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# The Role of Specific Attentional Influences in Anxiety and Perception

Doug G. Heck

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THE ROLE OF SPECIFIC ATTENTIONAL INFLUENCES  
IN ANXIETY AND PERCEPTION

by  
Doug G. Heck

Bachelor of Science, Emporia State University, 1980

A Thesis  
Submitted to the Graduate Faculty  
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for the degree of  
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The Role of Specific Attentional Influences  
in Anxiety and Perception

Doug G. Heck, M.A.

The University of North Dakota, 1983

Faculty Advisor: Dr. Don M. Tucker

The purpose of this study was to assess the relationships between trait anxiety, visual attention and perceptual closure. A neuropsychological model proposed by Pribram and McGuinness (1975) and elaborated by Tucker and Williamson (in press) is used as a basis for the concepts of attention, arousal, and cognition used in this paper. Specific, lateralized attentional systems, that of Activation and Arousal, are described and implicated in influencing perceptual closure in trait-anxious subjects. It was hypothesized that high trait-anxious subjects would perform less successfully on the closure task than the low trait-anxious subjects would, while exhibiting a higher eye-movement rate than the low trait-anxious subjects. A pilot study was conducted to help determine parameters for the present study.

The Speilberger State-Trait Anxiety Inventory (Spielberger 1968) was administered to 408 undergraduate male and female psychology students. From this group, a group of high trait-anxious and a group of low trait-anxious subjects who were familial right-handers were then determined. The Mooney Closure Faces Test (Mooney 1951) was the task selected. A series of 24 slides were shown to the subject for 10 seconds apiece at a visual angle of 7 degrees. From the subjects' descriptions, it was determined if they had seen the face in the slide. With the subject's permission, the session was videotaped through a two-way mirror in front of the subject. From this videotape, an eye movement rate for each subject was determined, using four raters. T-test analyses were used to determine differences in group means.

The results of this study showed that the high trait-anxious subjects recognized significantly fewer Mooney Faces than did the low trait-anxious subjects. No significant differences in eye movement rate were present, but the differences were in the predicted direction, however. No sex differences were present.

This paper discusses the implications that stimulus parameters and individual differences in anxiety have on perceptual closure. The relationship between the information processing capacities of the cerebral hemispheres,

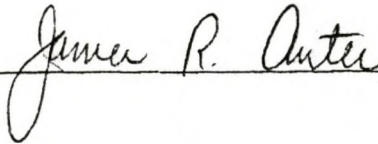


anxiety, and eye movements are described and implications for understanding cognition and perception in pathological states of anxiety are discussed.

This Thesis submitted by Doug G. Heck in partial fulfillment of the requirements for the Degree of Master of Arts from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.



(Chairperson)



This Thesis meets the standards for appearance and conforms to the style and format requirements of the Graduate School of the University of North Dakota, and is hereby approved.

  
Dean of the Graduate School

Permission

Title The Role of Specific Attentional Influences in  
Anxiety and Perception

Department Psychology

Degree Master of Arts

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## TABLE OF CONTENTS

LIST OF ILLUSTRATIONS.....	v
LIST OF TABLES.....	vi
ACKNOWLEDGMENTS.....	vii
ABSTRACT.....	viii
CHAPTER I. INTRODUCTION AND REVIEW OF LITERATURE...	1
CHAPTER II. METHOD.....	22
CHAPTER III. RESULTS.....	28
CHAPTER IV. DISCUSSION.....	33
REFERENCES NOTES.....	44
REFERENCES.....	46



LIST OF ILLUSTRATIONS

Figure	Page
1. Eye Movement Rate and Closure Faces Score by Trait Anxiety Classification.....	31

LIST OF TABLES

Table	Page
1. Trait Anxiety, Eye Movement Rate, and Performance.....	29
2. Six Differences in Eye Movement Rate and Number of Faces Recognized.....	32

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## ABSTRACT

The purpose of this study was to assess the relationships between trait anxiety, visual attention and perceptual closure. A neuropsychological model proposed by Pribram and McGuinness (1975) and elaborated by Tucker and Williamson (in press) is used as a basis for the concepts of attention, arousal, and cognition used in this paper. Specific, lateralized attentional systems, that of Activation and Arousal, are described and implicated in influencing perceptual closure in trait-anxious subjects. It was hypothesized that high trait-anxious subjects would perform less successfully on the closure task than the low trait-anxious subjects would, while exhibiting a higher eye-movement rate than the low trait-anxious subjects. A pilot study was conducted to help determine parameters for the present study.

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This paper discusses the implications that stimulus parameters and individual differences in anxiety have on perceptual closure. The relationship between the information processing capacities of the cerebral hemispheres, anxiety, and eye movements are described and implications for understanding cognition and perception in pathological states of anxiety are discussed.

## CHAPTER I

### INTRODUCTION AND REVIEW OF LITERATURE

The influence of attention and arousal in perception has long been studied in the psychological literature. Many of these studies have investigated the influence of arousal on visual perception. In most of these studies, however, the term "arousal" has been treated as a unitary concept. Walley and Weiden (1973) suggested that a unitary concept of arousal had "outlived its usefulness." By differentiating the specific aspects of "arousal" and their functions we may be able to better understand specific influences on visual perception.

For some time it has been acknowledged that there are both somatic and cognitive components involved in "arousal." Just what the interrelationships are between these two areas has been the subject of much research. The James-Lange view of emotional arousal stated that the individual cognitively associated a bodily state or sensation with the present environment. The somatic arousal was a precursor to emotional, cognitive arousal. Cannon (1929) was critical of this view and his research gave evidence to emotional arousal as being more mediated



by the central nervous system. In continuing to search for the interrelationships between visceral and cognitive, or cortical, arousal, Lacy (1967) found that specific cardiovascular changes correlated with specific cognitive changes. Eysenck (1975) has looked specifically at cortical arousal and its relationships to personality and emotion. It is clear from these studies that there are interrelationships and feedback systems between cortical and visceral arousal. This paper, while continuing to acknowledge these mutual influences, is concerned mainly with the area of cortical arousal and its relationship to visual attention.

