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Smoking topography and smoking-related outcome expectancies in smokers with schizotypy

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SMOKING TOPOGRAPHY AND SMOKING-RELATED OUTCOME EXPECTANCIES IN SMOKERS WITH SCHIZOTYPY

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Table of Contents

Abstract

Individuals with schizophrenia have extremely high smoking rates (70-88%). Compared to smokers in the general population, smokers with schizophrenia have more intense smoking patterns (e.g., more cigarettes per day; smoke stronger cigarettes; higher nicotine dependence, carbon monoxide (CO) boosts, cotinine, and nicotine levels; more extreme smoking topography) and more positive smoking outcome expectancies. However, the relationship between smoking and symptomatology is quite complex. Insight might be gleaned by studying the relationship between smoking and schizotypy, or the putative genetic vulnerability to developing schizophrenia, as it avoids many confounds associated with schizophrenia. This study investigated schizotypy symptoms, smoking characteristics and behaviors, and outcome expectancies in undergraduate students with psychometrically identified schizotypy and demographically matched controls without schizotypy. Results from the screening phase revealed no significant differences in schizotypy traits between smokers with schizotypy (n = 77) and nonsmokers with schizotypy (n = 69). Of those who attended the laboratory phase (n = 44), smokers with schizotypy (n = 26) had significantly higher nicotine dependence than control smokers without schizotypy (n = 18). There was also a non-significant trend in which smokers with schizotypy smoked more cigarettes per week. Additionally, results revealed that smokers with schizotypy were more likely than control smokers to endorse more positive consequences (i.e., improved state enhancement, stimulation, social facilitation, taste/sensorimotor manipulation; boredom and negative affect reduction) than negative consequences of smoking. There were no significant differences between smokers with schizotypy and control smokers on smoking behaviors such as smoking topography or CO readings. These preliminary findings offer insight into mechanisms underlying smoking in individuals with schizotypy.

Introduction

Cigarette smoking is the leading cause of morbidity and mortality in the United States. Each year, 8.6 million people live with smoking-related illnesses, and 438,000 individuals die from either smoking or exposure to smoke (Centers for Disease Control and Prevention (CDC), 2007). Although smoking prevalence for the general population has decreased during the past several decades, prevalence for those with psychiatric disorders has remained disproportionately high (Lasser et al., 2000; McChargue, Gulliver, & Hitsman, 2002). In fact, individuals with a current psychiatric disorder consume 44.3% of all cigarettes sold annually, and are more than twice as likely to be current smokers than those with no psychiatric disorder (41% vs. 20.8%, CDC, 2007; Lasser et al., 2000). It is notable that smoking is more prevalent in individuals with severe mental illnesses, such as schizophrenia (Hughes, Hatsukami, Mitchell, & Dahlgren, 1986; Workgroup on Substance Use Disorders, 2006).

Smoking and Schizophrenia

Schizophrenia is a chronic and disabling psychiatric disorder that affects approximately 1.5% of the population (American Psychiatric Association (APA), 2000). Symptoms fall into three categories: positive (e.g., delusions, hallucinations), negative (e.g., restricted range of affect, cognitive impairment, reduced goal-directed activity, anhedonia), and disorganization (e.g., odd or strange behavior, disorganized speech or behavior). Those with schizophrenia also typically struggle with interpersonal relationships, work, and self-care behaviors.

Individuals with schizophrenia tend to have higher smoking prevalence rates than those with other psychiatric disorders (CDC, 2008; de Leon, Diaz, Rogers, Browne, & Dinsmore, 2002a; Ucok, Polat, Bozkurt, & Meteris, 2004). Studies have found that 70% to 88% of persons with schizophrenia smoke cigarettes (de Leon, 1996; Esterberg & Compton, 2005; Goff et al., 2005; Hughes et al., 1986; Workgroup on Substance Use Disorders, 2006). Smokers with

schizophrenia typically smoke more cigarettes per day (de Leon et al., 1995; Ucok et al., 2004), endorse heavy smoking (≥ 25 cigarettes per day; Lasser et al., 2000), smoke stronger cigarettes (e.g., menthol, discount; Olincy, Young, & Freedman, 1997; Williams et al., 2007), and are more nicotine dependent (scores ≥ 6 on the Fagerström Test for Nicotine Dependence (FTND; de Leon, Becoña, Gupegui, Gonzalez-Pinto, & Diaz, 2002c; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), as compared to smokers without a diagnosis of schizophrenia. They also have lower rates of smoking cessation (Lasser et al., 2000). Although several randomized control trials have found that smokers with schizophrenia tend to report being motivated to quit, they usually have quite low quit rates (Williams & Hughes, 2003).

These smoking characteristics appear to be present in smokers with schizophrenia regardless of treatment setting (e.g., inpatient, outpatient), culture, and geographical location, and remain even when controlling for possible confounds such as alcohol use, socioeconomic status, marital status, age, gender, and antipsychotic medication use (de Leon et al., 1995; de Leon, Tracy, McCann, & McGrory, 2002b; Glassman, 1993; Hughes et al., 1986; Lohr & Flynn, 1992). Consequently, smoking-related illnesses occur at a disproportionately higher rate among smokers with schizophrenia (Wildgust, Hodgson, & Beary, 2010). Also, smokers with schizophrenia have an increased likelihood of dying from cardiovascular (30%) or respiratory (60%) disease as compared to smokers without schizophrenia (Baxter, 1996; Dalack, Healy, & Meador-Woodruff, 1998). As a result, their life expectancy is 20% lower compared to the general population (Hennekens, Hennekens, Hollar, & Casey, 2005).

Previous research and clinical observations indicate that smokers with schizophrenia have unique smoking characteristics. They are efficient and intense smokers (Kelly & McCreadie, 1999; Olincy et al., 1997; Strand & Nybäck, 2005; Tidey, Rohsenhow, Kaplan, & Swift, 2005) who often spend most of the day smoking, smoke their cigarettes down to the filter, and smoke

discarded butts and filters, which contain greater concentrations of nicotine (Williams & Ziedonis, 2004). Furthermore, smokers with schizophrenia differ significantly in their smoking topography. Smoking topography is defined as the physical characteristics of smoking, which include puff volume and duration, frequency, and interval between puffs. Compared to smokers in the general population, individuals with schizophrenia take more puffs per cigarette, have shorter inter-puff intervals, have larger total puff volumes, and obtain higher carbon monoxide (CO) boosts (Hitsman et al., 2005; Olincy et al., 1997; Tidey et al., 2005; Tidey, Rohsenow, Kaplan, Swift, & Adolfo, 2008; Williams, Gandhi, Karavidas, & Foulds, 2006; Williams et al., 2010). Previous studies have also found that smokers with schizophrenia have higher nicotine and cotinine (an active metabolite of nicotine) levels, suggesting a higher level of nicotine dependence (the psychiatric diagnosis which entails tolerance, withdrawal, and associated problems; APA, 2000; Olincy et al., 1997; Strand & Nybäck, 2005; Williams et al., 2005).

Factors Related to Increased Smoking Prevalence in Schizophrenia

Psychosocial and biological factors appear to contribute to the strong relationship between smoking and schizophrenia; however, the relative contribution of each remains complicated and unclear (Workgroup on Substance Use Disorders, 2006). Previous studies have explored this association by investigating differences among smokers and nonsmokers with and without schizophrenia (e.g., Ziedonis et al., 2008).

It is unknown which specific combination of variables contributes to the high rates of comorbidity between schizophrenia and smoking. However, research has suggested that psychosocial factors (i.e., low socioeconomic status, low educational attainment, unemployment, peer pressure, parental smoking, economic and familial restrictions) contribute to the relationship between smoking and schizophrenia (Riala, Hakko, Isohanni, Pouta, & Räsänen, 2004; Srinivasan & Thara, 2002; see Ziedonis et al., 2008).

Data suggest that smokers with schizophrenia might have unique motivators for smoking, or smoking outcome expectancies (Barr, Procyshyn, Hui, Johnson, & Honer, 2008; Benowitz, 1999; Forchuk et al., 2002; Glassman, 1993; Glynn & Sussman, 1990; Lohr & Flynn, 1992; McEvoy & Brown, 1999). Smoking outcome expectancies are the beliefs that smokers have about the consequences of smoking. Smoking expectancies can be either positive (i.e., smoking facilitates social interactions, smoking reduces boredom and/or negative affect) or negative (i.e., smoking is harmful to health, others might disapprove of smoking). Expectancies about smoking are associated with intention to quit and are predictive of success with smoking cessation. Notably, smokers who intend to quit smoking report higher concern about the negative consequences of smoking than those who do not intend to quit (Brandon, Juliano, & Copeland, 1999). Conversely, smokers with schizophrenia typically report more positive than negative smoking expectancies, as they smoke for relaxation, routine, socialization, sedation, control of medication side effects, and control of negative affect or symptoms (e.g., boredom, anhedonia; Forchuk et al., 2002; Galazyn, Steinberg, Gandhi, Williams, & Piper, 2010; Glynn & Sussman, 1990; Lohr & Flynn, 1992; Tidey & Rohsenow, 2009). Several studies found that for smokers with schizophrenia, reduction of negative affect was the most important positive expectancy (Buckley et al., 2005; Esterberg & Compton, 2005; Forchuk et al., 2002; Solty, Crockford, White, & Currie, 2009; Tidey & Rohsenow, 2009). Many smokers with schizophrenia perceive the benefits of smoking to outweigh the costs, report little social or psychiatric support for quitting, and have low motivation to quit smoking (APA, 2004; Esterberg & Compton, 2005; Forchuk et al., 2002; see Ziedonis et al., 2008). Positive smoking expectancies are associated with heavy and daily smoking in healthy adults (Brandon & Baker, 1991; Copeland, Brandon, & Quinn, 1995; Jeffries et al., 2004). Thus, it is not surprising that individuals with schizophrenia, who tend to be daily and heavy smokers, endorse strong positive smoking expectancies.

