INTROVERSION-EXTRAVERSION AND THE ROLE OF THE ORIENTING REACTION HABITUATION RATE IN SENSITIVITY TO THE APPARENT SIZE OF HUE

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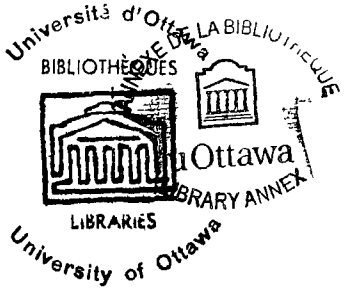
Thesis presented to the School of Graduate Studies of the University of Ottawa as partial fulfillment of the requirements for the degree of Doctor of Philosophy



Ottawa, Canada, 1972

ACKNOWLEDGMENTS

This thesis was prepared under the joint supervision of Dr. Robert Stelmack, Assistant Professor at the Faculty of Psychology of the University of Ottawa, and Dr. William Barry, Chairman of the Department of General-Experimental Psychology at the Faculty of Psychology of the University of Ottawa. The writer gratefully acknowledges their counsel and involvement in this research project.

The writer also wishes to thank Mr. Joseph Chien, M.A., for his continued interest in this study, and Mrs. M. Sadler and Mrs. I. Lawrence for enlisting the support of the student nurses of the Ottawa Civic Hospital who served as subjects. Grateful appreciation is also expressed to Mr. Kenneth Campbell for his participation in the testing of subjects, to Mr. Nathan Mandelzys for his assistance in the compilation of the data and scoring of the physiological tracings, and to Mr. Ernest Desjardins for his scoring of the plethysmographic records.

Thanks are also extended to Mr. Edwin Achorn and Mr. Robert Spratt for their technical advice and assistance.

Finally, the writer expresses his sincere appreciation to the National Research Council of Canada for the financial support granted to this study.

CURRICULUM STUDIORUM

Robert-Paul Bourgeois was born March 15, 1946, in Cornwall, Ontario. He received the Bachelor of Arts degree from the University of Ottawa in 1967. He obtained the Master of Arts degree in Psychology from the University of Ottawa in 1970. The title of his thesis was The Effects of Early Differential Environments on Photic Evolved Potentials, Arousal and Behaviour of the Mongolian Gerbil.

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INTRODUCTION

In the past few years, major theoretical and methodological advances toward a better understanding of perceptual behaviour have taken place in the Soviet Union. The concept of the Orienting Reaction represents a contribution of major consequence for an integrated approach to the analysis of the conditions of stimulus reception and learning.

Moreover, in the context of Klein's model of personality, since perceptual functioning and cognitive style represent stable dispositions of personality organization, the present study attempts to link personality variables to differential perceptual, conceptual and physiological modes of operation using chromatic stimuli. More specifically, an effort is made to reconcile the Eysenckian personality dimension of extraversion with Russian theory and research on the Orienting Reaction habituation rate, with Witkin's theory of psychological differentiation and with perceptual sensitivity as reflected in sensory ability on a size judgment task and in nonsensory, personal factors influencing sensory accuracy, using a signal detection method of analysis.

The rapprochement between physiological and personality variables is particularly suggested in view of the close resemblance between Eysenck's neurophysiological model for extraversion and Sokolov's neuronal model for the elicitation and habituation of the Orienting Reaction. The link between

extraversion and psychological differentiation has been provided by Eysenck, whereas the relationship between personality variables and perceptual performance has been proposed by both Russian and Western theorists and supported by related research evidence.

Chapter one contains a review of the theoretical background and relevant research findings which led to the formulation of the hypotheses to be investigated by the present study.

Chapter two describes the sample, the instruments, the methods of analysis and the statistical procedures employed in the testing of the hypotheses.

The results are presented and discussed in chapter three in relation to the theoretical problems posed in chapter one.

CHAPTER I

DEVELOPMENT OF THE PROBLEM

This chapter presents the various theoretical models and research findings which led to the formulation of the hypotheses to be tested in the present study. Section 1 deals with the nature, properties and functions of the Orienting Reaction and its role in perceptual sensitivity and the Eysenckian dimension of extraversion. Section 2 extends these concepts to the area of cognitive style and, more specifically, to Witkin's dimension of analytic ability as an indicator of extent of psychological differentiation and perceptual-cognitive complexity in personality organization and functioning. Section 3 explores the effect of chromatic stimuli on perceptual tasks as well as the link between responsiveness to colour and personality variables. Section 4 examines the theoretical rationale of Signal Detection Theory as well as its contribution to the present study. The chapter ends with a brief summary of the theoretical background which led to the statement of the hypotheses.

1. The Orienting Reaction, Extraversion and Sensitivity.

In his classical conditioning experiments, Pavlov had observed that the first few presentations of a to-be

conditioned stimulus always elicited behavioural arousal, in the sense that the animal was attending to the change in the environment. This behaviour suggested that the Orienting Reaction (OR) constituted an important initial phase of the conditioning process,[1] and was termed the "what-is-it" reaction.

It had also been noted that after the presentation of a novel stimulus the slow, high amplitude pattern in the EEG immediately changed to a fast, low amplitude discharge which was associated with behavioural arousal and orienting.[2] Adrian and Matthews,[3] in 1934, observed that this electrophysiological response to novel stimuli occurred after shorter response latencies than overt behavioural reactions and that the response did not terminate with the cessation of stimulation. In 1937, Jasper and Cruikshank[4] suggested that the arousal value or

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1 E. Grastyan, K. Lissak, I. Madarasz, and H. Donhoffer, "Hippocampal Electrical Activity During the Development of Conditioned Reflexes," EEG and Clinical Neurophysiology, Vol. 11, 1959, p. 409-430.

2 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.

3 E.D. Adrian and B.H.C. Matthews, "The Berger Rhythm: Potential Changes from the Occipital Lobes of Man," Brain, Vol. 57, 1934, p. 355-384.

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.

meaning of a stimulus may be the more important determinant of the response. More recent studies by Gastaut[5] suggest that the initial presentation of most stimuli produces a general desynchronization response in all areas of the neocortex as well as presumably related changes in the electrical activity of the midbrain and thalamic reticular formation. This generalized response disappears or habituates with repeated stimulus presentations and alpha blocking remains only in the sensory projection area of the particular stimulus modality. It may be noted that a number of authors[6,7,8,9] attribute the generalized alpha blocking typically observed after the first few stimulus presentations to the midbrain reticular formation whereas the modality specific local responses of the sensory projection areas mediating a more differentiated attentional state may represent the influence of the thalamic portion of

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5 H. Gastaut, "Etat actuel des connaissances sur l'électroencéphalographie du conditionnement, Colloque de Marseille," EEG and Clinical Neurophysiology, Supplement 6, 1957, p. 133.

6 J.D. French, "The Reticular Formation," in J. Field (ed.), Handbook of Physiology, Baltimore, Williams and Wilkins, 1960, p. 1284.

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

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

9 D.B. Lindsley, "Attention, Consciousness, Sleep and Wakefulness," in Field (ed.), op. cit., p. 1555.

the reticular formation. It has indeed been proposed that on the basis of information arising from the central nervous system, the reticular formation maintains a complex and constantly fluctuating state of excitation that biases the sensitivity of specific sensory modalities, which effect may be facilitatory or inhibitory on the receptor or conduction pathways. The inhibitory influence of the reticular formation appears to be typically smallest whenever the sensory signal is novel, sudden or intense, or when a signal assumes a special significance as a cue for other stimuli.

According to Pavlov,[10] it is the Orienting Reaction which brings about the immediate investigatory responses in man and animals to the slightest changes in the world around them.

According to more recent Russian theorists such as Sokolov[11] and Anokhin,[12] the OR is a holistic physiological response of an organism to novel stimuli. More specifically, Sokolov's basic interest is to identify the processes through

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

11 E.N. Sokolov, Perception and the Conditioned Reflex, New York, Macmillan, 1963, p. 132.

12 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.

which images are formed and to demonstrate the laws governing the way the human mind mirrors the external world. His approach to analyzing the process of reflection is to consider the nervous system as a mechanism which models the external world by specific changes occurring in its internal structure. In this sense a distinct set of changes in the nervous system is isomorphic with the external agent that it reflects and resembles. As an internal model develops in the nervous system in response to the effect of agents in the environment, the image performs the essential function of modifying the nature of behaviour allowing the organism to predict events and actively adjust to its environment.[13]

The components of the OR as discussed by Sokolov[14] and Maltzman and Raskin[15] can be somatic (movement of the body, head, eyes toward the source of stimulation); autonomic (changes in the electrical potential of the skin, vascular changes in peripheral blood vessels, deceleration of the heart

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13 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.

14 --------, "Neuronal Models and the Orienting Reflex," in M.A. Brazier (ed.), The Central Nervous System and Behavior, New York, Moon, 1960, p. 191.

15 I. 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. 1-2.

rate, momentary cessation of respiration); central (electroencephalographic desynchronization toward waves of faster frequency and lower amplitude corresponding to general excitation of the cortex); and sensory (the lowering of sensory thresholds thereby increasing the sensitivity of the sense organs). Sokolov[16] concludes that the OR is a system of reactions promoting the most favourable conditions for stimulus reception.

Concerning the properties of the OR, it is considered by Sokolov[17] to be an unspecific reflex initiated by any increase, decrease or qualitative change of a stimulus, independent of the modality of the stimulating agent. The second property is that it is subject to extinction or habituation upon repeated presentations.

The most widely used explanation for OR evocation and habituation is Sokolov's two-stage neuronal model[18] which assumes that the OR is cortically aroused.[19] The model which also postulates subtle interactions between subcortical structures and the cortex is explained as follows.

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16 Sokolov, Perception and the Conditioned Reflex, p. 285.

17 --------, "Neuronal Models and the Orienting Reflex," p. 189.

18 Ibid., p. 216.

19 E.N. Sokolov, N.P. Paramonova and M.V. Lomonosov, "Extinction of the Orienting Reaction," Journal of Higher Nervous Activity, Vol. 2, 1961, p. 1-10.

Novel stimuli arrive at the cortex via the specific pathways from the sense organs. Here its properties are analyzed and compared to a pre-existent model. Incoming stimuli leave traces of all their characteristics, such as stimulus intensity and duration, within the nervous system and especially in the cortex. These traces are the nervous models. If the properties of the incoming stimulus cannot be matched to a neuronal model in the cortex, excitatory impulses are sent to the reticular formation and activate it, thus producing the central and autonomic components of the OR. EEG desynchronization towards waves of higher frequency and lower amplitude takes place as a result of excitatory impulses from the reticular activating system and is reflected in heightened cortical arousal. This is the central OR component occurring via the DTPS (Diffuse Thalamic Projection System). Autonomic OR components occur as a result of reticular activation of the posterior hypothalamus. When habituation occurs, a neuronal model is generated containing all the dimensions of the particular stimulus. After the formation of such a model, the cortex transmits inhibitory impulses to the collaterals transmitting impulses from the sense organs to the reticular formation. Both central and autonomic OR components disappear indicating lessened cortical arousal to the stimulus. An illustration of this process is given in Figure 1.

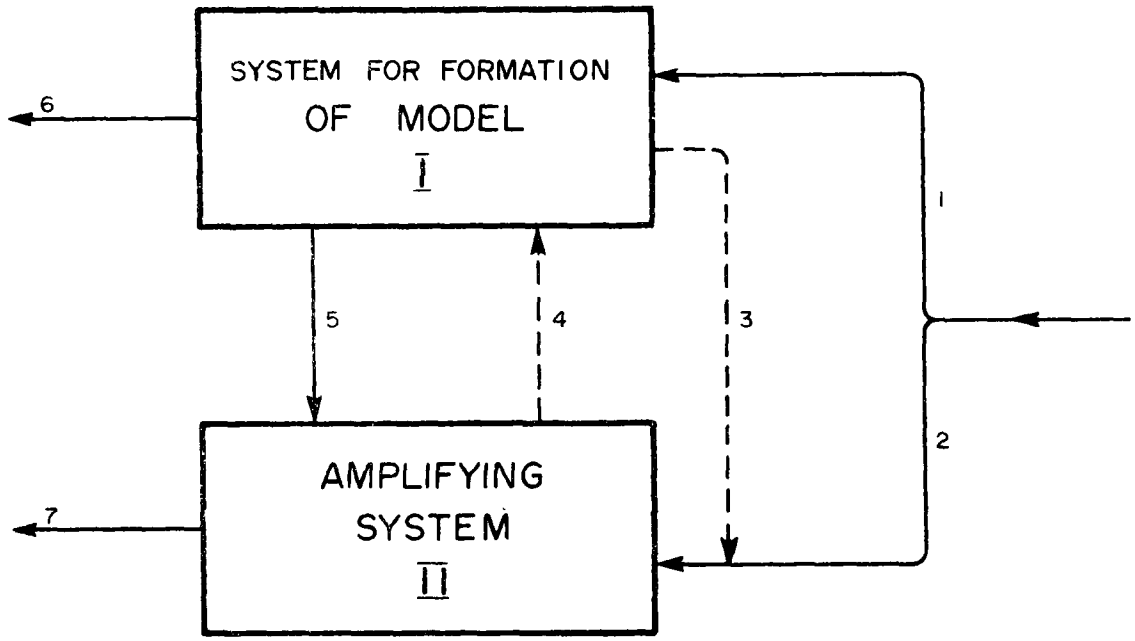

Figure 1.- Schema for the Orienting Reaction. I. Modeling system. II. Amplifying system. 1 = specific pathway from sense organs to cortical level of modeling system; 2 = collateral to reticular formation (represented here as an amplifying device); 3 = negative feedback from modeling system to synaptic 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, Moon, 1960, p. 216.

However, it is obvious that the slightest possible change in any stimulus parameter (qualitative, intensive,[20] temporal,[21] or intermodal[22]) may be sufficient to re-awaken the response because of the signals of discrepancy developing when afferent signals are compared with the trace formed in the nervous system by the earlier stimulus. Thus the neural model of a stimulus cannot be thought of as a static imprint but constantly undergoes revisions in order to account for the characteristics of the stimulus operating at a given moment.

According to Lynn[23] the purpose of OR habituation is to block or attenuate unimportant stimuli peripherally, thus freeing the higher cortical structures for more important functions. It thus permits the inference that there exists a selective process in which it is possible to monitor the relevance of information.

However, the quantification of individual differences in the various behavioural and physiological manifestations

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20 J.G. O'Gorman, G.L. Mangan and J.A. Gowen, "Selective Habituation of Galvanic Skin Response Component of the Orientation Reaction to an Auditory Stimulus," Psychophysiology, Vol. 6, 1970, p. 716-721.

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

22 R.L. Houck and R.B. Mefferd, "Generalization of GSR Habituation to Mild Intramodal Stimuli," Psychophysiology, Vol. 6, 1969, p. 202-206.