Recent evidence has suggested that cortical arousal itself is not a unitary concept. It has been shown that there are specific changes in cortical arousal that result in specific, qualitative differences in attention. Pribram and McGuinness (1975) describe three such attentional systems in the brain: the Arousal system, the Activation system, and the Effort system. These three systems are differentiated not only anatomically but also on the basis of their qualitatively different influences on information processing in the brain.

The Arousal attention system consists of neurons within the central nervous system that decrement their firing rate when repeatedly stimulated by the same

stimuli. This results in habituation to these stimuli. It is through this habituation that the individual is able to orient to novel stimuli. The Arousal system phasically primes the individual for perceptual input. This system appears to be centered in the amygdala, with the dorsolateral frontal cortex providing an excitatory influence, while the orbitofrontal cortex inhibits amygdala activity. It is through these and other neural projections that the individual is able to augment perceptual input. As stated earlier, this augmenting occurs through the rapid habituation to redundant, repeated stimuli.

The second attentional system, Activation, provides for a different but complimentary influence on perception by narrowing or restricting attention. It allows for vigilance on a tonic basis. In contrast to the Arousal system, the neurons that make up the Activation system increase their firing rates when repeatedly stimulated by the same stimuli. This allows for the perception of redundant stimuli. The basal ganglia seem to be integral to the Activation system. Thus, the Activation system appears to provide for motor readiness in response to the perceived stimuli (Tucker & Williamson, in press). This is complimentary in nature to the perceptual augmenting and orienting provided for by the Arousal system.

These two systems are integrated and operate on an ever-changing basis in order to bring about both a



detailed knowledge of the environment through vigilance, along with a broader perceptual basis for input through the orienting process.

The third system, Effort, is intimately involved with changes in the individual's attitude or "expectancies." The Effort system controls the organization of the Arousal and Activation systems in order that changes in the person's perceptual "set" may occur. This system appears to rely upon hippocampal circuits. This implies the implication of short-term memory which would be essential in forming a perceptual "set."

The present paper will discuss the roles of the Activation and Arousal systems in trait anxiety and perceptual closure.

In relating these attentional systems to visual perception it is of importance to describe their apparent asymmetry in the brain. Tucker and Williamson (in press) describe numerous behavioral, neuroanatomical, and neurochemical studies which indicate a lateral asymmetry of the Arousal and Activation attentional systems. Of relevance here is Cohen's (1975) remark: "Clinical observations and experimental results suggest that where hemispheric specialization does exist, it is not absolute, not constant, and not simple" (p. 366). However, there is sufficient evidence to support lateralized attentional systems that their laterality must be taken into account

when discussing their influences on visual information processing. Under the Arousal system, the phasic search for novel stimuli and the consequently broad perceptual readiness allows for a qualitatively different type of visual attention than that of the Activation system. The range of attention is more extensive and global. This would seem to be the type of information that the right hemisphere would be most adept at processing. This is in contrast to the tonic attentiveness to specific details within the visual world that is characteristic of the Activation system. This would be likely to result in a restricted, more analytical type of visual input. The left hemisphere's unique abilities to process this type of information would seem to be most beneficial in this case. Indeed, Tucker and Williamson (in press) cite evidence to support the left-lateralization of the Activation system with the Arousal system being based in the right hemisphere.

Some of the evidence for the right-lateralization of the Arousal system comes from examining the relationships between norepinephrine and serotonin pathways and the level of cortical arousal of the individual. The amygdala, which was earlier identified as being involved closely with the Arousal system (Pribram & McGuinness 1975), is connected extensively with NE and 5-HT pathways. NE pathways are often found to be present along with



5-HT pathways in many areas of the brain suggesting a NE/5-HT role in the control of basic arousal (McGuinness & Pribram 1980). Decreased NE levels have been found to be associated with a decreased ability to discriminate relevant from nonrelevant stimuli and a decreased ability to extinguish performance (Mason & Fibiger 1979). NE also seems to facilitate orienting to novel stimuli (Kostowski 1980). These data suggest that NE is integral in habituation and orienting which are main contributions of the Arousal system.

NE and 5-HT pathways appear to be closely tied to right hemisphere function. Schildkraut et al. (1978) proposed that NE covaries with mood level, with mania associated with a high level of NE and a low level of NE being associated with depression. Flor-Henry (1976) showed that right hemisphere arousal and function are impaired in psychiatric depression. The administration of lithium is used widely for the treatment of bipolar affective disorders and is thought to stabilize 5-HT transmission (Treiser et al. 1981). The right hemisphere seems especially sensitive to the administration of lithium (Flor-Henry & Koles 1981).

Along with the neurochemical evidence, there exists neurophysiological evidence that the Arousal system is closely tied to right hemisphere function. Heilman and Van Den Abell (1979) indicate that decreased behavioral

and electrodermal arousal levels occur with right hemisphere lesions, and they suggest that the right hemisphere controls general arousal level. Semmes (1968) notes that the right hemisphere is especially adept at integrating bilateral perceptual data. In order to accomplish this, the right hemisphere may benefit from the broad attentional state associated with Arousal system involvement. Tucker and Williamson (in press) argue that the unique changes in mood level, arousal level, and perception that are associated with the right hemisphere's functional abilities are facilitated by the influence of the Arousal system.