Biological research suggests that individuals with schizophrenia smoke to improve the functioning of several neurotransmitter systems (e.g., dopamine, serotonin, GABA, glutamate; Dalack et al., 1998; see Ziedonis et al., 2008). Also, smokers with schizophrenia might smoke as an attempt to self-medicate or control unpleasant medication side effects and symptoms of schizophrenia, including cognitive deficits (e.g., attention, memory, auditory sensory gating) and negative symptoms (e.g., anhedonia; Adler et al., 1998; Dalack et al., 1998; Leonard et al., 1998; 2001). Previous studies have supported the self-medication hypothesis by demonstrating that nicotine improves cognitive functioning in those with schizophrenia by normalizing an abnormal P50 auditory sensory gating response (Adler, Hoffer, Wise, & Freedman, 1993; Adler et al., 1998; George et al., 2006). The P50 suppression paradigm is a measure of sensory gating and purports that when two auditory stimuli occur 500 milliseconds apart, the response to the second stimuli is inhibited for healthy individuals. However, for individuals with schizophrenia, there is a failure to inhibit the response to the second stimulus, which reflects inhibitory deficits. In addition, for those with schizophrenia, nicotine enhances visuospatial working memory deficits (Sacco et al., 2005), verbal memory (Harris et al., 2004; Levin, Wilson, Rose, & McEvoy, 1996), and smooth-pursuit eye movement (Avila, Sherr, Hong, Myers, & Thaker, 2003; Olincy et al., 1998). Notably, nicotine is not associated with improved cognitive functioning in smokers without schizophrenia (e.g., Dalack et al., 1998).

Smoking and Schizophrenia Symptomatology

Although smoking has been related to less severe negative symptoms in patients with schizophrenia by some accounts (Esterberg & Compton, 2005; Forchuk et al., 2002; Ziedonis, Kosten, Glazer, & Frances, 1994), previous research has indicated that the relationship between smoking and symptomatology is quite complex. Studies have found a positive relationship between smoking and positive symptomatology (Ziedonis et al., 1994), negative

symptomatology (Patkar et al., 2002), both positive and negative symptomatology (Goff, Henderson, & Amico, 1992), disorganization symptomatology (Aguilar, Gurpegui, Diaz, & de Leon, 2005), and no relationship with either positive or negative symptoms (Addington, el-Guebaly, Campbell, Hodgins, & Addington, 1998; Dalack, Becks, Hill, Pomerleau, & Meador-Woodruff, 1999). It is important to note that the use of atypical antipsychotic medication (e.g., clozapine) leads to improvements in cognitive deficits and negative symptoms, as well as reduced smoking in heavy smokers (George, Sernyak, Ziedonis, & Woods, 1995; Light, Geyer, Clementz, Cadenhead, & Braff, 2000; McEvoy et al., 1999; McEvoy, Freudenreich, & Wilson 1995). In summary, while there are many potential reasons for the high smoking prevalence in persons with schizophrenia, research findings have lacked consistency.

Interestingly, studies have purported that most individuals with schizophrenia start smoking prior to the onset of schizophrenia (Beratis, Katrivanou, & Gourzis, 2001; de Leon, 1996; de Leon et al., 2002c; 2002a; Kelly & McCreadie, 1999; McEvoy & Brown, 1999; Riala et al., 2004). Beratis and colleagues (2001) reported that 86% of individuals with schizophrenia smoked prior to the onset of symptoms. This provides strong evidence that medication side effects alone are not to blame for increased smoking prevalence and suggests a shared vulnerability between cigarette smoking and schizophrenia (e.g., de Leon & Diaz, 2005). Perhaps subclinical symptomatology (e.g., cognitive deficits, negative symptoms) existing prior to illness onset makes individuals more susceptible to smoking. Further knowledge on these issues might be gained by examining the relationship between smoking and schizotypy.

Smoking and Schizotypy

Schizotypy is the putative genetic vulnerability to developing schizophrenia spectrum pathology without necessarily manifesting full-blown phenotypic expression (Chapman, Chapman, Raulin, & Edell, 1978; Meehl, 1962). Those with schizotypy exhibit subclinical

biologically determined traits (e.g., unusual beliefs or experiences, anhedonia, social awkwardness) that are similar to symptoms of schizophrenia (e.g., positive, negative, disorganization symptoms; Claridge, 1985; Siever, Kalus, & Keefe, 1993). Schizotypy traits are commonly observed in first-degree relatives of individuals with schizophrenia, but have also been described as a prodromal phase of schizophrenia (Fanous, Gardner, Walsh, & Kendler, 2001; Schultz & Andreasen, 1999; Tcheslavski, 2008). Research investigating the relationship between smoking and schizotypy is particularly important as it avoids many confounds associated with studying individuals with schizophrenia (e.g., medication interactions, illness chronicity, psychosocial decline; Esterberg, Jones, Comptom, & Walker, 2007). It is unlikely that these issues affect those with schizotypy.

Although few studies have explored the relationship between smoking and schizotypy, the evidence indicates a positive relationship between the two (Allan et al., 1995; Esterberg et al., 2007; Larrison, Briand, & Sereno, 1999; Stewart, Cohen, & Copeland, 2010; Wiles, Zammit, Bebbington, Singleton, & Meltzer, 2006). Allan and colleagues (1995) found that schizotypy was positively correlated with smoking and number of cigarettes smoked per day.

Research has also found that smokers tend to score higher than nonsmokers on measures of schizotypy (Esterberg, Goulding, Mclure-Tone, & Compton, 2009; Esterberg et al., 2007; Joseph, Manafi, Iakovaki, & Cooper, 2003; Larrison et al., 1999; Williams et al., 1996). One study exploring the association between smoking and schizotypy in a sample of healthy adults found that smokers had higher schizotypy scores than nonsmokers, even after controlling for possible confounds (e.g., age, gender, education, psychoticism, neuroticism; Williams et al., 1996). The authors concluded that smoking might contribute to the development of schizophrenia spectrum disorders. They noted that their results supported the contention that high schizotypy scores are associated with an increased risk for developing schizophrenia

(Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994), as smoking has been related to an earlier onset of and more severe symptoms of schizophrenia (Goff et al., 1992; Sandyk & Kay, 1991). Esterberg and colleagues (2007) conducted a study in which they assessed and compared schizotypal and smoking-related characteristics between healthy controls and first-degree relatives of individuals with schizophrenia. Results revealed that smokers had higher levels of schizotypy, but this relationship was only significant for first-degree relatives. This finding supports previous research suggesting a shared vulnerability between smoking and schizophrenia (e.g., de Leon & Diaz, 2005). Another study conducted by Wiles and colleagues (2006) yielded similar results. Using longitudinal data from the British National Psychiatric Morbidity Survey, the authors sought to determine specific risk factors for psychosis. Results indicated that smokers were 70% more likely than nonsmokers to report the incidence of psychotic symptoms.

As previously mentioned, research has indicated that smokers with schizophrenia have different smoking patterns from smokers in the general population (Kelly & McCreadie, 1999; Olincy et al., 1997; Strand & Nybäck, 2005; Tidey et al., 2005). They have higher cotinine and nicotine levels, more intense smoking topography (i.e., more puffs per cigarette, shorter inter-puff intervals, larger total puff volumes, greater puff duration), and higher CO boosts (Hitsman et al., 2005; Olincy et al., 1997; Strand & Nybäck, 2005; Tidey et al., 2005; Williams et al., 2006). Despite this, no previous studies have assessed smoking topography or biological indicators of smoking (i.e., CO, cotinine) in smokers with schizotypy. As individuals with schizotypy exhibit less severe symptoms than those with schizophrenia, research is needed to assess whether or not smokers with schizotypy have similar smoking behaviors and comparable levels of nicotine dependence to smokers with schizophrenia.

Smoking and Schizotypy Traits

Although previous research supports the relationship between schizotypy and smoking,

studies examining smoking prevalence across schizotypy traits have been inconsistent. To date, six studies have reported that smoking is associated with increased positive symptoms (Allan et al., 1995; Burch, Hemsley, & Corr, 2008; Esterberg et al., 2007, 2009; Joseph et al., 2003; Wan, Crawford, & Boutros, 2007), two studies found that it is associated with increased negative symptoms (Burch et al., 2008; Esterberg et al., 2007), one study found that it was linked to less severe negative symptoms (Stewart et al., 2010), and four found that it was related to increased disorganization symptoms (Esterberg et al., 2007, 2009; Stewart et al., 2010; Wan, Friedman, Boutros, & Crawford, 2008).

It has been suggested that these inconsistent findings might be due to the following three methodological issues (e.g., Stewart et al., 2010). First, prior studies have utilized various measures of schizotypy traits, and as a result, might not have captured the full spectrum of positive, negative, and disorganization schizotypy traits. Second, some measures of schizotypy (e.g., the "Psychoticism" scale from the Eysenck Personality Questionnaire) have questionable relevance to schizotypy. Third, many previous studies conceptualized schizotypy dimensionally when in fact, research and theory purport that it is categorical in nature, with a population incidence of about 10% (Blanchard, Gangestad, Brown, & Horan, 2000; Meehl, 1962). It is therefore likely that few participants from previous studies actually had schizotypy in any meaningful sense of the word.

