Schizophrenia and alcohol dependence: The combined effects on emotion processing

Sylvia An Ross
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SCHIZOPHRENIA AND ALCOHOL DEPENDENCE: THE COMBINED EFFECTS ON EMOTION PROCESSING

by

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A dissertation submitted in partial fulfillment of the requirements for the

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ABSTRACT

Schizophrenia and Alcohol Dependence: The Combined Effects on Emotion Processing

by

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Substance abuse co-occurs at high rates with schizophrenia, with alcohol as the most commonly abused substance. Dual diagnoses have been associated with lower levels of quality of life; greater rates of medication noncompliance, homelessness, hostility, violence, legal problems, interpersonal conflict; and increased costs for services.

The purpose of this study was to determine the impact of alcohol dependence on emotion processing in schizophrenia. There are currently no studies that investigate this. Research has identified deficits in facial affect processing and cognitive functioning in schizophrenia and chronic alcoholism. However, the level of impairment is less severe in alcoholism.

The current study investigated whether alcohol dependence detrimentally impacted emotion processing in schizophrenia. A comprehensive evaluation of diagnosis, symptoms, emotion processing, and neuropsychological functioning was performed for three groups of participants: Comorbid Schizophrenia with Alcohol Dependence (SZA), Schizophrenia (SZ), and Healthy Control (HC). There were 22 participants in each group.
who were screened for inclusion and exclusion criteria. Informed consent was obtained and participants were administered the Structured Clinical Interview for the DSM-IV to confirm diagnoses in the SZA and SZ groups and rule-out psychopathology in the HC group. Severity of psychiatric symptoms and extrapyramidal side-effects were rated for individuals in the schizophrenia groups. Individuals in the SZA group were assessed for the severity of alcohol use, current and past. All participants were administered neuropsychological and emotion processing tests.

Results of emotion processing testing revealed that the schizophrenia groups were more impaired on tests of facial affect labeling and discrimination and learning a list of emotional words than the HC group, regardless of the type of emotion. Results of neuropsychological testing revealed that the HC group outperformed the schizophrenia groups on tests of visual spatial processing, facial perception, verbal learning and memory, general knowledge, and attention. However, the SZA and SZ group did not significantly differ across tests.

In conclusion, the study did not support the presence of an additive detrimental effect on emotion processing and cognitive functioning for dually diagnosed individuals. Instead, this study revealed that individuals with schizophrenia had more global deficits in cognitive and emotion processing.
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CHAPTER 1

INTRODUCTION

Purpose of the Study

Schizophrenia is a severe and often debilitating psychiatric disorder characterized by positive symptoms, such as hallucinations and delusions; negative symptoms, such as flattened affect and psychomotor retardation; and disorganized symptoms, including loosely connected thoughts and odd behaviors. Lifetime prevalence rates for schizophrenia are 1%, worldwide (American Psychological Association, DSM-IV-TR, 2000). The onset of symptoms typically occurs in early adulthood, with an earlier age of onset associated with a poorer prognosis than a later age of onset. The course of the disorder may vary. Although periods of remission may occur, return to premorbid functioning is unlikely. The literature review will provide a more in-depth discussion of the cognitive and emotion processing deficits seen in individuals with schizophrenia.

The purpose of this study was to determine the impact of alcohol dependence on emotion processing in schizophrenia. Research has shown deficits in facial affect processing, including affect identification (Addington & Addington, 1998b, Borod et al., 1989), affect discrimination and recognition (Borod et al., 1989; Kerr & Neale, 1993), verbal expression of facial emotion (Braun, Bernier, Proulx, & Cohen, 1991; Kring & Neale, 1996), and nonverbal expression of facial emotion (Berndl, von Cranach, & Grüsser, 1986; Berndl, Grüsser, Martin, Remschmidt, 1986) in schizophrenia. Similarly,
deficits in facial affect processing (Walker, Marwit, & Emory, 1980; Walker, 1981) have been shown in children with schizophrenia. Moreover, deficits in emotion processing have not been limited to facial affect, such that individuals with schizophrenia demonstrated deficits in affective prosody (Fricchione, Sedler, & Shukla, 1986; Leentjens, Wielaert, van Harskapm, & Wilmink, 1998) and auditory emotion processing (Borod et al., 1990; Kerr & Neale, 1993). Thus, deficits in emotion processing associated with schizophrenia may reflect a more global deficit.

What causes these deficits? Many believe that neuroanatomic abnormalities may account for these impairments. For example, individuals with schizophrenia perform similarly to individuals with right-hemisphere brain damage on tests of facial affect processing, suggesting lateralized deficits in the right hemisphere may cause emotion processing impairments (Borod et al., 1989, 1990). Related arguments posit that certain emotions, such as sadness, are processed by the right hemisphere, whereas anger and happiness do not demonstrate the same lateralized processing patterns (Federman, Drebing, Zaret, & Oopen, 1998). Thus, the finding that individuals with schizophrenia have more pronounced difficulty interpreting the emotion of sadness (Wölwer, Streit, Polzer, & Gaebel, 1996) supports this lateralized deficit.

Others suggest that individuals with schizophrenia tend to focus upon the wrong facial attributes when judging facial affect, and thus this accounts for their emotion processing deficits (Streit, Wölwer, & Gaeber, 1997). However, individuals with schizophrenia tend to be biased towards positive emotions and may perform as well as normal controls when rating happy faces (Dougherty, Bartlett, & Izard, 1974). Furthermore, one study found great individual variability in emotion processing abilities,
with some individuals with schizophrenia performing better than normal controls (Hellewell, Connell, & Deakin, 1994). Consequently, if individuals with schizophrenia and normal controls can process certain facial emotions equally well, this theory seems flawed.

Similarly, other theories suggesting deficits in attention, visual spatial skills, and facial perception skills seem to also fall short. For example, some suggest that the visual spatial deficits seen in schizophrenia accounts for the deficits in facial affect processing. Although it is possible that these deficits may contribute to emotion processing deficits, they do not account for the bias towards positive emotions. Others have tried to answer this question by investigating whether individuals with certain subtypes of schizophrenia perform differently on affect perception tests. A limited number of studies have demonstrated that individuals with paranoid schizophrenia have fewer emotion processing deficits (Lewis & Garver, 1995), while individuals with deficit syndrome schizophrenia have more emotion processing deficits (Bryson, Bell, Kaplan, Greig, & Lysaker, 1998).

Thus far, the research has failed to reach a consensus as to what causes emotion processing deficits in schizophrenia. Moreover, there is no research investigating emotion processing deficits in dually diagnosed individuals. Overall, there is a general lack of basic science concerning emotion processing in dually diagnosed individuals.

Research has also demonstrated that chronic alcoholics demonstrate cognitive and emotion processing deficits. These deficits are similar to those seen in individuals with schizophrenia, in that they tend to globally affect cognitive and emotion processing ability. However, the level of impairment in alcoholics is less severe than seen in

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schizophrenia (Bell, Bryson, & Lysaker, 1997). Moreover, alcoholics demonstrate similar patterns of performance to individuals with schizophrenia on tests of emotion processing, such as greater difficulty processing negative emotions (Frigerio, Burt, Montagne, Murray, & Perrett, 2002). Furthermore, alcoholics also demonstrate deficits in affective processing, suggesting a more global deficit in emotion processing, similar to individuals with schizophrenia. One interesting difference between these groups is that alcoholics tend to overestimate the intensity of emotional faces (Philippot et al., 1999), whereas individuals with schizophrenia tend to underestimate the intensity of emotional faces (Morrison, Bellack, & Bashore, 1988).

Although there is a lack of basic research in the area of emotion processing and dual diagnoses, certain predictions may be made based upon the current research base. For example, there seems to be a large body of evidence supporting general emotion processing and cognitive deficits in individuals with schizophrenia and alcoholics. Additionally, a limited number of studies have examined the cognitive deficits of individuals dually diagnosed with schizophrenia and substance abuse. These studies indicate that there is an additive effect for cognitive deficits in dually diagnosed alcoholics, such that alcoholics are more impaired than normal controls, individuals with schizophrenia are more impaired than alcoholics, and dually diagnosed individuals are more impaired than singly diagnosed individuals with schizophrenia. Thus, based on the similar patterns of cognitive and emotion processing deficits in both individuals with schizophrenia and alcoholics, it was anticipated that a comorbid diagnosis of alcohol dependence would have an additive detrimental effect on emotion processing. Moreover, this study attempted to provide a basic foundation for this line of research.
It is concerning that this area of research has been untapped because the prevalence rates of comorbid disorders are so high, with conservative estimates of 34% of individuals with schizophrenia also abusing alcohol (Regier et al., 1990). Furthermore, the impact of comorbid substance use disorders has significant effects on the individual and society. For example, dually diagnosed individuals may experience lower levels of quality of life, more symptoms of depression and greater risk for suicide, greater risk for tardive dyskinesia, greater medication noncompliance, lower rates of employment, greater rates of homelessness, greater legal problems, greater risk for violence and engaging in criminal activities, and more interpersonal difficulties. Furthermore, one study found that individuals with psychiatric disorders comorbid with substance use disorders cost 60% more to treat than singly diagnosed individuals (Dickey & Azeni, 1996).

Research Questions/Definition of Terms

The primary purpose of this study was to determine if alcohol dependence detrimentally impacted emotion processing in schizophrenia. First, a baseline of visual spatial processing and facial perception needed to be established. Thus, the first question investigated whether dually diagnosed individuals, those with schizophrenia comorbid with alcohol dependence, experienced greater deficits in visual spatial skills than singly diagnosed individuals only diagnosed with schizophrenia and healthy controls. If confirmed, this would support the limited available research. Furthermore, this study attempted to determine whether there was an additive detrimental deficit in visual spatial processing for dually diagnosed individuals. In order to answer this question,
neuropsychological tests and facial discrimination tests were used to differentiate whether anticipated deficits were related to more visual spatial processing in general or were more specific to face processing.

The second question addressed whether dually diagnosed individuals demonstrated greater deficits in emotion processing than singly diagnosed individuals and healthy controls. Based upon the consistent findings that individuals with schizophrenia have deficits in emotion processing, it was expected that both schizophrenia groups would also demonstrate impairments in all tests of emotion processing, including facial affect processing, memory for emotional words, and attention shifting when presented with emotional words. Moreover, it was anticipated that there would also be an additive detrimental deficit for dually diagnosed individuals.

The third question examined whether there was a bias for specific types of emotions. First, it was expected that all groups would demonstrate a bias towards positive emotions, such that when the emotion of happiness or surprise was presented, participants would be less vulnerable to interference. This would further refute the explanation that global visual spatial and face perception deficits accounted for deficits in emotion processing. On the other hand, it was expected that dually diagnosed and singly diagnosed individuals would perform more poorly than normal controls when presented with negative emotions.
CHAPTER 2

LITERATURE REVIEW

First, a general overview will be provided to outline the influence of a comorbid substance abuse or dependence diagnosis with schizophrenia, henceforth referred to as dual diagnosis. Specifically, the impact of a comorbid diagnosis on the individual and society, and the identification of risk factors for the dually diagnosed will be explored. Next, a review of cognitive functioning and emotion processing in schizophrenia and substance abuse will be provided. Finally, the limited research on cognitive functioning in dually diagnosed individuals will be reviewed.

Prevalence

According to data collected from the Epidemiologic Catchment Area Study (ECA), the lifetime prevalence rates of substance use disorders in schizophrenia is 47%, with 34% abusing alcohol and 28% abusing other drugs (Regier et al., 1990). Additionally, individuals with schizophrenia are five times more likely to develop substance use disorders and three times more likely to develop alcohol use disorders than the general population. In this study, substance use disorders included both substance abuse and substance dependence. Although substance dependence and abuse are related disorders, they reflect different levels of severity. For instance, substance abuse reflects a less severe pattern of substance use characterized by risky behaviors, legal problems,
interpersonal difficulties, and psychosocial difficulty associated with substance use over a 12-month period (DSM-IV-TR). On the other hand, substance dependence reflects a more severe pattern of substance use characterized by symptoms of tolerance and withdrawal, significant amounts of time engaged in substance-related activities, and impaired psychosocial functioning over a 12-month period (DSM-IV-TR).

Prevalence rates from the ECA study (Regier et al., 1990) are fairly consistent with rates of current substance use disorders reported in the literature, such that 7% to 57% of individuals with schizophrenia abuse substances (e.g., Dixon, McNary, & Lehman, 1998; Green et al., 2004; Khalsa, Shaner, Anglin, & Wang, 1991; Mueser, Nishith, Tracy, DiGirolamo, & Molinaro, 1995). When examining substance use that does not reach diagnostic thresholds for abuse or dependence, the rates are much higher, ranging from 70% - 83% (Breakey, Goodell, Lorenz, & McHugh, 1974; Salyers & Mueser, 2001).

Alcohol, marijuana, and cocaine appear to be the most commonly abused drugs in the general population and for individuals with schizophrenia. For example, studies have found the following ranges in rates of substance abuse in schizophrenia: 11% to 83% for alcohol abuse (e.g., Brunette, Mueser, Xie, & Drake, 1997b; Buckley et al., 1994; Drake et al., 1990; Mueser et al., 1990, 1995), 13% to 42% for cannabis abuse (e.g., Baigent et al., 1995; Mueser et al., 1990; Munsey et al., 1992), and 15% to 20% for cocaine abuse (e.g., Miller & Tanenbaum, 1989; Munsey et al., 1992). On the other hand, prevalence rates for other drugs, such as hallucinogens, narcotics, and other stimulants are much lower than for alcohol, cannabis, and cocaine (Cuffel et al., 1993; Mueser et al., 1990). The variability in these estimates seems to be due to differences in methodological approaches across studies. These differences in preferences do not appear to be based on
the cost of different types of drugs, such that alcohol and crack cocaine users spend the same amount of money for their preferred substance (Munsey et al.). Could these differences be due to convenience or accessibility? Perhaps these differences could be attributed to demographic or geographic influences. These topics will be discussed later in this paper.

Part of the variability in substance abuse rates may be due to polysubstance use. A large proportion of individuals with schizophrenia abuse multiple substances, with estimates ranging from 10% - 28% (Baigent et al., 1995; Dixon, Haas, Weiden, Sweeney, & Frances, 1991; Mueser et al., 2000), and a median rate of abusing four different substances (Breakey et al., 1974). Alcohol is frequently abused in addition to other types of drugs. For example, it has been shown that individuals with schizophrenia who used or abused multiple substances tended to use alcohol as one of the multiple substances (Arndt et al., 1992; Mueser et al., 1995). Moreover, these individuals were more likely to abuse alcohol with other substances than to abuse alcohol alone (Mueser et al., 2000).

Other substances that are less problematic at a societal level, such as caffeine and tobacco, also have high rates of use (Fowler, Carr, Carter, & Lewin, 1998). On average, individuals with schizophrenia drink 4 to 5 cups of coffee daily. As many as 89% of individuals with schizophrenia smoke tobacco (Fowler et al.; Margolese, Malchy, Negrete, Tempier, & Gill, 2003), and 30% smoke between 1 and 2 packs of cigarettes per day (Fowler et al.).

Overall, these data indicate that a large proportion of individuals with schizophrenia are at high risk for abusing drugs or alcohol. Furthermore, when looking at substance use, in general, a pattern of very high use emerges. Although prevalence estimates vary
across studies, it seems evident that substance abuse comorbid with schizophrenia is problematic and occurs frequently.

The Effects of Dual Diagnoses on Prognosis

How does an additional substance abuse or dependence diagnosis impact the prognosis of individuals with schizophrenia? Substance use, abuse, or dependence in schizophrenia appears to be stable across time (Chouljian et al., 1995; Cuffel & Chase, 1994; Test, Wallisch, Allnes, & Ripp, 1989). This suggests that even substance use that is below clinically significant levels tends to be chronic. This coupled with the chronicity of schizophrenia, suggests that any adverse effects associated with dual diagnoses will also likely be chronic. As such, the effects on the course of the disorder, psychosocial functioning, quality of life, types of symptoms, severity of symptoms, comorbidity of additional psychiatric disorders, extra pyramidal side-effects, and medication compliance will be reviewed.

Psychosocial Functioning

Psychosocial functioning has a complex relationship with substance use. Upon initial inspection, the literature seems highly inconsistent with respect to psychosocial functioning. For example, one study found that treatment-resistant individuals with schizophrenia who abused substances demonstrated better psychosocial functioning than non-using individuals (Buckley et al., 1994). On the other hand, another study identified that individuals with schizophrenia with milder symptoms of psychosis had lower levels of psychosocial functioning than the singly diagnosed (Chouljian et al., 1995). While, yet another study revealed that individuals with schizophrenia with a remote history of
substance abuse did not differ from the singly diagnosed in overall psychosocial functioning, but had better social functioning than singly diagnosed individuals (Arndt et al., 1992). When these studies are viewed as a whole, a more complex interaction between psychosocial functioning and dual diagnosis emerges. It may be that the impact of substance use on psychosocial functioning may be dependent upon severity and recency of substance use, such that individuals with more severe psychosis and substance use patterns may have higher levels of functioning. Although this seems counterintuitive, the dually diagnosed may be more able to tolerate substances to self-medicate.

Quality of Life

Quality of life is essential for all people. Some studies have shown lower quality of life ratings for the dually diagnosed. For example, researchers demonstrated that the dually diagnosed who were currently abusing substances rated quality of life as lower than the singly diagnosed and those with past substance abuse (Addington & Addington, 1998a). Similarly, the dually diagnosed who abused substances in the past rated quality of life as lower than the singly diagnosed (Addington & Addington, 1997). On the other hand, dually diagnosed treatment-resistant alcoholics did not differ from singly diagnosed individuals who abused other drugs in ratings of quality of life (Buckley et al., 1994). Overall, these findings suggest that individuals who abuse drugs and have a history of substance abuse may experience lower levels of quality of life, and these lower levels of quality of life may be substance specific. The inconsistencies among studies may be attributed to the types of substances abused. For instance, when viewing substance abuse as a whole, lower quality of life ratings seem to occur. However, this may vary when
examined by the type of substance. This may also be influenced by individual reasons for using substances.

**Symptom Severity**

Findings are inconsistent as to whether dually diagnosed individuals differ from singly diagnosed individuals in symptom severity when using general indices of symptomology, such as the psychotic symptoms subscale of the Brief Psychiatric Rating Scale (BPRS). Some studies have shown that the dually diagnosed who are currently using drugs or who have past substance abuse also experience greater severity of psychosis (Fowler et al., 1998; Swofford et al., 1996). While, others have shown no differences in psychosis severity among individuals with schizophrenia with a history of substance abuse; individuals who currently abuse or use substances, including occasional use; and non-using individuals (DeQuardo et al., 1994; Dervaux et al., 2001; Salyers & Mueser, 2001), regardless of whether they abused alcohol, cannabis, or multiple substances (Cuffel et al., 1993). Similarly, substance use that occurs daily or less frequently was found to be unrelated to severity of psychosis (Munsey et al., 1992).

Two studies that have followed dually diagnosed individuals longitudinally have shown greater reductions in overall severity of psychosis following pharmacotherapy (Buckley et al., 1994; Dixon et al., 1991). The first study (Buckley et al., 1994) examined the effectiveness of clozapine for the treatment of 118 treatment-resistant individuals with schizophrenia or schizoaffective disorder comorbid with either a current diagnosis or past history of substance abuse. They initially found that dually diagnosed individuals exhibited less severe ratings of psychosis than individuals with schizophrenia who did not use substances. However, following 6 months of clozapine treatment, both
dually diagnosed and singly diagnosed individuals decreased in ratings of severity of psychotic symptoms, and there were no longer significant differences between the groups in symptom severity.

The second study (Dixon et al., 1991) followed 83 inpatients with schizophrenia spectrum disorders comorbid with either current or lifetime diagnoses of substance abuse or dependence. At initial testing when individuals were hospitalized, they found no differences in severity of symptoms between dually diagnosed and singly diagnosed individuals. However, following discharge, the dually diagnosed had lower ratings of psychotic symptoms than the singly diagnosed. In this study, the specifics regarding type of treatment provided and initial BPRS scores were not provided. Nevertheless, it seemed that the dually diagnosed had greater reductions of psychosis following treatment than the singly diagnosed.

Overall, pharmacotherapy seems to decrease severity of psychotic symptoms in both dually diagnosed and singly diagnosed individuals. Dixon et al.’s (1991) findings suggest that dually diagnosed individuals may benefit more in symptom reduction from pharmacotherapy than singly diagnosed individuals, whereas Buckley et al.’s (1994) findings suggest that the singly diagnosed benefit more in symptom reduction than the dually diagnosed. Thus, these studies do not help to clarify the impact of having a dual diagnosis on symptom severity. Perhaps the discrepancies are due to individual differences or differences based upon sample characteristics. Nevertheless, when examining the frequency and types of substances, it seems that symptom severity does not consistently differentiate dually diagnosed from singly diagnosed individuals.
Positive Symptoms

Positive symptoms seen in schizophrenia are characterized by symptoms that are in excess of normal thoughts and behaviors, including formal thought disorder, hallucinations, and delusions. Several studies have shown that the dually diagnosed had more positive symptoms than non-users. For example, a 5-year prospective study also found that dually diagnosed individuals had more delusions and hallucinations (Bühler, Hambrecht, Löffler, an der Heiden, & Häfner, 2002). With respect to cannabis abuse, the dually diagnosed reported more positive symptoms than non-cannabis abusers (Green et al., 2004). Similarly, another study found that individuals with schizophrenia who used cannabis had more hallucinations and delusions (Negrete, Knapp, Douglas, & Smith, 1986). With respect to alcohol abuse, studies have shown that dually diagnosed alcoholics had more symptoms of paranoia (Drake et al., 1989) and delusions (Barbee et al., 1989). Another study found that individuals with schizophrenia who drank more than 20 alcoholic drinks per week also had more positive symptoms, such as hallucinations and thought disordered symptoms (Soni & Brownlee, 1991).

On the other hand, others have failed to substantiate that positive symptoms differentiate between substance users and non-users, regardless of type of substance used (Arndt et al., 1992). Similarly, Dixon et al. (1991) initially found that positive symptoms did not differentiate among inpatients, at admission, with current substance use disorders, past substance use disorders, and no substance abuse. However, following discharge the dually diagnosed individuals who were currently abusing substances had less severe symptoms of thought disorder. They also found that those with current or past diagnoses of substance use disorders had fewer symptoms of paranoia or suspiciousness (Dixon et
al.). Yet, others have found that individuals with schizophrenia who did not have a history of substance use demonstrated higher levels of positive symptoms (Zisook et al., 1992).

As with other previously mentioned factors, positive symptoms seem to have a complex relationship with substance use. Dixon et al. (1991) proposed that dually diagnosed individuals may have a lower baseline level of symptoms that may be exacerbated by the use of substances. There may also be a dose-dependent relationship, such that as individuals progress from substance use to abuse to dependence, positive symptoms also increase.

**Disorganized Symptoms**

Disorganized symptoms are characterized by disorganized or inappropriate thoughts, emotions, and behaviors (DSM-IV-TR). For example, individuals with these symptoms tend to have loosely connected thoughts, odd movements and tics, and inappropriate expression of emotions. The relationship between disorganized symptoms and substance abuse has not been well-established. For instance, studies have indicated that the singly diagnosed had more disorganized symptoms (Bell, Greig, Gill, Whelahan, & Bryson, 2002; Zisook et al., 1992), as did those with a history of alcohol abuse (Bell et al., 2002). Another study found that dually diagnosed alcoholics had more disorganized speech (Drake et al., 1989). On the other hand, another study found that psychiatrically unstable dually diagnosed individuals initially exhibited fewer disorganized symptoms than non-using individuals (Buckley et al., 1994). Again, there are inconsistencies across studies, suggesting that disorganized symptoms do not effectively differentiate between dually diagnosed and singly diagnosed individuals.
**Negative Symptoms**

The majority of studies have demonstrated that the dually diagnosed experienced fewer negative symptoms. For example, research has shown that those singly diagnosed had more flattened affect than individuals with schizophrenia who used substances, and more social apathy than individuals who used alcohol (Salyers & Mueser, 2001). Additionally, individuals with a current substance abuse diagnosis had fewer negative symptoms than those with a lifetime diagnosis and nonusers (Addington & Addington, 1998a; Dixon et al., 1991). Another study found that the dually diagnosed exhibited fewer negative symptoms than the singly diagnosed (Buckley et al., 1994; Green et al., 2004). When examining specific type of substance, the singly diagnosed and the dually diagnosed with a history of alcohol abuse had more negative symptoms than those who abused other drugs (Bell et al., 2002). Similarly, individuals with schizophrenia who drank more than 20 alcoholic drinks per week also had fewer negative symptoms (e.g., anergia, psychomotor retardation, and social withdrawal) (Soni & Brownlee, 1991). Cannabis abusers also demonstrated fewer negative symptoms than non-cannabis users (Green et al.). Others have also shown that individuals with schizophrenia who currently abuse cocaine had fewer negative symptoms than non-users (Lysaker et al., 1994).

On the other hand, a limited number of studies have failed to find differences between dually diagnosed and singly diagnosed individuals with regards to negative symptoms. For example, one study found that individuals with schizophrenia who used substances did not differ from those who did not use substances in severity of negative symptoms, regardless of type of substance used (Arndt et al., 1992). Another study found that dually diagnosed individuals with a history of substance abuse, that was not chronic, and who
were not currently using substances did not differ in negative symptoms from those who
did not use substances (Addington & Addington, 1997; DeQuardo et al., 1994). Another
study failed to identify differences between the singly diagnosed and dually diagnosed
alcoholics with respect to negative symptoms (Lysaker et al., 1994).

Perhaps these findings were influenced by the severity of substance abuse, such that
the studies that failed to find differences between groups for negative symptoms used
participants who did not meet criteria for a substance use disorder, and the use was not
chronic. For example, one study found that the less severe the level of alcohol abuse in
schizophrenia, current and lifetime (Kirkpatrick et al., 1996), the more negative
symptoms and negative affect. Overall, the majority of literature supports that the dually
diagnosed with more chronic use experience fewer negative symptoms. It is uncertain
why this occurs. One possibility is that the dopaminergic properties of most substances
of abuse alleviate the secondary negative symptoms that result from antipsychotic
medications or those that are core features of the disorder. Alternatively, individuals with
dual diagnoses may have fewer or less severe negative symptoms to begin with, which
allows them to become involved in substance abuse.

Other Psychiatric Comorbidity

It has been suggested that individuals with schizophrenia with a history of substance
abuse tend to be more anxious (Fowler et al., 1998). Depression has also been associated
with comorbid substance abuse in schizophrenia, such that the severity of alcohol and
cannabis abuse was positively related to the severity of depressive symptoms in
individuals with schizophrenia who abused these substances (Brunette et al., 1997b).
Similarly, individuals with schizophrenia who abused or used alcohol also reported
higher levels of depression than controls (Brady, Killeen, & Jarrell, 1993; Drake et al.,
1989) and dually diagnosed cannabis abusers (Baigent et al., 1995). One study found that
individuals with schizophrenia who abused alcohol, cannabis, or multiple substances also
had higher ratings of depression than singly diagnosed individuals (Cuffel et al., 1993).
Individuals with schizoaffective disorders have also shown increased risk for substance
abuse (Strakowski et al., 1993).

In contrast, others have failed to find relationships between dually diagnosed
treatment-resistant alcoholics and those who abused other drugs in severity ratings of
depressive symptoms (Buckley et al., 1994). Similarly, Kamali et al. (2000) found that
individuals currently abusing substances, with a history of substance abuse, and non­
users did not differ in severity of depression. Yet, other studies have found the opposite
relationship between dual diagnoses and depression. For instance, one study reported
that dually diagnosed individuals had lower levels of depression than non-abusers
(DeQuardo et al., 1994). Again, there are many inconsistencies across studies. However,
depression does not tend to be chronic and remits over time (Brady et al., 1993; Cuffel et
al., 1993), which could account for the lack of differences found by some researchers.
Nevertheless, a large amount of research shows that dually diagnosed individuals may be
at greater risk for depression.