23 R. Lynn, Attention, Arousal and the Orientation Reaction, New York, Pergamon, 1965, p. 61.

of the OR has received limited attention by the Russian investigators. Since the OR is not a reaction to stimulation alone but to a difference between what is expected on the basis of prior experience and the incoming percept to memory schema, it follows that individual differences in OR responsiveness and habituation rates would reflect basic differences in personality organization and differential rates of perceptual and cognitive assimilation and functioning. Russian theorists such as Pavlov and Teplov, as quoted by Gray in 1964,[24] 1967,[25] and 1970[26] have hypothesized however that individuals characterized by a "weak nervous system" appear more sensitive, i.e., have lower sensory thresholds, are more excitable and amplify stimulation to a greater extent that "strong nervous system" individuals who damp down stimulation. "Weak nervous system" individuals begin to respond at low stimulus intensities which are ineffective for "strong nervous system" individuals, the responses of the former being closer to maximum level of responding than those of the latter. Gray concludes that there

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

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

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

appears to be sufficient evidence for it to be worth devoting serious attention to the hypothesis that the dimensions of strength of the nervous system and the western introversion-extraversion dimension identified by H.J. Eysenck are identical, both being based upon level of arousal. After a careful consideration of this position, Eysenck himself similarly concludes in two separate publications: "the conceptions of our two schools are in fact closely related and [...] empirical work directly devoted to a verification of this hypothesis would be of considerable value,"[27] and "it is therefore proposed that the two theories are so similar in many essential points that we may with advantage look at them together."[28]

More specifically, Eysenck[29] and Eysenck and Eysenck[30] have postulated that the personality dimension of introversion-extraversion, as extracted by factor analytic methods from a large number of psychological tests administered to military

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27 H.J. Eysenck, "Conditioning, Introversion-Extraversion and the Strength of the Nervous System," in H.J. Eysenck (ed.), Readings in Extraversion-Introversion, Vol. III, Bearings on Basic Psychological Processes, London, Staples, 1971, p. 500.

28 --------, The Biological Basis of Personality, Springfield, Ill., C. Thomas, 1967, p. 242.

29 Ibid., p. 226-262.

30 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.

personnel during the war years, may be related to sensitivity of stimulus intake.

The excitation-inhibition balance was originally taken as a hypothetical construct to explain the observed differences between the performance of introverts and extraverts on various behavioural and paper-pencil tests. In the extravert, inhibitory processes dominated and thus were said to be cortically inhibited, while in the introvert excitatory processes dominated. According to Eysenck, introverts were tonically in an aroused state because their reticular formations had a lower threshold than was the case of the extraverts.

More recently, Eysenck[31] has sought to explain the observed differences between the performance of introverts and extraverts on the basis of differential thresholds in the various parts of the ascending reticular activating system and relies heavily on the Sokolovian model. He states more specifically that the Sokolovian cortico-reticular loop is concerned with information processing, with cortical arousal and inhibition, and in its application to personality differences with introversion and extraversion.

The conceptual similarity in these positions has thus prompted Eysenck to suggest that the link between his theory

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31 Eysenck, The Biological Basis of Personality, p. 231.

of introversion-extraversion and the neuronal model of Sokolov might be the association of sensitivity with a high level of cortical arousal. In this regard, Gray[32] has speculated that the more highly aroused introvert is characterized by lower excitatory sensory thresholds and greater arousal of the brain stem reticular formation which enhances the efficiency of his sensory receptors. The extravert, however, would be expected to suppress sensory input because of more easily triggered cortical activity of the thalamo-cortical inhibitory system.

As Van Olst and Orlebeke[33] have pointed out, since one of the functions of the OR is specifically to produce an increment of the discriminative power of the receptors and tuning of the sensory analyzers, taking the form of a lowering of sensory thresholds, the Orienting Reaction may represent a useful research tool in the investigation of the preceding theoretical position. In the same line of thought, Sokolov himself has said:

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32 Gray, Pavlov's Typology, p. 248-260.

33 E.H. Van Olst and J.F. Orlebeke, "An Analysis of the Concept of Arousal," Nederlands Tijdschrift Voor De Psychologie En Haar Grensgebieden, Vol. 22, 1967, p. 592.

> The autonomic components of the orienting reflex provide control of analyser sensitivity over a wide range. As with the motor component of the orientation reflex, the autonomic component participates in the tuning of receptors and in the realization of the ultimate aim of the orientation reflex as a whole, namely increase of analyser sensitivity. A serious defect in work done on the orientation reflex has been that its autonomic and motor manifestations have usually been studied quite apart from its most important function, the enhancement of analyser sensitivity.[34]

Similarly, Baer and Fuhrer,[35] Maltzman and Raskin,[36] Raskin,[37] Edelberg,[38] and Germana[39] have also concluded on the basis of a number of studies that the OR is related to attention, to the ability to discriminate between stimuli and assume that activation by the reticular formation primarily affects the

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[34] Sokolov, Perception and the Conditioned Reflex, p. 12-13.

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

[36] I. 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.

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

[38] R. Edelberg, "The Relationship Between the Galvanic Skin Response, Vasoconstriction and Tactile Sensitivity," Journal of Experimental Psychology, Vol. 62, 1961, p. 194.

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

receptivity of stimuli and the consequent lowering of sensory thresholds. It is noted, for example, that when a light of subthreshold intensity is presented to the subject followed by a loud tone which evokes an OR, in the presence of the OR the weak light is detected both behaviourally and physiologically thus indicating greater perceptual intake..

This linkage of introversion-extraversion with perceptual sensitivity and arousal has received some empirical support. Smith,[40] using auditory stimuli, and Siddle et al.,[41] using visual stimuli, found that introverts, as defined by scores on the Eysenck Personality Inventory (EPI), had lower absolute sensory thresholds than extraverts. Bakan[42] has also noted that in a vigilance task, introverts display greater behavioural arousal than extraverts in their persistence in listening for signals even though they occur infrequently.

Concerning differential levels of physiological arousal and perceptual efficiency, Ross et al.[43] used a Mackworth

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

41 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.

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

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

"clock" test where the subject is required to detect double jumps of a clock pointer and respond to such jumps by pressing a switch. GSR readings taken during a four-and-a-half hour period suggested that high conductance level indicating greater arousal was positively related to high vigilance performance. Similarly, Coles and Gale[44] found a positive relationship between GSR habituation rate and detection efficiency in a discrimination task.

Concerning the differential levels of physiological arousal and introversion-extraversion, Mangan and O'Gorman[45] have shown that introverts have longer OR habituation rates to auditory stimuli than do extraverts. Similarly, Sadler et al.[46] have also noted that the mean number of GSR responses to auditory stimuli was greater for introverts than for extraverts.

Finally, concerning the problem of OR identification and measurement, although there is evidence of the generality

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

45 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.

46 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.

of the arousal response, Duffy[47] notes that the various physiological measures employed to measure arousal do not always show high intercorrelations. She concludes that there appears to be patterning in the excitation of each individual, the nature of which appears to depend upon the specific stimulus situation and upon organic factors within the individual. In fact, the problem of response specificity of the OR has been reported in the literature by Raskin,[48] Edelberg,[49] Obrist,[50] McDonald et al.,[51] Uno and Grings,[52]

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

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

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

50 P.A. Obrist, "Cardiovascular Differentiation of Sensory Stimuli," Psychosomatic Medicine, Vol. 25, 1963, p.. 450-458.

51 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.

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

Galbrecht et al.,[53] Furedy,[54] and Cohen and Johnson.[55] In particular, Raskin et al.[56] and Cohen and Johnson[57] believe that the vasomotor activity in the skin of the forehead does not differentiate between the OR and the DR (defensive reaction) which occurs to threatening or noxious stimuli, but that the heart rate component does, and Raskin et al. go on to say in another publicatio

> The use of cephalic vasomotor activity to differentiate ORs from DRs suffers from serious practical difficulties in recording the response and interpreting the data. The only simple method of recording vasomotor activity from the forehead is by means of a photoelectric plethysmograph attached to the surface of the skin. The control of pressure of application of the pickup and the reduction of movement artifacts present formidable problems, and the lack of a physiologically meaningful physical scale to use for quantifying the responses makes it extremely difficult to take account of the basal rate of the peripheral vasculature in the calculation of the amplitude of responses.[58]

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53 C.R. Galbrecht, R.A. Dykman, W.G. Reese and T. Suzuki, "Intrasession Adaptation and Intersession Extinction of the Components of the Orienting Response," Journal of Experimental Psychology, Vol. 70, 1965, p. 585-597.

54 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.

55 M.J. Cohen and H.J. Johnson, "The Effects of Signal and Non-Signal Stimuli on the Orienting and Defensive Responses," SPR Abstracts, Vol. 6, 1970, p. 626.

56 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.

57 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.

58 D.C. Raskin, H. Kotses and J. Bever, "Autonomic Indicators of Orienting and Defensive Reflexes," Journal of Experimental Psychology, Vol. 80, 1969, p. 424.

Furthermore, in a recent study by Desjardins the inter-rater scoring reliability of the vasomotor component of the OR was found to be .29 for one rater and .45 for two raters.[59] The author further states:

> Finally, because of the low test-retest reliability coefficients reported for various measures of autonomic functioning, where possible in OR studies, multiple autonomic response measures should be recorded (GSR, heart rate). The advantage is that a particular subject may demonstrate a response preference for one response modality and not another. If multiple response measures are not recorded, then significant response differences could go undetected.[60]

Thus, in order to investigate possible OR response specificity to the particular visual stimuli used in this study, three OR components will be measured, i.e., the vasomotor component, the heart rate component and the galvanic skin response component.

2. The Orienting Reaction, Extraversion and Psychological Differentiation.

According to Razran[61] the OR should be accorded cognitive status in view of the weight of experimental evidence

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59 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, as partial fulfillment of the requirements for the degree of Doctor of Philosophy, 1972, p. 56.

60 Ibid., p. 60-61.

61 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. 119.

pointing to distinctions in orienting reactivity within and between phylogenetic and ontogenetic hierarchies.

Similarly, in a discussion of the psychological significance of the concept of arousal, Duffy[62] advocates that further studies in this area should deal with the relationship between differential levels of arousal and attitudinal or cognitive personality characteristics. In fact, Bernstein has recently suggested that OR habituation rate may represent a direct evaluation of the significance or potential value of a novel stimulus to an indvidual and concludes: "The present study therefore suggests that the OR may reflect a more complex interaction of cognitive and motivational variables than has been considered so far in Sokolov's conception of an automatic reflex receptor mechanism."[63]

Interestingly enough, Sokolov[64] reports that in studying the Orienting Reaction phenomenon, he found that after habituation of the OR to a word, another word of similar semantic meaning did not evoke an OR, whereas a word of different meaning did. Similarly, Luria and Vinogradova,[65] investigating

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62 Duffy, op. cit., p. 273.

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

64 Sokolov, Perception and the Conditioned Reflex, p. 207.

65 A.R. Luria and O.S. Vinogradova, "An Objective Investigation of the Dynamics of Semantic Systems," British Journal of Psychology, Vol. 50, 1959, p. 96.

the OR to signal words in intellectually normal and "oligophrenic" subjects, noted that the normals had ORs to words similar in meaning while the subnormals reacted to words similar in sound. It thus appears that the meaning which the individual gives to the stimulus bears on the particular OR pattern given or, in more general terms, that the OR mechanism focuses on the stimulus not only with respect to its observable characteristics but also in terms of its particular environmental context and specific salience to the subject.

Israel[66] has indeed advocated the investigation of individual differences in perceptual cognitive behaviour via the measurement of physiological response patterns, along with the more generally used psychological measures. She has in fact demonstrated that the cognitive strategies or control principles as described by Klein[67] and inferred from performance on perceptual tasks can also be reflected in the Orienting Reflex. These cognitive control principles are conceived as relatively enduring, regulative and adaptive features of

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

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

cognitive organization which determine how the individual perceives and organizes sensory stimulation. They determine the extensiveness and selectiveness of attention deployment, govern the extent of informational feedback in environmental encounters and define the range of stimulus alternatives to which a person will react. Moreover, since the OR is not a reaction to stimulation alone but to a difference between what is expected on the basis of prior experience and the incoming percept, the process of OR habituation can be viewed as a function of the rate of assimilation of the novel percept to memory schemata. Individual differences in OR habituation rates might then be expected to reflect differences in perceptual-cognitive organization and functioning. Since personality, according to Klein,[68] embodies stabilized dispositions of perception and cognition, different personality types could be expected to display qualitative and quantitative differences in their physiological, perceptual and cognitive modes of functioning.

In this context, Luborsky[69] states that the occurrence, magnitude and frequency of the OR depends on the person's aims

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68 G.S. Klein, Perception, Motives and Personality, New York, Knopf, 1970, p. 10.

69 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.

and motives, on his typical way of taking in information from his environment, on his perceptual-cognitive style and, in particular, on his ability for differentiating a stimulus from its background. This ability is indeed, according to Gardner et al.[70] a cognitive control. More specifically, Eysenck[71] has himself suggested that possible rapprochement could be made between his introverted personality type and Witkin's[72] field independent mode of perceptual-cognitive functioning on the one hand, and between extraversion and field-dependence on the other. Evans[73] has advanced some empirical support for this position and has reported a correlation of .39 (significant at the .005 level) between field-dependence and extraversion as measured by the Maudsley Personality Inventory. In the context of the present study, this hypothesis will be re-examined by administering a test of analytic ability, the Hidden Figures Test, Form V,[74] to three groups of

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70 R.W. Gardner, P.S. Holzman, G.S. Klein, H.B. Linton, and D.P. Spence, "Cognitive Control," Psychological Issues, Vol. 1, 1959, p. 67.

71 Eysenck, The Biological Basis of Personality, p. 117.

72 H.A. Witkin, R.B. Dyk, H.F. Faterson, D.R. Goodenough, and S.A. Kays, Psychological Differentiation, New York, Wiley, 1962, xii-418 p.

73 F.J. Evans, "Field Dependence and the Maudsley Personality Inventory," in Eysenck (ed.), Readings in Extraversion-Introversion, p. 309-310.

74 D.N. Jackson, S. Messick and C.T. Myers, "Evaluation of Group and Individual Forms of Embedded-Figures Measures of Field-Independence," Educational and Psychological Measurement, Vol. 24, 1964, p. 177-192.

subjects ranging from low to high on the extraversion dimension.

According to Witkin, individuals have a preferred mode of perceiving, i.e., they either grasp a field globally as an undifferentiated unit or they articulate it into its component parts. Individuals who succumb to the pull of the field and consequently are unable to articulate its parts are field-dependent. Conversely, individuals who can perceive items as discrete from their background are field-independent and are characterized by a higher level of analytic ability, psychological differentiation and integrational complexity than field-dependent individuals. Moreover, concerning the level of conceptual complexity characteristic of an individual, Schroder et al have elaborated a theory of information processing which assumes that individuals develop quasi-stable systems of information processing reflecting the level of differentiation or the degree of perceptual and conceptual structure and complexity attained. Thus, in higher-level structures involving a greater degree of generation of rules and alternatives, it appears plausible that the more psychologically differentiated, complex introvert, as opposed to the extravert, when faced with a stimulus situation permitting associative elaboration

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

and discrimination would attend to the stimulus for longer periods of time. He would generate a greater degree of perceptual-cognitive elaboration and more signals of discrepancy would arise when actual incoming signals were compared with the memory trace. According to the information processing theory, the greater the psychological complexity of the individual, the more he searches for information, and the more he delays final decisions concerning the stimulus. Since the Orienting Reaction is considered a biological regulator which influences the way new information is selected and transmitted, this process could be reflected in longer OR habituation rates for the more introverted subjects. However, in a simple stimulus situation not apt to evoke many associations or elaborations, stimuli are simply matched against yes-no categories which they either do or do not fit. In this case, introverts could be expected to display shorter habituation rates than extraverts because the range of past experience and sensitivity of the former is greater than that of the latter and the matching procedure occurs more rapidly. This is in fact what has been found by Quirion[76] in a recent study conducted at the University of Ottawa. He reports a high and

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

significant correlation (r = .798) between extraversion and the Orienting Reaction habituation rates to a tone.

