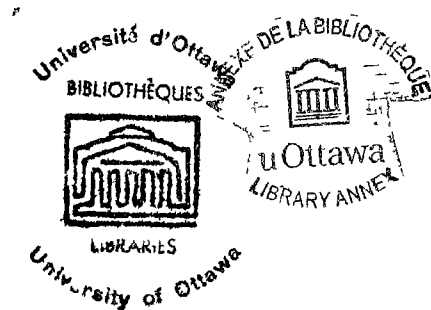


CARDIOVASCULAR RESPONSES DURING HABITUATION
AND ATTENTION AS MEASURES OF ANXIETY

by Barrie T. Jackson

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CURRICULUM STUDIORUM

Barrie T. Jackson was born in Liverpool, England, on July 27, 1940. He received the Bachelor of Arts degree, major in Psychology, from Sir George Williams University, Montreal, P.Q. in May 1961. He received the Master of Arts degree from the University of Ottawa in May 1965. The title of his thesis was Autonomic Responses of Autistic Children to Sudden Auditory Stimulation.

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INTRODUCTION

As the initial response to qualitative, intensive or temporal changes in stimulation, the orientation reaction is a non-specific reaction which habituates when the stimulus is repeated. It comprises a number of physiological adjustments that serve to enhance the sensitivity of the receptors. Among these changes are vasoconstriction in the extremities and a deceleration of heart rate. It has been reported that this latter reaction also characterizes attention.

This study will investigate the relation between quantified levels of anxiety and cardiac and vasomotor reactions during habituation and attention. The rationale for this research is embedded in the field of activation or arousal with particular emphasis on the reticular activating formation.

Chapter one contains a review of literature delineating the orientation reaction and its components, habituation, attention and anxiety. The presentation of the hypothesis concludes this chapter.

The second chapter consists of a description of the sample employed in this study, the instruments used, the experimental design and the treatment of results.

The obtained results are presented in chapter three and are interpreted in relation to the theoretical framework of chapter one. Suggestions for further research along with a few precautions terminate this final chapter.

CHAPTER I

REVIEW OF THE LITERATURE

This chapter will review and evaluate the following phenomena which are germane to this project: the orientation reaction, habituation, attention and the relation between anxiety and inhibition.

1. The Orientation Reaction.

The orientation reaction (henceforth abbreviated O.R.) was discovered in Pavlov's laboratory in 1910 and was initially considered to be the bane of students as it interfered with their conditioning experiments. It has been called the focussing reaction, the questioning reaction, the "what is it?" reaction, the investigatory reaction and the attitudinal reaction but the most enduring and accepted label is the orientation reaction (O.R.). The major body of literature on the O.R. has originated in Russia and particularly in the last ten to fifteen years when a resurgence of interest in it has developed. Razran wrote in 1960 that of 164 available experiments on the O.R., 115 were reported since 1954.¹

¹ G. Razran, "The Observable Unconscious and the Inferable Conscious in Current Soviet Psychophysiology: Interoceptive Conditioning, Semantic Conditioning and the Orienting Reflex", in Psychological Review, Vol. 68, March 1961, p. 140.

The O.R. is the organism's most "immediate response [...] to the slightest change"² about it and serves to enhance its sensitivity to impinging stimuli. O.R. patterns may be termed preadaptive than adaptive in nature in that they prepare the organism to deal more effectively with the stimulus. The components of the O.R. are skeletal, autonomic, electroencephalographic and sensory. To a novel or unexpected stimulus, the animal pricks its ears, turns its head to the source of the stimulus and sniffs. Both visual and auditory thresholds are lowered and there is a brief pause in respiration followed by a speeding up. There is a generalized EEG arousal, that is, faster and lower amplitude activity.³

Cardiovascular alterations as part of the O.R. have received considerable scrutiny and since it is these parameters that will be employed in this study, special consideration will be given to these findings. After reviewing and evaluating previous work in this field, Graham and Clifton conclude that heart rate deceleration is a major component of the O.R.⁴ Some controversy existed about whether the

² I.P. Pavlov, Conditioned Reflexes, Oxford University Press, London, 1927, p. 12.

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

⁴ F.K. Graham and H.K. Clifton, "Heart Rate Change as a Component of the Orienting Response", in Psychological Bulletin, Vol. 65, No. 5, p. 316.

heart rate change was a diphasic response of initial acceleration followed by deceleration; however, Lynn⁵ also agrees with Graham and Clifton's decision. Cardiac deceleration is also a concomitant of attention as has been shown and verified in the cases of neonates, children and adults. As an outcome of their work with infants, Lewis et al. assert that a monophasic response of deceleration typically accompanies the O.R.⁶ Vasoconstriction in the limbs and vasodilatation in the head occur during the O.R.

Heart rate acceleration is found during noxious stimulation, conceptual activity and during the defensive reaction (startle pattern). An accelerative response such as is seen in the startle pattern is relatively difficult to habituate and there is some evidence that acceleration is intensified by stimulus repetition.⁷

The orientation reaction can be evoked by any novel or unexpected stimulus regardless of the sense modality stimulated. A number of models have been proposed to account for the O.R. and that of S kolov will be presented here. The neuronal model of the O.R. "postulates a chain of neural cells which preserve information about the intensity, quality,

⁵ Lynn, Op. Cit., p. 4.

⁶ A. Lewis, et al., "The Cardiac Response as a Correlate of Attention in Infants", in Child Development, Vol. 37, 1960, p. 63-71.

⁷ Graham and Clifton, Op. Cit., p. 317.

duration and the order of presentation of the stimuli."⁹ This last characteristic was studied by Unger⁹ who presented numbers seriatim (1, 2, 3, 4, etc.) to subjects and then gave a digit out of sequence (8, 9, 10, 11, 12, 13) and observed the O.R. to this misplaced number. Thus it is not solely the novelty of the stimulus that results in the O.R. but also the "unexpectedness of the stimulus in the sequence in which it occurs."¹⁰ The O.R., according to Sokolov,¹¹ is evoked by "impulses of discrepancy" arising from the lack of concordance between the stimulus and the extant neuronal model in the cortex.

When the stimulus is appraised by the cortex as not being novel, that is matching the neuronal model, the O.R. does not result and the "block of impulses takes place somewhere between the collaterals from the specific pathway and the reticular formation [...] probably by hyperpolarization of synaptic connections."¹²

⁹ E.N. Sokolov, "Neuronal Models and the Orienting Reflex", in Mary A.E. Brazier, (ed.), The Central Nervous System and Behavior, Madison, New Jersey, Madison Printing Co., 1960, p. 205.

⁹ C.M. Unger, "Habituation of the Vasoconstrictive Orienting Reaction", in Journal of Experimental Psychology, Vol. 67, January 1964, p. 11-16.

¹⁰ Lynn, Op. Cit., p. 43.

¹¹ E.N. Sokolov, Perception and the Conditioned Reflex, Oxford, Pergamon Press, 1963 (h), p. 207.

¹² Sokolov, Op. Cit., 1960, p. 21.

Although the O.R. is evoked by novel stimuli, not all novel stimuli evoke orientation reactions but depending upon a number of conditions, they may also produce adaptive reactions or defensive reactions. The function of the adaptive reflex is to preserve the equilibrium of the organism by bringing about adaptation of the analyzers to the quality and intensity of the stimulus.¹³ The adaptation reflex involves only the analyzer such as light educing pupillary dilatation and the thermoregulatory changes to warmth and cold. Whereas the O.R. has a homeostatic positive feedback, the adaptation reflex has a negative feedback and lasts the duration of the stimulus while the O.R. habituates.¹⁴

The defensive reflex is a response to intense stimulation and corresponds to the startle pattern of Landis and Hunt.¹⁵ Like the O.R., the defensive reflex involves the whole body but the basic difference is the locus of organization, in that cortical centers participate in the O.R. but not in the defensive reflex.¹⁶ Vasoconstriction in both limbs and head occurs in the defensive reflex while only the

13 Sokolov, Op. Cit., 1963, p. 14.

14 Lynn, Op. Cit., p. 7.

15 C. Landis and W.A. Hunt, The Startle Pattern, New York, Ferrar and Rhinshart, 1939, 154 p.

16 Sokolov, Op. Cit., 1963, p. 15.

limbs manifest vasoconstriction in the O.R. The defensive reflex habituates but at a much slower rate than the O.R.¹⁷

To return to Sokolov's model for the orientation reaction, stimulus input is analyzed in the cortex after which the cortex engenders the excitation or inhibition of the O.R. Since this model will be used to explain habituation of the O.R. it will be elaborated in more detail.