Depression, alcohol abuse, and suicide have also been linked together, with
depression being the most salient factor associated with suicide in schizophrenia (Bartels,
Drake, & McHugo, 1992). For instance, the dually diagnosed reported more frequent
suicidal thoughts with greater intensity than the singly diagnosed and those with a history
of substance abuse (Kamali et al., 2000). Individuals with psychotic disorders who also
used substances (Verdoux et al., 1999) and dually diagnosed alcoholics demonstrated greater risk for suicide (Drake et al., 1989). However, the dually diagnosed did not have higher rates of suicide attempts (Dixon et al., 1991). Moreover, having a history of suicidal attempts appears to be the strongest predictor of suicidal behaviors in schizophrenia (Allebeck, Varla, Kristjansson, & Wistedt, 1987). Thus, there appears to be an increased risk of suicidal ideation in the dually diagnosed. However, whether those thoughts lead to actual attempts is uncertain.

**Impulsivity**

Impulsivity has also been suggested as a risk factor for worse prognosis in the dually diagnosed. For example, Dervaux et al. (2001) found that dually diagnosed individuals endorsed more impulsivity and sensation seeking than non-users. Similarly, another study demonstrated that those with a past diagnosis of substance abuse also had higher impulsivity scores. Sensation seeking may be related to personality characteristics or temperament that may differentiate between dually diagnosed and singly diagnosed individuals. Increased impulsivity and sensation seeking in the dually diagnosed may indirectly equate with a poorer prognosis due to the increased risk these individuals may take (Dervaux et al.).

**Extrapyramidal Side-Effects**

Extrapyramidal side-effects (EPS) typically result from taking neuroleptic medications and are generally characterized by excess involuntary, irregular movements that vary across individuals. EPS tend to be temporary and cease with cessation of medications. Several studies have failed to find differences in EPS between dually diagnosed and singly diagnosed individuals. For instance, one study showed that EPS
were unrelated to substance use in individuals with psychiatric disorders, including schizophrenia (Duke, Pantelis, & Barnes, 1994). Nevertheless, other studies have shown that individuals with schizophrenia who used substances did not differ from non-using individuals in EPS (Salyers & Mueser, 2001), nor did dually diagnosed alcoholics differ from the singly diagnosed in EPS (Buckley et al., 1994). Moreover, following 6 months of clozapine treatment, there were no differences in EPS between dually diagnosed and singly diagnosed treatment-resistant individuals (Buckley et al.).

A more extreme form of EPS is tardive dyskinesia, resulting from prolonged use of neuroleptic medications. Tardive dyskinesia is characterized by involuntary movements, such as tongue-darting, and may not remit with cessation of medications. Interestingly, in a large study utilizing over a thousand participants; dually diagnosed individuals were at greater risk for tardive dyskinesia (Bailey, Maxwell, & Brandabur, 1997). Others have also shown that dually diagnosed alcoholics were more likely to experience tardive dyskinesia than non-using individuals (Dixon, Weiden, Haas, Sweeney, & Frances, 1992). Dually diagnosed individuals who had chronic lifetime substance dependence who abused only alcohol or alcohol and cannabis together also had greater rates of tardive dyskinesia (Olivera, Kiefer, & Manley, 1990). Of this sample, 78% of individuals had psychotic disorders.

Others have also shown that those with a lifetime diagnosis of substance abuse and years of neuroleptic use were correlated with tardive dyskinesia in individuals who used additional drugs with alcohol (Dixon et al., 1992). On the other hand, others have shown that tardive dyskinesia was unrelated to substance use in individuals with psychiatric disorders (Duke, Pantelis, & Barnes, 1994). Interestingly, alcohol abuse or use of alcohol
with additional drugs accounted for a greater proportion of the risk for tardive dyskinesia than neuroleptic dose and the amount of time using neuroleptics (Dixon et al.).

The lack of differential findings by Salyers and Mueser (2001) may be due to their definition of alcohol and substance use, such that they included individuals whose average alcohol use was two to three times per month and drug use was once per week. Thus, EPS may be a function of chronicity and severity of substance use in dually diagnosed individuals, which would explain why other studies have shown greater risk for tardive dyskinesia in dually diagnosed individuals. Furthermore, Buckley et al.’s (1994) lack of findings may be because clozapine is an atypical antipsychotic and purports not to elicit EPS in individuals. Or perhaps there is an interaction between alcohol and neuroleptics that increases the risk for tardive dyskinesia, and it this may occur for those who use and abuse alcohol.

Interestingly, the overall findings do support that substance abuse, specifically alcohol use or abuse is related to a greater incidence of EPS in the dually diagnosed. This seems illogical in that substance abuse is associated with tardive dyskinesia, a more severe form of EPS, but not the lesser forms. Therefore, it is more likely that these discrepancies are due to methodological issues, more chronic or severe forms of substance abuse, and the type of substance used that is associated with greater risk for EPS in the dually diagnosed.

Medication Noncompliance and Dosage

Another issue surrounding dual diagnosis is medication noncompliance (Owen, Fischer, Booth, & Cuffel, 1996). It has been shown that dually diagnosed individuals were more likely to be noncompliant (Chouljian et al., 1995; Owen et al., 1996),
especially those currently abusing substances in comparison with those with a history of substance abuse and non-using individuals. Others have shown that the type of medication may affect noncompliance, such that, noncompliance occurred more for individuals treated with haloperidol than those treated with olanzapine (Green et al., 2004). This suggests that it may be the side-effects that are associated with more typical antipsychotic medications, such as haloperidol, that account for the greater levels of noncompliance. Conversely, it may be the decreased side-effects associated with atypical antipsychotic medications that accounts for the higher levels of compliance when individuals are prescribed these medications. If in fact, the dually diagnosed experience greater EPS due to the additional use of substances, then the presence of a comorbid substance use disorder may indirectly influence greater rates of noncompliance.

The issue of noncompliance is important due to the associated consequences. For example, medication noncompliance in dually diagnosed individuals was related to greater rates of hospitalization, supporting the revolving door phenomenon (Haywood et al., 1995), and a greater likelihood to be discharged from the hospital against medical advice (Miller & Tanenbaum, 1989). Moreover, continued abuse of substances, often accompanied by medication noncompliance and failure to maintain contact on an outpatient basis, resulted in exacerbated symptoms at 6-month follow-up (Owen et al., 1996). Furthermore, in a 4-year prospective study, Hunt, Bersen, and Bashir (2002) found that noncompliant dually diagnosed individuals had greater rates of rehospitalization than compliant dually diagnosed individuals and singly diagnosed individuals. These findings support a worse prognosis for dually diagnosed individuals.
in that these individuals tend to be more noncompliant, which is frequently associated with greater rates of hospitalization.

The literature does not support that difference in prescription practices affects noncompliance in dually diagnosed individuals. For instance, medication dosage does not differentiate between dually diagnosed and singly diagnosed individuals (Addington & Addington, 1997; Buckley et al., 1994; DeQuardo et al., 1994; Dixon et al., 1991; Green et al., 2004), nor does it differentiate between dually diagnosed alcoholics and singly diagnosed individuals (Drake et al., 1989; Gerding et al., 1999; Pristach & Smith, 1990). Furthermore, dually diagnosed alcoholics did not differ from non-using individuals in the number of medications prescribed (Allen et al., 1999). Although medication dosage does not appear to be related to dual diagnoses, dually diagnosed alcoholics acknowledged that they stopped taking their medication when they drank (Pristach & Smith, 1990).

**Summary of the Effects of Dual Diagnoses on Prognosis**

With most of these variables, there seems to be a complex relationship between substance use disorders and schizophrenia. For instance, severity and chronicity of substance use may differentially impact some of these variables, such that the more chronic and severe the substance use, the more likely it is to impact functioning and prognosis. This seemed to apply to symptoms of depression, disorganized symptoms, and impulsivity, such that the greater the severity and chronicity of substance use, the more likely these individuals were to be influenced by these symptoms. Similarly, the dually diagnosed reported lower levels of quality of life. The dually diagnosed had fewer disorganized symptoms. However, positive and negative symptoms, symptom severity,
and EPS did not reliably differentiate dually diagnosed from singly diagnosed persons. Dually diagnosed alcoholics were more at-risk for tardive dyskinesia and had higher rates of medication noncompliance. Lastly, the impact of comorbid substance use disorders on psychosocial functioning was uncertain due to inconsistencies in the literature.

The Effects of Dual Diagnoses on Society

How does comorbidity of substance abuse in individuals with schizophrenia impact society? The purpose of this section was to explore how dual diagnoses impact society, in general. Rates and duration of hospitalizations, employment, homelessness, crime, and the associated costs of these issues will be discussed.

Hospitalizations

The dually diagnosed tended to experience longer delays in receiving treatment than the singly diagnosed (Green et al., 2004). On the other hand, whether the dually diagnosed utilized services more than the singly diagnosed was unclear. For example, one study found that substance abuse in schizophrenia was unrelated to prior utilization of emergency services (Cuffel et al., 1993), whereas another study found that the dually diagnosed had a two-fold increased use of emergency services than the singly diagnosed (Bartels et al., 1993). These discrepancies may be due to differences in sample characteristics related to geographic location, such that Cuffel et al. used individuals from the ECA study who may have represented a more diverse sample, whereas Bartels et al. used rural outpatients.

When examining hospitalization rates, again the results are inconsistent. For instance, some studies have shown that dually diagnosed individuals (Bartels et al., 1993;
Gupta, Hendricks, Kenkel, Bhatia, & Hafike, 1996; Kashner et al., 1991) and individuals with schizophrenia who drank more than 20 drinks per week (Soni & Brownlee, 1991) had higher rates of hospitalization. Hunt et al. (2002) followed individuals with schizophrenia prospectively for 4 years and found that dually diagnosed individuals had higher rates of re-hospitalization. In contrast, others have shown current substance abuse (Cuffel et al., 1993; Dixon et al., 1991; Miller & Tanenbaum, 1989) and history of substance abuse (Addington & Addington, 1997; Dervaux et al., 2001) were unrelated to hospitalization rates in schizophrenia, whether abusing alcohol or cocaine (Lysaker et al., 1994). Similarly, when examining substance use versus substance abuse, there were no differences in number of previous hospitalizations between those who used and the singly diagnosed (Arndt et al., 1992).

When comparing hospitalization rates by type of substance used, there seems to be different influences, depending on the type of substance abused. For example, dually diagnosed individuals with a history of cocaine abuse had more hospitalizations than dually diagnosed with a history of abusing other substances (Bell et al., 2002). With regard to alcohol abuse, dually diagnosed alcoholics were more frequently hospitalized than the singly diagnosed (Drake et al., 1989). In contrast, others have failed to identify a relationship between number of hospitalizations and alcohol abuse in schizophrenia (Allen, Goldstein, & Aldarondo, 1999). When considering substance use, one study found that individuals with schizophrenia who used alcohol had fewer hospitalizations than individuals with schizophrenia who used other substances (Salyers & Mueser, 2001), while another study found that dually diagnosed individuals using marijuana or cocaine did not differ in rates of hospitalization from the singly diagnosed (Gerding et al., 2001).
Thus, hospitalization rates and duration do not appear to be good indicators for differentiating between dually diagnosed and singly diagnosed individuals.

Findings were also inconsistent as to whether duration of hospitalization could differentiate between dually diagnosed and singly diagnosed individuals. Bartels et al. (1993) reported that the dually diagnosed who currently abused substances had longer hospital stays that were more costly in comparison with individuals with a history of substance abuse and individuals who did not abuse substances. Similarly, others have shown that dually diagnosed alcoholics spent more time in the hospital than those who did not abuse alcohol (Gerding et al., 1999). In contrast, others have failed to support a relationship between hospitalization duration and the dual diagnosed. For instance, some have shown that dually diagnosed alcoholics did not differ from singly diagnosed individuals in length of hospitalization (Allen et al., 1999; Drake et al., 1989). Similarly, abuse of marijuana or cocaine did not differentiate between dually diagnosed and singly diagnosed individuals (Gerding et al., 1999). For those who used versus abused substances, there were no differences between groups in duration of hospitalizations (Arndt et al., 1992).

Although there were many inconsistencies, the majority of studies did not support the use of hospitalization history as an indicator for comorbidity of substance abuse. Perhaps it was severity and chronicity of substance abuse that was more indicative of whether a dual diagnosis increased rates of hospitalizations or length of hospital stays.

Methodological issues likely accounted for some of the differences in results. For example, Salyers and Mueser (2001) defined substance use loosely, including what others might consider occasional use and what would unlikely be considered problematic use.
In contrast, Zisook et al. (1992) defined substance use that was more consistent with problematic and regular use. Another explanation is that dually diagnosed individuals underutilized services. For example, Solomon and Davis (1986) found that individuals with psychiatric disorders who also used alcohol were less likely to receive services following hospital discharge.

**Employment**

Dually diagnosed alcoholics and individuals with schizophrenia who abused alcohol were more likely to experience financial difficulties (Drake et al., 1989). For example, Munsey et al. (1992) showed that 88% of dually diagnosed individuals had annual income levels below $10,000; with 80% receiving governmental assisted funding. In contrast, another study found that dually diagnosed individuals had lower rates of employment (Munsey et al., 1992). Although socioeconomic status (SES) did not differentiate substance use and abuse from non-use in individuals with schizophrenia (Arndt et al., 1992; Cuffel et al., 1993), lower SES was associated with cannabis abuse in one study (Mueser et al., 1990).

Some studies have shown that the dually diagnosed did not differ from the singly diagnosed in employment status (Dixon et al., 1991; Miller & Tanenbaum, 1989). Similarly, individuals with schizophrenia with a history of substance use did not differ from non-using individuals in receiving disability income and employment status (Zisook et al., 1992), nor did substance abuse history impact the number of hours worked (Bell et al., 2002). It is likely that the additive effects of comorbid substance abuse on employment are small, which may account for discrepancies in the research.
Homelessness

Homelessness is a general concern for many individuals with schizophrenia. Homelessness in individuals with schizophrenia was associated with low levels of support from the family (Caton et al., 1994) and greater likelihood of positive symptoms and antisocial personality disorder (Caton et al.). Individuals with psychiatric disorders comorbid with substance abuse, including psychotic disorders (Drake, Osher, & Wallach, 1991) and dually diagnosed individuals have been shown to be at greater risk for homelessness (Caton et al.). For example, Munsey et al. (1992) estimated that 40% of the dually diagnosed were recently homeless, and 40% had been homeless over the past 2 years. Overall, there seems to be a greater risk for homelessness in dually diagnosed individuals.

Crime

Dually diagnosed individuals who abused alcohol reported higher ratings of hostility (Drake et al., 1989). Similarly, individuals with schizophrenia who only abused one substance, either cocaine or alcohol in the past were more hostile than individuals who did not use drugs and individuals who abused other drugs (Bell et al., 2002). These findings may account for the finding that dually diagnosed alcoholics were at greater risk for violence (Räsänen et al., 1998; Smith & Hucker, 1994), and individuals with psychotic disorders comorbid with substance use disorders were more likely to have a history of violent and hostile behaviors (Scott et al., 1998). Similarly, Allebeck (1989) found that dually diagnosed individuals were more likely to have a history of violent behaviors. This increased risk for violence has been estimated as high as 12 times in the dually diagnosed (Cuffel, Shumway, Chouljian, & MacDonald, 1994). However, alcohol
and cannabis use that was below clinically significant levels did not increase violence in individuals with schizophrenia (Cuffel et al., 1994). Thus, it seems that substance use patterns must be greater than occasional use in order to increase the risk for violence. Finally, studies have shown that individuals with schizophrenia with a history of substance abuse were more likely to have charges against them (Fowler et al., 1998) and dually diagnosed individuals were more likely to have been incarcerated than non-using individuals (Bartels et al., 1993) supports there is an added risk for violence associated with substance abuse.

**Interpersonal Problems**

Substance use in schizophrenia, including occasional use, was associated with more interpersonal and family relationship problems, more conflict at home, and less difficulty with recreational socialization (Salyers & Mueser, 2001). One study found that individuals with schizophrenia who abused alcohol were more social than non-using individuals (Drake et al., 1989). This increase in socialization may be due to the decrease in inhibition associated with substance use. However, this does not equate with effective social skills. For instance, a study found that individuals with schizophrenia with a history of substance abuse did not differ in social functioning from those who did not use substances (Addington & Addington, 1997). Moreover, reductions in inhibition also impact behavioral controls. This inhibition coupled with less effective social skills may account for the increase in interpersonal conflict. This may also explain why even occasional use has deleterious effects on social functioning.
Cost

One study demonstrated that the dually diagnosed used more services than the singly diagnosed, resulting in greater associated costs (Bartels et al., 1993). Outpatient treatment services provided to dually diagnosed individuals who recently abused substances also cost more than services provided to individuals with schizophrenia without recent substance abuse (Kivlahan, Heiman, Wright, Mundt, & Shupe, 1991). Estimates have shown that individuals dually diagnosed with psychiatric disorders and substance abuse cost 60% more than those with singly diagnosed psychiatric disorders (Dickey & Azeni, 1996).

Summary of the Effects of Dual Diagnoses on Society

In summary, rates and duration of hospitalization and employment status did not differentiate dually diagnosed from singly diagnosed individuals. However, there was evidence, preliminary at best, that comorbid substance abuse in schizophrenia negatively impacted society. This included greater rates of homelessness, hostility, violence, legal problems, interpersonal conflict, and greater costs for services.

Indicators of Risk Associated with Dual Diagnoses

Who is at greater risk for developing comorbid substance abuse? What are the indicators that may help to predict risk? Several possible indicators will be discussed, including demographic variables, geographic locations, age of onset of symptoms and when first hospitalized, premorbid adjustment, and family history of psychiatric disorders. One demographic characteristic, level of education does not appear to
differentiate substance use, abuse (Allen et al., 1999; Dixon et al., 1991; Zisook et al., 1992), and history of abuse (Bell et al., 2002) from non-use in schizophrenia.

**Gender**

There was not a consensus as to whether there were gender differences in prevalence rates for the dually diagnosed. Several studies have shown that dually diagnosed individuals were male (Buckley et al., 1994; Cuffel et al., 1993; Dervaux et al., 2001; Green et al., 2004), regardless of type of substance abused (Mueser et al., 1990), and in comparison with singly diagnosed individuals and individuals with a lifetime diagnosis of substance abuse (Kamali et al., 2000). Those who did not meet criteria for substance abuse were also more likely to be male (Arndt et al., 1992; Zisook et al., 1992), as were dually diagnosed alcoholics (Drake et al., 1989). On the other hand, several studies have shown no gender differences in dually diagnosed individuals (Bartels et al., 1993; Brunette & Drake, 1997; Dixon et al., 1991), regardless of whether they used substances daily or less frequently (Munsey et al., 1992), or if they abused alcohol (Barbee et al., 1989).

This is interesting in light of the higher prevalence rates of substance abuse in men (e.g., an estimated five times greater risk for alcohol abuse in men) (DSM-IV-TR). Furthermore, gender differences were expected in dually diagnosed individuals due to the presence of a slight bias in prevalence rates for schizophrenia, with more men receiving a diagnosis of schizophrenia (DSM-IV-TR). Perhaps the lack of consistent findings may be attributed to differences in sample characteristics. For example, most of the studies that failed to detect gender differences in the dually diagnosed used more homogenous samples with smaller sample sizes, and only included diagnoses of schizophrenia or...
schizoaffective disorder (Barbee et al., 1989; Bartels et al., 1993; Brunette & Drake, 1997; Dixon et al., 1991; Munsey et al., 1992). On the other hand, most of the studies that found a gender bias for more males used more heterogeneous samples with larger sample sizes, from a variety of locations, and included schizophreniform diagnoses (Arndt et al., 1992; Buckley et al., 1994; Cuffel et al., 1993; Dervaux et al., 2001; Drake et al., 1989; Green et al., 2004; Mueser et al., 1990; Zisook et al., 1992). Nevertheless, these findings cannot be explained solely by sample characteristics, such that some of the studies that found a gender bias did not use such heterogeneous samples (Buckley et al.; Green et al.; Mueser et al.). Overall, the results were inconsistent. Perhaps, the effects of comorbid substance abuse are expressed differently in males and females. For example, one study identified that dually diagnosed women had more social supports, were at greater risk for victimization by violence, experienced more health problems, and were largely uninvolved with their children, whereas men had more legal difficulties (Brunette & Drake, 1997).

Marital Status

There seems to be a greater consensus that the dually diagnosed do not differ from the singly diagnosed for marital status (Cuffel et al., 1993; Dixon et al., 1991; Miller & Tanenbaum, 1989). For example, no marital status differences were apparent for individuals with schizophrenia with a history of substance use (Zisook et al., 1992), nor did dually diagnosed alcoholics differ in marital status from singly diagnosed individuals (Barbee et al., 1989). One study found the opposite, such that dually diagnosed individuals were more likely to be unmarried (Fowler et al., 1998). Nevertheless, the
majority of studies failed to support marital status as a useful indicator of comorbid substance abuse in schizophrenia.

Age

Age did not reliably differentiate between the dually diagnosed and the singly diagnosed. For instance, several studies have shown that the dually diagnosed were younger than the singly diagnosed (Bartels et al., 1993; Cuffel, Heithoff, & Lawson, 1993; Dervaux et al., 2001; Swofford, Scheller-Gilkey, Miller, Woolwine, & Mance, 2001). This also applied to those with a history of substance abuse (Fowler et al., 1998), and those who used substances, including occasional use (Salyers & Mueser, 2001). Interestingly, Munsey et al. (1992) found within-group differences for the dually diagnosed, such that those who abused substances on a daily basis were younger than those who abused substances less frequently. These variations may be attributed to differences in the type of substance abused. For example, dually diagnosed cocaine abusers and the singly diagnosed were younger than dually diagnosed alcoholics (Lysaker et al., 1994).

On the other hand, several studies have failed to find age differences between dually diagnosed and singly diagnosed individuals. For example, no age differences were apparent when comparing dually diagnosed individuals (Dixon et al., 1991; Miller & Tanenbaum, 1989), individuals with schizophrenia with a history of substance use (Zisook et al., 1992), and individuals with schizophrenia who currently used substances (Arndt et al., 1992) with singly diagnosed individuals, regardless of type of substance abused (Green et al., 2004).
Even greater disagreement occurs when examining age differences in dually diagnosed alcoholics. For instance, studies have shown that dually diagnosed alcoholics did not differ in age from the singly diagnosed (Barbee et al., 1989; Gerding et al., 1999). In contrast, others have shown that dually diagnosed alcoholics were younger than singly diagnosed individuals (Drake et al., 1989). Yet, others have demonstrated that dually diagnosed alcoholics were older than individuals with schizophrenia with a history of cocaine abuse and the singly diagnosed (Bell et al., 2002).

Some of the inconsistencies found in these studies may be explained by sample characteristics. For instance, the studies that failed to find differences used more homogenous samples, such as males with paranoid symptoms (Miller & Tanenbaum, 1989), first-episode psychosis (Green et al., 2004), and inpatients (Dixon et al., 1991). Other studies examined substance use rather than substance abuse (Arndt et al., 1992; Zisook et al., 1992). Severity of use may also account for differences in findings. Overall, the relationship between age and dual diagnosis is unclear.

**Ethnicity**

There do not appear to be significant ethnic differences across individuals with various types of Axis I disorders comorbid with substance use disorders (Jerrell & Wilson, 1997). More specifically, this also seems to apply to individuals with schizophrenia with comorbid substance abuse, in that ethnic differences did not discriminate dually diagnosed from singly diagnosed individuals (Cuffel et al., 1993; Dixon et al., 1991; Miller & Tanenbaum, 1989), regardless of whether they used daily or less frequently (Munsey et al., 1992). When examining ethnic differences by type of substance abused, the picture was less clear. Some have shown that dually diagnosed
alcoholics did not differ from singly diagnosed individuals (Gerding et al., 1999), whereas others have shown Caucasians were more likely to abuse alcohol and sedatives and less likely to abuse cannabis than African Americans (Mueser et al., 1990).

On the other hand, there were some differences between ethnicities in utilization of services and functioning. For instance, ethnic individuals with various types of Axis I disorders comorbid with substance use disorders were less likely to seek treatment, received fewer support services, and reported lower levels of psychosocial functioning than Caucasians (Jerrell & Wilson, 1997). Others have shown that African Americans were more likely to receive a diagnosis of schizophrenia and had higher rates of current and past substance use for cocaine and marijuana when compared with Caucasians (Mueser et al., 2001). On the other hand, others have failed to identify differences across ethnicities for age, gender, diagnosis, number of days hospitalized, level of psychosocial functioning, and severity of substance abuse (Jerrell & Wilson, 1997).

Overall, ethnicity does not appear to be a good indicator of dual diagnoses. The differences found by Mueser et al. (1990) may be due to differences in sample characteristics, such that they sampled from an acute population within a rural area. Nevertheless, there do appear to be differences in utilization of services that may be due to differences in ethnicity, which would be consistent with underutilization of services by most ethnic minorities in the general population.

**Geographic Location**

There were differences in individual characteristics based upon geographic location. For example, the dually diagnosed in an urban setting were represented by more ethnic minorities, predominantly African Americans; were less educated; unmarried;
unemployed; had higher income levels; were older; were recently homeless; had more legal charges against them and spent greater amounts of time incarcerated; and spent more time in substance abuse treatment facilities and less time in psychiatric hospitals (Mueser, Essock, Drake, Wolfe, & Frisman, 2001). They had more disorganized and activation symptoms than those in a rural setting (Mueser et al., 2001). Those who abused drugs demonstrated more severe symptoms than those living in rural settings with similar disorders (Mueser et al.). On the other hand, these individuals reported higher levels of life satisfaction in general, greater satisfaction with social relations, and more family contact than those living in rural areas (Mueser et al.).

On the other hand, dually diagnosed alcoholics in a rural setting demonstrated more severe symptoms than dually diagnosed alcoholics in urban areas (Mueser et al., 2001). Individuals with schizophrenia living in rural areas had higher rates of alcohol and cannabis abuse, current and lifetime; and higher rates of past abuse of sedatives, amphetamines, hallucinogens, and multiple substances (Mueser et al.). Others have also shown that dually diagnosed alcoholics residing in rural areas had more housing instability, symptoms of psychosis, multiple substance abuse, hospitalization rates, and denial of psychiatric problems (Osher et al., 1994). Of interest, those in rural settings tended to have greater levels of activity on a daily basis (Mueser et al.). Overall, there appear to be a variety of individual characteristics that are related to geographic location. However, generalizations should be made with caution due to the potential individual variability seen in different geographic locations.
Age at First Treatment

The data is highly inconsistent across studies with respect to whether the age of first treatment or first hospitalization differs between dually diagnosed and singly diagnosed individuals. For example, some studies have shown that the dually diagnosed received their first treatments at an earlier age than the singly diagnosed (DeQuardo et al., 1994; Fowler et al., 1998). On the other hand, others have failed to find differences in age of first hospitalization between dually diagnosed individuals (Addington & Addington, 1997; Bell et al., 2002), with a lifetime diagnosis of substance abuse (Dervaux et al., 2001) and singly diagnosed individuals.

When looking at sub-clinical use, the inconsistencies worsen. For example, one study found that individuals with schizophrenia who used substances had earlier first hospitalizations than non-using individuals and individuals with schizophrenia who used alcohol (Salyers & Mueser, 2001). Another study found the opposite, such that individuals with schizophrenia with a history of substance use had a later age of first hospitalization (Zisook et al., 1992). Yet, another study failed to find differences in age at first hospitalization among individuals with schizophrenia who used substances and non-using individuals (Arndt et al., 1992).