Conversely, the cognitive, perceptual, and arousal states associated with left-hemisphere function seem to be associated with the influence of the Activation attentional system. Dopamine pathways appear to be intimately involved in the neurochemical basis of the Activation system (Tucker & Williamson, in press). In research on rats, Denenberg (1981) cites evidence for the left-lateralization of DA pathways. Further evidence for this comes from evidence indicating over-activation of the left hemisphere in schizophrenia (Gur 1978; Flor-Henry 1974). When considering the prevalent theory that there is an excess of DA activity in schizophrenia (Metzler 1979), these data provide support for increased DA involvement in left-hemisphere function. The left hemisphere is also integral in motor control and motor-readiness (Tucker & Williamson



in press), which is a major component of the Activation system (Pribram & McGuinness 1975). Research by Dimond and Beaumont (1971, 1973) indicates that the left hemisphere modulates tonic vigilant attention, which is precisely the type of attention found under the influence of the Activation system. Under chronic amphetamine abuse, which overstimulates DA pathways, the individual exhibits extreme symptoms of the Activation system, which include extremely focal attention (Matthysse 1977), compulsive analytic cognition (Ellinwood 1967), and behavioral stereotypes (Ellinwood 1967).

We have seen the apparent associations between right-hemisphere function and the Arousal system and between the left hemisphere and the Activation system. This lateralized asymmetrical nature of these attentional systems allows for the clearer understanding of their qualitatively different contributions in information processing and perception.

Of particular interest when relating these attentional systems to visual perception is the area of eye movements. Yarbus (1967) suggests that the role of eye movements is to expose more of the visual field to the viewer. Through eye movements the fovea is moved from place to place within the visual field. This allows for increased detailed, discrete analysis of the visual field. Determining where

the fovea will fixate appears to be one function of peripheral vision (Boynton 1960; Mackworth 1965; Williams 1966). The eyes are moved, then, under the guidance of peripheral vision in an organized fashion that attempts to integrate the stimuli in the visual field. Loftus (1972), in a study investigating eye movements and recognition memory for pictures, found that the greater the number of fixations, the better the recognition performance. This suggests that each new fixation may be adding new information and helping to integrate the new with the old information.

An increase in eye movement rate, then, would allow for a greater input of detailed, discrete, visual information through the fovea. The influence of the Activation system, with its orientation towards specific analytical input may be associated with an increased reliance upon foveal input and consequently, an increased eye movement rate when contrasted with the influence of the Arousal system. The left hemisphere appears to be best suited to process this type of information. The left hemisphere (Kimura 1977) and the Activation system (Tucker & Williamson in press) also appear to be closely tied to the control of sequential fine motor activity, which implicates its influence over eye movement rate.

Conversely, with the Arousal system augmenting perceptual input that is attended to, a decreased eye



movement rate may be present due to an increased ability to rely upon peripheral information processing. This would possibly allow for a broader range of cue utilization. It would also allow for parallel processing and possibly, a more global, gestalt-based type of perception. The right hemisphere seems to be associated with this type of information processing (Bradshaw & Nettleton 1981). As Littman and Becklin (1976) state, "Eye movements are one of the consequences of visual selectivity rather than its cause" (p. 77).

Some support for the role of attentional systems in influencing eye movement rate comes from studies relating eye movement rate to cognitive activity. Early studies investigated the change in eye movement rate in relation to a change in thought content. Antrobus, Antrobus, and Singer (1964) found increased ocular motility to be associated with "active thinking" and a change in cognitive activity when compared to states of relatively relaxed, passive thinking. Other studies have been concerned with investigating the relationship between arousal and eye movement rate. Gaarder (1967) used EEG alpha frequency as a measure of arousal. Stating the "absence of alpha is considered to signify increased arousal," (p. 146) he found an increased eye movement rate during non-alpha periods when contrasted to alpha states. Gaarder suggested that "a correlated continuum is established of

state of attention and arousal on the one hand and rate of eye movements on the other" (p. 146). Eventually the concepts of "arousal" and "change in cognitive activity" were viewed as too vague and non-descriptive and the concept of attention began to be investigated. This is in agreement with the earlier views stated in this paper on the need to more accurately describe the role of attention in states of arousal. In investigating the relationship between attentional states and eye movement rate, Amadeo and Shagass (1963) used a word association task and an arithmetic task to provide states of heightened attention. They found a greater eye movement rate during these attention tasks than during tasks requiring less attention. They concluded that rapid eye movement rate "increases with attentive activity." Lorens and Darrow (1962) also found an increased eye movement rate during mental multiplication. Klinger, Gregoire, and Barta (1973) found an elevated eye movement rate to be associated with a high level of concentration. In investigating eye movement rate under varying attentional levels and also under rate of change of thought content, Ruth and Giambra (1974) found that eye movement rate increased under states of high attention irrespective of rate of thought content change. These studies lend support to the influence of attentional systems on eye movement rate. In order words, an increase in an individual's



attention appears to be associated with an increase in the number of eye movements.

When considering these results in respect of Pribram and McGuinness's (1975) views on attention, we can interpret the relationship between attention and eye movement rate as not only being based on a quantitative increase or decrease in attention, but also on a concomitant qualitative change in the type of attention. A change in attentional state has been seen to be associated with changes in eye movement rate. As stated earlier, an increased eye movement rate may result in more foveal input. The influence of the Activation system serves to facilitate the processing of detailed, redundant information such as the fovea might provide. These two areas then, that of increased attention and the Activation system appear to be compatible. A decreased eye movement rate has been associated with a decreased attentional state. The Arousal system, in facilitating the processing of broad, global perceptual input, may be associated with this lowered attentional state. This may be due to a possible increase in peripheral cue utilization and a decreased reliance upon foveal input. Some support for this comes from research investigating lateralized cognitive processes and ocular motility. Marks (1973), in a study assessing eye movements and picture recall, found

an increased eye movement rate to be associated with a low imagery ability, which is assumed to be a right hemisphere-mediated process. Weiner and Erlichman (1976) found an increased eye movement rate when subjects responded to questions eliciting left-hemisphere verbal processes and fewer eye movements in response to questions eliciting visuo-spatial or right hemisphere-based abilities. Hiscock and Bergstrom (1981) using three separate experiments, also found a significantly higher eye movement rate in response to verbal-conceptual questions, even when an oral response was not required. These studies support the concept of an increased eye movement rate being associated with left-hemisphere information processing and conversely a decreased eye movement rate being associated with right hemisphere information processing. In light of the evidence for the lateralized asymmetry of the Arousal and Activation systems, these studies also support the proposed relationship between eye movement rate and these attentional systems.