Two main centres are involved in the production of the O.R.: a modeling system in the cortical analyzer and an amplifying system in the reticular formation. Afferent impulses travel along the classical sensory pathways to the cortex (route number 1 in Figure 1) and also to the reticular formation via collaterals (route 2). The cortex analyzes the incoming stimulus and if it is novel or significant, sends excitatory impulses to the reticular formation (route 5) for the evocation of the O.R. If a nervous model in the cortex corresponds to all the parameters of the particular stimulus, the cortex withholds the excitatory impulses and blocks the afferent input before it reaches the reticular formation (route 3). To complete the explanation of Figure 1, route 4 carries messages from the reticular formation which increases the discriminatory power of the cortex as indicated

¹⁷ Lynn, Op. Cit., p. 7.

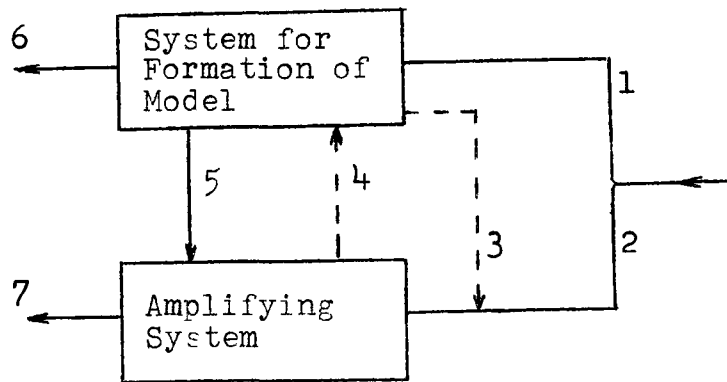


Figure 1.- Sokolov's Model for the Orientation Reaction.

E.N. Sokolov, "Neuronal Models and the Orienting Reflex", in H.A.B. Brazier, (ed.), The Central Nervous System and Behavior, New Jersey, Madison Printing Co. Inc., 1960, p. 216.

in the work of Lindsley.¹⁸ Fuster has demonstrated that concurrent stimulation of the reticular formation in the same region that produces cortical activation, improves both the accuracy and speed of visual discrimination in monkeys.¹⁹ Pathway 6 carries the specific responses and pathway 7 takes impulses for the vegetative and somatic components from the reticular formation.

In summary, the O.R. is a centrally organized, holistic system incorporating autonomic, somatic, EEG, and sensory changes. It is unspecific with regard to the sense modality stimulated and is initiated by any increase, decrease or qualitative change of a stimulus. It is subject to habituation and it is this characteristic which will be considered in the next section of this paper.

2. Habituation of the Orientation Reaction.

A stimulus that at one time had efficacy for the O.R. if repeatedly presented will eventually result in a cessation of response. This is called habituation or extinction. It is not a generalized reduction in responsivity but a

¹⁸ D.B. Lindsley, "The Reticular Formation and Perceptual Discrimination", in H.H. Jasper, (ed.), Reticular Formation of The Brain, London, Churchill, 1958, p. 524.

¹⁹ J.M. Fuster, "Effects of Stimulation of the Brain Stem on Tachistoscopic Perception", in Science, Vol. 127, 1958, p. 150.

selective one.²⁰ For example, there may be habituation to a particular frequency and loudness of sound and although the loudness may remain constant, a change in the frequency will reactivate the O.R.

Those variables that affect the course and rate of habituation have been placed in one of two classes by Lynn, stimulus and subject variables.²¹ The intensity and duration of the stimulus, the time intervals between stimuli and the difficulty of discrimination all affect habituation. Threshold stimuli are very resistant to habituation while habituation is usually rapid with low intensity stimuli. Stimuli of intermediate duration and those which require difficult discriminations are the hardest to habituate. The shorter the time interval between stimuli, the quicker the habituation. When habituation to a particular stimulus is established, continued stimulation results in the paradoxical return of the O.R., but this time it is intensified and similar to the defensive reaction. This reappearance of the O.R. is associated with drowsiness and sleep and may be explained by the irradiation of inhibition reaching the cortex.²²

20 Sokolov, Op. Cit., 1960, p. 199.

21 Lynn, Op. Cit., p. 26.

22 Sokolov, Op. Cit., 1963, p. 123-124.

The second group of variables that influence the rate of habituation are related to organismic states. It is this class of variable that will be investigated in this thesis. Lynn has reviewed the Russian work on schizophrenia and writes that chronic, deteriorated schizophrenics do not evince the O.R. to auditory, visual or tactile stimuli.²³ Stanishevskaya points to a profound functional disorder of the cortex and subcortex as underlying the disturbed O.R. in schizophrenics.²⁴ Sokolov²⁵ writes that "some types of neurosis" and "some forms of mental illness" show aberrations of the O.R. and habituation but he does not elaborate on this. Difficulties in extinction of the O.R. have been noted in persons suffering from senile dementia and mental retardation.²⁶ Luria²⁷ reports that retardates give powerful O.R.'s that are difficult to extinguish to intense stimuli but that weaker stimuli will evoke an O.R. that can be readily habituated in one or two stimulus presentations. One wonders whether the intense stimulation referred to by Luria might

23 R. Lynn, "Russian Theory and Research in Schizophrenia", in Psychological Bulletin, Vol. 60, 1963, p. 487.

24 M.N. Stanishevskaya, "The Vascular Component of the Orienting Reflex in Schizophrenics", in Paylov Journal of Higher Nervous Activity, Vol. 11, No. 1, 1961, p. 33.

25 Sokolov, Op. Cit., 1963, p. 122.

26 Ibid.

27 A.R. Luria, "Study of the Abnormal Child", in American Journal of Orthopsychiatry, Vol. 31, No. 1, January 1961, p. 9.

actually elude defensive reactions (startle pattern) which are known for their inextinguishability.

Intactness of the cortex is a requisite for habituation although the de-corticated animal will show the O.R. In spite of contradictory evidence reported by Sharpless and Jasper, Lynn asserts that the "weight of the evidence lies in favor of Pavlov's original conclusion that decortication greatly delays habituation of the O.R."²⁸ Jouvét found that eight hundred stimulus presentations could not produce habituation in the chronic decerebrated cat.²⁹

Before considering Sokolov's model of the O.R. and habituation in more detail, the quiddity of it will be repeated. The O.R. results from the mismatching of the stimulus with a pre-existing model in the cortex. Where congruence exists between the stimulus and model, the O.R. is thwarted between the collaterals from the afferent tracts and the reticular formation. Habituation of the O.R. is associated with the irradiation of inhibition.³⁰

Sokolov has sought support for his model at the neuronal level by assuming that a triad of different neurons makes up his model: afferent neurons, extrapolatory neurons

28 Lynn, Op. Cit., 1966, p. 31.

29 Ibid.

30 Sokolov, Op. Cit., 1963, p. 124.

and comparator neurons.³¹ The characteristics imputed to each type as well as the experimental evidence for each will now be considered.

The afferent neurons are always responsive to stimulation even after numerous presentations. Jung has found certain neurons in the visual cortex that do not habituate to light flashes.³² The cardinal characteristics of the afferent neurons are their specificity to the modality of stimulation and the "stability of their responses" with repeated stimulus presentations.

The second group of neurons in Sokolov's model are extrapolatory neurons which only begin to respond to stimulation after a number of presentations. Evidence for this type has been forwarded by Lettvin, et al., who described "sameness neurons" in the tectum of the frog. These neurons respond only some time after the appearance of a stimulus in the visual field. From then on, the object is tracked by these cells and no small or slow movement is unsignalled by the cell.³³

³¹ E.N. Sokolov, "Higher Nervous Functions: The Orienting Reflex", in V.E. Hall, (ed.), Annual Review of Physiology, Vol. 25, 1963, p. 588 (b).