3. Chromatic Stimuli and Perceptual Behaviour.

The initial investigation of the influence of colour on apparent size was suggested by the phenomenon of advancing and retreating colours. An advancing colour was defined as one which appeared to be nearer than other colours when it was in actual fact the same distance and size, whereas a retreating colour was considered to have the opposite effect. In an early investigation, Luckiesh[77] found that red was an advancing colour and blue a retreating colour. Subsequently, Wallis[78] attempted to make a quantitative statement of the effect of colour on apparent size by employing the method of constant stimuli as psychophysical procedure. The size of each colour used was varied in five size steps and each variable hue stimulus size was presented with a black or white standard stimulus always of the same size. The subject's task was to judge whether the chromatic stimulus was larger or smaller than the standard stimulus. It was reported that the

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77 M. Luckiesh, "On Retiring and Advancing Colors," American Journal of Psychology, Vol. 29, 1918, p. 182-186.

78 W.A. Wallis, "The Influence of Color on Apparent Size," Journal of General Psychology, Vol. 13, 1935, p. 193-199.

black, blue and green stimuli had to be larger than the standard in order to appear equal, while the red, white and yellow stimuli had to be smaller than the standard in order to appear equal. However, in the Wallis study, as well as in subsequent investigations,[79,80,81] it was noted that a high positive correlation existed between stimulus luminosity or brightness and the size rankings. The confounding of hue (wavelength) with brightness (luminance) in size judgment studies was controlled in an investigation by Over[82] where it was found that the red stimulus of longer wavelength was judged to appear larger than the green and blue stimuli of shorter wavelength. It has also been reported by Sanders and Wyszecki[83] that saturated colours such as a deep red required less luminance than less saturated colours such as a pink to appear

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79 A.H. Holway and E.G. Boring, "The Dependence of Apparent Visual Size Upon Illumination," American Journal of Psychology, Vol. 53, 1940,p. 587-589.

80 E.J. Robinson, "The Influence of Photometric Brightness on Judgments of Size," American Journal of Psychology, Vol. 67, 1964, p. 464-474.

81 C. Gundlack and C. Macoubrey, "The Effect of Color on Apparent Size," American Journal of Psychology, Vol. 43, 1931, p. 111.

82 R. Over, "Stimulus Wavelength Variation and Size and Distance Judgments," British Journal of Psychology, Vol. 53, Part 2, 1962, p. 141-147.

83 C.L. Sanders and G. Wyszecki, "Correlates for Lightness in Terms of C.I.E. Tristimulus Values," Journal of the Optical Society of America, Vol. 47, 1957, p. 398-412.

equally bright. An investigation by Stelmack[84] of the effects of hue and saturation on the apparent distance of chromatic stimuli equated for luminous reflectance demonstrated that high saturated hues were judged to appear nearer than their corresponding hues of lower saturation. In general, red and yellow hues appeared nearer than blue and green hues at the same level of saturation.

Concerning the relation between colour and personality, Schaie[85] has pointed out that colour responses on personality tests have been related to influences involving emotional behaviour and that colour stimuli produce physiological arousal and have psychological affective value.

Pressey[86] and Lewinski[87] had indeed noted many years ago that red was considered exciting and arousing, while blue was considered relaxing and pleasant. Similarly, red and

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84 R. Stelmack, The Effect of Hue and Saturation on Apparent Distance Judgments, unpublished Master's thesis presented to the Department of Psychology of the University of Windsor, Ontario, 1965, 49 p.

85 K. Warner Schaie, "On the Relation of Color and Personality," Journal of Projective Techniques and Personality Assessment, Vol. 30, 1966, p. 512-524.

86 S.L. Pressey, "The Influence of Color Upon Mental and Motor Efficiency," American Journal of Psychology, Vol. 32, 1921, p. 351.

87 R.J. Lewinski, "An Investigation of Individual Responses to Chromatic Illumination," The Journal of Psychology, Vol. 6, 1938, p. 155-160.

yellow were regarded by Goldstein and Rosenthal[88] as having an expansive effect on the organism, increasing the effect of the external world, while green and blue had the reverse effect, causing concentration and contraction. Staples[89] had also noted in 1932 that infants spent more time looking at red designs than at achromatic designs. Similar findings have more recently been reported by Dodd and Lewis.[90] Smets[91] has concluded that warm colours such as red, orange and yellow, as opposed to cold colours such as blue and green, bring to light a greater physiological and behavioural activity and are experienced as more dynamic. Warm colours also tend to come forward in space, while cold colours recede in space. Because of the preceding observations the three stimuli chosen in both the OR habituation phase and size judgment phase of the present study are red, blue and neutral grey.

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88 K. Goldstein and O. Rosenthal, "Zum Problem der Wirkung der Farben auf den Organismus," Schweiz. Arch. Neurol. Psychiat., Vol. 26, 1930, p. 13-26, quoted by R.D. Norman and W.A. Scott, "Color and Affect: A Review and Semantic Evaluation," The Journal of General Psychology, Vol. 46, 1952, p. 217.

89 R. Staples, "The Response of Infants to Color," Journal of Experimental Psychology, Vol. 5, 1932, p. 119-141.

90 C. Dodd and M. Lewis, "The Magnitude of the Orienting Response in Children as a Function of Changes in Color and Contour," Journal of Experimental Child Psychology, Vol. 8, 1969, p. 296.

91 G. Smets, "Time Expression of Red and Blue," Perceptual and Motor Skills, Vol. 29, 1969, p. 511.

Kenny[92] has, however, postulated that chromatic stimuli may function as a protusive cue that will disrupt perceptual and cognitive organizing functions in individuals with a weak decentering ability or poor ability to focus on specific and relevant aspects of a stimulus within its background. The link with Witkin's[93] field-dependence-independence dimension is thus obvious. One could therefore expect that chromatic stimuli would have a greater disruptive influence on the size judgment observations of field-dependent (low analytic ability) and possibly extraverted subjects as opposed to field-independent (high analytic ability) and possibly introverted subjects. The hypothesis is further supported by the consensus of thought and research evidence on the relation of Rorschach colour response to personality,[94,95] where the extravert passively acceded to colour as an important environmental determinant of his perceptions. In the present study, the

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92 D.T. Kenny, "Stimulus Functions in Projective Techniques," in B.A. Maher (ed.), Progress in Experimental Personality Research, Vol. I, New York, Academic Press, 1964, p. 321.

93 Witkin et al., Psychological Differentiation, p. 7.

94 D. Shapiro, "Color-Response and Perceptual Passivity," Journal of Projective Techniques, Vol. 20, 1956, p. 52-69.

95 D.M. Barrett and E.B. Eaton, "Preference for Color or Tint and Some Related Personality Data," Journal of Personality, Vol. 15, 1946, p. 232.

same chromatic stimuli are used in the OR recording experimental phase to investigate the physiological reactivity of introverted, middle and extraverted subjects to red, blue and neutral grey stimuli. It is hypothesized that because colour is firmly grounded in the extravert's experiential background,[96] his OR habituation rate to the hue stimuli would be shorter than that of the introvert for whom colour would have a greater arousal value. More specifically, according to Klein's[97] model, colour could be expected to arouse on the part of the more introverted subjects a greater number of peripheral motives, associations and non-visual physiognomic qualities and properties evoking connotative meanings and greater autonomic reactivity.

4. The Signal Detection Approach to Psychophysics.

Critics[98,99] of the classical psychophysical methods have suggested that estimates of sensory sensitivity or

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96 R.H. Fortier, "The Response to Color and Ego Functions," Psychological Bulletin, Vol. 50, 1953, p. 41-63.

97 Klein, Perception, Motives and Personality, p. 94-95.

98 E.G. Boring, "The Control of Attitude in Psychophysical Experiments," Psychological Review, Vol. 27, 1920, p. 450-452.

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

capacity which these methods yield may be confounded by non-sensory or personal determinants such as motives, attitudes or set which influence psychophysical judgments. The Signal Detection approach, however, provides measures of sensitivity that purport to be independent of the nonsensory factors that may influence psychophysical judgments and thus gives a more comprehensive picture of the subject's perceptual behaviour. In the context of the present study, it offers a means to consider separately the influence of sensory capacity or sensitivity and of personal factors on the apparent size judgments of chromatic stimuli for groups of introverted, middle and extraverted subjects. The principal advantage of the method of Signal Detection is that it compresses many nonsensory factors including the experiential background of the subject into a single variable referred to as the decision or response criterion.[100] The false-alarm responses which report that a difference in the physical continuum is present when in fact it is not, are used to estimate the level of the response criterion.

Since, as seen in Section 1 of this chapter, differences in the sensitivity of introverts and extraverts have been observed using the classical absolute sensory threshold

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

measures, it appears appropriate to further investigate this problem by a method which does not confound sensory capacity or physical sensitivity to size differences with personal factors which influence the observer's judgment. Concerning this issue, Eysenck himself has stated:

> [...] it would be difficult to test hypotheses about sensitivity by traditional methods of threshold measurement since a failure to find differences might pertain more to the decision-making habits and risk-taking propensities of the subject groups than to their actual thresholds. In other words, extraverts might be predicted to guess more frequently and therefore appear to have thresholds as low as or lower than those of the careful, scrupulous introverts.[101]

The experimental paradigm generally used for the Signal Detection procedure involves two classes of stimulus events varying on one dimension and having fixed a priori probabilities of occurrence. In this study, the two classes of stimuli are variable targets larger and smaller than a standard target. The subject is asked to make a forced-choice response stating which stimulus event appeared. If the subject reports that the stimulus is smaller when it is in fact smaller, a hit is recorded. If, however, the subject reports that the stimulus is smaller when in fact it is larger, a false alarm is recorded. Sensitivity is thus defined as the ratio of the probability of a hit to the probability of a false alarm. On

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101 Eysenck, The Biological Basis of Personality, p. 100-101.

the other hand, an estimate of the variation in the subject's subjective response criteria is provided by obtaining a sample of the various personal states under which the size judgment observations are made.[102]

As Price[103] has indeed pointed out, the traditional threshold measure is a global indicator of the observer's hit rate and does not allow analysis of all the stimulus-response contingencies in the experimental situation. He concludes that this is an important consideration in the study of personality and perception since the traditional threshold does not reflect all of the information which may be of interest. For example, the false alarm rate also conveys information about the subject's detection goals or strategies in the experimental situation. In a recent study by Stelmack[104] signal detection and uncertainty analyses indeed suggested that the influence of personal nonsensory factors in the size judgments of hue stimuli was greater for a low analytic ability group than for a high analytic ability group. Thus, in the present study, in order to arrive at the latter estimate, a rating procedure will

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103 R.H. Price, "Signal-Detection Methods in Personality and Perception," Psychological Bulletin, Vol. 66, 1966, p. 56.

104 R.M. Stelmack, 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, p. 123.

be employed where the subject indicates the response criterion used in each size judgment observation interval by giving a confidence rating of his accuracy on each trial.[105,106]

This concludes the presentation of the theoretical background which guided the development of the problem. In the following section, a brief summary precedes the final statement of the hypotheses of the present study.

5. Summary and Statement of the Hypotheses.

According to Pavlov and Sokolov, the Orienting Reaction is an investigatory response to novel stimulation through which a model of the external world is derived, thus reflecting the operation of perceptual and cognitive processes. In the Russian school, individual differences in OR elicitation and habituation had been noted in the strong versus weak nervous system individuals. The weak nervous system individual was considered more sensitive and was characterized by lower absolute sensory thresholds in perceptual tasks as compared with the strong nervous system individual who damped down

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105 J.A. 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.

106 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.

incoming stimulation. Gray, however, has postulated that the weak nervous system individual may be the introvert in Eysenck's personality dimension, while the strong nervous system individual may be the extravert. Eysenck has further contended that the introvert may be the field independent or high analytic ability subject in Witkin's theory of psychological differentiation or complexity, whereas the extravert may be the field dependent or low analytic ability subject. Moreover, since one of the functions of the OR, as described by Sokolov, is precisely to increase the sensitivity of sensory analyzers and is further assumed to reflect perceptual and cognitive elements of personality organization, the Orienting Reaction seems an appropriate research tool in the investigation of these hypotheses. Furthermore, since most studies attempting to relate personality variables to perceptual sensitivity have employed traditional psychophysical methods which do not differentiate between the subject's sensory capacity and non-sensory, personal factors which influence this sensory capacity, the present study includes a size judgment task using methods of analysis derived from Signal Detection Theory which provides separate estimates of these two factors. Finally, because of the richness of the tradition linking colour to perceptual organization, cognitive style and personality, two hues, matched for brightness and saturation, and a neutral grey

stimulus, matched for brightness, are used as stimuli in the present investigation.

Thus, the independent variables of the research are extraversion, as studied in three groups of Introverted, Middle and Extraverted subjects, and colour, i.e., red, blue and neutral grey. The dependent variables are three Orienting Reaction habituation rates, i.e., vasomotor component, heart rate component, galvanic skin response component, analytic ability, and two separate estimates of perceptual behaviour derived from Signal Detection Theory, i.e., sensory capacity and nonsensory factors affecting sensory accuracy.

From these considerations, the following null hypotheses are thus derived:

1. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Vasomotor OR habituation rate to red, blue and neutral grey stimuli.

2. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Heart Rate (HR) OR habituation rate to red, blue and neutral grey stimuli.

3. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Galvanic Skin Response (GSR) OR habituation rate to red, blue and neutral grey stimuli.

4. There is no significant difference between red, blue and neutral grey stimuli in their Vasomotor OR habituation rate.

5. There is no significant difference between red, blue and neutral grey stimuli in their Heart Rate (HR) OR habituation rate.

6. There is no significant difference between red, blue and neutral grey stimuli in their Galvanic Skin Response (GSR) OR Habituation rate.

7. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in level of analytic ability as indicated by the Hidden Figures Test, Form V.

8. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their apparent size judgments of red, blue and neutral grey stimuli as indicated by a measure of sensory capacity independent of nonsensory, personal factors which influence the observer's judgments.

9. There is no significant difference between red, blue and neutral grey stimuli in their influence on apparent size as indicated by a measure of sensory capacity independent of nonsensory personal factors which influence the observer's judgments.

10. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in a measure of the nonsensory, personal factors which influence the observer's judgments of red, blue and neutral grey stimuli.

11. There is no significant difference between red, blue and neutral grey stimuli in their influence on a measure of the nonsensory, personal factors which influence the observer's size judgments.

