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UNIVERSITY OF CALIFORNIA, SAN DIEGO
SAN DIEGO STATE UNIVERSITY

The Role of Alcohol Use and Social Factors in Young Adult Smoking

A dissertation submitted in partial satisfaction of the requirements for the degree
Doctor of Philosophy

in

Clinical Psychology

by

Catherine Amanda Schweizer

Committee in charge:

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2015

The Dissertation of Catherine Amanda Schweizer is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Chair

University of California, San Diego

San Diego State University

2015

DEDICATION

I dedicate this dissertation to my husband and my son, and in memory of my grandparents, Robert and Catherine Scholes.

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I am beyond thankful that I happened to wander into the office of my undergraduate professor, David Gard, who provided me with an introduction to clinical psychology in all its facets. Someday I hope to emulate his humorous and creative teaching style. I am grateful to Jodi Prochaska, with whom I worked as a research coordinator, for teaching me about the critical necessity of smoking research. Her dedication, productivity, and tenacity provide endless inspiration.

I am so appreciative to Justin Halpern, Joni and Sam Halpern, John and Kit Schweizer, Madeleine Amodeo, Jonah Charney-Sirrott, Nicole Crocker, Erin Green, and Lianne Tomfohr for their love, laughter, and encouragement.

Finally, I would like to acknowledge the support I received to complete this dissertation from the National Institute on Drug Abuse (#F31-DA030032).

Chapter 2, in full, is a reprint of the material that has been accepted for publication and will appear in *Addiction Research and Theory*. Schweizer, C. Amanda;

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Chapter 3, in full, is a reprint of the material as it appears in Journal of American College Health 2014. Schweizer, C. Amanda; Doran, Neal; Myers, Mark G. The dissertation author was the primary investigator and author of this paper.

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PUBLICATIONS

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doi:10.3109/16066359.2013.856884
- Schweizer, C. A., Doran, N., & Myers, M. G. (2014). Social facilitation expectancies for smoking: Psychometric properties of a new measure. *Journal of American College Health, 62*, 136-44.
- Doran, N., Schweizer, C. A., Myers, M. G. & Greenwood, T. (2013). A Prospective Study of the Effects of Impulsivity and the *DRD2/ANKK1* TaqIA Polymorphism on Smoking Initiation. *Substance Use & Misuse, 48*, 106-116.
- Myers, M. G., Doran, N., Edland, S., Schweizer, C. A., & Wall, T. (2013). Smoking initiation during college predicts future alcohol involvement: A matched samples study. *Journal of Studies on Alcohol and Drugs, 74*, 909-916.

- Doran, N., Khoddam, R., Sanders, P. E., Schweizer, C. A., & Myers, M. G. (2013). A Prospective Study of the Acquired Preparedness Model and Smoking Initiation and Frequency in College Students. *Psychology of Addictive Behaviors, 27*, 714-22.
- Heckman, B. W., Blank, M. D., Peters, E. N., Patrick, M. E., Bloom, E. L., Mathew, A. R., Schweizer, C. A., Rass, O., Lidgard, A. L., Zale, E. L., Cook, J. W., & Hughes, J. R. (2013). Training tomorrow's tobacco scientists, today: The SRNT Trainee Network. *Nicotine & Tobacco Research, 15*.
- Tomfohr, L., Schweizer, C. A., Dimsdale, J., & Loreda, J. (2013). Psychometric characteristics of the Pittsburgh Sleep Quality Index in English speaking non-Hispanic Whites and English and Spanish speaking Hispanics of Mexican descent. *Journal of Clinical Sleep Medicine, 9*, 61-66.
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ABSTRACT OF THE DISSERTATION

The Role of Alcohol Use and Social Factors in Young Adult Smoking

by

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Doctor of Philosophy in Clinical Psychology

University of California, San Diego, 2015

San Diego State University, 2015

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Young adults smoke cigarettes at higher rates than any other age group; understanding the risk factors for smoking in young adulthood is fundamental to informing intervention. This dissertation, in three studies, examines the role of alcohol use, social facilitation expectancies, and interpersonal influences on smoking among college-attending young adults.

Samples were comprised of young adults aged 18-24 who had smoked at least one cigarette in the last month. For study 1, latent transition analysis (LTA) was used to identify profiles of alcohol and cigarette co-use at three time points and estimate the probability of movement between groups over time. A three-profile solution emerged at each time with profiles representing varying levels of alcohol and tobacco co-use. The LTA probabilities highlighted instability in use. In study 2, the psychometric properties

of a new measure of social facilitation expectancies for smoking (SFE) were evaluated using cross-sectional survey data. A nine-item, one-factor scale was confirmed. Higher SFE scores were associated with greater smoking experience and with greater endorsement of other smoking related beliefs. For study 3, latent class growth analysis was used to extract distinct smoking trajectories and examine the effects of demographic, alcohol, and interpersonal factors on trajectory membership. Five smoking trajectories were identified and labeled based on smoking frequency and whether the rate of change indicated stable, decreasing, or increasing use over time. Sex, average number of cigarettes smoked per day, nicotine dependence, and percent of friends who smoke differed between groups, whereas alcohol use did not.

Young adult smoking is a temporally unstable behavior, particularly for those using at low levels, and often occurs in the context of alcohol use. Surprisingly, even though these behaviors frequently co-occur, our findings suggest alcohol use does not potentiate smoking progression over the short-term. Social factors may be important early in the smoking career and contribute to continued smoking and smoking progression. Social facilitation expectancies and alcohol use may be effective targets for prevention and early smoking intervention. Findings also highlight the heterogeneity of less than daily smoking in young adulthood and the shortcomings of broad classifications of “nondaily” smoking.

CHAPTER 1: INTRODUCTION

The transition from adolescence to adulthood is a period during which substance use and other health behaviors are being formed (Chassin, Presson, Pitts, & Sherman, 2000; Trinidad, Gilpin, Lee, & Pierce, 2004), making young adulthood an apt opportunity for intervening with persistent deleterious health behaviors such as tobacco use. Recent studies indicate tobacco use is common among college students (Asotra, 2005; L. D. Johnston, O'Malley, Bachman, & Schulenberg, 2011; Morrell, Cohen, Bacchi, & West, 2005; Rigotti, Lee, & Wechsler, 2000) and non-college attending young adults (CDC, 2010; L. D. Johnston, et al., 2011). The Centers for Disease Control estimate approximately 20% of adults aged 18-24 are current smokers (defined as having smoked 100 cigarettes in their lifetime and smoking every day or nearly every day; (CDC, 2010). Among college-attending young adults, Monitoring the Future national survey data from 2010 estimate approximately 20% have smoked in the last 30 days and 5-10% smoke daily (L. D. Johnston, et al., 2011). Young adults who smoke cigarettes are at risk for continuing smoking through adulthood and experiencing substantial health consequences associated with continued cigarette smoking, even among those who smoke on a less than daily basis, as no level of smoking is considered safe (USDHHS, 2006). Of added concern is evidence indicating the tobacco industry is targeting young adults (Ling & Glantz, 2002, 2004), increasing the vulnerability of this population to smoking initiation and progression (Gilpin, Lee, & Pierce, 2005). Effective smoking cessation methods for young adults, and college students in particular, are not well-established (Murphy-Hoefer et al., 2005; Villanti, McKay, Abrams, Holtgrave, & Bowie, 2010) and researchers have highlighted the importance of studies designed to inform young adult smoking cessation

interventions (Orleans, 2007). Further research on the course, characteristics, and factors contributing to the stability of, or change in, smoking during young adulthood may serve to inform interventions tailored to the unique needs of this population.

Young adult smoking is distinctive from the cigarette use of other age groups. In contrast to older adults, young adults are less concerned about the health consequences of smoking, believe low levels of smoking are innocuous, and lack recognition of the benefits of quitting (A. E. Brown, Carpenter, & Sutfin, 2011; Murphy-Hoefer, Alder, & Higbee, 2004; Prokhorov et al., 2003; Prokhorov et al., 2008; J. S. Rose, Chassin, Presson, & Sherman, 1996). In addition, young adults face emotional challenges unique to this transitional phase of life, in which relationships and responsibilities are evolving. This stress may place young adults at higher risk for substance use. The instability of tobacco use during the college years has been demonstrated with findings from several prospective studies (Jackson, Sher, & Schulenberg, 2005). High rates of smoking initiation are observed during college (Myers, Doran, Trinidad, Wall, & Klonoff, 2009; Wechsler, Rigotti, Gledhill-Hoyt, & Lee, 1998; Wetter et al., 2004) and there is evidence students' smoking may generally decrease during the school year (Colder et al., 2006). The temporal instability of young adult substance use may be explained by findings that young adult smoking is more influenced by environmental and social cues for smoking (e.g, friends' smoking patterns) than is older adults' smoking (Andrews, Tildesley, Hops, & Fuzhong, 2002; A. E. Brown, et al., 2011; Hines, Fretz, & Nollen, 1998; Moran, Wechsler, & Rigotti, 2004). Therefore, environmental context and social norms may pose an increased risk for progression of smoking.