³² R. Jung, "Neuronal Integration in the Visual Cortex and Its Significance for Visual Information", in W.A. Rosenblith, (ed.), Sensory Communication, New York, M.I.T. Press: J. Wiley, 1961, p. 627.

³³ J.Y. Lettvin, et al., "Two Remarks on the Visual System of the Frog", in W.A. Rosenblith, (ed.), Sensory Communication, New York, M.I.T. Press: J. Wiley, 1961, p. 773.

The "attention units" described by Hubel et al. are an example of the comparator neurons which compare the impulses transmitted by the afferent and extrapolatory neurons. Hubel et al. found cells that appeared to be sensitive to auditory stimuli only if the cat paid attention to the sound.³⁴ According to Sokolov, it is the comparator neurons which initiate the O.R. if the signals from the afferent and extrapolatory neurons do not match.

The above then comprises Sokolov's attempt to locate certain neurons whose functioning lends support to his nervous model for the O.R. Further work will undoubtedly corroborate or not, Sokolov's theorizing and interpretation of others findings. Lynn,³⁵ however, states that confidence in the theory is increased because of the studies of Hubel, Jung and Lettvin.

Throughout this paper it has become evident that the O.R. is a complex, multidimensional response and one might suspect that the elements of the O.R. do not habituate at uniform rates. This has been borne out by research. There appears to be a hierarchy for the habituation of the various components and the first system that disappears is the autonomic. The vascular component, which has a short latency,

³⁴ D. Hubel et al., "Attention' Units in the Auditory Cortex", in Science, Vol. 129, 1959, p. 1277-1280.

³⁵ Lynn, Op. Cit., 1966, p. 45.

is extinguished in three to five stimulus presentations in normal subjects.³⁶ EEG hypersynchronization in the analyzer of the sense organ being stimulated occurs next.³⁷ More prolonged stimulation results in inhibition of the cortex with slow waves recorded indicating low arousal.

Even during habituation stimuli are still being registered in the cortex which is analogous to the effects of barbiturate anesthesia which initially eliminates reticular enhancement of input.³⁸ Although the impulses are transmitted along classical sensory pathways, they are impotent without the contribution of the reticular formation. Further stimulation eventuates in cortical inhibition and the liberation of the reticular formation which brings about a stronger O.R., perhaps even approaching a defensive reaction. The subject finally falls asleep.

Hernández-Péon has coined the term afferent neuronal habituation to refer to the "electrophysiological correlates observed in awake cats along the specific sensory pathways."³⁹ This indicates that centrifugal fibers course from the

36 Stanishevskaya, Op. Cit., p. 37.

37 Lynn, Op. Cit., 1966, p. 46.

38 Lindsay, Op. Cit., p. 517.

39 H. Hernández-Péon, "Reticular Mechanisms of Sensory Control", in W.A. Rosenblith, (ed.), Sensory Communication, M.I.T. Press, 1961, p. 509.

reticular system to various peripheral receptors and inhibit responsiveness at the periphery as a result of repeated stimulation.⁴⁰ Cogent empirical evidence for this has been demonstrated including Hernandez-Peon's experiment in which electrodes were implanted in the dorsal cochlear nucleus of the cat and responses to clicks were recorded. However, when the cat was presented with two mice, a fish odor and a shock separately, the response to the auditory stimulus was diminished in comparison with control responses.⁴¹ Photic habituation at the retina, at the lateral geniculate body and in the visual cortex has also been reported.

Hernandez-Peon states that the reticular formation "filters by feedback circuits, all the sensory impulses at their entrance to the central nervous system."⁴² The feedback influence of the reticular formation on the receptor has also been considered by Sokolov who adds the effects of the sympathetic nervous system to those of the specific pathways.⁴³

⁴⁰ R.F. Thompson and W.A. Spencer, "Habituation: A Model Phenomenon for the Study of Neuronal Substrate of Behavior", in Psychological Review, Vol. 73, No. 1, 1966, p. 34.

⁴¹ R. Hernandez-Peon, "Modification of Electric Activity in Cochlear Nucleus During 'Attention' in unanesthetized Cats", in Science, Vol. 123, February 1956, p. 330.

⁴² -----, 1961. p. 517.

⁴³ Sokolov, Op. Cit., 1963 (a), p. 200.

3. Attention.

These variables that determine what we select for attention have been divided into external and internal classes, the former including movement, size, repetition, intensity, etc., of the stimulus. The internal states of the organism that govern what we attend to include needs, sets and attitudes. What transpires after an object has been selected for attention has been hypothesized by Deutsch and Deutsch. The similarities between their model and that of Sokolov for the O.R. are striking.

Deutsch and Deutsch aver that the incoming signal is analyzed by the cortex and a certain level of excitation is emitted. This is picked up by the reticular formation and taken as the minimum amount of excitation required to evoke a subsequent reaction.⁴⁴ The message that is analyzed by the cortex increases arousal in direct proportion to its importance.⁴⁵ Although attention may not be paid to input, it still reaches the perceptual and discriminatory mechanisms.

If the foregoing is compared with the model for the O.R. given by Sokolov, it is evident that both attribute the same functions to the cortex and the reticular formation.

⁴⁴ J.A. Deutsch and D. Deutsch, Physiological Psychology, Illinois, Dorsey Press, 1966, p. 170.

⁴⁵ -----, "Attention", in Psychological Review, Vol. 70, 1963, p. 85.

Both ascribe the decoding or interpreting of input to the cortex and the carrying out of orders for facilitating or inhibiting forthcoming stimuli to the reticular formation.

Characteristic cardiac changes accompany attention as mentioned earlier in this paper. Stimuli that require attention significantly decelerate the heart rate and this is associated with increased sensitivity to stimulation. This facilitatory effect may parallel what happens when direct stimulation of the reticular formation enhances the discrimination of stimuli. When two lights were presented to a cat 50 msec. apart, they registered in the cortex as one; however, when the reticular formation was simultaneously stimulated two responses were recorded.⁴⁶ It would be interesting to know the concomitant heart rate changes in this experiment. Regions in the reticular formation have been delimited which affect cardiac activity (cardiac regulatory centre) and others which affect vascular tones (vasomotor centre).⁴⁷ Stimulation of the nucleus reticularis gigantocellularis and the rostral part of the ventral reticular nucleus produces depressor effects on cardiac

⁴⁶ Lindsley, Op. Cit., p. 524.

⁴⁷ W. Birkmayer and G. Pilleri, The Brainstem Reticular Formation and Its Significance for Autonomic and Affective Behavior, Switzerland, Hoffman-La Roche Co. Ltd., 1966, p. 41.

activity,⁴⁹ which is what happens during attention and the O.R.

A distinction has been made between signal and non-signal stimuli, the difference being that the former is a harbinger of some other important stimulus, such as a tone preceding food in classical conditioning. There are a number of ways of converting a neutral (non-signal) stimulus into a conditioned (signal) stimulus.⁴⁹ As will be done in this experiment, the subject can simply be asked to watch out for the stimulus or pay attention to it. The subject now possesses a set for subsequent stimulation and a number of changes are brought about in the O.R. The O.R. becomes larger, stronger and quicker to the identical stimulus compared to when it had the status of a neutral stimulus. If habituation to the stimulus had occurred, the O.R. to it is revived. Thresholds are lowered so that subthreshold stimuli are now perceived. Intense stimuli that previously, as neutral stimuli, evoked defensive reactions, now as conditioned stimuli, evoke an O.R.⁵⁰

The changes outlined above should be observed in this experiment since a bell ring that evoked an O.R. and

48 Ibid., p. 41.

49 Lynn, 1966, Op. Cit., p. 62.

50 Ibid.

habituation to it, will be transformed into a conditioned stimulus by giving the subject instructions to "pay attention" to the bells. For heart rate there should be an even greater deceleration to the bells in this segment of the experiment than when the bells were neutral. In addition, increased resistance to habituation should be seen, although habituation to these stimuli is not of primary importance in this research.

