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The role of attention in affect perception: an examination of Mirsky's four factor model of attention in chronic schizophrenia

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THE ROLE OF ATTENTION IN AFFECT PERCEPTION: AN EXAMINATION OF
MIRSKY'S FOUR FACTOR MODEL OF ATTENTION IN CHRONIC
SCHIZOPHRENIA

A Dissertation

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in

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by
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Dedication

This work is dedicated to my wife Melissa and to my son Kenneth Mason who constantly remind me of what is truly important.

Acknowledgements

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Abstract

Attention and affect perception was examined in a sample of sixty-five persons with chronic schizophrenia. Attentional skills may be related to deficits in affect perception due to a lack of attention to important information contained in the face. Deficits of this sort can dramatically inhibit appropriate social functioning. However, there is a lack of empirical research on this topic. Mirsky's four factor model of attention was used as a broad-based assessment of attentional functioning. The four factors of attention were: 1) Focus-Execute, 2) Encode, 3) Sustain, and 4) Shift. Neuropsychological measures reflective of attentional factor were administered. In this study, Mirsky's four factor model of attention was replicated, and four clear factors of attention emerged from the analysis. In addition, a regression analysis showed that all four attentional factors and psychiatric diagnosis were significantly related to affect perception scores. In contrast, psychiatric symptoms, medication levels, demographic variables, verbal fluency, and face perception scores were unrelated to affect perception. The four factors of attention accounted for 78% of the variance in affect perception scores. Finally, persons who scored high and low on the affect perception measures were also found to differ on the attentional measures as well. All of these results point to the important role that attentional abilities play in the recognition of emotional states for persons with schizophrenia.

Overview of Study

It is believed by many researchers that schizophrenia, at its core, is essentially a social-cognitive disorder because the disorder has both impairments in social and cognitive functioning (Bellack, 1992; Kohler et al., 2000; Penn & Mueser, 1996; Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). Persons with schizophrenia have demonstrated a variety of social impairments, such as poor social skills, decreased nonverbal cue recognition, and social competence deficits, and they also have a wide-range of information-processing and neuropsychological deficits as well (Bellack, 1992; Penn et al., 1997). Specifically, problems in memory, attention, concept formation, and reasoning have all been found in persons with the disorder (Schwartz, Rosse, & Deutsch, 1992; see Zalewski, Johnson-Selfridge, Ohriner, Zarrella, & Seltzer, 1998 for a review). These information-processing deficits are so pervasive that they have been incorporated as a fundamental component of the disorder (Nuechterlein & Dawson, 1984a; Zubin & Spring, 1977). Recently, researchers have become increasingly interested in the link between information-processing and problems in social functioning (Bellack, 1992; Penn, Combs, Mohamed, 2001). It is believed that problems in cognitive functioning may affect the person's ability to learn, exhibit, and express social skills and behaviors (Bellack, 1992; Morrison, Bellack, & Mueser, 1988; Penn et al., 1997). However, studies examining social behaviors and cognitive abilities are limited in number and have been inconsistent in their findings (Green, 1996). Most often, information-processing variables only account for a moderate amount of the variance in social skill behaviors; Penn et al. (1997) suggested 25% as a typical estimate. In addition, most studies on information-processing have adopted a shotgun approach by selecting a wide-range of neurocognitive abilities to assess, rather that focusing on specific theoretically important areas. One aspect of social behavior that needs further study is the ability to perceive and identify another person's affective or emotional state. Deficits in affect perception are believed by some to be the most crucial and debilitating of all the social impairments found in

schizophrenia (Morrison, Bellack, & Mueser, 1988). A further understanding of the relationship between information-processing abilities and affect perception may lead to enhanced understanding of the characteristics of the disorder and possibly aid in rehabilitation efforts for this population (Green, 1996).

There is emerging evidence that attention may be an important component to affect perception. Previous researchers have noted that deficient attentional skills could be a possible reason for the impairment in affect perception found in this population (Bellack, 1992; Mandal, Prandey, & Prashad, 1998; Morrison et al., 1988). Quite simply, if a person cannot fully attend to facial stimuli, then his or her capacity to decode and interpret emotional expressions will be concomitantly impaired. Furthermore, because attention is a necessary precursor for processing incoming information, problems in attention can affect a wide-variety of higher-order cognitive abilities (Mapou, 1995). In fact, impairments in attention can explain most of the cognitive deficits found in schizophrenia. It is possible that the problems in affect perception may actually lie in deficient attention instead of impaired higher-level functions, such as language, reasoning, and judgment. A large number of studies have proposed that attentional skills may be a crucial factor in affect perception skills (Archer et al., 1992; Bentall, 1992; Bryson et al., 1997; Kerr & Neale, 1993; Mandal et al., 1998; Morrison et al., 1988), yet only a few studies have empirically examined the aforementioned link between attention and affect perception (Bryson, Bell, & Lysaker, 1997; Kee, Kern, & Green, 1998; Morrison, Bellack, & Bashore, 1988). Unfortunately, the results of these studies have been inconclusive regarding the relationship between attention and affect perception.

In sum, there is substantial theoretical argument that attention is important in affect perception (Bellack, 1992; Bryson et al., 1997; Mandal et al., 1998; Morrison et al., 1988). In order to perceive and recognize different emotional states, facial information must be attended to and perceived (Bellack, 1992). However, there have been few empirical studies, which have examined this relationship. An empirical investigation may

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provide additional evidence regarding the relationship between attention and affect perception. Thus, the study of attention and affect perception has important theoretical and empirical merit.

The purpose of this study was to explore the relationship between affect perception and attention in persons with chronic schizophrenia using an empirically validated model of attention. Mirsky, Anthony, Duncan, Ahearn, and Kellam (1991) identified four factors of attention (Shift, Sustain, Encode, and Focus-Execute) based on a factor analysis of common neuropsychological measures of attention. The four factors of attention have been replicated in previous research using persons with schizophrenia and provided a comprehensive model of attention to apply to schizophrenia (Kremen, Seidman, Faraone, Pepple, & Tsuang, 1992; Steinhauer et al., 1991).

The evidence obtained here will provide further data on the role of attention in affect perception. Since different factors of attention can be selectively impaired in different diagnostic and psychiatric groups (Mirsky et al., 1991), the present study will explore which specific component(s) of attention, if any, are the most crucial for affect perception. Before the methodology for the present study is described, a brief review of the signs and symptoms of schizophrenia will be presented, followed by a presentation of cognitive, anatomical, and factor analytic models of attention. A review of experimental studies on attentional dysfunction in schizophrenia and a review of affect perception research findings in schizophrenia will also be conducted. Finally, the role of attention in affect perception will be discussed in order to provide a rationale and purpose for the present study.

Definitions and Phenomenology

The historical development and study of schizophrenia has been described as "perplexing, frustrating, and at times professionally demoralizing" (Carson & Sanislow, 1993). This attitude among researchers is somewhat paradoxical given the amount of knowledge available and since the symptoms of schizophrenia have been described and studied for over 1000 years. The modern history of schizophrenia can be traced to the work of Emil Kraepelin when he separated dementia praecox from manic-depression, thus giving the syndrome later known as schizophrenia a formal identity. Subsequently, Eugen Bleuer expanded on the work of Kraepelin with his classic 4 A's of schizophrenia (i.e., autism, association, affect, and ambivalence). Bleuler's criteria were the diagnostic standard for many years, and he is credited with the first use of the term "schizophrenia." However, due to poor reliability and frustration from clinicians using Bleuler's criteria, a new definition of schizophrenia was proposed by Kurt Schneider with his listing of "first-rank"symptoms. First rank symptoms included thought insertion, hallucinations, and delusions and are currently classified as positive symptoms of the disorder in that these symptoms occur in excess of what would normally be expected. In addition to positive symptoms, there also appears to be support for a negative symptom dimension (APA, 1994), referring to symptoms involving a notable absence of behaviors that would normally be expected. Currently, positive symptoms include delusions, hallucinations, disorganized speech and odd behaviors (e.g., strange dress, poor hygiene, etc.), while negative symptoms include flat affect, poverty of speech, and avolition (lack of goal directed behavior). Some clinicians prefer to describe the disorder in terms of positive and negative symptoms rather than use traditional diagnostic categories (APA, 1997; Andreasen, 1990; Carson & Sanislow, 1993; Coleman & Gilberg, 1996). However, despite the lack of agreement on the utility of diagnostic categories, Schneider's definition eventually became the standard and was incorporated in the psychiatric

nomenclature. Over the years, the definitions and symptoms of schizophrenia have gradually changed with each new <u>Diagnostic and Statistical Manual for Mental Disorders</u> (DSM), but most of our current thinking about schizophrenia is still based on the work of Bleuer and Schneider. Currently, schizophrenia is comprised on the following signs and symptoms (APA, 1994).

A. Active Symptoms: Two or more symptoms listed below are present for one month. (Only one symptom is needed if the delusions are bizarre or if the hallucinations are voices, which keep a running commentary or converse with each other)

1. Delusions.

2. Hallucinations.

3. Disorganized Speech.

4. Disorganized Behavior.

5. Negative symptoms (e.g., flat affect, alogia, avolition).

B. Social or occupational impairment is present.

C. Active symptoms from section A that persists for one month and there has been at least six months of continuous signs of the disturbance.

D. Schizoaffective or mood symptoms cannot account for the disorder.

E. Medical or substance abuse conditions cannot account for the disorder.

F. If a developmental disorder is also present, the active symptoms are present for one month.

The DSM-IV lists five subtypes of schizophrenia, which include paranoid, disorganized, catatonic, undifferentiated, and residual schizophrenia (APA, 1994). Each subtype is associated with a different constellation of diagnostic signs and psychiatric symptoms.

Review of Literature

<u>Cognitive Theories</u>

Attention has been a focus for cognitive psychology since the 1950's and was one of the first areas of study and research for this emerging discipline (Pashler, 1998). Attention is often described by laypersons as a spotlight that can be focused on whatever task is at hand. However, as research continued on attention, new conceptualizations about attention have arisen with each new theory becoming increasingly more complex. We will now review several cognitive conceptualizations of attention.

In one of the first scientific observations about attention, Cherry (1953) described the "cocktail party phenomenon" in which a person could selectively attend to personally relevant stimuli even in distracting conditions. Even though these anecdotal observations were at the time important, empirical research was needed to further delineate and study the characteristics of attention. Donald Broadbent (1958) developed the first cognitive conceptualization of attention, which he called the Early Selection Theory of Attention (Braff, 1993). He stated that the attentional system was a single, limited capacity system in which some information passed through and was processed by higher-order cognitive processes. Other non-important information was not attended to and thus screened out. More specifically, he stated that all incoming stimuli was analyzed at the physical level (e.g. form, shading, and angulation), but only the most relevant information gets analyzed for symbolic and semantic properties. Thus, he postulated that attention was essentially a filter-based system. The concepts of filtering, categorization, and pigeonholing are important to understanding Broadbent's theory of attention (1958; 1971). The hypothetical attentional filter was believed to act on incoming data early in the sensory

perceptual process. The person analyzed the stimuli at a pre-attentive level of awareness (Kahneman & Treisman, 1984). Categorization (of incoming stimuli) occurred when only certain categories of data (e.g., names and faces) were processed while non-relevant categories (e.g., clothing) were lost. Finally, pigeonholing referred to a cognitive bias in which the categories most typically attended are rapidly processed. Pigeonholing allowed for the processing of more complex groupings of stimuli based on group membership properties and similarities. All of these mechanisms, filtering, categorization, and pigeonholing, served to reduce the amount of incoming stimuli that is processed.

Kahneman and Treisman (1984) expanded on the work of Broadbent by stating that attention is very limited in what it can process and functions as a "bottleneck" for incoming stimuli. Early filter theories of attention had three basic assumptions (Kahneman & Treisman, 1984). First, each person is constantly exposed to both relevant and irrelevant stimuli. Second, relevant stimuli are subject to complex cognitive process in which the significance of the stimuli can be ascertained. Kahneman and Treisman (1984) further believed that irrelevant stimuli were lost from awareness while relevant stimuli were held in sensory storage for further processing. Third, irrelevant stimuli could only be distinguished by their physical properties and no higher-order cognitive processing was conducted. Thus, irrelevant stimuli were only analyzed at the pre-attentive (sensory) level of analysis. Treisman (1960) revised Broadbent's early filter theory based on research, which found that unattended stimuli could be processed without conscious awareness (Dichotic listening studies). This finding led to a re-conceptualization of the hypothetical filter that moderates attention. Treisman (1960; 1964) along with Broadbent (1971) proposed that the attentional filter serves to only

attenuate incoming stimuli and does not completely eliminate it from awareness. Today, early filter theories are considered crude and lacking in research support (Pashler, 1984). However, they are important in that they were the first cognitive account of attention and served as the foundation for later theories of attention (Pashler, 1984).

Another variant and logical expansion of early filter theories that arose in the 1960's was the development of late filter theories of attention (Keele, 1973; Norman, 1968; Wickens, 1984). These theories arose from dichotic listening studies in which information presented to the unattended ear could be recalled or at least partially recognized (Moray, 1960; Treisman, 1960; 1964). In general, dichotic listening studies require that the person listen or repeat stimuli presented to one ear only and disregard stimuli in the other ear. Then the person was asked to recall stimuli from both ears. Information in the unattended ear could be recalled, particularly if the stimuli were personally relevant, unique, or distinctive in physical characteristics. Late filter theories proposed that the bottleneck or filter is not at the point of sensory perception (As argued by Broadbent), but acted later in the attentional process, at the point of decision-making. Thus, all stimuli are analyzed at the pre-attentive level of analysis and then passed on to higher-order processing areas, regardless of content. These higher-order processing areas acted to filter stimuli by deciding what to attend to and what not to attend. Personally relevant and other important stimuli were more likely to be attended to than unimportant stimuli (As discussed in Nuechterlein & Dawson, 1984). Furthermore, this processing took place across all sensory modalities (Wickens, 1984). One drawback to the late filter theories was that the actual filtering mechanism, which allowed some stimuli to be selectively attended to, remained unclear.

In addition to filter theories, another line of attentional theories, termed resource or capacity theories, were developed in the 1970's in response to the limitations of filter theories. Capacity theories arose in order to explain studies, which found that some tasks could be performed simultaneously without impairment while other types of tasks could not be performed together. Research studies have shown that tasks, which entailed making two motor responses or making two sensory judgments/perceptions at the same time, were more difficult than a task, which required a person to make a sensory discrimination and a motor response at the same time. Resource theories postulated that there existed only a finite amount of attentional resources that could be allocated toward any given task. Once these resources are allocated or used up, attentional abilities suffered and performance declined. This explained the difficulty in performing two motor or two sensory tasks at the same time. In addition, it was believed that these attentional resources existed in an undifferentiated, non-specific pool, which could be allocated flexibly toward various tasks. Thus, in contrast to filter theories, it was not a hypothetical filter, which constrained attention, but the limited availability of attentional resources. When attentional demand exceeded supply, problems in attention became apparent. In an extension of capacity theory, Kahneman (1973) proposed that attentional capacity was finite in amount at any given point in time, but can be increased or decreased by the core brain arousal system. Kahneman (1973) showed that as task difficulty or importance increased, variables related to arousal such as pupil diameter and skin conductance also increased along with attentional capacity. Knowles (1963) proposed a different view of how attentional capacity could be modulated. He proposed the existence of a "human processing operator" that was responsible for deciding how much attentional resources to allocate for a specific task. An important finding in capacity research was that people have different amounts of attentional resources available, and this factor accounted for individual differences in the performance of attentional tasks.

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A more recent advance in resource/capacity theories has been the idea that instead of a <u>single</u> pool of resources, there are <u>multiple resource pools</u>, which were independent from each other and were uniquely specialized for specific types of attentional tasks (Barff, 1993; Wickens, 1984). These multiple resource pools reflected the ability to handle different types of sensory input (visual and verbal) and different methods of output (motor, cognitive, and imaginal) at the same time without impairment. Tasks, which overlapped in mode of input or output, became more difficult and depleted that specific pool of resources. The documented existence of multiple resources pools of attention remains to be demonstrated.

