate Orienting Reaction
Habituation Rate Scores to Neutral and Affective
Words Matched for Stimulus Structural Similarity
Obtained from a Sample of Introverted, Middle
and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio
Between subjects	1152.542	29	39.743	
A (Extraversion)	125.617	2	62.808	1.651
Subjects within groups	1026.925	27	38.034	
Within subjects	1013.250	90	11.258	
B (Affectiveness)	60.208	1	60.208	4.832 ^a
AB	13.117	2	6.558	0.526
B X Subjects within groups	336.425	27	12.460	
C (Word Structure)	54.675	1	54.675	7.090 ^a
AC	2.85	2	1.425	0.185
C X Subjects within groups	208.225	27	7.712	
BC	6.075	1	6.075	0.528
ABC	10.550	2	5.275	0.443
BC X Subjects within groups	321.125	27	11.894	

a $p < .05$; $F_{.95}(1,27) = 4.23$

Note: This crossed factor design with the introduction of the stimulus structure factor is an alternative method of analysis of variance to the nested factor design given in Table VI.

Analysis of Variance of Galvanic Skin Response Orienting
Reaction Habituation Rate Scores to Neutral and
Affective Words Matched for Stimulus Similarity
Obtained from a Sample of Introverted, Middle
and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio
Between subjects	651.70	29	22.472	
A (Extraversion)	181.55	2	90.775	5.213 ^a
Subjects within groups	470.15	27	17.413	
Within subjects	1362.00	90	15.133	
B (Affectiveness)	45.63	1	45.633	3.433
AB	23.52	2	11.758	0.885
B X Subjects within groups	358.85	27	13.291	
C (Word Structure)	36.30	1	36.300	3.026
AC	226.85	2	113.425	9.456 ^b
C X Subjects within groups	323.85	27	11.994	
BC	0.83	1	0.833	0.066
ABC	5.02	2	2.508	0.199
BC X Subjects within groups	341.15	27	12.635	

a $p < .05$ $F_{.95}(2,27) = 3.35$

b $p < .01$ $F_{.99}(2,27) = 5.50$

Note: This crossed factor design with the introduction of the stimulus structure factor is an alternative method of analysis of variance to the nested factor design given in Table VIII.

APPENDIX 7

ANALYSIS OF VARIANCE APPLIED TO
FIVE BETA VALUES

APPENDIX 7A

Analysis of Variance of beta One Scores Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted
Subjects.

Source of Variation	SS	df	MS	F	p
Between subjects	12.892	29	0.445		
A (Extraversion)	0.297	2	0.148	0.318	n.s.
Subjects within groups	12.595	27	0.466		
Within subjects	10.438	60	0.174		
B (Stimulus Conditions)	0.352	2	0.176	0.964	n.s.
AB	0.217	4	0.542	0.297	n.s.
B X Subjects within groups	9.869	54	0.183		

Analysis of Variance of beta Two Scores Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted
Subjects.

Source of Variation	SS	df	MS	F	p
Between subjects	11.224	29			
A (Extraversion)	0.306	2	0.153	0.378	n.s.
Subjects within groups	10.195	27	0.404		
Within subjects	10.195	60	0.170		
B (Stimulus Conditions)	0.036	2	0.018	0.104	n.s.
AB	0.678	4	0.169	0.965	n.s.
B X Subjects within groups	9.481	54	0.176		

Analysis of Variance of beta Three Scores Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted
Subjects.

Source of Variation	SS	df	MS	F	p
Between subjects	16.586	29	0.572		
A (Extraversion)	0.955	2	0.478	0.825	n.s.
Subjects within groups	15.631	27	0.579		
Within subjects	9.661	60	0.161		
B (Stimulus Conditions)	0.128	2	0.064	0.405	n.s.
AB	0.991	4	0.248	1.566	n.s.
B X Subjects within groups	8.542	54	0.158		

Analysis of Variance of beta Four Scores Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted
Subjects.

Source of Variation	SS	df	MS	F	p
Between subjects	32.843	29	1.133		
A (Extraversion)	0.513	2	0.257	0.214	n.s.
Subjects within groups	32.330	27	1.197		
Within subjects	13.141	60			
B (Stimulus Conditions)	0.107	2	0.054	0.237	n.s.
AB	0.807	4	0.202	0.891	n.s.
B X Subjects within groups	12.227	54	0.226		

Analysis of Variance of beta Five Scores Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted
Subjects.