The methods employed to test the preceding hypotheses are presented in the following chapter.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter presents the methodology of the experiment. It describes the subjects involved in the Orienting Reaction, analytic ability and size judgment experimental phases--the dependent variables of the study as well as the procedure employed in the classification of subjects into groups of low, middle and high extraversion. Colorimetric data and the method of constructing the second independent variable, the hue stimuli, are also presented as well as the apparatus involved and methods of analysis used in the OR recording and size judgment phases of the experiment. The chapter concludes with a note on the general experimental design and statistical procedures involved in the testing of the hypotheses outlined in Chapter I.

1. The Subjects.

The subjects were thirty female students whose ages ranged from seventeen to twenty years. They were enrolled in first or second year at the Ottawa Civic Hospital School of Nursing. They were selected from an initial sample of fity-six female volunteers on the basis of scores obtained on the

Eysenck Personality Inventory (EPI), Form A.[1] They were the ten highest, ten lowest, and ten intermediate scorers on that test and were designated as the Extraverted group, the Introverted group, and the Middle group, respectively. The subjects attended two 3-1/2 hour sessions for which they were paid.

2. Classification Procedure: Eysenck Personality Inventory (EPI).

The Eysenck Personality Inventory (EPI) purports to measure two distinct and orthogonal personality dimensions, i.e., extraversion-introversion and neuroticism-stability. Evidence for the independence of the two dimensions is provided by Farley[2] and Eysenck and Eysenck.[3] Two parallel forms of the test are available (Form A and Form B), each consisting of fifty-seven items to which the subject must answer true or false. A Lie Scale is also included to pick out attempts on

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

2 F.H. Farley, "On the Independence of Extraversion and Neuroticism," in H.J. Eysenck (ed.), Readings in Extraversion-Introversion, Vol. I, Theoretical and Methodological Considerations, London, Staples Press, 1970, p. 248-251.

3 S.B.G. Eysenck and H.J. Eysenck, "On the Dual Nature of Extraversion," British Journal of Social and Clinical Psychology, Vol. 2, 1963, p. 46.

the part of subjects to answer the questions in a socially desirable manner. The validity and reliability data[4] presented in the manual appeared adequate for use of the test in the present study. The EPI (Form A) is reproduced in Appendix 1.

The EPI (Form A) was administered to a group of fifty-six female student nurses. The ten subjects obtaining the highest scores were designated as the Extraverted group, the ten subjects obtaining the lowest scores were designated as the Introverted group and the ten subjects scoring closest to the mean of the over-all sample were designated as the Middle group.

3. The Apparatus.

In this section the physiological instruments employed in recording the Orienting Reaction to the various hue stimuli will be presented first. There will follow a description of the tachistoscope used to present the stimulus targets for both the Orienting Reaction and the size judgment experimental phases.

(a) Physiological Instruments.- To record the Orienting Reactions, a Nihon Kohden Multipurpose Polygraph model RM -85 was used. This recording instrument was also equipped with an 8-channel monitor CRT oscilloscope, model VC-85, set at 2.5

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4 Eysenck and Eysenck, Manual, 5-27 p.

divisions per second, which permitted viewing of ongoing physiological reactivity across all recording channels. The ongoing activity was simultaneously recorded on paper by an Ink-writing Oscillograph using Nihon Kohden chart number FS 380-10 paper and Nihon Kohden red ink. Paper speed was 3 mm. per second. For possible further reference, the data were also stored on Charter Magnetic Tape using a Crown International Pro-700 Series 8-channel tape recording system, Model AR, made by the Vetter Company, Elkhart, Indiana, calibrated at 1 volt at the beginning of the experiment.

To obtain the plethysmograph, one photoelectric transducer of the reflection type, model MPP-3A, was placed on the subject's forehead above the left eyebrow at the point of detectable pulse and one photoelectric transducer of the cap type, model MPP-3B, was placed on the distal end of the subject's right index finger. These transducers sense the variation of blood flow volume in the peripheral vessels through the reflection of light on the forehead and finger tip and convert it into an electrical signal. A light-shielding strap was used to cover the forehead pickup transducer. The recording sites were thoroughly cleansed with alcohol to remove fatty substances in order to reduce contact resistance at the electrode.

To obtain the Galvanic Skin Response (GSR), two silver-plate electrodes were placed on the subject, one on each palm

of the hand. The recording sites and electrodes were cleansed with alcohol and Beckman Offner paste was applied. The electrical resistance between the two electrodes varies in accordance with variations of the action of the sweat glands which is converted into an electrical signal. The balance knob set at 0 was periodically readjusted as the contact resistances of the electrodes placed on the subject changed in time. These electrodes were attached to a Nihon Kohden Galvanic Skin Reflexograph bridge box model GSR-2, the voltage level being set at 1 volt.

To measure the heart rate changes, three ECG electrodes were placed on the subject, one on each wrist and a ground electrode on the subject's right leg above the ankle. The recording sites and electrodes were cleansed with alcohol and Beckman Offner paste was applied. The electrode leads were fed directly into an RBL-85 input box which was in turn connected to the AC input of the polygraph.

The forehead and finger transducers were individually connected to two photoelectric plethysmograph boxes, model MPP-35, with a built-in recharger, the power source being a 2.5 volt nickel-cadmium alkali battery which was recharged overnight. These boxes were in turn connected to the RBL-85 input box which led to the AC input of the polygraph. The forehead blood volume was amplified in Channel 4 of the polygraph by a Biophysical Preamplifier, model RB-5, the low cut being set at 2 Hz, the high cut at 30 Hz, and the sensitivity

at approximately 10 db. The finger blood volume was amplified in Channel 5 of the polygraph by a Biophysical Preamplifier, model RB-5, the low cut being set at 2 Hz, the high cut at 30 Hz and the sensitivity at approximately 3 db.

The GSR bridge box was connected to the RBL-85 input box leading to the AC input of the polygraph and the signal was amplified in Channel 6 of the polygraph by a Biophysical Preamplifier, model RB-5, the low cut being set at 2 Hz, the high at 30 Hz and the sensitivity at approximately 6 db.

In order to measure heart rate changes to stimulation, the ECG signals were fed to Channels 1 and 2 of the polygraph. Channel 1 consisted of a Biophysical Preamplifier, model RB-5, which gave the pulse rate of the subject, the low cut being set at 2 Hz, the high cut at 30 Hz and the sensitivity at 38.5 db. Channel 2, which was triggered by Channel 1, consisted of a pulse rate tachometer (Instantaneous) model RT-5 which measured the time from pulse to pulse and converted it to the heart rate per minute at each pulsation of the heart. The input selector was on ECG, the range was 1/2, the alarm set dial was off.

Channel 8 was used as the trigger input to indicate onset and offset of the stimuli. The input originated from a battery-operated transducer controlled by a Lafayette VIII Bank Timer, model 5040B, set at repeat which was connected to the stimulus source. The low cut was set at DC, the high cut at off and the sensitivity at 12 db. The input selector

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, the calibration at 2 mv.

(b) Tachistoscope.- A Scientific Prototype 2-channel tachistoscope, model 800F, was used to present the stimulus discs. The optical system is a 2-channel Dodge type with a single mirror to mix the images in the two separate channels. The mirror is a special front surface laminated unit with a magnesium fluoride, anti-reflection back coating. The two channels of the optical system each contain two lamps which illuminate the stimulus material. The duration, intensity and firing sequence were monitored automatically. A fifty-two inch plastic pipe five inches in diameter, to which a viewing hood was attached, was used to extend the viewing tunnel. The circular tunnel constructed by Plastics of Ottawa was coated inside with optical black paint. The viewing distance from the subject to the stimulus was eighty-four inches. The level of illumination on the visual fields of both channels was 1.75 footcandles, as measured by a Spectra Pritchard Photometer, model 1970-PR.

For the presentation of the hue stimuli during both the physiological recording phase, and the size-judgment phase, each of the three hue stimuli was presented in one channel of the tachistoscope on an optical black plate held by four-inch by five-inch stainless steel card holders. The second channel

was simply used to maintain light adaptation between stimulus presentations and presented only an optical black plate.

4. Construction of the Hue Stimuli.

The stimulus targets were constructed from Munsell papers[5] representing two hues, red, blue and a neutral grey. Each of the two hues had the same level of saturation, Munsell chroma 12. All three stimulus papers had a lightness of Munsell value 4 and were therefore approximately equated for luminous reflectance (brightness). These three stimulus papers served as stimuli in both the Orienting Reaction recording phase as well as in the size judgment phase.

For the presentation of the hue stimuli during the physiological recording phase, a particular hue stimulus, for example, red, was presented in one channel of the tachistoscope on a brass plate .0625 inches thick coated with optical black paint. The plate was held by a four-inch by five-inch stainless steel card holder. The plate contained two circles each having a diameter of .600 inches, the distance between the adjacent circumferences being .500 inches. The specific hue stimulus employed to investigate the Orienting Response habituation rate at a particular time, for example, red, was taped to the back of the plate and appeared through both circles.

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5 Munsell Book of Color, Baltimore, Munsell Color Co., 1943.

Concerning the size judgment phase of the experiment, the three variable hue stimuli were composed of six target sizes each on a brass plate .0625 inches thick coated with optical black paint. The plate was again secured by a four-inch by five-inch stainless steel card holder. The standard stimulus target was always the same size, having a diamter of .600 inches. Six plates were made, each having two holes which were the variable and standard stimuli. The six circles for the variable stimuli ranged from .5875 inches to .6125 inches in .005 inch steps. On each plate the distance between the adjacent circumferences of the standard and variable stimulus circles was .500 inches. The neutral grey Munsell paper was cut into eighteen squares of approximately one inch and each square was taped to an individual four-inch by five-inch celluloid card. This was done in such a way that when the celluloid card was inserted behind one of the six brass plates and the card-holder placed in the tachistoscope, the subject always viewed the neutral grey standard stimulus target of .600 inches in the left circle on each plate. The six target sizes for the three variable stimuli (red, blue, neutral grey) were obtained by cutting six one-inch squares from each of the three Munsell papers and then taping each square to one of the celluloid cards mentioned above. Thus, by inverting a celluloid card behind one of the six brass plates and securing the card-holder in the tachistoscope, the subject always viewed the grey

standard stimulus target to his left and one of the six target sizes for one of the three variable stimuli to his right.

5. The Experiment.

Stated in outline form, the experiment was divided into two testing sessions, the first being the psychological testing and physiological recording phase, the second being the psychological retesting and size-judgment psychological recording phase.

Concerning the first testing session, upon arrival at the laboratory the subject was taken to a small testing room where she was administered Form B of the Eysenck Personality Inventory (EPI) for reliability purposes. The time lapse between the administrations of Forms A and B was approximately two weeks. She was then tested for visual acuity and color blindness on a Bausch and Lomb Orthorater, number 71 21-31. The Visual Profile Performance Card yielded no serious visual abnormalities for any of the thirty subjects tested. The subject was then administered the Otis Higher Examination, Form A in thirty minutes. Finally, she was given the Hidden Figures Test-Form V, recommended by Jackson et al.[6] as a

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6 D.N. Jackson, S. Messick and C.T. Myers, "Evaluation of Group and Individual Forms of Embedded-Figures Measures of Field-Independence," Educational and Psychological Measurement, Vol. 24, 1964, p. 189.

test of analytic ability. The time allowed was ten minutes.

The Hidden Figures Test-Form V (HFT-V) is a group administered test based on Witkin's individually administered Embedded Figures Test (EFT).[7] Although both tests are highly similar in format and have high correlations, the HFT-V substituted original achromatic items for the EFT items. The subject's task is to outline a simple design contained in a larger more complex pattern. Sixteen items are presented in a small booklet with a complex design on the first page and a simple design on the next. The score is the number of correct items in a ten-minute period. Instructions and a sample problem are illustrated in Appendix 2.

The subject was then taken to the physiological laboratory where the Orienting Reaction habituation rate testing took place. She was seated in a well-padded chair with adjustable arm-rests and instructed to look into the viewing hood of the tachistoscope, to relax as much as possible, but not to move, to refrain from talking during the course of the experiment, and was told that no noxious stimuli would be presented. The transducers, electrodes and earphones were then put into position and the polygraph turned on. An interval of approximately ten minutes was allotted so as to arrive at a relatively stable

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7 H.A. Witkin, "Individual Differences in Ease of Perception of Embedded Figures," Journal of Personality, Vol. 19, 1950, p. 1-15.

baseline for each subject, after which the timer and tachistoscope were switched on and the first stimulus appeared. Stimulus presentation was four seconds, interstimulus interval, twenty-five seconds. This sequence of stimulus presentation was repeated until the Orienting Reaction no longer appeared to the particular hue stimulus under investigation (for example, red). The subject was then allowed a two-minute rest period, in which she was permitted to move and talk. The second hue stimulus was then presented (for example, blue) with the identical presentation sequence, again until the Orienting Reaction disappeared. This was followed by another two-minute rest period and the third stimulus presented (for example, grey), as described above. To eliminate the possible order effect of hue stimulus presentation, counterbalancing was done so that in each of the experimental groups, each stimulus hue appeared in the first position an equal number of times,in second position an equal number of times and in third position an equal number of times.

Concerning the second testing session which took place approximately one-and-a-half weeks after the initial testing session, the subject was introduced into the same small testing laboratory where she was again administered the HFT-V to obtain test-retest reliability data. It is to be noted, however, that because of the amount of time required to complete the size-judgment task within the three-and-one-half hour sessions,

only fifteen of the thirty subjects took the HFT-V a second time.

The subject was then taken to an air-conditioned laboratory where the psychophysical testing took place, and instructed to look into the viewing hood of the tachistoscope as the instrument was turned on. The following instructions, adapted from Price and Erikson,[8] were read to the subject:

> When you look into the viewer you will see two circles. Your task is to tell me whether the circle on the right is really larger or smaller than the circle on the left. The circle on the left will always be the same size. One half of the circles that you see on the right will be larger than the circle on the left and one half will be smaller. Some of the circles will be easy to judge and some will be more difficult. No one is able to judge them all correctly so just do your best. After you have said whether you think the circle on the right is larger or smaller than the one on the left, I want you to tell me how confident you are of your judgment. Tell me whether you were positive, fairly sure or whether it was a guess. For example, if you are fairly sure that the circle on the right was larger, you would say larger, fairly sure. Try to use all three of the ratings, positive, fairly sure and guess.

The instructions thus required a judgment of the variable stimulus as larger or smaller than the standard stimulus as well as a confidence rating of positive, fairly sure, and guess. The rating scale thus took the form: (1) smaller, positive; (2) smaller, fairly sure; (3) smaller, guess; (4) larger, guess; (5) larger, fairly sure; and (6) larger, positive.

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7 R.H. Price and C.W. Erikson, "Size Constancy in Schizophrenia," Journal of Abnormal Psychology, Vol. 71, 1966, p. 157.