Perhaps inconsistencies in the literature are due to the type of substance used. For example, dually diagnosed individuals who abused cocaine were found to be younger when first hospitalized than dually diagnosed alcoholics and non-users (Lysaker et al., 1994). At this time, the research is highly inconsistent, and it is uncertain what the relationship is between the age of first hospitalization and dual diagnosis.
Age of Onset of Symptoms

Again, the research is not clear as to the relationship between the age of onset of symptoms and dual diagnosis. Some studies have shown that dually diagnosed treatment-resistant individuals had a later age of onset of psychosis (Buckley et al., 1994). Others have found the opposite, such that individuals with schizophrenia with a lifetime diagnosis of substance abuse (Addington & Addington, 1998a), whether severe or moderate (Cleghorn et al., 1991) had a younger age of onset. For sub-clinical substance use, there were no differences in age of onset of psychosis between individuals with schizophrenia who used substances and non-using individuals (Arndt et al., 1992). However, when examining alcohol abuse, there seems to be more consistency, such that dually diagnosed alcoholics did not differ from singly diagnosed individuals in age of onset of psychosis (Addington & Addington, 1997; Allen et al., 1999; Barbee et al., 1989; DeQuardo et al., 1994; Dixon et al., 1991).

In general, it does not appear that age of onset of psychosis is sensitive to differentiating dually diagnosed from singly diagnosed individuals. However, the research is more consistent with respect to dually diagnosed alcoholics, such that there do not appear to be differences between dually diagnosed alcoholics and singly diagnosed individuals, with respect to the age of onset of psychosis.

Premorbid Adjustment

Individuals with schizophrenia with problematic substance use demonstrated better premorbid adjustment than non-using individuals, regardless of the type of substance used (Arndt et al., 1992). This same study indicated that alcohol and cannabis use were most related to better premorbid adjustment, and those who used these substances had
fewer prodromal symptoms than non-users. Furthermore, those who used alcohol had fewer premorbid symptoms than non-users (Arndt et al.). There were no premorbid adjustment differences in childhood or adulthood for psychosocial functioning and sexual adjustment between dually and singly diagnosed individuals (Dixon et al., 1991). On the other hand, dually diagnosed individuals demonstrated premorbid adjustment deficits related to academic functioning during adolescence (Dixon et al., 1991). Therefore, substance use seems to be related to better premorbid adjustment in individuals with schizophrenia.

**Intelligence**

Dually diagnosed alcoholics did not differ from singly diagnosed individuals in premorbid intellectual functioning, which was assessed with the reading scores on the Wide Range Achievement Test (Allen et al., 1999). However, when using neuropsychological tests, dually diagnosed individuals had higher intellectual functioning, suggesting better premorbid cognitive functioning than singly diagnosed individuals (Sevy et al., 2001). Overall, it is difficult to make generalizations based on a limited number of studies that have employed different approaches to estimating premorbid intelligence.

**Family History of Psychiatric Illness**

Family history for psychiatric illness did not increase the risk of having a dual diagnosis (Dixon et al., 1991). This finding extended to first-degree and second-degree relatives with psychopathology, including schizophrenia, alcohol abuse, and mood disorder (DeQuardo et al., 1994). Furthermore, this applied whether substance abuse was frequent or less frequent (Munsey et al., 1992). The apparent lack of heritability of dual
diagnoses was supported by a study examining monozygotic and dizygotic twins (Kendler, 1985). They found that monozygotic twins had greater heritability rates for schizophrenia and alcoholism. However, this finding was not extended to dually diagnosed individuals. Therefore, family history of alcoholism or schizophrenia does not seem to increase risk for dual diagnoses.

Summary of Indicators of Risk Associated with Dual Diagnoses

Despite inconsistent findings in many areas, the preceding review of the literature allows several conclusions to be drawn. Dually diagnosed individuals had better premorbid adjustment than singly diagnosed individuals. Whether individuals resided in rural or urban settings was related to a variety of different patterns of substance abuse. Level of education, marital status, ethnicity, age of onset of psychosis, and family history of schizophrenia or alcoholism did not differentiate between singly and dually diagnosed individuals. Finally, it was unclear what the relationship was between dual diagnosis and gender, age, and premorbid intelligence.

Summary of Characteristics Associated with Dual Diagnoses

Overall, it should be clear that comorbid substance use disorders detrimentally impact individuals with schizophrenia. These associated characteristics also negatively impact society, including greater rates of homelessness, violence risk, and costs to society. Furthermore, much of the basic information regarding dual diagnoses is unknown due to discrepancies across studies in subject inclusion, methodology, diagnosis, etiology, and interventions (Salloum et al., 1991).

For instance, terminology varied across studies, such that alcohol use, abuse, and dependence were often grouped together (Salloum et al., 1991). Also, many studies
included both current and lifetime substance use disorders to define substance use disorders (e.g., Buckley et al., 1994; Dixon et al., 1991). Similarly, individuals with schizophrenia spectrum disorders were often included in research, while there may be distinct differences between these disorders (e.g., Arndt et al., 1992; Bell et al., 2002; Buckley et al., 1994; Dervaux et al., 2001; Dixon, 1999; Green et al., 2004; Kamali et al., 2000). Whether schizoaffective disorder is a schizophrenia spectrum disorder (Evans et al., 1999) or distinct from schizophrenia and affective disorders (Kendler, McGuire, Gruenberg, & Walsh, 1995) is still currently debated. Furthermore, dual diagnosis research often included subjects with any Axis I, Axis II, or organic brain disorders (e.g., D'Mello, Boltz, & Msibi, 1995; Jerrell & Wilson, 1997; Strakowski et al., 1993), which made the results difficult to generalize to any specific subtype of psychiatric client. This lack of consistency in operationally defining diagnoses of schizophrenia and substance use disorders also resulted in difficulties making generalizations.

Discrepancies in the literature may also reflect difficulties associated with diagnosing these individuals, such as which disorder is primary, symptoms from one disorder masking the symptoms of another disorder, and ruling out other disorders with similar presentations such as alcohol induced hallucinosis (Freed et al., 1975). Standard alcohol screens may be insufficient for identifying substance abuse in individuals with schizophrenia and additional sources of information are needed, such as a clinical interview (Drake et al., 1990). Clinical records alone are frequently insufficient to detect problematic use of substances (Drake et al.). However, substance abuse is detectable through clinical interviews and the clinical skills of those who have established a relationship with the client (Drake et al.). Clinical rating scales have shown concurrent
validity in assessing substance abuse with other psychiatric disorders (Carey, Cocco, & Simons, 1996). Structured clinical interview had high inter-rater reliability when individuals were only diagnosed with a single psychiatric disorder and lower inter-rater reliability when individuals were diagnosed with a psychiatric disorder comorbid with a substance use diagnosis (Corty, Lehman, & Myers, 1993). Individuals may be unwilling to disclose substance abuse, which can influence diagnoses. Furthermore, comorbid diagnoses have been shown to be vulnerable to clinician bias (Hall, Popkin, Devaul, & Stickney, 1977).

Dual diagnoses also complicate prognosis and treatment (Buckley, 1998; Dixon, 1999; Frances, 1996; Jerrell & Wilson, 1997; Littrell & Littrell, 1999; Salloum, Moss, & Daley, 1991; Mueser, Bellack, & Blanchard, 1992; Soyka, 2000). This population is difficult to work with because individuals with schizophrenia are often difficult to manage and frequently reject treatment (Salloum et al., 1991). The recommended treatment approach for the dually diagnosed combines approaches for the treatment of schizophrenia and substance abuse (Frances, 1996; Lehman, Myers, & Corty, 2000; Mueser et al., 1992; Selzer & Lieberman, 1993). However, treatment is often less than ideal and dually diagnosed individuals often receive two treatments that are separate to deal with one set of symptoms. This may, in part, be due to differences in treatment approaches between the psychiatric and substance abuse communities (Selzer & Lieberman, 1993). Some have noted that the current classification or diagnostic system looks at two separate diagnoses, and thus sets the pace for treatment (Lehman et al., 2000). Yet, when two separate programs treat dually diagnosed individuals, both diagnoses are kept separate when in fact these symptoms are actually integrated within
the individual into a complex set of symptomology (Lehman et al.; Mueser et al.). Furthermore, integrated treatment programs have been shown to decrease hospitalization rates and increase abstinence in individuals dually diagnosed with psychotic disorders and substance use disorders (Ho et al., 1999).

Alcohol itself has also been shown to decrease the amounts of serum level neuroleptic, thus when considering the effects of alcohol abuse or problematic alcohol use on neuroleptic pharmacokinetics, it is likely that there is an interaction between alcohol use and the effectiveness of neuroleptics (Forrest, Forrest, & Finkle, 1972; Soni, Bamrah, & Krıeka, 1991). One study found that for individuals who drank more than 20 drinks/week regularly, the alcohol decreased serum levels of fluphenazine (Soni & Brownlee, 1991). Thus, alcohol use likely affects the metabolism of other antipsychotic medications.

**Cognitive Deficits in Schizophrenia**

Global deficits in cognitive functioning, including impairments in executive functioning, attention (Goldman-Rakic, 1994), memory (Goldman-Rakic, 1994; Hellewell et al., 1994), and sensory perceptual skills (Bellack, Blanchard, & Mueser, 1996) occur in schizophrenia. Individuals with symptoms of thought disorder have been shown to use less complex cognitive strategies (Livesay, 1984).

Visual spatial perception is also impaired in schizophrenia (Cooper, 1960); including difficulty with recognition of geometric patterns (Hellewell et al., 1994). Some have suggested that greater impairments may occur in the initial stages of visual processing, attention, and visual-spatial processing (Addington & Addington, 1998). However, when
given additional visual information or cues, more accurate comparisons (e.g., larger or smaller) may be made (Pishkin, 1966). Thus, this suggests that individuals with schizophrenia require more information to increase accuracy of visual spatial judgments.

Place and Gilmore (1980) compared individuals with schizophrenia with substance abusers on tasks of visual spatial perception. First, they found that individuals with schizophrenia had poor perceptual organization skills when presented with visual stimuli, such as geometric shapes. Individuals with schizophrenia also experienced difficulty when distracter shapes were presented with the stimuli, and tended to focus upon all of the stimuli. On the other hand, substance abusers were better able to ignore distracter variables and organize elements of the visual presentation. Thus, these findings suggest that deficits in visual spatial processing may be due to a lack of a filter for extraneous variables, and that these other variables interfere with general cognitive processing.

Other factors also impact visual spatial skills. For example, one study investigated the relationship between complex rules and visual spatial processing (Spiegel, Gerard, Grayson, & Gengerelli, 1962). They found that individuals with schizophrenia were able to follow complex instructions when asked to perform visual spatial tasks, but had difficulty with abstraction for visual spatial stimuli. More specifically, when provided with adequate instructions, individuals with schizophrenia were able to follow the rules. However, when required to develop their own rules, deficits in abstraction seemed to decrease their visual spatial skills. They attributed this to people making up bizarre rules or being susceptible to interference from abstraction deficits. This suggests a cognitive overload that may impact overall cognitive functioning.
The same study examined the relationship between simple and complex visual spatial skills in schizophrenia (Spiegel et al., 1962). When asked to make bipolar judgments associated with visual spatial tasks, no deficits were evident. Thus, individuals with schizophrenia performed as well as controls on simple visual spatial tasks. However, deficits occurred when performing more complex visual spatial tasks. Additionally, problem-solving abilities and cognitive flexibility were impaired, which likely influenced performance on these complex tasks.

Visual spatial perception does not appear to be influenced by symptom severity in schizophrenia (Cooper, 1960). Difficulty filtering out extraneous information suggests an attention problem. Additionally, when complex tasks or rules are added to an already taxing process, visual spatial abilities continue to be impaired. Thus, multiple factors may contribute to what seems to be more of a generalized impairment of visual spatial ability in schizophrenia.

**Facial Perception Deficits**

Individuals with schizophrenia have consistently demonstrated impairments in facial discrimination (Bellack et al., 1996; Hellewell et al., 1994). These deficits included difficulties in accurate discrimination when asked to determine if two upright faces matched each other (Feinberg, Rifkin, Schaffer, & Walker, 1986; Hellewell et al.) and when determining if two inverted faces matched (Feinberg et al. 1986). A small number of studies have failed to show deficits in facial discrimination in schizophrenia (Walker et al., 1980), including matching three-quarter and profile faces with target faces (Archer, Hay, & Young, 1992). These discrepancies may be accounted for by individual differences in performance. For example, Hellewell et al. found that a few individuals
with schizophrenia performed better than the best controls on tests of face discrimination. Thus, facial discrimination deficits seem to occur in most individuals with schizophrenia. However, performance may vary based upon individual differences. Or perhaps partial faces are less complex than full faces, and thus result in less cognitive overload.

Individuals with schizophrenia also performed more poorly than controls in the ability to discriminate age when presented with photographs of faces (Heimberg, Gur, Erwin, Shtasel, & Gur, 1992; Schneider, Gur, Gur, & Shtasel, 1995) or when rating age using a 7-point anchored scale (Schneider et al., 1995). However, they were less impaired on facial age discrimination tasks than emotion discrimination tasks, whereas the opposite effect was found for controls (Heimberg et al., 1992). In contrast, another study found that individuals with schizophrenia were able to accurately judge who was older when presented with two faces, suggesting that they were able to attend to facial features (Cutting, 1981).

One explanation for these discrepancies was that differences were related to the chronicity of psychosis. For example, acute and chronic individuals with schizophrenia were impaired on facial age discrimination tasks when individuals were asked to determine whether the depicted face was young or old, whereas individuals with schizophrenia in remission performed similarly to controls on these tasks (Gessler, Cutting, Frith, & Weinman, 1989). Perhaps these discrepancies were dependent upon task difficult. Overall, the research suggests there may be impaired performance on facial age discrimination tasks, but performance may vary depending upon the complexity of the task and the chronicity of psychosis.
Individuals with schizophrenia also demonstrated deficits in facial recognition when instructed to identify which faces matched from an array of photos (Addington & Addington, 1998b; Kerr & Neale, 1993; Mueser et al., 1996; Salem, Kring, & Kerr, 1996) and when recalling if a face had been present in a previously viewed video (Berndl, von Cranach et al., 1986; Berndl, Grüsser, et al., 1986). On the other hand, individuals with schizophrenia did not demonstrate deficits in forced-choice recognition of famous faces compared with controls (Archer et al., 1992). Perhaps this finding is due to differences in the processing of familiar and unknown faces. Or these discrepancies may be attributed to the complexity of the task. Nevertheless, the majority of studies indicated that individuals with schizophrenia had deficits in facial recognition of unknown faces.

Social Skills Deficits in Schizophrenia

Deficits in social skills are commonly associated with schizophrenia. These deficits include impaired interpersonal problem-solving skills; inappropriate problem-solving strategies; inaccurate identification of interpersonal conflict; difficulty judging the effectiveness of problem-solving strategies (Bellack, Sayers, Mueser, & Bennet, 1994); lack of assertiveness; and denial of errors rather than use of typical socially accepted behaviors, such as apologizing (Bellack, Mueser, Wade, Sayers, & Morrison, 1992). Individuals with schizophrenia don’t seem to differ from controls in ability to be assertive with friends (Bellack et al., 1992). Thus, this implies that individuals with schizophrenia do not lack these skills completely. However, they generally seem to experience difficulty in applying these behaviors towards others with whom they feel less comfortable or familiar. Individuals with schizophrenia also experience difficulty
differentiating between hostile and normal inquiries from partners and use poor coping responses, such as lying and denying (Bellack et al., 1992). Therefore, if individuals with schizophrenia interpret neutral questions from loved ones as hostile or simply lack the ability to make a differential judgment of intent, this may account for their apparent defensive response. Furthermore, if this pattern of interpersonal exchange continues and escalates, it may increase tension and conflict with those who are close to them.

Decreased attunement to social cues has also been related to deficits in the initial stages of visual processing and auditory recognition memory in individuals with schizophrenia (Corrigan, Green, & Toomey, 1994). Deficits in visual scanning may be related to deficits in emotion processing (Addington & Addington, 1998b; Corrigan et al., 1994), such that individuals with schizophrenia may not attend to or process all relevant cues needed to judge affect. Deficits may be attributed to the type of cue. For example, individuals with schizophrenia tend to be more responsive to more overt social cues, such as verbalizations and behaviors, but less responsive to more covert social cues (Corrigan & Green, 1993). Others have also demonstrated that when evaluating how loving-hating and accepting-rejecting a positive or negative message was, individuals with schizophrenia tended to focus less on nonverbal cues (Colussy & Zuroff, 1985).

Others have investigated the amount of personal space preferred by individuals with schizophrenia. One such study instructed individuals to approach a life-sized projection of a person exhibiting various emotions (Srivastava & Mandal, 1990). They found that individuals with schizophrenia employed greater distances when approaching stimuli, especially when the stimulus was non-arousing (i.e., happy, sad, neutral). These findings
seem counter intuitive in that controls tend to employ greater distances from others when more arousing emotions are being exchanged, such as anger.

Overall, it appears that individuals with schizophrenia fail to attend to nonverbal cues and prefer greater personal space when non-arousing emotions are expressed during interpersonal exchanges. Moreover, nonverbal cues are an important component of communication. This may account for some of the impairments seen in interpersonal relationships and difficulties with emotion processing in individuals with schizophrenia. Deficits associated with the initial stages of visual scanning may also contribute to this lack of attention to nonverbal cues and other essential skills needed for normal social interactions.

Many relationships have been found between social skills and emotion processing. For example, social mixing and personal appearance were related to accuracy in facial affect identification, facial discrimination, and facial affect discrimination (Mueser et al., 1996). Additionally, facial affect identification was positively related to nonverbal social skills (Mueser et al., 1996) and social competence and negatively related to defensive self-enhancement (Garfield, Rogoff, & Steinberg, 1987). Finally, altered activity level was related to accuracy in facial affect discrimination and facial recognition (Mueser et al., 1996). These studies reinforce that social skill deficits may also be related to underlying emotion processing deficits (Heimberg et al., 1992).

For example, when viewing sad videos without sound, individuals with schizophrenia and controls performed equally well in accuracy of emotion identification (Bellack et al., 1996). However, when auditory cues were added to the same videos, individuals with schizophrenia did not improve in emotion identification in comparison with controls.
(Bellack et al.). Controls were better at identifying happy videos than individuals with schizophrenia when no auditory cues were present. However, when auditory cues were added, both groups performed similarly. Finally, when presented with angry videos, there were no differences in performance for individuals and controls, regardless of the presence or absence of auditory cues. Therefore, for angry and happy expressions, individuals with schizophrenia were able to utilize auditory cues to accurately identify facial emotions. However, for sad videos individuals with schizophrenia demonstrated deficits, regardless of auditory cues.

In summary, individuals with schizophrenia are able to utilize basic social skills. They are more receptive to overt nonverbal cues. However, there are deficits in accurately interpreting interpersonal interactions. This may be due to deficits in interpreting emotions. For instance, individuals with schizophrenia rely on verbal expressions to accurately judge angry and happy emotions. However, verbal and nonverbal cues do not seem to aid in correctly recognizing sadness. Thus, deficits in social skills may be linked to deficits in emotion processing.

Motivations for Substance Abuse

Why do people abuse drugs and alcohol? Initially, researchers believed that individuals with schizophrenia used substances to self-medicate themselves in order to decrease the dysphoria associated with psychotic symptoms and the negative side-effects resulting from antipsychotic medications (Khantzian, 1985). For example, individuals with schizophrenia reported using alcohol to decrease symptoms of depression and to escape problems, but alcohol was not used to increase sociability (Pristach & Smith,
1996). Similarly, another study identified that substances were used to decrease symptoms of depression, negative symptoms, and positive symptoms (Littrell & Littrell, 1999). Another study found that these individuals abused substances to decrease the side-effects of medications or symptoms of their illness, but further examination of this finding revealed that only a few individuals endorsed this belief (Fowler et al., 1998).

Most of the research does not support the self-medication hypothesis. For example, other studies have found the opposite, in that individuals did not report abusing substances to counter the negative side-effects of psychotropic medications (Cuffel et al., 1993), nor did they report using alcohol to alleviate any type of psychotic symptoms (Noordsy et al., 1991). Furthermore, individuals with schizophrenia tended to abuse hallucinogens, rather than dopaminergic substances, such as cocaine and amphetamines, which does not support the self-medication hypothesis (Lammertink, Löhrer, Kaiser, Hambrecht, & Pukrop, 2001). Dually diagnosed individuals reported beginning to use substances primarily in response to peer pressure; to relieve negative affect, such as depression; and for experimentation (Baigent et al., 1995). Thus, it may be that the self-medication hypothesis accounts for why individuals begin to use substances, but not why they continue to do so.

There does not appear to be a single overarching reason why individuals with schizophrenia use or abuse substances. Their motivations seem to be more specific to the type of substance abused. For example, individuals with schizophrenia used caffeine, amphetamines, tobacco, and cannabis due to the feelings of intoxication (i.e., feeling high) and avoiding dysphoria (i.e., avoiding depression) (Fowler et al., 1998). Individuals reported using alcohol for the dysphoric feelings and to improve social
experiences (Fowler et al.). Thus it may be severity of abuse or use of substances that differentiates motivations for substance use.

The primary reported disadvantages of using drugs were the negative physical symptoms (e.g., hangovers); changes in emotions; increased psychosis, cognitive confusion, family conflicts, financial problems, and legal difficulties (Fowler et al., 1998). This suggests that substance use may initially provide relief, but longer-term use exacerbates psychiatric symptoms. Individuals also noted that the advantages of quitting were improved physical symptoms, higher self-esteem, and increased social relationships (Fowler et al.). This suggests that individuals are aware of the impact of substance abuse on psychiatric symptoms and interpersonal relationships. Finally, individuals reported that the disadvantages of quitting drugs were the withdrawal symptoms, the relapse cycle, loss of drug-abusing friends, cravings, and the pressure to use drugs (Fowler et al.).

Therefore, the self-medication hypothesis has shown some evidence, but most of the research does not support that individuals with schizophrenia continue to abuse substances in order to decrease psychiatric symptoms or to cope with the negative side-effects of medications. Some have suggested that motivations for use vary according to the type of substance that is abused. It is more likely that individuals are motivated to abuse substances based upon personal and individual reasons. Individuals also seem to be aware of the impact of substance abuse on interpersonal relationships.

Does Substance Abuse or Schizophrenia Come First?

Several studies have shown that substance abuse tends to occur prior to the onset of psychosis in individuals with schizophrenia with comorbid substance use disorders.
(Breakey et al., 1974; Cleghorn et al., 1991; Cuffel et al., 1993; Silver & Abboud, 1994), which was confirmed by self-reports (Baigent et al., 1995). Additionally, individuals with schizophrenia who used substances began use an average of 6 years prior to the onset of psychosis (Arndt et al., 1992). Other studies have shown that the type of substance abused affects whether substance use occurs before or after the onset of schizophrenia. For instance, alcohol abuse tended to occur prior to the onset of psychosis, whereas abuse of other drugs tended to occur following the onset of psychosis (Hambrecht, & Häfner, 1996). Yet, others have reported that approximately two-thirds of individuals with schizophrenia abused substances prior to their first psychotic break and approximately half of the individuals with schizophrenia abused alcohol before their first psychotic break (Bühler et al., 2002; Soyka et al., 1993). Barbee et al. (1989) found that dually diagnosed alcoholics began using alcohol at an earlier age than non-using individuals with schizophrenia. Some researchers suggest that substance abuse defers the onset of psychotic symptoms (Turner & Tsuang, 1990), whereas others propose that substance abuse increases the risk of psychosis (Dixon, Haas, Weiden, Sweeney, & Frances, 1990).

Silver and Abboud (1994) compared individuals with schizophrenia who began using substances prior to the onset of psychosis with those who began using substances following the onset of psychosis. They found that these groups did not seem to differ on demographic variables, including age, sex, ethnicity; course of disorder, including age of onset of psychosis, number of hospitalizations, duration of hospitalizations; psychiatric symptoms, including subtypes of schizophrenia and severity of symptoms; family history, including family history of psychiatric or substance use disorders; complications
associated with schizophrenia, including level of noncompliance; and premorbid functioning.

Overall, the research in this area is inconsistent. Nevertheless, whether substance abuse occurs before or after the onset of psychosis does not seem to affect the prognosis of these individuals. Similarly, there does not appear to be any obvious differences in characteristics that differentiate whether substance abuse occurs before or after the onset of psychosis.

*Emotion Processing in Individuals with Schizophrenia*

**Facial Affect Identification**

The majority of emotion processing literature focuses upon facial affect identification. Multiple studies have shown that individuals with schizophrenia demonstrated deficits when asked to identify or label, from a list of emotions, the facial emotion depicted in a photograph (Addington & Addington, 1998b; Bell et al., 1997; Borod et al., 1989, 1990; Cramer, Weegmann, & O’Neil, 1989; Feinberg et al. 1986; van der Gaag & Haenen, 1990; Garfield et al., 1987; Kerr & Neale, 1993; Mandal & Palchoudhury, 1985; Mandal & Rai, 1987; Mueser et al., 1996; Muzekari & Bates, 1977; Salem et al., 1996; Walker et al., 1980; Zuroff & Colussy, 1986). Impairment of facial emotion identification occurs in both acute and chronic individuals with schizophrenia (Wölwer et al., 1996). Interestingly, individuals with schizophrenia performed comparably with individuals with right-hemisphere brain damage on tests of facial emotion identification (Borod et al., 1989), suggesting lateralized deficits contributing to facial emotion identification deficits in schizophrenia.
Deficits in identification of facial affect were also seen in children with schizophrenia (Walker et al., 1980; Walker, 1981) and adolescents (13-19 years) (Walker et al.). However, others have failed to support these findings. For example, Guthrie and Smouse (1981) found that adolescents and children with schizophrenia did not differ from neurotic, personality disordered, and normal children and adolescents in accuracy of facial emotion identification (Guthrie & Smouse, 1981). However, adolescents, regardless of presence or absence of psychiatric illness, were more accurate in facial emotion identification than children (Guthrie & Smouse, 1981), seems developmentally appropriate. The differences between these two studies may be due to sample characteristics, such that Walker et al. used individuals aged 13 to 19 years, in comparison with Guthrie and Smouse (1981) used individuals aged 13 to 16 years. Furthermore, Guthrie and Smouse (1981) based their findings on a sample of five children with schizophrenia in comparison with Walker et al. used 16 children for each group.

Interestingly, individuals with schizophrenia performed worse on tests of facial emotion identification than on facial emotion discrimination (Heimberg et al., 1992; Mandal & Palchoudhury, 1995; van der Gaag & Haenen, 1990). Others have shown that individuals with schizophrenia had greater variability in responding, as evidenced by the greater number of adjectives chosen (Hellewell et al., 1994) and more deviant responses used to describe facial emotions (Cramer et al., 1989; Hellewell et al., 1994).

Other patterns related to facial emotion processing have been noted. For example, individuals with schizophrenia exhibited biases for certain emotions. Individuals with schizophrenia took longer to identify emotions, except happy (Mandal & Rai, 1987).
Deficits in identification of negative emotions were more pronounced than for positive emotions (Bell et al., 1997). However, alcoholics and controls did not demonstrate this pattern (Bell et al.). The complexity of the emotion also seems to impact the ability of individuals with schizophrenia to accurately judge facial affect, such that individuals with schizophrenia exhibited deficits when judging complex facial emotions that expressed more mixed emotions than less complex emotional faces when compared with substance abusers and controls (Bell et al.). Finally, deficits in facial affect identification in schizophrenia were stable across short periods of time, for 4 to 5 weeks (Bell et al.; Wölwer et al., 1996).

Although the majority of the research has shown individuals with schizophrenia to be impaired on facial affect identification tasks, some studies have failed to note this difference. For example, one study found that there were no differences between individuals with schizophrenia and controls on facial emotion identification (Bellack et al., 1996; Zuroff & Colussy, 1986). Similarly, individuals with schizophrenia were not impaired when asked to identify emotions depicted on a video and asked to check as many emotions that applied (Joseph, Sturgeon, & Leff, 1992). One possibility for this finding is that these videos contained social context, which may explain why deficits were not seen. However, other research has shown that individuals with schizophrenia frequently fail to attend to nonverbal cues (Colussy & Zuroff, 1985) and covert social cues (Corrigan & Green, 1993).