One spin off of capacity theories has been the attention-allocation model developed from research on substance abuse (Steele & Josephs, 1986). This model states that alcohol and other substances (e.g., smoking) reduce a person's attentional capacity. This reduction in attentional capacity limits the amount of attentional/cognitive resources that can be directed to a specific task. Thus, substances reduce the amount of controlled directed processing (e.g., conscious thinking and deliberation) that the person can engage in. Experimentally, it has been shown that alcohol and smoking reduced one's level of anxiety and stress by allowing the persons to focus on distracting activities, instead of using their attentional resources to worry (Kassel & Shiffman, 1997; Steele & Josephs, 1988). The attention-allocation model can be viewed as a clinical application and extension of the concepts from capacity theories of attention.

Cognitive formulations of attention were dramatically altered based on the experimental work of Richard Shiffrin and Walter Schneider. Shiffrin and Schneider (1977) along with Posner (1978) demonstrated that attention could be conceptualized into automatic and serial processes. Several years earlier Neisser (1967) proposed a similar dichotomy when he divided attention into pre-attentive (unlimited) and serial processing components. Shiffrin and Schneider (1977) showed that some visual targets (usually a shape or letter that a person must identify) could be perceived very quickly regardless of

how many distracter shapes were also present. For other tasks, identification of the target was slow and inherently more difficult. They noted that some shapes seemed to "pop out" and were easily discriminated, while others were harder to perceive and required sustained visual scanning. This "pop out" phenomenon gave rise to the automatic versus controlled processing view of attention (Schneider, Dumais, & Shiffrin, 1984). Automatic processes were described as fast, parallel, effortless, and have a nearly unlimited capacity that is not affected by short-term memory limitations. Automatic processing was not under conscious control and seemed to operate without one's awareness. In contrast, controlled processing was described as the slow, effortful, consciously controlled scanning of stimuli. Controlled processes were limited in their capacity to perceive information and were subject to sensory overload (Posner & Synder, 1975). According to Schneider et al. (1984) and Posner (1978), the hypothetical bottleneck for attention could be found in the operation of controlled processes with its limited capacity. The automatic/serial processing view of attention combined the conceptualization of a filter or bottleneck along with findings that some information processing can be handled without attentional effort. Thus, it represented a hybrid model linking past theories of attention with new empirical findings.

Recently, work by Treisman and colleagues (Treisman, 1986; Treisman & Gormican, 1988) have expanded on the research of Shiffrin and Schneider (1977) by focusing on automatic and controlled processing of visual-spatial shapes (studied the extraction of features from shapes). Treisman (1986) proposed that the basic features of a stimulus could be perceived in an automatic fashion. Features such as color, orientation, size, and distance can be perceived without limitations of capacity and effort. However, as the discrimination becomes more difficult, or as the distracters and targets become more similar in appearance, a higher degree of attention was needed to make perceptual discrimination choices. Thus, more difficult and detailed processing was conducted in a serial or as Treisman (1986) describes a "conjunctive fashion." One example was that a

person can see that there are different shapes presented to them, but in order to find a specific shape from among a complex array, serial processing (i.e., scanning the picture to find the shape) was required. In conclusion, the work of Shiffrin and Schneider is still relevant today and no account of attention is complete without a discussion of automatic and serial processing. Despite their appeal, one of the main drawbacks of cognitive theories is the failure to link their findings on attentional abilities with anatomical brain areas. We will now discuss four prominent anatomical views of attention.

Anatomical Theories

Different anatomical theories of attention have been proposed over the last 25 years. Mirsky et al. (1991) reported that most well-known theories of attention use the same research data, but have different interpretations of that data. He further noted many commonalties between the various anatomical theories of attention.

Pribram and McGuinness (1975) proposed one of the earliest anatomical theories of attention. According to their theory, attention was composed of three distinct yet integrated anatomical systems. Pribram and McGuinness divided attention into arousal, activation, and effort. The first component, arousal, was considered the most primitive attentional system and was located in the spinal cord, reticular activating system (RAS) and the mid-brain hypothalamus. These arousal components were also called the "core brain arousal system" due their singular function and their presence in higher-order animal species. According to Pribram and McGuinness (1975), this system was responsible for increasing or decreasing the levels of cortical arousal. They noted that if this system were left uncontrolled there would be no way for arousal to change based on environmental demands. The second component, activation, was believed to exert control over the arousal process through frontal lobe and amygdala modulation of the arousal state. Thus, the frontal lobes and amygdala could increase or decrease the activity levels in the core brain arousal system depending on task demands and complexity. The

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activation system also contained the basil ganglia, which was believed to be responsible for the mobilization of motor neurons for action. The inclusion of motor neurons allowed the person to act on the attended stimuli. The final component, effort, was considered a complex higher-order system and was functionally dependent on the hippocampus. If needed, the hippocampus could exert control over both the arousal and activation systems. Thus, not only could it affect the level of arousal, but it could modify any actions toward intended objects as well. According to Pribram and McGuinness, effort was related to neuronal activity in the hippocampus, which lead to changes in the "central representation" (internal image) of certain stimuli. Changes in central representation were essentially a change in expectancies or attitudes. For example, attention could be increased or decreased by one's expectations for what may occur in a given situation. However, despite the apparent simplicity and empirical support for the Pribram and McGuinness model, there are some important limitations. One major criticism of this model comes from the reliance on animal models of attention, which may or may not apply to the human attentional system.

A second model of attention was developed by Posner and Petersen (1990) and recently expanded on by Fernandez-Duque and Posner (2001). Posner and Petersen postulated that attention was composed of three component parts, which included an orienting, detection, and alert/sustain component. In addition, the attentional system could be further divided into a posterior and an anterior attentional system. The posterior system contained the inferior parietal lobe, superior colliculus, and the posterior thalamus. These three sites were thought to be responsible for the first component of attention, orienting. Posner and Petersen (1990) summarized the orienting function as a "disengage, shift, and re-engage process" in response to novel stimuli. According to Posner and Petersen (1990), the parietal lobe served to disengage attention, the superior colliculus helped to shift attention, and the posterior thalamus re-engaged attention toward its new target. Thus, all three anatomical areas were necessary for orientation. The

second component of attention, the detection system, was believed to be located on the anterior portion of the cortex and was composed of the lateral frontal lobes and the anterior cingulate gyrus. The anterior system directed and controlled the activity of the posterior system (e.g., orientation). The main function of this system was the detection system was the identification of important stimuli. This system could detect both language and visual patterns in the environment. The detection system was also responsible for handling complex tasks (i.e., overcome interference, distraction, or handle multiple tasks at the same time). The anterior system was believed to posses the resources to temporarily pass control of attentional resources to the posterior system if it was busy handling other tasks or is overloaded with information. The final component of attention, the alert or sustain system, served to prolong and potentiate the activity of the attentional system so that important information was not missed. Posner and Petersen (1990) did not provide a locus for this system, but believed that it resided in the right hemisphere. This location was selected because previous research studies found deficits in vigilance following right hemisphere lesions.

The third anatomical model of attention was based on the research of Heilman, Watson, and Valenstein (1995) and Mesulam (1987). This model of attention was developed from research on attentional neglect syndrome. According to this theory, the Reticular Activating System (RAS) was the key component of attention. Furthermore, Mesulam described two forms of attention, an RAS mediated tonic form (steady state of attention) of attention, which consisted primarily of sustained attentional tone or a readiness to respond, and a vector form of attention, which was more directed and focused toward specific targets. Vector attention was also known as "directed attention" and implied conscious control of attentional processes. The frontal lobes, unimodal, association, and tertiary cortex were believed to be key components of directed attentional processes. Particular importance was given to the parietal lobe, which Heilman et al. (1995) believed provided the initial focusing and registration of attention.

Another important attentional area included the reticular thalamus. The reticular formation is linked with the RAS to form an attentional network, which can then modify the distribution of sensory input to the cortex. If the RAS or reticular thalamus was damaged, the cortex becomes inhibited and may not recognize the presence of incoming sensory stimuli (e.g., visual neglect is produced). Mesulam (1987) described the reticular thalamus as an "attentional value" which cold turn up or turn down the sensitivity of the cortex to external stimuli. Most often, contralateral neglect was observed in persons who had damage to either the parietal lobe or reticular thalamus. In sum, the most important anatomical areas in the Mesulam (1987), and Heilman et al. (1995) model were the reticular activating system and the reticular thalamus.

The final anatomical theory of attention comes from A.F. Mirsky and colleagues (1987; 1991). Mirsky derived four factors of attention based on a factor analysis of common measures of attention. He labeled these factors of attention Sustain, Shift, Focus-Execute, and Encode. Mirsky used both experimental and clinical data to link each attentional factor to a corresponding brain area. Thus, Mirsky "localized" attention to very specific brain areas. Mirsky further added that even though the four factors appeared to be separate, in fact, all of these brain areas are linked together to form the human attentional system. Mirsky, believed that the Sustain factor was associated with activity in the RAS, tectum, and the reticular thalamus. The Shift factor was found in the frontal lobes and the anterior cingulate gyrus. The Shift factor was not merely the movement of the eyes as proposed by Posner and Petersen (1990). Posner and Petersen (1990) placed shift in the superior colliculus while Mirsky placed it in the frontal lobes. The Focus-Execute factor was associated with the inferior parietal lobes, basal ganglia, and superior temporal lobes. The Focus-Execute component was believed to be more complex than the other factors. This component has both a recognition (parietal lobe, superior temporal lobe) and a motor component (found in the basal ganglia). The final factor, Encode, was believed to lie in the hippocampus and amygdala. Lesions of the hippocampus often

resulted in problems in visual/auditory span, short-term memory impairment, and problems in attention (Mirsky, 1991). Mirsky postulated that there are specific brain areas devoted to attention, however, his model of attention still remains speculative as replication evidence is lacking.

The four factor model proposed by Mirsky is potentially the most useful since it is based on a wide variety of clinical and experimental evidence. Also, his model is based on data from many different subject groups, and thus has the potential to generalize to different patient populations more so than the other models. Finally, Mirsky developed his model based on a review of human attentional studies as compared to animal models of attention (See Pribraum & McGuinness).

However, after reviewing the four anatomical models of attention there appears to be a great degree of consistency between the various theories. All four theories posit some breakdown of attentional functions into separate yet integrated components. Also, most of the theories view the RAS, the reticular thalamus, and the frontal lobes as an important component in attentional processes. In particular, the work of Heilman et al. (1995), Mesulam (1987) and Mirsky (1987) are strikingly similar in their proposed anatomical models of attention.

Factor Analytic Theories

Factor analytic theories of attention are based on the relationship between different psychological measures of attention. Attentional measures related to each other are grouped into a factor, and each factor is believed to measure a different component of attention (Mirsky, 1987). In this section we will review the assessment-based evidence for Mirsky's four-factor model of attention, which is currently the most accepted factor analytic theory of attention.

The initial factor analytic study of attention was conducted by Mirsky (1987) after he factor analyzed data from 86 persons using the NIMH (National Institute of Mental

Health) neuropsychological assessment battery. Mirsky (1987) used already existing tests of attention to determine how may factors of attention could be identified from different assessment measures. Mirsky identified four factors of attention labeled as: 1) Focus-Execute, 2) Shift, 3) Sustain, and 4) Encode. The first factor, Focus-Execute, was composed of the Trails Making Test (part A and B), the Stroop Test, the Talland Letter-Cancellation test, and Digit Symbol-Coding from the WAIS-R. This factor was believed to reflect the ability to identify a stimulus (Focus) and then perform some type of motor operation on that stimulus (Execute). The second factor, Sustain, was composed of scores from the Continuous Performance Test (CPT), and measured the ability to sustain visual attention over long periods of time. The CPT task required the person to remain vigilant for target stimuli contained in a sequence of irrelevant stimuli. A follow-up study by Kremen, Seidman, Faracone, Pepple, and Tsuang (1992) found that a different version of the CPT, the Auditory Continuous Performance test, also loaded heavily on the Sustain factor. The Sustain factor appears to be comprised of both auditory and visual vigilance. The Shift factor was composed of scores from the Wisconsin Card Sorting Test (WCST) and was thought to measure a person's ability to make conceptual shifts based on underlying grouping principles and rules found in the test. Some believe that the WCST measures executive functions more so than attention; however, since attention and executive functions are both localized to the frontal lobes there may not be an effective way to dissociate their relationship (Mirsky et al., 1995). The final factor, Encode, was composed of the Arithmetic and Digit-Span tests from the Wechsler Adult Intelligence Test. This factor was described as the ability to hold information in short-term memory and then perform mental operations that information. In a replication study with a larger sample, Mirsky et al. (1991) confirmed the four factor solution in a mixed sample of normal adults and persons with psychiatric disorders. Furthermore, the same four factors were found in a sample of 435 school-aged children. In addition to his factor structure of attention, there was another important finding evident in the data. Mirsky et al. (1991)

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demonstrated that any of the four factors of attention could be differentially impaired by various neurological or psychiatric conditions. For example, persons with closed head injury often show impaired focus-execute and sustain skills, but intact shift and encoding abilities.

Mirsky's four factor solution has been replicated in several studies with a variety of different measures and with different populations. Steinhauer et al. (1991) used a mixed sample of persons with schizophrenia and their non-affected relatives and found evidence for three of the four factors (focus-execute, shift, sustain). Kremen et al. (1992) studied 34 persons with varying degrees of psychosis and found a "virtually identical" factor solution to that of Mirsky et al. (1991). Allen et al., (1997) studied 25 males with chronic schizophrenia both on and off haloperidol and found that Mirsky's four factors were stable across medication changes. A study by Shum, McFarland, and Bain (1990) found a three-factor solution, which they characterized as having a visual-motor component, a sustained component, and a visual-auditory span component. Shum et al. (1990) used different attentional measures from that of Mirsky et al. (1991), but there is similarity among the derived factors. Picano, Klusman, Hornbostel, and Moulton (1992) replicated the results of Shum et al. (1990) when they found a three-factor solution with prominent motor, sustained, and conceptual components based on a sample of HIV positive males. More recently, a confirmatory factor analytic study of Mirsky's work by Pogge, Stokes, and Harvey (1994) found a similar, yet much simpler factor structure, which consisted of three primary factors using attentional data from a sample of inpatient adolescents. They found a sustained, a numeric-mnemonic, and a complex effort factor which were highly similar to Mirsky's sustain, encode, and focus-execute factors. Thus,

there seems to be converging evidence that Mirsky's four-factor solution is stable across different populations and assessment measures.

Despite the support for Mirsky's four factor model of attention, there have been several studies that have failed to replicate his findings. Schmidt, Trueblood, Merwin, and Durham (1994) used twelve different measures of attention and controlled for method variance (i.e., a concept in which tests which use the same method of completion, such as paper-pencil format, are similar only due to the method of test taking; see Campbell & Fiske, 1959 for a complete discussion) and were not able to replicate the results of Mirsky et al. (1991) or Shum et al. (1990). In this study, only two factors, a visual-motor scanning and a visual-auditory span were found. A more recent study by Strauss, Thompson, Adams, Redline, and Burant (2000) used structural equation modeling in an attempt to confirm Mirsky's four factor solution using data from Mirsky's et al. (1991) original two samples. Results with these new samples showed that the data did not fit the proposed four factor solution previously found and called into question whether four factors of attention could be reliably replicated.

In summary, there seems to be a considerable, but not unanimous body of evidence supporting a four factor model of attention. Whether attention can be best broken down into 3 or four factors is not yet known, but many of the factors (sustain, focus-execute, encode) identified were highly consistent between studies (Kremen et al., 1992; Mirsky 1987; Mirsky et al., 1991; Picano et al., 1992; Pogge et al., 1994; Shum et al, 1990; Steinhauer et al., 1991). However, it should be remembered that just because this factor structure is present among a group of measures does not mean that this organization scheme is also present in the human brain in such as localized and simplistic

manner. Also, since many of the attentional measures have the same method of completion (paper and pencil format), the confound of a common method variance, which may account for the results, should be kept in mind (Campbell & Fiske, 1959 as discussed in Mirsky et al., 1991). Further research is needed to link the identified factors with specific brain areas. Also, replication studies with different samples and a variety of measures would provide a further test of Mirsky's four factors of attention.