Further support for the proposed close relationship between an elevated eye movement rate and left-hemisphere mediated information processing comes from research investigating the left hemisphere's role in motor control. Iverson (1977) has shown that the left hemisphere appears to be closely tied to the control of sequential fine motor behavior. Semmes (1968) noted that motor control



is more focally represented in the left hemisphere and more diffusely represented in the right hemisphere. This, she suggests, is the primary differentiation between hemisphere specialization. Kimura (1977) has related the left-hemisphere's control of sequential motor actions to speech. The association between fine motor control and the left hemisphere may implicate eye movements as also being under the influence of these same control mechanisms due to their fine sequential nature.

These studies also indicate the importance of considering both the type of attention and stimulus characteristics when investigating the relationship between attentional systems and eye movement rate as Hiscock and Bergstrom (1981) emphasize. This supports the proposed concept of the qualitative differences in information processing (facilitated by the influences of the attentional systems Activation and Arousal) being an integral aspect of quantitative changes in the level of attention.

This is not to say that all foveal input goes directly to the left hemisphere and that all peripheral input goes to the right hemisphere. This has been shown to be inaccurate by Haun (1978). He gave evidence showing lateral functional differences from foveal input alone and from peripheral input alone. What can be said, however, is that the individual's own arousal state will



qualitatively alter his or her visual attention so as to facilitate an analytical (Activation system) or global (Arousal system) visual strategy.

This is most easily shown by looking at some studies done relating arousal level and visual perception. The results of these studies showed that as arousal increased, the subjects were less able to make use of peripheral stimuli. Bahrick, Fitts, and Rankin (1954), in using incentive as a way of increasing arousal, found that as the incentive increased, performance on a central tracking task improved at the cost of decreased proficiency on a broader (central + peripheral) task. Bursill (1958) required subjects to keep a pointer superimposed upon another moving pointer as a central task, while the peripheral task required a response to lights. Two experimental conditions were used, one in which the room was heated to 60-70 degrees F., and another condition of 95-105 degrees F. He reported that the peripheral lights were missed at a greater frequency in the hotter condition. Proficiency on the narrower task was increased at the expense of the broader task. Easterbrook (1959), in reviewing the literature concluded that as arousal increases, the range of cue utilization decreases. He described this as a "narrowing," or "funnelling" of perception.

This narrowing of visual perception appears to not just be a function of foveal and peripheral orientation.

It seems that it is the function of visual attention. The peripheral stimuli may indeed be perceived, but are not selected, or attended to. Solso, Johnson, and Schatz (1968), in using high and low-anxious subjects and varying exposure time and cue location, concluded that what had been termed as "perceptual narrowing" may actually be a narrowing in the use of the stimuli present. Hockey (1970), in a study using a primary task of motor pursuit and a secondary task of monitoring lights in the periphery, found that some peripheral stimuli were attended to and some were not. He interpreted this as a "shift in efficiency over the various task positions." It is not an overall impairment of secondary task performance, but it is an "attentional narrowing."

Expanding on this concept, Cornsweet (1969) suggested that peripheral cues are attended to only to the extent that they are perceived to be relevant to the goal of the individual. In other words, we might see better performance on tasks including foveal plus peripheral selection if the peripheral stimuli are needed to complete the task. Studies by Braly (1962) and Kausler and Trapp (1960) support this concept. In determining the effect of both relevant foveal and relevant peripheral cues on attentional narrowing, Reeves and Bergum (1972) found that subjects with a high level of arousal attended to relevant stimuli whether they were foveal or



peripheral. These studies show the importance of perceived stimulus relevance in visual perception under high arousal. These studies may also be showing the influence of the Effort system mentioned earlier by Pribram and McGuinness (1975). Its influences may be such that it acts to regulate the phasic nature of the Arousal system and the tonic nature of the Activation system in ways that are adaptive and relevant to the external environment. When this Effort system allows for an unadaptive or overregulated relationship between the Activation and Arousal systems then we may see an individual who is characteristically analytical or global in his or her visual strategy.

Attempts to look at visual strategy, arousal level, and personality characteristics have most often employed subjects that were labeled as "anxious" or "not anxious." In light of the proposed relationships between the Activation system, the left hemisphere, an increased eye movement rate, and an analytical visual attentional state, and also between the Arousal system, the right hemisphere, a decreased eye movement, and a more global range of visual attention, it is important to look again at these studies on anxiety and visual strategy.

Anxiety can be viewed as a level of arousal. Groen (1975) states,

When an individual on certain environmental signals experiences anxiety, this sets in motion



complicated feedback mechanisms which involve arousal, i.e., increased activation of certain areas of the cortex, the limbic and ascending reticular system; these in turn activate the sympathetic system and its peripheral effector organs and by positive feedback the experience of anxiety (p. 736).

Specifically, anxiety may be viewed as an extension of the Activation system. Several studies have supported the increased involvement of the left hemisphere in anxiety. In one study, a right visual half-field performance deficit was found in high-anxious subjects, suggesting increased left-hemisphere processing (Tucker, Antes, Stenslie, & Barnhardt 1978). Tyler and Tucker (1982) found that high trait-anxious subjects approached discrimination tasks with an analytical visual strategy. In a study using Rorschach Inkblot cards, high trait-anxious subjects saw more details in comparison to wholes (Dawson 1981). With regard to eye movement rate, high anxious subjects have been shown to have an increased eye movement rate when compared to low anxious subjects when reading a fixed word passage (Disney, Rankin, & Johnston 1969).