In summary, the majority of studies revealed impairments in emotion identification for individuals with schizophrenia, and these deficits tend to be stable across time. There
also seems to be a bias towards positive emotions. These findings also suggest that these deficits may depend upon the complexity of the emotions.

**Facial Affect Discrimination and Recognition**

Individuals with schizophrenia have also demonstrated deficits in facial emotion discrimination when determining if two faces portrayed the same emotion (Borod et al., 1990; Feinberg et al. 1986; Kerr & Neale, 1993; Mueser et al., 1996; Salem et al., 1996; van der Gaag & Haenen, 1990; Walker et al., 1980). Facial affect recognition has also been shown to be impaired in schizophrenia. For example, individuals with schizophrenia were impaired when given a forced-choice recognition test and asked to choose a specific emotion from an array of facial photographs (Archer et al., 1992; Walker et al.) and when asked to choose two faces from an array displaying the same emotions (Mandal & Palchoudhury, 1985).

In contrast, one study found that individuals with schizophrenia and controls did not differ in performance on an emotion discrimination task (Bellack et al., 1996). Nevertheless, the majority of studies have consistently demonstrated deficits in facial emotion discrimination and recognition. Labeling of emotions may be a more complex task than a matching task, thus greater difficulties for labeling of emotions may be attributed to deficits in problem-solving and cognitive flexibility. This would account for why deficits in facial affect identification are greater than for facial affect discrimination.

**Other Measures of Facial Affect Processing**

Early studies assessed facial affect processing using different stimuli and procedures than what is currently used. For example, when individuals with schizophrenia were presented with emotional facial stimuli and asked to rank order 11 faces on a continuum
from happy to angry and given polar anchors, individuals with schizophrenia performed comparably to controls (Spiegel et al., 1962). However, when arranging nine cards with moon faces, individuals with schizophrenia demonstrated deficits in comparison with normal adults, college students, and children aged 9 to 12 years (Iscoe & Veldman, 1963). Interestingly, they did not differ in performance from children aged 5 to 8 years (Iscoe & Veldman, 1963). Perhaps the moon faces were too abstract and thus more difficult for individuals with schizophrenia to detect affect.

Individuals with schizophrenia were also impaired when determining facial affect using bipolar rating scales. For example, individuals with schizophrenia were unable to accurately judge facial affect on ratings of unpleasant-pleasant, but were able to judge facial affect on ratings of aroused-non-aroused (Mandal, 1986). Individuals with schizophrenia gave more deviant responses when compared with controls when asked to rate faces depicting emotions on like-dislike (Meer & Amon, 1963). When subjects were asked to rate facial affect as loving, hateful or neither, they tended to provide more neutral responses than non-psychotic patient controls (Andorfer, Shimkunas, & Sciarini, 1975). Individuals with schizophrenia were also impaired when using 7-point bipolar ratings for happy-sad compared with controls (Schneider et al., 1995), and this has been shown to occur cross-culturally in individuals with schizophrenia (Habel et al., 2000). Similarly, individuals with schizophrenia were impaired when using bipolar ratings to determine if a face was depicting happy-neutral, sad-neutral (Heimberg et al., 1992), or meaner-friendlier (Cutting, 1981).

On the other hand, individuals with schizophrenia did not demonstrate deficits in judging facial affect on ratings of aversive-preference (Spiegel et al., 1962). Others have
found greater inconsistencies across these types of ratings (Mandal & Rai, 1987). When subjects were asked to rate emotional video segments as angry, happy, or neutral, they did not differ in performance from controls (Morrison, Bellack, & Bashore, 1988). Perhaps these findings are due to the presence of context and cues that are not present in static photographs. Acute and chronic individuals with schizophrenia were not impaired when rating happy-sad faces (Gessler et al., 1989). Differences in methodology may account for differences in findings. For example, the choice of bipolar ratings of happy-sad gives two opposite emotions to choose from. On the other hand, happy-neutral and sad-neutral differ to lesser degrees than happy-sad. Thus, it may be that individuals have more difficulty differentiating between more subtle ratings. This would also account for better performance when rating happy-sad on a 7-point scale.

In summary, individuals with schizophrenia were impaired on facial affect ratings using bipolar ratings. Perhaps it is more difficult to differentiate between the subtle differences in facial emotions, such as happy-neutral than it is to differentiate happy from sad on a 7-point scale. Others have suggested that the labeling of the anchors is what is problematic, and when rating aroused-non-aroused performance is better. Nevertheless, individuals with schizophrenia seem to demonstrate impaired performance on these measures of affect perception.

Individuals with schizophrenia also demonstrated deficits in the labeling of emotions when asked to describe the facial emotions depicted in a free-form manner (Dougherty et al., 1974; Muzekari & Bates, 1977), especially for fear, surprise, and neutral stimuli (Srivastava & Mandal, 1990). Perhaps this is due to a lack of focus on the stimuli and being distracted by other extraneous variables. For example, when presented with photos
of actors portraying facial emotions individuals with schizophrenia made more comments relating personal information about them to the photograph (Pilowsky & Bassett, 1980). They also made fewer comments on the emotional states of the depicted faces or actors (Cramer, Bowen, & O’Neil, 1992; Hellewell et al., 1994), made more comments on physical appearance or the internal state of the actor, gave more bizarre responses, were less verbose and used less emotionally descriptive adjectives (Hellewell et al.).

However, others have found that individuals with schizophrenia did not make more errors in free-form identification of facial affect in comparison with controls (Leentjens et al., 1980) and alcoholics (Pilowsky & Bassett, 1980). The studies that did not find deficits in emotion processing may have been due to individual differences based on small sample sizes of 10 (Pilowsky & Bassett, 1980) and 26 individuals (Leentjens et al., 1998) with schizophrenia. Alternatively, if given sufficient time to describe what is seen in a picture, an individual may eventually produce the correct response.

Research has shown that individuals with schizophrenia were impaired in facial affect processing. Very few studies have found contradictory results. For example, individuals with schizophrenia demonstrated deficits when perceiving and expressing facial emotions (Mandai, Pandey, & Prasad, 1998). They also demonstrated decoding deficits, regardless of subtype of schizophrenia (Mandai et al., 1998). Finally, the research supports the presence of greater deficits when processing negative emotions (Mandai et al.). Mueser et al. reported similar results in a review that compared three similar studies (Bellack et al., 1996; Kerr & Neale, 1993; Mueser et al., 1996) that investigated facial emotion processing in schizophrenia. They concluded that individuals with chronic schizophrenia exhibited deficits in facial affect identification, discrimination, and recognition of facial
emotions. However, facial emotion processing deficits in acute individuals with schizophrenia individuals tended to be limited to facial emotion recognition (Mueser et al., 1997).

Subjective Experience of Emotions

Individuals with schizophrenia have also been shown to be impaired in self-ratings of emotions following a mood induction task, especially when happy was induced (Schneider et al., 1995). These findings were consistent with a cross-cultural study that found that individuals with schizophrenia reported decreased feelings of happy and sad (Habel et al., 2000). On the other hand, others have shown that individuals with schizophrenia rated their emotion levels comparably to that of controls following viewing film clips intended to induce mood (Kring & Neale, 1996). These differences may be due to differences in stimuli and methodology. For example, Kring and Neale (1996) included an additional emotion, fear, along with happy and sad. Furthermore, the individuals were not medicated when tested. On the other hand, Schneider et al. only included stimuli portraying the emotions of happy and sad and used simple 5-point scales to assess the intensity of happy or sad (Schneider et al.). They also reported that medication was not related to differences in ability to experience emotion. Although these results may give us insight into two or three emotions, it seems that generalizations of ability to induce mood and self-reported experiences of emotion based upon two or three emotions should be done with caution. However, these studies provide preliminary evidence that individuals with schizophrenia do experience emotions, but may have difficulties articulating or expressing them.
When individuals with schizophrenia were asked to think about a person familiar to them and asked to rate that persons’ interpersonal attractiveness across multiple domains, these ratings were highly variable and inconsistent across multiple ratings (Livesay, 1981). The authors attributed this to the use of simplistic cognitive strategies by individuals with schizophrenia (Livesay, 1984). Thus, difficulties with attending to stimuli and being distracted by other factors may contribute to deficits in emotion processing. Studies have consistently demonstrated behaviors, such as story telling, focusing on irrelevant aspects of stimuli, and providing bizarre and inconsistent responses that are analogous to loosely connected thoughts often seen in schizophrenia that may extend to facial affect processing.

Subjective Ratings of Emotion

There seem to be discrepancies between self-reported subjective ratings of emotions and the actual emotional experience. For example, following viewing of emotional videos, individuals with schizophrenia rated their own feelings on a bipolar scale of arousal-tense, and these ratings did not differ from controls. Further, tests of skin conductance were unable to differentiate individuals with schizophrenia from controls (Kring & Neale, 1996). Interestingly, skin conductance tests showed that not medicated individuals with schizophrenia were more aroused when viewing sadness, fear, happiness, and neutral (Kring & Neale, 1996). This suggests a lack of differentiation of responsiveness across emotions in schizophrenia or subjects were aroused in response to some other aspect of the testing procedure.

As previously suggested, expression of emotion may not reflect internal emotional states (Sweet, Primeau, Fichtner, & Lutz, 1998). Deficits in expressed emotion have
been shown to be unrelated to deficits in emotion recognition (Kring et al., 1993; Kring & Neale, 1996). Individuals with schizophrenia with blunted affect demonstrated inconsistencies between expressed emotion and subjective ratings of emotional experiences, such that they reported experiencing emotions, but did not express them accordingly. Thus, flattened affect should not be interpreted as decreased subjective emotional experiences in individuals with schizophrenia (Kring & Neale, 1996). On the other hand, individuals with schizophrenia without blunted affect were more consistent in expressed emotion and reported subjective emotional experiences (Berenbaum & Oltmanns, 1992).

Overall, research findings suggest that less intensive self-reported ratings of emotion may reflect more of a difficulty in verbally expressing the subjective emotional experience, which would be consistent with findings that individuals with schizophrenia were impaired on expressed emotions.

Expression of Facial Emotions

Expression of facial emotions is universal across cultures (Ekman et al., 1987). This applies to the expression of multiple emotions, in that universally, people are able to express which emotion is primary and secondary. Furthermore, universally, people are able to determine the intensity of the expressed emotions. However, individuals with schizophrenia have demonstrated impairments in the expression of facial emotions, regardless of the type of emotion expressed (Braun et al., 1991) and medication status (Kring, Kerr, Smith, & Neale, 1993; Kring & Neale, 1996). Individuals with schizophrenia demonstrated deficits in the expression of emotion whether following verbal instructions to express a particular emotion or asked to imitate a facial emotion.
seen in a photograph (Gaebel & Wölwer, 1992). Others have shown that individuals with schizophrenia were most impaired when verbally instructed to express an emotion, less impaired when instructed or asked to express the same emotion depicted in a photograph, and least impaired when instructed to express the same neutral facial expression depicted in a photograph (Braun et al., 1991).

Individuals with schizophrenia were also impaired in nonverbal facial expression, such as recognition of mimic expressions and gestures (Berndl, von Cranach, & Grüsser, 1986; Berndl, Grüsser, Martin, Remschmidt, 1986). Deficits in expressed emotions of individuals with schizophrenia tend to persist over short periods of time (Gaebel & Wölwer, 1992). These persistent deficits also occur regardless of level of chronicity of psychosis (Gaebel & Wölwer, 1992). Although the literature consistently demonstrates that those with schizophrenia have deficits in expressed emotion, one study found that individuals with schizophrenia did not differ in expressed emotion from controls and depressed individuals (Flack, Jr., Cavallaro, Laird, & Miller, 1997).

Others demonstrated that individuals with schizophrenia performed similarly to individuals with right-hemisphere brain damage (Borod et al., 1989, 1990), with both groups expressing facial emotions less intensely. Individuals with schizophrenia and individuals with right-hemisphere brain damage tended to be most accurate and intense when expressing negative emotions (Borod et al., 1990). Again, this suggests a lateralized deficit associated with facial emotion processing.

Another study asked females with schizophrenia and controls to tell three stories about themselves in which they felt sad, angry, or happy (Gottheil, Paredes, Exline, & Winkelmayer, 1970). These stories were videotaped without sound (nonverbal) and the
stories were transcribed (verbal). Judges then viewed the stories and were asked to identify which stories demonstrated the happy, sad, and angry themes. They found that individuals with schizophrenia told their stories with decreased emotional intensity than controls. The emotional intensity with which controls told their stories was consistent with their nonverbal expressions of emotion. Interestingly, this consistency between verbal emotional intensity and nonverbal emotional expression was not found in individuals with schizophrenia. Thus, their emotional expressions may not have reflected their subjective emotional experiences.

Individuals with schizophrenia also displayed deficits in affective prosody (Fricchione et al., 1986; Leentjens et al., 1998; Ross et al., 2001), which is the ability to express the emotional component of language. More specifically, individuals with schizophrenia experienced deficits in spontaneous prosody, prosodic recognition, and prosodic repetition in comparison with controls (Leentjens et al.). One study found that aprosodia occurred in all individuals with negative symptoms (Fricchione et al., 1986). While others have shown that individuals with schizophrenia and individuals with right-hemisphere brain damage had similar patterns of performance in response to tests of affective prosody (Ross et al.). Again, individuals with schizophrenia seem to have difficulty with expression of emotion in speech.

In summary, individuals with schizophrenia experience deficits in expressed emotion. They perform relatively better when provided with verbal instructions. Additionally, these deficits appear to be chronic. They also demonstrate deficits in nonverbal expression of emotions. Individuals with schizophrenia perform similarly to individuals with right-hemisphere brain damage, thus impairments in emotion processing may be due
to lateralized brain deficits. Furthermore, subjective reports confirm that individuals with schizophrenia experience emotions, but these internal feelings are inconsistent with their expressed emotions. Thus, caution should be used when interpreting the subjective internal feelings in individuals with schizophrenia.

**Subtypes of Schizophrenia and Facial Affect Processing**

Due to the inconsistent findings in the literature regarding facial affect processing, some researchers have investigated whether certain subtypes of schizophrenia may differentially impact emotion processing. This would account for individual differences found in certain studies. One study identified that individuals with paranoid schizophrenia had fewer deficits in facial affect identification than non-paranoid individuals with schizophrenia (Lewis & Garver, 1995). Another study found that individuals with schizophrenia with deficit syndrome had poorer performance on facial emotion identification in comparison with non-deficit individuals (Bryson et al., 1998). These deficits were not attributable to differences in intelligence, but were related to a decreased sense of purpose (Bryson et al., 1998). Thus, there is some preliminary evidence that individuals with paranoid symptoms may be less impaired in facial affect processing, whereas individuals with deficit syndrome may be more impaired in facial affect processing. On the other hand, individuals with schizophrenia with thought disordered symptoms did not differ in free-form facial emotion identification from non-thought disordered individuals (Cramer et al., 1992). Similarly, individuals with affective blunting did not differ from individuals without affective blunting in facial emotion identification or self-ratings of mood when viewing videos where the actors used gesturing in addition to depicting facial emotions (Sweet et al., 1998).
Bias for Specific Emotions

Individuals with schizophrenia demonstrated biases for positive emotions, such that they were better at identifying positive facial emotions and worse at identifying negative facial emotions (Borod et al., 1990). Similarly, others have found that they did not differ from controls in their ability to identify happy faces (Dougherty et al. 1974; Garfield et al., 1987; Mandal, 1987) or amount of time required to identify happy faces (Mandal & Rai, 1987). Others have shown that those with schizophrenia rated faces as more happy on facial emotion identification and free-form facial emotion labeling tasks (Dougherty et al.). This apparent bias for happy emotions extended to facial emotion identification in children and adolescents with schizophrenia and normal controls (Guthrie & Smouse, 1981). Furthermore, happy faces were more accurately recognized (Archer et al., 1992) and identified, and required less intense facial markers in order to be identified in normal controls (Frigerio et al., 2002).

On the other hand, others have found no bias in discriminating sad-neutral and happy-neutral faces (Heimberg et al., 1992). Yet, others have found the opposite effect, such that individuals with schizophrenia made more errors when identifying facial affect for positive or neutral emotions (Zuroff & Colussy, 1986). Again, inconsistencies occurred when different methodologies were used. More consistency in findings for a bias towards positive emotions occurred when individuals were instructed to identify the emotion depicted in a photo or video from a list of emotions. However, when making bipolar judgments and only using a limited number of emotions, greater discrepancies occurred, which do not support a bias towards positive emotions. These discrepancies may be due to methodological issues. Nevertheless, most studies support a bias towards
positive emotions in normal controls. This bias also extends to individuals with schizophrenia. Furthermore, if individuals with schizophrenia perform as well as controls when labeling happy emotions, this suggests that there is not a global affect perception deficit in schizophrenia and impairment is primarily found in certain emotions.

Conversely, there are greater deficits when processing negative emotions. For instance, individuals with schizophrenia made more errors identifying negative emotions, such as sadness (Wölwer et al., 1996). Individuals with schizophrenia also demonstrated deficits in free form-labeling of faces depicting sadness, anger, and fear (Muzekari & Bates, 1977). Interestingly, those with schizophrenia were less likely to indicate disgust and shame as responses during a facial affect identification task and less likely to free-form label facial affect as distress (Dougherty et al. 1974). Perhaps these emotions are more complex than happiness and anger, thus making it more difficult to differentiate these types of emotions.

One study illustrated the opposite effect and found that individuals with schizophrenia were more likely to identify faces as expressing disgust and neutral (Garfield et al, 1987). These deficits may be due to the tendency of individuals with schizophrenia to underestimate the intensity of negative emotions (Bellack et al., 1992). Flack, Jr. et al. (1997) also found that individuals with schizophrenia rated angry faces with less intensity than controls. Another study found that individuals with schizophrenia made more errors when identifying negative emotions when the facial expressions were less obvious or extreme rather than subtle (Mandal, 1987). It may be that individuals with schizophrenia are more prone to giving neutral responses. Alternatively, these
responses may reflect defenses used to avoid negative emotions. Finally, children and adolescents, those with or without schizophrenia, made the most errors when identifying fearful faces (Guthrie & Smouse, 1981). When presented with faces depicting fear and anger, individuals with schizophrenia generally made more verbal comments, and when presented with anger and joy made less comments concerning affect than alcoholics and controls (Pilowsky & Bassett, 1980).

When subjects were asked to rate the intensity of emotional video segments they underestimated the intensity of negative emotions (Morrison, Bellack, & Bashore, 1988). When rating the intensity of six emotions for each picture, individuals with schizophrenia were accurate in emotion identification, but underrated the intensity of anger compared to normal controls (Flack, Jr., et al., 1997). Ratings of emotional intensity increased for individuals with schizophrenia when audio was added to video scenes (ratings pleasant/aroused-unpleasant/unaroused) (Bellack et al., 1996). One explanation for this is that individuals with schizophrenia may experience difficulty detecting slight variations of emotional expressions (Iscoe & Veldman, 1963), thus it may not be the emotion itself, but a deficit in attention or ability to discriminate subtle nuances that is problematic.

**Auditory Emotion Processing**

Deficits in the auditory processing of emotions are also present in schizophrenia. For example, individuals with schizophrenia demonstrated deficits in auditory emotion discrimination (Borod et al., 1990; Kerr & Neale, 1993) and auditory emotion identification (Borod et al., 1990; Kerr & Neale, 1993). Individuals with schizophrenia also performed similarly to individuals with right-hemisphere brain damage (Borod et al.,
1989). Individuals with schizophrenia who exhibited symptoms of excitement or lacked symptoms of psychomotor retardation misinterpreted intonations as threatening (Jonsson & Sjöstedt, 1973). On the other hand, negative symptoms and bizarre symptoms were related to deficits in emotion discrimination (Schneider et al., 1995). Overall, deficits in auditory emotion processing occur in schizophrenia. Some research has shown that those with positive symptoms associated with agitation misinterpreted emotions as threatening, whereas individuals with negative or bizarre symptoms were impaired on emotion discrimination tasks.

Brain Abnormalities Associated with Deficits in Emotion Processing

One explanation for facial affect processing deficits is that individuals with schizophrenia focus on the wrong facial attributes when judging facial affect. This was supported by an eye tracking study that identified that individuals with schizophrenia focused on the area between the eyes or on the center of the face (Streit et al., 1997). However, when they focused on the mouth they were more accurate in identifying emotions. In contrast, controls were more accurate in emotion identification when they focused on the right eye. Individuals with schizophrenia with affective flattening focused less at the typical facial attributes that assist in accurate identification of facial emotions. On the other hand, individuals without affective flattening had response patterns more similar to that of controls, as in looking at appropriate facial attributes (Streit et al., 1997).

One explanation for inaccurate attention to facial attributes is that individuals with schizophrenia have deficits in structuring or organizing incoming stimulus which slows down cognitive processes and results in difficulty separating out irrelevant information.
(Cramer et al., 1992). Perhaps the deficits in visual processing and general face processing account for emotion processing impairments. Alternatively, individual differences may account for the discrepancies across studies. It may be that certain individuals have scanning deficits that account for emotion processing deficits. Nevertheless, neither of these explanations seems to account for all individuals with schizophrenia.

Others found scanning of facial attributes was unrelated to deficits in emotion processing (Schwartz, Rosse, Johri, & Deutsch, 1999). However, they did find that individuals with schizophrenia did not alter their strategies when scanning faces that were inverted. This suggests that deficits in strategies of visual scanning for cues exist in schizophrenia (Schwartz et al., 1999), which has been supported by others who have found that individuals with schizophrenia have deficits in the initial stages of visual scanning (Addington & Addington, 1998b; Corrigan et al., 1994). Therefore, these deficits in visual scanning may contribute to impairments in emotion processing. Furthermore, individuals with flattened affect may also focus upon the wrong facial attributes when making judgments of facial affect, resulting in decreased accuracy of emotion processing.

Anatomical abnormalities in certain brain structures may contribute to deficits in emotion processing. For example, in normal controls, facial emotion discrimination for fear and anger corresponded with left and right amygdala activation (Hariri, Bookheimer, & Mazziotta, 2000). Gender differences are also apparent in emotion processing. For example, males processed emotional stimuli while viewing emotion eliciting vignettes with the right amygdala, whereas women processed the same emotional stimuli with the
left amygdala (Cahill & van Stegeren, 2003). Facial affect discrimination was also associated with right prefrontal cortex activation (Hariri et al., 2000).

Neuroanatomic abnormalities in the amygdala, anterior insula, and ventral striatum may account for deficits in emotion processing in individuals with schizophrenia. However, studies are limited in this area (Phillips, Drevets, Rauch, & Lane, 2003). Certain emotions have more lateralized processing. For example, sadness is processed by the right hemisphere, but anger and happiness do not show the same lateralized effects (Federman et al., 1998). This may account for why individuals with schizophrenia have such difficulty processing the emotion of sadness. Interestingly, all individuals did not demonstrate these laterality effects (Federman et al., 1998). Thus, this could help to explain why some individuals vary in affect processing, such that if individuals with schizophrenia perform similarly to individuals with right-hemisphere brain damage, then this would relate to difficulties with interpreting sadness, which is also believed to be processed primarily by the right hemisphere. Another study found a laterality effect for facial perception based upon the subtype of schizophrenia. They found that those with paranoid schizophrenia had a right-hemisphere deficit when faces were presented to the left visual field, whereas non-paranoid individuals demonstrated a left-hemisphere deficit when letters were presented to the right visual field (Magaro & Chamrad, 1983). This would be consistent with why individuals with schizophrenia tend to do relatively better on facial affect tasks when given verbal instructions than when asked to mimic a depicted emotion.

Overall, these findings support that certain emotions, such as sadness, are processed by one hemisphere of the brain. Thus, if most individuals with schizophrenia experience
a right-hemisphere deficit and sadness is processed primarily by the right hemisphere, then this would help to explain why there appear to be differential deficits in processing certain emotions. Furthermore, this laterality may not occur in certain individuals or may be related to the subtype of schizophrenia, which would account for some of the discrepancies found in the literature. Finally, there appear to be gender differences in controls with lateralized differences, thus it would be interesting to see if these gender differences also occurred in individuals with schizophrenia.

*Indicators of Deficits in Emotion Processing in the Dually Diagnosed*

In general, identification of whether certain variables can predict deficits in emotion processing in schizophrenia has not revealed any significant findings. For example, greater global psychotic symptoms, positive symptoms, negative symptoms, age of onset of psychosis, and duration without medication treatment were unrelated to facial affect identification, at baseline or following 2 weeks of treatment with haloperidol (Lewis & Garver, 1995). Similarly, others have found that emotion identification was unrelated to medication dose (Streit et al., 1997; Wölwer et al., 1996) and negative symptoms (Wölwer et al.). Ability to free-form label and identify facial affect was also unrelated to psychiatric symptoms (Muzekari & Bates, 1977).

Others have found the opposite effects, such that deficits in facial emotion discrimination, facial emotion identification and attention corresponded with increased negative symptoms (Addington & Addington, 1998). Perhaps differential deficits are due to the type of emotion processing task. Similarly, deficits in facial emotion discrimination using bipolar ratings of happy-sad were not influenced by medication
status for individuals with schizophrenia (Schneider et al., 1995). Furthermore, greater severity of symptoms (Bellack et al., 1996; Salem et al., 1996), length of hospital stay, medication dose (Salem et al.), intelligence (Walker, McGuire, & Bettes, 1984), and negative symptoms (Bellack et al., 1996) were not related to facial emotion identification and facial emotion discrimination in schizophrenia. Finally, duration of hospitalization and illness were also not related to deficits in the recognition of faces, mimic expression and gestures (Bemdl, von Cranach, et al., 1986).

On the other hand, some have shown that as females with schizophrenia become more stable, patterns of deviant responses on a bipolar scale of like-dislike for facial affect decreased (Meer & Amon, 1963). This suggests that certain deficits associated with affective processing are not chronic. Interestingly, earlier age when first hospitalized, more time hospitalized, and anergia were associated with deficits in the identification of facial emotions, but unrelated to deficits in facial affect discrimination (Mueser et al., 1996). Greater deviant responses of like-dislike for facial affect were associated with longer hospital stays (Meer & Amon, 1963). No gender differences have been associated with deficits in free-form labeling of facial affect; identification of facial affect (Muzekari & Bates, 1977); facial affect discrimination (Archer et al., 1992; Borod et al., 1990); and facial expression of emotion (Borod et al.), including visual and auditory expressions (Borod et al.).

Again, there seem to be several inconsistencies throughout the literature concerning whether facial emotion processing deficits affect symptom severity, prognosis of schizophrenia, and societal impacts. Nevertheless, it has been consistently shown that gender differences don’t seem to account for differences in emotion processing deficits.
Other factors, such as severity of symptoms, positive symptoms, medication dosage, medication status, and intelligence seem unrelated to emotion processing. On the other hand, greater negative symptoms and greater rates and durations of hospitalization may be better indicators of emotion processing deficits in dual diagnosis. However, these studies are limited in number and thus any generalizations should be considered preliminary at this time. Furthermore, the above-mentioned findings were based upon correlational data, and thus causative relationships cannot be determined.