Attention and Schizophrenia

The study of attention in persons with schizophrenia did not effectively begin until the seminal work of Joseph Zubin (1975). However, long before Zubin's work, other clinicians noticed that persons with schizophrenia displayed impairments of attention. Emil Kraepelin stated that persons with schizophrenia exhibited "a certain unsteadiness in attention" (Kraepelin, 1913). Bleuler (1950) further noted that in schizophrenia, "acute attention seems to be lacking." Bleuer observed that at times persons with schizophrenia would display high levels of attention and other times would appear to ignore the world completely (As reported in Zubin, 1975). McGhie and Chapman (1961) reported that some schizophrenic persons have reported that at times "everything would grip their attention despite their persistent lack of interest in anything." Thus, even though it appeared that attentional impairments were commonly observed and reported, there was a general lack of empirical study in this area.

In 1975, Zubin conducted experiments designed to assess and explore attentional capacity in this schizophrenia. Zubin (1975) postulated that attention consisted of three primary components: select, maintain, and shift. Zubin presented persons with schizophrenia a series of same modality (ipsamodal) or different modality (crossmodal)

stimuli. Visual and auditory stimuli were most commonly used. He then measured their

reaction times to the different stimuli that were presented (e.g., press the key whenever

you see or hear the letter "t"). It was found that persons with schizophrenia had slower

reaction times compared to ipsamodal stimuli, but they were extremely impaired in

responding to crossmodal stimuli. Zubin attributed their slowness to respond to

ipsamodal stimuli (which should be easier) to motivational factors (i.e. decreased interest

in the task). He noted that their reaction times would improve to near normal levels under

condition of duress. However, when crossmodal stimuli were presented,2 reaction times

were still slow regardless of motivational levels. Zubin argued that persons with

schizophrenia had problems with stimulus interference. Specifically, there may be some

type of sensory/memory trace that impaired their performance on these crossmodal tasks.

These problems occurred when switching from one stimulus type to another (visual to

auditory or vise versa). Thus, he concluded that in schizophrenia, attentional impairments

were related to impairments in the shift factor rather than impairment in the select or

maintain factors. Zubin's work served to highlight and further refine the work on

attention in persons with schizophrenia by showing greater deficits in one specific aspect

of attention.

The work of Zubin was important because it served as an impetus for further

study of attention in schizophrenia. We will now review some of the current research in

this area and draw some conclusions about the nature of attentional impairments in this

population. In general, persons with schizophrenia have attentional deficits on a wide-

range of cognitive experimental tasks. Particular attention has been devoted to the area of

sustained attention or vigilance. On measures of sustained attention, attentional problems

have been found in persons with chronic (Orzack & Kornetsky, 1966), remitted (Arsanow & Macrimmon, 1978), and acute schizophrenia (Wohlberg & Kornetsky, 1973). Usually, vigilance was measured with a Continuous Performance Test (CPT), which required the person to maintain their attention over time and detect a predetermined stimulus target from a series of distracter targets. According to Braff (1993) research findings have convincingly shown that on a variety of CPT vigilance tests, persons with schizophrenia have performance deficits. Furthermore, persons with schizophrenia have produced vigilance deficits on several versions of the CPT (Cornblatt et al., 1989; Nuechterlein, 1991; Orzack & Kornetsky, 1966). These different versions of the CPT vary test format and usually include some level of interference making the test more difficult. It was interesting to note that the non-impaired relatives of a person with schizophrenia also showed CPT vigilance problems. These deficits are of an attenuated form, but their profiles are quantitatively different from those obtained from individuals without a schizophrenic proband. This data suggested that the observed attentional problems may have some form of genetic linkage.

In addition to vigilance problems, persons with schizophrenia also showed deficits on visual attention tasks (Braff, 1993; Nuechterlein & Dawson, 1984b), which were defined as the ability to visually detect, scan, track, and follow targets. Problems in directed visual attention have been observed in the manner in which persons with schizophrenia examine faces. It was found that deluded persons displayed abnormal eye scanning deficits when viewing faces as compared to normal controls (Phillips & David, 1997; 1998). Deluded persons directed their attention to more irrelevant and nonessential areas of the face. In contrast, unimpaired persons scanned the eyes, nose, and mouth

regions, which presumably provides the most information about the person. Besides examining faces, there have been other visual scanning deficits reported.

Impairment in smooth pursuit eye tracking, in which the person must following moving shapes with their eyes, has been consistently replicated across many experimental tasks (Abel et al., 1991; Holzman 1987; Litman et al., 1991). Impairment in eye tracking was believed to further reflect attentional deficits in this population. In addition to problems in eye tracking, there appeared to be impairments in the amount of information that the person with schizophrenia can visually encode and perceive in a single glance (Asarnow et al., 1991. Tests using the Span of Apprehension test, which required the person to report if a specific stimulus was present from an array of other stimuli that only appears for a brief interval, found impairments in amount of information that was reported. Results found that persons with schizophrenia were less accurate in detecting target letters that were embedded in the stimulus array and showed increasing performance deficits as the number of irrelevant stimuli increased (Asarnow et al., 1991; Asarnow & Macrimmon, 1978; Braff, 1993). This finding has been linked to a decreased attentional capacity associated with the disorder.

Furthermore, persons with schizophrenia were also subject to the effects of visual masks in which the recognition of a stimulus shape is disrupted by the presence of a subsequent second stimulus (Braff & Saccuzzo, 1982; Green, 1998; 1999; Miller et al., 1979; Saccuzzo et al., 1974). In normal persons, the perception of a target (presented first) was often unaffected by the visual mask (which is presented second). Thus, the first target could be accurately reported. However, persons with schizophrenia were especially

vulnerable to the masking effect, and it was believed that the mask retroactively interfered with the recognition of the first target stimulus.

Also, there have been documented problems on eye saccade movement tasks in this population as well (Braff & Saccuzzo, 1982). Saccades are the reflexive eye movements that serve to bring an object into attentional focus. Attentional deficits have been observed in studies that required the person to consciously inhibit this saccade (called the anti-saccade paradigm) and instead look in the opposite direction. Instead of looking at the stimulus when it appeared, the person had to inhibit this saccade and look in the opposite direction. Persons with schizophrenia were less able to inhibit their reflexive saccades as compared with normal subjects.

Finally, researchers using electrophysiological recordings have found that persons with schizophrenia show decreased inhibition to repeated stimuli. The P50 neuronal wave has been used to measure attentional arousal to novel stimuli. Normally, on the first presentation of a novel stimulus, the P50 wave spike is large and gradually reduces (in amplitude) over time to repeated presentations (e.g., Habituation). In normals, the P50 spike is considerably less each time the stimulus is repeated (evidence of habituation). This habituation process was impaired in schizophrenia. The gradual attenuation of the P50 wave was absent or diminished in persons with schizophrenia, perhaps leading to sensory overload and/or problems screening out irrelevant stimuli from their attention (cannot habituate to stimuli). Thus, the person may be attending to myriad stimuli making full comprehension any of them difficult.

In summary, it appears that schizophrenia is associated with a variety of attention deficits. Specifically there are problems in sustained and visual attention. Even though

there have been substantial evidence of attentional problems found, there has been a general lack of theoretical explanation as to why these problems exist. Most of the findings are presented in an atheoretical context with little cogent explanation. In order to facilitate an understanding of what these results mean, the research findings need to be integrated into current cognitive or anatomical theory. We will now consider some possible explanations for attentional impairments in schizophrenia. An explanation of previous findings demonstrating attentional impairment in schizophrenia should be integrated with current models of attention. However, for the most part, there is no single theoretical model prominent. To account for the findings of attentional deficits, many independent postulations currently exist, which often leads to confusion. Several of the more influential ideas about the reasons for attentional disturbance in schizophrenia will now be discussed. According to Zubin (1975), persons with schizophrenia are subject to and controlled by the events immediately preceding the task. Thus, they become stimulus bound and cannot shift their attention to a new task. In essence, they become unable to disengage from the previous stimulus and re-focus attention on newer more relevant stimuli. Also, Zubin speculated that it is possible that complex tasks (crossmodal tasks involving both visual and auditory stimuli), which are more difficult, may use more neuronal activity than simpler tasks. The recruitment and utilization of more neurons to complete a more difficult task may serve to reduce the amount of activity that can be allocated for attentional functions. In this manner, Zubin (1975) equated attentional problems to a reduction in attentional capacity. A more recent treatise on attentional problems and schizophrenia noted that in general, schizophrenics have deficits on information processing/attentional tasks when the tasks required a high processing load,

consisted of multiple tasks to be performed at the same time, used distraction to increase the difficulty level, or added other stressors to the task.

According to Braff, capacity theories predict that persons with schizophrenia may show problems in the following areas: 1) a decreased ability to allocate their attentional resources, 2) excessive sensory stimulation may interfere with processing, 3) a decreased pool of resources from which to draw upon, 4) an inability to mobilize these resources, and, 5) an excessive allocation of these resources to irrelevant stimuli. A wide-variety of research findings, such as problems on span of apprehension, cross-modal, and vigilance tasks, can be explained using capacity based theories of attention (See Kahneman's capacity model, 1973; Nuechterlein, Parasuraman, & Qiyuam, 1983 for other examples). Currently, capacity theories of attention are the most accepted explanation for attentional problems in schizophrenia (Nuechterlein & Dawson, 1984a).

Callaway and Naghid (1982) proposed an alternative explanation drawing on the basic differences between parallel and serial processing. They proposed that attentional problems in schizophrenia are the result of deficits in controlled (serial) attention and not the result of problems in automatic processing. Serial processing is laborious, time-intensive, and uses up a lot of cognitive resources, while parallel processing is resource free and can handle tasks without effort. Persons with schizophrenia often showed problems with attention on demanding tasks, which are more likely to require serial processing. In contrast, easier tasks, which are more automatically processed, are usually completed within normal limits.

Research evidence, which demonstrated problems in sustained attention, has given rise to the idea that attentional dysfunction is the result of problems in sustained

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attention. Shakow (1962, 1979) noted that the primary problem in attentional dysfunction in schizophrenia is the failure to maintain task set or the lack of a general readiness to respond. According to Shakow, a person with schizophrenia often cannot stay focused (remain vigilant) on a task long enough to perform it efficiently. Research, which demonstrated problems on the CPT, has been used as the main support for idea of sustained attentional disturbance in schizophrenia (Nuechterlein & Dawson, 1984b).

Questions' regarding the stability of attentional problems has led to another set of explanations. Some researchers believe that attentional problems are a product of an acute psychotic state and will remit when psychosis abates (Zubin & Spring, 1977). Other researchers have proposed that attentional impairments are a stable and fundamental component of the disorder and are present across all phases of the disorder (Nuechterlein & Dawson, 1984a). Research findings in this area have consistently demonstrated attentional problems across the entire spectrum of psychosis (Nuechterlein & Dawson, 1984a; 1984b). Attentional problems have been found in the acutely psychotic, but have also been found in persons who are in remission and normal persons who score high on psychosis-proneness measures (i.e., which may indicate a potential to become psychotic in the future). Problems in attention are believed to be so fundamental to schizophrenia that it has been incorporated as one of the core vulnerability traits of the illness (Nuechterlein & Dawson, 1984a). This claim has been further supported by the findings that attentional deficits have been found in non-schizophrenic family members as well. Problems in span of apprehension, vigilance, eye-tracking, backward visual masking, P50 gating, reaction time, and attentional saccades have all been found in the relatives and siblings of persons with schizophrenia (Nuechterlein & Dawson, 1984b). However, it

does appear that the presence of acute psychosis can influence the severity of the attentional problems, but it is unlikely to be the primary cause of the problems. Thus, as Nuechterlein and Dawson (1984) stated, the observed attentional problems seem to be more indicative of a vulnerability indicator (stable trait) than a psychotic state indicator.

In sum, the most widely accepted idea has been that attentional deficits in schizophrenia are related to a reduction in attentional capacity. Furthermore, this reduced capacity is considered fundamental to the disorder and not the product of a psychotic state.

Affect Perception Studies

A variety of social and cognitive impairments have been associated with schizophrenia (Penn et al., 1997). Persons with schizophrenia often exhibit deficits in social skills, social competence, conversation skills, understanding social cues and sequences, problem solving, and poor community outcome. (Green, 1996; Penn et al., 1997). Arguably, a primary social-cognitive deficit is an impairment in the recognition of emotional states of themselves and others (Morrison et al., 1988). Problems in affect perception can result in the expression of inappropriate behaviors, the misunderstanding of a person's motives and intentions, and a reduced ability to have meaningful social interactions with others. Because of these problems, persons with schizophrenia may isolate themselves, which can lead to further social impairment. The study of affect perception is important in schizophrenia because it is not only considered a major impairment in this population, but it can impact many aspects of their daily lives in addition to their prognosis for rehabilitation and treatment.

Affect perception is usually studied by presenting stimuli which depicts different emotional states. The person is told to identify which emotion is present (Morrison et al., 1988). The emotional states can be presented on videotape, audiotape, or in picture format. Izard (1971) and Eckman and Freisen (1975) have produced standardized pictures

of different affective states that have been used in most studies. However, some studies present emotional states on audiotape in a verbal/audio format, which require the person to decode emotional states by listening to both the speech content and voice tone. Due to limitations of a visual or audio only presentation, more recent tests have combined both visual and audio presentations in order to tap both areas (e.g., The Bell-Lysaker Emotion Recognition Test; Bell, Bryson, & Lysaker, 1997).

Research on affect perception and schizophrenia has been conducted over the last 10 years. However, each study used different samples and measures of affect perception making it difficult to compare results across studies (Morrison et al., 1988; Penn et al., 1997; Mandal et al., 1998). However, as Mandal et al. (1998) stated, it is clear that persons with schizophrenia demonstrate problems in affect perception in relation to normal control subjects. What is not entirely clear is how persons with schizophrenia perform across different phases of the disorder (e.g., acute, chronic, in remission), or how they perform in relation to other psychiatric disorders (depression). We will now review previous research on affect perception in schizophrenia.

Most studies of affect perception have been conducted on persons with chronic schizophrenia with lengthy stays in institutional settings (Archer et al., 1992; Cramer et al., 1989; Doughtery et al., 1974; Mandal & Palchudhury, 1985; 1989; Muzekie & Bates, 1977; Novic et al., 1984; Penn & Combs, 2000; Penn et al., 2000; Schneider et al., 1995). In general, persons with chronic schizophrenia perform worse on affect perception measures than other comparison groups in part due to the poor institutional environment. In addition, other studies have focused on persons with acute schizophrenia (Bellack et al., 1996; Curring, 1981; Gessler et al., 1989), persons in remission (Joseph et al, 1992), and unmedicated persons with schizophrenia (Heimberg et al., 1992; Kerr & Neale, 1993). Unmedicated persons generally show affect perception deficits where as acute and/or remitted persons may not show these problems (Bellack et al., 1996; Joseph et al., 1992).

Several studies have compared affect perception scores of persons with schizophrenia with persons showing other forms of psychiatric disturbance. In order to control for the factors of institutionalization and the presence of psychiatric disturbance, more recent studies have included a psychiatric comparison group in addition to a normal control group. However, findings in this area have been mixed. Several studies have shown that persons with schizophrenia performed worse on all measures of affect perception (Archer et al., 1992; Bell, Bryson, & Lysaker, 1997; Feinberg et al., 1996; Walker et al., 1984). Other studies have found that both the schizophrenia and psychiatric controls scored lower than normal controls, but they were no different from each other (Bellack et al., 1996; Schneider et al., 1992; Zuroff & Colossi, 1986). There were no studies found that showed psychiatric controls performing worse than the schizophrenia group. An interesting study by Mandal and Palchoudhury (1989) compared a group of hospitalized schizophrenics with a group of persons with neurotic disorders and a normal control group. They found that persons with schizophrenia showed problems in affect perception for pictures of whole faces, but not when partial faces were shown. This suggested a whole face processing deficit or problems in context interpretation.