When viewing anxiety as being associated with an increased involvement of the Activation system, we then can hypothesize a restricted visual strategy in which peripheral stimuli are not attended to as well as foveal stimuli. This may be mediated by a specific attentional system, Activation. This system restricts visual attention to details within the visual field. The attention

to details would facilitate the use of the left hemisphere's analytical processing abilities. In order to acquire detailed, discrete information, a reliance upon foveal vision is hypothesized. An increased eye movement rate would facilitate this analytical input through the fovea.

In contrast, the low-anxious person may have a broader visual style in which peripheral as well as foveal stimuli are attended to. This suggests an increased utilization of peripheral vision. This would lead to a broader, global visual style that is associated with the right hemisphere. A decreased eye movement rate is hypothesized due to the integrated use of both peripheral and foveal vision.

The purpose of this study was to assess any differences in eye movement rates between high and low trait-anxious subjects while involved in a visual closure task. The closure task is one in which the use of an analytical visual strategy will make difficult its successful completion. In this way, it may be determined if an increased eye movement rate is accompanied by an increased reliance upon foveal input. It is hypothesized that the high trait-anxious subjects will exhibit a higher eye movement rate along with completing fewer closure tasks while the low trait-anxious subjects are hypothesized to complete



a greater number of closure tasks while exhibiting a lower eye movement rate.

A pilot study was conducted to help determine the parameters for this study. The original parameters in this prior study included an N of 23, a viewing time for the closure task of 30 seconds, five closure tasks, and a visual angle of more than 7 degrees (Heck Note 1).

In assessing these parameters for their use in the present study, it was determined that there was a possible confound in the recognition process of the closure task due to the large visual angle presented to the subject. The large visual angle may have facilitated the use of a detailed visual strategy by the subjects. Therefore, in the present study it was of interest to present a visual angle that would not facilitate either a global or detailed visual strategy, that of 7 degrees (Kinchla & Wolfe 1979). These authors found that a visual angle of greater than 6-9 degrees resulted in the perception of details within the stimulus faster than the perception of the stimulus as a whole. The opposite was found when the visual angle was less than approximately 6-9 degrees. For this reason, the visual angle of 7 degrees was chosen for the present study, so as to not facilitate either type of perception.

Another inadequacy of the pilot study was that the length of the viewing time was too long. Often the subject's eyes would wander off target, so the present study



included a shorter viewing time. Also, a further restriction of the screening process for the subjects was decided on in the present study, that of familial righthandedness.

## CHAPTER II

### METHOD

#### Subjects

A measure of trait anxiety, the Spielberger State-Trait Anxiety Inventory (Spielberger 1968), was administered to 408 undergraduate psychology students. The students were asked to specify their handedness, and left-handers were excluded from the study. From the resulting group of 350 right-handed individuals a high trait-anxious group (HTA) and a low trait-anxious (LTA) group were determined. Criteria scores determined group membership, using criteria scores that were as far apart as possible while at the same time obtaining a large enough N for each group. Those individuals that scored above 47 were included in the HTA group and those scoring below 30 were included in the LTA group. From the available norms on undergraduate students, the cutoff score of 48 corresponds to a t-score of 61 (males and females) and a percentile rank of 86 (males and females). For the LTA group the cutoff score of 29 corresponds to t-scores of 41 (males) and 38 (females) and percentile ranks of 19 (males) and 12 (females). The HTA group then consisted of 37

subjects whose range of scores were from 48 to 57 out of a possible 80. The mean score was 51 with a variance of 7.35 and a SD of 2.71. The LTA group consisted of 44 subjects with a range of scores from 21 to 29. Their mean score was 26 with a variance of 4.93 and a standard deviation of 2.22.

An additional screening was done for familial righthanders. Only those subjects that reported no left-handers in their immediate family were included in the study. Some subjects' data were lost due to difficulties with the recording process. For instance, it was difficult to record accurately the eye movements of those subjects who wore eyeglasses. The final groups consisted of 20 subjects for the HTA group and 19 for the LTA group. The researcher was naive to the group membership of the subjects until after all sessions were completed.

### Task

In order to assess the presence of an analytical visual strategy, a task was selected in which the use of an analytical visual strategy hinders its successful completion. The Mooney Closure Faces Test (Mooney 1956) presents the subject with incomplete discontinuous stimuli that appear ambiguous until they are integrated and synthesized as a whole. The stimuli then are collectively recognized as a face.



If HTA subjects do characteristically have a restricted, analytical visual strategy as Tyler and Tucker (1981) have suggested, then we might assume that these individuals would recognize significantly fewer Mooney faces than the LTA subjects. Further support for this would arise if the HTA subjects exhibited a significantly higher eye movement rate, consistent with an increased reliance upon foveal vision. LTA subjects, on the other hand, may recognize significantly more Mooney Faces due to their hypothesized global visual strategy. Further support for this would be present if the LTA subjects also exhibited a significantly lower eye movement rate than the HTA subjects. This would possibly be due to an increased utilization of peripheral vision.

In order to assess any differences between groups in their mean eye movement rate, a camera and videotape recorder were placed behind a two-way mirror directly in front of the subjects. Eye movements were recorded as the subjects viewed the Mooney faces.

### Procedure

The subjects were individually shown a set of 24 slides of Mooney Faces in a small, quiet room. Each seated subject viewed the slides from a distance of three feet projected onto a fifteen square inch white cardboard background.

The slide was projected just below the mirror through which the camera recorded the subjects' eye movements. The projected image was 4.4 inches in height by 3.5 inches in width which presents the subject with a visual angle of approximately 7 degrees. This corresponds to Kinchla and Wolfe's (1979) observation that when stimuli are viewed from a visual angle of less than 6-9 degrees, they will be viewed first using a global visual strategy. When stimuli are viewed from a visual angle of greater than 6-9 degrees, a focal analytical visual strategy is used first. Thus, the stimuli were presented at a visual angle (7 degrees) that did not favor one visual strategy over another.