Cognitive Functioning and Emotion Processing

Certain cognitive processes have shown preliminary results for being able to predict emotion processing deficits in individuals with schizophrenia. For instance, abstraction-cognitive flexibility, memory, learning, language skills, and spatial organization were positively correlated with emotion discrimination measured using a bipolar 7-point happy-sad scale in individuals with schizophrenia (Schneider et al., 1995). Bryson, Bell, and Lysaker (1997) used neuropsychological tests to try to predict emotion processing deficits. They found that digit span scores; misses, correct, and incorrect scores of the Continuous Performance Test; and the number of categories completed, perseverative errors, and errors in general for the Wisconsin Card Sorting Test were positively correlated with emotion identification in individuals with schizophrenia (Bryson et al., 1997). Furthermore, these variables were able to predict emotion identification using stepwise multiple regression. These studies are again preliminary, but support a relationship between cognitive deficits and emotion processing, which is consistent with previously mentioned studies suggesting lateralized deficits and brain abnormalities associated with emotion processing deficits in individuals with schizophrenia.
Summary of Deficits in Emotion Processing in the Dually Diagnosed

Emotion processing deficits in schizophrenia cannot be completely explained by current hypotheses. The variability of findings of emotion processing deficits across studies suggests that not all individuals with schizophrenia experience the same emotion processing deficits (Morrison, Bellack, & Bashore, 1988). These deficits may be attributed to environmental factors, such as limited social enrichment, resulting in inadequate learning of appropriate social behaviors (Morrison, Bellack, & Mueser, 1988). Others have suggested that over-stimulation leads to feelings of confusion in individuals with schizophrenia, and results in an overload and inability to attend to cues (Bellack et al., 1992).

Poor performance on facial recognition, facial emotion identification, and facial emotion discrimination tests supports a generalized deficit in face perception (Salem et al., 1996). Furthermore, these variables have been shown to correlate with each other (Addington & Addington, 1998b). Similarly, chronicity of schizophrenia and stability of emotion processing deficits also supports a more generalized deficit in schizophrenia (Streit et al., 1997). Furthermore, deficits in the processing of faces, including non-affective and affective facial stimuli (Archer et al., 1992; Feinberg et al., 1986; Gessler et al., 1989) provides further support for a generalized face processing deficit in schizophrenia. However, the bias for positive emotions in schizophrenia does not support a general face processing deficit.

Characteristics Associated with Substance Abuse

Similar to individuals with schizophrenia, individuals with substance use disorders, specifically chronic alcoholism, also demonstrate global cognitive deficits. Studies have
also identified emotion processing deficits in alcoholics. However, the severity of these impairments in alcoholics is less severe than those seen in individuals with schizophrenia. First, some background information regarding prevalence rates will be provided in order to give perspective on how alcohol abuse affects individuals and society. Secondly, comorbidity of other psychiatric disorders will be discussed in order to provide a general picture of the complexities frequently associated with psychiatric disorders. Then a review of the research illustrating the cognitive and emotion processing deficits in substance abuse will be presented.

Prevalence

According to data from the ECA study, the prevalence of lifetime diagnoses of alcohol abuse or dependence in the population is 13.5% (Regier et al., 1990). These prevalence rates tend to be much higher in certain populations. For example, 40% of individuals in psychiatric hospitals were diagnosed with substance use disorders and 34% of individuals were diagnosed with alcohol use disorders. On the other hand, prisoners had much higher rates, such that 72% of prisoners had a lifetime diagnosis of substance abuse and 56% had a lifetime diagnosis of alcohol use disorders. Finally, nursing homes demonstrated lower rates, such that 14% of individuals had substance use disorders.

Other Comorbidity in Substance Abuse

Comorbidity of other psychiatric disorders also frequently occurs in alcoholism. For example, depression (Beatty, Hames, Blanco, Nixon, & Tivis, 1996; Hutner & Oscar-Berman, 1996; Kornreich et al., 2001b; Monnot, Nixon, Lovallo, & Ross, 2001; Penick, Powell, Liskow, Jackson, & Nickel, 1988; Wilson, Wiedmann, & Phillips, 1988), antisocial personality disorder, and abuse of other substances are the most commonly

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comorbid psychiatric disorders with alcoholism (Penick et al., 1988). However, differences in depression severity do not tend to differentiate between current abusers and those who are abstinent (Loas, Fremaux, Otmani, Lecercle, & Delahousse, 1997). Others have shown gender differences associated with depression influence prognosis. For example, one study found that major depression was associated with poorer outcome in men, but not in women (Rounsaville, Dolinsky, Babor, & Meyer, 1987).

Alcoholics also reported greater levels of anxiety (Beatty et al., 1996; Kornreich et al., 2001b), including state and trait anxiety (Townshend & Duka, 2003; Wilson et al., 1988). Alcoholics also more frequently had a history of Attention Deficit Hyperactive Disorder than healthy controls (Beatty et al.). Thus, comorbidity of other psychiatric disorders seems problematic in alcoholism, and comorbidity in substance abuse seems to be chronic and stable (Penick et al.). Comorbidity in alcoholism has been linked to poor prognosis and treatment outcome, specifically major depression, antisocial personality disorder, and abuse of additional drugs were related to poorer treatment outcome (Rounsaville et al., 1987). Another consequence associated with alcoholism was increased rates of health problems (Wilson et al.).

**Cognitive Deficits in Substance Abuse**

Cognitive deficits are also associated with alcoholism (Parsons, 1987). These deficits are most pronounced during the first few weeks of detoxification, including significant impairments in cognitive processing across domains, such as executing functioning, learning, memory, perceptual-motor skills, visual spatial skills (Nixon & Phillips, 1999), and complex tasks (Goldman, 1986). Nevertheless, there is individual variability in the types of cognitive deficits expressed (Parsons, 1987). Interestingly, heavy social drinkers
who consume more than 10 units of alcohol per occasion show cognitive deficits analogous to those seen in alcoholics (Parsons & Nixon, 1998). This suggests that severity of alcohol abuse may account for some of the variability seen in studies.

Following 2 to 3 weeks of detoxification, simple task performance, memory, and verbal skills were relatively intact (Tarter & Ryan, 1988). However, complex task performance was impaired, including psychomotor, visual spatial problem-solving, and abstract reasoning abilities (Tarter & Ryan, 1988). Recently detoxified alcoholics were also impaired on tasks associated with perceptual organization (O’Mahony & Doherty, 1993; Tamkin & Dolenz, 1990) and conceptual thinking (Tamkin & Dolenz, 1990). Furthermore, alcoholics demonstrated deficits in problem-solving ability involving motor skills (Beatty et al., 1996; O’Mahony & Doherty, 1993; Wilson et al., 1988). They also demonstrated deficits in motor coordination (Beatty et al., 1996) and psychomotor speed, (O’Mahony & Doherty, 1993; Tamkin & Dolenz, 1990; Wilson et al.). Although patterns of cognitive deficits have been identified in alcoholics, the motor deficits seen in chronic alcoholism may influence poor performance on other neuropsychological tests. It may be that deficits interpreted as attention or concentration impairments may be influenced by deficits in motor ability (Wilson et al.).

In contrast, verbal abilities seem less influenced by alcoholism. For example, verbal abilities were intact in recently detoxified alcoholics (O’Mahony & Doherty, 1993; Wilson et al., 1988). One study found that alcoholics were impaired on verbal ability, but these researchers used established norms as a comparison group (Tamkin & Dolenz, 1990). Comparison of alcoholics with individuals with Korsakoff’s syndrome demonstrated that individuals with Korsakoff’s had memory deficits on verbal tasks.
when presented with visual, auditory, or tactile stimuli (Butters, Lewis, Cermak, & Goodglass, 1973). However, alcoholics did not demonstrate memory deficits for verbal or nonverbal tasks, when presented in any of these modalities (Butters et al., 1973). Furthermore, chronic alcoholics tended to be of normal intelligence (Tarter & Ryan, 1988).

Attention, short-term memory (O’Mahony & Doherty, 1993; Wilson et al., 1988), and ability to shift attention (Townshend & Duka, 2003) were intact in recently detoxified alcoholics. On the other hand, concentration was impaired in recently detoxified alcoholics (O’Mahony & Doherty, 1993). Younger alcoholics performed more poorly on measures of attention and concentration than older alcoholics (Hutner & Oscar-Berman, 1996).

Memory does not appear to be impaired in recently detoxified and long-term abstinent alcoholics (Rourke & Grant, 1999). Similarly, associated memory performance in alcoholics was intact (Wilson et al., 1988). On the other hand, others have shown that recently detoxified alcoholics were impaired on tests of logical memory, immediate and delayed (O’Mahony & Doherty, 1993). Older alcoholics also had lower logical memory scores than younger alcoholics (Hutner & Oscar-Berman, 1996). These findings suggest that chronicity and severity of alcohol abuse may differentially affect different types of memory.

Individuals with liver disease, whether related to alcoholism or unrelated, demonstrated memory deficits (Arria, Tarter, Kabene, et al., 1991). This suggests that memory deficits associated with chronic alcoholism may be more attributable to liver dysfunction. Perhaps some of these deficits seen in alcoholics are due to damage to the
liver. For example, one year following liver transplant, alcoholic cirrhotics demonstrated recovery of problem-solving skills, perceptual organizational skills, motor function, attention, and mental speed (Arria, Tarter, Starzl, & Van Thiel, 1991). It may be that long-term abstinence allows the liver to recover, which might account for why abstinence is associated with recovery of most cognitive abilities. On the other hand, alcoholic cirrhotics did not demonstrate changes in memory functioning one year following liver transplant (Arria, Tarter, Starzl et al., 1991). Perhaps, liver functioning plays a role in memory, but the damaging effects of alcohol are unlikely to be limited to the liver, and may explain why recovery of memory functioning does not return following liver transplant. Furthermore, attempts at memory retraining did not improve memory in alcoholics (Hannon, de la Cruz-Schmedel, Cano, Moreira, & Nasuta, 1989).

Recognition and identification of previously unknown stimuli was impaired in chronic alcoholics and those with Korsakoff's (Markowitsch, Kessler, Bast-Kessler, & Riess, 1984). Recognition memory in recently detoxified alcoholics was also impaired (Markowitsch, Kessler, & Denzler, 1984). Individuals with Korsakoff's and alcoholics demonstrated memory deficits in encoding (Cermak & Butters, 1972). However, when cues were provided during an encoding tasks, alcoholics were able to improve recall, whereas individuals with Korsakoff's did not improve recall (Cermak & Butters, 1972).

Recently detoxified alcoholics also demonstrated deficits in visual-spatial processing and other cognitive functions. For example, recently detoxified chronic alcoholics were impaired on tests of visual reproduction, immediate and delayed, following two weeks (Townshend & Duka, 2003) or one month of abstinence (O'Mahony & Doherty, 1993). Recently detoxified chronic alcoholics, with 10 or 28 days of abstinence, demonstrated
deficits in tracking and ability to shift attention when visual stimuli were presented quickly (Wilson et al., 1988). One study found that chronic alcoholics, with one month of detoxification did not differ from healthy controls in tests of visual-perceptual and perceptual-motor performance, executive functioning, and memory (Krabbe 

Visual spatial perception also seems to be impaired in alcoholics. For instance, recently detoxified alcoholics demonstrated deficits in visual scanning and attention (Beatty et al., 1996), mental rotation, visual imagery, reproduction of visual images, recall of the Rey-Osterrieth Complex test (Beatty et al.), visual reproduction (Hutner & Oscar-Berman, 1996), and all subtests of the Rey-Osterrieth Complex test (Wilson et al., 1988). Although alcoholics appear to be able to judge distances on a map, they demonstrated deficits when determining directional orientation between two locations (Beatty et al.). Similarly, alcoholics demonstrated poorer performance on the New Map Test (Beatty et al.).

Two studies tested chronic alcoholics who were intoxicated at the time of testing. They found that the intoxicated alcoholics demonstrated superior performance in visual spatial learning over chronic alcoholics who were recently detoxified (Schandler, Clegg, Thomas, & Cohen, 1996; Schandler, Cohen, & McArthur, 1988) and alcoholics who had been abstinent for an average of 4 years (Schandler et al., 1996). These findings seem counter intuitive. One explanation for these results is that the intake of alcohol aids in visual processing in alcoholics, and when they are detoxified there is a disruption in this attentional process. Alternatively, the physical impact of the detoxification process likely interferes with cognitive functioning.
The difficulty with visual spatial ability in chronic alcoholics was especially pronounced when the right hemisphere was required for performance (Reschikova & Myamlin, 1988; Tsagareli, 1995). Thus, this suggests a laterality effect. Other demographic variables seem to influence visual spatial skills. For example, males demonstrated superior performance over females on tests of visual spatial ability, which was consistent with the general population. However, there were no gender differences between substance using and non-using groups (Beatty et al., 1996). Younger alcoholics performed more poorly on visual memory tasks than younger healthy controls (Hutner & Oscar-Berman, 1996).

Facial Perception Deficits

Alcoholics did not demonstrate deficits in their ability to identify gender when presented with emotional faces (Frigerio et al.). Furthermore, when compared with individuals with Korsakoff’s, as expected the individuals with Korsakoff’s demonstrated deficits in facial recognition tasks involving matching faces, but alcoholics did not demonstrate deficits in facial recognition matching tasks (Dricker, Butters, Berman, Samuels, & Carey, 1978). Thus, these findings support that alcoholics have intact facial perception. Therefore, deficits associated with facial affect perception are not due to visual spatial face perception deficits.

Abstinence and Cognitive Recovery

Many studies have shown that abstinence from alcohol is associated with recovery of some cognitive abilities. However, cognitive recovery seems to vary across individuals, with verbal ability recovering first (Nixon & Phillips, 1999). Cognitive recovery may be a function of time or experience. For example, attempts to improve neuropsychological
functioning have been shown to facilitate recovery of cognitive deficits associated with alcohol abuse (Goldman, 1986). Thus, this provides support that recovery of cognitive functioning may be experience-dependent (Goldman, 1986). On the other hand, long-term abstinence for chronic alcoholics has been associated with recovery of cognitive functioning (Markowitsch et al., 1984).

Abstinence from alcohol seems to influence recovery of cognitive abilities in alcoholics (Rourke & Grant, 1999). Alcoholics who were recently detoxified for an average of 30 days demonstrated deficits in sensory perception, problem-solving, perceptual organization, psychomotor speed, learning, and motor abilities. In contrast, alcoholics who had been abstinent for an average of 4 years only demonstrated motor deficits. At two-year follow-up, there were differential effects on cognitive recovery, depending on whether individuals remained abstinent or resumed drinking. Alcoholics who continued to abuse alcohol also continued to demonstrate cognitive deficits across domains. However, alcoholics who were abstinent for the 2-year period no longer demonstrated deficits across cognitive domains, but rather continued to show deficits in psychomotor speed and motor skills. On the other hand, alcoholics who maintained abstinence for over 6 years did not differ from controls on neuropsychological test performance across domains.

The relationship between abstinence and cognitive recovery is also affected by age (Rourke & Grant, 1999). As mentioned above, younger and older recently detoxified alcoholics demonstrated deficits in problem-solving, perceptual organization, and psychomotor speed. However, older adults also demonstrated deficits in sensory
perception, learning, and memory. At 4 and 6 years of abstinence, older alcoholics continued to demonstrate deficits in motor skills.

These results suggest that recovery of cognitive functioning returns following periods of abstinence. For example, 2 years of abstinence allowed for recovery of most cognitive abilities, with the exception of psychomotor speed and motor ability (Rourke & Grant, 1999). Additionally, alcoholics who had been abstinent for 4 years demonstrated only motor deficits. Finally, following 6 years of abstinence, alcoholics performed as well as controls on neuropsychological tests. On the other hand, individuals who continue to abuse alcohol, also continue to demonstrate deficits in cognitive abilities, regardless of age.

Age also interacts with abstinence and cognitive recovery. For example, older adults who were recently detoxified demonstrated greater deficits in cognitive functioning than younger alcoholics and similar-aged controls. Following 2 years of abstinence, younger alcoholics no longer demonstrated cognitive deficits across domains, whereas older adults demonstrated continued deficits in psychomotor speed and motor ability. Finally, following 4 and 6 years of abstinence, older adults continued to demonstrate deficits in motor skills.

Cognitive deficits exhibited in alcoholism are diverse, and do not lend support for various theories, including theories of lateralized deficits, egocentric versus allocentric deficits, featural versus configural deficits, categorical versus coordinate spatial processing deficits, and anterograde versus remote spatial memory deficits (Beatty et al., 1996). Various theories have been posited to explain cognitive deficits associated with alcoholism, such as family history of alcohol abuse, childhood behavior disorders,
antisocial personality disorder, and motivational factors. However, most theories seem to explicate variables that are related to alcoholism, but fail to strongly demonstrate a causal relationship (Nixon & Phillips, 1999).

There are two competing theories, one that posits that cognitive recovery is time-dependent, and thus abstinence alone will result in cognitive recovery. On the other hand, others suggest that recovery is experience-dependent and that cognitive training facilitates recovery. One study found that following a two-week interval between testing times, visual spatial abilities in older alcoholics did not improve, thus not supporting time-dependent recovery of cognitive functioning in alcoholics (Forsberg & Goldman, 1985). On the other hand, they found that visual spatial abilities improved following efforts to improve neuropsychological functioning by practicing visual spatial skills (Forsberg & Goldman, 1985). What is more likely is that cognitive training may facilitate the recovery process. However, without cognitive retraining, time will also eventually facilitate the recovery process.

Korsakoff’s Syndrome

The importance of discussing Korsakoff’s disorder is that it is most frequently seen in severe, chronic alcoholism, thus the more profound deficits seen in Korsakoff’s may shed some light onto the cognitive deficits seen in alcoholism. Korsakoff’s is characterized by profound anterograde amnesia and retrograde amnesia primarily surrounding onset of the disorder (Butters & Cermak, 1980). However, earlier memories are relatively intact (Butters & Cermak, 1980). These individuals tend to be of normal intelligence, but demonstrate significant deficits in visual spatial skills (Butters & Cermak, 1980). Prior to the onset of Korsakoff’s syndrome, they tend to be characterized as impulsive and
aggressive and abuse alcohol (Butters & Cermak, 1980). On the other hand, following
the onset of the disorder, individuals exhibit dramatic changes in personality and
behavior, such as flattened affect and behavior and generally cease drinking alcohol
(Butters & Cermak, 1980). Alcohol-induced Korsakoff's is believed to be caused
primarily by thiamine deficiency, resulting in atrophy of the dorsomedial nucleus of the
thalamus and the mammillary bodies of the hypothalamus (Butters & Cermak, 1980).

Alcoholics with Korsakoff's demonstrate impaired cognitive functioning across
cognitive domains, including apraxia (Brand et al., 2003). These individuals tend to
make more errors when identifying affect and verbal affect processing, with a bias
towards positive affect (Brand et al.). Measures of cognitive estimation ability in
Korsakoff's individuals have demonstrated a lack of reality testing, resulting in bizarre
responses (Brand et al.). Individuals with Korsakoff's demonstrate more profound
deficits than chronic alcoholics in cognitive ability across domains, including executive
functioning, memory, and visual-perceptual and perceptual-motor abilities (Krabbendam
et al., 2000). Anatomical differences seen in Korsakoff's individuals include an enlarged
third ventricle and atrophy in the mammillary bodies (Krabbendam et al.)

Emotion Processing in Substance Abuse

Alexithymia

Alexithymia is characterized by deficits in emotion processing, including deficits in
eemotion identification, subjective experience of emotions, and emotional expression
(Ziółkowski, Gruss, Rybakowski, 1995). Normal controls seem to process visual
presentations of negative emotional words with the right hemisphere, whereas positive
and neutral emotional words do not seem to have lateralized effects (Hutner & Oscar-Berman, 1996). On the other hand, alcoholics tend to process visual presentations of positive and negative emotional words and neutral words with the left hemisphere. Furthermore, age does not appear to have lateralized effects on the processing of emotional words.

Greater alcohol use corresponds with greater risk for alexithymia (Kauhanen, Julkunen, & Salonen, 1992). The prevalence of alexithymia ranges from 42% - 50% in substance abusers (Haviland, MacMurray, & Cummings, 1988; Haviland, Hendryx, Shaw, & MacMurray, 1994) and 48% - 78% in alcoholics (Loas et al., 1997; Rybakowski, Ziótkowski, Zasadzka, & Brzaeziński, 1988; Taylor, Parker, & Bagby, 1990; Uzun, 2003). It does appear as if recovery of emotion perception may occur in alcoholics, as indicated by the absence of alexithymia in 52% - 60% of abstinent alcoholics (Loas et al., 1997; Ziótkowski et al., 1995).

Alcohol use and severity of alcohol use were positively related with severity of alexithymia (Uzun, 2003). Approximately two-thirds of alcoholics with less than 1 year of abstinence demonstrated greater rates of alexithymia, in comparison with approximately one-third of alcoholics with more than 1 year of abstinence (Ziótkowski et al., 1995). Alexithymia corresponded with lower socioeconomic status for alcoholics and controls and lower levels of education in alcoholics (Uzun, 2003). Alexithymia was not associated with marital status or age (Uzun, 2003; Ziótkowski et al.). However, there was disagreement whether alexithymia was associated with age of onset of alcoholism and length of time of alcohol dependence (Uzun, 2003; Ziótkowski et al., 1995).
Alexithymia was not related to the presence of family history of alcoholism and family history of alexithymia in individuals with alcohol dependence (Rybakowski & Ziolkowski, 1990). However, higher levels of depression were related to greater symptoms of alexithymia in alcoholics (Haviland et al., 1988). More specifically, differences in identifying emotions and separating emotions from physical symptoms were associated with depression (Haviland, Hendryx, Cummings, Shaw, & MacMurray, 1991). Alexithymia and depression were predicted by state anxiety (Haviland et al., 1994). Greater rates of alexithymia were found in women than men in substance abuse treatment programs (Haviland et al., 1994). In summary, alexithymia is highly prevalent in alcoholism and seems to be related to depression. However, alexithymia may remit with abstinence.

Facial Affect Processing

Similar to individuals with schizophrenia, alcoholics also exhibited deficits in facial affect processing. Facial affect identification deficits seen in alcoholism seem to be intermediate between controls and individuals with schizophrenia (Bell et al., 1997). As with individuals with schizophrenia, there is a bias towards positive emotions. For example, alcoholics had deficits in identifying sad faces, and often misinterpreted sad faces as angry or disgusted (Frigerio et al., 2002). Others have shown that alcoholics were less accurate in labeling of faces displaying fear and disgust (Townshend & Duka, 2003). Furthermore, they misperceive emotions, such as happiness was perceived as negative and disgust was perceived as anger (Philippot et al., 1999).

When looking at substance abuse in general, substance abusers also demonstrated a bias for positive emotions. For instance, they performed as well as controls when
identifying positive facial emotions, but had decreased accuracy for negative facial affect identification than controls (Bell et al., 1997). Substance abusers also had better overall performance than individuals with schizophrenia (Bell et al.). Substance abusers performed equally well on an emotion identification task when presented with complex and less complex faces (Bell et al.).

Alcoholics also show patterns of overestimating the intensity of emotional faces, regardless of whether the intensity of the facial expression is moderate, weak, or neutral (Philippot et al., 1999). Similarly, another study found that alcoholics gave higher intensity ratings for fear (Townshend & Duka, 2003). However, when controlling for state anxiety, there did not appear to be differences in intensity ratings between alcoholics and controls (Townshend & Duka, 2003). Furthermore, alcoholics in general required more intense stimuli with increased facial markers in order to identify facial emotions (Frigerio et al.).

Alcoholics did not indicate more difficulty than controls for emotion processing tasks, thus they may not be cognizant of these deficits. Misinterpretation towards negative affect may reflect interpersonal difficulties (Philippot et al., 1999). This was supported by deficits in social skills associated with alcohol use, such that the severity of alcohol use was related to deficits in social skills in adolescents (Hover & Gaffney, 1991).

Age also seems to impact emotion processing. For instance, older subjects, alcoholics and controls, had memory deficits for facial emotions (Oscar-Berman, Hancock, Mildworf, Hutner, & Weber, 1990). Older controls and alcoholics performed comparably on facial emotion identification compared with younger controls. Alcoholics had mild deficits in identification of emotional intonation. Age and alcoholism did not
seem to have interactive effects on auditory emotion processing and older subjects had more deficits. Thus, alcoholism does not seem to impair auditory emotion processing, but does impair visual facial emotion processing.

Kornreich et al., (2001a) evaluated inpatient alcoholics and normal controls for facial emotion processing deficits. For alcoholics correct emotional labeling and emotional intensity level of the stimuli were not correlated with the amount of alcohol consumed daily, the number of years of alcohol abuse, number of previous substance abuse treatment, and presence of family history of alcoholism. Overall, controls were more accurate than alcoholics in emotion labeling for moderate emotional stimuli (70%). On the other hand, when presented with mild emotional stimuli (30%), accuracy of labeling of emotions did not differ between groups. Researchers then evaluated the relationship between accuracy of emotion identification and the emotions of happiness, anger, and fear across groups. They found that controls were more accurate in emotion identification than alcoholics for happy and angry faces. Researchers then evaluated participants’ intensity ratings for the emotions of happiness, anger, and fear for mild and moderate emotional stimuli across groups. Overall, they found that alcoholics gave higher intensity ratings for mild emotional stimuli when compared with controls. However, these findings were not significant for the moderate emotional stimuli. Finally, no differences were found across groups for level of difficulty in rating each emotional stimulus.

Kornreich et al. (2001b) conducted a follow-up study comparing recently detoxified alcoholics, alcoholics who were abstinent for 2 or more months, and controls for facial emotion processing deficits. They found that short-term abstinent and recently detoxified
alcoholics were less accurate in labeling anger and disgust. Recently detoxified alcoholics gave higher intensity ratings for negative emotions of anger, sadness, disgust, and fear, whereas this effect was not present in short-term abstinent alcoholics. Thus, alcoholics demonstrated deficits in emotion labeling for faces portraying moderate intensities of emotion. They experienced greater deficits when happy and angry faces were presented. They also overestimated mild portrayals of emotions. Finally, these deficits were more pronounced in recently detoxified alcoholics in comparison with short-term abstinent alcoholics.

The deficit for processing negative emotions may be explained in terms of a potentiated startle response. For example, alcohol "attenuated" the fear potentiated startle response for a divided attention task, but not for a threat-focus task (Curtin, Patrick, Lang, Cacioppo, & Birbaumer, 2001). The authors explained this was due to alcohol influencing the fear response indirectly. For example, alcohol impaired attention, a cognitive function, whereby it mediates the influence on fear responses. In other words, alcohol impaired the fear response not via the amygdala directly, but rather by mediation of cognitive functioning (Curtin et al., 2001).

Affective Prosody

Affective prosody is the ability to express the emotional component of language that reflects the speaker's emotions associated with the verbalization (Monnot et al., 2001). These researchers demonstrated that alcoholics were impaired in affective prosody when compared with healthy controls, but were less impaired than subjects who had been exposed to alcohol during the fetal period. These findings support a more general emotion processing deficit in alcoholics.
Korsakoff's Syndrome

When people with Korsakoff's were asked to rate emotionally laden words and facial emotions for likeability, they performed similarly to alcoholics (Douglas & Wilkinson, 1993). This suggests that although individuals with Korsakoff's exhibited flattened emotional expressiveness, they experienced emotional states consistent with alcoholics with a history of heavy drinking and alcoholics who currently drink light-to-moderate amounts of alcohol. It should be noted that this study used a sample of 5 individuals with Korsakoff's syndrome. However, these individuals were not taking any medication and had been stringently screened to decrease the presence of other potentially confounding variables.

Individuals with Korsakoff also demonstrated deficits in facial emotion perception and memory for emotion-laden stimuli in comparison with alcoholics and controls (Oscar-Berman et al., 1990). They had lower ratings of emotional intensity compared to controls. Furthermore, individuals with Korsakoff's were impaired in auditory emotion processing.