In addition to these comparisons, it has been believed that specific subtypes of schizophrenia may show differential patterns of affect perception deficits. This idea stemmed from Magaro (1981) who stated that persons with paranoid schizophrenia had higher levels of cognitive functioning as compared to the other schizophrenia subtypes. In support of Magaro's ideas, studies by Kline et al. (1992) and Lewis and Garver (1995) both found that persons with paranoid schizophrenia scored better on affect perception tasks than persons with non-paranoid schizophrenia. Another area of interest is the effect of negative symptoms on affect perception skills. Persons with negative symptom schizophrenia showed deficits for the labeling of negative emotions in this group, but the identification of positive emotions was unimpaired (Borod et al., 1993).

Other areas of research have explored the relationship between hemispheres of the brain (left versus right) and affect perception ability (Borod, 1992; 2000). Specifically, researchers have wondered which hemisphere, left or right, was more important in affect perception (laterality hypothesis). A related question is whether the type of affect, positive or negative, is important (valence hypothesis). For example, it has been argued that the right hemisphere is more involved in negative emotional states and the left hemisphere is more important for positive emotions (Borod, 2000; Heller, 1990) Across a variety of studies, it has been consistently demonstrated that the right hemisphere was more dominant (than the left) in processing for the labeling of facial and vocal affect (Borod et al., 1998). Persons with unilateral right hemisphere brain damage have significant impairments in the identification of facial and vocal affect (Borod, 1992; Morrison et al., 1988; Strauss & Moscovitch, 1981). Right hemisphere dominance for emotional processing has been replicated with normal persons using specialized equipment that can present stimuli to a specific hemisphere. (Borod, 1992). The comparison between the performance of persons with schizophrenia and those with right hemisphere lesions are intriguing and may suggest common anatomical areas of impairment. Borod et al. (1993) compared a group of persons with schizophrenia, right brain damage, and normal controls on affect perception skills. In both patient groups (Right brain damaged and schizophrenia), the identification of negative affect was impaired. However, there were no impairments found for labeling positive emotions. This study supported that the type of affect presented was important to performance. It is possible that affect type (positive and negative) may interact with each hemisphere in a unique way. This interaction may explain some of the findings that the right hemisphere is more dominant for negative emotions and the left for positive emotions. At present, it appears that the right hemisphere is more crucial for the identification of emotions. There is also some evidence that the right hemisphere is more active in processing negative affective states.

In conclusion, there is evidence across a wide-range of studies that persons with schizophrenia have impairments in affect perception. These impairments are oftentimes comprable in severity to persons with right hemisphere brain damage. The central research question now centers on potential causes and other mediating factors for these problems, and whether these problems be treated with rehabilitation methods (Penn & Combs, 2000). We now turn our attention to a discussion of two theoretical positions that attempt to explain affect perception impairments found in schizophrenia.

Research has demonstrated that persons with schizophrenia have deficits in the identification and recognition of emotions (Mandal et al., 1998; Mueser & Penn, 1996 for a review). There are two main theories that were developed to possibly explain these deficits (Kohler et al., 2000). The first theory is based on a link between cognitive ability and social cognition. This theory is labeled the generalized deficit model. Bellack (1992) stated that most social tasks have substantial cognitive demands that are necessary in order for successful completion. Researchers now believe that the cognitive impairments found in schizophrenia are related (or even responsible) to deficits in affect perception and other social behaviors (Bellack, 1992; Green, 1993; Mandal, Pandey, & Prashad, 1998; Morrison, Bellack, & Mueser, 1992). This view assumes that some type of cognitive impairment is responsible for impaired social functioning. This perspective was based on the theoretical work of Lazarus (1984) who postulated that cognition was a primary mental ability and emotionality was secondary and dependent on cognition. The proposed deficit in cognitive ability may manifest itself as problems in conceptual formation, memory, attention (Braff, 1993; Nuechterlein & Dawson, 1984), the perception of faces in general (Kerr & Neale, 1993; face perception deficits), or a combination of these skills (Morrison, Bellack, & Mueser, 1992). Green (1993) stated that cognitive dysfunction theories assert that social/affect perception problems are most likely related to "input dysfunction" problems which are described as deficits in early visual processing or a decreased capacity of information/attentional processing (i.e.,

cannot attend to emotional cues contained in the face; Bellack, 1992). In sum, cognitive dysfunction theories posit that there is some problem in cognitive ability that produces impaired affect perception.

In contrast, the specific deficit theory proposes that persons with schizophrenia have deficits that are restricted to the identification of emotional stimuli only. The specific deficit model states that some aspect of emotionality is problematic for persons with schizophrenia (Penn, Corrigan, Bentall, Racenstein, & Newman, 1997). Mandal et al. (1998) proposed that persons with schizophrenia may fail to recognize emotional cues or avoid of emotional situations. This model predicts that other face perception abilities, such as familiar face recognition, age discrimination, and forced-choice face discrimination, will be relatively intact, whereas the identification of affect will be selectively impaired (Mandal, Pandey, & Prashad, 1998). Thus, according to the specific deficit model, the role of cognitive impairments in affect perception are minimized. This perceptive is based on the theoretical work of Zajonc (1984) who argued that emotion was primary and cognitive processes were dependent on emotion in order to operate. Thus, there are currently two theories of affect perception that postulate two distinct mechanisms for the observed deficits. A review of empirical research, which compared the two theories against each other, is one way to critically evaluate which theory has more validity.

Unfortunately, attempts to empirically examine the specific versus generalized deficit models of affect perception have been rather limited. Ten previous studies have attempted to address this issue by comparing affect perception with a generalized perception task (see Penn et al., 1997 for a review). Most of the studies seem to support the generalized view of impairment, but the evidence is not entirely conclusive (Kohler et al., 2000; Mandal et al., 1998; Penn et al., 1997). Studies by Archer et al. (1992) and Kerr and Neale (1993) specifically tested these two models against each other. The findings of both studies supported the generalized deficit model with deficits found on both affect

perception and general face recognition tasks. Kerr and Neale (1993) used tasks that were matched for difficulty based on the performance of normal persons and then cross-validated on a sample of persons with schizophrenia. The matching of tests based on difficulty level is very important since persons with schizophrenia perform poorly on almost all cognitive tasks. Furthermore, persons with schizophrenia may show deficits on one task just because it is more difficult, whereas in normals, who have intact cognitive skills, there is no performance deficit. Thus, their scores tell us nothing about the abilities of the person, but only reflects the psychometric characteristics of the test itself. However, this is important to mention because most of the early research was insensitive to task difficulty. Only tasks that are matched on difficulty level can provide conclusive evidence of a general versus specific impairment in affect perception (Chapman & Chapman, 1973; 1978). In further support of the generalized deficit model, Green (1993; 1996) presented data from many studies, which demonstrated that cognitive impairments are moderately related to a wide variety of social skills problems. Not only are cognitive impairments related to social skill acquisition, but they are also related to many other social cognitive skills such as social competence and problem-solving skills (Green, 1996). However, there are a handful of studies that showed deficits only for emotion perception tasks and normal face perception skills. These findings support the specific deficit model because general cognitive skills remain intact (Mandal et al., 1998). Due to the equivocal findings in the literature, more evidence is needed to explore whether affect recognition deficits are related to cognitive impairments or restricted to emotionally laden material only.

Affect perception has been a topic of research and speculation in many other disciplines and areas of study. Affect perception research can be found in such diverse areas as evolutionary biology, anthropology, clinical neuropsychology, primate studies, and developmental disabilities (Eckman, 1972; Penn et al., 1997).

In the area of developmental disabilities, most of the research on affect perception has been conducted with persons with autism and mental retardation (MR). In general, persons with autism and mental retardation consistently show problems with affect perception similar those found in persons with schizophrenia (APA, 1994).

Specifically, persons with autism have been shown to identify and process emotional stimuli more poorly than normal controls. There have been two primary explanations for this problem in autism: 1) theory of mind deficits and 2) brain-based emotional deficits. The theory of mind hypothesis suggests that persons with autism have problems in their ability to attribute mental states, such as intentions, beliefs, and attributes, to themselves and others (Frith, 1989). Problems in attribution can also lead to impairments in identifying the emotional states of others. According to the theory of mind hypothesis, affect perception deficits are the result of faulty cognitions and attributions. There have been several studies that have shown a modest link between theory of mind tasks and the ability to identify emotions (Buitleaar & van der Wees, 1997; Buitelaar, van der Wees, Swab-Barneveld, & van der Gaag, 1999). It was also shown that several neurocognitive variables, such as verbal memory and Performance IQ scores, were related to performance on theory of mind tasks and emotion recognition performance. The relationship between verbal memory and IQ with affect perception highlights the importance of cognitive variables in perception of emotion for persons with autism.

The second hypothesis is based on evidence that problems in affect perception in autism are due to brain-based anatomical dysfunction in which the brain areas needed to effectively process emotional stimuli are impaired or damaged. Critchley et al. (2000) using functional MRI imaging, found that persons with autism showed reduced brain activity in the cerebellar, mesolimbic, and temporal lobe areas, which are supposedly linked to affect perception ability. The impact of structural brain impairments on affect

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perception was partially based on the work of Borod (1992) who found that persons with right hemisphere brain impairment had associated problems recognizing various emotional states.

In the area of mental retardation (MR), most studies have shown that persons with mental retardation perform worse on emotion recognition tasks than normally developing children and adults (McAlpine, Singh, Kendall, & Ellis, 1992; Rojahn, Lederer, & Tasse, 1995a). Rojahn, Rabold, and Schneider (1995b) reported that persons with MR performed poorly on emotion recognition tasks, but within normal limits on general perceptual tasks, which suggested that the problem lies in the visual perception of the emotional stimuli. Thus, the facial expressions associated with emotions may be more difficult or complex for the person with MR to attend to and respond to appropriately. A recent study by Harwood, Hall, and Shrinkfield (1999) suggested that problems in emotion perception lie in defective visual processing of the face. Other researchers have suggested that level of intelligence plays an important role in emotion perception. Several studies found that IQ scores were most predictive of affect perception scores (Simon, Rosen, Grossman, & Pratowski, 1995; Simon, Rosen, & Ponpipom, 1996). The above results are consistent with the findings that emotion perception scores decrease as the level of MR becomes more severe (See Rojahn et al., 1995a for a review). Regardless of the actual deficit, there does seem to be link between cognitive abilities and emotion recognition in this population. The relationship between cognitive and affect variables led Rojahn et al. (1995a) to call for more research is this area (See Eckert, 2000 for a recent study along these lines). Several studies have included emotion perception components into social skill training programs for persons with MR (Marchetti & Campbell, 1990).

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Social skill programs use a variety of operant learning techniques (positive reinforcement) along with instruction, modeling, practice, and feedback to increase the person's level of social skills. Stewart and Singh (1995) used rehearsal techniques to improve both the recognition and expression of emotional states in six boys with MR. In other social skill training programs, the remediation of emotion perception deficits are included within the larger training package and are not specifically targeted as in the Stewart and Singh (1995) study. Because of the cognitive limitations of the person with MR, extensive training is required to achieve gains in social communication and functioning. Again, the cognitive limitations associated with mental retardation point to the influence of cognitive variables for successful affect perception performance.

Affect perception has been a topic in other areas such as evolutionary biology, anthropology, and primate studies. Darwin (1872), in his work <u>The Expression of Emotions in Man and Animals</u>, made observations about the emotional expressions of various animal species. He suggested that emotional expressions had communicative value, and those animals that could not "interpret" these expressions had a lower chance of survival. In humans, the importance of emotional recognition was studied by Paul Eckman and colleagues who found that different emotional states could be identified by persons in other cultures (Eckman, Friesen, & Ellsworth, 1982). Thus, there seems to be basic categories of emotions that are universally recognized by persons across the world. Darwin's notion about the importance of emotional and social communication can also be seen in the work of Cosmides and Tooby (1994) who stated that our cognitive processes are not content free, but are developed for specific purposes. According to Cosmides and Tooby, the mind has evolved over time to process different stimuli (e.g., social versus

nonsocial) using highly specialized cognitive mechanisms. Brothers (1990) took this idea one step further by postulating a separate social domain of intelligence (based on her research with primates) that handled our social interactions and functioning and was independent from our cognitive functioning. It is clear that affect perception and to a larger extent social functioning has an important place in evolutionary biology and its adaptive survival value cannot be underestimated.

The Relationship Between Attention and Affect Recognition

One particular cognitive ability, attention, is believed to have an important link to affect perception. Morrison et al. (1988) stated that affect perception required information-processing abilities, which included an attention to and decoding of facial stimuli. Bruce and Young (1986) also posited an important role for visual attention in general face recognition and in affect/expression analysis as well. Affect perception requires that the person select which parts of the face to attend to, and then sustain their attention in order to collect important information about another's emotional state (Bryson, et al., 1997; Green, 1996; Morrison et al., 1988). The importance of visual attention was evident in a series of studies by Phillips and David (1997; 1998) in which persons with delusions showed abnormal face scanning patterns. Normal persons scanned more relevant areas of the face, while delusional persons looked at more non-relevant areas, such as the chin, forehead, and the surrounding outer areas of the picture. These findings are very similar to experimental studies, which have shown that persons with schizophrenia have problems in filtering out irrelevant stimuli (Boutrous, Belger, Campbell, D'Souza, & Krystal, 1999).

Using an information-processing paradigm to explain affect perception deficits, Bellack (1992) stated that affect perception deficits may be related to a decreased capacity in information-processing and/or attentional abilities. In his view, a person with schizophrenia cannot store all of the information presented in the face so affect

perception suffers. Another view of the importance of attention in affect perception comes from stage theories of information-processing. Stage theorists believe that cognition follows a hierarchy in which attention serves as the initial processor of incoming information and should be evaluated first before other cognitive skills are examined (As reviewed by Green, 1996). In addition, Mapou (1995) placed attentional skills as an early processor of incoming information, upon which higher-order cognition (e.g., affect perception) may depend. Both Mapou (1995) and Green (1996) stated that attention is crucial in affect perception because it serves as the initial processor on information. If attention is impaired then facial information may be not be processed at higher levels. Thus, there appears to be an important role for attentional skills in affect perception.

There is good cause to believe that attention is important in affect perception, although few studies have been conducted. Although many research studies on affect perception have stated that attentional problems may be responsible for the observed deficits, only a few have specifically explored this topic. Furthermore, attentional factors are often viewed as mediating and/or nuisance variables in affect performance research despite the many calls for research into their effect. Thus, attentional variables are often overlooked and neglected (Archer et al., 1992; Bryson et al., 1997; Kerr & Neale, 1993). The results of four studies that have examined the role of attention in affect perception will now be reviewed.

Bryson et al. (1997) assessed a group of 63 male, medication stable schizophrenics on several measures of attention/information-processing and a single measure of affect perception (Bell-Lysaker Emotion Recognition Test; BLERT). The results showed that the Digit-Span test, which measured one's attentional capacity (Mirsky, 1987), was the best predictor of affect perception scores and accounted for the highest amount of variance in affect perception scores. In addition, vigilance and the ability to shift attention were also significant contributors to affect perception, but

accounted for less variance. Thus, several factors of attention were moderately related and predictive of affect perception scores. Overall, the entire battery of neurocognitive measures accounted for 34% of the variance in affect perception scores. The researchers stated that the importance of attention in affect perception cannot be minimized and needs further study with other samples and different measures. Limitations of this study were: 1) the sample was almost entirely male, 2) the lack of inclusion of other measures of affect perception, 3) the failure to include a measure of general face perception as a control task.

A second study by Morrison, Bellack, and Bashore (1988) examined the relationship between affect perception and a single measure of attention, the visual-monitoring task, which purported to measure sustained visual attention. Results showed that the visual-monitoring task was not related to affect perception scores. However, this measure of attention was developed specifically for this study by the authors. No psychometric data was reported so the results should be viewed with caution.

Although not specifically a study of attention, Kee, Kern, and Green (1998) evaluated the relationship between several neurocognitive measures and affect perception skills. A group of 30 chronic, treatment resistant persons with schizophrenia completed the Span of Apprehension Test, Continuous Performance Test (CPT), and the Digit-Span test. The results of the study showed that the Span of Apprehension test correlated with all three of the affect perception measures used in the study. The results suggested that early attentive (pre-attentive span) processes were important in affect perception. It now appears that span of attention may be an important variable as it was significantly related to affect perception in two studies (Bryson et al., 1997; Kee et al., 1998).