To our knowledge, only three previous studies defined schizotypy categorically Esterberg et al., 2007; Stewart et al., 2010; Wan et al., 2008). The first of these studies is the aforementioned Esterberg et al. (2007) study. The researchers reported that for biological relatives of individuals with schizophrenia, smoking was related to more severe positive, negative, and disorganization schizotypy traits. In the second study, Wan and colleagues (2008) assessed gender differences in schizotypy and smoking in a sample of healthy adults. Results

indicated that daily smoking was related to cognitive-perceptual deficits and name lapses, while non-daily smoking was associated with memory problems. In addition, males were more likely than females to report name lapses and interpersonal and disorganized deficits. More recently, Stewart et al. (2010) compared schizotypy traits and smoking characteristics in a sample of nonpsychiatric adults with psychometrically identified schizotypy and a normative reference group. Smokers with schizotypy reported more severe disorganization (i.e., difficulties in cognitive control, regulation of cognitive, affective, and behavioral processes; e.g., Kerns, 2006) and less severe negative (i.e., attentional and memory problems) schizotypy traits than nonsmokers with schizotypy. Results from these studies suggest that those with disorganized symptoms might smoke to improve certain cognitive functions, and therefore, be self-medicating. This is consistent with research linking smoking to enhanced cognitive functioning in those with schizophrenia (e.g., Adler et al., 1998). Smokers in two of these studies (Stewart et al., 2010; Wan et al., 2008) were less likely than nonsmokers to endorse negative traits, which is consistent with previous research in the schizophrenia literature (Ziedonis et al., 1994). This is particularly interesting because negative schizotypy is partially defined by social withdrawal, so smoking might decrease negative symptoms and lead to improved social interactions. Conversely, it is also possible that individuals with negative symptoms are less likely to smoke, as smoking is a social activity for many.

Smokers with schizophrenia tend to report more positive (e.g., relaxation, routine, socialization, sedation, control of medication side effects and negative symptoms) than negative smoking outcome expectancies (Galazyn et al., 2010; Glynn & Sussman, 1990; Forchuk et al., 2002; Lohr & Flynn, 1992; Tidey & Rohsenow, 2009). However, no previous research has explored smoking-related expectancies of smokers with schizotypy. Although it is possible that individuals with schizotypy might smoke cigarettes for the same reasons as those with

schizophrenia, research is needed to clarify this relationship.

Current Study and Hypotheses

The relationship between smoking and schizotypy, the presumed vulnerability to developing schizophrenia, is a promising area of research as it avoids many confounds associated with schizophrenia. Further investigation of smoking-related characteristics (e.g., smoking topography, CO, smoking outcome expectancies) in individuals with schizotypy may provide insight into the underlying mechanism by which smoking and schizophrenia co-occur.

The present study examined schizotypy traits, smoking-related characteristics, and smoking behaviors in adults with psychometrically identified schizotypy and demographically matched controls without schizotypy. It was hypothesized that: 1) smokers with schizotypy would report experiencing more disorganization and fewer negative traits (as measured by the Schizotypal Personality Questionnaire-Brief Revised) than nonsmokers with schizotypy; 2) smokers with schizotypy would report more intense smoking-related characteristics (greater number of cigarettes smoked per week, shorter time to first cigarette upon waking, daily smoking) and higher nicotine dependence, than control smokers without schizotypy; 3) smoking outcome expectancies would differ between smokers with schizotypy and control smokers without schizotypy, such that smokers with schizotypy would report more positive (e.g., improved stimulation and social facilitation, reduced negative affect and boredom) than negative consequences of smoking; and 4) compared to control smokers without schizotypy, smokers with schizotypy would display more intense smoking behaviors (i.e., topography measures such as more puffs per cigarette, shorter inter-puff intervals, and larger total puff volume, and higher CO levels and boosts).

Method

Participants

Participants were undergraduate students enrolled at Louisiana State University who were at least 18 years old, not currently pregnant, and able to read English. During the initial screening phase, undergraduate students completed several online questionnaires, which included the Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR) and the Smoking Status Questionnaire (SSQ).

Eligibility for the laboratory phase was determined based on results from the screening phase. Participants who identified as current smokers and scored in specified ranges of the SPQ-BR (see below) were invited to attend the laboratory phase. They were not required to smoke a specific number of cigarettes each day, as research has found that the majority of college student smokers are "light" or "occasional" smokers. Specifically, Sutfin et al. (2009) purported that "heavy" smokers (28%) smoke 6-10 cigarettes per day, "moderate" smokers (22%) smoke 10-19 days per month (2-5 cigarettes per smoking day), "social" smokers (19%) typically smoke only on weekends (3-5 days per month, 2-5 cigarettes per smoking day), and "puffers" (26%) smoke 1-2 days per month ($\leq$ 1 cigarette per smoking day). Studies suggest that schizotypy is a categorical construct with an incidence of 10% (e.g., Blanchard et al., 2000; Meehl, 1962). Therefore, smoking participants were eligible to complete the laboratory phase if they scored at or above the 95th percentile ($\geq$ 1.65 SD from gender and ethnicity-determined means) on the positive, disorganization, and/or the negative SPQ-BR subscales. Smokers without schizotypy, or those with scores below the gender and ethnicity-determined means (50^{th} percentile) from the same SPQ-BR subscales, were invited to participate in the laboratory phase as demographically matched controls.

Materials: Screening Phase

Demographic Questions. Participants completed a self-report measure of demographics that included questions pertaining to age, ethnicity, gender, and relationship status.

Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR). The SPQ-BR (Cohen, Matthews, Najolia, & Brown, 2010) is a modified, shortened version of the Schizotypal Personality Questionnaire (Raine, 1991), a screening measure commonly used in schizotypy research (see Appendix A). This 32-item self-report measure is based on DSM-IV criteria for Schizotypal Personality Disorder. Participants rate items on a 5-point Likert scale (ranging from 1 = "strongly disagree" to 5 = "strongly agree"). The SPQ-BR includes seven subscales (i.e., Ideas of Reference/Suspiciousness, No Close Friends/Constricted Affect, Eccentric Behavior, Social Anxiety, Magical Thinking, Odd Speech, Unusual Perception) that are subsumed under three superordinate scales (i.e., positive, negative, disorganized). Preliminary research has reported that the SPQ-BR has good convergent validity and reliability and the average alpha for the three superordinate scales was 0.74 (Cohen et al., 2010). In the present study, the SPQ-BR was administered during the screening phase to differentiate between participants with and without schizotypy.

Infrequency Scale. The Infrequency Scale (Chapman & Chapman, 1983) was used to identify and screen out responders who provide random or grossly invalid responses (see Appendix B). In the present study, an abbreviated 3-item version was used (e.g., Cohen & Davis, 2009). An example of one item is, "I find that I often walk with a limp, which is the result of a skydiving accident." Infrequency items were administered as part of the screening study, and participants who endorsed two or more infrequency items (66% of total items) were excluded from participating in the laboratory phase. No participants were screened out based on infrequency scale items.

Smoking Status Questionnaire (SSQ). The SSQ (see Appendix C) assesses demographic information and past and current smoking characteristics (e.g., smoking frequency, previous quit attempts). It also includes the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al., 1991), a widely used measure of nicotine dependence. Heatherton and colleagues (1991) reported that Cronbach's alpha was 0.61 for the FTND. This is likely due to the fact that the FTND assesses several dimensions of nicotine dependence. The FTND is a valid measure of nicotine dependency, as it is positively correlated with biochemical indicators of smoking (e.g., carbon monoxide level; Heatherton et al., 1991).

Materials: Laboratory Phase

Wisconsin Inventory of Smoking Dependence Motives (WISDM-30). The WISDM-30 (Smith, Piper, Fiore, & Baker, 2007; see Appendix D) is an abbreviated version of the WISDM-68 (Piper et al., 2004), a commonly used multidimensional measure of nicotine dependence. This 30-item self-report measure was designed to assess theoretically derived motivational processes (e.g., craving) that are related to dependence. The WISDM-30 consists of 10 subscales (i.e., Craving, Automaticity, Cognitive Enhancement, Cue Exposure/Associative Process, Affiliative Attachment, Loss of Control/Tolerance, Negative/Positive Reinforcement, Social Environmental Goals, Taste/Sensory Process, Weight Control), and participants respond to items on a 7-point Likert scale (ranging from 1 = "Not true of me at all" to 7 = "Extremely true of me"). The WISDM-30 has good psychometrics, and the average coefficient alpha for the subscales was 0.84 (Smith et al., 2007).

Smoking Consequences Questionnaire-Adult (SCQ-A). The SCQ-A (Copeland et al., 1995) is a 55-item self-report measure of participants' expectations of the consequences of smoking (see Appendix E). Previous research has indicated that positive outcome expectancies are positively correlated with nicotine dependence (i.e., the FTND; Rash & Copeland, 2008).

Possible consequences of smoking are rated on a 0 to 9 Likert scale (0 = Completely Unlikely, 9 = Completely Likely). The SCQ-A includes the following ten subscales: Negative Affect Reduction, Stimulation/State Enhancement, Health Risks, Taste/Sensorimotor Manipulation, Social Facilitation, Weight Control, Craving/Addiction, Negative Physical Feelings, Boredom Reduction, and Negative Social Impression. The average coefficient alpha for the subscales was 0.87 and the subscales have demonstrated good construct validity (Copeland et al., 1995).