4. Anxiety and Inhibition.

Anxiety will be considered in this section only as it is directly bound to this paper. Because anxiety is to be defined by a score on a self-reporting personality questionnaire, it will be treated as a conscious rather than pre-conscious or unconscious phenomenon. The motor, autonomic and humoral expressions of anxiety both within normal limits and without, have received considerable attention. Linking psychological traits with somatic ills, both at conscious and unconscious levels has given rise to psychosomatic medicine.

Many viewpoints about anxiety have been offered but the one to be employed here is that of Malmo who proposed that anxiety may be understood in terms of weakened inhibition

and might represent a "disease of over-arousal."⁵¹ In other words, pathological anxiety, which must be differentiated from transient, situational anxiety, could be based on reduced central inhibition. It is a well-established fact that reticular stimulation effaces the after-discharges of evoked cortical potentials. Malmø suggests that some such inhibitory mechanism (as the one which abolishes after-discharges) may be weakened in anxiety.

Difficulties with attention are invariably found in anxiety states resulting in varying degrees of impairment. "Relative autonomy of the organism with respect to control over attention and concentration appears to be a prime sign of optimal functioning", according to Redlich and Freedman.⁵² Part and parcel of anxiety is distractibility plus the inability to focus on one aspect of the environment to the exclusion of competing stimuli. Among normals a definite deceleration of heart rate has been reported to accompany attention and since people with anxiety have difficulty with attention, perhaps this can be reflected by cardiac alterations.

The O.R. has been exploited by the Russians to measure a number of functions including hearing capacity, intelligence,

⁵¹ A.B. Malmø, "Anxiety and Behavioral Arousal", in Psychological Review, Vol. 64, September 1957, p. 282.

⁵² F.C. Redlich and D.X. Freedman, The Theory and Practice of Psychiatry, New York, Basic Book, 1966, p. 110.

attention among children, concept formation and understanding.⁵³ Thus the versatility of the O.R. will be challenged once again in this thesis to relate anxiety levels to habituation and attention using cardiovascular changes.

5. Summary and Hypotheses.

The presentation of a novel stimulus of moderate intensity triggers a complex, distinguishable array of skeletal, autonomic, electroencephalographic and sensory responses which collectively have been called the orientation reaction. It is not specific to any sense modality and its primary function is to enhance the discriminatory power of the receptors and induce a state of alertness or attention in the organism.

Upon repetitive stimulation, the orientation reaction weakens and finally dissipates. This process is called habituation. It is carried out at the command of the cortex which emits impulses to block the orientation reaction at the level of the reticular formation.

Malmo has suggested that anxiety in its extreme forms may be based on defective inhibitory mechanisms. If this is correct, then anxious subjects should respond more often to

⁵³ A.R. Luria, "Study of the Abnormal Child", in American Journal of Orthopsychiatry, Vol. 31, No. 1, January 1961, p. 7.

novel stimuli than non-anxious subjects. That is, they should not habituate as rapidly. It has been reported and substantiated that a deceleration of heart rate accompanies attention and it is to be expected that anxious subjects who invariably exhibit difficulties with attention, will not show the same amount of cardiac deceleration as non-anxious subjects.

The hypotheses will be stated in null form:

1. There will be no significant correlation between anxiety levels and habituation levels as measured by peripheral vasoconstriction to fifteen non-signal auditory stimuli.
2. There will be no significant correlation between anxiety levels and the amount of change in cardiac rate between conditions of attention and rest.

CHAPTER II

EXPERIMENTAL DESIGN

This chapter will be divided into four sub-headings describing the subjects, the tools, the experimental procedure and the methods of evaluating the results.

1. Subjects.

Subjects were recruited in a number of ways for this project including inviting students of a class to participate, posting notices requesting volunteers in strategic places on the campus and asking seminarians to participate. Whatever the method all potential subjects were assured that they would receive no noxious stimulation, that the experiment would take approximately forty-five minutes and that the results would be kept confidential. When the writer addressed a class, the professor left so that students would feel no coercion to volunteer.

By dint of the literature on volunteers and the particular personality propensities they bring into the experimental situation, the writer was well aware of possible contamination of results. The alternatives to accepting volunteers were either making participation mandatory for a class or remunerating the subjects. Neither of these was feasible.

The assumption has been made that the testees would not dissemble anxiety because of lack of primary or secondary gain. By assuring the subjects that they would not be exposed to any harm, it was felt that any possible punitive effects that participation could produce, were eliminated. It is known that volunteers' strong needs for approval but if this existed in these subjects, it would have to be gratified solely by their peers as their professors were not aware of who volunteered and the writer was a stranger to them. One professor who was contacted by the writer in hopes of obtaining volunteers, insisted that he personally interview prospective subjects individually to get them to cooperate. His offer was politely refused.

Although all the subjects in this study were volunteers, it is felt that generalizations beyond a group of volunteers are justified.

Forty-six males were used in this project although fifty-four went through the experiment but eight had to be rejected for reasons to be presented in the chapter on results. The mean and standard deviation of the age of the forty-six subjects are 21.30 and 3.03 respectively. With the exception of two high school students, all subjects attended the University of Ottawa with all but four being undergraduates.

2. Tools.

The instruments utilized in this experiment were the I.P.A.T. to measure anxiety psychometrically and a polygraph to gauge the cardiovascular alterations during attention and habituation.

The criteria for selecting a test of anxiety among the myriad available on the market were validity, reliability, ease of administration, ease of scoring, time required to take it and, if possible, a parallel form in French in case it was necessary. It was decided that the I.P.A.T. Self Analysis Form¹ (hereafter referred to as I.F.A.T.) best met these criteria. The only reservation that the writer had about using this test was that it did not contain validity scales as does the Minnesota Multiphasic Personality Inventory. With this potential shortcoming in mind, the writer gave special consideration to his method of soliciting volunteers. These precautions were explained in the previous section of this paper.

A copy of the I.P.A.T. is to be found in Appendix 1.

The I.P.A.T. Anxiety Scale is administered in five to ten minutes to either a group or individuals and is scored by superimposing a stencil on the booklet, and adding the

¹ Published by the Institute for Personality and Ability Testing, 1602 Coronado Drive, Champaign, Illinois, 61825.

responses. The instructions are printed on the first page of the booklet and were read aloud to the subjects and then they were asked if they had any questions.

Reviews of the test in Buros^{2,3} have been laudatory, the consensus being that it is a good overall measure of anxiety. It evolved from the factor analytic research of Cattell and is reputed to assess general free anxiety levels, to be distinguished from neurotic and psychotic anxiety.⁴

Cohen quotes reliability coefficients ranging from .80 to .93 and concludes that the evidence is impressive regarding its validity.⁵

Heart rate and digital blood volume were measured continuously on an E & M Physiograph "Four".⁶ Cardiac rate was measured by a "Heart Sound Microphone" which detects heart sounds. This was placed over the heart and held snugly by means of an adjustable rubber strap. Blood volume was gauged by a "Photoelectric Pulse Pick-up" which was placed on the

2 J.P. Guilford, "The I.P.A.T. Self Analysis Form", in O.K. Buros, (ed.), The Fifth Mental Measurements Yearbook, New Jersey, Gryphon Press, 1959, p. 130.

3 J. Cohen, "The I.P.A.T. Self Analysis Form", in O.K. Buros, (ed.), The Sixth Mental Measurements Yearbook, New Jersey, Gryphon Press, 1965, p. 255.

4 Ibid.

5 Ibid.

6 E & M Instrument Co. Inc., Houston, Texas, 77021.

distal end of the subject's right forefinger. This is a plethysmographic transducer with a built-in light source and changes in light transmission caused by variations of the volume of blood in the tissues, are detected by a sensitive photoconductor. Changes in blood volume produce corresponding changes in wave amplitude. The paper moved at a rate of .5 cm. per second. A timer was set to deliver a downward mark at five-second intervals and an upward deflection was made on the paper to indicate each event.