After the instructions were read, a series of thirty practice trials were administered to the subject employing the neutral grey variable stimulus presented in a written pre-determined order which was identical for all subjects. No response time restraint was placed on the subjects at this point. Following this, three variable stimuli were presented in blocks of 180 random experimental trials. The six size targets for each of the three variable stimuli (red, blue and neutral grey) were presented thirty times each and in random but written pre-determined order which was identical for each subject and for each of the three variable stimuli. Each subject thus made a total of 540 size judgments.[9]

Between experimental trial presentations, the viewing surface was switched to the second channel of the tachistoscope where an illuminated optical black plate was presented to maintain light adaptation. On each of the experimental trials, the tachistoscope was programmed to present the stimulus for two seconds, and the subject was required to respond within the four-second period when the blank plate came into view. The latency period between trial presentations was four seconds. A five-minute rest period was given after each block of 180 trials. The order of presentation of the three variable stimuli treatments was the same as in the physiological recording phase.

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

6. Method of Analysis of Orienting Reaction Data.

Concerning the Orienting Reaction data, the variable under investigation was the OR habituation rate to each of the three variable hue stimulus conditions (red, blue, and neutral grey) for each of the OR parameters studied, i.e., Heart Rate Response, Galvanic Skin Response and Vasomotor Response. OR habituation rate is defined as the number of stimulus repetitions required before three consecutive presentations of the stimulus fail to evoke the OR. This criterion is in keeping with the current practices in OR research as suggested by Vinogradova and Sokolov,[10] Royer,[11] Unger,[12] Sadler et al.[13] and O'Gorman et al.[14] and as followed

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

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

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

13 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. 313.

14 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.

by Quirion,[15] Rosenberg,[16] and Desjardins[17] at the University of Ottawa.

Concerning the vasomotor OR, this response, according to Sokolov[18,19] and Razran,[20] is characterized by simultaneous finger vasoconstriction and cephalic vasodilatation, whose function is to shunt blood away from the extremities and viscera to the brain for more efficient information processing. Dilatation of the cutaneous vessels of the forehead is reflected in an upward deflection of the plethysmograph tracing associated with the increased amount of blood volume in the forehead tissues while constriction of the

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

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

17 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, Ontario, 1972, v-71 p.

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

19 --------, "Higher Nervous Functions: The Orienting Reflex," Annual Review of Physiology, Vol. 22, 1963, p. 546.

20 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.

cutaneous cells of the finger is denoted by a downward deflection associated with a decrease of blood volume in the finger. In accordance with Quirion,[21] the magnitude of deflection required to consider a response an OR was a 2.54 mm. upward deflection of the pen for the cephalic component and a 2.54 mm. downward deflection of the pen for the digital component. Also, in order to avoid confusing the Orienting Reactions to the stimulus with those not directly related to it, the latency of the response also had to be considered in scoring. A latency of 2.5 to 5 seconds following stimulus presentation is proposed by Sokolov with the reaction reaching its peak at the seventh second from the time of application of the stimulus.[22] In the present research, the latency range was extended to ten seconds following onset of stimulation so as not to miss Orienting Reactions occurring earlier or later.

Concerning the Heart Rate OR, or the change in heart rate resulting from the presentation of a stimulus, Smith and Strawbridge[23] state that, based on a thorough review of the literature in the area as well as on their study, heart rate

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21 Quirion, op. cit., p. 46.

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

23 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.

deceleration is a component of the OR. Heart rate acceleration, in their view, is neither an orienting, defensive nor adaptive response but is largely secondary to respiratory changes. However, studies of the form of the heart rate response to simple auditory stimuli by Davis et al.,[24] Lang and Hnatiow,[25] and Hord et al.[26] have, for the most part, described the response as comprised of two major components, an initial heart rate acceleration followed by a period of heart rate deceleration. Meyers and Gullickson[27] have also reported this diphasic pattern but indicate that the only statistically reliable component to the first presentation of an unfamiliar stimulus is heart rate decleration. Further evidence from a study of classical heart rate conditioning conducted by Geer[28] indicates that heart rate deceleration

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24 R.C. Davis, A.M. Buchwald and R.W. Frankman, "Autonomic and Muscular Responses and Their Relation to Simple Stimuli," Psychological Monographs, Vol. 69, 1955.

25 P.J. Lang and M. Hnatiow, "Stimulus Repetition and the Heart Rate Response," Journal of Comparative and Physiological Psychology, Vol. 55, 1962, p. 784.

26 D.J. Hord, A. Lubin and L.C. Johnson, "The Evoked Heart Rate Response During Sleep," Psychophysiology, Vol. 3, 1966, p. 46-54.

27 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. 56-66.

28 J.H. Geer, "Measurement of the Conditioned Cardiac Response," Journal of Comparative and Physiological Psychology, Vol. 57, 1964, p. 426-433.

is the major response on the first trial of a visual conditioned stimulus. Studies of complex visual stimuli conducted by Davis and Buchwald[29] and Wenger et al.[30] have reported that slides of objects and reading texts with lengths of presentation of a minute or more also decelerate the heart rate. Graham and Clifton[31] have reviewed the heart rate literature in terms of Sokolov's orienting, defensive and adaptive responses and conclude that heart rate deceleration best satisfies the criteria for identifying the Orienting Response to stimuli of weak or moderate intensity, as employed by researchers such as Germana and Klein[32] and Uno and Grings.[33] Heart rate acceleration is suggested to be indicative of an adaptive, defensive or startle reaction. Weisbard and Graham[34]

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29 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.

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

31 F.K. Graham and R.K. Clifton, "Heart-Rate Change as a Component of the Orienting Response," Psychological Bulletin, Vol. 65, 1966, p. 305-320.

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

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

34 C. Weisbard and F.K. Graham, "Heart-Rate Change as a Component of the Orienting Response in Monkeys," Journal of Comparative and Physiological Psychology, Vol. 76, 1971, p. 74.

take a similar position with respect to the heart rate changes observed in monkeys and state that deceleration is obtained when the conditions are appropriate for eliciting orienting stimuli, whereas acceleration is obtained when stimuli are intense. Similarly, in the human, Raskin et al.[35] have observed that the heart rate response to an 80 db. stimulus is characterized by a short latency deceleration which differentiates the OR from the greater degree of acceleration obtained in the DR response to a 120 db. stimulus. Such findings appear well in line with the theoretical positions taken by Obrist,[36] Obrist et al.[37] and Lacey and Lacey[38] that sensory stimuli decelerate heart rate even in the presence of increased sympathetic tonus, whereas noxious and highly conceptual tasks accelerate heart rate. These authors consider cardiovascular activity as instrumental in enhancing or rejecting environmental

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35 D.C. Raskin, Harry Kotses and J. Bever, "Cephalic Vasomotor and Heart Rate Measures of Orienting and Defensive Reflexes," Psychophysiology, Vol. 6, 1969, p. 158.

36 P.H. Obrist, "Cardiovascular Differentiation of Sensory Stimuli," Psychosomatic Medicine, Vol. 25, 1963, p. 450-451.

37 P.H. Obrist, R.A. Webb, J.R. Sutterer and J.C. Howard, "Cardiac Deceleration and Reaction Time: An Evaluation of Two Hypotheses," Psychophysiology, Vol. 6, 1970, p. 695.

38 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.

inputs, cardiac deceleration being linked to inhibition of ongoing, task-irrelevant somatic activities so as to facilitate perceptual intake, cardiac acceleration being linked to stimulus rejection. However, whereas Lacey argues that cardiac deceleration reduces afferent impulses from the baroreceptors to bulbar centers which otherwise exert an inhibitory influence on higher cortical mechanisms, cardiac deceleration thus facilitating attention, Obrist argues that cardiac deceleration is only one aspect of a general cessation of somatic activity which accompanies attention-like states.

Edwards and Alsip[39] and Goyeche and Thysell,[40] commenting on the Laceys position, state that cardiac deceleration and an increase in skin conductance, termed directional fractionation, accompany the environmental intake and pleasant tasks and that cardiac acceleration and an increase in skin conductance accompany the environmental rejection and unpleasant tasks. In this context, Deane[41] has also reported that heart rate acceleration seems to be a component of an

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39 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.

40 J.R.M. Goyeche and R.V. Thysell, "Cardiac Index of the Orienting Reaction as a Function of Anticipation Interval," Perceptual and Motor Skills, Vol. 32, 1971, p. 619.

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

anxiety response, whereas deceleration appears to occur in anticipation of any stimulation.

Because of the nature of the hue stimuli used in the present study, a heart rate deceleration of nine beats per minute occurring up to the twelfth post-stimulus beat as compared, by visual inspection, to the mean of the three pre-stimulus beats was considered an OR. The criterion of a change in heart rate of nine beats per minute from the mean of the three pre-stimulus beats was prompted by Hare's[42] observation that most experimental stimuli produce a heart rate deceleration of approximately six beats per minute. The method of obtaining heart rate habituation rates used in the present study represents an outgrowth of the Raskin et al.[43] method to judge magnitude of heart rate change to a stimulus sequence. Similar procedures have also been used by Germana and Klein,[44] Uno and Grings,[45] and Jennings et al.[46]

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[42] R. Hare, personal communication, Ottawa, January 14, 1972.

[43] D.C. Raskin, H. Kotses, and J. Bever, "Autonomic Indicators of Orienting and Defensive Reflexes," Journal of Experimental Psychology, Vol. 80, 1969, p. 425.

[44] Germana and Klein, op. cit., p. 325.

[45] Uno and Grings, op. cit., p. 314.

[46] J.R. Jennings, J.R. Averill, E.M. Opton and R.S. Lazarus, "Some Parameters of Heart Rate Change: Perceptual Versus Motor Task Requirements, Noxiousness, and Uncertainty," Psychophysiology, Vol. 7, 1971, p. 201.

Finally, concerning the Galvanic Skin Response OR, Ball et al.[47] stress the point that the GSR is a sensitive psychophysiological indicator of the OR. It consists of a drop in the electrical resistance of the skin surface. Darrow and Gullickson[48] have further expanded on the response mechanism of the GSR. Following excitation, sympathetic impulses to cutaneous tissues and subsequent release of acetylcholine account for the initial negative polarity and resistance changes. When these incoming impulses are sufficiently persistent, secretion by the sweat glands is initiated and large drops in the skin resistance occur.

In accordance with the current criteria for GSR-OR identification established in the literature by Coles et al.[49]

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47 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, Vol. II, New York, Mazel, 1971, p. 352.

48 C.W. Darrow and G.R. Gullickson, "The Peripheral Mechanism of the Galvanic Skin Response," Psychophysiology, Vol. 6, 1970, p. 597-598.

49 M.G.H. Coles, A. Gale, and P. Kline, "Personality and Habituation of the Orienting Reaction: Tonic and Response Measures of Electrodermal Activity," Psychophysiology, Vol. 8, 1971, p. 57.

Israel,[50] Sadler et al.[51] O'Gorman,[52] O'Gorman et al.,[53] Das and Bower,[54] Maltzman et al.[55] Uno and Grings,[56] Germana[57] and Hare et al.,[58] a GSR-OR was defined as an increase in skin conductance of at least three hundred ohms occurring within a ten-second period following stimulus onset.

After the experimenter had scored the OR records (without knowledge of the subject's position on the extraversion dimension) for each of the three Orienting Reaction habituation rate parameters, they were scored once again

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50 N.R. Israel, "Individual Differences in GSR Orienting Response and Cognitive Control," Journal of Experimental Research in Personality, Vol. 1, 1966, p. 245.

51 Sadler et al., op. cit., p. 313.

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

53 O'Gorman et al., op. cit., p. 718.

54 J.P. Das and A.C. Bower, "Orientating Responses of Mentally Retarded and Normal Subjects to Word-Signals," British Journal of Psychology, Vol. 62, 1971, p. 90.

55 I. Maltzman, L. Harris, E. Ingram and C. Wolff, "A Primary Effect in the Orienting Reflex to Stimulus Change," Journal of Experimental Psychology, Vol. 87, 1971, p. 202.

56 Uno and Grings, op. cit., p. 314.

57 J. Germana, "Response Characteristics and the Orienting Reflex," Journal of Experimental Psychology, Vol. 78, 1968, p. 612.

58 R. Hare, K. Wood, S. Britain, and J. Frazelle, "Autonomic Responses to Affective Visual Stimulation: Sex Differences," Journal of Experimental Research in Personality, Vol. 5, 1971, p. 16.

independently by another judge so as to obtain interrater scoring reliability estimates.

7. Methods of Analysis of Size Judgment Data.

In the context of the theory of signal detection, two stimulus situations were defined corresponding to noise and signal plus noise conditions. In the present study, the two stimulus situations were (1) presentation of variable stimuli targets which were larger than the standard stimulus target (noise), and (2) presentation of variable stimuli targets which were smaller than the standard stimulus target (signal plus noise). Following each stimulus presentation, the subject responded either "smaller" or "larger." The two types of stimulus conditions, small and large variable stimuli targets, and the two response categories, smaller and larger, resulted in four stimulus-response alternatives.[59] These four stimulus-response alternatives are illustrated in the stimulus and response alternative matrix in Figure 2. The hit rate P(Js/Ss), i.e., judged small, stimulus small, is the probability that the subject would judge the variable stimulus as smaller when, in fact, it was smaller than the standard. The false alarm rate P(Js/Sl), i.e., judged small, stimulus large, was

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59 J.A. Swets, W.P. Tanner, Jr., and T.G. Birdsall, "Decision Processes in Perception," Psychological Review, Vol. 68, 1961, p. 306.

RESPONSE ALTERNATIVE	Stimulus Alternative: Small	Stimulus Alternative: Large
Smaller	P(Js/Ss) Judged smaller/Stimulus small Hit	P(Js/Sl) Judged smaller/Stimulus large False Alarm
Larger	P(Jl/Ss) Judged larger/Stimulus small Miss	P(Jl/Sl) Judged larger/Stimulus large Correct Rejection

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

the probability that the subject would judge the variable stimulus smaller when in fact it was larger than the standard. These two stimulus-response alternatives are sufficient to describe the stimulus and response alternative matrix.

Following the rating procedure described by Egan et al.[60] each decision, i.e., larger or smaller, was taken according to a response criterion (positive, fairly sure, guess) adopted by the subject. In actual fact, the subject divided her observations into six response categories representing a continuum of various judgment criteria, attitude or motivation adopted by her during the psychophysical experiment.

The frequency of response for the three smaller stimulus targets for each of the six response categories was computed as well as the frequency of response for the three larger stimulus targets again for each of the six response categories for one variable hue stimulus. An example of this procedure is given in Appendix 3. These twelve values were entered on an IBM data card for subsequent analysis. The same procedure was followed for each of the three variable hue stimuli. The data were then analyzed with the use of an IBM 7094 Fortran IV computer program developed by Ogilvie and Creelman,[61] which yielded two separate

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60 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.

61 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.

estimates of the subject's performance for each of the three variable hue stimuli. The relationship between the hit and false alarm proportions served as the index of sensory capacity. The higher the hit proportion as determined by sensory factors only and the smaller the false alarm proportion, as determined by nonsensory personal factors, the greater was the sensitivity to size differences and the greater the value of "D Star." The variation in the hit and false alarm proportions for the various response criteria adopted by the subject reflected the influence of different criterial or attitudinal components on the observer's decisions. By averaging the various "Beta" values which the program yielded, an estimate of the effect of nonsensory variables such as set, attitude or motives of the subject on her sensory accuracy was obtained. "Beta" is defined as the level at which the subject decides to make the cut-off point between Noise and Signal plus Noise responses in her criterion. In general, a high "Beta" value indicates a greater degree of caution or a more conservative attitude in a size judgment task than a low "Beta" value.[62]

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62 J.F. Mackworth, "Vigilance, Arousal and Habituation," Psychological Review, Vol. 75, 1968, p. 310.