Cognitive Deficits in the Dually Diagnosed

The research concerning cognitive functioning in dually diagnosed individuals is limited. One study compared individuals with schizophrenia who abused substances for less than 1 year with individuals with schizophrenia who did not use substances, and found no differences between groups in mental status scores, regardless of the type of substance used (Arndt et al., 1992). Another study looked at dually diagnosed individuals and failed to find differences from singly diagnosed individuals who did not
use substances in verbal ability, visual spatial ability, verbal memory, visual memory, executive functioning and frontal lobe functioning, and visual attention (Addington & Addington, 1997). These researchers used individuals with a history of substance abuse who had been abstinent for a minimum of 6 years, and who were not chronic substance abusers (i.e., used for less than 5 years). Another study found that substance abusers did not differ from non-substance abusers on intelligence and memory (Herman, 2004). However, this study found that dually diagnosed individuals had higher scores on measures of executive functioning. The data concerning severity, chronicity, length of time of abstinence, and patterns of substance use were not provided in this study, thus, it is difficult to make comparisons with other studies. Others have also failed to find differences in cognitive ability between dually diagnosed individuals and individuals with schizophrenia only (Cleghorn et al., 1991; Nixon, Halford, & Tivis, 1996). However, these discrepancies may be accounted for by small sample sizes.

In contrast, other studies have demonstrated differences between the dually diagnosed and the singly diagnosed. For example, others have found that individuals with schizophrenia who currently used substances or who had a history of substance use demonstrated greater cognitive deficits (Swofford et al., 2000). Additionally, individuals with a history of cocaine abuse demonstrated deficits in the encoding of verbal information (Sevy, Kay, Opler, & van Praag, 1990). Others have also shown that dually diagnosed individuals were more impaired on neuropsychological test performance than non-using individuals, and the individuals with schizophrenia were more impaired than alcoholics (Allen et al., 1999). Finally, dually diagnosed individuals were more impaired on tests of visual spatial perception and construction than individuals with schizophrenia.
(Allen et al., 1999). There appears to be an additive effect of substance abuse on
cognitive deficits in schizophrenia (Silverstein & McDonald, 1988).

Interestingly, some studies have demonstrated certain cognitive strengths in the
dually diagnosed, including planning and verbal skills (Joyal, Hall, Lapierre, &
Hodgkins, 2003). Similarly, Sevy et al. (1990) found that individuals with schizophrenia
with a history of cocaine abuse performed better on tasks of attention and psychomotor
speed than non-using individuals and individuals who abused other drugs. Additionally,
within 3 days of abstinence from cocaine, the dually diagnosed were more impaired on
tests of verbal memory and learning than the singly diagnosed and cocaine abusers
(Serper, Bergman et al., 2000; Serper, Copersino, Vadhán, Richarme, & Cancro, 2000).
Of interest, they found that recent cocaine abuse had no impact on attention and
executive functioning. However, the side-effects associated with detoxification and
withdrawal may have influenced these findings. Furthermore, the type of drug that is
abused may have differential effects on cognitive performance.

However, when comparing dually diagnosed alcoholics with alcoholics, the dually
diagnosed individuals exhibited greater cognitive deficits than the alcoholics on measures
of practical knowledge and social judgment; concentration; psychomotor speed and
visual-motor integration; visual concentration; and organizational, planning, and social
knowledge (Allen et al., 1999). The dually diagnosed also had poorer performance than
alcoholics on measures of problem-solving, perceptual organization, motor, aphasia, and
overall impairment (Allen et al.). With age, dually diagnosed alcoholics, alcoholics, and
individuals with schizophrenia increased in cognitive decline, as expected (Allen et al.).
However, dually diagnosed alcoholics between 40 and 50 years of age demonstrated
significant increases in cognitive decline, more than that demonstrated by alcoholics, individuals with schizophrenia, and patient comparisons. These patterns associated with age and cognitive decline for the dually diagnosed were also supported by others (Goldstein, Allen, & Sanders, 2002).

What causes such high prevalence rates of substance abuse in schizophrenia? CT and MRI scans have not supported structural brain differences between the dually diagnosed and the singly diagnosed (Buckley et al., 1994; Scheller-Gilkey, Lewine, Caudle, & Brown, 1999). In contrast, Sullivan et al. (2000) found that dually diagnosed individuals had enlarged fourth ventricles, decreased vermian gray matter, and decreased volume in the cerebellum, whereas individuals with schizophrenia who did not abuse alcohol had enlarged fourth ventricles and alcoholics had decreased volume in the cerebellum. Another study also found differential brain abnormalities for singly diagnosed and dually diagnosed individuals, such that dually diagnosed alcoholics had decreased volume in the pons and thalamus, similar to alcoholics, whereas medicated individuals with schizophrenia had only decreased volume in the thalamus (Sullivan, Rosenbloom, Serventi, Deshmukh, & Pfefferbaum, 2003). Finally, others have shown that dually diagnosed alcoholics had greater deficits in the volume of gray matter, especially in the superior anterior thalamus and prefrontal areas, than non-using individuals with schizophrenia, alcoholics, and controls (Mathalon, Pfefferbaum, Lim, Rosenbloom, & Sullivan, 2003).

Together these studies support that there is an additive effect of comorbid alcohol abuse on cognitive deficits in schizophrenia. The additive cognitive deficits seen in dually diagnosed individuals are likely related to the brain abnormalities also seen in
dually diagnosed individuals, such as enlargements in the fourth ventricle and atrophy of gray matter in the cerebellum, thalamus, pons, prefrontal area, and superior anterior temporal lobe.

Mueser, Drake, and Wallach (1998) reviewed research related to the various etiological theories for the comorbidity of substance abuse in severe mental disorders. Overall, they found that much of the research was less than convincing for any particular theory, including the self-medication theory, genetic predisposition models, alleviation of dysphoria, and secondary psychiatric illness models. Some evidence supports the relationship between antisocial personality disorder and dual diagnoses. However, confounding factors such as misdiagnosis of behaviors resulting from substance abuse as antisocial personality traits has yet to be ruled out. Furthermore, it is difficult to differentiate whether characteristics, such as antisocial traits, low socioeconomic status, and cognitive functioning are risk factors or actual precursors for receiving a dual diagnosis. Additionally, some evidence supports stress-vulnerability models, which takes into account the above-mentioned risk factors.

Hypotheses

Based upon the review of the literature, three primary hypotheses were investigated. The first hypothesis examined differences in visual spatial and facial perception skills among the three groups (Comorbid Schizophrenia with Alcohol Dependence (SZA), Schizophrenia (SZ), and Healthy Controls (HC)). In general, dually diagnosed individuals have shown greater cognitive deficits than individuals with schizophrenia, and individuals with schizophrenia have shown greater cognitive deficits than controls.
Thus, it was expected that the SZA group would perform worse on tests of visual spatial and facial perception, such as the WAIS-III Block Design and Inverted Facial Matching task than the SZ group. It was also expected that both the SZA and SZ groups would perform more poorly on these tests than the HC group. If this hypothesis was confirmed, it would support the existing literature that individuals with schizophrenia experience visual spatial perception deficits, including visual spatial facial perception. Additionally, it would begin to establish whether the comorbidity of alcohol dependence has an additive detrimental effect on visual spatial perception in schizophrenia.

The second hypothesis investigated differences in emotion processing among the three groups (SZA, SZ, and HC). Research has shown deficits in facial affect processing, auditory emotion processing, affective prosody, and expression of emotion in schizophrenia. Alcoholism has also been associated with greater rates of alexithymia. Similar to individuals with schizophrenia, alcoholics exhibited deficits in facial affect processing. However, the facial affect identification deficits seen in alcoholism seemed more intermediate between individuals with schizophrenia and controls (Bell et al. 1996). Thus, it was hypothesized that the SZA group would perform worse than the SZ group on tests of affect processing, such as the Facial Affect Matching task, Facial Affect Labeling task, Emotional Color-Word Stroop test (E-Stroop), and Emotional Verbal Learning Test (EVLT). Furthermore, it was expected that the SZA and SZ groups would perform more poorly than the HC group on these tests of emotion processing.

The first part of the third hypothesis assessed whether there was a bias for positive emotions among the three groups (SZA, SZ, and HC). There seems to be a general bias for positive emotional words, such as happiness, in normal controls, individuals with
schizophrenia, and alcoholics. Similarly, studies have shown that individuals with schizophrenia did not differ from controls on identification of happy faces (Dougherty et al., 1974; Garfield et al., 1987; Mandal, 1987) or amount of time required to identify happy faces (Mandal & Rai, 1987). Thus, it was hypothesized that the SZA, SZ, and HC groups would not differ in performance on tests of emotion processing when presented with the emotion of happiness or surprise. These tests included the Facial Affect Matching task, Facial Affect Labeling task, E-Stroop, and EVLT. If this hypothesis was supported, this would rule-out the explanation that visual spatial deficits or deficits in basic facial perception were solely responsible for the deficits frequently seen in facial affect processing.

The second part of the third hypothesis evaluated whether there were greater deficits when processing negative emotions among the three groups (SZA, SZ, and HC). Individuals with schizophrenia have demonstrated difficulty processing negative emotions, such as underestimating the intensity of negative emotions and making more errors when labeling negative emotions than controls (Bellack et al., 1992). Similarly, alcoholics expressed deficits in facial affect processing. However, alcoholics tend to overestimate negative feelings. Thus, it was hypothesized that the SZA group would have greater deficits than the SZ group when presented with negative emotions on the tests of emotion processing. These tests included the Facial Affect Matching task, Facial Affect Labeling task, E-Stroop, and EVLT. Furthermore, it expected that both the SZA and SZ groups would have more impaired performance on these tests than the HC group.
CHAPTER 3

METHOD

Participants

Three groups of participants were recruited from the University of Nevada, Las Vegas (UNLV) and from within the community. The participants consisted of 22 individuals diagnosed with schizophrenia (SZ), 22 individuals diagnosed with schizophrenia comorbid with a lifetime diagnosis of alcohol dependence (SZA), and 22 healthy controls (HC). For the entire sample, ages ranged from 19 to 67 years, with a mean age of 40.62 years ($SD = 11.79$). Years of education ranged from 8 to 16 years, with a mean of 12.67 years ($SD = 2.03$). The sample consisted of 28 males and 38 females. Ethnicities represented, included 16 African Americans, 4 Asian American, 35 European Americans, 3 Hispanic Americans, 1 Native American, 4 biracial, and 3 other. The demographic characteristics of each group are contained in Table 1. The SZ and SZA participants were recruited from Mojave Adult, Child, and Family Services. The HC were recruited from the UNLV Psychology Department's subject pool, in accordance with university guidelines and procedures, and from the community. Students who participated were eligible to apply their participation time, with each hour of participation corresponding to one credit hour, towards fulfillment of course requirements or to receive extra credit. Participants recruited from the community were paid $5.00 per hour ($2.50 per half-hour) with a $30 bonus for completing the study.
The inclusion criteria for the SZ and SZA groups included individuals with a lifetime DSM-IV diagnosis of Schizophrenia or Schizoaffective Disorder. For the SZA group, participants also had a lifetime DSM-IV diagnosis of alcohol dependence. Diagnoses were confirmed using the Structured Clinical Interview for DSM-IV (SCID-IV; see Measures section for a description). Furthermore, the SCID-IV was used to rule out the presence of psychiatric disorders, such as schizophrenia and major depressive disorder, in the HC group. Participants were initially screened using the Demographic Questionnaire (see Measures section for a description). Participants were excluded from the study if they met any of the following exclusion criteria: 1) English as a second language; 2) cognitive deficits due to past traumatic brain injury, medical condition, neurological disease, mental retardation, or medication effects; 3) current and lifetime substance abuse diagnosis for the SZ and HC groups; and 4) inability to provide informed consent. Participants meeting both inclusion and exclusion criteria were eligible to continue participation in the study.

The original sample was comprised of 104 participants. The majority of SZ and SZA participants signed releases so that their medical records could be reviewed. Of the original 104 participants, 44 were in the SZ group, 23 in the SZA group, and 37 in the HC group. Of this sample, 13 participants were excluded because of a non-alcohol substance dependence diagnosis; 12 people were excluded for Axis I disorders other than schizophrenia or alcohol dependence; eight individuals were excluded due to only having a substance abuse diagnosis that did not meet criteria for alcohol dependence; and three participants were excluded for having a history of neurological disorders (e.g., seizures, head injury, and mental retardation). Finally, two participants from the HC group were
removed to create equal $n$ among groups. Two of the youngest people in this group were selected for removal to more evenly match demographic characteristics of the HC group with SZ and SZA groups.

**Characteristics of the SZ and SZA Groups**

With respect to diagnosis, 13 participants in the SZ and SZA groups had a diagnosis of schizoaffective disorder, with 12 in the SZA group. For the SZA group, 7 of the 22 people only had a diagnosis of alcohol dependence, without additional substance abuse or dependence diagnoses. The overall current level of alcohol use was mild, such that individuals in the SZA group reported a range of 0 to 8 days of drinking over the prior month, with 77% of the SZA group not drinking in the past month. However, the SZA group had a history of more chronic alcohol use, with a mean of 12.24 years of drinking regularly and 11 years of drinking regularly to intoxication. The SZA group also had a history of using more than one substance, such that 76% of the SZA group reported a mean of 10.59 years of regularly using more than one substance. Two people in the SZA group admitted to using substances in the past month, which were cocaine, cannabis, and hallucinogens. The SZA group also had a number of other lifetime substance dependence diagnoses (i.e., 10 (15%) cannabis, 6 (9%) cocaine, 5 (8%) stimulant, 3 (5%) hallucinogen, 2 (3%) sedative, 1 (2%) opium, and 1 (2%) other substance dependence). Both groups reported similar patterns of smoking cigarettes. Table 2 contains means and standard deviations of substance use patterns for the SZA group.
Procedures

Prior to commencement of any study protocols, approval for this study was obtained on September 29, 2005 by the UNLV Institutional Review Board. Participants were recruited through community and mental health agencies and flyers were posted at various locations with a description of the study and contact information. Participants were also recruited through the UNLV Psychology Department’s subject pool. Informed consent was obtained from all participants prior to completion of any study procedures. Separate informed consent forms were used for each group of participants. The informed consent was read aloud to ensure understanding of the protocol and participants were encouraged to ask questions about the procedures. Once informed consent was obtained, the principal investigator or two other doctoral-level graduate student researchers performed neuropsychological and clinical evaluations. All persons conducting these evaluations were trained under the guidance of the research advisor to administer the tests in a reliable and standardized manner.

All participants were assessed using the same neuropsychological test battery. Testing occurred in three settings. Participants were tested across a number of sessions, typically two or three sessions, which often occurred on different days of the week. Multiple sessions were necessary for many participants in order to avoid fatigue and maintain motivation. Tests were administered in a semi-random order, based upon participant needs and ability to tolerate certain types of testing. Testing order was varied to decrease frustration, improve concentration and interest, and to accommodate time constraints imposed by transportation arrangements. For example, if a participant seemed to have difficulty or was frustrated with a certain type of task, such as a
computerized test, he or she was encouraged to take a break to decrease fatigue and a different type of test was administered next, such as a motor task. If the participant was only available for a limited amount of time, then tests that would fit within the allotted time were administered. Certain general rules were followed throughout testing, such as the Demographic Questionnaire and the clinical interview were administered first. Other rules included that memory tests were not administered during the delay periods of another memory test.

*Computerized Tests*

All tests administered via the computer were presented on a 17" monitor. Unless otherwise specified, stimuli were presented for a maximum of 5 seconds with an inter-stimulus interval of 1 second. Participants responded by speaking into a voice-activated microphone that when triggered would remove the stimulus from view. The examiner coded whether the response was correct or incorrect using a Serial Response Box #300 that would then prompt the next stimulus to appear.

*Measures*

*Demographic and Health-Related Information*

All participants completed a 30-item demographic and health history questionnaire. Demographic items included gender, age, marital status, living arrangements, and history of homelessness. Health-related questions included a history of seizures, head injuries, medical conditions, learning disabilities, smoking habits, birth-related questions, family history of mental illness, and current medications. A release of information was also

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obtained from all individuals with schizophrenia in order to verify diagnoses and medical histories, when available.

*Measures of Symptomology*

*Structured Clinical Interview for DSM-IV Axis I Disorders: Research Version*

The Structured Clinical Interview for DSM-IV (SCID-IV; First, Gibbon, Spitzer, & Williams, 1996) was used to establish DSM-IV (APA, 1994) diagnoses for the current study. The SCID-IV is a semi-structured interview used to diagnose psychiatric, Axis I, disorders based upon DSM-IV criteria. The SCID-IV has been applied to psychiatric and medical patients, and has been used for the general population for research purposes. It is most commonly used for adults with an eighth grade or above educational level. The primary utility of the SCID-IV was to confirm a schizophrenia spectrum diagnosis (i.e., schizophrenia or schizoaffective disorder) in the SZ and SZA groups, to confirm a diagnosis of lifetime alcohol dependence for the SZA group, and to rule-out other major Axis I disorders, especially in the HC group. The mood disorders, psychotic disorders, anxiety disorders, and substance use disorders modules of the research version of the SCID-IV were utilized. Each module consists of multiple items rated by the clinician on a scale from 1 to 3 (i.e., 1 = absence of the symptom, 2 = sub-clinical symptoms, and 3 = presence of the symptom). Diagnoses were further confirmed by review of medical charts and collateral information from treatment providers, including the treating psychiatrist.

The SCID has been shown to have good sensitivity (.89), specificity (.96), and agreement (.86) for psychotic disorders in comparison with psychiatric diagnoses given at
first-admission hospitalizations (Fennig et al., 1994). A review of the psychometric properties of the scores from the substance use module of the SCID revealed adequate test-retest reliability for alcohol dependence diagnoses, ranging from .63 to .79; and adequate between-measure concordance rates for alcohol dependence diagnoses with the International Classification of Diseases, 10th edition, ranging from .61 to .80 (Hasin, Hatzenbuehler, Keyes, & Ogburn, 2006).

**Addiction Severity Index**

The Addiction Severity Index (ASI; McLellan et al., 1980) is a widely used structured interview and was used to determine the lifetime severity of substance abuse and functioning across multiple domains, including health, legal, family, and interpersonal relationships. The self-report 35-item version of the ASI was used in this study. This shortened version significantly reduces the amount of time required to administer this instrument. The self-report version focuses on current substance abuse severity. Thus, three items were added to determine the lifetime severity of alcohol abuse and polysubstance use. This measure was only administered to individuals in the SZA group. Each item was read aloud to participants.

The ASI has been used in research with individuals with schizophrenia, alcoholism, and dual diagnoses (e.g., Bell et al., 2002; Brunette & Drake, 1997; Carey et al., 1996; Dixon et al., 1998; Lysaker et al., 1994; Mueser et al., 2001). A review of the ASI demonstrated high internal consistency for the alcohol use composite score, with one study reporting a low alpha of .46 and the remaining 12 studies ranging from .74 to .92 (Mäkelä, 2004). This same review reported test-retest reliability for homeless people tested at nine sites was .86 for the alcohol use composite score.
Time-Line Follow Back

The Time-Line Follow Back procedure (Sobell et al., 1980) was utilized to retrospectively establish the amount of alcohol used over the previous 4-week period and to ascertain patterns of current alcohol use. Participants were shown a calendar spanning the previous 4-week period. Any significant events that occurred over this time period were marked on the calendar in an effort to provide anchors or reminders. The amount and frequency of alcohol use and frequency of stays in a controlled environment were then charted. This procedure has been used with dually diagnosed individuals and those with substance use disorders to recreate an accurate estimate of substance abuse patterns (e.g., Brunette & Drake, 1997; Carey et al., 1996; Mueser et al., 2001).

Test-retest reliability, using intraclass correlation coefficients, ranged from .70 to .94, and similar Pearson correlation coefficients were also reported (Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000). Another study examined three time intervals, and the amount of time using alcohol was correlated with other measures, including the ASI (ranging from .30 to .36) and the Michigan Alcoholism Screening Test (ranging from .32 to .44) (Fals-Stewart et al.).

Calgary Depression Scale for Schizophrenia

Due to the high comorbidity of depression associated with schizophrenia, the Calgary Depression Scale for Schizophrenia (CDSS; Addington, Addington, & Maticka-Tyndale, 1993) was administered to individuals in the SZ and SZA groups. The CDSS is a 9-item interview-based rating scale that measures the severity of depression. Each item is rated on a 4-point scale (i.e., 0 = absent to 4 = severe). The CDSS was developed specifically for use with individuals with schizophrenia because previous studies had shown that

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these individuals often experienced difficulty completing self-report inventories (Addington, Addington, & Maticka-Tyndale, 1993b).

The CDSS has demonstrated good psychometric properties (Addington, Addington, & Maticka-Tyndale, 1994). The CDSS was highly correlated with other standardized measures of depression, including the Hamilton Depression Rating Scale (.83) and the Expanded Brief Psychiatric Rating Scale-Depression subscale (.81) (Kontaxakis et al., 2000). Furthermore, this measure has been validated in other languages, demonstrating reliability with individuals with schizophrenia, cross-culturally (Bernard, Auquier, Reine, & Addington, 1998; Kim et al., 2006; Muller et al., 1999).

**Brief Psychiatric Rating Scale**

The Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962) was used to assess current psychiatric symptom severity and psychosocial functioning in individuals with schizophrenia. The BPRS is an interview-based 18-item rating scale that measures the severity of psychiatric symptoms, including psychotic symptoms, over the past week. Each item is rated on a 7-point scale (i.e., 1 = not reported to 7 = very severe). The BPRS has been widely used in research with individuals with schizophrenia and the dually diagnosed (e.g., Blanchard et al., 1994; Brunette & Drake, 1997; Buckley et al., 1994; DeQuardo et al., 1994; Dixon et al., 1991; Kirkpatrick et al., 1996; Mueser et al., 1996; Munsey et al., 1992; Owen et al., 1996; Salyers & Mueser, 2001; Scott et al., 1998). Overall concordance rates for all items was .83, ranging from .60 for .98 across items, indicating overall high validity of the BPRS (Greenwood & Burt, 2000).
Scale for Assessment of Positive Symptoms and Negative Symptoms

The Scale for Assessment of Positive Symptoms (SAPS; Andreason, 1986) and the Scale for Assessment of Negative Symptoms (SANS; Andreason, 1982) were used to assess the current severity of positive and negative symptoms. The SAPS and SANS were completed following a semi-structured interview with each participant in the SZ and SZA groups. The SANS is a 30-item scale that assesses for affective flattening, alogia, avolition, anhedonia-asociality, and attention. The SAPS is a 34-item scale that assesses for hallucinations, delusions, bizarre behavior, and formal thought disorder. Each item on both scales is rated on a 6-point scale. The global ratings for each of the aforementioned domains were summed to arrive at a total score for positive and negative symptoms.

Inter-rater reliability of the summary scores for the SANS ranged from .60 to .84 (Andreasen & Olsen, 1982; Norman, Malla, Cortese, & Diaz, 1996). Inter-rater reliability for the summary score for the SAPS was .84 (Norman et al.). The summary score of the SANS was highly correlated with the negative symptom subscale of the PANSS (.88), and the summary score of the SAPS was highly correlated with the positive symptom subscale of the PANSS (.91).

Extrapyramidal Side-Effects (EPS)

Multiple measures were used to assess for extrapyramidal side-effects or symptoms in order to develop a more comprehensive picture of the negative side-effects often associated with antipsychotic medications. The Abnormal Involuntary Movements Scale (AIMS; Wojcik et al., 1980) consists of 12 motor tasks required of the participant (e.g., “Ask the patient to stand up”). The AIMS rates facial and oral movements, extremity

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movements, trunk movements, dental status, and global judgments. Each item is rated on a 5-point scale, reflecting the severity of abnormal involuntary movements. Inter-rater reliability using Pearson correlations, ranged from .46 to .80 for each of the anatomic regions, and using intraclass correlation coefficients, ranged from .50 to .79 (Lane, Glazer, Hansen, Berman, & Kramer, 1995).

The Barnes Akathisia Rating Scale (BARS; Barnes, 1989) was used to assess for akathisia, characterized by subjective and motor restlessness. The BARS takes into consideration the person’s perception and level of distress associated with symptoms of akathisia, as well as the clinician’s observations of these symptoms. Individual items are rated on a 4-point scale. A global clinical assessment of akathisia is rated on a 6-point scale (i.e., 0 = absent to 5 = severe akathisia). The global score of the BARS has been shown to be more sensitive in screening for neuroleptic-induced akathisia, with good sensitivity (.81) and specificity (.97) (Janno, Holi, Tuisku, & Wahlbeck, 2005).

The EPS scale was used to assess Parkinsonian-type EPS. Participants were asked to perform a variety of motor tasks, including arm dropping, walking, and arm movements. The EPS is a 14-item rating scale, with each item rated on a 4-point scale.

The Rockland Rating Scale (RRS) assesses for abnormal facial and oral, neck and trunk, extremities, and entire body movements. The RRS consists of 14 items, with each rated on a 6-point scale (i.e., 1 = absent to 6 = severe).
Measures of Affect Perception

Facial Affect Labeling Task

The Facial Affect Labeling Task was used to assess the ability to accurately identify facial emotions. Photographs of human faces depicting five standard emotions of happiness, sadness, anger, surprise, fear and a neutral face depicting no emotion were used in this task. The stimuli developed by Ekman and Friesen (1976) contained both males and females who were Caucasian or Asian. The 48 stimuli were presented on a computer (see Computerized Tests section for a description of procedures). Each emotion was presented 8 times in random order. A list of the abovementioned emotions was displayed on a placard in front of the participant. Participants identified which emotion was depicted in the photograph by speaking into a voice-activated microphone. The examiner recorded the participant’s response on a scoring sheet and coded the accuracy of the response using a Serial Response Box.

Facial Affect Matching Task

The Facial Affect Matching Task measured one’s ability to discriminate facial emotions. Participants were shown two faces and asked if they portrayed the same emotions. Stimuli consisted of male and female Caucasian faces reflecting the emotions of happiness, sadness, disgust, anger, fear, and neutral. Stimuli were randomly selected to provide equal numbers of same and different responses and each emotion combination was equally represented. The 120 stimuli were presented on a computer (see Computerized Tests section for a description of procedures). Participants were asked to determine whether the two depicted faces expressed the same or different emotion and responded into a voice-activated microphone. The examiner recorded the participant’s
response on a scoring sheet and coded the accuracy of the response using a Serial Response Box.

*Emotional Stroop Color-Word Test*

The Emotional Stroop Color-Word Test (E-Stroop; Strauss, Allen, Jorgensen, & Cramer, 2005) assessed the influence of emotional words on attention shifting. This test was developed based upon the original Stroop Color-Word test (Stroop, 1935). The stimuli on the E-Stroop test were emotionally-laden words representing the emotions of happiness, sadness, anger, anxiety, and neutral. Words were presented in one of four colors (i.e., red, yellow, green, and blue). The 30 stimuli were presented on a computer (see Computerized Tests section for a description of procedures). The participant was asked to name the color of the text, rather than name the word. It was expected that emotional words relevant or significant to the participant would interfere with the participant’s ability to name the correct color. Participants responded into a voice-activated microphone. The examiner recorded the participant’s response on a scoring sheet and coded the accuracy of the response using a Serial Response Box. Although this was a recently developed test, all emotional words were normed on college students (Strauss & Allen, in press) and preliminary research indicated high test-retest reliability, ranging from .88 to .94 for each emotion (Strauss et al., 2005).

*Emotional Verbal Learning Test*

The Emotional Verbal Learning Test (EVLT; Strauss & Allen, unpublished manuscript) assessed verbal emotional memory and learning. The EVLT was based upon and uses the same standardized procedure as the CVLT (a description of this test is provided under the Neuropsychological Tests section that will follow). List A consisted
of 16 words representing four emotion categories of happiness, sadness, anger, and anxiety. As in the CVLT, the EVLT assessed free-recall, cued-recall, recognition, delayed recall, delayed recognition, and the effects of interference on recall. The purpose of the EVLT, in contrast to the CVLT, was to determine the effects of emotion-laden words on memory and learning. Although this was a recently developed test, preliminary research suggested that normal controls were biased towards remembering happy words (Strauss & Allen, unpublished manuscript).