Source of Variation	SS	df	MS	F	p
Between subjects	43.314	29	1.494		
A (Extraversion)	1.726	2	0.863	0.560	n.s.
Subjects within groups	41.589	27	1.540		
Within subjects	24.356	60	0.406		
B (Stimulus Conditions)	0.338	2	0.169	0.412	n.s.
AB	1.900	4	0.475	1.160	n.s.
B X Subjects within groups	22.119	54	0.410		

APPENDIX 8

ANALYSIS OF VARIANCE APPLIED
TO RECOGNITION-DURATION
THRESHOLD

APPENDIX 8A

Mean Recognition-Duration Threshold Estimates Obtained Under
Neutral-Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions for Groups of
Introverted, Middle and Extraverted Subjects.

Group	N	N-N	N-A	A-A	Average
Introverted	10	8.0	7.4	7.9	7.77
Middle	10	11.9	9.1	8.7	9.90
Extraverted	10	11.5	10.5	9.8	10.60
Average	30	10.47	9.0	8.8	9.42

Analysis of Variance of Recognition-Duration Threshold
Estimates for Groups of Introverted, Middle and
Extraverted Subjects Obtained Under Neutral-
Neutral, Neutral-Affective and Affective-
Affective Stimulus Conditions.

Source of Variation	SS	df	MS	F	p
Between subjects	1017.289	29	35.079		
A (Extraversion)	130.689	2	65.344	1.990	n.s.
Subjects within groups	886.600	27	32.837		
Within subjects	448.667	60	7.477		
B (Stimulus Condition)	49.689	2	24.844	3.614	.05
AB	27.778	4	6.944	1.010	n.s.
B X Subjects within groups	371.200	54	6.874		

Note: Threshold estimates for the sample are presented in Appendix 3M.

Tukey's Test for Significance of Differences Between
Pairs of Stimulus Treatment Means of Recognition-
Duration Threshold Estimates for Stimulus
Condition Main Effect.

Comparison of Means	Absolute Contrast ^a	q statistic ^b	p ^c
N-N - N-A	1.47	3.09	n.s.
N-N - A-A	1.67	3.49	<.05
N-A - A-A	0.20	0.44	n.s.

^a Means for N-N, N-A and A-A stimulus conditions in Recognition-Duration Threshold estimate = 10.47, 9.00 and 8.8, respectively.

^b q statistic = HSD or Contrast/ 0.478

^c $q_{.05,54} = 3.40$

APPENDIX 9

ABSTRACT OF

Introversion-Extraversion and the Role of the
Orienting Reaction Habituation Rate and
Recognition Sensitivity to Neutral
and Affective Words

APPENDIX 9

ABSTRACT OF

Introversion-Extraversion and the Role of the
Orienting Reaction Habituation Rate and
Recognition Sensitivity to Neutral
and Affective Words¹

This thesis was designed to assess the relationships between the Eysenckian personality dimension of Introversion-Extraversion, the differential physiological reactivities to neutral and affective word stimuli as indicated by the Orienting Reaction Habituation Rate, and recognition judgment behavior as reflected by two independent estimates of recognition sensitivity and recognition decision criterion derived from Signal Detection analysis.

The experiment consisted in selecting three groups of ten female subjects in each group on the basis of their scores on the Extraversion dimension of the Eysenck Personality Inventory, Form A, designated as Introverted, Middle, and Extraverted subjects. In the first experimental testing session, each subject was tachistoscopically presented with two neutral and two affective word stimuli (in a predetermined counterbalanced order and equated for word frequency

¹ Joseph Chien, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ontario, April 1973, xi-176 p.

of occurrence, stimulus structure and context, brightness and duration), which served to elicit the Orienting Reaction. From the physiological recordings, the habituation rates of three Orienting Reaction components were obtained: Vaso-motor OR, Heart Rate OR, and Galvanic Skin Response OR. In the second experimental testing session, each subject was required to make recognition judgments of word stimuli tachistoscopically presented at variable duration times. Three stimulus conditions were employed: neutral word paired with neutral word, neutral word paired with affective word, and affective word paired with affective word, each pair of words being equated for frequency of occurrence and stimulus structure. The data were analyzed by the decision theory of Signal Detection to obtain two independent measures of perceptual sensitivity and recognition decision criterion.

The results of the Orienting Reaction data indicated that introverts tend to have longer Orienting Reaction habituation rates to both neutral and affective word stimuli than extraverts, except for the Heart Rate OR component. There also appeared to be a tendency for longer Orienting Reaction habituation rates to affective word stimuli than to neutral word stimuli. The results of the recognition judgment experiment did not demonstrate that Introversion-Extraversion and the stimulus condition have significant effects on recognition judgment behavior. No significant

differences were found between the three groups of subjects, Introverted, Middle, and Extraverted, and between the three stimulus conditions in either recognition sensitivity estimate or recognition decision criterion estimate, two independent indices provided by the method of Signal Detection.

The results were discussed in terms of related theoretical models in the literature.