Finally, Kohler, Bilker, Hagendoorn, Gur, and Gur (2000) assessed emotion perception among a sample of 35 persons with schizophrenia and 45 normal controls. For persons with schizophrenia, emotion perception scores were correlated with several neuropsychological variables including variables of attention. For normal controls, there

was no correlation between emotion perception and neuropsychological test scores. The results further suggested that cognitive abilities are important in affect perception in schizophrenia even more so than for persons in the normal population.

In summary, the majority of evidence has shown that attention is important and related to affect perception. Measures of encoding, sustained attention, and the ability to shift attention were shown to be related to affect perception scores (Bryson et al, 1997). A comprehensive examination of the role of attention in affect perception is needed to provide additional evidence regarding the role of attention in this ability, and to further explore which specific factor(s) of attention are most crucial in affect perception.

Rationale and Purpose

Deficits in affect perception have been called the one of the most critical and devastating of all the interpersonal and social impairments found in schizophrenia (Morrison et al., 1988). Penn et al. (1997) and others have noted that schizophrenia is primarily a social-cognitive disorder. Therefore the focus and study of social-cognitive aspects of this disorder is needed. Persons with schizophrenia have demonstrated a variety of attentional and information-processing impairments (Nuechterlein & Dawson, 1984a). It can be further argued that these information-processing impairments may impair the ability to perform social tasks, such as affect perception (Morrison et al, 1988). Specifically, the role of attention in affect perception needs to be examined, since the ability to recognize affect may have significant attentional demands (Bellack, 1992; Morrison et al., 1988). Even though a link between attention and affect perception has been proposed for over 10 years, only a handful of studies have empirically examined this relationship. The four studies that have dealt directly with affect perception and attention have shown contradictory findings (Bryson et al., 1997; Kee et al., 1998; Kohler et al., 2000; Morrison et al., 1988). These studies used limited and narrow samples of participants, employed single and sometimes unvalidated measures of affect perception and attention, and with the exception of Kohler et al. (2000), were not based on the theoretical predictions between information-processing skills and affect perception problems (e.g., generalized deficit model; Penn et al., 1997).

In order to effectively test the relationship between attention and affect perception, an empirically validated model of attention must be adopted. Mirsky's four factor model of attention is one such model. The four factors of attention (Shift, Sustain, Encode, and Focus-Execute) have been replicated in previous samples of schizophrenics and can provide an empirically validated, comprehensive way to examine attention (Kremen et al., 1992; Mirsky et al., 1991; Steinhauer et al., 1991). Mirsky's factors of attention would allow specific aspects of attention to be examined to determine if any of

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these attentional components are related to affect perception (Bryson et al., 1997). Furthermore, Morrison et al. (1988) argued that affect perception research should include several measures of attention in their design (Shift, Sustain, etc.) in order to evaluate their individual and combined effect. The application of Mirsky's four factor model would provide both specificity and comprehensiveness. Furthermore, the examination of attention abilities would further allow a test of alternative models for problems in affect perception (i.e., whether attention is important in this skill or if it is a specific deficit).

Anecdotal evidence for the importance of attention in affect perception was obtained in a study conducted by Penn and Combs (2000) in which persons with schizophrenia were described as overly distractible during the affect perception tasks. Participants appeared unable to focus on the stimuli and appeared to be examining non-relevant areas of the picture. In addition, the participants in the Penn and Combs (2000) study, required constant prompting and reinforcement to maintain their focus on the stimuli. These observations are very similar to the findings of Phillips and David (1997; 1998), which showed abnormal face scanning patterns in persons with delusions.

Finally, Green (1996) has argued that it is now time to begin to focus in on information processing skills at a more specific level of analysis and to determine which specific cognitive skills are related to social behaviors and outcomes. Green (1996) along with Hogarty and Flesher (1992) added that before rehabilitation efforts are directed at improving cognitive skills in schizophrenia, we must show that the skill is impaired and in fact related to the task. Thus, the study of attention in affect perception meets that criteria of specificity, and its exploration has important theoretical, empirical, and clinical merit.

The purpose of the present study was to examine the relationship between attention (Mirsky's four factors: Shift, Sustain, Encode, and Focus-Execute) and affect perception in a sample of persons with chronic schizophrenia. It addition, two other neurocognitive measures (e.g., verbal fluency and general face perception) were included

to examine what role, if any, these skills play in affect recognition. Specifically, verbal fluency was examined to explore if problems in affect perception are due to an inability to generate the names for different emotions. A measure of general face recognition will be administered as a control measure for the affect perception tasks (Kerr & Neele, 1993; Kohler et al., 2000).

The present study had three goals. First, an attempt will be made to replicate Mirsky's four factor solution with a larger and more heterogeneous sample of persons with schizophrenia. Second, the relationship between attention and affect perception will be examined to determine which factor(s) of attention are most related to affect perception ability. This analysis will provide evidence as to whether the impairment in affect perception is due to a specific deficit in one factor of attention, a general impairment across all measures of attention, or some other variables. Third, persons who score high and low (based on a median split) on the affect perception tasks will be compared to explore whether there are differences on any of the attentional variables between the groups. Group differences in attentional variables may account for a successful versus a poor performance on the affect perception measures (See Bryson et al., 1997 for a similar analysis).

It is hypothesized that:

1) Mirsky's four factors of attention (Shift, Sustain, Encode, and Focus-Execute) will be replicated in a sample of persons diagnosed with chronic schizophrenia.

2) Several of Mirsky's four factors of attention will be significantly related to affect perception. Based on previous research findings it appears that the sustained, shift, and encode factors will be the most predictive of affect perception scores than the other attentional and neurocognitive measures.

3) A comparison of persons who score high and low (based on a median split) on the affect perception tasks will show that these groups will differ on attentional variables as well. Specifically, persons who show better higher perception scores will also show

relatively better attentional scores in comparison to the low performing group. In addition to the above hypotheses, the relationship between medication dosage and type and levels of psychiatric symptomatolgy (positive and negative symptoms) will be examined as possible factors influencing affect perception scores.

Method

<u>Participants</u>

Participants were sixty-five persons diagnosed with chronic schizophrenia who were recruited from two large state psychiatric hospital settings in Louisiana. Selection sites were Southeast Louisiana State Hospital (SELSH) and Eastern Louisiana Mental Health System (ELMHS). Both settings were tertiary care treatment centers for persons with chronic mental illness, and treat a similar patient population. A total of 36 males and 29 females participated in the study. By ethnicity, 17 were Caucasian, 47 were African-American, and 1 was Asian-American. A 2 (gender) x 3 (ethnicity) chi-square analysis, did not reveal any differences in the total sample according to both gender and ethnicity, χ^2 (2) = 1.3, $\underline{p}$ = .50. All participants were assessed using the Structured Clinical Interview for the DSM-IV (SCID I/P; First, Spitzer, Gibbon, & Williams, 1995) in order to confirm their diagnosis. Participants were required to have a DSM-IV diagnosis of schizophrenia (paranoid, disorganized, undifferentiated, or catatonic), schizoaffective disorder, or psychotic disorder not otherwise specified (NOS) to be eligible for the study. Current levels of psychiatric symptomatology were assessed using the expanded version of the Brief Psychiatric Rating Scale (BPRS; Lukoff, Nuechterlein, & Ventura, 1986). Tardive dyskinesa symptoms were assessed by a review of the person's Abnormal Involuntary Movement Scale (AIMS) score. Type and dosage of antipsychotic medication was collected, and medication dosages were converted into standardized chlorpromazine equivalents to compare doses across participants.

Participants who had documented substance abuse problems were required to be in remission or in a controlled environment for six months prior before participating. In order to ensure that this criterion was met, each person's substance abuse screening test was reviewed to ensure that they were not actively using substances (which could mimic psychosis) at the time of the study. Other exclusion criteria included the presence of a documented neurological condition (e.g., stroke, traumatic brain injury, seizure disorder),

diagnosis other than schizophrenia (e.g., mood disorder with psychotic features), too disorganized to give consent or complete the protocol, refusal to complete the study, the person is deemed unsuitable by hospital staff for inclusion, concerns of malingering are present, or the person has a reading level below 4th grade level (as assessed by the WRAT-III reading test). A summary of the participant's demographic information along with respective diagnostic and symptom ratings can be found in Table 1. There were no differences found for gender, ethnicity, diagnosis, or selection site (SELSH vs. ELMHS) sites on the study variables.

Table 1

Summary of Participant Demographics

Variable	Total Sample Mean (SD)	ELMHS Mean (SD)	SELSH Mean (SD)
Age	40.7 (7.9)	41.0 (8.0)	40.2 (8.0)
Education (Years)	11.2 (1.7)	11.1 (1.8)	11.5 (1.6)
Gender (n)			
Male	36	24	12
Female	29	19	10
Ethnicity (n)			
Caucasian	17	10	7
African-American	47	32	15
Other	1	1	0
SCID Diagnosis (n)			
Paranoid Schiz.	40	25	15

(table continued)

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Undiff. Schiz.	8	6	2
Disorg. Schiz.	4	2	2
Schizoaffective	13	10	3
CPZ Equivalents[a]	854.0 (494.5)	864.2 (534.7)	834.0 (415.8)
Anticholingeric Medication (%)	36%	44%	22
BPRS Total Score	53.8 (5.9)	54.3 (6.0)	52.8 (5.8)
AIMS Score	.17 (.57)	.21 (.64)	.09 (.43)
Length of Illness (Months)	218.8 (97.7)	220.5 (102.9)	216.5 (88.9)
Length of Stay (Weeks)	86.0 (110.7)	84.4 (123.4)	89.2 (82.9)
Number of Hospital Admits	11.1 (17.3)	13.6 (20.8)	6.4 (4.1)
WRAT-III Reading	79.8 (9.0)	79.4 (8.6)	80.7 (10.0)

[a] Medication dosages were converted to chlorpromazine (CPZ) equivalents to compare medication doses across selection sites and to provide a standard metric for assessing these doses.

Participants were selected using a methodology employed in previous research studies in these settings (Penn & Combs, 2000, Penn et al., 2000). The selection process was as follows. First, a general overview of the study was presented to all potential participants (in a group format) that detailed the purposes of the study, its requirements, and potential benefits and risks. Second, a listing of all persons with diagnoses that met study eligibility criteria (i.e., schizophrenia diagnosis) was constructed from the hospital roster. This list provided the initial pool of participants for the study (N available for study was between 225-250). Third, appropriate staff (e.g., psychiatrists, psychologists, and ward nurses) was consulted regarding the suitability of each patient to participate in the study. ELMHS had morning staff meetings where potential participants were discussed to ensure they were good candidates for participation in the study. This method allowed staff to have input in participation decisions, and appeared to increase the

involvement and acceptance of the staff for the project. Actual participation in the study involved either: 1) the person volunteered to take part in the study after the general overview, or 2) a potential participant was identified (based on diagnosis) and approached for participation. At this point, the study was again explained to the person, and consent to participate was obtained. Throughout the entire study, only one person refused to participate, and two people refused to continue testing. In all three cases, the participant became disorganized, psychotic, and confused.

It should be emphasized that the principal investigator had no additional knowledge about the participants other than they met the preliminary diagnostic requirements for eligibility. The SCID-I/P was administered after participant selection to obtain an independent diagnosis separate from the diagnosis given by hospital staff. The agreement between the SCID-I/P and the person's hospital diagnosis was 83.1%, and represented an acceptable level of diagnostic agreement.

A basic demographic questionnaire was used to obtain background information for each participant. In addition to age, education, and ethnic background, the demographic measure covered other areas such as length of illness, duration of current episode, number of inpatient hospitalizations, AIMS score, and medication type (traditional, atypical, or combination antipsychotic) and dosage. This information was obtained from the person's hospital chart and prior medical reports.

The SCID-I/P is a structured interview used for the purpose of deriving a clinical psychiatric diagnosis based on the DSM-IV system (First et al., 1995). The SCID-I/P allowed the researcher to rule out other diagnoses and conditions that may mimic psychotic disorders. The SCID I/P used in this study covered psychotic, mood, and substance abuse conditions, which are most common in this population. The principal investigator was trained to 100% reliability on the SCID-I/P with previously trained raters (Penn & Combs, 2000; Penn et al., 2000).

The BPRS was developed to assess a person's current level of symptomatology over the previous 1-2 week period of time (Lukoff et al., 1986). The BPRS contains 24 items, which cover a wide-range of psychiatric symptoms. The BPRS is rated on a 1-7 Likert scale with a score of 1 indicative of no pathology and a score of 7 indicative of severe pathology. The BPRS contains four factors (Long, & Brekke, 1999; Mueser, Curran, & McHugo, 1997) labeled thought distortion, anergia, affect, and disorganization. The principal investigator was trained to acceptable reliability on the BPRS (80%+; Penn & Combs, 2000; Penn et al., 2000).

The WRAT-III (Wilkinson, 1993) reading subtest was used to screen participants for problems in reading. This test presented words of increasing difficulty that the person must read aloud. Total score for correct words read was used to compute both standardized ($\underline{M} = 100$, $\underline{SD} = 15$) and grade equivalent scores. Persons who scored at the 4th grade level or below (standard score of 65) were not included in the study. The 4th grade reading level has been used in previous research as the lower limit for reading proficiency to ensure adequate understanding of the study and consent form (Penn et al., 2000).

The measures of attention used in this study were selected based on the work of Mirsky et al. (1991). Factor analytic studies have shown that four factors can be reliably derived from a set of attentional measures. The factors of attention were Focus-Execute, Encode, Sustain, and Shift. Neuropsychological measures that corresponded to each attentional factor are described below.

The Trail Making Test was part of the original Halstead Reitan battery for the assessment of brain damage (Reitan & Davison, 1974). This test required the person to connect numbers and letters in alternating sequences. Trails A involved only numbers and Trails B had both letters and numbers. Time to complete (in seconds) both Trails A and Trails B were recorded (Mirsky et al., 1991; 1995).

The Digit-Symbol Coding Test is part of the Wechsler Adult Intelligence Test - III (WAIS-III). This test required the person to copy nine different geometric symbols that correspond to nine numbers. Each symbol was paired with a number. The test was timed and the number of correct symbols produced in 120 seconds was recorded (Mirsky et al., 1991; 1995).

The Arithmetic subtest from the WAIS-III was used to measure encoding skills. In this test, the person was presented with mathematical problems of increasing difficulty to solve without the use of pencil and paper. The number of correct answers was recorded (Mirsky et al., 1991; 1995).

The Digit-Span test from the WAIS-III was used as another measure of encoding. This subtest measures the size of a person's attentional capacity and is thought to be a pure measure of encoding. In this subtest, the person was presented with an increasing number of digits, which are to be repeated by the person. This was done in a forward fashion and then in a backward fashion where the person had to repeat the numbers in the reverse order. Total score from both the forward and backward trials were used in the analyses (Mirsky et al., 1991; 1995)

The standard version of the Continuous Performance Test (CPT) was used to measure sustained attentional vigilance. The CPT measured sustained attention and has been widely used in previous research on schizophrenia (Nuechterlein, 1991). The CPT required the person to remain vigilant for a specified character (in this study a "0") that randomly appeared on a computer screen. The person must respond by pressing the mouse button whenever the digit appeared and not respond when other distracter numbers appeared. The CPT test lasted approximately 8 minutes. The test presented a total of 480 numbers of which 120 were targets ("0"), which the participant must respond to. Each number was presented for 29 milliseconds. A two-minute training test was provided to familiarize the person with the test and to troubleshot any problems with the computer equipment. The standard version CPT used in this study was obtained from the UCLA

Neuropsychiatric Institute's Schizophrenia Research Laboratory (Nuechterlein, 1991). Variables of interest from the CPT included number of hits, misses, and false alarms as well as reaction time to respond to all targets (Kremen et al., 1992; Mirsky et al., 1991; 1995). The CPT also provided a sensitivity index (d'; based on signal detection theory), which measured the person's sensitivity to correctly respond to targets and ignore distracter numbers.