8. Statistical Procedure.

The statistical design followed the two-factor analysis of variance model with repeated measures on one factor.[63] The two factors considered were the introversion-extraversion dimension and hue. Repeated measures were taken on the hue factor consisting of three variable stimuli treatments, red, blue and a neutral grey. The introversion-extraversion factor consisted of three levels of extraversion, an Introverted group, a Middle group and an Extraverted group. All subjects in a group were tested under the three variable stimuli treatments. This general design was employed in three phases. The dependent measures in these three phases were: (1) habituation rates for each of the three OR parameters; (2) "D Star" or the sensory capacity of the subject independent of nonsensory, personal factors which influence the observer's size judgments; (3) "Beta" or the nonsensory, personal factors which influence the observer's size judgments. To investigate the differences in analytic ability between Introverted, Middle and Extraverted subjects, a one-factor analysis of variance model[64] was used, analytic ability being the dependent measure.

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63 B.J. Winer, Statistical Principles in Experimental Design, New York, McGraw-Hill, 1962, p. 302.

64 Lawrence-T. Dayhaw, Manuel de Statistique, 3 ième édition, Editions de l'Université d'Ottawa, 1966, p. 412-415.

Where these procedures yielded over-all significant differences at the .05 level or above, the post hoc procedure employed was the Tukey test,[65] again set at the .05 level of significance.

Two-tailed t tests for significance of differences between the groups on the EPI personality dimensions were also used.[66]

Scorer reliability estimates for each of the three OR parameters used in this study were calculated for all thirty subjects using Ebel's formula.[67]

Test-retest reliability estimates of the EPI and HFT-V were obtained with the Pearson "r" method.[68]

In the following chapter, the results of the study are presented and discussed.

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

66 J.P. Guilford, Psychometric Methods, New York, McGraw-Hill, 1954, p. 395-397.

67 Dayhaw, op. cit., p. 359-361.

68 Ibid., p. 126.

CHAPTER III

PRESENTATION AND DISCUSSION OF RESULTS

This chapter presents the results of the statistical analyses of the data and their interpretation in the light of the theoretical background and hypotheses outlined in Chapter I.

1. Presentation of Results.

A. Selection Data for Groups of Introverted, Middle and Extraverted Subjects

Three groups of ten Introverted, ten Middle and ten Extraverted subjects were selected from an initial sample of fifty-six student nurses on the basis of their scores on the Eysenck Personality Inventory (EPI), Form A. The means of the Extraversion and Neuroticism dimensions for the total population group of fifty-six subjects were 13.57 and 11.79, respectively, whereas the means of the Extraversion and Neuroticism dimensions for the total sample group of thirty subjects were 13.93 and 11.73, respectively. It may be noted that these values are highly similar to the norms for student nurses provided by Eysenck and Eysenck in their EPI Manual,[1]

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

the mean for Extraversion is 12.4 and the mean for Neuroticism is 10.5. The means of the Extraversion dimension for the ten Introverted, ten Middle and ten Extraverted subjects were 9.20, 14.20 and 18.40, respectively. The means of the Neuroticism dimension for the ten Introverted, ten Middle and ten Extraverted subjects were 12.70, 12.30 and 10.00, respectively. These scores are shown in Table I.

T-tests applied to the sample data indicated that for the Extraversion dimension each of the three groups differed significantly from each other ($p \leq .001$), whereas they did not for the Neuroticism dimension. These values are presented in Table II.

Thus, while the three sample groups differed significantly from each other on the Extraversion dimension, they were approximately equal for Neuroticism, age and educational level. Furthermore, the mean Otis (Higher Examination, Form A) I.Q. scores for the Introverted, Middle and Extraverted groups were 114.1, 115.3, and 113.5, respectively (Table III.) A one-factor analysis of variance model used to analyze the data yielded no significant differences between the groups (Table IV). Pearson "r" coefficients computed between the EPI (Form A) and EPI (Form B) for the thirty subjects of the sample yielded a reliability estimate of .78 ($p < .001$).

Table I.-

EPI (Form A) Score Distributions on Extraversion (E) and Neuroticism (N) for Total Population Group, Total Sample Group and Introverted, Middle and Extraverted Groups.

Group	N	(E) Mean	(E) S.D.	(N) Mean	(N) S.D.
Total population group	56	13.57	3.54	11.79	4.32
Total sample group	30	13.93	4.14	11.63	4.27
Introverted group	10	9.20	1.69	12.70	4.45
Middle group	10	14.20	1.81	12.30	4.57
Extraverted group	10	18.40	1.43	10.00	3.68

Note: The EPI scores for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table II.-

"t" Values Obtained for Extraversion(E) and Neuroticism(N) Dimensions for Introverted(I), Middle(M), and Extraverted(E) Groups on the EPI (Form A).

Dimension	Group	I	M	E
E	I		6.057*	12.483*
	M			5.456*
	E			
N	I		.235	1.403
	M			1.125
	E			

$t_{.95}(18) = 2.101$
$t_{.99}(18) = 2.878$
$t_{.999}(18) = 3.922$

*$p < .001$

Table III.-

Mean Otis I.Q. Scores for Introverted, Middle and Extraverted Groups.

Group	N	I.Q.
Introverted group	10	114.1
Middle group	10	115.3
Extraverted group	10	113.5
Average	30	114.3

Note: The Otis I.Q. scores for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table IV.-

Analysis of Variance of Otis (Higher Examination, Form A) I.Q. Scores for Groups of Introverted, Middle and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio
Between subjects	16.8	2	8.4	0.17
Within subjects	1327.5	27	49.2	
Total	1344.3	29		

$F_{.95}(2,27) = 3.35$

B. Orienting Reaction Habituation Rate Data

The mean vasomotor OR habituation rates for the Introverted, Middle and Extraverted groups were 5.5, 1.9 and 0.8, respectively, while those for the neutral grey, red and blue hue stimuli were 2.7, 2.7 and 2.5 respectively, the overall mean vasomotor OR habituation rate being 2.7. These results are shown in Table V and indicate that, as predicted, the Introverted group had the longest OR habituation rate, the Extraverted group the lowest, the Middle group occupying an intermediate position.

The analysis of variance yielded a significant F ratio of 11.11 ($p<.001$) for the extraversion factor. No significant differences were noted for the hue factor or for the interaction of extraversion and hue (Table VI). Analysis of main effects for extraversion yielded a significant difference of 4.70 ($p<.02$) between the means of the Introverted and Extraverted groups. The differences in means obtained between the Introverted and Middle groups and between the Middle and Extraverted groups were not considered statistically significant (Table VII). Interrater reliability was .1447 for one rater and .2528 for two raters combined (Appendix 5).

The mean Heart Rate OR habituation rates for the Introverted, Middle and Extraverted groups were 5.6, 7.4 and 2.1, respectively, while those for the neutral grey, red and

Table V.-

Mean Vasomotor OR Scores to Hues for Introverted, Middle and Extraverted Groups.

Group	N	Grey	Red	Blue	Average
Introverted group	10	6.5	4.5	5.5	5.5
Middle group	10	1.0	3.2	1.4	1.9
Extraverted group	10	1.5	0.4	0.5	0.8
Average	30	2.7	2.7	2.5	2.7

Table VI.-

Analysis of Variance of Vasomotor OR Habituation Rate Scores to Hues for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between Subjects	806.72	29		
A (Extraversion)	364.29	2	182.15	11.11*
Subjects within groups	442.43	27	16.40	
Within Subjects	1171.34	60	2.15	
B (Hues)	4.29	2	12.65	0.10
AB	50.58	4	20.68	0.61
B x subjects within groups	1116.47	54		

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

Note: The Vasomotor OR habituation rate scores to hues for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table VII.-

Differences Between Pairs of Means of Vasomotor OR Habituation Rate Scores for Extraversion Main Effect.

	Introverted Group	Middle Group	Extraverted Group
Introverted group		3.63	4.70*
Middle group			1.10
Extraverted group			
Significant gap (.02) = 4.48			

*p < .02

blue hue stimuli were 4.1, 4.3 and 6.8, respectively, the over-all mean Heart Rate OR habituation rate being 5.0. The Heart Rate component of the Orienting Reaction thus took longer to habituate than the Vasomotor component. These results are shown in Table VIII and again indicate, as in the case of the Vasomotor component, that the Introverted group had a longer OR habituation rate than the Extraverted group. The Middle group, however, in the case of the Heart Rate OR component had the longest OR habituation rate.

The analysis of variance again yielded a significant F Ratio of 6.92 ($p<.01$) for the Extraversion factor. As in the case of the Vasomotor OR component, no significant differences were noted for the Hue factor or for the interaction of Extraversion and Hue (Table IX). Analysis of main effects for Extraversion yielded a significant difference of 5.27 ($p<.05$) between the means of the Middle and Extraverted groups. The differences in means obtained between the Introverted and Middle groups and between the Introverted and Extraverted groups were not considered statistically significant (Table X). Interrater reliability was .8916 for one rater and .9427 for two raters combined (Appendix 5).

The mean Galvanic Skin Response OR habituation rates for the Introverted, Middle and Extraverted groups were 5.8, 1.1 and 0.3, respectively, while those for the neutral grey, red and blue hue stimuli were 2.5, 2.3 and 2.4,

Table VIII.-

Mean Heart Rate OR Scores to Hues for Introverted, Middle and Extraverted Groups.

Group	N	Grey	Red	Blue	Average
Introverted group	10	4.9	3.0	8.8	5.6
Middle group	10	5.7	6.6	9.9	7.4
Extraverted group	10	1.6	3.2	1.6	2.1
Average	30	4.1	4.3	6.8	5.0

Table IX.-

Analysis of Variance of Heart Rate OR Habituation Rate Scores to Hues for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	1266.23	29		
A (Extraversion)	428.87	2	214.44	6.92*
Subjects within groups	837.37	27	31.01	
Within subjects	1660.67	60		
B (Hues)	135.80	2	67.90	2.71
AB	173.93	4	43.48	1.74
B x Subjects within groups	1350.94	54	25.02	

$p < .01$ $F_{.99}(2,27) = 5.49$

Note: The Heart Rate OR habituation rate scores to hues for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table X.-

Differences Between Pairs of Means of Heart Rate OR Habituation Rate Scores for Extraversion Main Effect.

	Introverted Group	Middle Group	Extraverted Group
Introverted group		1.83	3.44
Middle group			5.27*
Extraverted group			
Significant gap (.05) = 5.10			

*p < .05

respectively, the over-all mean Galvanic Skin Response OR habituation rate being 2.3, thus highly similar to the over-all mean Vasomotor OR habituation rate of 2.7. These results are shown in Table XI and indicate that once again, the Introverted group had the longest OR habituation rate, the Extraverted group the lowest, with the Middle group occupying an intermediate position.

In line with the results obtained for both the Vasomotor and Heart Rate OR components, the analysis of variance of the Galvanic Skin Response OR habituation rate yielded a significant F ratio of 6.08 ($p<.01$) for the Extraversion factor. Once again, no significant differences were noted for the Hue factor or for the interaction of Extraversion and Hue (Table XII). Analysis of main effects for Extraversion failed to reveal significant differences between pairs of means. It was, however, observed that the difference in means obtained between the Introverted and Extraverted groups was 5.47 ($p<.10$) and, in fact, approached the .05 level of significance. This is noted as a trend in line with the results obtained for the Vasomotor OR component (Table XIII). Inter-rater reliability was .8625 for one rater and .9261 for two raters combined (Appendix 5).

These results thus indicate that, as predicted for all three of the OR parameters investigated, the Extraversion factor produced significant differences in OR habituation

Table XI.-

Mean Galvanic Skin Response OR Scores to Hues for Introverted, Middle and Extraverted Groups.

Group	N	Grey	Red	Blue	Average
Introverted group	10	7.1	5.0	5.2	5.8
Middle group	10	0.3	1.5	1.5	1.1
Extraverted group	10	0.1	0.3	0.5	0.3
Average	30	2.5	2.3	2.4	2.3

Table XII.-

Analysis of Variance of Galvanic Skin Response OR Habituation Rate Scores to Hues for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	1683.38	29		
A (Extraversion)	523.02	2	261.51	6.08*
Subjects within groups	1160.36	27	42.98	
Within subjects	1162.00	60		
B (Hues)	.81	2	0.41	0.02
AB	36.45	4	9.11	0.44
B x Subjects within groups	1124.74	54	20.83	

*$p < .01$ $F_{.99}(2,27) = 5.49$

Note: The Galvanic Skin Response OR habituation rate scores to hues for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table XIII.-

Differences Between Pairs of Means of Galvanic Skin Response OR Habituation Rate Scores for Extraversion Main Effect.

	Introverted Group	Middle Group	Extraverted Group
Introverted group		4.67	5.47
Middle group			0.80
Extraverted group			

Significant gap (.05) = 6.00
Significant gap (.10) = 4.98

rates with the Introverts showing longer habituation rates than the Extraverts, the Middle subjects generally occupying an intermediate position while the influence of Hue and the interaction of Extraversion and Hue produced negligible differences in OR habituation rates.

Consequently, the first three null hypotheses outlined in Chapter I and stated once again as follows are rejected:

1. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Vasomotor OR habituation rate to red, blue and neutral grey stimuli.

2. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Heart Rate (HR) OR habituation rate to red, blue and neutral grey stimuli.

3. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their Galvanic Skin Response (GSR) OR habituation rate to red, blue and neutral grey stimuli.

However, in accordance with the results presented above, null hypotheses four, five and six outlined in Chapter I and stated once again as follows are not rejected:

4. There is no significant difference between red, blue and neutral grey stimuli in their Vasomotor OR habituation rate.

5. There is no significant difference between red, blue and neutral grey stimuli in their Heart Rate (HR) OR habituation rate.

6. There is no significant difference between red, blue and neutral grey stimuli in their Galvanic Skin Response (GSR) OR habituation rate.

C. Analytic Ability Data

The mean Hidden Figures Test-Form V (HFT-V)[2] scores for the Introverted, Middle and Extraverted groups were 7.0, 5.2 and 4.8, respectively, the over-all mean being 5.67. These results are shown in Table XIV and indicate that, as predicted, the Introverted group solved a greater number of problems correctly than the Extraverted group, the Middle group occupying an intermediate position. Thus, the Introverts displayed a higher degree of analytic ability and field independence than the Middle and Extraverted groups. However, this finding is questionable because of the low test-retest reliability coefficients obtained on the HFT-V ("r" = .45, $p < .10$). Moreover, the analysis of variance did not yield a significant F ratio at the .05 level of confidence (Table XV). Consequently, null hypothesis seven outlined in Chapter I and stated once again as follows is not rejected:

7. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in level of analytic ability as indicated by the Hidden Figures Test-Form V.