Young adult smoking patterns more closely resemble adolescents' than older adults'; youth are more likely than older adults to be nondaily smokers (Gilpin, Cavin, & Pierce, 1997; Hassmiller, Warner, Mendez, Levy, & Romano, 2003). Smoking on a less than daily basis, termed "nondaily," "episodic," "intermittent," or "occasional," (i.e., a smoking pattern that is inconsistent over time), is more common than daily smoking among college students (Ames et al., 2009; Moran, et al., 2004; Sutfin, Reboussin, McCoy, & Wolfson, 2009). This type of irregular cigarette use may reflect an early stage of smoking progression, with subsequent transition to heavier daily smoking and nicotine dependence, or a time-limited period of experimentation (Kenford et al., 2005). Alternatively, there is evidence individuals may maintain relatively low levels of smoking for extended periods of time (Hassmiller, et al., 2003; Levy, Biener, & Rigotti, 2009) or may transition back and forth regularly between daily and nondaily smoking (Etter, 2004; Hennrikus, Jeffery, & Lando, 1996; Nguyen & Zhu, 2009; White, Bray, Fleming, & Catalano, 2009; Zhu, Sun, Hawkins, Pierce, & Cummins, 2003). The tobacco research community has identified the need to focus on low levels of smoking (Dierker et al., 2007; Okuyemi et al., 2002; Shiffman, 2009) to further understanding of these patterns.

Biopsychosocial Model of Addiction

The biopsychosocial model conceives of addiction as a process involving both biological (e.g., physical dependence, pharmacological reinforcement) and social-behavioral factors (environmental influences, learning history, cognitions and attitudes, etc.) (Donovan, 1988). An important premise of this approach is a similar process of

addiction across substances, as reflected by similarities in the course of addiction and difficulties in maintaining behavior change (Brownell, Marlatt, Lichtenstein, & Wilson, 1986). The biopsychosocial model of addiction forms the conceptual basis of this project, which examines environmental factors (alcohol use and interpersonal social influences) in relation to young adult cigarette smoking, taking into consideration cognitive (substance use expectancies, desire to quit smoking), and intrapersonal/biological (nicotine dependence, negative affectivity) factors.

Cigarette and Alcohol Co-use

Prevalence rates from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) indicate that problematic alcohol use, cigarette use, and co-use (i.e., the use of both substances within a given time frame) are highest among young adults aged 18-24 (Falk, Yi, & Hiller-Sturmhofel, 2006). Among college students in the United States 41.7% report binge drinking (i.e., drinking 5 or more drinks on one occasion for men or 4 or more drinks on one occasion for women; (Wechsler, Dowdall, Davenport, & Rimm, 1995) in the past two weeks (Substance Abuse and Mental Health Services Administration, 2009). Rates of alcohol use among college student smokers are especially high, with 98% of past 30 day cigarette smokers in the Harvard School of Public Health College Alcohol Study reporting they had used alcohol in the last year (Weitzman & Chen, 2005). Additionally, young adults frequently use tobacco and alcohol concurrently and report the majority of smoking occurring on drinking days, smoking increasing while drinking, and drinking increasing while smoking (Harrison & McKee, 2008; Jackson, Colby, & Sher, 2010; Witkiewitz et al., 2012). Jackson and

colleagues (2010) found that smoking was 2.75 times more likely to occur for college student smokers on a drinking day than a nondrinking day. Episodic and occasional smoking, in particular, is a pattern of smoking often occurring in conjunction with alcohol use (Dierker et al., 2006; Krukowski, Solomon, & Naud, 2005; Nichter, Carkoglu, & Lloyd-Richardson, 2010).

Use of either alcohol or cigarettes may place an individual at increased risk for initiation or progression in use of the other substance (Fleming, Leventhal, Glynn, & Ershler, 1989; Kahler et al., 2008; Myers, Doran, Edland, Schweizer, & Wall, 2013; Reed, McCabe, Lange, Clapp, & Shillington, 2010; Reed, Wang, Shillington, Clapp, & Lange, 2007; Saules et al., 2004; Schorling, Gutgesell, Klas, Smith, & Keller, 1994; Sher, Gotham, Erickson, & Wood, 1996). This may be explained by alcohol and tobacco use sharing common risk factors, such as family history of alcoholism, sex, ethnicity, availability, social cues, expectancies, or stress (Bobo & Husten, 2000; Jackson, et al., 2010; McKee, Harrison, & Shi, 2010; Sher, Gotham, et al., 1996), or alcohol and tobacco directly influencing each other. Alcohol use increases craving for cigarettes among smokers (Burton & Tiffany, 1997; King & Epstein, 2005; Piasecki et al., 2011), smokers report greater subjective effects from the concurrent use of alcohol and tobacco (McKee, Hinson, Rounsaville, & Petrelli, 2004; J. E. Rose et al., 2002), were more likely to report positive reinforcement from smoking while under the influence of alcohol (McKee, et al., 2004; Piasecki, et al., 2011), are more likely to have alcohol-related problems (McKee, Falba, O'Malley, Sindelar, & O'Connor, 2007) and smoke more while drinking (Harrison, Hinson, & McKee, 2009; McKee, et al., 2010) than nonsmokers. Nondaily smokers hold similar subjective expectations for the effects of alcohol improving the cigarette smoking

experience as do daily smokers (McKee, et al., 2010) yet may be at higher risk for problems from drinking. Harrison and colleagues found 63% of daily smokers and 72% of nondaily smokers who participated in the NESARC reported engaging in hazardous drinking (Harrison, Desai, & McKee, 2008).

The important public health implications of concurrent cigarette and alcohol use among young adults have led to increased research attention to this issue. For example, existing studies have provided valuable knowledge by examining the temporal patterning of young adult cigarette and alcohol use in drinking situations (Harrison, et al., 2009), and the subjective effects of smoking while drinking (McKee, et al., 2004). However, most investigations to date have been cross-sectional (Harrison, et al., 2008; Harrison, et al., 2009; Harrison & McKee, 2008; Reed, et al., 2007), or demonstrate momentary associations between alcohol and tobacco (Jackson, et al., 2010; Piasecki, et al., 2011). There is only one identified prospective investigation (Jackson, et al., 2005) and none have assessed the role of social influences on concurrent smoking and alcohol use. An additional consideration for studies of alcohol and tobacco co-use is that, like tobacco use, there is temporal variability in alcohol use among young adults. Substance use trajectory studies suggest young adults follow one of several paths of alcohol use, the majority of which indicate changes in use over the college years (Chassin, Forthofer, & King, 2004; Jackson, Sher, Gotham, & Wood, 2001; Jackson, et al., 2005; Tucker, Orlando, & Ellickson, 2003), with a notable proportion of students reporting increases in problematic drinking during college (Doran, Myers, Luczak, Carr, & Wall, 2007; Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005; Schweizer, Doran, Roesch, & Myers, 2011). While longitudinal studies with infrequent assessment provide information about general

patterns in use over long periods of time, Del Boca and colleagues (2004) highlight the significant temporal variability in alcohol use among first-year college students and emphasize the utility of frequent assessment for observing changes in substance use over time (Del Boca, Darkes, Greenbaum, & Goldman, 2004). Investigations that prospectively evaluate the role of social influences on concurrent cigarette and alcohol use with frequent assessment intervals are important to address gaps in the extant body of knowledge.

Social Influences on Smoking

The few examinations of interpersonal factors in young adult smoking indicate the importance of these influences (Levinson et al., 2007; Moran, et al., 2004), which is corroborated by the tobacco industry internal emphasis on this topic, for both research and marketing efforts (Ling & Glantz, 2002). Tobacco product branding is developed with specific young adult social activities such as bars and clubs, military service, and college as targets, and is based on internal research of young adult culture, including music, language, trends, buying patterns, politics, and media (Ling & Glantz, 2002). For example, businesses and events catering to college students and the general population of young adults are typical sites for tobacco promotions, such as sponsorship of musical events or distribution of free cigarettes (Jiang & Ling, 2011; Rigotti, Moran, & Wechsler, 2005).

Non-industry research has demonstrated young adults' smoking often mirrors their close friends' smoking (Andrews, et al., 2002) and social consequences of smoking and perceived peer norms regarding smoking may be particularly salient to young adults

(Myers, McCarthy, MacPherson, & Brown, 2003; Rigotti, et al., 2000). Qualitative research has revealed college students interpret social contexts and parties as “permission” to use tobacco (Nichter, et al., 2010). These findings are supported by the increase in smoking prevalence and quantity among college students observed during weekends and holidays, when socialization is more likely to occur (Colder, et al., 2006). A large number of college students self-identify as “social smokers” (Levinson, et al., 2007; Moran, et al., 2004; Morley, Hall, Hausdorf, & Owen, 2006) and report smoking primarily in social situations (Gilpin, White, & Pierce, 2005a; Waters, Harris, Hall, Nazir, & Waigandt, 2006). Self-identity and behavioral observations have both been used to define a pattern of tobacco use termed “social smoking” and both are associated with smoking on a less than daily basis, low motivation to quit, high confidence in ability to quit, low scores on measures of nicotine dependence, and initiating tobacco use at a later age than those who smoke daily or identify as regular smokers (Moran, et al., 2004; Song & Ling, 2011; Waters, et al., 2006). However, Song and Ling (2011) found predictors of social smoking differ by definition. Notably, compared to established smokers, those who identify as social smokers are less likely to report intention to quit smoking or a past year quit attempt, while behavioral social smokers are more likely to report intention to quit and quit attempts, highlighting the important role of cognitions in motivating young adult smoking (Song & Ling, 2011). While many individuals who smoke primarily in social situations or at bars, parties, or clubs self-identify as social smokers others do not identify as smokers at all, despite regular tobacco use (Levinson, et al., 2007; Waters, et al., 2006). This poses a challenge for intervention; these individuals may be unlikely to seek out services or may not disclose tobacco use to providers.