The following instructions were given:

Each of the following slides is of a face. These slides may appear to be ambiguous in that you may not be able to see the face right away or maybe not at all. These faces are more like cartoons or caricatures than actual pictures. You will be shown each slide for 10 seconds after which I will ask you to describe the face you saw. Please refrain from responding during these 10 seconds and continue to look at the slide for the full 10 seconds.

From the subject's descriptions of the face, it was determined whether or not they recognized the face in the slide. Criteria for each slide were established to assess the extent of recognition of each slide. These criteria were: in what direction the Mooney face was facing, in what direction the eyes were looking, approximate age of the



person (child, middle-aged adult, senior-aged adult), and outline of facial features.

Prior to the session, each subject was informed of the presence of the camera behind the mirror and that the session would be videotaped. The subjects were not told, however, that their eye movements were being recorded. Each subject was offered the opportunity to ask questions and to receive full feedback concerning the experiment after its completion.

After all sessions were completed, the researcher and three raters, all naive to the group membership of the subjects, viewed the videotapes and independently counted each subject's eye movements for each slide. A practice session was held to familiarize the raters to the method of counting eye movements.

### Statistical Analysis

To determine any differences in eye movement rates between the groups, a t-test analysis was used. A t-test was also employed to help determine if there are any significant differences between the mean number of Mooney faces recognized by each group. A Pearson-r correlation was determined to assess the relationship between eye movement rate and the recognition of the Mooney faces. An analysis of sex differences in task performance and in eye movement rate was also conducted by correlating sex



with trait anxiety and also with eye movement rate and number of Mooney faces recognized.

## CHAPTER III

### RESULTS

An inter-rater reliability coefficient showed that the eye movements were reliably counted ( $\alpha = .94$ ). A mean eye movement rate across pictures and raters was determined for each subject for the set of 24 Mooney slides. The subjects were then identified as to group membership and a grand mean eye movement rate was determined for each group (LTA and HTA). The mean eye movement rate for the HTA subjects was 3.92 and for the LTA group was 3.69. A t-test analysis showed no significant difference between these two group means ( $t = -.53$ ,  $df = 37$ ,  $p < .60$ ). The difference was in the predicted direction however, with the HTA group's mean eye movement rate higher than the LTA group's (see Table 1).

In order to assess any group differences in task performance, the mean number of Mooney faces recognized was determined for each group after identifying the number recognized for each individual in the group. The mean number of Mooney faces recognized for the HTA group was 18.6 and for the LTA group 20.3 (see Table 1). A t-test analysis showed that there is a significant difference



Table 1. Trait Anxiety, Eye Movement Rate, and Performance

Trait Anxiety	N	Mean Eye Movement Rate	SD	Mean Number of Faces Recognized	SD
Low	19	3.69	1.37	20.32	1.77
High	20	3.92	1.42	18.60	2.58

between these group means ( $t = 2.41$ ,  $df = 37$ ,  $p < .02$ ). This finding was in the expected direction and lends support to the hypothesis that HTA individuals have a detailed visual strategy that would make global, closure perception difficult. Figure 1 illustrates the data and relationships found between trait anxiety, the number of Mooney faces recognized, and eye movements.

A Pearson- $r$  correlation was run between eye movement rate and the number of faces recognized for each subject to determine how eye movement rate is associated with the perception of Mooney faces. These two variables were virtually uncorrelated ( $r = -.03$ ).

An analysis of sex differences shows that there are no significant differences between males and females in their eye movement rates while viewing the Mooney faces (males = 3.84, females = 3.79,  $t = .11$ ,  $df = 28$ ,  $p < .91$ ). There also are no apparent sex differences in the number of Mooney faces recognized (males = 20.17, females = 19.08,  $t = .20$ ,  $df = 23$ ,  $p < .24$ ) (see Table 2).