The ability to shift attention was measured with the Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948; Heaton, 1981). This test presented the person with a stimulus card that must be matched to one of four different cards. The underlying matching rule was not known to the participant, however, it could be color, shape/form, or number. The person had to figure out the matching rule that was used for each trial. After 10 consecutive correct responses, the rule changed (e.g., from color to shape). The person must be able to disengage from the previous response set and shift attention to the new set (Mirsky et al., 1995). For this study, a computerized version of the WCST was used for ease of examination. The test averaged 20-25 minutes for completion. Percentage of correct responses, number of categories completed, and number of errors were recorded (Kremen et al., 1992; Mirsky et al., 1991; 1995; Steinhauer et al., 1991).

The BLERT is a 21 item videotaped presentation of seven different emotional states (Bell Bryson, & Lysaker, 1997; Bryson et al., 1997). The emotional states included happiness, sadness, anger, fear, disgust, surprise, and no emotion. Each emotional state was presented for ten seconds and the person must decide which affective state was presented. Each emotion was displayed by a male actor who recited a series of three standard monologues concerning situations about his job. The BLERT provided a total score (range 0-21), which was used in the analyses. A benefit of the BLERT was that it contained both visual and auditory emotional information. The BLERT has good categorical stability data (kappa= .76) and test-retest stability (five-month test retest reliability was .76).

The BLERT has demonstrated good discriminant and convergent validity as well (Bell et al., 1997; Bryson et al., 1997)

The FEIT was developed by Kerr and Neale (1993) using still photograph pictures taken from the work of Eckman (1976) and Izard (1971). The FEIT consisted of 19 videotaped pictures of six different emotional states. Emotions were happiness, sadness, anger, surprised, afraid, and ashamed. The person must look at the picture and decide which emotion was being presented. Scores ranged from 0-19. The FEIT was developed in order to have an affect perception test with acceptable reliability and validity. Reliability results showed an internal consistency value ranging from .56 and .71 (Kerr and Neale (1993). Comparable reliability results were replicated in another study using a similar state hospital sample (Penn et al., 2000). The FEIT has demonstrated good discriminant and convergent validity (Kerr & Neale, 1993).

In order to evaluate the person's verbal fund of information, the Controlled Oral Word Association Test (COWAT) was administered. The purpose of administering this measure was to examine whether deficits in emotion recognition were due to problems in verbal fluency that might prevent the person from generating the names for different emotions. The COWAT required the person to verbally generate as many items beginning with the letters "F, A, and S" as they can in 60 seconds. In previous research by Whittaker, Connell, and Deakin (1994) and Chen, Chen, and Chan (2000), verbal fluency was moderately related to affect perception scores.

The Benton Test of Facial Recognition (TFR; Benton, VanAllen, Hamsher, & Levin, 1983) was administered as a control measure for the emotion recognition task. The test presented 27 pictures of different faces that the person matched in identity to a target face. The value of this test was that it controlled (holds constant) for the emotional content of the faces and thus served as a pure face recognition test. This test was matched for difficulty with the FEIT (Kerr & Neale, 1993). The TFR has been used in previous studies to compare face perception and affect recognition (Kerr & Neale, 1993).

A listing of all of the study measures with their respective scores is presented in Table 1. The measures are divided into clinical and diagnostic measures, measures of attention, affect perception tests, and other neurocognitive measures. The clinical, diagnostic, medication, and other neurocognitive variables were of potential interest only if they are found to be significantly related to the affect perceptions scores.

Table 2

Summary of Measures

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Measure	Variable of Interest

_____

Clinical and Diagnostic Measures[a]

Psychiatric Diagnosis	DSM-IV Diagnosis
BPRS	Total Score
Medication Classification	Medication Type
Medication Dosage	CPZ Dosage

Attention Measures

Continuous Performance	Mean Reaction Time
Test	d' Sensitivity Index
	Number Correct
	Number of Errors (Misses and False Alarms)
Wisconsin Card Sort Test	Percentage Correct
	Categories Completed
	Total Number of Errors
Digit Span	Number Correct

(table continued)

Arithmetic	Number Correct
Trail Making Test	Time in Seconds
Digit-Symbol Coding	Number Correct

Affect Perception Measures

BLERT	Total Score
FEIT	Total Score

Other Neurocognitive Measures[a]

Controlled Oral Word Association Test	Total Words Generated
Test of Facial Recognition	Total Score Correct

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[a] The diagnostic, symptom, and neurocognitive measures are of potential interest only if they are found to be significantly related to affect perception scores in which they will be included in the statistical analyses.

After each participant was selected from the hospital roster and agreed to participate, consent was obtained according to current university and state IRB guidelines. This was followed by the completion of the demographic questionnaire, the SCID-I/P, the BPRS, and the WRAT-III reading subtest.

The main component of the study was the administration of the measures of attention and affect perception. The measures of attention were administered individually and randomized before administration. The CPT and the WCST were administered using a computerized testing format. The other attentional measures were administered orally by the principal investigator (e.g., Arithmetic, Digit-Span) or in a paper-pencil format (e.g., Trail Making Test, Digit-Symbol). These were followed by the verbal fluency test (COWAT) and the Benton Test of Facial Recognition (TFR). Finally, the affect perception measures (BLERT and FEIT) were administered. Each participant was compensated $5 for time and effort. This stipend was presented only after completion of

the entire study protocol. Completion of the research protocol took approximately 1.5 hours to complete. However, due to the cognitive deficits found in this population, testing for some participants was spread out over several days to ensure full cooperation. Also, ample rest periods and/or smoke breaks were provided to reduce the stress and fatigue associated with intensive testing. A flowchart of the study's procedures and measures and can be found in Figure 1.

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┌─────────────────────────────────────┐
│   Affect Perception Study Flow Chart │
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                   │
                   ▼
┌─────────────────────────────────────┐
│          Overview of Study          │
│          Consent Obtained           │
│          Demographic Data           │
│       SCID Diagnostic Interview     │
│        BPRS Symptom Assessment      │
│      WRAT-III Reading Assessment    │
└─────────────────────────────────────┘
                   │
                   ▼
┌─────────────────────────────────────┐
│         Attentional Measures        │
│                WCST                 │
│                CPT                  │
│          Arithmetic/Digit-Span      │
│         Trail Making Test/Digit-    │
│                Symbol               │
└─────────────────────────────────────┘
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┌─────────────────────────────────────┐
│        Neurocognitive Measures      │
│            Verbal Fluency           │
│       Test of Facial Recognition    │
└─────────────────────────────────────┘
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┌─────────────────────────────────────┐
│          Affect Perception          │
│              Measures               │
│                BLERT                │
│                FEIT                 │
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│          Payment of Stipend         │
│            Final Questions          │
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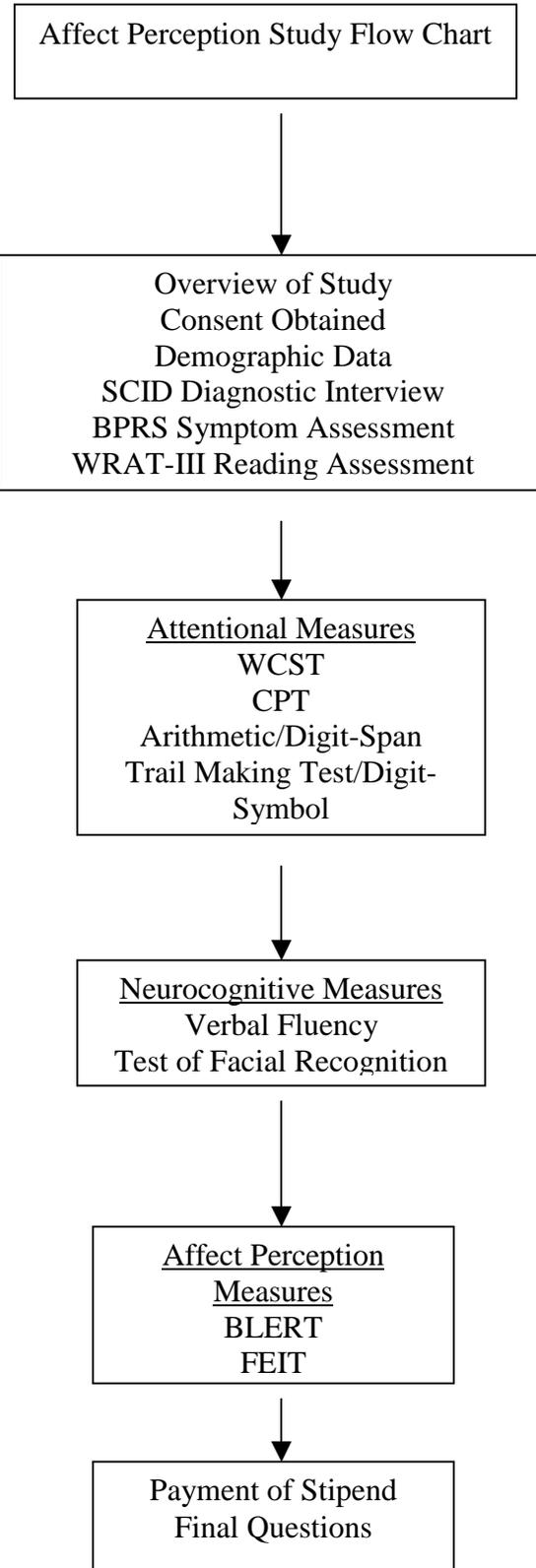
Figure 1. Study Flow Chart

Results

All data were numerically coded and entered into SPSS 10.0 for statistical

analyses. Categorical demographic data (e.g., gender, race, etc.) were recoded as

dichotomous data (0/1 dummy coded data) in order to facilitate their inclusion in the

statistical analyses. All other variables were measured on interval or continuous scales of

measurement. The statistical analyses proceeded in the following manner. First, a

Principal Components Analysis was conducted in an attempt to replicate the four factor

model specified by Mirsky et al. (1991). Second, in order to determine which attentional

variables were related to affect perception scores, a stepwise multiple regression analysis

was conducted. Thirdly, persons who scored high and low (based on a median split of the

sample) on the affect perception tasks were compared on the attentional measures to

determine if there were differences on these variables between the two groups.

In order to determine the underlying factor structure of the attentional measures

used in the study, a Principal Components Analysis (PCA) with a Varimax rotation was

conducted. In order to account for a smaller sample size ($\underline{N}$ = 65) and maximize stability

of the factor solution (N=65), only factor loadings with coefficients greater than .50 were

interpreted (Gardner, 2001). Variables selected for inclusion in the PCA were: 1) Digit-

Symbol Coding raw score, 2) Trail Making Test (Parts A and B) time in seconds,

3) Digit-Span raw score, 4) Arithmetic raw score, 5) CPT total number of correct hits,

errors (misses + false alarms), mean reaction time, and d' sensitivity index, and 6) WCST

percentage correct, number of categories completed, and total number of errors. The

specific variables listed above were selected based on the work of Mirsky et al. (1991),

Kremen et al. (1992), and Steinhauer et al. (1991) who performed similar factor analyses on attentional variables.

A range of 3 - 5 factor solutions were examined and a variety of rules (i.e., Kaiser's eigenvalue rule, Scree plot, 2% variance rule, and interpretability) were used to determine the best number of factors to extract (Devillis, 1991; Diekoff, 1992). A four factor solution was chosen because it best fit the data. The results of the Principal Components Analysis are presented in Table 3. The Shift factor was comprised of the WCST number of errors, percentage correct, and categories completed. The Sustain factor was comprised of scores from the CPT (Hits, Errors, and d" Sensitivity Index). Reaction time from the CPT loaded moderately on this factor as well, but was not above the threshold value of .50 to be included in this factor. The Focus-Execute factor was based on Trails A and B time, Digit-Symbol Coding, and CPT reaction time. The fact that CPT reaction time loaded on this factor was somewhat surprising, but given the substantial motor component of this factor it was not entirely unexpected. Mirsky et al. (1991) found that CPT reaction time loaded on both the Focus-Execute factor and Sustain factor as well. Due to the motor component of tests in the Focus-Execute factor, scores was not related to the presence of extrapyradmial side effects as measured by the AIMS (r = -.051, ns). The Encode factor was comprised on scores from the Digit-Span and Arithmetic tests. Subsequent to derivation of factors in the PCA, factor scores (uncorrelated composite scores based on factor loadings) for the above four factors were computed were used in the upcoming multiple regression analysis to alleviate the problem of multicollinearity (Diekoff, 1992). One important concern in this analysis was the participant to variable ratio. The more participants included in the PCA, the more

stable and reliable the results become (Diekoff, 1992). It has been recommended that a participant to variable ratio of 5 to 10 persons per variable is adequate (Bryant & Yarnold, 1995; Devillis, 1991; Tinsley & Tinsley, 1987 as cited in Devillis, 1991), while others have suggested that a 2 to 1 ratio is sufficient, especially if the factor loadings are high (e.g., above .80; Guadagnoli & Velicer, 1988). This study met that criteria and the participant to variable ratio was above the five to one ratio (12 attentional variables to 65 participants). Previous PCA research using persons with schizophrenia have used lower numbers of participants mainly due to the difficulty in the recruitment of these participants. For example, Kremen et al. (1992) used PCA to analyze data from 34 persons with schizophrenia while Steinhauer et al. (1991) utilized a sample of 30 persons with schizophrenia. Both studies argued that since the number of attentional factors was predicted a priori, a smaller sample size was acceptable.

Table 3

Principal Components Analysis Results

| | Rotated Factor Pattern | | | |
Measure	Shift	Sustain	Focus-Execute	Encode
Digit Symbol Coding	.217	.173	**-.752**	.272
Trails A (time)	-.135	-.254	**.729**	-.395
Trails B (time)	-.305	-.310	**.688**	-.344
Arithmetic	.380	.233	-.369	**.716**
Digit Span	.274	.247	-.232	**.856**
CPT Hits	.136	**.914**	-.228	.151
CPT Errors	-.145	**-.903**	.275	-.227

(table continued)

CPT Reaction Time	-.045	-.414	**.756**	.050
CPT d' Index	.166	**.865**	-.383	.195
WCST Correct (%)	**.961**	.111	-.142	.137
WCST Errors	**-.950**	-.127	.160	-.182
WCST Categories	**.883**	.161	-.166	.271
% Variance Explained	25.4	24.4	22.3	15.2
Eigenvalues	3.05	2.90	2.67	1.83

A stepwise multiple regression analysis was conducted in order to determine which factor(s) of attention was most predictive of affect perception scores. Stepwise multiple regression reduces multicollinearity (correlations) between variables used in the analyses (Diekoff, 1992), and is preferred when the research is exploring relationships among a set of variables. Predictor variables were the four factors of attention and any other study variable that was related to affect perception scores. To determine which other variables were related to affect perception, the simple bivariate correlations between demographic, medication, symptom, and neurocognitive variables were examined. This preliminary correlational analysis served to reduce the entire set of variables (with the exception of the attentional factors) to only those with significant relationships to affect perception. Scores on the Controlled Oral Word Association Test (COWAT; $r = .326$, $p = .002$), the Test of Facial Recognition (TFR; $r = .450$, $p = .0001$), Brief Psychiatric Rating Scale total score (BPRS; $r = -.329$, $p = .008$), and DSM-IV psychiatric diagnosis ($r = -.321$, $p = .009$) were found to be significantly related to affect perception and were included as additional predictor variables. The independent predictor variables used in the multiple regression analysis were the four factors of attention (Shift, Sustain, Focus-Execute, and Encode

factor scores) along with scores from the BPRS (total score), COWAT, TFR, and psychiatric diagnosis.

A composite affect perception score served as the dependent variable in this analysis. This composite total score represented a more global, comprehensive measure of affect perception. Since scores from the BLERT and FEIT were found to be highly correlated ($\underline{r}$ = .85, $\underline{p}$=.0001), the two affect perception scores were converted into standardized $\underline{Z}$ scores, and a mean affect perception score was computed (Mean $\underline{Z}$ scores from BLERT and FEIT). The conversion of these scores into $\underline{Z}$ scores was needed since the BLERT and FEIT have different numbers of test items and have different presentation formats (BLERT having an audio-visual format and the FEIT being only visual). There were no differences in the results on the multiple regression analysis when the BLERT and FEIT were analyzed separately. The results of the stepwise multiple regression are presented in Table 4.