Adolescent tobacco use research has suggested peers and social contact may provide direct pressure to smoke, influence subjective prevalence estimates of smoking, provide a positive image for smoking, increase access to tobacco, and facilitate social cohesion (Baker, Brandon, & Chassin, 2004). How peers and social context influence young adult smoking is not clear. To enhance understanding of the function of the social factors on young adult smoking research in this area should include examinations of smoking context, peer smoking, smoker identity, and cognitions regarding the positive social effects of smoking, as well as alcohol use, which often occurs in conjunction with “social smoking” and often precedes tobacco use within social situations (Nichter, et al., 2010).

Cognitive Influences on Smoking

There is substantial evidence substance use expectancies (i.e., beliefs about the consequences of substance use) affect use and greater positive outcome expectancies are associated with higher levels of use (Brandon & Baker, 1991; S.A. Brown, Goldman, Inn, & Anderson, 1980; Chassin, Presson, Sherman, & Edwards, 1991; Copeland & Brandon, 2000; Fromme & Dunn, 1992; Fromme, Stroot, & Kaplan, 1993). Expectancies about the positive and negative effects of both smoking and cessation have been shown to have an effect on young adults’ tobacco use behaviors. For example, young adults’ expectancies about the reinforcing effects of smoking cigarettes have been shown to influence and are influenced by the initiation of smoking (Copeland, Brandon, & Quinn, 1995; Doran, Schweizer, & Myers, 2011). Similarly, alcohol-related expectancies predict future drinking and heavier drinking is associated with greater positive outcome expectancies

(Sher, Wood, Wood, & Raskin, 1996). Alcohol use and expectancies for alcohol use have also been shown to have an effect on smoking expectancies. Engaging in alcohol use and anticipating the effects of alcohol have been shown to increase expectancies about the negative reinforcement properties of smoking (Kirchner & Sayette, 2007; McKee, et al., 2004) and young adults report greater positive subjective effects of smoking while drinking than without alcohol present (McKee, et al., 2004).

There is some evidence tobacco use expectancies may function differently for occasional smokers than heavier smokers. Positive reinforcement expectancies have been shown to predict increased smoking among light or occasional smokers, but not daily smokers (Wetter, et al., 2004) and greater negative reinforcement expectancies for smoking are associated with smoking progression and development of nicotine dependence (Copeland, et al., 1995; Wetter, et al., 2004). As noted previously, cognitions regarding the positive social effects of smoking may be an important component to understanding the mechanism linking social context and smoking behavior, particularly among young adults who smoke on an intermittent or occasional basis. Although multiple measures of tobacco use expectancies exist, none are specifically developed to measure expectancies regarding social facilitation properties for smoking.

Negative Affect and Smoking

Individual temperamental risk factors for substance use have been identified and warrant inclusion in models investigating smoking behaviors. Negative emotionality and depression symptoms have been linked to initiation (Saules, et al., 2004), persistence and prevalence of smoking (Audrain-McGovern, Rodriguez, & Kassel, 2009; Bares &

Andrade, 2012) as well as higher levels of Nicotine Dependence among adults (Haas, Munoz, Humfleet, Reus, & Hall, 2004; Hall, Munoz, Reus, & Sees, 1993).

Using Latent Variable Modeling in Smoking Research

Defining and classifying smoking patterns among young adults remains a challenge, as exemplified with the numerous labels for smokers who do not smoke heavily (e.g. light, occasional, intermittent, episodic) and lack of consistent definition for social smoking. Researchers have employed diverse indicators to capture tobacco use, which has undoubtedly affected research findings (e.g., An et al., 2009; Boulos et al., 2009; Husten, 2009)]. A shift toward using multiple indicators and latent variable modeling techniques may enhance our ability to identify and distinguish between different classes of smokers, particularly those who smoke at lower levels. Additionally, using latent variable modeling techniques with longitudinal smoking and alcohol use data will add to the sparse literature on the temporal patterns of smoking and alcohol use. One such analytic technique, growth mixture modeling, was applied to longitudinal epidemiological data from the Monitoring the Future (MTF) survey to model developmental trajectories of conjoint alcohol and tobacco use over a five-year period by Jackson and colleagues (2005). Participants were young adults (18-26) assessed every one to two years, with up to five data points per person. Results yielded seven trajectories, with the largest groups representing non-users (56%) and heavy drinkers with low rates of smoking (14%), with the remaining five groups each comprising 5-8% of the sample (Jackson, et al., 2005). Notably, individuals who did not use tobacco or alcohol were included in the study; including nonusers likely affected the emergent trajectories. While

participants who are similar to each other are grouped together in latent trajectory analysis, there is also the possibility that nonsmokers or nondrinkers could be placed into a conjoint use trajectory and slightly affect the use characteristics of the group. The study by Jackson and colleagues (2005) revealed a general reduction in alcohol use through young adulthood and, for many, what appears to be stable cigarette use, both at high and low or nonsmoking levels. However, meaningful change occurring over briefer time periods may be obscured by this method. For example, An and colleagues found more than half the young adults they surveyed reported smoking different amounts at baseline and seven months later (An, et al., 2009). The methodology used by Jackson and colleagues (2005) provides a broad picture of the stability and change in alcohol and tobacco use over young adulthood. An investigation of the change in conjoint alcohol and tobacco use occurring over briefer time periods will allow for a more detailed analysis of the course of use.

Several latent variable techniques have been used by researchers in recognition of the heterogeneity of young adult substance use; latent transition analysis (Jackson, et al., 2001; B.O. Muthén & Muthén, 2000; Velicer, Martin, & Collins, 1996) and growth mixture modeling or latent class growth analysis (B.O. Muthén & Muthén, 2000; Nagin, 1999) may be particularly useful for studying the relationship between alcohol and tobacco co-use during college. Latent transition analysis permits a detailed examination of temporal variability in use over time, while contributing to understanding of how these two behaviors cluster together. This technique has been identified as particularly useful in the study of substance use (Chung, Park, & Lanza, 2005; Lanza, Patrick, & Maggs, 2010); LTA results have revealed the probability of movement between classes based on

alcohol consumption (Auerbach & Collins, 2006; Guo, Collins, Hill, & Hawkins, 2000; Jackson, et al., 2001) or readiness to quit smoking (Martin, Velicer, & Fava, 1996). Growth mixture modeling (GMM) and latent class growth modeling (LCGM) are approaches that assume individuals can be clustered into meaningful groups with shared trajectories (B.O. Muthén & Muthén, 2000; Nagin, 1999). These techniques, widely used in substance use research, have been applied specifically to cigarette use data to identify smoking trajectories (Brook et al., 2008; Caldeira et al., 2012; Chassin, et al., 2000; Costello, Dierker, Jones, & Rose, 2008; Fuemmeler et al., 2013; Jackson, et al., 2005; Klein, Bernat, Lenk, & Forster, 2013; Orlando, Tucker, Ellickson, & Klein, 2004, 2005; White, Pandina, & Chen, 2002). After extracting trajectories, covariates may be tested, providing evidence for who may be at risk for future smoking and informing intervention targets. Although several studies have focused on identifying trajectories across developmental periods, very few have focused on trajectories of stability of and change in smoking during young adulthood.

Summary and Current Studies

Young adults represent an age group with especially high rates of health risk behaviors. The vulnerability of this population to the consequences of continued tobacco use is evident in the frequent initiation of smoking among college students (Myers, et al., 2009) and high prevalence of current smoking among young adults (CDC, 2010). In addition, young adults have the highest prevalence of problem drinking (Chassin, et al., 2004; Falk, et al., 2006). Emerging evidence suggests concurrent smoking and alcohol use, particularly for light smokers, further increases the risk of hazardous drinking

(Harrison, et al., 2008). Despite the important public health implications of concurrent smoking and alcohol use, these behaviors have typically been studied independently from one other, leaving important gaps in available knowledge. Specific gaps include a dearth of research regarding the role of alcohol in the maintenance and progression of smoking and the relative salience of social factors in motivating young adults to smoke. To address these gaps, we conducted three studies to systematically examine the role of alcohol use, cognitive factors (social facilitation expectancies), and interpersonal context (friends who smoke), on smoking among college-attending young adults. Study 1 is a prospective examination of the stability of, and change in, cigarette and alcohol co-use profiles using latent transition analysis; in study 2, the psychometric properties of a new measure of the anticipated social benefits of smoking are established; and study 3 involves the identification of distinct cigarette smoking trajectories and an examination of the effects of baseline and time-varying covariates (e.g., demographics) and predictors (e.g., alcohol use, percent of friends who smoke) on trajectory membership.

CHAPTER 2: EXAMINING THE STABILITY OF YOUNG-ADULT ALCOHOL AND
TOBACCO CO-USE: A LATENT TRANSITION ANALYSIS

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ABSTRACT

Although use of both alcohol and tobacco is common among college-attending young adults, little is known about the stability of co-use over time. Difficulties in studying change in these behaviors may reflect inconsistencies in how smoking in particular is categorized. The current study used longitudinal data, gathered at three time points three months apart, to examine cigarette and alcohol use profiles and the stability of profile structure and membership. Undergraduate student smokers' (N=320) past 30-day alcohol and cigarette use was assessed using the timeline followback procedure. Smoking (number of cigarettes and number of smoking days) and drinking (number of drinks and number of binges) were entered into a latent transition analysis (LTA) to identify the latent taxonomic structure within the sample, and determine the probability of movement between groups over time. A 3-profile solution emerged at each time-point. The LTA probabilities highlighted both progression and reduction in the lower use groups. Overall, findings revealed notable changes in tobacco and alcohol use behaviors over the span of six months, affecting both profile structures and individual membership status. This suggests that among young adults both tobacco and alcohol use are temporally unstable behaviors, particularly among those using at lower levels.