Expired Carbon Monoxide (CO). CO levels were measured using a portable Vitalograph ecolyzer (Vitalograph Incorporated, Lenexa, KS, USA). According to the Society for Nicotine and Tobacco Subcommittee on Biochemical Verification (2002), a CO reading of 8-10 parts per million (ppm) distinguishes nonsmokers from smokers. However, CO has a short half-life, ranging from 1-8 hours depending on factors such as daily smoking rate and recency of smoking (SRNT Subcommittee on Biochemical Verification, 2002). As college student smokers are typically light or occasional smokers (see Sutfin, Reboussin, McCoy, & Wolfson, 2009), CO levels were expected to be quite low in this population. CO levels were used in this study to biochemically verify self-reported smoking status. CO was assessed during the laboratory phase prior to and after participants smoked a cigarette in order to calculate CO boosts, or the difference between CO prior to and following smoking.

Smoking Topography. Smoking topography was obtained from all smoking participants during the laboratory phase. Each participant smoked one cigarette using the Clinical Research Support System (CReSS; Plowshare Technologies, Baltimore, MD, USA) portable smoking topography device. Participants smoked through a plastic mouthpiece connected to an analog-digital converter with plastic tubing. The topography device calculates and stores data on a number of parameters, including: number of puffs per cigarette, time to smoke each cigarette, interpuff interval, total and average puff volume, total and average puff duration, and maximum

puff velocity. Data from these measures were averaged to obtain one value for each parameter. The CReSS smoking topography system has good reliability and validity, and previous research has indicated that smoking behaviors do not appear change as a function of smoking through a plastic mouthpiece (Lee, Malson, Waters, Moolchan, & Pickworth, 2003).

Procedure

All procedures were reviewed and approved by Louisiana State University's Institutional Review Board (IRB). Data were collected between January 2010 and March 2011. Two means of recruitment were used for the screening phase. In the first, as part of a larger mental health study, students were contacted through email and invited to complete an online survey. They were entered into a lottery (10 prizes of $25 each) for compensation. In the second, participants were recruited through the LSU psychology participant pool and given the opportunity to participate in the screening phase for course credit. The screening surveys included the following: informed consent, demographic questions, the SSQ, the SPQ-BR, and infrequency scale items. Questionnaires with incomplete responses or questionable validity were discarded.

As mentioned, participants were eligible to complete the laboratory phase if they reported being current smokers in addition to scoring at or above the 95th percentile ($\geq$ 1.65 SD from gender and ethnicity-determined means) on the positive, disorganization, and/or the negative subscales of the SPQ-BR. Smoking participants with scores below the gender and ethnicity-determined means (50^{th} percentile) from the same subscales of the SPQ-BR were invited to participate in this phase as smoking controls without schizotypy.

Prior to their laboratory appointments, participants were contacted and asked to bring a pack of their preferred brand of cigarettes with them. They were also asked to abstain from smoking for six hours prior to their appointments. When participants arrived for the laboratory phase, the experimenter explained the informed consent, which participants signed if they agreed

to participate. They then completed the SSQ, the WISDM-30, and the SCQ-A. After completing the questionnaires, participants' CO levels were assessed. Then, they smoked a cigarette using the CReSS portable smoking topography device. After smoking, CO levels were again assessed in order to determine CO boosts. Participants were compensated for their time with either cash ($10 or $20) or psychology course credit. Due to difficulties with recruitment, monetary compensation was increased from $10 to $20 halfway through the study.

Statistical Analyses: Screening Phase

Chi Square analyses and analyses of variance (ANOVAs) were conducted to assess for possible demographic or clinical differences among groups (i.e., nonsmokers with schizotypy vs. smokers with schizotypy). To determine whether smokers with schizotypy reported experiencing more disorganized and fewer negative symptoms than nonsmokers with schizotypy (hypothesis 1), a multivariate analysis of variance (MANOVA) with participant grouping (i.e., smokers with schizotypy vs. nonsmokers with schizotypy) as the independent variable and schizotypy symptoms (i.e., positive, negative, disorganization) as the dependent variables was performed.

Statistical Analyses: Laboratory Phase

First, Chi Square analyses and ANOVAs were conducted to assess for possible demographic or clinical differences among groups (i.e., smokers with schizotypy vs. control smokers without schizotypy; those who completed the laboratory phase vs. those who declined to participate). Second, to examine whether smokers with schizotypy reported more intense smoking-related characteristics (i.e., higher nicotine dependence, more cigarettes smoked per day, shorter time to first cigarette upon waking) than smokers without schizotypy (hypothesis 2), a MANOVA with participant grouping (i.e., smokers with schizotypy vs. control smokers without schizotypy) as the independent variable and smoking-related characteristics as dependent variables was conducted. Third, to examine whether smoking-related outcome expectancies

differed between smokers with schizotypy and control smokers without schizotypy, such that smokers with schizotypy would report more positive (e.g., improved stimulation and social facilitation, reduced negative affect and boredom) than negative consequences of smoking (hypothesis 3), a MANOVA with participant grouping (i.e., smokers with schizotypy vs. control smokers without schizotypy) as the independent variable and SCQ-A subscale means as dependent variables was performed. Fourth, to compare whether smokers with schizotypy would displayed more intense smoking behaviors (i.e., topography measures such as more puffs per cigarette, shorter inter-puff intervals, and larger total puff volume; higher CO boosts) than control smokers without schizotypy (hypothesis 4), a multivariate analysis of covariance (MANCOVA) was conducted. Average topography variables and CO readings were entered as dependent variables, participant grouping (i.e., smokers with schizotypy vs. smoking controls without schizotypy) was entered as the independent variable, and smoking-related variables (i.e., FTND and WISDM-30 total scores, time to first cigarette, cigarettes smoked per week, daily smoking) were entered as covariates.

Results

Screening Phase

Descriptive Characteristics. A total of 1,351 participants (1,110 from the mental health study pool and 241 from the psychology pool) completed the screening phase. Based on eligibility criteria, 77 nonsmokers with schizotypy and 69 smokers with schizotypy were identified (n = 146). Seventy-two percent (n = 50) of smokers with schizotypy were daily smoking that reported smoking an average of 6.46 (± 5.82) cigarettes per day or 44.84 (± 40.90) cigarettes per week. Nondaily smokers (n = 19; 28%) reported smoking an average of 4.68 (± 5.43) cigarettes per week. Demographic information (i.e., age, ethnicity, relationship status) was missing for 36 of these participants (27 nonsmokers with schizotypy and 9 smokers with schizotypy) who completed the mental health study; however, gender was available for all 146 participants. Not including these missing data, participants were predominantly female (n = 97; 66%), Caucasian (n = 85; 77%), and single (n = 71; 65%), with a mean age of 20.10 (± 4.10) years. Group comparisons were conducted to assess for differences in schizotypy traits between participants with missing demographic data and those with complete data. ANOVAs were performed for these continuous variables (i.e., SPQ-BR positive, negative, and disorganization subscales scores). Results revealed no significant differences between groups on these variables (p's > 0.05). Thus, participants with missing demographic data did not differ from those with complete demographic data on schizotypy traits.

Group comparisons were also conducted to compare smokers with schizotypy versus nonsmokers with schizotypy on demographic variables. ANOVAs were conducted for continuous variables (e.g., age), and Chi Square analyses were performed to explore differences in categorical variables (i.e., gender, ethnicity, relationship status). Results from these analyses were not significant (p's > 0.05), suggesting that smokers with schizotypy did not differ from

nonsmokers with schizotypy on any relevant demographic variables.

Hypothesis Testing/Hypothesis 1: Differences between Smokers with Schizotypy and Nonsmokers with Schizotypy on Schizotypy Traits. In the first hypothesis, it was expected that smokers with schizotypy would report experiencing more disorganization and fewer negative symptoms than nonsmokers with schizotypy. An a priori power analysis was calculated using the G*Power 3.0 program (Faul, Erdfelder, Lang, & Buchner, 2007). In order to detect a medium effect with a power of 0.80, the recommended sample size for this hypothesis was at least 48 participants (24 smokers with schizotypy and 24 nonsmokers with schizotypy). As 69 smokers with schizotypy and 77 nonsmokers with schizotypy were included, the power of this analysis was adequate.

A MANOVA was conducted to test this hypothesis. Schizotypy traits (i.e., positive, negative, disorganization) were entered as dependent variables and participant grouping (smokers with schizotypy vs. nonsmokers with schizotypy) was entered as the independent variable. There were no significant differences in schizotypy symptoms between smokers and nonsmokers with schizotypy, Wilks' Lambda = 0.96, F (3, 142) = 2.02, p = 0.11. See Table 1 for means with standard deviations, 95% confidence intervals, difference scores, and effect sizes.

Laboratory Phase

Descriptive Characteristics. One hundred forty-eight participants (69 smokers with schizotypy and 79 control smokers without schizotypy) were eligible to participate in the laboratory phase. Of these, 46 (28 smokers with schizotypy and 18 control smokers without schizotypy) agreed to attend and participate in the laboratory phase either for course credit (n = 17; 37%) or monetary compensation (n = 29; 63%). Group comparisons were conducted in order to compare eligible participants who agreed to participate (n = 46) versus those who declined to participate (n = 102). ANOVAs were conducted for continuous variables including age, smoking

Table 1: SPQ-BR subscale means scores for smokers with schizotypy (n = 69) and nonsmokers with schizotypy (n = 77).