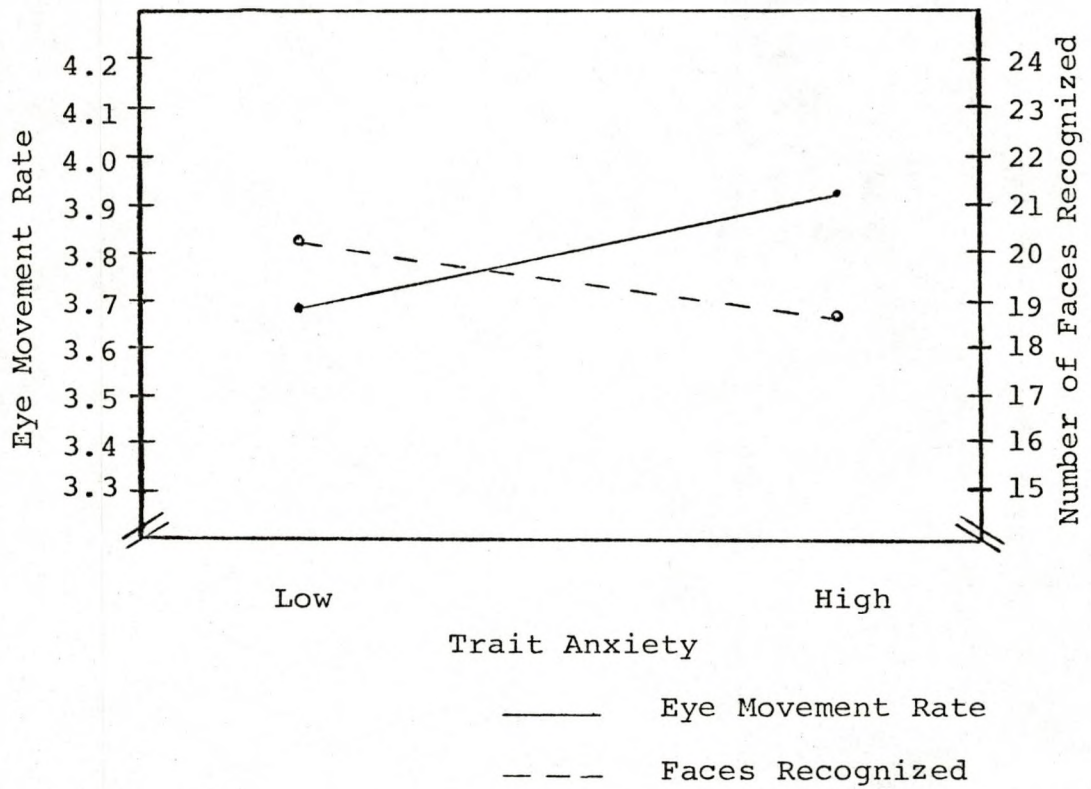


Figure 1. Eye movement rate and closure faces score by trait anxiety classification.

Table 2. Sex Differences in Eye Movement Rate and Number of Faces Recognized

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	Mean Eye Movement Rate	Mean Number of Faces Recognized
N = 14 Males	3.84	20.17
	SD = 1.37	SD = 2.64
N = 25 Females	3.79	19.08
	SD = 1.42	SD = 2.16

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## CHAPTER IV

### DISCUSSION

The data indicate a difference between HTA and LTA individuals in their integration of ambiguous visual stimuli in a closure task. This was predicted from the hypothesis that HTA individuals more frequently employ a detailed, analytical visual strategy. This type of visual strategy would make the successful completion of the Mooney Closure task difficult. Indeed, the HTA group was found to have recognized significantly fewer Mooney faces than the LTA subjects who were hypothesized to have a broader, more global visual strategy. This finding replicates the result of a study in which the performance of low trait-anxious subjects was superior to that of high trait-anxious subjects on a perceptual closure task (Pazzaglini 1970). No sex differences in task performance or in eye movement rate were present.

In an attempt to help provide further support for the hypothesis that HTA individuals have a detailed visual strategy, the mean eye movement rate for each group was measured and analyzed for group differences. There was no significant difference however, between the LTA and

HTA groups in their mean eye movement rates. This does not necessarily discount the hypothesis that the two groups use different visual strategies. The size of the stimulus is an important variable to consider when interpreting this result. The size of the stimulus may determine the size of the eye movements made. This is particularly relevant when counting eye movements from a videotape. It may be helpful to consider in detail the findings of the pilot study conducted prior to this research.

The present findings are different from those found in the earlier pilot study (Heck, Note 1). This difference may be accounted for by methodological differences between these studies.

The first study found a significant difference in eye movement rate between HTA and LTA subjects, but found no differences in task performance. The task was the same as in the present study. A critical difference in this study over the present study was the size of the visual angle that the stimulus projected to the subject. The larger visual angle covered a greater area of the subject's retina and when eye movements were made, many were longer in their distance between fixation points. In order for the subjects to view the whole face, larger and longer eye movements were needed because of the large size of the stimulus. The stimulus projected not only on the fovea and the perifoveal areas of the subject's



retina, but also well into the peripheral areas of the retina. This would have necessitated the use of larger eye movements to move the fovea from point to point within the stimulus. Thus when the raters viewed the eye movements on the videotapes, the eye movements were large and easy to count. In this way, any difference present in the mean eye movement rates of the two groups would have been able to be detected. The finding in the pilot study that the HTA subjects exhibited a higher eye movement rate than the LTA subjects while recognizing essentially the same number of Mooney faces, lends support for the hypothesis that HTA individuals rely more on their foveal vision to integrate stimuli than do LTA subjects.

After reviewing Kinchla and Wolfe's (1979) findings, it was determined that the visual angle of the stimulus in the first study was large enough to have possibly imposed the use of a detailed visual strategy on all subjects. This determination is supported by looking at the mean number of Mooney faces recognized across groups. In the first study only 54% of the faces were recognized, while in the second study when the stimulus and visual angle was smaller, the mean recognition rate was 81%. This suggests that the size of the stimulus in the first study was too large to let individual differences in visual strategy influence task performance. Also supporting this is the eye movement rate per second differences

between the two studies. In the first study, the number of eye movements per second across groups was .511, while in the present study it was .38. The eye movement rate per slide was 3.8 in the present study and 30.7 in the first study. This last difference must be viewed in terms of the different viewing times allowed the subjects. The subjects viewed the slides for 60 seconds in the first study and for only 10 seconds in the present study. The increased eye movement rate per second in the first study supports the presence of a detailed visual strategy being facilitated by the size of the stimulus.

Therefore, in the present study, the stimulus size and visual angle were set at a point (7 degrees) at which neither an analytical nor a global visual strategy would be facilitated, according to Kinchla and Wolfe (1979). This resulted in a different pattern of results from the first study in that no eye movement rate difference was found, but a difference in task performance between the groups was found. It seems as if the smaller visual angle allowed the discrimination between groups on their integrative abilities, as Kinchla and Wolfe (1979) suggested, but did not allow for differences in eye movement rate to be detected.

The difference in eye movement rate may be accounted for when considering the small size of the stimulus. At 7 degrees visual angle, the edge of the stimulus is not far



from foveal vision. Thus the individual need not move his or her eyes far to input all of the stimulus through foveal vision. The eye movements made would thus be smaller in length. If indeed there are differences between HTA and LTA individuals in their reliance upon foveal and peripheral visual input as hypothesized, then this present study's size of stimulus and visual angle would not allow for this discrimination.