Introduction

Cigarettes and alcohol are the most commonly used psychoactive substances in the United States (Falk, et al., 2006; L.D. Johnston, O'Malley, Bachman, & Schulenberg, 2006). Co-use or conjoint use, defined as use of both substances by the same person in a given time period (Falk, et al., 2006), and concurrent use, defined as simultaneous use of both substances, are also common. Used alone each substance poses health risks to the individual. Cigarette use is a persistent behavior and, along with obesity, is the leading cause of preventable death in the United States (CDC, 2008). Heavy alcohol use is also a major public health concern for its role in many chronic diseases and numerous high risk behaviors, including driving while intoxicated, accidents, violence, and unsafe sex practices (Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; Naimi et al., 2003). Research demonstrates chronically using the two substances in conjunction may produce, at minimum, additive risk for various cancers (e.g. throat, mouth, esophageal), cardiovascular disease, and hypertension (Zacny, 1990).

Use of either alcohol or cigarettes may place an individual at increased risk for initiation or progression in use of the other substance (Fleming, et al., 1989; Kahler, et al., 2008; Reed, et al., 2010; Reed, et al., 2007; Saules, et al., 2004; Schorling, et al., 1994; Sher, Gotham, et al., 1996). This may be explained by alcohol and tobacco use sharing common risk factors, such as family history of alcoholism, sex, ethnicity, availability, social cues, expectancies, or stress (Bobo & Husten, 2000; Jackson, et al., 2010; McKee, et al., 2010; Sher, Gotham, et al., 1996), or alcohol and tobacco directly influencing each other. Cross-sectional experimental studies show a cross-substance craving effect with alcohol or tobacco acting as a conditioned cue for the other substance (Burton & Tiffany,

1997; Piasecki, et al., 2011). Smokers report greater subjective rewarding effects from the concurrent use of alcohol and tobacco (McKee, et al., 2004; J. E. Rose, et al., 2002), are more likely to report positive reinforcement from smoking while under the influence of alcohol (McKee, et al., 2004; Piasecki, et al., 2011), and smoke more while drinking (Harrison, et al., 2009; McKee, et al., 2010). Nondaily smokers hold similar subjective expectations for the effects of alcohol improving the cigarette smoking experience as do daily smokers (McKee, et al., 2010) yet may be at higher risk for problems from drinking. Harrison and colleagues found 63% of daily smokers and 72% of nondaily smokers who participated in the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) reported engaging in hazardous drinking (Harrison, et al., 2008).

Prevalence rates from the NESARC indicate problematic alcohol use, cigarette use, and co-use are highest among young adults aged 18-24 (Falk, et al., 2006). Among college students in the United States, approximately twenty percent report cigarette use in the past month and about 40% report drinking 5 or more drinks in a row in the past two weeks (L. D. Johnston, et al., 2011). Rates of alcohol use among college student smokers are especially high, with 98% of past 30 day cigarette smokers in the Harvard School of Public Health College Alcohol Study reporting they used alcohol in the last year (Weitzman & Chen, 2005). Additionally, young adults frequently use tobacco and alcohol concurrently and report the majority of their smoking occurs on drinking days, smoking increases while drinking, and drinking increases while smoking (Harrison & McKee, 2008; Jackson, et al., 2010; Witkiewitz, et al., 2012). Jackson and colleagues (2010) found smoking was 2.75 times more likely to occur for college student smokers on a drinking day than a nondrinking day.

While population-based cross-sectional studies show alcohol and tobacco use are prevalent among college students, the instability of these behaviors during the college years is demonstrated with findings from several prospective studies. High rates of smoking initiation are observed during college (Myers, et al., 2009; Wechsler, et al., 1998; Wetter, et al., 2004), and are associated with greater alcohol involvement (Reed, et al., 2010; Reed, et al., 2007; Saules, et al., 2004). Additionally, there is evidence students' smoking may generally decrease over the school year (Colder, et al., 2006). Variability in alcohol use is also observed. Substance use trajectory studies suggest young adults follow one of several paths of alcohol use, the majority of which indicate changes in use over the college years (Chassin, et al., 2004; Jackson, et al., 2005; Tucker, et al., 2003), with a notable proportion of students reporting increases in problematic drinking during college (Doran, et al., 2007; Greenbaum, et al., 2005; Schweizer, et al., 2011). While longitudinal studies with infrequent assessment provide information about general use patterns over long periods of time, Del Boca and colleagues (2004) highlight the significant temporal variability in alcohol use among first-year college students and emphasize the importance of frequent assessment for observing changes in substance use over time (Del Boca, et al., 2004).

Smoking on an intermittent or occasional basis (i.e., a smoking pattern that is inconsistent over time) is more common than daily smoking among college students (Ames, et al., 2009; Moran, et al., 2004; Sutfin, et al., 2009). This pattern of smoking may reflect an early stage of smoking progression, with subsequent transition to heavier daily smoking and nicotine dependence, or a time-limited period of experimentation (Kenford, et al., 2005). Alternatively, there is evidence individuals may maintain

relatively low levels of smoking for extended periods of time (Hassmiller, et al., 2003; Levy, et al., 2009) or may transition back and forth regularly between daily and nondaily smoking (Etter, 2004; Hennrikus, et al., 1996; Nguyen & Zhu, 2009; White, et al., 2009; Zhu, et al., 2003). The tobacco research community has identified the need to focus on light and nondaily smoking (Dierker, et al., 2007; Okuyemi, et al., 2002; Shiffman, 2009) to further understanding of this smoking pattern.

Defining and classifying smoking patterns remains a challenge; researchers have employed diverse indicators to capture tobacco use, which has undoubtedly affected research findings (An, et al., 2009; Boulos, et al., 2009; Harrison, et al., 2008; Husten, 2009; McKee, et al., 2004; Nichter et al., 2006). A shift toward using multiple indicators and latent variable modeling techniques may enhance our ability to identify and distinguish between different classes of smokers, particularly those who smoke at lower levels. Additionally, using latent variable modeling techniques with longitudinal smoking and alcohol use data will add to the sparse literature on the temporal patterns of smoking and alcohol use. One such analytic technique, growth mixture modeling, was applied to longitudinal epidemiological data from the Monitoring the Future (MTF) survey to model developmental trajectories of conjoint alcohol and tobacco use over a five-year period by Jackson and colleagues (2005). Participants were young adults (18-26) assessed every one to two years, with up to five data points per person. Results yielded seven trajectories, with the largest groups representing non-users (56%) and heavy drinkers with low rates of smoking (14%), with the remaining five groups each comprising 5-8% of the sample (Jackson, et al., 2005). Notably, individuals who did not use tobacco or alcohol were included in the study; including nonusers likely affected the emergent trajectories. While

participants who are similar to each other are grouped together in latent trajectory analysis, there is also the possibility that nonsmokers or nondrinkers could be placed into a conjoint use trajectory and slightly affect the use characteristics of the group. The study by Jackson and colleagues (2005) revealed a general reduction in alcohol use through young adulthood and, for many, what appears to be stable cigarette use, both at high and low or nonsmoking levels. However, meaningful change occurring over briefer time periods may be obscured by this method. For example, An and colleagues found more than half the young adults they surveyed reported smoking different amounts at baseline and seven months later (An et al., 2009). The methodology used by Jackson and colleagues (2005) provides a broad picture of the stability and change in alcohol and tobacco use over young adulthood. An investigation of the change in conjoint alcohol and tobacco use occurring over briefer time periods will allow for a more detailed analysis of the course of use.

Several latent variable techniques have been used by researchers in recognition of the heterogeneity of young adult substance use, such as latent growth curve modeling, growth mixture modeling (Colder, et al., 2006; Jackson, et al., 2005), latent class analysis (J. S. Rose et al., 2007), and latent transition analysis (Jackson, et al., 2001; B.O. Muthén & Muthén, 2000; Velicer, et al., 1996). Each method has particular strengths for answering questions about changes in substance use over time. For exploring the co-use of alcohol and tobacco over time, an understudied area of research, the use of latent transition analysis in particular permits a detailed examination of temporal variability in use over time, while contributing to understanding of how these two behaviors cluster together. This technique has been identified as particularly useful in the study of

substance use (Chung, et al., 2005; Lanza, et al., 2010); and has revealed the probability of movement between classes varies by alcohol consumption (Auerbach & Collins, 2006; Guo, et al., 2000; Jackson, et al., 2001) or readiness to quit smoking (Martin, et al., 1996).

The current study examined temporal patterns of alcohol and tobacco co-use in a sample of cigarette using college students, extending previous work in this area by employing a briefer assessment interval than previous studies and through the novel use of LTA with continuous variables. The goal of the present investigation was to identify subtypes of young adult alcohol and tobacco users and examine the stability of the subtypes and of use over time. The primary hypotheses for the current study are that patterns of alcohol and tobacco co-use among young adults will be relatively stable over this brief assessment period, and that movement between classes representing differing levels of use will be common as participants increase or decrease their use.

Method

Participants

Participants (N = 322; 59.3% male) are undergraduates at two public universities in San Diego who were interviewed in person at three time points, three months apart as part of two longitudinal studies of smoking self-change (PI: Mark Myers, PhD).