Table 4

Stepwise Regression Analysis Results

Step/Variable		R	R^2	ΔR^2	Beta	t	p value
1.	Shift	.597	.356	.356	.584	10.3	.0001
2.	Encode	.736	.541	.185	.484	7.6	.0001
3.	Focus-Execute	.830	.689	.147	-.400	7.1	.0001
4.	Sustain	.887	.786	.097	.300	5.3	.0001
5.	DSM-IV Diagnosis	.903	.815	.029	-.127	3.0	.003

Note. Excluded variables were the BPRS total score, COWA, and TFR.

Overall, the four factors of attention and psychiatric diagnosis accounted for 81% of the variance in affect perception scores. The four factors of attention accounted for 78% of the variance in affect perception scores, and psychiatric diagnosis accounted for 2.9% of the variance. In addition, each factor of attention added a substantial amount of variance at each step in the MR analysis to remain in the final solution. The Shift factor had the highest predictive value (35%) followed by the Encode (18.5%), Focus-Execute (14.7%), and Sustain (9.7%) factors. Probing of the effect of diagnosis revealed that participants with paranoid schizophrenia had higher affect perception scores than participants with non-paranoid schizophrenia, F (1,63) = 7.3, p =.009. None of the other variables (COWAT, TFR. BPRS) were included in the stepwise analysis, which suggested that attentional skills are an important component of affect perception abilities even more so than level of psychiatric symptomatology, verbal fluency, or the ability to recognize and discriminate facial features.

Comparison Analyses

In order to explore whether differences in attentional scores were found among participants with high and low affect perception scores, a series of comparison t tests were conducted. A person's composite Z score on the FEIT and the BLERT were used to form a high and low scoring group (independent variable) using a median spilt method. Although this method is more conservative than other methods, it will maximize the number of participants in the analysis. The dependent variables were the attentional factor scores derived from the PCA analysis. A benefit of using the factor scores was a reduction in the number of variables compared (from twelve to only four). Bryson et al. (1997) conducted a similar comparison by examining differences in demographic and

attentional variables based on high and low scores on the BLERT. A Bonferroni

correction procedure was employed to control for alpha error inflation across the

comparisons. The results are presented in Table 5. The results of the comparison analyses

showed that the Shift, Focus-Execute, and Encode factor scores were significantly

different between high and low affect perception groups. However, the Sustain factor

was not found to be significantly different between the two groups. Thus, it appeared that

sustained attention scores were similar between the high and low scoring groups, and

may suggest that sustained attention is not particularly important in discriminating high

and low affect perception performance. However, the Shift, Focus-Execute, and Encode

were different and suggested that persons who scored higher on these factors also showed

higher affect perception scores and vise versa.

Table 5

<u>Comparison Test Results for High and Low Affect Perception Groups</u>

Factor	High Group Mean (SD)		Low Group Mean (SD)		t value	p
N	32		33			
Shift	.537	(.928)	-.520	(.772)	5.0	.0001
Sustain	.175	(.763)	-.170	(1.17)	1.40	.164
Focus-Execute	-.336	(.955)	.326	(.944)	2.81	.007
Encode	.339	(1.09)	-.329	(.784)	2.84	.006

<u>Note.</u> Bonferroni adjusted <u>p</u> value = .025

Discussion

<u>Summary of Findings</u>

The purpose of this study was to examine the role of attention in affect perception among a sample of persons with chronic schizophrenia. To accomplish this goal, a variety of neuropsychological measures reflecting four factors of attention were administered based on the work of Mirsky et al. (1991). Affect perception was assessed using two standardized measures that were developed using persons with schizophrenia (Kerr & Neele, 1993; Bryson et al., 1997). The sample used in this study consisted of sixty-five persons with schizophrenia who were receiving treatment in two inpatient state hospital settings. Most of these participants had long-term episodes of illness, multiple inpatient hospitalizations, and all were taking antipsychotic medication at the time of study. The majority of the sample consisted of persons diagnosed with paranoid schizophrenia (n = 40), and on average participants reported a moderate level of psychiatric symptomatology (based on the BPRS results). Since none of the participants were actively abusing substances at the time of the study, the diagnostic and symptom information obtained can be viewed as a true assessment of their current psychiatric status. Furthermore, there was a relative lack of documented problems with extrapyramidal side effects (e.g. tardive dyskinesia) stemming from their medication treatment, which was important since some of the measures (Trail Making Test, Digit-Symbol Coding, CPT) have a psychomotor component that could have been adversely affected by any motor problems. Also, all of the participants had adequate reading levels to comprehend the test materials and instructions for the study. Demographically, the

sample was balanced according to both gender and ethnicity, so the participants are fairly representative of those persons currently receiving psychiatric treatment in Louisiana.

There were three primary hypotheses generated for this study. First, it was hypothesized that a four factor model of attention could be replicated in a new sample of persons with schizophrenia (Mirsky et al., 1991). Second, it was hypothesized that several specific factors of attention would be related to affect perception scores, thus reflecting the importance of attentional variables in affect perception. Based on previous research it was concluded that the Encode, Sustain, and Shift factors of attention would be related to affect perception scores. Finally, it was hypothesized that persons who scored high and low on the affect perception measures would differ on attentional variables as well. Thus, persons who performed well on the affect perception tests would show better scores on the attentional variables.

The results of the Principal Components Analysis (PCA) showed that a four factor model of attentional functioning best fit the data, thus supporting hypothesis number one. The four factor model of attention replicated the findings of Mirsky et al. (1991), as well as, those from Kremen et al. (1992) and Steinhauer et al. (1991). The factors identified were very similar to the Shift, Sustain, Focus-Execute, and Encode identified in these prior studies. It was encouraging to note that with a different sample, a similar factor solution was obtained. Mirsky's (1987) four factor model of attention has now obtained a wide range of empirical support with different populations, such as adults, children, persons with traumatic brain injury, general psychiatric conditions, schizophrenia, and toxic exposures (Mirsky 1987; Mirsky et al., 1991). A thorough discussion of each of the four factors derived in this study will be conducted later.

The stepwise multiple regression analysis showed that all four factors of attention along with psychiatric diagnosis were significantly related to affect perception scores, which supported hypothesis number two. The Shift and Encode factors were found to be the strongest predictors of affect perception performance. Focus-Execute and Sustain were also significant predictors, but accounted for less variance than Shift and Encode. The four attentional factors accounted for 78% of the variance in affect perception scores. Bryson et al. (1997) and Kee et al. (1998) presented similar evidence that encoding skills, sustained attention, and the ability to shift attention were related to affect perception scores. It is important to note that in the Bryson et al. study (1997), cognitive-attentional variables accounted for only 34% of the variance on the BLERT. The attentional variables used in the present study accounted for much more variance (78% versus 34%). With respect to psychiatric diagnosis, the finding that participants with paranoid schizophrenia showed better affect perception scores is consistent with the results of Lewis and Garver (1995) and Kline et al. (1992). In addition, Magaro (1981) and Strauss (1993) argued that persons with paranoid schizophrenia have more intact cognitive abilities than persons with non-paranoid schizophrenia. Thus, the importance of diagnosis may be due to the higher cognitive functioning of the paranoid schizophrenia group than with the actual symptoms of the diagnosis. Overall, the results of this study were generally consistent with the existing body of research with the exception that the Shift factor was found to be the strongest predictor of affect perception instead of encoding scores.

Surprisingly, there was no empirical relationship between affect perception and current psychiatric symptoms (both positive and negative), medication type or dosage,

demographic, or other illness-related variables. This suggested that affect perception scores may not be an artifact of psychiatric symptoms, medications, or chronicity of illness. With regards to illness-related variables, one study showed that chronicity (e.g., a higher the number of hospitalizations) was paradoxically associated with better affect perception scores (Salem, Kring, & Kerr, 1996), while another study showed that chronicity was linked poorer scores (Mueser et al., 1996). Symptom wise, previous research studies showed a modest association between affect perception and psychiatric symptoms, with negative symptoms associated with lower affect perception scores (Borod et al., 1993; Kohler et al., 2000; Penn et al., 2000; Schneider et al., 1995). In the present study, although the BPRS total score was initially correlated with affect perception scores, its influence was better accounted for by the attentional and diagnostic variables. Also, it was somewhat surprising that there was no relationship with medication type or dosage. The proposed effect of antipsychotic medication on affect perception is believed to be an indirect one. It is currently believed that the medication improves cognition (e.g. attention, working memory), which in turn improves affect perception skills (Green, 1996; Stip & Lussier, 1996). Corrigan and Penn (1995) suggested a variable effect of antipsychotic medications in which they impair cognitive functioning at high doses, but may improve cognition at low doses. A study by Sweeney et al. (1991) found a negative relationship between chlorpromazine dosage and scores on a simple vigilance test, such that higher doses were linked to poorer vigilance scores. In contrast, a study by Allen et al. (1997) showed that attentional scores were unaffected by the administration of Haloperidol. The lack of association with medication type is even more surprising since the newer atypical antipsychotics have been associated with an

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improvement in some domains of cognitive functioning (Nagamoto et al., 1996). This present study found no relationship between affect perception and medication-related variables.

In addition, neither verbal fluency nor face recognition scores were related to affect perception. Even though both verbal fluency and face recognition were initially correlated with affect perception scores, their influence was better accounted for by the attentional and diagnostic variables. The lack of a relationship with verbal fluency was an important one since it suggested that the problems with affect perception are not based on the person's ability to generate the names or labels for the emotions. The lack of a relationship between affect perception and general face recognition may suggest that the ability to decode and label emotions may be independent from those used to recognize and identify faces. Neuropsychological studies have shown a similar dissociation between face and emotion recognition (Kolb & Whishaw, 1996). Furthermore, Kohler et al. (2000) demonstrated that the ability to recognize affect was correlated with several cognitive variables (e.g., attention, memory, etc), but face recognition was not found to be dependent on cognitive functioning.

Differences between persons high and low in affect perception on the attentional variables were examined using comparison tests. The results showed that the Shift, Encode, and Focus-Execute factors were significantly different between the two groups, but Sustained attention was not (thus, partially supporting hypothesis # 3). Bryson et al. (1997) conducted a similar comparison analysis using high and low scorers on the BLERT and found significant differences on the WCST (errors and categories

completed) and CPT (number of errors only), but not on a measure of encoding (Digit-Symbol subtest).

The lack of group differences on the Sustained attention factor may indicate that this factor was less important (or perhaps unimpaired) for successful affect perception performance than the other factors. A study by Strum, Willmes, Orgass, and Hartje (1997) may provide some insight into the reduced role of sustained attention found in this study. Strum et al. (1997) argued that sustained attention was the lowest, most basic form of attention that can be improved by an attention training program, and it was a necessary precursor for other higher forms of attention to function effectively (Shift, etc.). In that study, training at the Sustained levels of attention could be used to improve more complex forms of attention. However, training at higher levels of attention could not improve Sustained attentional skills. According to Strum et al. (1997), attentional vigilance may serve as the foundation for the other forms of attention and could be considered the most basic form of attention. Thus, the participants in the present study may have had intact basic attentional skills (sustained attention), but impaired higher-order attentional skills (Shift, Focus-Execute, Encode). However, this idea is inconsistent with the body of research that showed sustained attentional deficits in persons with schizophrenia (Nuechterlein, 1991). There does appear to be some support for a tentative hierarchy of attention with sustained attention at the bottom as several anatomical models of attention (Posner & Peterson, 1990; Mirsky et al., 1991) propose that less complex brain areas of attention are subject to the control of higher functioning brain areas. In contrast, Bryson et al. (1997) stated that sustained attention was very important in affect perception because it helps the person distinguish relevant stimuli from irrelevant stimuli.

Another explanation for the lack of differences on sustained attention was that the CPT used in this study was too easy or not sensitive enough to detect these impairments (Kremen, Seidman, Faraone, Toomey, & Tsuang, 2000). There are more difficult forms of the CPT available, such as those that use degraded stimuli or those that use sequences of numbers to increase the difficulty of the test. Perhaps, these more difficult tests would have picked up differences in sustained attention in this sample.

<u>Factors of Attention</u>

The Principal Components Analysis identified four factors of attention based on the measures used in this study. Each factor of attention will now be briefly discussed.

The Shift Factor was comprised of variables from the WCST test. This factor measures the ability to disengage one's attention from a stimulus and shift it to another stimulus (Mirsky et al., 1991). Variables that loaded on this factor included the number of categories completed, number of errors, and percentage of correct responses. Persons who were not able to shift their attention to new categories made more errors because they become stuck on previous stimuli. Thus, they lacked the ability to shift attention between sets. The relationship between the WCST and the Verbal Fluency Test (COWAT) is an interesting one since both are believed to be sensitive to frontal lobe functioning and involve judgment, abstract reasoning, higher-order cognition, and problem-solving skills for successful completion (Spreen & Strauss, 1998). However, only the Shift factor, which was comprised on scores from the WCST, was related to affect perception, and suggested that it is the attentional component (shifting attention) that was important and not the ability to generate the names for the emotions presented.

The Focus-Execute factor appears to be dominated by psychomotor speed and the ability to identify relevant targets and then respond to them (Mirsky et al., 1991). Thus, this factor has two important components: 1) the identification of relevant targets and 2) the motor response component. Variables that loaded on this factor included the Trail Making Test (parts A and B), Digit-Symbol Coding, and the reaction time measure from the CPT. All of these measures have a significant motor component upon which the person's score depends upon. For example, the reaction time score on the CPT was determined by how fast the person could respond by pressing the mouse key. Notably, this factor was unrelated to the severity of extrapyramidal side-effects as reflected by the person's AIMS score.

The Sustain factor measured the ability to sustain attention over a long period time and required a readiness to respond to a target at any time. In this study, this factor was comprised of scores from the CPT including number of correct hits, total number of errors (Misses + False Alarms), and the sensitivity index (d'), which measured the person's the ability to discriminate targets from non-targets (e.g., accuracy of responding). It is interesting to note that Sustained attention did not differ among persons high and low in affect perception, but was included in the regression analysis, albeit as the last attentional factor. Perhaps, vigilance plays a minor role in affect perception and needs to be only grossly intact for affect perception.

The final factor, Encode, was comprised of scores from the Arithmetic and Digit-Span subtests. Both subtests presented the person with an increasing number of stimuli (numbers in Digit Span and more complex math problems in Arithmetic) to complete. This factor measured the person's attentional span and the amount of information that the

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person can hold and manipulate in their attentional focus. Motor responses are minimal and limited to a verbal output of the answer. These tasks required the use of a person's cognitive resources for effective performance. It can be argued that this factor is actually measuring the person's working memory capacity instead of attention, but there has been little empirical work to differentiate the two constructs. For example, in the Wechsler Adult Intelligence Test (WAIS) series, the Arithmetic and Digit-Span subtests utilized in this study have been grouped together into both a Freedom from Distractibility factor (attentional focus) and a Working Memory factor. This similarity between attention and working memory was also evident in the memory conceptualization of Baddeley (1981). Baddeley argued that a component of memory called the "central executive" provides short-term storage for information while attention is diverted to other tasks. The central executive is involved in both attention and working memory operations. In Baddeley's conceptualization, both attentional encoding and working memory capacity are used interchangeably and may actually be the same cognitive mechanism.

How Does Attention Affect Emotion Perception?

The results of this study showed that all four factors of attention were significantly related to affect perception scores. Problems in affect perception have been shown to relate to a variety of problems in social functioning (see Penn et al., 1997 for a review). The findings of this study were consistent with the generalized deficit model of emotion perception (Mandal et al., 1988; Penn et al., 1997), which states that cognitive skills and abilities are important in affect perception. According to the generalized deficit model, impaired information processing (i.e., attention) leads to poor emotion recognition.

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A proposed theoretical model on the relationship between attention and affect perception is presented below, which suggests how attentional problems might lead to impairments in affect perception. Specifically, this section presents how each attentional factor may influence affect perception. Theoretically, there has not been much in the way of elucidating this relationship. However, the practical and homogeneous nature of the four factors suggests some possible avenues of influence.