	Smokers with Schizotypy		Nonsmokers with Schizotypy		Difference Scores	F	Effect Sizes (d)
	Mean (SD)	95% CIs	Mean (SD)	95% CIs			
Positive Traits	1.52 (0.88)	1.29-1.75	1.24 (1.05)	1.02-1.46	0.28	3.10	0.29
Negative Traits	1.02 (0.99)	0.79-1.26	1.29 (1.00)	1.06-1.51	0.27	2.52	0.27
Disorganization Traits	1.26 (0.77)	1.09-1.44	1.31 (0.74)	1.15-1.48	0.05	0.16	0.07

Note: There were no significant group differences on these variables

rate, and FTND scores. Chi Square analyses were performed to examine any differences in categorical variables (i.e., gender, ethnicity) among those who participated versus those who declined to participate. Results from these analyses were not significant (p's > 0.05) suggesting that individuals who participated in the laboratory participate did not differ from those who declined to participate.

Missing Data. The data were screened for missing values, and 11 missing data points were found. Missing data was replaced using expectation maximization (EM). EM is an iterative method, and estimates data missing at random in two steps for each iteration. First, in the expectation step, conservative expected estimates of missing data are derived based on observed values and parameters. Next, maximum likelihood estimation of model parameters is performed based on these values (Tabachnik & Fidell, 2007). EM was conducted using NORM version 2.3 software (Schafer, 2000).

Normality Testing. Data were checked for univariate outliers and normality using SPSS version 19.0. As suggested by Tabachnick and Fidell (2007), cases in excess of 3.29 standard deviations from the mean were viewed as potential outliers. Since analyses were conducted with grouped data, schizotypy and control groups were checked for outliers separately for the following variables: smoking frequency, FTND, CO prior to and after smoking a cigarette, and CO boosts. Two data points were identified as potential outliers. One participant (a smoker with schizotypy) had a CO prior to screening that was 4.75 standard deviations above the mean. Incidentally, this participant also reported having smoked a cigarette just three hours prior to the lab appointment, which most likely inflated the laboratory value. Another smoker with schizotypy had a FTND score that was 3.47 standard deviations above the mean. As these cases were extremely different from the remainder of the sample, they were removed from the analyses. In addition, two participants (smokers with schizotypy) had unusable smoking

topography data, as their cigarettes were too loosely inserted into the CReSS smoking topography device. They were excluded from only the final analysis.

Participant Characteristics. Participants who completed the laboratory phase (n = 44) were predominantly female (n = 24; 55%), Caucasian (n = 36; 82%), and single (n = 30; 68%), with a mean age of 20.09 years ($\pm$ 1.94). Smokers with schizotypy (n = 26) were compared to control smokers without schizotypy (n = 18) on demographic characteristics to determine whether the groups differed significantly. Chi Square analyses were conducted for categorical variables (i.e., gender, ethnicity) and ANOVAs were used for continuous variables (i.e., age). There were no significant differences between groups on any of these analyses (p's > 0.05), suggesting that groups did not differ from one another on any demographic variables.

Hypothesis Testing/Hypothesis 2: Differences between Smokers with Schizotypy and Control Smokers without Schizotypy on Smoking-Related Characteristics. In the second hypothesis, it was postulated that smokers with schizotypy group would endorse more intense smoking-related characteristics (i.e., nicotine dependence as measured by the FTND and WISDM total scores, cigarettes smoked per week, time to first cigarette upon waking, daily smoking) than control smokers without schizotypy. G*Power 3.0 (Faul et al., 2007) was used to perform an a priori power analysis in order to calculate the suggested sample size needed to detect differences between groups. Based on the limited previous research in this area, sample size was calculated assuming a medium effect with a power of 0.80. The recommended sample size for this hypothesis was at least 58 participants (29 smokers with schizotypy and 29 control smokers without schizotypy).

To test this hypothesis a MANOVA was conducted, with smoking characteristics as dependent variables with participant grouping (i.e., smokers with schizotypy vs. smokers without schizotypy) as the independent variable. Results from the MANOVA indicated significant

differences in smoking-related characteristics between smokers with schizotypy and smoking controls without schizotypy, Wilks' Lambda = 0.74, F (5, 38) = 2.62, p = 0.04. Notably, this analysis was significant despite being underpowered (see power analysis above). As seen in Table 2, follow-up ANOVAs revealed significant differences between groups on the WISDM-30 total score, F (1, 42) = 7.56, p = 0.01 and a trend towards significance for cigarettes smoked per week, F (1, 42) = 3.77, p = 0.06.

Hypothesis Testing/Hypothesis 3: Differences between Smokers with Schizotypy and Control Smokers without Schizotypy on Smoking-Related Outcome Expectancies. In the third hypothesis, it was anticipated that outcome expectancies would differ between smokers with schizotypy and control smokers without schizotypy, such that smokers with schizotypy would report experiencing more positive (e.g., improved stimulation and social facilitation, reduced negative affect and boredom) than negative consequences of smoking. An a priori power analysis using G*Power 3.0 (Faul et al., 2007) was conducted assuming a medium effect with a power to detect at 0.80. The recommended sample size for this hypothesis was at least 78 participants (39 smokers with schizotypy and 39 control smokers without schizotypy).

To test this hypothesis, a MANOVA with SCQ-A subscale means as dependent variables and participant grouping (i.e., smokers with schizotypy vs. control smokers without schizotypy) as the independent variable was performed. Results revealed significant differences between groups, Wilks' Lambda = 0.61, F (10, 33) = 2.14, p = 0.049. This analysis was significant despite being underpowered (see power analysis above). As seen in Table 3, follow-up ANOVAs indicated significant differences between groups on the following SCQ-A subscales: Negative Affect Reduction, F (1, 42) = 5.71, p = 0.02; Stimulation/State Enhancement, F (1, 42) = 10.63, p = 0.03; Taste/Sensorimotor Manipulation, F (1, 42) = 10.66, p = 0.002; Social Facilitation, F (1, 42) = 18.57, p = 0.001; Boredom Reduction, F (1, 42) = 4.61, p = 0.04.

Table 2. Smoking characteristics of smokers with schizotypy (n = 26) and smokers without schizotypy (n = 18).

	Smokers with Schizotypy		Smokers without Schizotypy		Difference Scores	F	Effect Sizes (d)
	Mean (SD)	95% CIs	Mean (SD)	95% CIs			
Cigarettes smoked per week	35.65 (39.18)	22.96-48.35	16.56 (16.83)	1.30-31.81	19.09	3.77	0.63
Daily smoker	14 (54%)		7 (39%)			0.93	
Nicotine dependence (FTND)	1.04 (1.40)	0.57-1.51	0.72 (0.75)	0.16-1.28	0.32	0.76	0.28
First cigarette of day (within 1 hour)	8 (30%)		5 (28%)			0.00	
WISDM total score	35.62 (7.88)	32.49-38.74	28.96 (7.91)	25.21-32.72	6.66	7.56**	0.84

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Table 3. SCQ-A subscale scores for smokers with schizotypy (n = 26) and smokers without schizotypy (n = 18).

	Smokers with Schizotypy		Smokers without Schizotypy		Difference Scores	F	Effect sizes (d)
	Mean (SD)	95% CIs	Mean (SD)	95% CIs			
Negative Affect Reduction	5.99 (1.68)	5.25-6.73	4.62 (2.11)	3.74-5.51	1.37	5.71*	0.72
Stimulation/State Enhancement	4.24 (1.28)	3.65-4.83	2.78 (1.74)	2.07-3.48	1.46	10.27**	0.96
Health Risks	7.82 (1.79)	7.14-8.50	7.69 (1.60)	6.88-8.51	0.13	0.06	0.08
Taste/Sensorimotor Manipulation	5.66 (1.40)	5.10-6.21	4.25 (1.41)	3.59-4.92	1.41	10.66**	1.00
Social Facilitation	5.55 (1.57)	4.90-6.21	3.36 (1.79)	2.56-4.15	2.19	18.57***	1.30
Appetite/Weight Control	3.09 (2.01)	2.23-3.95	2.03 (2.39)	1.00-3.07	1.06	2.54	0.48
Craving/Addiction	5.08 (1.37)	4.40-5.77	4.25 (2.16)	3.43-5.08	0.83	2.42	0.46
Negative Physical Feelings	3.91 (1.96)	3.09-4.73	3.70 (2.24)	2.72-4.69	0.21	0.11	0.10
Boredom Reduction	5.66 (1.57)	4.88-6.45	4.36 (2.46)	3.42-5.30	1.30	4.61*	0.63
Social Impression	4.63 (1.79)	3.87-5.39	5.41 (2.09)	4.50-6.32	0.78	1.76	0.40

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Hypothesis Testing/Hypothesis 4: Differences between Smokers with Schizotypy and Control Smokers without Schizotypy on Smoking Behavior. In the fourth hypothesis, it was expected that compared to control smokers without schizotypy, smokers with schizotypy would display more intense smoking-related behaviors (e.g., more puffs per cigarette, shorter inter-puff intervals, larger total puff volume, higher CO readings and boosts), as measured by smoking topography and carbon monoxide readings. An a priori power analysis was performed using G*Power 3.0 (Faul et al., 2007). Based on the lack of previous research in this area, sample size was calculated assuming a medium effect with a power of 0.80. The recommended sample size for this hypothesis was at least 70 participants (35 smokers with schizotypy and 35 control smokers without schizotypy).