Participants have a mean age of 19.87 years (SD = 1.54) and the ethnic composition of the sample was Asian (37.6%), White (35.0%), Mixed (9.1%), Hispanic/Latino (8.4%), Pacific Islander (2.7%), African-American (1.1%), Native American (.4%) and other (5.7%). Inclusion criteria for the studies are identical: 1) having smoked at least one cigarette in each of the four weeks prior to the baseline interview, 2) aged between 18

and 24 years old, and 3) enrollment as an undergraduate student for the duration of the study (six months). Participants completed in-person interviews at baseline and again 3- and 6-months post-baseline. Seventy-six percent (n=243) completed all three interviews, 14% (n=46) completed two (baseline and either the three-month or six-month follow-up), and 10% (n=31) completed only the baseline interview. Those who completed all three interviews did not differ from those who completed only one or two interviews with regard to gender, age, ethnicity, or baseline alcohol and tobacco use (p 's > .05).

Procedure

After screening for eligibility, a trained research assistant explained study participation and obtained informed written consent. Participants were interviewed individually in person. Each interview occurred approximately three months apart and lasted approximately 90 minutes. Participants were reimbursed \$30-\$40 for their time. The universities' Institutional Review Boards approved the studies.

Measures

Alcohol and Cigarette Use. Cigarette and alcohol use over the previous 90 days was assessed at each interview with the Timeline Followback procedure (L. C. Sobell & Sobell, 1992; M. B. Sobell, Sobell, Klajner, Pavan, & Basian, 1986), which has been shown to have good psychometric properties when assessing alcohol and tobacco use, including nondaily tobacco use (Harris et al., 2009), with college students. Past 30-day data from the TLFB were used to compute number of smoking days, number of total

cigarettes smoked, number of total drinks consumed, and number of binge drinking episodes. A binge drinking episode was defined as consuming 4 or more drinks on one occasion for women and 5 or more drinks on one occasion for men (NIAAA, 2005).

Data Analysis

First, latent profile analysis (LPA) models, specifying 2-5 classes, for each time point (T1: baseline, T2: three-month follow-up, and T3: six-month follow-up) were fit using maximum likelihood estimation in MPlus version 5.1 (Muthén & Muthén, 2007).

Participants were grouped into a profile with others who have common tobacco and alcohol use patterns, with each profile representing a distinct and unique group. For each profile conditional response means for each observed variable were calculated for interpretation, and a probability of group membership was generated for each individual (i.e., the likelihood of being in each profile group). Fit criteria consulted to determine goodness of fit of the LPA models included the sample size adjusted Bayesian information criterion [sBIC; (Schwarz, 1978)] and the Aikake information criterion [AIC; (Akaike, 1987)], and entropy. To compare solutions to each other these three values were utilized (lower AIC and BIC and higher entropy values were considered indicators of better fit) as well as the Lo-Mendell-Rubin adjusted likelihood ratio test (Lo, Mendell, & Rubin, 2001) and the Bootstrapped Parametric Likelihood Ratio Test [BLRT; (McLachlan & Peel, 2000)], which statistically compared a model with k profiles to one with one with $k-1$ profiles, with a significant test indicating that the model with more

profiles was an improvement (Nylund, Asparouhov, & Muthén, 2007). Final model selection was based on these fit indicators as well as substantive coherence.

Latent transition analysis (LTA) was applied to the TLFB data to examine stability and change of profiles of alcohol and cigarette use among young adults. This approach has previously been used for examining substance use stability and progression (e.g., Lanza, Patrick, and Maggs, 2009). However, previous applications of this technique have been limited to categorical manifest variables and predetermined stages. In addition to contributing to the extant alcohol and tobacco co-use literature, using latent transition analysis with continuous variables and allowing for profile structure to vary between time points is a novel methodological approach.

Once LPA solutions were selected for all three time points, LTA was applied to the data to determine the probability of profile membership at T3, given profile membership at T2 and the probability of profile membership at T2, given profile membership at T1 (Chung, et al., 2005; Collins, 2006; Velicer, et al., 1996). By determining the LPA models separately, starting values and profile structure could be entered into the LPA analysis, wherein the profile solutions are re-estimated. MPlus assumes missing values are missing at random (B.O. Muthén & Muthén, 2005). In the current study, LTA was used to model the stability of alcohol and tobacco co-use over the course of six months in college, from baseline interview to three-month follow-up to six-month follow-up, taking into account missing data at three and six months.

Results

Cigarette and Alcohol Use Profiles

Using LPA, models with two to five profiles were fit separately for T1, T2, and T3. Manifest variables included in the each of the LPA models represented quantity and frequency of past 30-day cigarette use (smoking days and total cigarettes) and frequency and intensity of past 30-day alcohol use (total drinks and number of binge drinking episodes). Model fit statistics are presented in Table 2.1. For T1 and T2, model fit criteria supported a three-profile solution, which was corroborated by an examination of the conditional response means. For T3, model fit criteria supported both a two-profile and a three-profile solution, so both solutions were tested with LTA. An LTA model was then applied to the profile solutions from all three time points simultaneously to model the probability of movement from one class to another using all available data. Two LTA models were tested; the first specified a three-profile structure at each time point (3-3-3) and the second specified a three-profile structure at T1 and T2 and two-profile structure at T3 (3-3-2). Starting values with the conditional response means from the latent profiles structures outlined above were entered into each the model. We allowed the conditional response means to be re-estimated in the LTA for T2 and T3 profiles and fixed the values for T1 profiles. The model fit criteria for the two LTA models were compared and the 3-3-3 model was retained. The entropy value for the 3-3-3 model (.862) was slightly higher than the entropy value for the 3-3-2 model (.861) and so does not distinguish between the two well, however, the 3-3-3 model had a lower AIC value than the 3-3-2 model (28217.975 vs. 28442.489) and a lower sBIC value than the 3-3-2 model (28247.800 vs. 28468.139), taking the three together the 3-3-3 model was preferred. Conditional response means for the profile solutions that emerged from the retained LTA are presented in Table 2.2. At T1, all three profiles are suggestive of regular, but less than

daily smoking that differ on amount smoked per smoking day, and differing levels of alcohol use, including light alcohol use (b), heavy (a), and very heavy alcohol use (c). Profiles at T2 and T3 are similar and are suggestive of a) nondaily but frequent smoking and heavy drinking, b) occasional smoking and light drinking, and c) daily smoking and light alcohol use.

Given the three profiles at each time point, there were 27 (3^3) possible transition patterns, however only 21 patterns were observed. Seventy-nine percent of participants fell into one of five patterns, each containing 5-35% of the sample, with the other sixteen patterns representing the other 21% and including < 4% of the sample each (Figure 2.1 indicates the most common transition patterns). Next the transition probabilities, which are presented in Table 2.3, were examined. These values indicate the probability of being in a given class at time t based on class membership at time $t-1$ (i.e., probability of T2 profile membership given T1 profile membership and probability of T3 profile membership given T2 profile membership). The latent transition probabilities revealed movement between groups, with both reductions and increases in alcohol and tobacco use over six months. The group with the lowest tobacco and alcohol use at T1 was most likely to be in a group at T2 with similar tobacco use and higher alcohol use (probability = .482). The smallest group at T1 with the heaviest mean tobacco and alcohol use, was most likely (probability = .713) to be in the heaviest drinking group at T2. The group at T1 with the lowest mean alcohol use had the highest probability of transitioning to a profile with lower mean tobacco use and similar alcohol use (probability = .509) and also were likely (probability = .440) to be in a group at T2 with much higher mean tobacco use and similar alcohol use. From T2 to T3, participants in the frequent smoking/heavy

drinking group were most likely (probability = .457) to transition to the occasional smoking/light drinking group. Participants in the occasional smoking/light drinking group were most likely (probability = .833) to be in the occasional smoking/light drinking group at T3 and participants in the heavy smoking/light drinking group at T2 were most likely (probability = .776) to remain in the heavy smoking/light drinking group at T3.

Discussion

Previous longitudinal studies of the co-use of alcohol and cigarettes have largely utilized epidemiological survey data collected at annual or longer intervals over several years. These methods do not allow for an examination of the changes occurring in alcohol and tobacco use during relatively short time periods during young adulthood. The current study examined changes in conjoint tobacco and alcohol use among college-attending young adult cigarette users at three time-points over six months. Profiles were determined using latent profile analysis and latent transition analysis was subsequently applied to the profile structures to characterize stability and change in use over the six months. Results supported a three-profile structure at each time point, with each profile solution including groups reflecting heavy drinking with nondaily smoking and nondaily smoking with low drinking. Changes in use over time were revealed in the differing profile structures between baseline and three and six month follow-ups, as characterized by the conditional response means between time points, as well as in the transition probabilities. The latent transition probabilities revealed participants were more likely to move into a group with higher or lower use between baseline to 3-month followup, while less change was observed in the latter three month interval.