First, since affect perception is a dynamic process and subject to constant change, the ability to shift attention from one facial expression to another would be valuable. Persons who are impaired in this aspect of attention may become stuck on one particular emotion, thus missing out on subsequent shifts in emotion. The results of this study showed that the shift factor was the most predictive of affect perception scores and is arguably the most important factor. Second, the ability to sustain attention over time may of importance since the person must constantly follow social dialogue in order to detect any changes in emotional states. A person who constantly looks away and does not stay focused on the conversation at hand is more likely to miss important social and emotional cues. Bryson et al. (1997) argued that sustained attention was very important so that the person is always ready to detect important aspects of emotion. Thirdly, encoding of the entire face (and possibly other bodily cues) may also be key in that narrowly focusing on a certain aspect of the face (e.g., a person who looks only at the eyes or mouth) may lead to the wrong conclusion regarding the expressed emotion. For example, some emotions, such as fear and surprise, are so similar in appearance that the whole face needs to be encoded or examined in order to make this fine distinction (Eckman, 1976). The effect of encoding can be seen in a study by Mandal and Palchoudhury (1989) in which persons

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with schizophrenia made more errors in affect perception when shown pictures of the whole face and than when only parts of the face were presented.

The influence of the Focus-Execute factor of attention is more difficult to define. The important aspects of this factor are: 1) ability to identify an important feature (to focus) and 2) to respond to it (to execute). With respect to focusing, it has been demonstrated that persons with delusions and schizophrenia tend to examine more non-relevant areas of the face (Phillips & David, 1997; 1998; Quirk 2000). Thus, the person may not be focusing on the most relevant areas of the face to obtain the most information. The ability of the motor system to generate emotionally appropriate responses (via speech or non-verbal cues) is another key component of this factor. In the present study, even if the participant knew the correct emotion presented on the tape, if they were not quick with the answer, then the information may become lost or the emotion may change. Socially, if in conversation and the person does not respond (or is slow to respond) to an emotion, the other person may lose interest, become upset, or end the interaction. A study by Mandal and Rai (1987) showed that persons with schizophrenia were slower to identify emotional pictures than a group of persons with anxiety disorders and a control group.

In sum, it can be argued that each attentional factor could impair affect perception. A summary of the proposed theoretical relationship between attention and affect perception adopted in this study can be found in Figure 2. The fact that all four factors of attention were related to affect perception suggests that there are many places where this skill can become impaired in persons with schizophrenia.
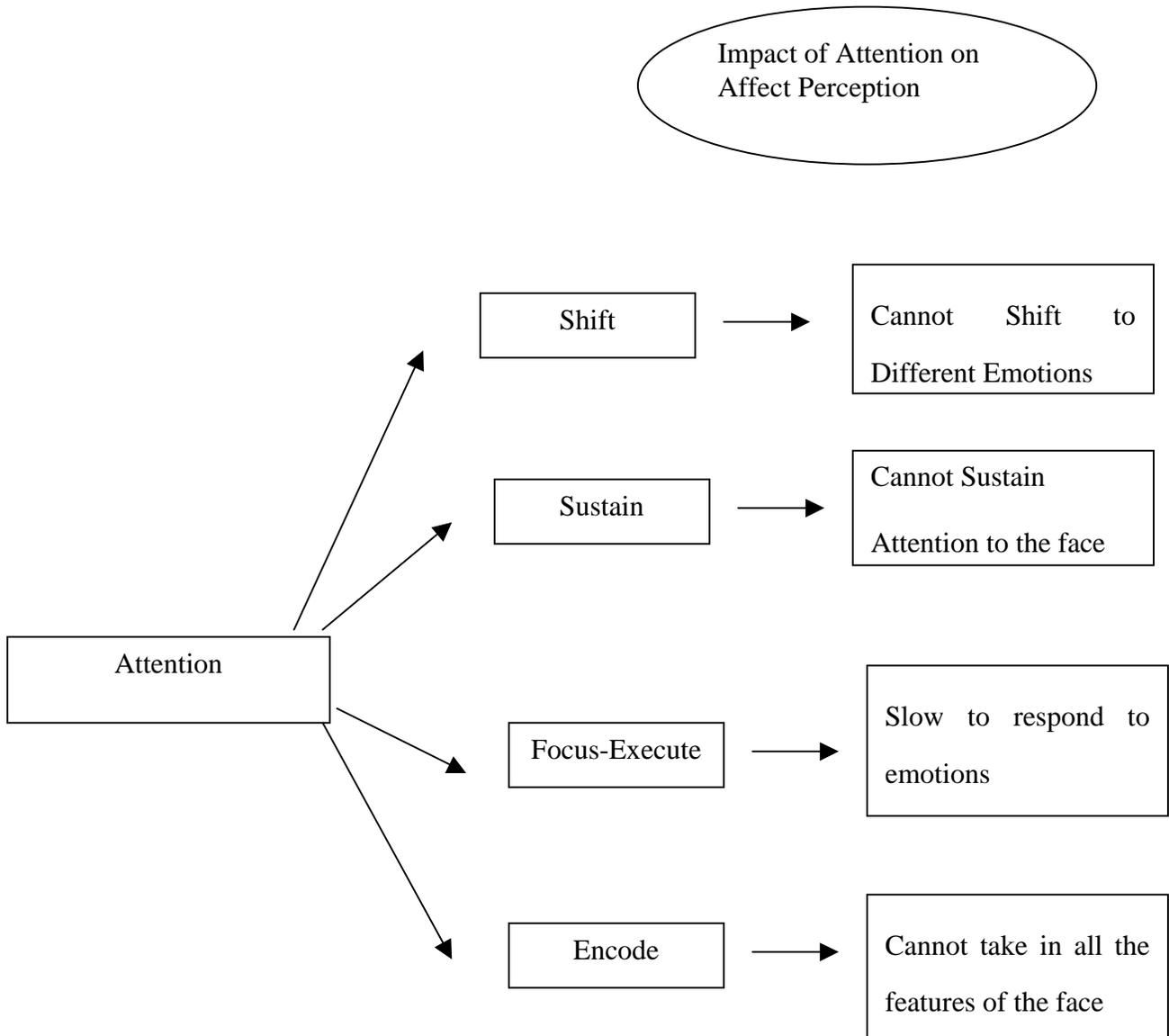
Figure 2: Impact of Attention on Affect Perception

The present study has several limitations that should be mentioned. First, it can be argued that Principal Components Analysis requires at the minimum at least 100 participants for the results to be considered reliable and stable (Devillis, 1991). However, there is a great deal of debate on this issue, and the recommended participant to variable ratio ranges from 2:1 (Gardner, 2001) to over 100:1 (Devillis, 1991). In order to minimize the influence of a less than ideal sample size, several statistical controls were included in this study. First, since four factors were specified a priori, then the use of fewer participants to test this model is arguably acceptable (Kremen et al. 1992). Second, only factor loadings above .50 were interpreted, which according to Gardner (2001) may reduce the influence of sample size limitations. Practically, obtaining a larger sample of ($\underline{N}$ = 100+) persons with schizophrenia would be very difficult, not to mention expensive and time consuming. It should be noted that previous factor analytic studies with schizophrenia used sample sizes of 28 (Kremen et al., 1991) and 34 (Steinhauer et al., 1991) respectively.

Sample size is also a concern for the multiple regression (MR) analysis and for the number of pairwise comparisons made in this study. Specifically, it is recommended that multiple regression procedures have a participant to variable ratio of at least 10:1 to ensure some degree of generalization (Diekoff, 1992). For this study, the number of variables in the MR (8) was relatively acceptable to the number of participants ($\underline{N}$ = 65). In addition, the combination of the attentional measures (via PCA) into four independent factors further reduced the number of variables in the multiple regression analysis (Diekoff, 1992). The use of bonferroni adjusted probability values across analyses helped minimize error rates.

Finally, the measures of attention used in this study cannot be considered pure measures of attention, but most likely involve other cognitive abilities as well. In fact, most psychological measures require a combination of abilities for successful completion (Spreen & Strauss, 1998). For example, the WCST has aspects of attention, problem-solving, motor skills, and abstract reasoning (Spreen & Strauss, 1998). The CPT has visual, motor, and attentional requirements. Thus, while the measures used in this study have significant attentional components, they do have other aspects that should be considered in the interpretation of these findings.

<u>Implications of Findings</u>

The results of this study showed that attention was related to affect perception skills in a sample of persons with schizophrenia. Persons who showed better attentional functioning (except sustained attention) also performed better on the affect perception tests. The next question is how these results could be integrated into existing rehabilitation treatments to improve social skills and affect perception. Attention training programs are one possible avenue. Attention training programs involve the use of repeated testing and training with computerized tests of attention to improve these skills. Oftentimes, this training takes place for weeks to months and involves several hours of intensive training per day. The use of attention training has a long history of use with the traumatic brain injured population (see Sohlberg & Mateer, 1987; Strum et al., 1997), but has a more limited use in schizophrenia (Benedict et al., 1994). In general, research on the use of these programs for persons with schizophrenia has been inconsistent with most of the studies showing improvement only on the task that is trained and there has been little transfer to other areas of information processing (Benedict & Harris, 1989;

Benedict et al., 1994). To date, the results of this area of research have been generally disappointing.

Attention is also a component in most formal social skill training programs, but it is emphasized in more of an informal manner. For example, in the UCLA social skills training modules, the person is continuously prompted to attend to the lectures and teaching models so that the information is learned more efficiently (Liberman et al., 1993). Persons who are attending to the training are provided with positive reinforcement to increase their attention to future tasks. Social skill training programs do not provide direct methods for improving attention and consider attentional skills to be more supplemental (which this current study refutes) to learning.

The use of computers may provide the best use of attention training methods specifically designed for the improvement of affect perception abilities. The proposed training module presented below is based on the research by Phillips and David (1997; 1998) and Quirk (2000) who used eye tracking devices to monitor what part of the face a person was looking at and for how long. Since the effect of attention training programs are very specific and of limited generalizability, a specific attention training program that uses affect perception stimuli would be ideal. For example, the person could be shown a face depicting an emotional state. Then with the use of computers, a prompt would appear on the most important aspects of the face to cue the person to look at this area. This would specifically target the Focus-Execute factor. Second, a warning stimulus could be given when a shift in faces is about to occur (Shift factor).   The above described prompts and warning stimuli could be faded out over time to promote generalization and self-directed application of the skill. If a person is not looking at the face for long enough

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(vigilance problems) then feedback could be provided as to how long the person looked at the face before a decision was made. Finally, encoding problems, in which the person is not attending to the entire face, could be remediated by showing the person a computer generated diagram of their visual scan pattern so they can see where they were looking. The participant could then modify their visual search pattern based on the feedback given to ensure that the whole face is encoded. The development of such a program would be costly, but it may provide a method for improving affect perception that may show sound beneficial results.

Conclusion

In sum, this study provided substantial evidence for the role of attentional variables in affect perception. All four factors of attention were significantly related to affect perception scores. In addition, diagnosis was also found to be a significant predictor, but its impact may be due to the improved cognitive functioning of persons with paranoid schizophrenia. The link between cognitive and social variables provides hope that by identifying specific cognitive deficits, an effective means of remediation can be found for the many problems in social functioning faced by persons with schizophrenia.

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Appendix A

Consent Form

1. **Project Title:** <u>The Role of Attention in Affect Perception</u>

2. **Research Locations:**   Eastern Louisiana Mental Health System
Southeast Louisiana State Hospital

3. **Principal Investigator:**   Dennis Combs, M.S.   Phone: 388 - 8745
Wm. Drew Gouvier, Ph.D.   Phone: 388 - 8745

Address: Department of Psychology
Louisiana State University
236 Audubon Hall
Baton Rouge, LA 70803 - 5501
Hours: 8 a.m- 5 p.m; Monday-Friday

4. **Purpose of Study:** To explore how attention affects a person's ability to recognize different emotional states

5. **Description of Study:**   1. We will be asked background questions
about ourselves and our current symptoms.
2. We will complete several tests of attention.
3. We will be asked to identify different emotions
that will be presented on a television screen.
4. Our time to complete the study will be about 1 hour.

6. **Participants:**
Inclusion - Persons must have a diagnosis of schizophrenia in order to be eligible for participation and be 18 years or older.
Exclusion- Persons who cannot tolerate the testing, become disorganized or confused, or judged by staff as inappropriate for the study.

7. **Number of Participants:** A maximum of 75 persons will be included.

8. **Benefits to Subjects:** There are no known benefits to the participants from taking part in this study. However, participants will be paid a stipend of $5 for their participation in this study.

9. **Risks to Subjects:** There are no known risks to participation in this study above that which is normally assumed from participation in any research project.

10. **Alternatives to Participation:** The alternative is not to participate in this project.

11. **Subjects Right to Refuse to Participate or to Withdraw:** I understand that participation in this research is <u>voluntary</u>, and that I may refuse to participate in or may

withdraw from this study at any time without being penalized in any way, especially as it concerns my status in or the services received from this program/facility, either now or in the future. Should the research lead to learning new and important things, which may change my willingness to participation, such information will be shared with me.

12. **Subjects Right to Privacy:** I understand that my privacy will be protected and neither my name nor any information identifying me will be used under any circumstances. The study will be anonymous with no identifying information collected. The consent forms will be stored separately from any test data.

13. **Release of Information:** I understand that this form does not authorize the release of any identifying information to any party under any circumstances; nor does it authorize the release of material from my case record.

14. **Publication/Distribution of findings:** I understand that the results of this research may be published or otherwise distributed, but that these results will not contain any identifying information.

14. **Assurances/Signatures:** This study has been discussed with me (or read to me). I have been able to ask questions and those questions have been answered to my satisfaction. I understand that I may ask other questions of the researcher at anytime. I also have been informed that if I have any concerns about the rights of human subjects of research I may call the Division of Research and Development at (225) 342-2256 or the LSU Institutional Review Board at (225) 388-1492. I agree with all of the terms of this consent form and have been given a copy.

_____   _____
Signature of Participant   Date

_____   _____
Signature of Witness   Date

Reader Attests: The subject has informed me that he (she) is unable to read. I hereby certify that I have read this consent form to the subject and have explained that by signing in the above section, he (she) agrees to participate.

_____   _____
Signature of Reader   Date

Appendix B

Demographic Questionnaire

ID number: _____

Age: _____   Educational Level:_____

Gender: Male   Female   Race:_____

Marital Status: _____   Handedness:_____

Medications and Dosage:

1._____   2._____

3._____   4._____

Length of Illness: _____

Number of Previous hospitalizations: _____

Weeks of Current Stay: _____

Any visual problems that may affect performance?: Yes   No

WRAT Reading Score: Raw_____   Standard Score:_____

BPRS Scores: AIMS Score:_____
Thought Disturbance:_____
Anergia:_____
Disorganization:_____
Affect:_____
Total Score:_____

DSM-IV Diagnoses:

Axis I:_____   Axis II:_____

Axis III:_____

Axis IV:_____   Axis V:_____

Appendix C

Supplementary Results

Table B1

<u>Supplementary Results</u>

Variables	Affect Perception Score
	Correlation Coefficient (r value)
BPRS Total Score	-.329*
BPRS Thought Disturbance	-.106
BPRS Anergia	-.103
BPRS Affect	.138
BPRS Disorganization	-.215
Psychiatric Diagnosis	-.321*
Medication Type[a]	.049
Medication Dosage[b]	-.024
Test of Facial Recognition	.450*
Verbal Fluency (COWAT)	.326*
Length of Illness (months)	-.202
Lengths of Stay (weeks)	-.153
Number of Inpatient Commitments	-.240

<u>Note.</u> N = 65
[a] Medication Types were Traditional, Atypical, or Combination of Traditional/Atypical
[b] Medication doses were transformed to chlorpromazine equivalents.
* $p < .01$

Vita

      Dennis R. Combs was born in Lubbock, Texas. He attended East Texas Baptist University in Marshall, Texas where he earned a Bachelor of Arts in psychology and later went on to obtain his master's degree in clinical psychology from the University of Texas at Tyler. His master's thesis was on psychological subtypes among persons with HIV.

      In pursuit of a doctoral degree in clinical psychology, Dennis and his family moved to Louisiana State University where he continued his studies in the areas of neuropsychology and schizophrenia. Currently, Dennis is on internship completing a specialty internship program in neuropsychology at the South Texas Veteran's Health Care System in San Antonio, Texas. His future goals are to obtain a position in academia where he can continue his research interests, and help mold and develop a new generation of students to love psychology as much as he does.