**Neuropsychological Tests**

The neuropsychological tests measured cognitive functioning in a variety of domains, including attention/psychomotor speed/visual motor processing, visual constructional and visual spatial organization, and estimates of intelligence. These tests were chosen due to their common utilization by researchers, specifically in the assessment of individuals with schizophrenia. All assessments were administered and scored in accordance with their respective test manuals.

**Stroop Color-Word Association Test**

The Stroop Color-Word Association Test (Stroop, 1935) measured attention, psychomotor speed, and visual motor processing. The 80 stimuli were the names of colors presented in varying colors (i.e., yellow, blue, red, green, or purple) in random order on a computer (see Computerized Tests section for a description of procedures). Some words were congruent (e.g., the word red appeared in red ink), whereas other words were incongruent (e.g., the word green appeared in red ink). The participant was asked to name the color of the text and ignore the printed word. Participants responded
into a voice-activated microphone that when triggered would remove the stimulus from view and prompt the next stimulus to appear. The interval between presentations of each stimulus was 250 ms. The total number of correct responses was used as an indicator of information processing speed and attention. Test-retest reliability was .71 for congruent words and .79 for incongruent words (Strauss, Allen, Jorgensen, & Cramer, 2005). Others have reported similar overall 2-week test-retest reliability at .67 (Franzen, Tishelman, Sharp, & Friedman, 1987).

Inverted Facial Matching Task

The Inverted Facial Matching Task assessed facial perception and visuospatial skills. Participants were shown two inverted faces and asked to determine whether they were the same or different person. Stimuli consisted of male and female Caucasian faces reflecting neutral or no emotion. Stimuli were randomly selected to provide equal numbers of same and different responses. The 56 stimuli were presented on a computer (see Computerized Tests section for a description of procedures). Participants were asked to determine whether the two depicted faces were the same or different person and responded accordingly into a microphone. The examiner recorded the participant’s response on a scoring sheet and coded the accuracy of the response using a Serial Response Box. Tests of facial discrimination and recognition using photographs of actors have been used with individuals with schizophrenia to assess emotion processing (Addington & Addington, 1998; Archer et al., 1992; Bellack et al., 1996; Feinberg et al., 1986; Hellewell et al., 1994; Kerr & Neale, 1993; Mueser et al., 1996; Salem et al., 1996; Walker et al., 1980).
**California Verbal Learning Test**

Declarative verbal learning and memory were measured with the California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987). The CVLT assesses free recall, the effects of interference on recall, short-delayed free recall, short-delayed cued recall, long-delayed free recall, long-delayed cued recall, and long-delayed recognition. The experimenter reads a list of 16 words categorized as clothing, tools, spices and herbs, and fruits (List A), at a rate of one word per second. The participant is then asked to freely recall words from the list. This same procedure is repeated for a total of 5 trials. A second distractor list (List B), is then read aloud and the participant is again asked to freely recall words from this list. A short-delayed free recall trial is administered and the participant is again asked to freely recall words from List A. A short-delayed cued recall trial is given and the participant is asked to recall words from List A that are clothing, tools, spices and herbs, and fruits. Following a 20-minute delay, participants are asked to perform free-recall and cued-recall tasks for List A. Finally, participants perform a long-delayed forced-choice recognition task from a list of 48 words. The total correct responses for the sum of accurately recalled words from the first 5 free recall trials, short delayed free-recall, long delayed free-recall, and long delayed recognition tasks were used in the analyses.

**Wechsler Adult Intelligence Scales-3rd version**

Three subtests of the Wechsler Adult Intelligence Scales-III (WAIS-III; Wechsler, 1997a) were administered. Premorbid intelligence was estimated from the WAIS-III Vocabulary and Information subtests (Wechsler, 1997a). These two subtests have demonstrated high reliability, and tend to measure more crystallized cognitive functions.
that are stable over time and less susceptible to brain injury (Reitan & Wolfson, 1993). Current intellectual functioning was estimated using the WAIS-III Block Design and Information subtests.

Visuospatial perception and visual construction ability were assessed using the WAIS-III Block Design subtest. This test taps nonverbal problem-solving skills, visuospatial organization, attention, and visual motor coordination. This subtest is less influenced by educational background because it relies less on personal experience and exposure to enriched experiences or interests. The participant is given a set of red and white blocks with two solid red colored sides; two solid white colored sides; and two sides that are half red and half white, split on the diagonal. The participant is shown a design from a stimulus booklet and asked to replicate the design using the given blocks. The task is scored for speed and accuracy, with additional points given for faster completion rates. The completed design must also be oriented the same as the model, such that rotations of more than 30° are coded as incorrect. Scoring for the first six designs ranges from 0 to 2, depending upon the number of trials required to accurately recreate the design. Scoring for the remaining designs ranges from 0 to 7, depending upon the amount of time required to complete the design.

The Vocabulary subtest assesses general verbal ability. This subtest consists of 33 words. Each of the vocabulary words is read aloud and presented visually to the participant via a stimulus booklet. The participant is then asked to define the word, with the level of difficulty increasing gradually with each item. Testing is discontinued following six consecutive errors. Scores range from 0 to 2 points for each item and are based upon the complexity of the participant’s response.
The WAIS-III Information subtest assesses general knowledge of current and historical information. This subtest consists of 28 general questions (e.g., “How many weeks are in a year?” and “Name all of the continents”). The experimenter reads aloud each question. Testing is discontinued after six consecutive errors. Scores range from 0 to 1 point (i.e., 0 = incorrect, 1 = correct).
CHAPTER 4

RESULTS

Data Screening

Prior to performing the main analyses on the data, a number of steps were taken to ensure the integrity of the data. All of the variables that were entered into the main analyses were examined to ensure that they met the assumptions for univariate and multivariate analysis of variance. For example, outliers were identified using a number of methods, including inspecting boxplots and comparing the 5% trimmed mean with the original mean. Scores greater than 2 standard deviations from the mean were considered outliers. Consequently, outliers were identified for a number of variables including scores on the E-Stroop, Facial Affect Matching, CVLT, EVLT, and WAIS-III subtests. For each of these variables, outliers were first examined to ensure that they were not the result of an error in data entry. Also, the individuals who had outlying scores were examined to ensure that they were valid members of the populations under investigation.

Since none of the outliers resulted from data entry errors and all participants with outlying scores were deemed to be part of the populations under investigation, outliers were adjusted so that they maintained their extreme positions in the distribution but were one unit larger (or smaller) than the next highest (or lowest) score in the distribution. This procedure allowed the outliers to maintain their extreme position in the distribution yet decreased their influence on the distribution of scores (Tabachnik & Fiddel, 2001).
However, even after these adjustments were made the variables did not attain normal
distribution based on estimates of skewness and kurtosis.

Additional assumptions of univariate and multivariate analysis of variance were
examined. For example, the assumption of linearity was met by comparing scatterplots
for each pair of variables. Multicollinearity did not apply, which was evaluated by
comparing correlations between the dependent variables. A number of methods were
used to test for the assumptions of normality. For univariate normality, these included
examining skew and kurtosis values, the Kolmogorov-Smirnov statistic, and histograms.
With respect to multivariate normality, Mahalanobis distances were calculated.
Examination of these factors revealed that the data was not normally distributed.

Consequently, rather than transforming all of the variables so that they would be more
normally distributed, the main analyses were examined using both parametric and
nonparametric analyses and the results of these two types of analyses were compared to
determine, what, if any effect the non-normal distribution of the variables was having on
the results of the parametric analyses. If the results for both types of analyses turned out
the same, then this was taken as an indication that despite non-normally distributed data,
the results of the parametric analyses were valid (Conover, 1999).

In order to conduct the nonparametric analyses, the data was ranked and subsequent
analyses were performed on this ranked data. Whether ranked or unranked data was
used, the results were highly similar suggesting that the abnormal distribution of scores
for some of the variables did not meaningfully affect the results of the parametric
analyses. Therefore, the results of the parametric analyses are presented in the text, with
reference to the results of the nonparametric analyses which are contained in the
corresponding tables. For the main hypotheses, the general approach to analyzing the data was a between-groups design with group membership (SZ, SZA, and HC) serving as the between-subject factor and the emotion processing and neuropsychological measures as the dependent variable. Appropriate post-hoc analyses were used when the main analyses were significant.

**Preliminary Analyses**

Descriptive statistics were calculated for the demographic variables (see Table 1). A one-way analysis of variance (ANOVA) was performed to determine if there were differences in age and education among the SZA, SZ, and HC groups. Results indicated there were no significant differences among groups for age. However, there was a significant difference in years of education between groups, $F (2, 63) = 6.14, p < .01$. Scheffe’ post-hoc analysis indicated that the significant differences were accounted for by the HC group having significantly more years of education than the SZA group ($p < .01$), with the SZ group holding an intermediate position between the SZA and HC groups, but not significantly differing from the SZ and HC groups.

Given the differences among the groups on education and its known association with performance on some neuropsychological tests, correlations were performed to examine the associations between education and the neuropsychological variables. These correlations were used to determine whether education should be included as a covariate in the main analyses. The results of the correlations are presented in Table 2. Significant relationships were present between education and the CVLT (Sum of Trials 1 – 5, Short Delayed Free-Recall, and Long Delayed Free-Recall) and WAIS-III (Vocabulary,
Table 1
Demographic Characteristics for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC)

<table>
<thead>
<tr>
<th>Demographic Variable</th>
<th>SZA</th>
<th>SZ</th>
<th>HC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Age</td>
<td>44.95</td>
<td>9.60</td>
<td>39.73</td>
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<tr>
<td>Education (years)</td>
<td>11.80</td>
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<td>12.45</td>
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<th>HC</th>
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</tr>
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<td>European American</td>
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<td>13</td>
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<td>Hispanic American</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Native American</td>
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<td>Other</td>
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<table>
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<th>Gender</th>
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<th>SZ</th>
<th>HC</th>
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<tr>
<td>Females</td>
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<th>HC</th>
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<tbody>
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<td>Single</td>
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<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Married</td>
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<td>0</td>
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<tr>
<td>Widowed</td>
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<td>0</td>
</tr>
<tr>
<td>Divorced</td>
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<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Separated</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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Table 2

Correlations Between Neuropsychological Test Variables and Education

<table>
<thead>
<tr>
<th>Test</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVLT Sum Trials 1-5</td>
<td>0.32*</td>
</tr>
<tr>
<td>CVLT SD Free recall</td>
<td>0.28*</td>
</tr>
<tr>
<td>CVLT LD Free Recall</td>
<td>0.31*</td>
</tr>
<tr>
<td>CVLT LD Recognition</td>
<td>0.24</td>
</tr>
<tr>
<td>WAIS-III Vocabulary</td>
<td>0.43****</td>
</tr>
<tr>
<td>WAIS-III Information</td>
<td>0.39***</td>
</tr>
<tr>
<td>WAIS-III Block Design</td>
<td>0.35***</td>
</tr>
<tr>
<td>Stroop Color-Word</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Note. **** p < .0005, *** p < .005,* p < .05.
SD = Short-Delay, LD = Long-Delay.

Information, and Block Design subtests). Consequently, MANCOVAs with education as a covariate were performed for the analyses that utilized these tests as dependent variables, specifically for hypothesis 2 and the neuropsychological tests. However, these MANCOVAs did not reveal a significant main effect for education. (Multivariate and univariate data are contained in Appendices A and B). Moreover, the main effect for group remained significant when education was covaried in the analyses. When comparing MANOVAs, with and without education covaried, the overall results were highly similar. Therefore, due to education not significantly influencing the dependent variables, education was not used as a covariate in any of the final analyses.
Table 1 also includes data regarding ethnicity and gender. Chi-square analysis indicated that there were no significant differences among the groups with regard to gender and ethnicity. Analyses were performed to compare the two schizophrenia groups (SZ with SZA) on other important demographic and clinical variables including lifetime rates of homelessness, number of hospitalizations, extrapyramidal symptoms, and psychiatric symptom severity. Table 3 contains descriptive data for these variables. Chi-square revealed significant differences in self-reported lifetime rates of homelessness, $\chi^2 = 11.21, p < .005$, with the SZA group having a higher lifetime rate of homelessness.

A one-way ANOVA did not find significant differences between the two schizophrenia groups with respect to the number of hospitalizations, $F(1, 40) = .70$, and age of onset of psychosis, $F(1, 28) = .04$. A MANOVA was used to examine differences in extrapyramidal symptoms for the two schizophrenia groups. Total scores from the Abnormal Involuntary Movement Scale, Barnes Akathisia Scale, the EPS Scale, and Rockland Rating Scale were included as dependent variables and group served as the between-subjects factor. The MANOVA indicated that there were no significant differences between the groups, $F(4, 38) = .63$. Similarly, a MANOVA examining psychiatric symptom severity, included the Brief Psychiatric Rating Scale, Schedule for Affective Positive Symptoms, Schedule for Affective Negative Symptoms, and the Calgary Depression Rating Scale as dependent variables indicated no significant differences between the groups, $F(4, 38) = 2.05$. 

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### Table 3

**Psychiatric Characteristics and Substance Use Patterns for Comorbid Schizophrenia/Alcohol Dependence (SZA) and Schizophrenia Controls (SZ)**

<table>
<thead>
<tr>
<th>Group</th>
<th>SZA</th>
<th>SD</th>
<th>SZ</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>22</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Psychiatric Variables and Substance Use Patterns</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Hospitalizations</td>
<td>7.65</td>
<td>10.19</td>
<td>5.55</td>
<td>5.73</td>
</tr>
<tr>
<td>Age of Onset of Psychosis</td>
<td>18.79</td>
<td>8.52</td>
<td>19.25</td>
<td>4.64</td>
</tr>
<tr>
<td>Severity of Psychiatric Symptoms (BPRS)</td>
<td>42.48</td>
<td>12.35</td>
<td>39.59</td>
<td>6.22</td>
</tr>
<tr>
<td>Severity of Negative Symptoms (SANS)</td>
<td>9.67</td>
<td>5.37</td>
<td>10.59</td>
<td>5.37</td>
</tr>
<tr>
<td>Severity of Positive Symptoms (SAPS)</td>
<td>8.14</td>
<td>2.41</td>
<td>8.36</td>
<td>2.79</td>
</tr>
<tr>
<td>Severity of Depression (CDSS)</td>
<td>5.33</td>
<td>6.13</td>
<td>1.55</td>
<td>2.06</td>
</tr>
<tr>
<td>No. Cigarettes Smoke/Day</td>
<td>8.95</td>
<td>10.05</td>
<td>7.05</td>
<td>9.59</td>
</tr>
<tr>
<td>No. of Years Drank Regularly</td>
<td>12.24</td>
<td>10.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Years Drank Regularly to Intoxication</td>
<td>11.00</td>
<td>9.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Years Regularly Used More than One Substance</td>
<td>10.59</td>
<td>10.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:* BPRS = Brief Psychiatric Rating Scale, SANS = Schedule for Assessment of Negative Symptoms, SAPS = Schedule for Assessment of Positive Symptoms, CDSS = Calgary Depression Scale for Schizophrenia.

### Evaluation of the Main Hypotheses

The first hypothesis addressed differences between the SZ, SZA, and HC groups with respect to visual spatial and facial perception skills. It was predicted that the SZ group would have higher scores on these tasks than the SZA group, and that the HC group would have higher scores than both schizophrenia groups. For the first hypothesis, the...
dependent variables were the total mean scores for the Block Design subtest and the Inverted Faces Matching task, and group (SZ, SZA, and HC) served as a between-subjects variable. A MANOVA revealed a significant main effect for group, $F(4, 122) = 9.95, p < .0005, \text{ Wilks' Lambda } = .57, \eta^2 = .25$. Subsequent univariate tests indicated significant differences between groups for the Block Design subtest, $F(2, 62) = 19.74, p < .0005, \eta^2 = .39$, and for the Inverted Faces task, $F(2, 62) = 6.82, p < .005, \eta^2 = .21$. Follow-up Scheffe’ post-hoc tests for the Block Design subtest indicated that the HC group had higher scores than both SZ and SZA, $p's < .0005$, with no significant differences between SZ and SZA. For the Inverted Faces task, HC had higher scores than SZ, $p < .005$, while the SZ and SZA groups did not differ from each other. Figure 1 illustrates these patterns of performance. Table 4 includes descriptive statistics, the results of the univariate tests, and post-hoc comparisons. Table 4 also includes comparable analysis of the ranked data, including mean ranks for each group. Comparisons of ranked and unranked data revealed highly similar results. Using the

![Figure 1. Mean unranked scores for facial perception tests for Comorbid Schizophrenia / Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC).](image)

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Table 4

Performance on Measures of Facial Perception for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked and Unranked Data

<table>
<thead>
<tr>
<th>Test</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SZA</td>
<td>SZ</td>
<td>HC</td>
</tr>
<tr>
<td></td>
<td>n = 21</td>
<td>n = 22</td>
<td>n = 22</td>
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<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Unranked Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block Design</td>
<td>20.81</td>
<td>7.67</td>
<td>22.68</td>
</tr>
<tr>
<td>Inverted Faces</td>
<td>47.43</td>
<td>5.51</td>
<td>45.41</td>
</tr>
<tr>
<td>Ranked Data</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Block Design</td>
<td>22.95</td>
<td>26.86</td>
<td>50.36</td>
</tr>
<tr>
<td>Inverted Faces</td>
<td>29.07</td>
<td>25.09</td>
<td>44.66</td>
</tr>
</tbody>
</table>

Note. **** p < .0005, ***p < .005.
unranked data resulted in a loss of significance on the Inverted Faces task between the HC and SZA groups (this result approached significance, $p = .05$).

The second hypothesis examined whether there were differences in measures of emotion processing between the three groups (SZA, SZ, and HC). It was predicted that the SZ group would have higher scores on these tests than the SZA group, and that the HC group would have higher scores than both schizophrenia groups. A MANOVA was again used to test this hypothesis, with the dependent variables including the total mean scores for the Facial Affect Labeling task, Facial Affect Matching task, Emotional Stroop test (E-Stroop), and Emotional Verbal Learning Test (EVLT; Sum of Trials 1 – 5, Short Delayed Free-Recall, Long Delayed Free-Recall, and Long Delayed Recognition). A MANOVA revealed a significant main effect for the emotion processing tests, $F (14, 106) = 4.95, p < .0005$, Wilks’ Lambda = .37, $\eta^2 = .40$. Subsequent univariate tests identified significant differences between groups for each of the dependent variables, with the exception of the E-Stroop test, which was not significant. See Tables 5a and 5b for means, standard deviations, and univariate F-test results for the ranked and unranked data. Follow-up Scheffe’ post-hoc tests were calculated to determine group differences. For the EVLT Recognition test, HC had higher mean scores than SZ, $p < .005$, and SZA, $p < .0005$, with no significant differences between SZ and SZA. For the Facial Affect Matching and Facial Affect Labeling tasks, the HC group had higher mean scores than SZ, $p < .0005$, and SZA, $p < .005$, with no significant differences between SZ and SZA. For the Sum of Trials 1 – 5, Short Delayed Free-Recall, and Long Delayed Free-Recall tests of the EVLT, HC had higher mean scores than both SZ and SZA, $p's < .0005$, with no significant differences between SZ and SZA. Figure 2 depicts these patterns of
Table 5a

Performance on Measures of Emotion Processing for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Unranked Data

<table>
<thead>
<tr>
<th>Test</th>
<th>SZA</th>
<th>SZ</th>
<th>HC</th>
<th>Univariate Tests</th>
<th>Scheffe’</th>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SZ</td>
<td>n = 22</td>
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<td></td>
</tr>
<tr>
<td>HC</td>
<td>n = 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unranked Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EVLT Sum Trials 1-5</td>
<td>26.10</td>
<td>27.55</td>
<td>49.00</td>
<td>32.85****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT SD Free Recall</td>
<td>3.50</td>
<td>4.73</td>
<td>9.55</td>
<td>24.88****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT LD Free Recall</td>
<td>3.10</td>
<td>3.86</td>
<td>9.30</td>
<td>30.79****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT LD Recognition</td>
<td>10.20</td>
<td>11.41</td>
<td>15.10</td>
<td>11.36****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Affect Matching</td>
<td>92.15</td>
<td>87.05</td>
<td>105.95</td>
<td>14.05****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Affect Labeling</td>
<td>33.80</td>
<td>31.09</td>
<td>41.30</td>
<td>12.74****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>E-Stroop</td>
<td>28.95</td>
<td>29.14</td>
<td>29.55</td>
<td>0.51</td>
<td>ns</td>
</tr>
</tbody>
</table>

Note. **** p < .0005, SD = Short Delay, LD = Long Delay.
Table 5b

Performance on Measures of Emotion Processing for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked Data

<table>
<thead>
<tr>
<th>Test</th>
<th>SZA</th>
<th>SZ</th>
<th>HC</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVLT Sum Trials 1-5</td>
<td>22.65</td>
<td>25.07</td>
<td>53.43</td>
<td>31.06****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT SD Free Recall</td>
<td>21.20</td>
<td>27.98</td>
<td>51.60</td>
<td>25.94****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT LD Free Recall</td>
<td>22.65</td>
<td>25.93</td>
<td>52.68</td>
<td>27.68****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>EVLT LD Recognition</td>
<td>23.53</td>
<td>30.11</td>
<td>48.20</td>
<td>13.35****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Affect Matching</td>
<td>27.13</td>
<td>23.89</td>
<td>52.08</td>
<td>21.50****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Affect Labeling</td>
<td>28.20</td>
<td>25.20</td>
<td>50.05</td>
<td>15.57****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>E-Stroop</td>
<td>33.18</td>
<td>28.61</td>
<td>33.00</td>
<td>.59</td>
<td>ns</td>
</tr>
</tbody>
</table>

Note. **** p < .0005. SD = Short Delay, LD = Long Delay.
performance among groups. Results were highly similar, whether using ranked or unranked data.

![Graph showing mean unranked scores on tests of emotion processing for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ), and Healthy Controls (HC).]

Figure 2. Mean unranked scores on tests of emotion processing for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ), and Healthy Controls (HC).

The third hypothesis examined whether there was a bias for positive emotion and greater deficits for processing negative emotions among the three groups (SZA, SZ, and HC). For the first part of the third hypothesis, it was hypothesized that the groups would not differ in performance on tests of emotion processing when presented with the emotion of happiness or surprise. With respect to the second part of the third hypothesis, it was hypothesized that the SZA group would have greater deficits than the SZ group...
when presented with negative emotions on the tests of emotion processing, and that both schizophrenia groups would have more impaired performance on these tests than the HC group. Separate analyses were performed for each task to determine whether there were differences in the processing of specific emotions. More specifically, the dependent variables were the scores for each of the six emotions for the Facial Affect Labeling task (anger, sadness, happiness, fear, neutral and surprise) and Facial Affect Matching task (anger, sadness, happiness, fear, neutral and disgust). Similarly, for the EVLT the dependent variables were the mean scores for each of the four emotions (anger, sadness, happiness and anxiety). Finally, for the E-Stroop test, the dependent variables were the mean scores for each of the five emotions (anger, sadness, happiness, anxiety, and neutral).

For the Facial Affect Labeling task, the MANOVA revealed a significant main effect for group, $F(12, 116) = 2.27, p < .05$, Wilks’ Lambda = .66, $\eta^2 = .19$. Subsequent univariate tests identified significant differences between groups for each emotion, and these values are reported in Tables 6a and 6b. Follow-up Scheffe’ post-hoc tests were calculated to determine group differences. Results indicated that the HC group had higher mean scores than the SZ group for anger ($p < .01$), fear, and surprise ($p$'s < .05). For sadness, the HC group had higher mean scores than SZA ($p < .05$). For happiness and neutral, the HC group obtained higher scores than both SZ, $p < .05$ and $p < .005$, respectively, and SZA groups, $p$'s < .05. There were no significant differences between the SZ and SZA groups for any of the emotions. Figure 3 demonstrates these patterns of performance among groups. Again, comparison of the results, whether using ranked or unranked data, revealed highly similar results.
Table 6a

Facial Affect Labeling Task Performance by Type of Emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Unranked Data

<table>
<thead>
<tr>
<th>Affect Labeling Emotion</th>
<th>SZA</th>
<th>SZ</th>
<th>HC</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Unranked Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>5.41</td>
<td>1.71</td>
<td>4.77</td>
<td>2.14</td>
<td>6.45</td>
</tr>
<tr>
<td>Sadness</td>
<td>4.18</td>
<td>2.02</td>
<td>4.55</td>
<td>2.67</td>
<td>6.14</td>
</tr>
<tr>
<td>Happiness</td>
<td>6.91</td>
<td>1.54</td>
<td>6.82</td>
<td>1.62</td>
<td>7.95</td>
</tr>
<tr>
<td>Fear</td>
<td>3.36</td>
<td>2.26</td>
<td>3.23</td>
<td>2.11</td>
<td>5.09</td>
</tr>
<tr>
<td>Neutral</td>
<td>6.23</td>
<td>2.11</td>
<td>5.64</td>
<td>2.46</td>
<td>7.95</td>
</tr>
<tr>
<td>Surprise</td>
<td>6.27</td>
<td>1.83</td>
<td>6.09</td>
<td>1.77</td>
<td>7.41</td>
</tr>
</tbody>
</table>

Note. **** p < .0005, *** p < .005, ** p < .01, * p < .05.
Table 6b

Facial Affect Labeling Task Performance by Type of Emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked Data

<table>
<thead>
<tr>
<th>Affect Labeling Emotion</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SZA</td>
<td>SZ</td>
<td>HC</td>
</tr>
<tr>
<td></td>
<td>n = 22</td>
<td>n = 22</td>
<td>n = 22</td>
</tr>
<tr>
<td>Ranked Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>31.68</td>
<td>26.27</td>
<td>42.55</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sadness</td>
<td>26.45</td>
<td>30.68</td>
<td>43.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happiness</td>
<td>28.75</td>
<td>27.48</td>
<td>44.27</td>
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</tr>
<tr>
<td>Fear</td>
<td>29.57</td>
<td>28.48</td>
<td>42.45</td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>28.77</td>
<td>23.82</td>
<td>47.91</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Surprise</td>
<td>29.89</td>
<td>27.95</td>
<td>42.66</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. ****p < .0005, **p < .01, *p < .05.
For the Facial Affect Matching test, MANOVA revealed a significant main effect for group, $F(12, 116) = 3.28, p < .0005$, Wilks’ Lambda = .56, $\eta^2 = .25$. Subsequent univariate tests identified significant differences between groups for each emotion that are reported in Tables 7a and 7b. Follow-up Scheffe’ post-hoc tests were performed to determine group differences. These analyses indicated that the HC group obtained significantly higher scores than the SZA group for happiness, sadness, $p’s < .05$, and neutral, $p < .0005$; and significantly higher scores than the SZ group for happiness, sadness, anger, fear, $p’s < .005$; neutral, $p < .0005$; and disgust, $p < .01$. Again, no differences were present between the SZ and SZA groups for any of the emotions. Figure 4 shows these patterns of performance among groups. Comparison of ranked and
Table 7a

Facial Affect Matching Task Performance by Type of Emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Unranked Data

<table>
<thead>
<tr>
<th>Affect Matching Emotion</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SZA n=22</td>
<td>SZ n=22</td>
<td>HC n=22</td>
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<tr>
<td>Unranked Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>23.82</td>
<td>2.82</td>
<td>21.45</td>
</tr>
<tr>
<td>Sadness</td>
<td>21.36</td>
<td>3.44</td>
<td>20.45</td>
</tr>
<tr>
<td>Happiness</td>
<td>25.27</td>
<td>3.41</td>
<td>24.41</td>
</tr>
<tr>
<td>Fear</td>
<td>23.18</td>
<td>3.43</td>
<td>21.36</td>
</tr>
<tr>
<td>Neutral</td>
<td>22.68</td>
<td>4.39</td>
<td>22.50</td>
</tr>
<tr>
<td>Disgust</td>
<td>12.64</td>
<td>2.38</td>
<td>11.73</td>
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</table>

Note. ****p < .0005, ***p < .005, **p < .01.
Table 7b

Facial Affect Matching Task Performance by Type of Emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked Data

<table>
<thead>
<tr>
<th>Affect Matching Emotion</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
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</thead>
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<td>SZ</td>
<td>HC</td>
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<tr>
<td></td>
<td>n = 22</td>
<td>n = 22</td>
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<td>Anger</td>
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<td>M</td>
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<tr>
<td>Sadness</td>
<td>34.98</td>
<td>24.91</td>
<td>40.61</td>
</tr>
<tr>
<td>Happiness</td>
<td>28.23</td>
<td>26.64</td>
<td>45.64</td>
</tr>
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<td>Fear</td>
<td>28.86</td>
<td>24.48</td>
<td>47.16</td>
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<td>Neutral</td>
<td>30.43</td>
<td>25.14</td>
<td>44.93</td>
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<td>Disgust</td>
<td>25.20</td>
<td>24.86</td>
<td>50.43</td>
</tr>
<tr>
<td></td>
<td>30.14</td>
<td>25.48</td>
<td>44.89</td>
</tr>
</tbody>
</table>

Note. ****p < .0005, ***p < .005, *p < .05.
unranked data revealed similar results. Use of unranked data resulted in a loss of significant findings for the emotions of fear and disgust, such that the HC group did not significantly differ from the SZA group when using unranked data, but did differ significantly when using ranked data.