At baseline, participants were grouped into one of three profiles. Although the average amount of cigarettes smoked differed between groups, all three reflected tobacco use that was on average frequent (> 15 days during the month) but less than daily, with alcohol use levels varying across profiles. The largest group at baseline (n=226) represented nondaily smoking and relatively light alcohol use, followed by the nondaily smoking/heavy drinking group (n=86), and lastly, a very small group (n=8) with the highest average alcohol and tobacco use. The three-profile structures that emerged from both follow-up interviews were very similar to each other and included groups who could be summarized as nondaily but frequent smokers/heavy drinkers, daily smokers/light drinkers, and occasional smokers/light drinkers. Sample-wide change, (i.e., change on a macro level) is observed in the varying profile structure between time points. While we hypothesized the profile structure would remain relatively stable over time given that individuals' environments and external factors were not likely to change during this period (i.e. all were enrolled in school for the duration of the study), the characteristics of each group differed between time points. On a macro-level college student use and changes in use would primarily be influenced by external factors, such as education or advertising campaigns, campus use policies, and changes in access to substances (Borders, Xu, Bacchi, Cohen, & SoRelle-Miner, 2005; Clapp, Whitney, & Shillington, 2002; Ling & Glantz, 2002; Nelson & Wechsler, 2003; Wechsler, Seibring, Liu, & Ahl, 2004). As noted previously, another potential source of macro-level change is the seasonal fluctuations in use rates observed in college students (Colder, et al., 2006; Del Boca, et al., 2004). However, external factors are not likely the primary influence for the observed profile changes. Data for the current study were collected throughout the school

year over three calendar years from two very large universities and across classes (i.e. freshman, sophomores, juniors, and seniors). While predictors of macro level changes will differ between universities, the long assessment period and the distribution of participants across campuses makes this an unlikely source for the change observed. Given this, we expected profile structure to be relatively stable over the six-month period. It is likely the changes in profile structure represent group level fluctuations in use that may not be indicative of long-term shifts in use, as may be expected from policy changes or public health campaigns. One potential explanation for the changes in conditional response mean values from three month follow-up to six month follow-up is that while all participants in the current study reported recent smoking, for some smoking had recently been initiated. Greater changes to the profile characteristics were observed in the profiles with lower mean tobacco use. Progression or discontinuation among the recently initiated during the six-month period may influence the mean use of these profiles, as expected with the current methodology (continuous observed variables). Those who recently initiated tobacco use are not likely to have progressed to daily smoking during this period (Wetter, et al., 2004), which is corroborated by the relative stability of the use characteristics of the heaviest smoking groups between three months and six months. Also, while more substantial changes in profile structure were noted from baseline to three months than from three to six months, it may be that the participants in the very small heavy smoking/very heavy drinking group (representing 2.5% of the sample) were interviewed during an irregular very heavy alcohol use period.

While there was some change in profile structure across time, the trajectories presented by Jackson and colleagues (2005) have similarities to the profiles derived in the

current study. In both studies the profiles/trajectories represented a range of possible combinations of alcohol and tobacco use, and did not indicate an exclusively linear relationship between alcohol and tobacco use (i.e., heavy drinking did not only occur with heavy smoking). In the current study at both three-month and six-month follow-ups the group with the heaviest smoking, on average, did not have the heaviest average drinking. Consistent with findings from Harrison and colleagues (2008), the group representing regular but less than daily smoking had a higher average number of binge drinking episodes than the group who smoked more frequently. While the profiles are influenced by the current sample, inherent in the methodology, and might not replicate in subsequent studies, a similar profile structure emerged in a separate sample using cross-sectional latent profile analysis (Schweizer, Roesch, & Myers, 2010). Taken together, these findings lend support to the concern that individuals who smoke on less than daily basis or who smoke primarily in the context of alcohol use may be at higher risk for problems from alcohol use than those who frequently smoke when they are not drinking (Harrison, et al., 2008).

The latent transition probabilities revealed changes in use occurring over six months on the individual level (i.e., change on a micro level). Given that profile characteristics changed between baseline and three months, all transition probabilities between baseline and six months reflected change in use over the three-month period. For example, participants in the two largest groups at baseline were likely to subsequently be placed in groups that had either overall lower or higher mean alcohol and tobacco use. From three-month follow-up to six-month follow-up participants in the heaviest smoking groups and heaviest drinking groups at three months were most likely to be in similar

groups at six months. However, while the groups can be similarly characterized, the conditional response means for the groups differed and so the profiles cannot be considered identical. Considering all three timepoints together, the largest proportion of participants transitioned from the frequent smokers/heavy drinkers at baseline (T1b), to the daily smoking group at three months to the daily smoking group at six months. This is not surprising, given that daily smoking is associated with nicotine dependence, which may be contributing to persistent smoking patterns among heavier smokers. Progression of smoking and stability of heavy smoking may also be observed in that the proportion of the sample in the heaviest smoking group increased from three-month follow-up (31.6%, n=101) to six-month follow-up (37.2%, n=119). Reduction in tobacco use may also be occurring among the most common transition patterns, particularly among those who fell into two transition patterns, including those who moved from either T1a or T1b to T2b to T3a. The pattern from T1a to T2a to T3c appears to characterize stable nondaily smoking and high drinking. Among the most common transition patterns (those representing $\geq 5\%$ of the sample each), it is notable that change in use over the six-month period is more common than stability in use, particularly among those who do not smoke daily.

The predictors of stability and change in young adult alcohol and tobacco co-use would likely differ between macro level and micro level. As stated above, macro level change is affected by influences such as campus-wide policy enactment or changes to access. In contrast, micro level change predictors common to both alcohol and tobacco use are individual level variables including personality and emotional factors (e.g., sensation seeking, negative affectivity, anxiety), family history of alcoholism, demographic variables, expectancies for use, and social factors (Borsari, Murphy, &

Barnett, 2007; Emmons, Wechsler, Dowdall, & Abraham, 1998; Wechsler, et al., 1998; Wetter, et al., 2004). For example, peer use and perceptions of social approval may effect change for both smoking and alcohol use (Andrews, et al., 2002; Moran, et al., 2004; Myers & MacPherson, 2008; Yanovitzky, Stewart, & Lederman, 2006). Additionally, individual level variables may differentially predict transitions for those at lower levels of use than those for whom smoking and drinking is more established (Wetter, et al., 2004). Social factors and expectancies may more strongly influence those who use at lower levels, while internal cues and physiological dependence may account for continued heavy use.

Previous research has noted the temporal instability of smoking patterns among college students (An et al, 2009) and has prospectively investigated alcohol and tobacco co-use over several years (Jackson, et al., 2005). The current study adds to this literature by focusing on change in the co-use of alcohol and tobacco during a brief time period during college. Differences in the methods of the current study and those of Jackson and colleagues (2005) regard the variables used and the cohort examined. Large-scale surveys are limited by the information that can be extracted from the ordinal variables included, whereby individuals indicated the quantity of cigarettes smoked per day in one ordinal-choice question and frequency of heavy alcohol use in another (Jackson et al., 2005). The sample characteristics also differ between studies. Jackson and colleagues included individuals who do not smoke cigarettes, whereas the current student restricted eligibility to current smokers. Additionally, the choices available in the survey questions create a distribution that may not reflect the current smoking patterns of young adults, such that

those who smoke less than one cigarette per day are grouped into one response category, obscuring the wide variability observed among nondaily users.

The analyses employed in the current study have not been previously applied to the present question and type of data (i.e. using latent trajectory analysis with continuous manifest variables and allowing profile structure to differ between times). By identifying the changes in latent taxonomic structure over time, rather than imposing a structure, the drawbacks of creating ordinal categories of use to indicate smoking and drinking became even clearer since the common ordinal categories (e.g. non-smoker, light smoker, heavy smoker) do not reliably emerge. Predetermined categories, as with studies that have used LTA to model transitions in stage of change for smoking cessation (Martin, et al., 1996) or progression to alcohol dependence (Guo, et al., 2000) are theory-driven predictions of diagnostic categories or readiness for treatment. However, discrete categories of young-adult substance use require further research and replication (Sutfin, et al., 2009).

The limitations in the current study include sample size and generalizability as well as other methodological issues. First, the sample size of the current study and large number of transition patterns precluded our ability to examine predictors of group membership or transitions between groups. Second, the data were collected from two large universities in the Southwestern United States and may not generalize to college students in other geographic areas. However, strengths of the study lending to its generalizability are the ethnic diversity present in the sample and that two universities were included reducing the likelihood the findings were site specific. Third, drawing conclusions about progression during college is precluded by the recruitment of the sample across years in college; however, including students distributed across the college

years does demonstrate instability in use occurring throughout college. Fourth, results of latent profile analysis are based on mean responses to manifest variables and individual variability exists within groups, so the use of a small number of individuals in each group will not be well represented by the mean values. Fifth, as previously noted, external factors may affect college student substance use, however, recruiting participants throughout the school year reduces the likelihood that these factors affected the current findings.

The developmental period of young adulthood is characterized by experimentation and the seeking out of new behaviors, particularly health risk behaviors such as alcohol and tobacco use. It has been previously noted that college student smoking is a mutable behavior, however, an effective treatment for smoking cessation has not been well established (Villanti, et al., 2010) nor for alcohol and tobacco co-use (Ames et al., 2010). The present findings suggest individuals early in tobacco use or who use at low levels change their behaviors rapidly. These rapid changes highlight that these behaviors are not well established, indicating an opportunity for intervention. However, low rates of use point to the difficulty of engaging those who would benefit from intervention and suggest urgency for intervening before behaviors are entrenched. Intervening with cigarette and alcohol use behaviors, particularly in conjunction given the high rates of co-use, while they are still forming may prevent some of the costs associated with continued use. To inform interventions, future studies may build upon the current research by investigating the influence of alcohol on smoking progression across baseline levels of smoking as well as identifying the predictors of transitions in use.

Chapter 2, in full, is a reprint of the material that has been accepted for publication and will appear in *Addiction Research and Theory*. Schweizer, C. Amanda; Roesch, Scott C.; Khoddam, Rubin; Doran, Neal; Myers, Mark G. The dissertation author was the primary investigator and author of this paper.

Table 2.1: Fit indices for LPA models with 2-5 profiles at all three timepoints. The models selected for the LTA are indicated in bold.