To examine this hypothesis, a MANCOVA was conducted. Dependent variables included: 1) average topography variables (i.e., number of puffs per cigarette, interpuff interval, maximum puff velocity, mean puff volume), 2) CO levels, and 3) CO boosts. The independent variable was participant grouping (i.e., smokers with schizotypy vs. smokers without schizotypy). Covariates were smoking-related variables (i.e., FTND and WISDM-30 total scores, time to first cigarette, cigarettes smoked per week, daily smoking). Smoking-related variables were controlled for in these analyses because they might have impacted smoking behaviors. Results revealed no significant differences between smokers with schizotypy and smokers without schizotypy, Wilks' Lambda = 0.86, F (7, 34) = 0.78, p = 0.61. However, this analysis was underpowered (see above power analysis). See Table 4 for smoking behavior characteristics (i.e., means, standard deviations, 95% confidence intervals, difference scores, effect sizes) of smokers with and without schizotypy.

Table 4. Smoking behavioral measures for smokers with schizotypy (n = 26) and smokers without schizotypy (n = 18).

	Smokers with Schizotypy		Smokers without Schizotypy		Difference Scores	F	Effect Sizes (d)
	Mean (SD)	95% CIs	Mean (SD)	95% CIs			
Puffs per cigarette	13.83 (4.90)	11.83-15.84	12.17 (4.82)	9.85-14.48	1.66	1.21	0.34
Interpuff interval (sec)	29.72 (28.38)	20.63-38.80	20.84 (7.21)	10.35-31.33	8.88	1.67	0.43
Maximum puff velocity (ml/sec)	38.36 (11.28)	33.17-44.56	37.09 (14.17)	31.10-43.09	1.27	0.11	0.10
Mean puff volume (ml)	40.67 (14.06)	34.32-47.02	43.23 (17.04)	35.90-50.56	2.80	0.29	-0.16
Mean puff duration (sec)	1.47 (0.43)	1.25-1.79	1.62 (0.66)	1.37-1.88	0.15	0.83	-0.27
Time 1 CO (ppm)	3.00 (2.90)	1.95-4.05	2.50 (1.98)	1.28-3.72	0.50	0.40	0.20
Time 2 CO (ppm)	6.71 (4.20)	5.15-8.26	5.89 (3.10)	4.09-7.69	0.82	0.49	0.22
CO boost (ppm)	3.71 (2.12)	2.90-4.52	3.39 (1.72)	2.46-4.32	0.32	0.27	0.17

Note: There were no significant group differences on these variables

Discussion

Results from the present study suggest that smokers with schizotypy differ from smokers without schizotypy on certain smoking-related characteristics. Specifically, smokers with schizotypy reported higher levels of nicotine dependence (as measured by the WISDM-30) and smoked more cigarettes per week than control smokers without schizotypy. Compared to control smokers without schizotypy, smokers with schizotypy endorsed more positive (e.g., improved stimulation, social facilitation, and taste/sensorimotor manipulation and reduced negative affect and boredom) than negative consequences of smoking. Despite this, there were no significant differences between smokers with schizotypy and control smokers without schizotypy on smoking behaviors such as smoking topography and CO readings and boosts. Also, smokers with schizotypy and nonsmokers with schizotypy did not differ on schizotypy traits. Results will be discussed in relation to each hypothesis.

Hypothesis 1

It was expected that smokers with schizotypy would report more severe disorganization and less severe negative traits than nonsmokers with schizotypy. This hypothesis was not supported. Based on results from the screening phase of the current study, there were no significant differences between smokers with schizotypy and nonsmokers with schizotypy on schizotypy traits. This is inconsistent with previous research (e.g., Esterberg et al., 2007; Stewart et al., 2010; Wan et al., 2008). One potential reason for this finding is that previous studies have only included daily smokers, whereas the current study did not require participants to smoke a specific number of cigarettes per day, as most college student smokers are "light" or occasional smokers (Sutfin, Reboussin, McCoy, & Wolfson, 2009). While most of the smokers that completed the screening phase reported daily smoking, they were in fact "light" smokers. Additional research should investigate the relationship between schizotypy traits and smoking among daily and non-daily smokers with schizotypy and nonsmokers with schizotypy.

Hypothesis 2

It was expected that smokers with schizotypy would report more intense smoking-related characteristics (i.e., greater number of cigarettes smoked per week, shorter time to first cigarette upon waking, daily smoking) and higher nicotine dependence (as measured by the FTND and WISDM-30), than control smokers without schizotypy. This hypothesis was supported by significant findings. Specifically, smokers with schizotypy reported significantly higher levels of nicotine dependence, as measured by the WISDM-30, but not by the FTND. This finding might be explained by the fact that the WISDM-30 is a theoretically-derived multidimensional measure of nicotine dependence motives, while the FTND is a measure of physical dependence that is strongly influenced by heaviness of smoking (i.e., number of cigarettes smoked per day, time to first cigarette upon waking; see Piper et al., 2008; Schuster & Johanson, 1974; Smith et al., 2008). Given the group differences on WISDM-30 scores, it is notable that there were no group differences on time to first cigarette upon waking or daily smoking status, as these are common indicators of nicotine dependence (Schuster & Johanson, 1974). There was a nonsignificant trend by which smokers with schizotypy reported smoking more cigarettes per week than smoking controls without schizotypy. It is important to note that many of the smokers who completed the laboratory phase of the study were "light" and non-daily smokers. As this hypothesis was underpowered, further research is needed to explore differences in smoking characteristics in a larger sample of smokers with and without schizotypy. Also, future studies should assess for possible differences in smoking-related characteristics between non-daily and daily smokers with schizotypy and smoking controls without schizotypy.

Hypothesis 3

It was anticipated that smoking-related outcome expectancies would differ between smokers with schizotypy and control smokers without schizotypy, such that smokers with schizotypy would report more positive (e.g., improved stimulation and social facilitation,

reduced negative affect and boredom) than negative consequences of smoking. This hypothesis was supported. Compared to control smokers without schizotypy, smokers with schizotypy reported that they smoked for stimulation or state enhancement, to improve taste and sensorimotor manipulation, to enhance social facilitation, and to reduce negative affect and boredom. In addition, although follow-up ANOVAs were not significant for other subscales, there were medium effect sizes for the following subscales: Craving/Addiction, Appetite/Weight Control, Craving/Addiction, and Boredom Reduction. It is therefore possible that with a larger sample size, significant differences would have been detected.

The present study was the first to assess differences in smoking-related outcome expectancies between smokers with schizotypy and smoking controls without schizotypy. Notably, these results are consistent with findings from schizophrenia research that suggest that smokers with schizophrenia report more positive than negative smoking expectancies, such as relaxation, routine, social facilitation, sedation, control of medication side effects, and control of negative affect or symptoms (Galazyn et al., 2010; Glynn & Sussman, 1990; Forchuk et al., 2002; Lohr & Flynn, 1992; Tidey & Rohsenow, 2009). As smoking outcome expectancies are associated with intention to quit and predict smoking cessation (see Brandon et al., 1999), future studies should explore how outcome expectancies relate to intention to quit smoking or stage of change in smokers with schizotypy. In addition, research should assess for potential differences in outcome expectancies among smokers with schizophrenia, smokers with schizotypy, and smoking controls.

Hypothesis 4

It was hypothesized that compared to control smokers without schizotypy, smokers with schizotypy would display more intense smoking behaviors (i.e., topography measures such as more puffs per cigarette, shorter inter-puff intervals, and larger total puff volume; and higher CO readings and boosts). This was not supported; there were no group differences on smoking

behaviors. One potential explanation for this is that the analyses were underpowered; however, it is also possible that results were impacted by daily vs. non-daily smoking. Future research should investigate this relationship in a larger sample size of non-daily and daily smokers with and without schizotypy. In addition, research should compare smoking behaviors among smokers with schizotypy, smokers with schizophrenia, and smoking controls.

Implications and Directions for Future Research

The current study investigated the relationship between smoking and schizotypy, the putative genetic vulnerability to developing schizophrenia. This is a rich area for research, as it avoids many confounds associated with schizophrenia (e.g., medication side effects, illness chronicity) and may offer knowledge into the underlying mechanism by which smoking and schizophrenia co-occur. This study adds to previous research while avoiding many of the methodological issues (e.g., schizotypy was categorically defined) found in previous studies.

Consistent with previous research (e.g., Allan et al., 1995), smokers with schizotypy reported smoking more cigarettes per week and had higher levels of nicotine dependence than smoking controls without schizotypy. Notably, there were no group differences between smokers with schizotypy and nonsmokers with schizotypy on schizotypy traits. This is inconsistent with prior research purporting that smokers with categorically defined schizotypy are more likely to experience more severe disorganization traits and less severe negative traits than nonsmokers with schizotypy (see Stewart et al., 2010; Wan et al., 2008).

The present study adds to the literature in that it is the first to assess smoking behaviors (e.g., smoking topography, CO) and smoking outcome expectancies in individuals with categorically defined schizotypy. Although there were no significant differences between groups on smoking topography or CO, this might have been due to inadequate power, as the sample size was quite small. It is also possible that groups just do not differ in smoking behaviors. Compared to control smokers without schizotypy, smokers with schizotypy endorsed more positive than

negative smoking-related outcome expectancies, suggesting that they have unique motivators for smoking. This finding is striking, as it is consistent with prior research conducted with smokers with schizophrenia (Galazyn et al., 2010; Glynn & Sussman, 1990; Forchuk et al., 2002; Lohr & Flynn, 1992; Tidey & Rohsenow, 2009) and suggests that individuals with schizotypy might smoke for the same reasons (e.g., social facilitation, boredom reduction) as those with schizophrenia. This might be useful in guiding the development of smoking cessation programs tailored for this population.