3. Experimental Procedure.

The physiological recordings were conducted in a semi-darkened, sound attenuated room with a temperature range of 72 to 74 degrees Fahrenheit.

Those subjects who had not taken the I.P.A.T. were administered it before the experiment according to the instructions in the manual. The subject was then led into the experimental room and asked to remove his clothes from the waist up except for his undershirt. He was then told to lie down on a couch and the polygraph was explained to him. He was not told that he would hear the bell tones, but he was reassured that he would receive no harmful stimulation of any kind. While the subject was recumbent as he was for the duration of the experiment, the heart sound microphone was placed over his heart and held by means of a rubber

strap. The photoelectric pulse pick-up was put on the subject's right forefinger and fastened by a strap. The subject was then told to find a comfortable position and to try not to move around and the earphones were placed on the subject's head. The subject was then requested to shut his eyes and the tape recording began. The physiograph was started and the experimenter marked, by means of a remote control cable, each bell ring on the paper.

The auditory stimuli were presented through Philips earphones from a Wollensak tape recorder. The subject first heard ten minutes of white noise of 150 millivolts peak to peak. Then fifteen, one-and-a-half second bell tones at thirty-second intervals were presented to the subject at 400 millivolts peak to peak. The fifteen bells were followed by the instructions, "You are to pay close attention and listen carefully to the bells, until you are told to stop." Fourteen bell tones of one-and-a-half second duration were presented in two minutes and fifteen seconds. The subjects was then told that he would not hear any more bell rings, although the white noise continued for three minutes. The subject was informed that the experiment was completed and he was asked not to reveal the nature of the experiment to his classmates.

4. Evaluation of Results.

The I.P.A.T. forms were scored according to the instructions in the manual and a total score was derived for each subject and converted into the appropriate sten score using the norms for college males.

The assessment of the polygraph tracings was not so straightforward. Finger blood volume was gauged in the following manner. The amplitude of the waves was measured in millimeters for the seven waves immediately preceding each bell. A latency of usually three seconds but never more than five, was allowed following each bell and then the initial seven waves after the latency period were taken as the actual response. Whether or not a response occurred was determined by a t test between non-independent measures with t having to be significant at the .01 level of confidence in order for the vasoconstriction to be judged a reaction.

The above method was used after a trial of computing the mean and standard deviation of the amplitude of the waves for a minute preceding the first bell. This standard was then compared to each individual response of vasoconstriction. This procedure, however, ignores the dynamic, ever-changing aspect of the organism as a result of feedback. For example, some subjects manifest a significant vasoconstriction to the first bell but did not show the usual

compensatory vasodilatation in preparation for subsequent stimulation. If the first seven waves, allowing for the latency period, were averaged they would be less than the resting amplitude, although no vasoconstriction occurred.

Ackner sums up the rationale for this method of evaluation by writing that the size of the volume reduction is partly related to the degree of dilatation present at the time of the stimulus and that no constriction can be expected if the vessels are not dilated beforehand.⁷

The criterion for habituation was established as being three consecutive state of non-vasoconstriction to three bells or three non-vasoconstrictions in a series of any four consecutive bells. Thus a subject who did not evince vasoconstriction to Bells 6, 7 or 8 was said to have habituated to Bell 6. Other features of vasoconstriction during habituation can also be used for ascertaining the point of habituation and include a diminished volumetric change in the blood vessels, a quicker return to the baseline and an increased latent period.⁸ These last three characteristics were observable in the records but were not employed as criteria since the one delineated above proved to be very adequate.

⁷ B. Ackner, "Emotions and the Peripheral Vasomotor System", in Journal of Psychosomatic Research, Vol. 1, 1956, p. 9.

⁸ Y.N. Sokolov, Perception and the Conditioned Reflex, Pergamon Press, New York, 1963, p. 39-40.

It has been reported, as mentioned in chapter one, that a deceleration of heart rate occurs during attention and as a component of the orientation reaction. To find it became a major problem for the writer.

Two generic approaches to quantify cardiac variations are available: one is to count the frequency of beats in a pre-determined time interval or determine how long it takes for a prescribed number of cardiac cycles to be completed. There can be, of course, numerous versions of these methods but the half dozen utilized in this study were not fruitful. First, the writer counted the number of beats in twenty-second periods for pre- and post-stimulus conditions but found no differences. The time period was reduced to fifteen-, ten- and five-second intervals but with no success. It was then decided to determine how long it took for the initial 6, 12, and 18 beats to occur but it was evident that the rates did not differ significantly from resting rates. If a deceleration of heart rate occurred, as previous work would indicate, the slowing down must be evanescent and probably was followed by immediate compensation.

The only information obtained from measuring heart rate was checking on whether cardiac deceleration occurred during attention. Cardiac rate was determined for twelve thirty-second pre-stimulus periods (six minutes) and the mean and the standard deviation were computed. This was

compared to the mean cardiac rate for four thirty-second periods for which the subjects were instructed to pay attention to the auditory stimulation.

The statistical treatment of the results will be as follows: as mentioned previously, whether or not vasoconstriction occurred to each bell will be determined by whether t between the amplitude of the waves reaches significance at the one per cent level of confidence.

A coefficient of correlation will be computed (a) between the I.F.A.T. sten scores and the habituation rates, and (b) between the I.F.A.T. sten scores and the change in cardiac rate from resting to attention conditions. A t test will then be made for each coefficient. If significant, a linear regression formula will be applied and the standard error of estimate will be determined.

CHAPTER III

PRESENTATION AND DISCUSSION OF RESULTS

This chapter will contain a presentation of the results followed by an interpretation in light of the theoretical background assembled in the review of the literature.

1. Presentation of Results.

A condition for inclusion of a subject in this study was that vasoconstriction must be elicited by the auditory stimuli. Without this prerequisite, it would be impossible to determine a level of habituation since habituation is defined by the absence of a vasoconstrictive reaction.

The results to be reported herein are based on forty-six males although eight additional subjects were tested but had to be jettisoned for the following reasons. Seven subjects were vasoconstrictively unreactive while the remaining subject manifested an erratic pattern of vasodilatation to the first few bells. The mean and standard deviation of the ages of these unsuitable subjects are 22.50 and 3.24, respectively. The mean and standard deviation for their I.P.A.T. sten scores are 6.75 and 2.43. There is no significant difference between the I.P.A.T. scores of the eight rejected subjects and the forty-six subjects used in this study ($t=.51$).

The mean I.P.A.T. sten scores for the forty-six subjects is 6.28 with a standard deviation of 2.50. Allowing a three to four week interval, test-retest reliability for twenty-nine subjects was .94.

The coefficient of correlation between I.P.A.T. sten scores and the habituation rates is .808 ($t=9.06$, significant at the .01 level of confidence).

A linear regression was computed and found to be

$$\begin{aligned}y' &= a + bx \\ &= 2.49 + .42(x)\end{aligned}$$

where x represents the obtained level of habituation. The standard error of estimate for y equals 1.93.

A coefficient of correlation was calculated between the sten scores on the I.P.A.T. and the difference in cardiac rates during rest and attention. It was found to be -.04 with a t value of .26.

These results regarding cardiac activity merit explanation. As stated in chapter two, numerous methods were employed in attempting to quantify heart rate with equal abortiveness. It is very possible that a comparison of cardiac rates between resting conditions and attention as perpetrated in this study is meaningless even if it was possible to identify what would appear to be critical, fleeting periods of cardiac change.

Just because the subjects were told to "pay attention" there is no guarantee that they did attend to the auditory stimuli and it is possible that if they did listen for the bells, the processes of concentration and vigilance are involved rather than attention. It is likely that the use of the word "attention" is a misnomer as the selectivity of the stimuli is minimized because the subjects have been forewarned that they will be hearing bells.

It is doubtful that even if a significant correlation was obtained between I.P.A.T. and the difference in heart rates between resting conditions and "attention", generalizations could be vindicated.

The results indicate a significant correlation between levels of anxiety as measured by the I.P.A.T. and the habituation rates, as measured by peripheral vasoconstriction and therefore the hypothesis of no correlation must be rejected.