# of Profiles	AIC	Sample-Size Adjusted BIC	Entropy	Lo-Mendell- Rubin Adjusted Likelihood Ratio Test	Parametric Bootstrapped Likelihood Ratio Test
Baseline					
2	10902.91	10910.62	.905	ns	$p < .0001$
3	10648.80	10659.49	.940	$p = .024$	$p < .0001$
4	10515.84	10529.49	.901	ns	$p < .0001$
5	10392.34	10408.96	.914	ns	$p < .0001$
3-mo follow-up					
2	9431.56	9437.39	.959	$p = .0210$	$p < .0001$
3	9259.07	9267.09	.965	$p = .0004$	$p < .0001$
4	9115.20	9125.46	.939	ns	$p < .0001$
5	8966.48	8978.96	.947	ns	Ns
6-mo follow-up					
2	8628.22	8623.94	.969	$p = .0120$	$p < .0001$
3	8454.59	8460.76	.950	ns	$p < .0001$
4	8318.77	8327.12	.961	ns	ns
5	8164.20	8174.37	.959	ns	ns

Table 2.2: Conditional response means of past-30 day alcohol and tobacco use for each emergent latent profile at T1, T2, and T3.

Profile	Cigarettes M (SE)	Smoking Days M (SE)	Drinks M (SE)	Binge Episodes M (SE)
Baseline				
T1a (n=86)	83.46 (9.01)	19.49 (1.10)	64.61 (3.29)	6.89 (0.36)
T1b (n=226)	113.64 (8.76)	20.49 (0.69)	15.68 (1.19)	1.41 (0.13)
T1c (n=8)	201.74 (49.61)	22.63 (2.76)	170.38 (14.01)	15.00 (1.38)
3-mo follow-up				
T2a (n=54)	85.94 (17.03)	16.12 (1.72)	96.83 (5.91)	9.84 (0.67)
T2b (n=165)	16.68 (2.46)	6.46 (0.86)	18.71 (1.77)	1.86 (0.19)
T2c (n=101)	169.45 (16.78)	27.18 (0.57)	17.55 (2.21)	1.66 (0.23)
6-mo follow-up				
T3a (n=166)	9.41 (1.34)	4.08 (0.53)	18.39 (1.92)	1.69 (0.23)
T3b (n=119)	170.38 (13.69)	27.18 (0.44)	22.51 (3.44)	2.20 (0.34)
T3c (n=35)	67.37 (30.05)	11.03 (3.32)	98.03 (12.01)	9.85 (0.99)

Table 2.3: Conditional latent transition probability estimates representing probability of group membership at time t (columns) given membership at time $t-1$ (rows).

Profile	T2a	T2b	T2c
T1a	0.482	0.355	0.163
T1b	0.051	0.509	0.440
T1c	0.713	0.142	0.145

Profile	T3a	T3b	T3c
T2a	0.161	0.382	0.457
T2b	0.833	0.136	0.031
T2c	0.173	0.776	0.051

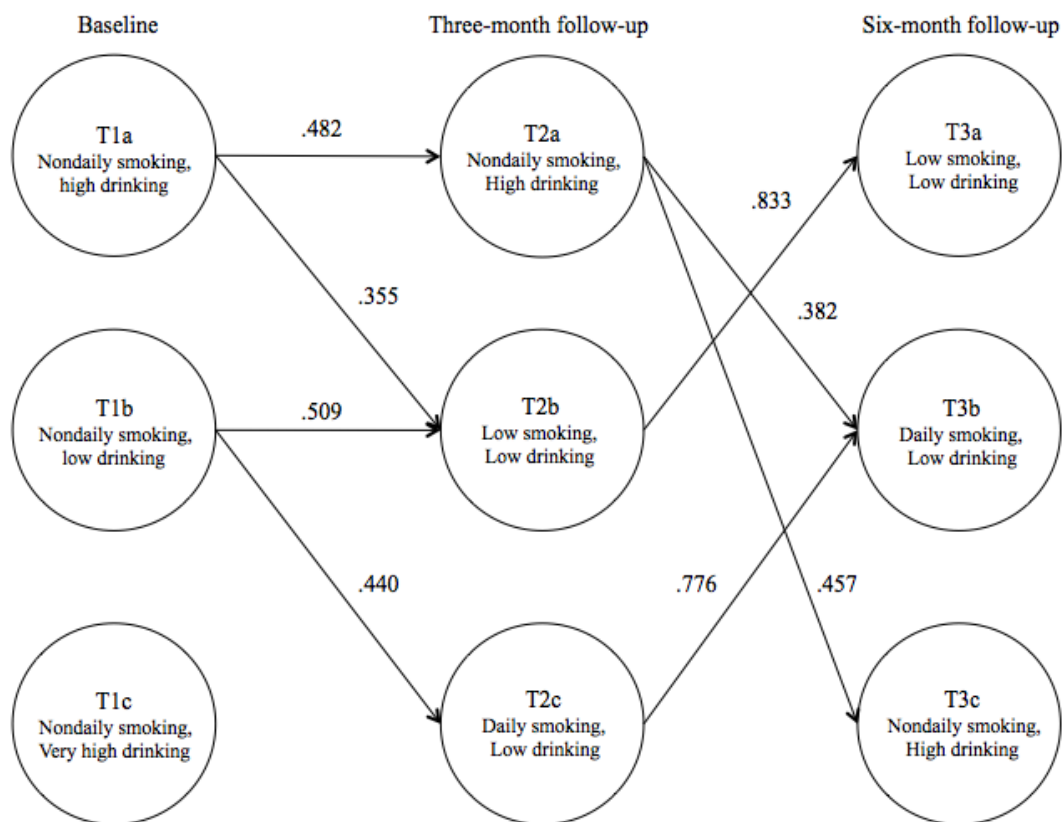


Figure 2.1: The five most common transitional paths, with latent transition probabilities

CHAPTER 3: SOCIAL FACILITATION EXPECTANCIES FOR SMOKING:
INSTRUMENT DEVELOPMENT AND PSYCHOMETRIC EVALUATION

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ABSTRACT

Expectancies about social outcomes for smoking are relevant to college student smokers, who frequently report “social smoking.” A new measure, the Social Facilitation Expectancies (SFE) scale, was developed to assess these beliefs. The SFE was administered to undergraduate college student smokers (N=1096; study completed in May 2011). Items were scored on a five-point scale with a summed total score. The sample was randomly split and principle axis factoring and confirmatory factor analysis applied to determine scale structure. The structure was tested across sex and smoking groups and validation analyses were conducted. A nine-item, one-factor scale was replicated within each group. Higher SFE scores were observed among those with greater smoking experience and higher scores were associated with greater endorsement of other smoking related beliefs. These preliminary findings provide support for the sound psychometric properties of this measure for use with young adult college students.

Introduction

Results from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) indicate the prevalence of cigarette use is highest among young adults aged 18-24 (Falk, et al., 2006). Among college students in the United States, approximately twenty percent report cigarette use in the past month (L. D. Johnston, et al., 2011). Additionally, a substantial portion of smokers initiates smoking or may progress to regular smoking and nicotine dependence during young adulthood and college specifically (Chassin, et al., 2000; Freedman, Nelson, & Feldman, 2012; Myers, et al., 2009). High rates of young adult tobacco use are cause for concern given the paucity of effective interventions developed for this population (Freedman, et al., 2012; Murphy-Hoefer, et al., 2005) and the risks smoking poses for future health, even at very low levels, as is common among college students (Ames, et al., 2009; Moran, et al., 2004; Sutfin, et al., 2009). Identifying the important influences on young adult smoking, especially related to uptake and progression, is key for intervention development. The social factors that contribute to tobacco use may be particularly relevant to smoking among college students (Moran, et al., 2004). Although expectancies (i.e., beliefs about the consequences of engaging in a particular behavior) are a well-known contributor to smoking (Brandon & Baker, 1991), little research has specifically addressed cognitions related to perceived social aspects of smoking.

Social Influences

The few examinations of interpersonal factors in young adult smoking indicate their importance (Levinson, et al., 2007; Moran, et al., 2004), which is corroborated by

the tobacco industry's internal emphasis on this topic for both research and marketing efforts (Ling & Glantz, 2002). Tobacco product branding is developed with specific young adult social activities as targets (Ling & Glantz, 2002). For example, businesses and events catering to college students and the general population of young adults are typical sites for tobacco promotions, such as sponsorship of musical concerts or distribution of free cigarettes at bars or nightclubs (Jiang & Ling, 2011; Rigotti, et al., 2005).

Non-industry research similarly highlights the importance of social influences by demonstrating that young adults' smoking often mirrors their close friends' smoking (Andrews, et al., 2002) and social consequences of smoking and perceived peer norms regarding smoking may be particularly salient to young adults (Myers, et al., 2003). A large number of college students self-identify as "social smokers" (Levinson, et al., 2007; Moran, et al., 2004; Morley, et al., 2006; Song & Ling, 2011) and report cigarette use primarily in social situations (Gilpin, White, et al., 2005a; Waters, et al., 2006). Qualitative research has revealed that college students interpret social contexts and parties as "permission" to use tobacco (Nichter, et al., 2010), indicating a cognitive component to the link between social situations and smoking.

Adolescent tobacco use research has suggested peers and social contact may provide direct pressure to smoke, influence subjective estimates of smoking prevalence, provide a positive image for smoking, increase access to tobacco, and facilitate social cohesion (Baker, et al., 2004). Yet, how peers and social context influence young adult smoking is not clear. Further research is needed on the effect of interpersonal influences

on young adult tobacco use; beliefs about positive social effects from smoking may be particularly relevant.

Cognitive Influences

There is substantial evidence that substance use expectancies affect use and that greater positive outcome expectancies are associated with higher levels of use (Brandon & Baker, 1991; S.A. Brown, et al., 1980; Chassin, et al., 1991; Copeland & Brandon, 2000; Fromme & Dunn, 1992; Fromme, et al., 1993). Expectancies about the anticipated positive and negative effects of both smoking and cessation have been shown to affect young adults' tobacco use behaviors. For example, young adults' expectancies about the reinforcing effects of smoking cigarettes have been shown to influence and be influenced by the initiation of smoking (Copeland, et al., 1995; Doran, et al., 2011).