For the Emotional Verbal Learning Test, MANOVA revealed a significant main effect for group, $F(8, 120) = 7.08, p < .0005$, Wilks’ Lambda = .46, $\eta^2 = .32$. Subsequent univariate ANOVAs showed significant differences among groups for each emotion, $p’s < .0005$, and these values are reported in Table 8. Follow-up Scheffe’ post-hoc tests were calculated to determine group differences. For each emotion of anger, sadness, happiness, and anxiety, HC had higher mean ranked scores than both SZ and SZA,
Table 8

Emotional Verbal Learning Test (EVLT) Performance by Type of Emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked and Unranked Data

<table>
<thead>
<tr>
<th>EVLT Emotion</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
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</thead>
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<td>SZ</td>
<td>HC</td>
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<tr>
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<td>n = 22</td>
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</table>

Unranked Data

<table>
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<th>M</th>
<th>SD</th>
<th>M</th>
<th>SD</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>Anger</td>
<td>5.91</td>
<td>4.00</td>
<td>5.91</td>
<td>2.94</td>
<td>11.27</td>
<td>2.68</td>
<td>19.90****</td>
<td>HC&gt;SZ, SZA</td>
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<tr>
<td>Sadness</td>
<td>6.41</td>
<td>3.51</td>
<td>6.82</td>
<td>3.40</td>
<td>11.73</td>
<td>3.30</td>
<td>16.61****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Happiness</td>
<td>7.95</td>
<td>3.51</td>
<td>9.18</td>
<td>3.39</td>
<td>13.86</td>
<td>3.17</td>
<td>18.96****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
<tr>
<td>Anxiety</td>
<td>6.05</td>
<td>2.63</td>
<td>5.64</td>
<td>3.95</td>
<td>11.41</td>
<td>3.29</td>
<td>20.57****</td>
<td>HC&gt;SZ, SZA</td>
</tr>
</tbody>
</table>

Ranked Data

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th></th>
<th>M</th>
<th></th>
<th>F</th>
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<tbody>
<tr>
<td>Anger</td>
<td>25.41</td>
<td>25.27</td>
<td>49.82</td>
<td></td>
<td>18.45****</td>
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</tr>
<tr>
<td>Sadness</td>
<td>24.43</td>
<td>26.86</td>
<td>49.20</td>
<td></td>
<td>16.58****</td>
<td></td>
</tr>
<tr>
<td>Happiness</td>
<td>22.39</td>
<td>28.55</td>
<td>49.57</td>
<td></td>
<td>19.03****</td>
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</tr>
<tr>
<td>Anxiety</td>
<td>26.57</td>
<td>23.16</td>
<td>50.77</td>
<td></td>
<td>22.73****</td>
<td></td>
</tr>
</tbody>
</table>
No differences were present between the SZ and SZA groups. Figure 5 demonstrates these patterns of performance among groups. Comparison of ranked and unranked data revealed highly similar results.

Figure 5. Mean unranked scores on the EVLT by type of emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC).

A MANOVA examining the E-Stroop by type of emotion was not significant, $F(10, 110) = .88$, indicating that the groups did not differ on this measure. Means and standard deviations are presented in Table 9. Figure 6 illustrates these patterns of performance among groups.

Neuropsychological Tests

Finally, the neuropsychological test results were used in an additional analysis to compare overall cognitive functioning between groups. The dependent variables were
Table 9

*Emotional Stroop Test (E-Stroop) Performance by Type of Emotion for Comorbid Schizophrenia / Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked and Unranked Data*

<table>
<thead>
<tr>
<th>E-Stroop Emotion</th>
<th>SZA</th>
<th>SZ</th>
<th>HC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Unranked Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>5.80</td>
<td>0.52</td>
<td>5.86</td>
</tr>
<tr>
<td>Sadness</td>
<td>5.85</td>
<td>0.67</td>
<td>5.73</td>
</tr>
<tr>
<td>Happiness</td>
<td>5.75</td>
<td>0.55</td>
<td>5.86</td>
</tr>
<tr>
<td>Anxiety</td>
<td>5.80</td>
<td>0.41</td>
<td>5.82</td>
</tr>
<tr>
<td>Neutral</td>
<td>5.85</td>
<td>0.37</td>
<td>5.86</td>
</tr>
<tr>
<td>Ranked Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td>29.78</td>
<td>30.34</td>
<td>34.50</td>
</tr>
<tr>
<td>Sadness</td>
<td>33.33</td>
<td>29.39</td>
<td>32.00</td>
</tr>
<tr>
<td>Happiness</td>
<td>30.25</td>
<td>33.55</td>
<td>30.50</td>
</tr>
<tr>
<td>Anxiety</td>
<td>29.90</td>
<td>31.64</td>
<td>32.95</td>
</tr>
<tr>
<td>Neutral</td>
<td>30.00</td>
<td>31.64</td>
<td>32.85</td>
</tr>
</tbody>
</table>

the mean total scores for the Stroop Color-Word test, WAIS-III Vocabulary subtest, WAIS-III Information subtest, and CVLT (Sum of Trials 1 – 5, Short Delayed Free-Recall, Long Delayed Free-Recall, Long Delayed Recognition). A MANOVA revealed a significant main effect for group, $F(14, 108) = 4.48$, $p < .0005$, Wilks’ Lambda = .40,
Figure 6. Mean unranked scores on the E-Stroop test by type of emotion for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC).

\[ \eta^2 = .37 \]. Subsequent univariate tests identified significant differences between groups for each emotion and these values are reported in Tables 10a and 10b.

Follow-up Scheffe’ post-hoc tests were calculated to determine group differences. For the CVLT Sum of Trials 1 – 5, Short Delayed Free-Recall, and Long Delayed Free-Recall; HC had higher mean scores than both SZ and SZA, \( p's < .0005 \). For the CVLT Long Delayed Recognition, HC had higher mean scores than both SZ, \( p < .05 \) and SZA, \( p < .005 \). For the WAIS-III Vocabulary subtest, HC had higher mean scores than both SZ and SZA, \( p's < .0005 \). For the WAIS-III Information subtest, HC had higher mean scores than both SZ and SZA, \( p's < .01 \). For the Stroop test, HC had higher mean scores...
Table 10a

*Performance on Neuropsychological Tests for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Unranked Data*

<table>
<thead>
<tr>
<th>Test</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SZA n = 20</td>
<td>SZ n = 21</td>
<td>HC n = 22</td>
</tr>
<tr>
<td>CVLT Sum Trials 1-5</td>
<td>30.90 13.00</td>
<td>32.48 10.70</td>
<td>54.18 8.75</td>
</tr>
<tr>
<td>CVLT SD Free Recall</td>
<td>5.05 3.91</td>
<td>5.90 3.49</td>
<td>11.05 2.66</td>
</tr>
<tr>
<td>CVLT LD Free Recall</td>
<td>5.25 4.00</td>
<td>5.76 3.16</td>
<td>11.77 2.39</td>
</tr>
<tr>
<td>CVLT LD Recognition</td>
<td>11.75 3.61</td>
<td>12.57 2.56</td>
<td>14.91 1.15</td>
</tr>
<tr>
<td>WAIS-III Vocabulary</td>
<td>25.85 11.16</td>
<td>25.00 13.48</td>
<td>42.32 12.55</td>
</tr>
<tr>
<td>WAIS-III Information</td>
<td>10.75 4.59</td>
<td>10.95 4.90</td>
<td>15.82 4.86</td>
</tr>
<tr>
<td>Stroop Color-Word</td>
<td>73.90 10.43</td>
<td>75.43 4.79</td>
<td>79.32 1.46</td>
</tr>
</tbody>
</table>

*Note.* **** \( p < .0005 \), *** \( p < .005 \), * \( p < .05 \).
### Table 10b

**Performance on Neuropsychological Tests for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked Data**

<table>
<thead>
<tr>
<th>Test</th>
<th>Groups</th>
<th>Univariate Tests</th>
<th>Post-Hoc Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SZA</td>
<td>SZ</td>
<td>HC</td>
</tr>
<tr>
<td></td>
<td>n = 20</td>
<td>n = 21</td>
<td>n = 22</td>
</tr>
<tr>
<td>CVLT Sum Trials 1-5</td>
<td>23.00</td>
<td>26.38</td>
<td>52.68</td>
</tr>
<tr>
<td>CVLT SD Free Recall</td>
<td>24.10</td>
<td>27.60</td>
<td>51.14</td>
</tr>
<tr>
<td>CVLT LD Free Recall</td>
<td>24.08</td>
<td>26.33</td>
<td>52.18</td>
</tr>
<tr>
<td>CVLT LD Recognition</td>
<td>26.43</td>
<td>29.10</td>
<td>46.25</td>
</tr>
<tr>
<td>WAIS-III Vocabulary</td>
<td>26.95</td>
<td>25.52</td>
<td>47.16</td>
</tr>
<tr>
<td>WAIS-III Information</td>
<td>27.28</td>
<td>28.29</td>
<td>45.77</td>
</tr>
<tr>
<td>Stroop Color-Word</td>
<td>27.13</td>
<td>26.81</td>
<td>43.57</td>
</tr>
</tbody>
</table>

*Note.* **** $p < .0005$, *** $p < .005$. 
Figure 7. Mean scores on the neuropsychological tests for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC).

than SZA, \( p < .05 \). Figure 7 depicts these patterns of performance. Comparing ranked and unranked data revealed similar results. Using unranked data resulted in the loss of significant findings for the Stroop test when using unranked data, such that there was a significant difference between the HC group and SZ group on Stroop performance when using ranked data.
CHAPTER 5

DISCUSSION

The current study investigated differences in the processing of emotional information for individuals with schizophrenia, comparing those with schizophrenia and a comorbid diagnosis of alcohol dependence to individuals with schizophrenia alone and to healthy controls. It was hypothesized that the group with both schizophrenia and alcohol dependence would have more difficulty processing emotional information than the other two groups, not only because it was expected that the neurotoxic effects of alcohol would generally diminish performance on neurocognitive tests, but also because individuals with substance use disorders have been found to have deficits in a number of areas of social and emotional functioning that is unrelated to and predates the substance use disorder. The approach taken to investigate these issues was to utilize a number of well-established neuropsychological measures as well as some experimental cognitive procedures that were specifically developed to evaluate various component processes of the emotion processing system. Comparing and contrasting performance on standard non-emotional measures of neurocognitive function to those with emotional content provided a number of unique insights regarding the compounding effect of alcohol dependence on the emotion processing deficits already present in those with schizophrenia. Component processes of the emotion processing system that were examined included facial perception, attention, and memory. Additionally, differences in
the processing of positive and negative emotional information were investigated. In the following sections, findings regarding these component processes are discussed as are those results bearing on potential differences in the processing of positive and negative emotions.

Discussion of the Results

Hypothesis 1

The first hypothesis examined differences in visual spatial skills and facial perception among the three groups (SZA, SZ, and HC). Based on the literature, it was expected that the SZA group would perform worse on tests of visual spatial perception, such as the WAIS-III Block Design and Inverted Facial Matching task than the SZ group. It was also expected that both the SZA and SZ groups would perform more poorly on these visual spatial tests than the HC group. The MANOVA examining these differences did not support an additive detrimental effect for the SZA group. However, it did support that both the SZA and SZ groups performed worse on tests of visual spatial skills than the HC group.

The deficits on Block Design performance for the SZA and SZ groups were consistent with findings that individuals with schizophrenia have general deficits in visual spatial skills (Cooper, 1960; Hellewell et al., 1994; Place & Gilmore, 1980; Spiegel et al., 1962). Similarly, the deficits on the Inverted Facial Matching task for the SZA and SZ groups were consistent with findings that individuals with schizophrenia have consistently demonstrated impairments in facial processing (Bellack et al., 1996; Hellewell et al., 1994), including when asked to determine if two inverted faces matched.
(Feinberg et al. 1986). These results taken together support the existing literature that visual spatial perception and visual spatial facial perception are impaired in schizophrenia.

However, it does not appear that there are differential effects for comorbid schizophrenia with alcohol dependence. This may have been due to the low levels of current alcohol use of the SZA group, with most of these individuals having a lifetime rather than current diagnosis of alcohol dependence. For instance, research has shown that alcoholics recover cognitive functioning if they remain abstinent (Rourke & Grant, 1999). On the other hand, these same researchers noted that if alcoholics continue to drink, they also continue to demonstrate cognitive impairments. Nevertheless, the individuals in the SZA group reported low levels of alcohol use, which may have allowed for recovery of cognitive functioning. This in turn may account for the lack of significant findings. Another contributing factor is that some have shown that alcoholics do not demonstrate deficits in facial perception (Dricker et al., 1978).

**Hypothesis 2**

The second hypothesis investigated differences in emotion processing among the three groups (SZA, SZ, and HC). Based upon prior research, it was expected that the SZA group would perform worse than the SZ group on tests of affect processing, such as the Facial Affect Matching task, Facial Affect Labeling task, E-Stroop, and EVLT. Furthermore, it was expected that the SZA and SZ groups would perform more poorly than the HC group on these tests of emotion processing. The MANOVA examining these differences did not support an additive detrimental effect for the SZA group. However, it did support that both the SZA and SZ groups performed worse on three of the four tests.
of emotion processing than the HC group. Overall, these findings suggest that HC were better at labeling and discriminating facial affect and their attention was less influenced when presented with emotional words.

The findings that controls were more accurate in labeling and discriminating facial affect than individuals with schizophrenia supports the majority of the literature (Addington & Addington, 1998b; Bell et al., 1997; Borod et al., 1989, 1990; Cramer, Weegmann, & O’Neil, 1989; Feinberg et al. 1986; van der Gaag & Haenen, 1990; Garfield et al., 1987; Kerr & Neale, 1993; Mandal & Palchoudhury, 1985; Mandal & Rai, 1987; Mueser et al., 1996; Muzekari & Bates, 1977; Salem et al., 1996; van der Gaag & Haenen, 1990; Walker et al., 1980; Zuroff & Colussy, 1986). However, the expectation that SZA would have greater emotion processing deficits than SZ was not supported. Researchers have identified deficits in facial affect labeling, and predicted that these deficits would be intermediate between controls and individuals with schizophrenia (Bell et al., 1997). It has also been shown that severity of alcohol use is related to alexithymia (Uzun, 2003). Perhaps, the lack of additive detrimental effects was due to the current low severity level of alcohol use in the SZA group and the majority of participants in this group were abstinent. Research has shown that with alcoholics, approximately 52% - 60% experience recovery from symptoms of alexithymia with abstinence (Loas et al., 1997; Ziôtkowski et al., 1995).

Hypothesis 3

The first part of the third hypothesis examined whether there was a bias for positive emotions among the three groups (SZA, SZ, and HC). Based upon the literature, it was hypothesized that the SZA, SZ, and HC groups would not differ in performance on tests
of emotion processing when presented with the emotion of happiness or surprise. These tests included the Facial Affect Matching task, Facial Affect Labeling task, E-Stroop, and EVLT. The MANOVAs examining these differences did not support this hypothesis. Instead, the results revealed that the HC group had more accurate responses when presented with the emotion of happiness on three of the four tests of emotion processing than both the SZA and SZ groups, and there were no significant differences in performance between the SZA and SZ groups. The E-Stroop test result was not significant. Overall, these findings do not support a bias for the emotion of happiness. The emotion of surprise only occurred on one test, on which, the HC group was more accurate at labeling facial affect than the SZ group. Thus, participants performed similarly whether presented with the emotion of happiness or surprise.

These findings were inconsistent with several studies with individuals with schizophrenia (Borod et al., 1990; Dougherty et al. 1974; Frigerio et al., 2002; Garfield et al, 1987; Mandal, 1987) and Korsakoff’s syndrome (Brand et al., 2003). However, others have also failed to identify a bias for positive emotions (Heimberg et al., 1992; Zuroff & Colussy, 1986).

The second part of the third hypothesis evaluated whether there was greater impairment for the processing of negative emotions among the three groups (SZA, SZ, and HC). Based upon prior research, it was hypothesized that the SZA group would have greater deficits than the SZ group when presented with negative emotions on the tests of emotion processing. These tests included the Facial Affect Matching task, Facial Affect Labeling task, E-Stroop, and EVLT. Furthermore, it expected that both the SZA and SZ groups would have more impaired performance on these tests than the HC group. The
MANOVAs did not support an additive detrimental effect for the SZA group. Overall, analyses supported that the HC group was generally more accurate in processing negative emotions on three of the four tests of emotion processing. However, the patterns of difference were not uniform. For example, the E-Stroop test was not significant across types of emotion. There were no significant differences in performance between the SZA and SZ groups.

Due to the lack of uniformity of findings, with respect to negative emotions, each emotion will be presented separately. When presented with angry stimuli, the HC group was more accurate at labeling and discriminating facial affect than the SZ group, and the HC group learned more emotionally-laden words than both the SZ and SZA groups. For the emotion of fear/anxiety, the HC group was more accurate at labeling facial affect than the SZ group, and the HC group was more accurate at discriminating facial affect and learned more emotionally-laden words than both the SZ and SZA groups. When presented with sad stimuli, the HC group was more accurate at labeling facial affect than the SZA group, and the FIC group was more accurate at discriminating facial affect and learned more emotionally-laden words performed better than both the SZ and SZA groups.

The emotion of disgust occurred on one test, on which, the HC group was more accurate at discriminating facial affect than both the SZA and SZ groups. Neutral stimuli were only used on the facial affect tasks. When presented with neutral stimuli, the HC group was also more accurate at labeling and discriminating facial affect than the SZ group.
When the results of parts 1 and 2 of the third hypothesis are taken together, there does not appear to differences in the processing of positive and negative emotions. The lack of significant findings for a bias towards positive emotions and greater impairments in the processing of negative emotions is contradictory to much of the research (Borod et al., 1990; Dougherty et al. 1974; Frigerio et al., 2002; Garfield et al, 1987; Mandal, 1987; Wölwer et al., 1996). Perhaps this lack of findings is due to the intensity of depicted emotions, such that facial expressions are easier to identify when they are more obvious (Mandal, 1987). Komreich et al., (2001a) looked at mild and moderate variations of facial emotions, and found that controls were more accurate in emotion identification than alcoholics for the moderate displays of facial emotions. These same researchers also showed a bias for happy and angry faces in alcoholics.

Overall, the data support that controls are more accurate in emotion processing than individuals with schizophrenia. It is acknowledged that there was some variability in which schizophrenia group differed from controls, depending on the specific emotion or test. However, when the SZ and SZA group are viewed holistically, a clear picture of emotion processing deficits emerges for the schizophrenia group. These deficits cannot be completely attributed to deficits in facial processing because individuals with schizophrenia were also impaired on visual spatial tasks. Thus, it seems that deficits associated with facial perception may be due to deficits in visual spatial skills. Consequently, this suggests a more generalized deficit in emotion processing in schizophrenia (Salem et al., 1996; Streit et al., 1997).

If emotion processing deficits in schizophrenia are in fact more of a generalized deficit, then this does not support hypotheses that neuroanatomic abnormalities in the
amygdala, anterior insula, and ventral striatum may account for deficits in emotion processing in individuals with schizophrenia (Phillips, Drevets, Rauch, & Lane, 2003). As such, other theories, including the possibility that deficits in visual scanning that may contribute to impairments in emotion processing may better explain these deficits (Addington & Addington, 1998b; Corrigan et al., 1994; Schwartz et al., 1999). Another related possibility is that deficits in structuring or organizing incoming stimulus slows down cognitive processes and results in difficulty separating out irrelevant information (Cramer et al., 1992). Perhaps, individuals focus on the wrong facial attributes when judging facial affect (Streit et al., 1997).

Studies have also shown that certain emotions are more lateralized in the brain, such as sadness (Federman et al., 1998). However, not all people demonstrate these laterality effects (Federman et al., 1998). Another study found a laterality effect for facial perception based upon the subtype of schizophrenia, specifically paranoid schizophrenia (Magaro & Chamrad, 1983). Yet, another study noted gender differences, such that males processed certain emotional stimuli with the right amygdala, whereas women processed the same emotional stimuli with the left amygdala (Cahill & van Stegeren, 2003). Interestingly, alcoholics tend to process visual presentations of positive and negative emotional words and neutral words with the left hemisphere (Hutner & Oscar-Berman, 1996). These studies may account for some of the variability seen in the literature.

**Neuropsychological Tests**

The neuropsychological test results were used in an additional analysis to compare overall cognitive functioning between groups. Although specific initial predictions were
not made, based upon the limited literature, it was expected that the HC group would outperform the SZA and SZ groups on all cognitive variables, and that the SZ group would perform better than the SZA group. The tests used in the analyses were the Stroop; WAIS-III Vocabulary subtest; WAIS-III Information subtest; and CVLT (the sum of trials 1 through 5, short delayed free-recall, long delayed free-recall, and long delayed recognition). A MANOVA revealed that the HC group performed better than the SZA and SZ groups on all of the tests, and there were no significant differences between the SZA and SZ groups. These findings support the belief that individuals with schizophrenia have global cognitive deficits (Bellack, Blanchard, & Mueser, 1996; Goldman-Rakic, 1994; Hellewell, Connell, & Deakin, 1994).

Strengths of the Study

The most important strength of this study is that it investigated the relationship between comorbid schizophrenia with substance dependence and emotion processing, which has not occurred in the literature to date. The approach to assessing diagnoses, cognitive functioning, and emotion processing was comprehensive in nature. The participants in the SZA and SZ groups were homogenous in many characteristics, including diagnoses, outpatient day treatment program, and stabilization on medication.

Overall, this study revealed that individuals with schizophrenia have more global deficits in cognitive and emotion processing. With respect to emotion processing, individuals with schizophrenia were impaired on tests of facial affect labeling, facial affect discrimination, and emotional verbal learning and memory. As for cognitive
functioning, individuals with schizophrenia were impaired on tests of attention, verbal memory and learning, general knowledge, and verbal knowledge.

Limitations of the Study

There are also limitations to this study. The primary purpose of this study was to establish some of the basic foundation for this line of research in order to generate interest and increase future studies in this area. One limitation was the use of a small sample size. A larger sample size was initially targeted. However, due to stringent criteria to remove as many confounds as possible, the size of each group was 22, for a total of 66 participants. Smaller sample sizes often result in decreased power to detect differences. As such, the results reflect a fairly conservative statistical approach to evaluating the hypotheses, thus the significant results that were obtained seem to be robust.

Another limitation related to the sample was the use of both current and lifetime diagnoses of alcohol dependence. Initially, attempts were made to only utilize individuals in the SZA group with a current diagnosis of alcohol dependence. However, soon after data collection began it became apparent that this was not feasible. For example, at the end of data collection, only 32% of the resulting SZA group had a current diagnosis of alcohol dependence. Furthermore, the current level of use for the SZA group was mild, but these individuals had a history of chronic and severe alcohol use. As such, this trend in alcohol use may have differed from other studies, which may account for some of lack of significant findings between the SZ and SZA groups.
Another limitation was the lack of an alcoholic control group. As previously mentioned, the purpose of this study was to establish some basic science concerning the impact of a dual diagnosis on schizophrenia. Therefore, it is my hope that future research will further explore this area of research using an additional alcoholic group, using a multi-center diverse population of participants, with even more stringent criteria for inclusion in the study.

Another possible limitation is the type of emotional stimuli that were utilized for the study. Future research may explore the relationship between different intensities of emotion and dual diagnoses. Future research may also explore different modalities of emotion, including auditory measures.

Conclusions

The research has failed to reach a consensus as to what causes emotion processing deficits in schizophrenia. Moreover, there is no research investigating emotion processing deficits in dually diagnosed individuals. Overall, there is a general lack of basic science concerning emotion processing in the dually diagnosed. As such, this study attempts to gain insight into emotion processing in the dually diagnosed and lay some of the basic foundation for the literature.

This type of research is important because having a better understanding of emotional and cognitive processes in dual diagnoses, may provide greater insight into developing and improving treatments for these individuals. It is surprising that this area has not been more researched because of the high prevalence rates of comorbid schizophrenia with alcohol abuse disorders, an estimated 34% (Regier et al., 1990). Furthermore, the impact
of comorbid substance use disorders has significant effects on the individual and society. For example, dually diagnosed individuals tend to report lower levels of quality of life; have greater risk for depression; have higher rates of medication noncompliance and legal problems; have greater risk for violence, engaging in criminal activities, homelessness, and tardive dyskinesia; and experience more interpersonal difficulties.

The findings suggest that emotion processing deficits are reflective of a global deficit in this area. Given that these deficits tend to be stable across time (Bell et al.; Wölwer et al., 1996), it seems that this may be a target area for remediation and treatment. At this time, the primary treatment for schizophrenia is medication. However, given the high rates of medication noncompliance and the large proportion of individuals who are treatment-resistant, it seems that other areas of remediation need to be explored and utilized.

The results also support that cognitive functioning is detrimentally affected in schizophrenia. The impact of substance use on cognitive functioning in schizophrenia is not well-established in the literature, such that there are only a limited number of studies. As previously mentioned, the high prevalence rates of comorbidity with substance abuse exist, yet the effects of this are largely unknown. As such, it is uncertain if this dually diagnosed population differs significantly from the singly diagnosed individuals with schizophrenia. Moreover, if there are differences, these may provide insight into other target areas for treatment.
Table A1

Performance on Measures of Facial Perception for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked and Unranked Data, with Education Covaried

<table>
<thead>
<tr>
<th>Test</th>
<th>Multivariate / Univariate Tests</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>$F$</td>
</tr>
<tr>
<td>Unranked Data</td>
<td></td>
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<tr>
<td>Main Effect for Group</td>
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<td>Main Effect for Education</td>
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<td>Block Design</td>
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<tr>
<td>Inverted Faces</td>
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<td>Ranked Data</td>
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<td>Main Effect for Group</td>
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<td>Block Design</td>
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</tr>
<tr>
<td>Inverted Faces</td>
<td>6.17</td>
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</table>
APPENDIX B

Table B1a

*Performance on Neuropsychological Tests for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Ranked Data, with Education Covaried*

<table>
<thead>
<tr>
<th>Test</th>
<th>Multivariate / Univariate Tests</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Stroop Color-Word</td>
<td>5.31</td>
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Table B1b

**Performance on Neuropsychological Tests for Comorbid Schizophrenia/Alcohol Dependence (SZA), Schizophrenia Controls (SZ) and Healthy Controls (HC) for Unranked Data, with Education Covaried**

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REFERENCES


Kamali, M., Kelly, L., Gervin, M., Browne, S., Larkin, C., & O’Callaghan, E. (2000). The prevalence of comorbid substance misuse and its influence on suicidal ideation...


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