The hypothesis of no significant correlation between levels of anxiety and cardiac change is not rejected, although it is possible that this is due to a failure in detecting the change rather than there being no change.

2. Interpretation of Results.

Before interpreting the results of this study, the meaning and implications of a crucial concept, anxiety, will be considered. The manual of the I.P.A.T. states that a sten score of nine or ten indicates that the examinee requires counselling or psychotherapy. One could find a plethora of such high anxious people in a mental hospital but these must be distinguished from the high anxious subjects in this study who are at least ambulatory. Thus it is tempting to generalize from the anxious subjects in this research to all anxious people but this would not be justified. On the other hand, anxiety as it alludes to the subjects here, certainly goes beyond the transient, situational variety that abates upon environmental change.

The correlation of .803 between anxiety levels and the threshold for habituation is supportive of Alme's hypothesis that anxiety may represent a disease of overarousal and be based on weakened inhibition. The locus for this deficiency, in line with Lokolov's work would be the reticular formation.

In the definition of anxiety used for this study, salience has been given to the anticipatory attitude of the person in preparation for a threat to his self esteem. It would seem reasonable that if the person anticipated a threat, the reticular formation would be attuned to facilitating

sensory input. The turning of the hypothalamus, particularly the posterior portion which is part of the reticular formation, is of great importance in anxiety states controlling the dominance of the sympathetic branch of the autonomic nervous system and its dynamic response thresholds.

The peripheral vasoconstriction to the auditory stimuli observed in this experiment is interpreted as one measure of input that receives reticular amplification, which is essential if the message is to be registered. Once the reticular formation has been called into play, the entire biological and psychological levels are altered commensurate with the significance of the stimulus. Thus the reticular formation regulates incoming messages and initiates the cortical, affective, autonomic and spinal arousal reactions at the behest of the cortex.

The anxiety-activation relation is changed by defensive processes which are directed at limiting or minimizing the anxiety. If these defences are successful in alleviating even a modicum of the anxiety, there occurs a reduction in the facilitatory influence of the reticular formation and the level of arousal because of negative feedback from the cortex.

The reduction of cortical bombardment, which was initiated at one time by the cortex in anticipation of a threat, now becomes an end in itself. In other words, the anxiety and concomitant activation were beneficial in readying

the person for a real or imagined threat, but it is this anxiety-arousal complex that now gets out of hand and must be quelled. Anxiety begets anxiety. The reticular formation is now directed to inhibit sensory input. This is done to maintain what integrity the person possesses because, as Jasper writes, "Indiscriminate arousal reactions to all stimuli could only result in chaotic behavior, as may be the case in certain mental disorders."¹

Levels of anxiety can be plotted along an activation continuum; however, degrees of activation do not necessarily correspond to similar degrees of anxiety. The arousal reaction may also be galvanized in the service of predominantly non-affective functions such as attention, perception and cognition. The subjective awareness of apprehension is an essential ingredient for the diagnosis of anxiety.

The relation between activation-anxiety and performance can be described by an inverted U curve in which secretions of activation enhance performance up to an optimal level, after which performance begins to deteriorate.² Further arousal may

1 H.H. Jasper, "Recent Advances in our Understanding of Ascending Activities of the Reticular System", in H.H. Jasper, (ed.), Reticular Formation of the Brain, Boston, Little, Brown and Co., 1958, p. 321.

2 R.B. Maimo, "Activation: A Neurophysiological Dimension", in Psychological Review, Vol. 66, 1959, p. 370.

reduce efficiency. This type of relation could be instrumental in determining when the reticular formation should switch from facilitating to inhibiting sensory input as part of the systemic defences of the organism. In other words, the person is capable of withstanding just so much activation-anxiety and now must deal with the arousal which has become deleterious. The reticular formation, which in anticipation of a threat, facilitated input is now programmed to inhibit the amount of stimulation permitted access to the central nervous system. If this is the case, those people who experienced anxiety to the point of failing to habituate, now that defensive measures have been implemented, one could conjecture that they would habituate sooner.

To summarize thus far, it has been suggested that in anticipation of a threat, of unknown nature and origin, the reticular formation is tuned by corticofugal and hypothalamic-efferent impulses to facilitate the sensory input, and thus the persistent vasoconstriction to the bells. This arousal attains such magnitude that it becomes potentially harmful to the subject and must be curbed. Inhibitory mechanisms, both physiological and psychological, are introduced to restore the functional integrity of the organism.

Schachter and Singer have proposed that in a state of physiological arousal, the person labels this state and describes his feelings according to the cognitions available

to him. "The same state of physiological arousal could be labelled 'joy' or 'fury' or 'jealousy' [...] depending on the cognitive aspects of the situation."³ To verify this hypothesis, subjects were injected with epinephrine to induce sympathetic activation and the very disparate states of anger and euphoria were produced by means of cognitive manipulations. If emotional states share the same backdrop of arousal, the intensity dimension of behavior, it seems likely that people in an extreme state of joy, fury or jealousy would show similar habituation rates according to the propositions of Schachter and Singer. The difficulty in demonstrating this would be in separating the interaction of anxiety from conditions with which it has been known to co-exist and also in maintaining an authentic emotional state for the experimental period.

The concept of the "neuronal model of the stimulus" was forwarded by Sokolov to account for the orientation reaction and habituation. To briefly recapitulate this, the model is a cell system in which information is stored concerning the different parameters of the stimulus. The orientation reaction results from impulses of discrepancy between the model and the current stimulus; however, when congruence

1 S. Schachter and J.E. Singer, "Cognitive, Social, and Physiological Determinants of Emotional State", in Psychological Review, Vol. 69, 1962, p. 397.

exists, the reaction is blocked at a pre-reticular level. Evidence indicating that the block occurs at a pre-reticular level comes from Sokolov who writes that the "extinction of the orienting reflex by direct stimulation of the reticular system is not observed in intact animals."⁴

The significant difference in habituation levels between anxious and non-anxious subjects has been construed in relation to the activity of the reticular formation and arousal, with no mention of what reputedly transpires in the sensory analyser of the cortex. After all it is here where the stimulus is appraised and compared to extant models.

It has been reported that high arousal during learning makes the trace of the material less available for immediate recall.⁵ A possible explanation for this might be Hebb's suggestion that a high level of arousal may facilitate irrelevant responses and therefore interfere with the registration of the engram.⁶ Differences between anxious and non-anxious subjects, based on Manifest Anxiety Scale scores, have

⁴ E.N. Sokolov, Perception and the Conditioned Reflex, Oxford, Pergamon Press, 1963, p. 290.

⁵ B. Weiner, "Effects of Motivation on the Availability and Retrieval of Memory Traces", in Psychological Bulletin, Vol. 65, No. 1, January 1966, p. 26.

⁶ D.O. Hebb, "Drive and the C.N.S. (Conceptual Nervous System)", in Psychological Review, Vol. 62, 1955, p. 253-254.

been shown in performance levels during conditioning and extinction with anxious subjects manifesting a greater resistance to extinction.⁷ A high degree of correlation between the number of orienting reactions and the number of conditioned responses during a period of extinction has been found.⁸

The preceding findings lead to the tentative conclusion that the persistent vasoconstrictive reactions in the anxious subject could be due to a disturbance of cortical origin. The high level of activation of the anxious subject may interfere with the etching of the stimulus trace in the cortex. The cortex establishes the level of activation that the reticular formation generates, and by feedback, the excitation level of the cortex thereby is determined. If this is of sufficient intensity to impede appropriate formation of the "neuronal model of the stimulus", subsequent stimuli have an incomplete, if that, standard for comparison and consequently the orientation reaction is produced.

This latter interpretation is compatible with what has been said regarding activation but conflicts with the functions attributed to the reticular formation. It has previously been

⁷ K.W. Spence and I.E. Farber, "Conditioning and Extinction as a Function of Anxiety", in Journal of Experimental Psychology, Vol. 45, 1953, p. 116-119.