The present study had several limitations. First, there was reliance upon on self-report measures, which can be biased and unreliable. To account for this, smoking topography and CO levels and boosts were assessed as biological indicators of smoking status in participants who attended the laboratory phase. However, many of the participants were light or non-daily smokers, therefore CO was quite low for most participants. Future research should consider assessing cotinine (an active metabolite of nicotine) levels within this population, as previous research has found that individuals with schizophrenia tend to have higher cotinine levels than smokers without schizophrenia (e.g., Strand and Nybäck, 2005). Second, as this sample consisted of a relatively homogeneous sample of college students who were primarily light smokers and Caucasian females, the generalizability of these results to the larger population is questionable. Third, the sample size was rather small, so several of the analyses were underpowered.

Future studies are needed to replicate the current study with a larger and more heterogeneous sample (i.e., varying ethnicities, young adults who are not students, daily vs. non-daily smokers, heavier smokers). Results from the present study suggested that smokers with schizotypy differ from smokers without schizotypy in regards to certain smoking characteristics such as smoking frequency, nicotine dependence, and smoking outcome expectancies. These findings were similar to findings from previous studies conducted with individuals with schizophrenia. As a result, there are several lines of research that might further elucidate the

relationship between smoking and schizophrenia by utilizing smokers with schizotypy. First, research should continue to investigate the relationship between smoking and schizotypy traits by using daily and non-daily smokers with schizotypy and nonsmokers with schizotypy. Second, research should examine smoking-related characteristics among non-daily and daily smokers with schizotypy, smokers with schizophrenia, and smoking controls without schizotypy. Third, smoking-related outcome expectancies are associated with intention to quit smoking and smoking cessation (e.g., Brandon et al., 1999); thus, studies should explore how outcome expectancies might relate to intention to quit smoking or stage of change in smokers with schizotypy. Research should assess for potential differences in outcome expectancies among smokers with schizophrenia, smokers with schizotypy, and smoking controls. Smokers with schizophrenia typically rate "reduction of negative affect" as the most important positive expectancy (e.g., Tidey et al., 2009) so future studies should consider having participants rank the importance of smoking expectancies. Fourth, research should investigate differences in smoking behaviors such as smoking topography, CO, and cotinine following a period of abstinence among smokers with schizotypy, smokers with schizophrenia, and smoking controls.

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Appendix A: Schizotypal Personality Questionnaire – Brief Revised (SPQ-BR)

Instructions: Please rate your level of agreement for each of the following statements using the following scale:

0	1	2	3	4
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1. I sometimes avoid going to places where there will be many people because I will get anxious.	0	1	2	3	4
2. Other people see me as slightly eccentric (odd).	0	1	2	3	4
3. Do you believe in telepathy (mind-reading)?	0	1	2	3	4
4. People sometimes comment on my unusual mannerisms and habits.	0	1	2	3	4
5. I sometimes jump quickly from one topic to another when speaking.	0	1	2	3	4
6. I am not good at expressing my true feelings by the way I talk and look.	0	1	2	3	4
7. When you look at a person or yourself in a mirror, have you ever seen the face change right before your eyes?	0	1	2	3	4
8. I sometimes forget what I am trying to say.	0	1	2	3	4
9. I rarely laugh and smile.	0	1	2	3	4
10. Do you sometimes get concerned that friends or co-workers are not really loyal or trustworthy?	0	1	2	3	4
11. I get anxious when meeting people for the first time.	0	1	2	3	4
12. Do you believe in clairvoyance (psychic forces, fortune telling)?	0	1	2	3	4
13. I often hear a voice speaking my thoughts aloud.	0	1	2	3	4
14. I find it hard to be emotionally close to other people.	0	1	2	3	4
15. I often ramble on too much when speaking.	0	1	2	3	4
16. Do you often feel nervous when you are in a group of unfamiliar people?	0	1	2	3	4
17. Do you feel that there is no one you are really close to outside of your immediate family, or people you can confide in or talk to about personal problems?	0	1	2	3	4

18. When shopping do you get the feeling that other people are taking notice of you?	0	1	2	3	4
19. I feel very uncomfortable in social situations involving unfamiliar people.	0	1	2	3	4
20. Have you had experiences with astrology, seeing the future, UFO's, ESP, or a sixth sense?	0	1	2	3	4
21. Do everyday things seem unusually large or small?	0	1	2	3	4
22. Have you ever felt that you are communicating with another person telepathically (by mind-reading)?	0	1	2	3	4
23. Do you tend to wander off the topic when having a conversation?	0	1	2	3	4
24. I often feel that others have it in for me.	0	1	2	3	4
25. Do you sometimes feel that other people are watching you?	0	1	2	3	4
26. Do you sometimes feel that people are talking about you?	0	1	2	3	4
27. Are your thoughts sometimes so strong that you can almost hear them?	0	1	2	3	4
28. Do you often have to keep an eye out to stop people from taking advantage of you?	0	1	2	3	4
29. Do you feel that you cannot get "close" to people.	0	1	2	3	4
30. I am an odd, unusual person.	0	1	2	3	4
31. I have some eccentric (odd) habits.	0	1	2	3	4
32. I tend to keep my feelings to myself.	0	1	2	3	4

Appendix B: Infrequency Scale

Instructions: Please rate your level of agreement for each of the following statements using the following scale:

0	1	2	3	4
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

1.	Driving from New York to San Francisco is generally faster than flying between these cities.	0	1	2	3	4
2.	I cannot remember a time when I talked with someone who wore glasses.	0	1	2	3	4
3.	I find that I often walk with a limp, which is the result of a skydiving accident.	0	1	2	3	4
4.	I believe that most light bulbs are powered by electricity.	0	1	2	3	4

Appendix C: Smoking Status Questionnaire

1. Age: _____

2. Gender a. Female b. Male

3. Date of Birth: ___/___/_____

4. Which ethnic/racial group do you most identify yourself? (circle one)

a. Caucasian	e. American Indian or Alaskan Native
b. Black/African-American	f. Pacific Islander (including Hawaii and Philippines)
c. Asian	g. Other (please specify): _____
d. Latino/Hispanic	

5. What is your relationship status? (circle one)

a. Single/Never married	d. Divorced
b. In a committed relationship	e. Separated
c. Married	f. Widow

6. Do you smoke cigarettes every day? (circle one) YES NO

7. Did you *ever* smoke every day? (circle one) YES NO

If YES: 6a. How long did you smoke? _____
6b. How long has it been since you stopped smoking? _____
6c. When you were smoking daily, how many cigarettes per day did you usually smoke? _____

7. Do you ever smoke now? (circle one) YES NO

If YES: 7a. I smoke an average of _____ (enter number) cigarettes per: (circle one)
a. week
b. month
c. year

8. How many years have you been smoking daily? _____

9. How many cigarettes per day do you smoke? _____

10. What is your preferred brand of cigarettes? _____

11. How soon after you wake up do you smoke your first cigarette? (circle one)

a. within 5 minutes
b. 6-30 minutes
c. 31-60 minutes
d. after 60 minutes

12. Do you smoke more frequently during the first hours after waking than during the rest of the day? (circle one)

YES NO

13. Which of all the cigarettes you smoke in a day would you most hate to give up? (circle one)

a. the first cigarette of the day
b. all others

14. Do you find it difficult to refrain from smoking in places where it is forbidden, e.g., in church, at the library, in the theatre, etc.? (circle one)

YES NO

15. Do you smoke if you are so ill that you are in bed most of the day? (circle one)

YES NO

16. How concerned are you about gaining weight when you quit smoking?

0 1 2 3 4 5
Not at All Extremely

17. How many **serious** attempts to quit smoking (at least 24 hours) have you made to quit smoking? _____

18. If *yes* to # 17, how have you tried to quit smoking in the past? (circle all that apply)

a. Cold turkey
b. Medication
c. Hypnosis
d. Support from family/friends
e. Herbs or vitamins
f. Gradual reduction
g. Nicotine patch
h. Nicotine nasal spray
i. Nicotine gum
j. Other (please specify):
_____

19. Are you currently trying to stop smoking? (circle one)

YES NO

20. If *yes* to # 19, how have you tried to quit smoking? (circle all that apply)

a. Cold turkey
b. Medication
c. Hypnosis
d. Support from family/friends
e. Herbs or vitamins
f. Gradual reduction
g. Nicotine patch
h. Nicotine nasal spray
i. Nicotine gum
j. Other (please specify):
_____

Appendix D: The Wisconsin Inventory of Smoking Dependence Motives (WISDM-30)

Instructions: Below are a series of statements about cigarette smoking. Please rate your level of agreement for each using the following scale:

1	2	3	4	5	6	7
Not True of Me At All						Extremely True of Me

1.	I enjoy the taste of cigarettes most of the time.	1	2	3	4	5	6	7
2.	Smoking keeps me from gaining weight.	1	2	3	4	5	6	7
3.	If I always smoke in a certain place it is hard to be there and not smoke.	1	2	3	4	5	6	7
4.	I often smoke without thinking about it.	1	2	3	4	5	6	7
5.	Smoking a cigarette improves my mood.	1	2	3	4	5	6	7
6.	The flavor of a cigarette is pleasing.	1	2	3	4	5	6	7
7.	I rely upon smoking to control my hunger and eating.	1	2	3	4	5	6	7
8.	Smoking helps me feel better in seconds.	1	2	3	4	5	6	7
9.	Cigarettes keep me company, like a close friend.	1	2	3	4	5	6	7
10.	There are particular sights and smells that trigger strong urges to smoke.	1	2	3	4	5	6	7
11.	Smoking helps me stay focused.	1	2	3	4	5	6	7
12.	I frequently light cigarettes without thinking about it.	1	2	3	4	5	6	7
13.	Most of my daily cigarettes taste good.	1	2	3	4	5	6	7
14.	I frequently crave cigarettes.	1	2	3	4	5	6	7
15.	Most of the people I spend time with are smokers.	1	2	3	4	5	6	7
16.	Weight control is a major reason that I smoke.	1	2	3	4	5	6	7
17.	I'm really hooked on cigarettes.	1	2	3	4	5	6	7
18.	My urges to smoke keep getting stronger if I don't smoke.	1	2	3	4	5	6	7

19. My concentration is improved after smoking a cigarette.	1	2	3	4	5	6	7
20. I would feel alone without my cigarettes.	1	2	3	4	5	6	7
21. A lot of my friends or family smoke.	1	2	3	4	5	6	7
22. When I haven't been able to smoke for a few hours, the craving gets intolerable.	1	2	3	4	5	6	7
23. When I do certain things I know I'm going to smoke.	1	2	3	4	5	6	7
24. Most of my friends and acquaintances smoke.	1	2	3	4	5	6	7
25. I smoke within the first 30 minutes of awakening in the morning.	1	2	3	4	5	6	7
26. Sometimes I'm not aware that I'm smoking.	1	2	3	4	5	6	7
27. Smoking helps me think better.	1	2	3	4	5	6	7
28. Smoking really helps me feel better if I've been feeling down.	1	2	3	4	5	6	7
29. I consider myself a heavy smoker.	1	2	3	4	5	6	7
30. Giving up cigarettes would be like losing a good friend.	1	2	3	4	5	6	7

Appendix E: Smoking Consequences Questionnaire – Adult

Instructions: This questionnaire is designed to assess beliefs people have about the consequences of smoking a cigarette. We are interested in your general expectations about the consequences of your smoking. Below is a list of statements. Each statement contains a possible consequence of smoking. For each of the statements listed below, please rate how LIKELY or UNLIKELY you believe each consequence is <u>for you</u> when you smoke. If the consequence seems LIKELY to you, circle a number from 5-9. That is, if you believe that a consequence would never happen, circle 0; if you believe a consequence would happen every time you smoke, circle 9. If it seems a little unlikely to you, you would circle 4.

0 Completely Extremely **1** **2** Very Somewhat **3** **4** A little **5** A little Somewhat **6** **7** Very **8** Extremely **9** Completely

←----------**UNLIKELY**----------X----------**LIKELY**----------→

	Unlikely									Likely
1. Cigarettes taste good.	0	1	2	3	4	5	6	7	8	9
2. Smoking controls my appetite.	0	1	2	3	4	5	6	7	8	9
3. My throat burns after smoking.	0	1	2	3	4	5	6	7	8	9
4. Cigarettes help me deal with anxiety or worry.	0	1	2	3	4	5	6	7	8	9
5. Nicotine "fits" can be controlled by smoking.	0	1	2	3	4	5	6	7	8	9
6. When I'm angry, a cigarette can calm me down.	0	1	2	3	4	5	6	7	8	9
7. When I'm alone, a cigarette can help me pass the time.	0	1	2	3	4	5	6	7	8	9
8. I become more addicted the more I smoke.	0	1	2	3	4	5	6	7	8	9
9. If I'm tense, a cigarette helps me to relax.	0	1	2	3	4	5	6	7	8	9
10. Cigarettes keep me from overeating.	0	1	2	3	4	5	6	7	8	9
11. Smoking a cigarette energizes me.	0	1	2	3	4	5	6	7	8	9
12. Cigarettes help me deal with anger.	0	1	2	3	4	5	6	7	8	9
13. Smoking calms me down when I feel nervous.	0	1	2	3	4	5	6	7	8	9
14. Cigarettes make my lungs hurt.	0	1	2	3	4	5	6	7	8	9
15. I feel like I do a better job when I am smoking.	0	1	2	3	4	5	6	7	8	9

16. A cigarette can give me energy when I'm bored and tired.	0	1	2	3	4	5	6	7	8	9
17. Cigarettes can really make me feel good.	0	1	2	3	4	5	6	7	8	9
18. When I'm feeling happy, smoking helps me keep that feeling.	0	1	2	3	4	5	6	7	8	9
19. I will enjoy the flavor of a cigarette.	0	1	2	3	4	5	6	7	8	9
20. If I have nothing to do, a smoke can help kill time.	0	1	2	3	4	5	6	7	8	9
21. I will enjoy feeling a cigarette on my tongue and lips.	0	1	2	3	4	5	6	7	8	9
22. Smoking will satisfy my nicotine cravings.	0	1	2	3	4	5	6	7	8	9
23. I feel like part of a group when I'm around other smokers.	0	1	2	3	4	5	6	7	8	9
24. Smoking makes me seem less attractive.	0	1	2	3	4	5	6	7	8	9
25. By smoking, I risk heart disease and lung cancer.	0	1	2	3	4	5	6	7	8	9
26. Smoking makes me enjoy people more.	0	1	2	3	4	5	6	7	8	9
27. Cigarettes help me reduce or handle tension.	0	1	2	3	4	5	6	7	8	9
28. I feel better physically after having a cigarette.	0	1	2	3	4	5	6	7	8	9
29. I enjoy parties more when I am smoking.	0	1	2	3	4	5	6	7	8	9
30. People think less of me if they see me smoking.	0	1	2	3	4	5	6	7	8	9
31. A cigarette can satisfy my urge to smoke.	0	1	2	3	4	5	6	7	8	9
32. Just handling a cigarette is pleasurable.	0	1	2	3	4	5	6	7	8	9
33. If I'm feeling irritable, a smoke will help me relax.	0	1	2	3	4	5	6	7	8	9
34. Smoking irritates my mouth and throat.	0	1	2	3	4	5	6	7	8	9
35. When I feel bored and tired, a cigarette can really help.	0	1	2	3	4	5	6	7	8	9
36. I will become more dependent on nicotine if I continue smoking.	0	1	2	3	4	5	6	7	8	9

37. Smoking helps me control my weight.	0	1	2	3	4	5	6	7	8	9
38. When I'm upset with someone, a cigarette helps me cope.	0	1	2	3	4	5	6	7	8	9
39. The more I smoke, the more I risk my health.	0	1	2	3	4	5	6	7	8	9
40. Cigarettes keep me from eating more than I should.	0	1	2	3	4	5	6	7	8	9
41. I enjoy the steps I take to light up.	0	1	2	3	4	5	6	7	8	9
42. Conversations seem more special if we are all smoking.	0	1	2	3	4	5	6	7	8	9
43. I look ridiculous while smoking.	0	1	2	3	4	5	6	7	8	9
44. Smoking keeps my weight down.	0	1	2	3	4	5	6	7	8	9
45. I like the way a cigarette makes me feel physically.	0	1	2	3	4	5	6	7	8	9
46. Smoking is hazardous to my health.	0	1	2	3	4	5	6	7	8	9
47. I enjoy feeling the smoke hit my mouth and the back of my throat.	0	1	2	3	4	5	6	7	8	9
48. When I smoke, the taste is pleasant.	0	1	2	3	4	5	6	7	8	9
49. I like to watch the smoke from my cigarette.	0	1	2	3	4	5	6	7	8	9
50. When I am worrying about something, a cigarette is helpful.	0	1	2	3	4	5	6	7	8	9
51. Smoking temporarily reduces those repeated urges for cigarettes.	0	1	2	3	4	5	6	7	8	9
52. I enjoy the taste sensations while smoking.	0	1	2	3	4	5	6	7	8	9
53. I feel more at ease with other people if I have a cigarette.	0	1	2	3	4	5	6	7	8	9
54. Cigarettes are good for dealing with boredom.	0	1	2	3	4	5	6	7	8	9
55. Smoking is taking years off my life.	0	1	2	3	4	5	6	7	8	9

Vita

Diana Stewart was born in Fort Knox, Kentucky, and grew up primarily in Lansing, Kansas. Following high school, she attended the University of Kansas where she graduated with honors in 2005 with a Bachelor of Arts degree in psychology and a minor in English. Upon graduating, Diana entered the doctoral program in clinical psychology at Louisiana State University, where she is now in her fifth year. She received her Master of Arts degree in clinical psychology from Louisiana State University in 2008. Diana is currently completing a predoctoral internship in clinical psychology with a focus on behavioral medicine at Brown Medical School. In August 2011, she will graduate from Louisiana State University with a Doctor of Philosophy in clinical psychology and a specialization in behavioral medicine. Diana is looking forward to continuing her training as a postdoctoral fellow in health disparities and addictions research at M.D. Anderson Cancer Center in Houston, Texas. Her line of research will continue to focus on tobacco use and cessation in difficult to reach and underserved populations (e.g., low income, ethnic minority, severe mental illness).