Also of importance is the method of counting eye movements. Recording eye movements on videotape is a tedious process and clear resolution is of the utmost importance. In the first study, the raters were easily able to count the eye movements because of their larger size. In the second study, the eye movements were also able to be easily counted, but there most probably were many small eye movements that were not detected and counted by the raters due to the small size of the stimulus. A difference in the mean eye movement rate of the two groups may have been present, but the nature of the videotape and recorder did not allow for the counting of fine, minute eye movements.

In light of the results of the present study, the qualitatively different roles of the attentional systems described by Pribram and McGuinness (1975) continue to be of relevance. There were two levels of information

processing that were examined in this study, that of visual input and that of a higher-level cognitive processing of this input. It seems that the Activation and Arousal attentional systems may influence both of these levels.

Research has provided evidence to support the close relationship between the Activation system's tonic focused attention to details and the left hemisphere's abilities to process this type of information. There is also evidence to support the right hemisphere's abilities in processing global stimuli and the phasic "priming" for broad perceptual input that arises as a result of the influence of the Arousal system. As we have also discussed, anxiety appears to be associated with many of the same processes unique to the left hemisphere and the Activation system. From the results of both the present and the prior pilot study, trait anxiety has been shown to influence both the input of visual information (through eye movements) and the cognitive processing of this input (the integration of the stimuli in the Mooney faces). It would seem apparent then, that the influence of the Arousal system would also be present in both of these levels of information processing. In augmenting perceptual input, the Arousal system may influence the input of visual information through fewer eye movements. It may also influence the cognitive processing of this input by facilitating a broad, global analysis of the information. It is



as if the Activation and Arousal systems act conjointly to bring about an ever-changing mode of inputting and processing visual information. Their respective influences appear to fluctuate and mutually facilitate the assessment of our visual field. Again, it is important to consider characteristics of the stimulus such as size and visual angle, along with individual differences such as anxiety when attempting to determine the relationship between eye movements and attention, as Hiscock and Bergstrom (1981) have emphasized.

The results of the present study along with those of the pilot study, do indicate a relationship between perceptual performance, trait anxiety, and eye movements. Further research needs to be conducted to address the clarification of these relationships. Differing levels of arousal are associated with variable perceptual performance (Easterbrook 1959). In an attempt to address this area more succinctly, this study associated the concept of arousal with specific influences of brain attentional systems, that of Activation and Arousal (Pribram & McGuinness 1975). This allows for the study of specific changes in perception along with specific influences of attention. The qualitatively-specific concept of attentional control should lead to clearer predictions of performance change than are indicated by the more vague, diffuse concept of arousal.

In investigating the relationships between arousal and perception, individual differences in cognitive style must be considered, as this study indicates. These individual differences are important in that they influence the manner in which an individual perceives situations, processes information, and affectively responds to the environment. In addressing the issue of specific brain attentional systems having specific influences on perception as this study has done, it is hoped to clarify these relationships in psychopathological cognition and behavior.

For example, schizophrenia has been characterized as being associated with an "overactivation" of the left hemisphere leading to dysfunction (Tucker 1981). With this in mind, we might expect to find parallels between symptoms in schizophrenia and characteristics of the Activation system. Indeed this has been shown to be the case. Most of the support for the parallels comes from research on brain neurotransmitter pathways. With the close relationship between the Activation system and central dopaminergic activity (Tucker & Williamson, in press) in mind, it can be seen how an increase in dopamine may be accompanied by an increased influence of the Activation system. This can be demonstrated by looking at chronic amphetamine abusers, whose dopamine systems are over-activated. These individuals characteristically exhibit an analytical cognitive style (Ellinwood 1967) along with



a restricted detailed attentional focus (Matthysse 1977). This state often cannot be differentiated from that present in schizophrenia, paranoid type (Ellinwood 1967). These cognitive correlates and the increased left hemisphere activity indicate a close relationship between the Activation system and characteristics of schizophrenia.

Similar evidence exists for the asymmetrical influence of the Arousal system in affective disorders (Tucker & Williamson, in press). For example, manic individuals exhibit a diffuse, global cognitive style (Kushnir, Gordon, & Heifetz, Note 2) while quickly habituating to redundant stimuli, thus constantly being perceptually aware of novel stimuli (Tucker & Williamson, in press). This suggests increased right hemisphere activity and greater influence of the Arousal system in manic states. Norepinephrine, in being closely associated with the Arousal system (Tucker & Williamson, in press), has been implicated in the etiology of depression (Schildkraut 1969).

The influences of the Activation and Arousal systems not only appear to be present in psychopathology, but also in states of stress. As reviewed earlier, studies investigating the influence of arousal on perception often used induced stress to alter the subject's level of arousal. It was found that under states of stress, or high arousal, the subject's attention became restricted to a narrower range of stimuli (Easterbrook 1959). These

states of stress were often of a state or situational nature. In contrast, the present study investigated a more consistently present state of anxiety which is assumed to involve a certain amount of stress. From the results of the present study along with those from the earlier reviewed studies, it appears that trait anxiety and also state anxiety may be associated with similar narrowing and restrictedness of attention and possibly cognitive activity as well.

In investigating anxiety and its influence in cognition and perception, it seems of pertinent clinical interest to continue to clarify the characteristics involved. Anxiety appears to be a fundamental part of human existence. Cohen (1975) notes that fear and most probably anxiety are clearly present in Egyptian hieroglyphics. The poet W.H. Auden has described the twentieth century as the "Age of Anxiety" (May 1950). Although it is generally acknowledged that anxiety plays a role in most human activities, it is not always clear what exactly this "anxiety" is, and exactly what influences it has in human cognition and behavior. Not only does it influence normal cognition and behavior and general states of stress, but we have also seen that it is associated with pathological cognition and behavior. Future research may provide a clearer understanding of these relationships.



It may be possible to understand the adaptive functions of anxiety as we clarify the brain systems involved and document the specific changes that anxiety produces in perceptual strategy.

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