⁸ M.A. Stewart et al., "Adaptation and Conditioning of the Galvanic Skin Response in Psychiatric Patients", in Journal of Mental Science, Vol. 105, 1959, p. 1109.

implied that the reticular formation receives the appropriate command from the sensory analyser but is incapable of effecting the required adjustments. But it is possible that because of the intense activation emanating from the reticular system, the appropriate orders are not given to the reticular formation. The reticular formation does not inhibit the multiple components of the orientation reaction because the command to do so was not transmitted from the sensory analyser.

Although Sokolov has not confronted the above quandary, he affirms the importance of the cortex in the habituation of stimuli. He writes that the cortex plays an active role in the inhibition of the orientation reaction and supports this with evidence from experiments in which cortical control was temporarily abolished by sleep inhibition and also from experiments on decorticate animals.⁹

Konorski asserts that recent memory is based on the activity of reverberating circuits of neurons excited by a stimulus. This activity continues until it dissipates spontaneously or "is knocked out by some inhibitory influence arising from other foci of antagonistic excitation."¹⁰ It

⁹ Sokolov, Perception and the Conditioned Reflex, p.269.

¹⁰ J. Konorski, "The Physiological Approach to the Problem of Recent Memory", in J.F. Delafresnaye, (ed.), Brain Mechanisms and Learning, Oxford, Blackwell Scientific Publications, 1961, p. 120.

is possible that in the case of intense arousal, as in anxiety, it is the arousal which provides the antagonistic excitation that effaces the trace. Returning to this experiment, the strong arousal interferes with the registration of the characteristics (intensity, frequency and duration) of bell one. Since there has been no remnant of bell one, bell two arrives at the same barren background as bell one and so on for the subsequent bells.

A synthesis of the foregoing then suggests that the cortex, because of its action on the reticular formation, has established a level of arousal in its anticipation of a threat, which interferes with the evaluation and disposition of following stimuli. The properties of the stimulus are not recorded and subsequent stimuli are functionally novel, fulfilling the prerequisite to elicit an orientation reaction and thereby delaying habituation.

Difficulties with recent memory (for example, the Digit Span subtest of the Wechsler Adult Intelligence Scale) can be diagnostic of anxiety states and may be due to the same faulty mechanism that accounts for the delayed habituation. That is, high activation levels could interfere with the registration of the cue.

The marked resistance to extinction characteristic of anxious people could also be explained by heightened arousal. The stimulus-response bond fades in normal subjects

because of the lack of reinforcement but in anxious subjects, the stimulus presented during the period of extinction could summate with the already present arousal to produce sufficient energy to evoke a conditioned response without reinforcement.

This area abounds in topics for further investigation but a number of problems are apparent to the writer. Firstly, it is felt that fifteen bell tones are not sufficient to maximally differentiate anxious subjects at the higher end of the habituation scale and that twenty would be a minimum. This might also permit a look at dishabituation and its psychological concomitants.

The question of reliability of habituation has been eschewed thus far but it must now be tackled. The writer is not familiar with any studies that have checked the reliability of the orientation reaction and habituation. If one is looking for such evidence, the search would have to be carried on outside the domain of Soviet psychology because of their lack of concern with quantification as it pertains to individual differences. Repeating the experimental situation with a substantial number of the subjects was avoided because of interpretation difficulties. However, five subjects were retested for habituation rates, three of whom reported themselves not anxious and the remaining two as anxious on the I.P.A.T. The non-anxious subjects considerably

reduced their habituation score while the two anxious subjects maintained their original level. The question of equality of units of vasoconstrictive reactions enters here in that, does a decrement from eight to five reactions equal a reduction from fifteen to twelve reactions obtained from test-retest? This question could better be answered in an open-end scale in which as many stimuli as necessary to produce habituation are presented. Still a reduction in the number of stimuli to bring about habituation must be expected during retest conditions.

This field offers copious research projects such as studying the effects of drugs on habituation thresholds assuming that those that depress activation will engender reduced habituation rates. Relating the effectiveness of defensive processes to habituation levels is a possibility, postulating that defences reduce activation and consequently habituation rates. The relationship between cognitive functioning, both the level and efficiency, and arousal could also offer many research possibilities.

SUMMARY AND CONCLUSIONS

This study was undertaken to investigate Halmó's proposal that anxiety may represent a "disease of overarousal" and be based on defective inhibitory mechanisms. The orientation reaction comprises a number of motor, visceral, electroencephalographic and sensory adjustments designed to increase the discriminatory power of the person or animal. It is elicited by an increase, decrease or qualitative change in a stimulus but is subject to habituation following repeated stimulation. It has been suggested that the stimulus is analyzed in the cortex and if it is judged to be novel and significant, the cortex transmits excitatory impulses to the reticular formation and the orientation reaction is engendered. If, however, the current stimulus coincides with an already existing one, the orientation reaction is inhibited at a pre-reticular level. If, as Halmó suggests, the anxious person has difficulties with inhibition, he would continue to respond to stimulation while non-anxious subjects would have habituated.

Forty-six males with a mean age of 21.30 years, all but two of whom attended the University of Ottawa, were administered the I.P.A.T. to gauge their anxiety levels. The subjects were then wired to a polygraph to measure heart rate changes and vaso-motor responses to non-signal stimuli.

Fifteen one-and-a-half second bell tones were presented at thirty-second intervals following ten minutes of white noise. The auditory stimulation was presented from a tape recorder through earphones. The subjects were then instructed to pay attention to the bells and fourteen bells of one-and-a-half second duration were presented in two minutes.

A coefficient of correlation of .308 was found between the psychometric measure of anxiety and the number of bells required to produce habituation. A correlation of -.04 was obtained between level of anxiety and cardiac change from resting to attention. However, it was felt that this might be the result of inadequate measurement techniques.

The results were discussed in relation to activation theory and Sokolov's model of the stimulus. It was proposed that in anxious people, the high level of arousal interferes with the establishment of the trace so that subsequent stimuli have no model against which to be evaluated and the orientation reaction continues. Evidence concerning recent memory and arousal was entered in support of this theory.

It was concluded that this is a very fertile area for research and a number of topics were suggested along with precautions for future projects.

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Jasper, H.H., (ed.), et al., Reticular Formation of the Brain, Boston, Little, Brown and Co., 1958, 3-766 p.

This book contains the most complete presentation of information on the reticular formation. Numerous articles in this book were consulted for this paper.

Lynn, R., Attention, Arousal and the Orientation Reaction, Oxford, Pergamon Press, 1966, 1-113 p.

This book offers one of the few English attempts at reviewing the literature on the orientation reaction. All aspects of the orientation reaction are covered along with a number of theories for this phenomenon and its habituation.

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

Although this review is much briefer than Lynn's, it provides an excellent complement. Its sources are almost exclusively Russian.

Sokolov, E.N., Perception and the Conditioned Reflex, New York, Pergamon Press, 1963, 1-309 p.

This was the most frequently used source for this paper. The role of feedback in perception is the central theme of this book which offers a refreshing, sound approach to perception. It was first published in Russian in 1958 but was not translated into English until 1963.

-----, 'Neuronal Models and the Orienting Reflex', in Mary A.B. Brazier, (ed.), The Central Nervous System and Behavior, New Jersey, Madison Printing Co., 1960, p. 189-216.

The "neuronal model of the stimulus" is elaborated in this article and was employed in the interpretation of results.

APPENDIX 1

I.P.A.T. SELF ANALYSIS FORM

I PAT SELF ANALYSIS FORM

NAME _____ TODAY'S DATE _____
 First Middle Last

SEX _____ AGE _____ OTHER FACTS _____
 (Write M or F) (Nearest Year) (Address, Occupation, etc., as instructed)

CONFIDENTIAL

Inside this booklet you will find forty questions, dealing with difficulties that most people experience at one time or another. It will help a lot in self-understanding if you check Yes, No, etc., to each, frankly and truthfully, to describe any problems you may have.

Start with the two simple examples just below, for practice. As you see, each inquiry is actually put in the form of a sentence. By putting a cross, X, in *one* of the three boxes on the right you show how it applies to you. Make your marks now.