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2 D.N. Jackson, S. Messick and C.T. Myers, "Evaluation of Group and Individual Forms of Embedded-Figures Measures of Field Independence," Educational and Psychological Measurement, Vol. 24, 1964, p. 189.

Table XIV.-

Mean HFT-V Scores for Total Sample Group and Introverted, Middle and Extraverted Groups.

Group	N	HFT-V
Total sample group	30	5.67
Introverted group	10	7.0
Middle group	10	5.2
Extraverted group	10	4.8

Table XV.-

Analysis of Variance of HFT-V Scores for Groups of Introverted, Middle and Extraverted Subjects.

Source of Variation	SS	df	MS	F Ratio
Between subjects	27.47	2	13.735	0.83
Within subjects	447.20	27	16.563	
Total	474.67	29		

$F_{.95(2,27)} = 3.35$

Note: The HFT-V scores for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

D. Signal Detection Analysis

The mean "D Star" or sensory capacity scores independent of the observer's nonsensory, personal factors which influence his sensory accuracy for the Introverted, Middle and Extraverted groups were 2.47, 2.12 and 1.67, respectively, while those for the neutral grey, red and blue hue stimuli were 2.24, 1.71 and 2.31, respectively, the over-all mean "D Star" value being 2.09. These results are shown in Table XVI and indicate that, as hypothesized, the Introverted group displayed the greatest sensitivity to size differences, the Extraverted group the lowest, with the Middle group occupying an intermediate position. Again, as hypothesized, blue had the greatest facilitating effect on sensory capacity, red the most disruptive effect, with neutral grey occupying an intermediate position.

The analysis of variance yielded a significant F ratio of 3.21 ($p<.05$) for the Hue factor. No significant differences were noted for the Extraversion factor or for the interaction of Hue and Extraversion (Table XVII). Analysis of main effects for Hue failed to reveal significant differences between pairs of means. It was, however, observed that the difference in means obtained between the blue and red hues was .60 ($p<.20$). This is noted as a trend and will be interpreted accordingly (Table XVIII).

Table XVI.-

Mean "D Star" Scores to Hues for Introverted, Middle and Extraverted Groups.

Group	N	Grey	Red	Blue	Average
Introverted group	10	2.63	2.09	2.70	2.47
Middle group	10	2.39	1.49	2.47	2.12
Extraverted group	10	1.69	1.55	1.77	1.67
Average	30	2.24	1.71	2.31	2.09

Table XVII.-

Analysis of Variance of "D Star" Scores for Hues for Introverted,, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	183.68	29		
A (Extraversion)	10.39	2	5.195	.81
Subjects within groups	173.29	27	6.418	
Within subjects	67.42	60		
B (Hues)	6.95	2	3.475	3.21*
AB	1.98	4	0.495	.46
B x Subjects within groups	58.49	54	1.083	

$p < .05$ $F_{.95(2,54)} = 3.15$

Note: The "D Star" scores to hues for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

Table XVIII.-

Differences Between Pairs of Means of "D Star" Scores for Hue Main Effect.

	Grey	Red	Blue
Grey		.53	.07
Red			.60
Blue			

Significant gap (.05) = .94
Significant gap (.10) = .77
Significant gap (.20) = .60

Consequently, the eighth null hypothesis outlined in Chapter I and stated once again as follows is not rejected:

8. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in their apparent size judgments of red, blue and neutral grey stimuli as indicated by a measure of sensory capacity independent of nonsensory, personal factors which influence the observer's judgments.

However, based on the results summarized above, the ninth null hypothesis outlined in Chapter I and stated once again as follows is rejected:

9. There is no significant difference between red, blue and neutral grey stimuli in their influence on apparent size as indicated by a measure of sensory capacity independent of nonsensory personal factors which influence the observer's judgments.

The mean "Beta" scores or nonsensory, personal factors affecting the observer's sensory capacity in the size judgment task, for the Introverted, Middle and Extraverted groups were 1.39, 1.14 and 0.92, respectively, while those for the neutral grey, red and blue hue stimuli were 0.94, 1.18 and 1.32, respectively, the over-all mean "Beta" value being 1.15. The results are shown in Table XIX and indicate that, as hypothesized,,,,,, the Introverted group displays the greatest degree of caution and the most conservative attitude in the size judgment task, the Extraverted group the least, with the Middle group occupying an intermediate position.

Table XIX.-

Mean "Beta" Scores to Hues for Introverted, Middle and Extraverted Groups.

Group	N	Grey	Red	Blue	Average
Introverted group	10	1.12	1.47	1.57	1.37
Middle group	10	1.17	0.91	1.34	1.14
Extraverted group	10	0.52	1.17	1.06	0.92
Average	30	0.94	1.18	1.32	1.15

However, the analysis of variance failed to yield significant F ratios. No significant differences were noted for the Extraversion factor, for the Hue factor or for the interaction of Extraversion and Hue (Table XX).

Consequently, the tenth and eleventh null hypotheses outlined in Chapter I and stated once again as follows were not rejected:

10. There is no significant difference between groups of Introverted, Middle and Extraverted subjects in a measure of the nonsensory, personal factors which influence the observer's size judgments of red, blue and neutral grey stimuli.

11. There is no significant difference between red, blue and neutral grey stimuli in their influence on a measure of the nonsensory, personal factors which influence the observer's size judgments.

2. Discussion of Results.

The Orienting Reaction habituation rates obtained in this study suggest that, as stated by Sokolov[3] and Anokhin,[4] the OR is a holistic response to novel stimulation which habituates with repeated stimulus presentations but which reappears when a qualitative change is introduced in a stimulus

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

4 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, D.C., American Institute of Biological Sciences, 1965, p. 3.

Table XX.-

Analysis of Variance of "Beta" Scores to Hues for Introverted, Middle and Extraverted Groups.

Source of Variation	SS	df	MS	F Ratio
Between subjects	54.99	29		
A (Extraversion)	3.29	2	1.65	0.86
Subjects within groups	51.70	27	1.91	
Within subjects	46.89	60		
B (Hues)	2.30	2	1.15	1.47
AB	2.21	4	0.55	0.71
B x Subjects within groups	42.38	54	0.78	

Note: The "Beta" scores to hues for the Introverted, Middle and Extraverted subjects are given in Appendix 4.

parameter, i.e. various hues. This statement concerning the holistic nature of the Orienting Reaction is suggested by the fact that the habituation rate data were highly similar across all three OR parameters investigated. Thus, the problem of response specificity of various OR parameters as reported by Raskin et al.[5] was not observed in this study. However, the low interrater reliability coefficients obtained for the Vasomotor component are in agreement with similar findings reported by Desjardins[6] in a recent investigation of this particular problem

The longer Orienting Reaction habituation rates obtained by introverts as opposed to extraverts across the three OR parameters are in accordance with similar findings reported by Mangan and O'Gorman[7] and Sadler et al.[8] and indicate a

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5 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.

6 E.C. Desjardins, The Rater Reliability of a Plethysmograph Scoring Methods of the Vasomotor Orienting Reaction Habituation, interim reported presented to the Faculty of Psychology of the University of Ottawa for the degree of Doctor of Philosophy, Ottawa, Ontario, 1972, p. 56.

7 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.

8 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.

relationship between a physiological reactivity index, the Orienting Reaction and the Eysenckian personality dimension of introversion-extraversion. The results are also supportive of Gray's[9,10,11] contentions regarding the introvert or "Weak Nervous System" individual. Compared to the extravert, it thus appears that the introvert is physiologically aroused for longer periods of time and, in the context of Sokolov's neuronal model,[12] generates more signals of discrepancy when actual incoming stimuli are compared to past memory traces; he therefore seems to delay the final decision concerning the salience of the stimulus. Furthermore, in the context of Klein's[13] model of personality organization and functioning, this may indicate that when novel stimuli are presented to the introvert, in addition to the higher level of physiological activity observed, a greater wealth of peripheral motives,

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

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

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

12 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.

13 G.S. Klein, Perception, Motives and Personality, New York, Knopf, 1970, p. 94-95.

associations and physiognomic qualities are called into operation than may be the case for the extravert. Also, in the context of Schroder et al.'s[14] theory of information processing, this may suggest that the introvert's response repertoire to novel stimulation is more varied and complex than that of the extravert. The greater number of response alternatives and rules already present in the introvert's memory schemata would thus generate a geater "mismatch" between novel stimulation and past neuronal models. It follows that such a situation could conceivably lead to sustained attention and to a thorough examination of all possible stimulus attributes for longer periods of time than the extravert, the entire process being reflected in longer Orienting Reaction habituation rates.

The Orienting Reaction habituation rate data to chromatic stimuli may thus indicate, as previously suggested by Lynn,[15] that the OR monitors the relevance and the salience of information impinging on the organism and support Bernstein's[16] conception of the OR habituation rate as a direct evaluation

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

15 R. Lynn, Attention, Arousal and the Orientation Reaction, New York, Pergamon, 1965, p. 61.

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

of the value of the novel stimulus to an individual. It was in fact noted many times in this research that a subject displaying a long habituation rate to a particular hue stimulus later reported that this was her favourite colour. It thus appears that the meaning which the subject gives to the stimulus bears on the type of OR pattern given. Thus, as Maltzman and Raskin[17] have reported, OR reactivity may be linked to attention and discrimination as well as to the person's aims and motives concerning the stimulus, thus reflecting an individual's typical way of taking in information from his environment.[18] This study thus suggests a link between OR habituation rate and differential modes of perceptual-cognitive assimilation, taking the form of a greater degree of perceptual and conceptual elaboration to chromatic stimuli by the more introverted subjects. The shorter OR habituation rates of the extraverts to chromatic stimuli are supportive of Fortier's[19] hypothesis that colour forms such a central part

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17 I. 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.

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

19 R.H. Fortier, "The Response to Color and Ego Function," Psychological Bulletin, Vol. 50, 1953, p. 41-63.

of the extravert's perceptual and cognitive style that it has little arousal value to him and consequently stops responding to the hue stimulus earlier than the introvert. The OR habituation rate findings of this research appear in accord with Bakan's[20] observations that introverts display greater behavioural arousal than extraverts in listening for signals which occur infrequently in a lengthy vigilance task, as well as with Ross et al.'s[21] findings of a positive relationship between high Galvanic Skin Response conductance levels and sustained attention in a vigilance task.

The OR habituation rate results of differential arousal levels for Introverted, Middle and Extraverted subjects thus offer support for Eysenck's[22,23,24] hypothesized relationship between the Western personality dimension of extraversion and the Russian dimension of "Strong" and "Weak Nervous Systems"

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

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 H.J. Eysenck, "Conditioning, Introversion-Extraversion and the Strength of the Nervous System," in H.J. Eysenck (ed.), Readings in Extraversion-Introversion, Vol. III, Bearings on Psychological Processes, London, Staples, 1971, p. 500.

23 --------, The Biological Basis of Personality, Springfield, Ill., Thomas, 1967, p. 242.

24 Ibid., p. 231.

as related to OR research. However, the longer OR habituation rates and longer arousal levels to chromatic stimuli for the Introverted subjects were not paralleled by greater sensory accuracy in the size judgment task to the same chromatic stimuli or by differences in the nonsensory, personal factors such as set, attitudes or motives influencing sensory capacity. Consequently, the results of these two separate estimates of perceptual functioning derived from Signal Detection Theory do not differentiate between the performance of introverts and extraverts in a size judgment task. More specifically, they do not support Gray,[25] Eysenck[26] and Eysenck and Eysenck[27] in their hypothesis that the more highly aroused introvert is characterized by greater sensitivity of perceptual intake, efficiency in sensory processing and lower excitatory sensory thresholds than the extravert. Thus, introversion and high cortical arousal as indicated by longer OR habituation rates does not seem concomitant with greater perceptual efficiency or accuracy as indicated by the results obtained in the size judgment task. Although the OR habituation rate data suggest differential modes of perceptual and cognitive complexity and

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25 Gray, "Strength of the Nervous System, Introversion-Extraversion, Conditionability and Arousal," p. 151-169.

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

27 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.

functioning as well as differential levels of attention deployment and discrimination for introverts and extraverts, these qualitative differences do not appear to be indicative of greater perceptual efficiency or higher levels of performance in a perceptual judgment task. Consequently, the results obtained in this research are not in agreement with the findings of Smith[28] and Siddle et al.[29] who report that introverts display higher performance levels than extraverts in auditory and visual discrimination tasks. Similarly, the results of Coles and Gale[30] linking Galvanic Skin Response habituation rate with superior detection efficiency in a discrimination task were not found in this investigation.

Furthermore, no significant differences were noted in the perceptual performance of introverts and extraverts in a test of analytic ability which requires that the subject extract a simple figure from a more complex background. This lends further support to the hypothesis that introversion is not concomitant with greater perceptual efficiency.

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

29 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.

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

Parenthetically, it is also noted that these results do not support Eysenck's[31] contention of a relationship between introversion and field-independence on the one hand and extraversion and field-dependence on the other. The significant relationship obtained by Evans[32] between these two dimensions is therefore not replicated in this study. This, however, may be due to the fact that the tests used to measure extraversion and analytic ability were not identical to those used in this research.

Finally, concerning the hypothesized relationship between specific hues and their differential arousal values, the OR results do not support the contentions of Lewinski,[33] Pressey[34] and Smets[35] that red is more physiologically arousing than blue. However, concerning the hypothesized relationship between specific hues and their influence on sensory capacity,

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31 Eysenck, The Biological Basis of Personality, p. 117.

32 F.J. Evans, "Field Dependence and the Maudsley Personality Inventory," in Eysenck (ed.), Readings in Extraversion-Introversion, p. 309-310.

33 R.J. Lewinski, "An Investigation of Individual Responses to Chromatic Illumination," The Journal of Psychology, Vol. 6, 1938, p. 155-160.

34 S.L. Pressey, "The Influence of Color Upon Mental and Motor Efficiency," American Journal of Psychology, Vol. 32, 1921, p. 351.

35 G. Smets, "Time Expression of Red and Blue," Perceptual and Motor Skills, Vol. 29, 1969, p. 511.

the Signal Detection analyses suggest, as noted many years ago by Goldstein and Rosenthal,[36] that blue enhances sensory accuracy. Red, however, appears to function as a protusive cue which disrupts perceptual and cognitive organizing functions as compared to blue and as reflected in lower sensory accuracy scores. This finding is only partially supportive of Kenny's[37] position that colour may have a disruptive influence on perceptual functioning for individuals with weak decentering ability, since in this research, colour and personality variables showed no interaction effects.

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36 K. Goldstein and O. Rosenthal, "Zum Problem der Wirkung der Farben auf den Organismus," Schweig. Arch. Neurol. Psychiat., Vol. 26, 1930, quoted by R.D. Norman and W.A. Scott, "Color and Affect: A Review and Semantic Evaluation," The Journal of General Psychology, Vol. 46, 1952, p. 217.

37 D.T. Kenny, "Stimulus Functions in Projective Techniques," in B.A. Maher (ed.), Progress in Experimental Personality Research, Vol. I, New York, Academic, 1964, p. 321.

CONCLUSION

The results of this study suggest that the Orienting Reaction is related to the personality dimension of Extraversion and that the OR may lead to a better understanding of differential modes of perceptual and cognitive elaboration and functioning.

The findings of this research of shorter Orienting Reaction habituation rates for the extravert as opposed to the introvert may be linked to differences in level of attention to both internal and environmental stimulation. It seems indeed noteworthy that Rosenberg[1] has indicated a relationship between high and certain self-concept reporting, high extraversion and low vasomotor OR habituation rates. There thus appears to be a possibility that these individuals know and esteem themselves highly and do not pay attention to environmental stimuli unless they have a particular salience or subjectively meaningful context for them.

It is suggested that further research attempting to link the personality variable of extraversion with differential Orienting Reaction reactivity and perceptual-cognitive style attempt to record these dependent variables simultaneously.

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1 G. Rosenberg, Self-Concept Certainty Reporting and Orienting Reaction Habituation Rate, unpublished doctoral thesis presented to the Faculty of Psychology of the University of Ottawa, Ontario, 1971, p. 90-91.

Indeed, in this study the failure to observe differences in perceptual intake may be due to the fact that these differences only manifest themselves to the initial presentations of a novel stimulus, and are not applicable to general perceptual efficiency. The use of varying levels of stimulus complexity via different sensory modalities is also warranted, so as to investigate the level of generality of the findings reported in this study for chromatic stimuli.

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This article proposes a link between extraversion, Russian typologies, arousal and perceptual sensitivity.

Green, O.M., and J.A. Swets, Signal Detection Theory and Psychophysics, New York, Wiley, 1966, xi-455 p.
This is a source book of experimental procedures illustrating the Signal Detection method.

Jackson, D.N., S. Messick, and C.T. Myers, "Evaluation of Group and Individual Forms of Embedded-Figures Measures of Field-Independence," Educational and Psychological Measurement, Vol. 24, 1964, p. 177-192.
This article influenced the selection of the HFT-V as a measure of analytic ability in this study.

Kenny, D.T., "Stimulus Functions in Projective Techniques," in B.A. Maher (ed.), Progress in Experimental Personality Research, Vol. I, New York, Academic, 1964, p. 285-354.
This paper advances the hypothesis that chromatic stimuli may function as a protusive cue for individuals with weak decentering ability.

Lynn, R., Attention, Arousal and the Orientation Reaction, New York, Pergamon, 1965, viii-118 p.
This text offers a concise review of the literature on the Orientation Reaction.

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 article advances theoretical and experimental evidence of the hypothesis that the Orienting Reaction is linked to attention and discrimination.

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.

This article contains a valuable review of mainly Russian studies concerning the Orienting Reaction and presents the hypothesis that the OR is linked to cognition.

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

This is the basic reference in the understanding of the functions of the Orienting Reaction.

--------, "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 article discusses the Orienting Reaction in terms of a tool for the evaluation of sensory analysis and presents the neuronal model.

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, 1970, vii-123 p.

This study was very influential in guiding the theoretical development of the problem as well as the actual experimental procedures used in this study.

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

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APPENDIX 1

EYSENCK PERSONALITY INVENTORY, FORM A

EYSENCK PERSONALITY INVENTORY

FORM A

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

Name_____ Age_____ Sex_____

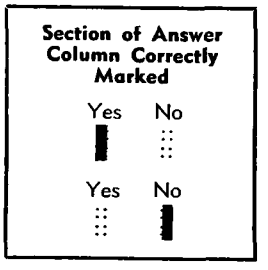
Grade or Occupation _____ Date_____

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.

PUBLISHED BY EDUCATIONAL AND INDUSTRIAL TESTING SERVICE
BOX 7234, SAN DIEGO, CALIFORNIA 92107

E N L

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
15. 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

PLEASE CHECK TO SEE THAT YOU HAVE ANSWERED ALL THE QUESTIONS.

APPENDIX 2

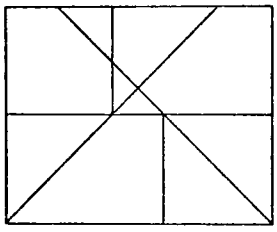
SAMPLE PROBLEM FROM HIDDEN FIGURES TEST-FORM V

SAMPLE PROBLEM FROM HIDDEN FIGURES TEST-FORM V

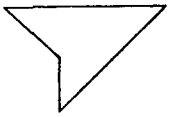
HIDDEN FIGURES TEST—V

Each problem in this test is made up of two designs, a complicated figure on the first page and a simple figure on the next. In each problem the simple design is contained in the complicated design. You are to find where the simple design is contained in the larger design and sketch it in over the lines of the figure.

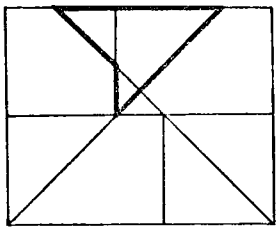
Here is an example of a complicated figure, a simple figure, and the complicated figure shown again with the simple figure sketched in.



Complicated figure



Simple figure



Simple figure sketched in

The smaller figure is always present in the larger figure and always in the upright position. Be sure the figure you find is exactly the same as the simple figure, both in size and proportions. Work carefully and as systematically as you can. If you feel that you cannot solve one of the figures, you may skip it and come back to it later if you have time, but you will waste time if you keep skipping from figure to figure. Do not worry about erasing completely if you have one or two incorrect lines, but be sure that you have all the correct ones clearly indicated.

APPENDIX 3

STIMULUS-RESPONSE FREQUENCY MATRIX

APPENDIX 3

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

Response Category	Signal	Stimulus Value (in .005 inches) .5875	.5925	.5975	.6025	.6075	.6125	Noise
SP	42	11	14	17	1	3	1	5
SF	22	9	8	5	1	2	0	3
SG	4	1	2	1	3	0	0	3
LG	6	3	2	1	1	5	2	8
LF	9	3	0	6	11	9	3	23
LP	7	3	4	0	13	11	24	48

APPENDIX 4

RAW DATA FOR EPI, HFT-V, OTIS, OR HABITUATION RATES, "D STAR" AND "BETA"

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

Hidden Figures Test - Form V (HFT-V) Scores on First(1) and Second(2) Testing for Groups of Introverted, Middle and Extraverted Subjects.

Subject	HFT-V(1)	HFT-V(2)
Introverted		
44	4	
25	12	15
34	6	11
59	13	
16	12	13
35	1	1
19	14	
11	6	7
8	0	
56	2	
Middle		
27	9	
57	5	14
53	6	8
47	11	
43	0	
42	3	
2	6	14
51	3	
33	6	
12	3	
Extraverted		
32	3	
22	8	13
54	4	16
30	5	5
24	3	11
28	1	1
40	0	10
38	5	
13	9	5
58	10	

Otis Higher Examination (Form A) I.Q. Scores for Groups of Introverted, Middle and Extraverted Subjects.

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

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

Subject	Hue: Grey		Red		Blue	
	Judge 1	Judge 2	Judge 1	Judge 2	Judge 1	Judge 2
Introverted						
44	12	0	1	0	0	0
25	14	26	2	20	2	14
34	2	0	5	0	11	5
59	10	4	9	0	6	3
16	0	6	17	8	9	10
35	2	0	0	0	14	13
19	0	0	4	1	2	2
11	2	2	1	0	0	2
8	18	0	0	0	3	18
56	5	0	6	0	8	2
Middle						
27	0	0	0	0	3	0
57	0	9	0	17	0	7
53	0	4	0	3	0	6
47	0	0	0	0	0	5
43	6	8	3	0	9	0
42	0	1	0	0	0	9
2	0	0	3	3	1	3
51	0	0	0	0	0	0
33	4	2	0	0	0	0
12	0	3	26	0	1	4
Extraverted						
32	4	1	1	5	0	0
22	1	5	0	1	0	0
54	3	0	1	0	0	14
30	0	0	0	0	0	2
24	3	3	2	0	2	4
28	1	0	0	0	1	0
40	3	5	0	3	0	3
38	0	10	0	15	0	10
13	0	3	0	0	1	2
58	0	0	0	0	1	0

Heart Rate(HR) Orienting Reaction Habituation Rates for Groups of Introverted, Middle and Extraverted Subjects by Two Judges.

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

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

Subject	Hue: Grey Judge 1	Grey Judge 2	Red Judge 1	Red Judge 2	Blue Judge 1	Blue Judge 2
Introverted						
44	0	0	4	4	7	7
25	29	29	30	30	1	1
34	10	1	2	2	13	13
59	0	0	0	0	0	0
16	0	0	2	2	1	1
35	0	5	10	9	11	1
19	0	0	1	1	7	6
11	0	0	0	1	0	0
8	25	6	0	0	11	1
56	7	7	1	1	1	1
Middle						
27	0	0	0	0	0	0
57	1	2	7	5	1	4
53	2	2	1	1	1	1
47	0	0	1	1	0	0
43	0	0	0	0	0	0
42	0	0	0	0	0	0
2	0	0	0	0	4	4
51	0	0	0	0	0	0
33	0	0	0	0	0	0
12	0	0	6	6	9	9
Extraverted						
32	0	0	0	0	1	1
22	0	0	1	1	0	0
54	0	0	1	1	0	0
30	0	0	0	0	0	0
24	0	0	0	0	3	3
28	1	1	0	0	0	0
40	0	0	0	0	0	0
38	0	0	1	4	0	0
13	0	0	0	0	0	0
58	0	1	0	0	1	1

"D Star" of Hues for Groups of Introverted, Middle and Extraverted Subjects.

Subject	Hue		
	Grey	Red	Blue
Introverted			
44	2.55	2.98	2.23
25	2.86	3.28	7.66
34	3.86	1.70	2.86
59	1.79	1.47	1.91
16	2.62	1.05	1.30
35	0.46	0.72	2.35
19	5.35	2.28	2.44
11	1.08	1.54	1.29
8	3.82	4.24	3.16
56	1.90	1.63	2.76
Middle			
27	-1.12	-0.61	-0.80
57	1.64	2.38	2.21
53	3.08	2.71	3.01
47	6.77	1.59	6.54
43	2.44	1.98	2.52
42	1.12	1.28	0.83
2	2.85	0.45	2.99
51	2.26	1.78	2.47
33	2.48	1.82	2.44
12	2.39	1.49	2.47
Extraverted			
32	1.24	2.75	3.57
22	1.40	2.86	2.26
54	2.50	2.33	1.34
30	0.02	0.91	1.02
24	1.79	0.91	1.71
28	2.42	2.33	2.58
40	-2.29	-5.05	-1.53
38	3.49	3.18	2.05
13	2.80	2.74	1.77
58	3.56	2.57	2.96

"Beta" of Hues for Groups of Introverted, Middle and Extraverted Subjects.

Subject	Hue		
	Grey	Red	Blue
Introverted			
44	1.95	1.84	1.47
25	1.64	1.76	3.74
34	.988	1.13	1.00
59	.23	.68	.44
16	1.31	.99	.70
35	- .75	1.64	2.23
19	2.75	.91	2.22
11	.03	1.91	.16
8	2.06	3.27	1.66
56	.97	.57	2.03
Middle			
27	- .79	- .76	1.08
57	1.09	-1.13	.73
53	1.83	2.50	1.85
47	2.54	.22	2.34
43	1.66	1.19	1.54
42	.62	1.02	.92
2	1.39	- .19	1.33
51	.82	4.20	1.18
33	1.40	1.13	1.07
12	1.17	.91	1.34
Extraverted			
32	.21	1.62	1.54
22	.35	1.71	2.16
54	.63	1.28	.59
30	- .52	.95	.32
24	.50	1.17	.83
28	.79	2.60	.69
40	- .68	-2.81	- .71
38	2.00	3.17	1.36
13	1.71	1.52	1.43
58	.17	.51	2.41

APPENDIX 5

ESTIMATES OF RATING RELIABILITY OF ORIENTING REACTION HABITUATION RATE FOR VASOMOTOR COMPONENT, HEART RATE COMPONENT AND GALVANIC SKIN RESPONSE COMPONENT

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

	Vasomotor	Heart Rate	Galvanic Skin Response
$\bar{r}_{11}$ for one rater	.1447	.8916	.8625
r_{22} for two raters combined	.2528	.9427	.9261

APPENDIX 5A

PEARSON "r" COEFFICIENTS BETWEEN SELECTED VARIABLES

Pearson "r" Coefficients Between Selected Variables

Variable:	EPI(A)	BV	HR	GSR	d'	BETA
EPI(A)		-.33	-.14	-.37	-.11	-.09
BV			.25	.41	.00	.06
HR				.19	.06	.09
GSR					.16	.14
d'						.09
BETA						

APPENDIX 6

ABSTRACT OF

Introversion-Extraversion and the Role of the Orienting Reaction Habituation Rate in Sensitivity to the Apparent Size of Hue

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Introversion-Extraversion and the Role of the Orienting Reaction Habituation Rate in Sensitivity to the Apparent Size of Huel

This thesis attempted to investigate the relationship between the Eysenckian personality dimension of introversion-extraversion with differential physiological reactivity, as manifested in the Orienting Reaction habituation rate, to chromatic stimuli, analytic ability as assessed by a Hidden Figures Test and perceptual functioning. The latter measure was studied in a size judgment task to chromatic stimuli using methods of analysis derived from Signal Detection Theory.

Three groups of ten female subjects selected on the basis of the Eysenck Personality Inventory, Form A, and designated as Introverted, Middle and Extraverted subjects, were presented with red, blue and neutral grey Munsell colour samples equated for brightness and saturation which served as the orienting stimuli. Three autonomic response components were utilized in the Orienting Reaction habituation rate analysis: Vasomotor OR, Heart Rate OR, and Galvanic Skin

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1 Robert-Paul Bourgeois, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ontario, 1972, x-131 p.

Response OR. In a second experimental phase, the subjects applied size judgments to the three variable hue stimuli outlined above, and the data were analyzed by Signal Detection methods.

The results of the Orienting Reaction data suggested that introverts had longer OR habituation rates than extraverts across all three physiological parameters investigated. However, the results of the analytic ability and size judgment data did not demonstrate that introversion-extraversion is related to differential perceptual efficiency. In fact, there were no significant differences between Introverted, Middle and Extraverted subjects in two separate estimates of perceptual functioning provided by Signal Detection methods, i.e., sensory capacity and the influence of nonsensory, personal factors affecting sensory accuracy. It was, however, noted that sensory capacity was greater for blue than for red for the total sample investigated.

These results were interpreted in the light of related theoretical background and research studies.

ERRATA

Curriculum Studiorum:"Evoked"instead of"Evolved"

p. 12: footnote: H. J. Eysenck

p. 15: footnote 40: Psychophysiology

p. 23: footnote 71: H. J. Eysenck

p. 33: footnote 101; H. J. Eysenck

p. 34: delete reference 102

p. 39: should read "fifty": 2nd line from bottom

p. 47: "diameter": line 6

p. 56: "deceleration" instead of"decleration": 3rd line from bottc

p. 69: 11.63 instead of 11.73: 3rd line from bottom

p. 96: 1.39 instead of 1.37

p.123: 3 instead of 2 (Extraverted group, Grey, Judge 1, Judge 2, Candidate 54)

p. 93: add * to $p < .05$ at bottom of table

p. v: add Appendix 5A: "Pearson "r" Coefficients Between Selected Variables" p. 128b