1. I enjoy walking

Yes Occasionally No

A middle box is provided for when you cannot definitely say Yes or No. But use it as little as possible.

2. I would rather spend an evening :

(A) talking to people, (B) at a movie

A In between B

About half the items inside end in A and B choices like this. B is always on the right. Remember, use the "In between" or "Uncertain" box only if you cannot possibly decide on A or B.

Now :

1. Make sure you have put your name, and whatever else the examiner asks, in the place at the top of this page
2. Never pass over an item but give some answer to every single one. Your answers will be entirely confidential.
3. Do not spend time pondering. Answer each immediately, the way you want to at this moment (not last week, or usually). You may have answered questions like this before; but answer them as you feel *now*.

Most people finish in five minutes; some, in ten. Hand in this form as soon as you are through with it, unless told to do otherwise. As soon as the examiner signals or tells you to, turn the page and begin.

STOP HERE—WAIT FOR SIGNAL

1. I find that my interests, in people and amusements, tend to change fairly rapidly..... True In between False
2. If people think poorly of me I can still go on quite serenely in my own mind..... True In between False
3. I like to wait till I am sure that what I am saying is correct, before I put forward an argument..... Yes In between No
4. I am inclined to let my actions get swayed by feelings of jealousy..... Sometimes Seldom Never
5. If I had my life to live over again I would:
(A) plan very differently, (B) want it the same..... A In between B
6. I admire my parents in all important matters..... Yes In between No
7. I find it hard to "take 'no' for an answer", even when I know what I ask is impossible..... True In between False
8. I doubt the honesty of people who are more friendly than I would naturally expect them to be..... True In between False
9. In demanding and enforcing obedience my parents (or guardians) were: (A) always very reasonable, (B) often unreasonable..... A In between B
10. I need my friends more than they seem to need me..... Rarely Sometimes Often
11. I feel sure that I could "pull myself together" to deal with an emergency..... Always Often Seldom
12. As a child I was afraid of the dark..... Often Sometimes Never
13. People sometimes tell me that I show my excitement in voice and manner too obviously..... Yes Uncertain No
14. If people take advantage of my friendliness I:
(A) soon forget and forgive, (B) resent it and hold it against them..... A In between B
15. I find myself upset rather than helped by the kind of personal criticism that many people make..... Often Occasionally Never
16. Often I get angry with people too quickly..... True In between False
17. I feel restless as if I want something but do not know what..... Very rarely Sometimes Often
18. I sometimes doubt whether people I am talking to are really interested in what I am saying..... True In between False
19. I have always been free from any vague feelings of ill-health, such as obscure pains, digestive upsets, awareness of heart action, etc..... True Uncertain False
20. In discussion with some people, I get so annoyed that I can hardly trust myself to speak..... Sometimes Rarely Never

Qs(-)

C(-)

L

0

Q

CONTINUE ON NEXT PAGE.

A Score

B

- | | | | |
|--|-----------------------------------|---|---------------------------------------|
| 21. Through getting tense I use up more energy than most people in getting things done | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |
| 22. I make a point of not being absent-minded or forgetful of details | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |
| 23. However difficult and unpleasant the obstacles, I always stick to my original intentions | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 24. I tend to get over-excited and "rattled" in upsetting situations | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 25. I occasionally have vivid dreams that disturb my sleep | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 26. I always have enough energy when faced with difficulties | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 27. I sometimes feel compelled to count things for no particular purpose | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |
| 28. Most people are a little queer mentally, though they do not like to admit it | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |
| 29. If I make an awkward social mistake I can soon forget it | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 30. I feel grouchy and just do not want to see people:
(A) occasionally, (B) rather often | A
<input type="checkbox"/> | In between
<input type="checkbox"/> | B
<input type="checkbox"/> |
| 31. I am brought almost to tears by having things go wrong | Never
<input type="checkbox"/> | Very rarely
<input type="checkbox"/> | Sometimes
<input type="checkbox"/> |
| 32. In the midst of social groups I am nevertheless sometimes overcome by feelings of loneliness and worthlessness | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 33. I wake in the night and, through worry, have some difficulty in sleeping again | Often
<input type="checkbox"/> | Sometimes
<input type="checkbox"/> | Never
<input type="checkbox"/> |
| 34. My spirits generally stay high no matter how many troubles I meet | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 35. I sometimes get feelings of guilt or remorse over quite small matters | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 36. My nerves get on edge so that certain sounds, e.g., a screechy hinge, are unbearable and give me the shivers | Often
<input type="checkbox"/> | Sometimes
<input type="checkbox"/> | Never
<input type="checkbox"/> |
| 37. If something badly upsets me I generally calm down again quite quickly | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |
| 38. I tend to tremble or perspire when I think of a difficult task ahead. | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| 39. I usually fall asleep quickly, in a few minutes, when I go to bed | Yes
<input type="checkbox"/> | In between
<input type="checkbox"/> | No
<input type="checkbox"/> |
| I sometimes get in a state of tension or turmoil as I think over my recent concerns and interests | True
<input type="checkbox"/> | Uncertain
<input type="checkbox"/> | False
<input type="checkbox"/> |

Qs(-)

C(-)

L

O

Q4

STOP HERE. BE SURE YOU HAVE ANSWERED EVERY QUESTION.

B Score

Name _____ Sex _____ Age _____ Date _____ Examiner _____

Raw Scores: A Score (Covert, indir.) _____ (p. 2 score) B Score (Overt, manifest, sympt.) _____ (p. 3 score)

TOTAL RAW SCORE _____ (A + B)

Q₃(-) _____, C(-) _____, L _____, O _____, Q₄ _____ Overt-Covert Ratio $\left(\frac{B}{A}\right)$ _____

Stens: Q₃(-) _____, C(-) _____, L _____, O _____, Q₄ _____

TOTAL, STANDARD STEN SCORE _____ (from Table 4)

Qualitative Observations:

Diagnostic Summary:

APPENDIX 2

ABSTRACT OF

Cardiovascular Responses During Habituation and
Attention as Measures of Anxiety

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ABSTRACT OF

Cardiovascular Responses During Habituation and Attention as Measures of Anxiety¹

A novel or unexpected stimulus of moderate intensity will elude a series of skeletal, autonomic, electroencephalographic, and sensory adjustments aimed at enhancing the sensitivity of the receptors. Collectively these changes have been called the orientation reaction and are subject to habituation upon repeated stimulation. According to Sokolov, the orientation reaction is elicited by impulses of discrepancy between the stimulus and the neuronal model of it, while concordance produces habituation. If anxiety is based on overarousal due to defective inhibitory mechanisms at a reticular level, the anxious subject should take longer to habituate than the non-anxious subject.

Forty-six males with a mean age of 21.30 years, all of whom with the exception of two, attended university were administered the I.P.A.T. Self Analysis Form to obtain a measure of their anxiety levels. To determine his habituation rate, each subject was wired to an E & M Physiograph to gauge heart rate and finger blood volume since cardiac deceleration

¹ Barrie T. Jackson, doctoral thesis presented to the Faculty of Psychology and Education of the University of Ottawa, Ontario, 1967, v-52 p.

and peripheral vasoconstriction are components of the orientation reaction. Ten minutes of white noise was presented to the subject through earphones from a tape recorder and followed by fifteen one-and-a-half second bell tones at thirty-second intervals. Instructions were then given to "pay attention to the bells" and fourteen bells of one-and-a-half second duration were presented in two minutes.

A coefficient of correlation of .506 was found between the sten scores on the I.P.A.T. and the number of stimuli necessary to reach habituation of the vasoconstrictive response. Cardiac change from rest to attention was not significantly correlated with anxiety levels ($r = -.04$) but the writer concedes that this might be due to faulty measurement techniques.

Accepting Sokolov's theory of the "neuronal model of the stimulus," the results were interpreted in terms of heightened arousal in anxious people which interferes with the registration of the properties of the stimulus and subsequent stimuli are functionally novel. This framework was also to explain the difficulties with recent memory seen in anxious people as well as their resistance to extinction in conditioning experiments.

Further research was advocated after a number of changes that should be made in the experimental design were suggested.