There is some evidence tobacco use expectancies may function differentially for occasional smokers than heavier smokers. Positive reinforcement expectancies have been shown to predict increased smoking among light or occasional smokers, but not daily smokers (Wetter, et al., 2004) and greater negative reinforcement expectancies for smoking are associated with smoking progression and development of nicotine dependence (Copeland, et al., 1995; Wetter, et al., 2004). Cognitions regarding the positive social effects of smoking may be an important component to understanding the mechanism linking social context and smoking behavior, particularly among young adult college students who smoke on a less than daily or intermittent basis. Consistent with this assertion, studies of early smoking experiences of adult smokers have highlighted the role of social context in initial tobacco use (Acosta et al., 2008; Aloise-Young, Graham, &

Hansen, 1994) and, from the adolescent tobacco use literature, social approval has been shown to be a key motive for smoking initiation (Flay et al., 1994). Additionally, when asked to complete the sentence “Smoking makes one ____” college students generated such terms as “fun,” “sociable,” “socially acceptable,” and “cool” (Hendricks & Brandon, 2005).

Although multiple measures of tobacco use expectancies exist, none were specifically created to measure expectancies regarding social facilitation properties for smoking (Brandon & Baker, 1991; Hendricks & Brandon, 2005; Rohsenow et al., 2003). The original version of the Smoking Consequences Questionnaire [SCQ; (Brandon & Baker, 1991)] is a 50-item questionnaire developed for measuring college students’ cigarette smoking expectancies. The SCQ includes two items related specifically to social facilitation expectancies (Brandon & Baker, 1991). To our knowledge, there have been no investigations of how these items function independent of the other items. The SCQ is the most widely used measure of tobacco use expectancies and has been adapted and validated in diverse samples (Buckley et al., 2005; Cepeda-Benito & Ferrer, 2000; Copeland, et al., 1995; Copeland et al., 2007; Lewis-Esquerre, Rodrigue, & Kahler, 2005; Myers, et al., 2003; Rash & Copeland, 2008; Reig-Ferrer & Cepeda-Benito, 2007; Schleicher, Harris, Catley, Harrar, & Golbeck, 2008; Thomas et al., 2009; Vidrine et al., 2009). Although Copeland and colleagues’ (1995) modification of the SCQ for use with more experienced adult smokers led to the inclusion of three additional social facilitation items, none of the modifications isolated the social facilitation expectancies, with the most commonly used short version of the SCQ eliminating social facilitation expectancies items altogether (Myers, et al., 2003). Another measure of smoking

outcome expectancies, the Smoking Effects Questionnaire [SEQ; (Rohsenow, et al., 2003)] was designed to measure both positive and negative tobacco use expectancies. The SEQ includes five items (of 33 total items) measuring social facilitation expectancies. This measure was developed for use with the general adult population of smokers - the validation sample's median age was 42 and mean level of smoking was 24 cigarettes per day - to measure future smoking and likelihood for cessation (Rohsenow, et al., 2003). Notably, the authors did not find a correlation between the positive social effects scale and number of previous quit attempts (Copeland, et al., 2007), and the correlation between anticipated positive social effects and current smoking level was small. A possible explanation for this is that expectancies for positive social outcomes from smoking are most relevant during initiation and smoking uptake, and, although they may persist for heavier or more established smokers, their influence may be lesser than other anticipated effects of smoking (e.g., negative reinforcement expectancies) in continuation or cessation of smoking behavior.

Current Study

The current study examines the psychometric properties of a new measure of social facilitation expectancies for smoking (SFE). The factor structure of the SFE was derived in a sample of college-attending young adults. The structure was then tested for invariance across relevant groups, including sex and lifetime smoking experience. Although smoking expectancies have been shown to increase with smoking experience and smoking rates have been shown to differ by sex, the content of the expectancy scale items is designed to apply to all levels of smoking, including never smokers, and so no

differences in factor structure were hypothesized across groups. Invariance tests were followed by a preliminary assessment of the concurrent and construct validity and internal consistency of the scale. Consistent with existing research on expectancies and on the social role of smoking among young adults, we hypothesized social facilitation expectancies for smoking would be positively associated with stronger endorsement of beliefs regarding negative social consequences of quitting smoking, greater expected difficulty of resisting a cigarette offer in a social situation, and with greater exposure to cigarette smoking.

Method

Participants

The sample consisted of 1096 current college students participating in a cross-sectional study of smoking self-change efforts. Participants were aged 18-24 years old ($M = 20.02$, $SD = 1.64$), 63.9% were female and 30.2% were Hispanic/Latino, 24.5% were non-Hispanic White/Caucasian, 23.0% were Asian/Asian-American, 1.7% were African-American, and 5.1% identified as Mixed, 1.4% identified as Other, and 14.1% declined to state their race/ethnicity. The eligibility criteria for the parent study were: age between 18-24 years old, have smoked at least one cigarette in the last 30 days at the time of survey completion, and current enrollment at one of two large public universities in the San Diego area.

Procedure

Students completed the SFE as part of an anonymous cross-sectional online survey for which they received a credit in an undergraduate psychology or cognitive science course. Students in participating courses were recruited via a university-managed online posting system for research studies. After indicating their interest in the study, students were provided with the link to a website with the study consent form. Those who provided electronic consent then completed the 30-40 minute online study battery that included the SFE, in addition to demographic information and questionnaires measuring smoking attitudes and experiences. Following study completion, participants were taken to a separate web page where they provided their student identification number, in order to receive credit for completion. Student ID was not linked to study responses. Data collection was completed in 2011. The universities' Institutional Review Boards approved the studies.

Measures

Demographics. Collected demographic information included age, sex, and race/ethnicity.

Social Facilitation Expectancies for Smoking. The SFE was designed to measure beliefs regarding the expected social benefits of cigarette smoking. Ten items initially selected for inclusion in the scale were adapted from existing instruments that include social-facilitation-related expectancy items: a smoking expectancy questionnaire developed for adult smokers (Rohsenow, et al., 2003), and a young adult measure of alcohol-related expectancies (Fromme & Dunn, 1992). Response options for the 10 SFE

items were on a 5-point Likert-type scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The SFE items were initially administered to undergraduate students (n=28), approximately half nonsmokers and half current smokers (smoked at least on a weekly basis) who provided written feedback on item wording, clarity of instructions, and appropriateness of the response options. This feedback was incorporated into the scale used in subsequent analyses. For reliability and validity analyses following factor structure assessments, a total scale score was computed by summing the responses to each of the five items.

Cigarette Use. Participants' recent and lifetime cigarette use was assessed. Participants provided the number of days they smoked in the last month and the average number of cigarettes smoked per smoking day scored on ordinal scales, with responses ranging from once to daily for frequency and one to more than 20 for quantity. Regarding lifetime smoking, participants indicated whether they had smoked at least 100 cigarettes in their lifetimes (yes/no), a level commonly used to delineate those who are more experienced smokers from those who are not yet established smokers (Sargent & Dalton, 2001). These items were used to describe the sample, to test for invariance across smoking groups, and for establishing concurrent validity.

Social Consequence of Quitting Smoking. Participants responded to a scale of items designed to assess perceived consequences of quitting (CQSE), of which one ("It will hurt my social life," rated on a five point scale from 1 = *strongly disagree* to 5 = *strongly agree*) assessed a subjective social effect of quitting cigarette smoking. This

single item was chosen as a measure of construct validity to indicate the extent to which individuals anticipated negative social consequences of quitting smoking.

Temptation Coping Expectancies. The Temptation Coping Questionnaire [TCQ; (Myers & Wagner, 1995)] was administered to assess perceived ability to cope (i.e., not smoke) in a tempting social situation. One item from this measure (“How difficult would it be to abstain in this situation: It's Saturday night, you're hanging out with a few friends that you usually smoke around at a party. Everyone is socializing and having some drinks. The friends you're talking with are smoking cigarettes and someone offers you a smoke,” rated on a five point scale from 1 = *not at all* to 5 = *very*) assessed perceived difficulty of not smoking in a social situation and was used in validation analyses for establishing construct validity.

Social Exposure to Cigarette Smoking. Social exposure to cigarette smoking was assessed via one item indicating the percentage of the participant's friends (0-100) who smoked cigarettes. This item was chosen as a measure for construct validity.

Scale Structure Analyses

Data from the full sample (n=1096) were randomly split into two groups. Participants were assigned to either exploratory factor analysis (EFA) or confirmatory factor analysis (CFA) to examine the structure and internal reliability of the SFE. For the exploratory factor analysis principal axis factoring was applied using SPSS statistical software package version 21. Loadings greater than .30 for any particular item were considered acceptable and emergent factors were investigated for theoretical consistency. The derived factor structure was then confirmed within the other half of the sample using

CFA with maximum likelihood estimation in the MPlus statistical software package version 7 (L. K. Muthén & Muthén, 1998-2012). Model fit was determined by consulting the Comparative Fit Index [CFI; 0-1 range, values $> .90$ indicate acceptable fit and $\geq .95$ indicate excellent fit; (Hu & Bentler, 1999)] the Standardized Root Mean Square Residual [SRMR; 0-1 range, values $\leq .05$ indicate good fit; (Hooper, Coughlan, & Mullen, 2008) and the Chi-square test, as recommended by Hu and Bentler (1999).

Multiple Group Analyses

To determine the reliability of the SFE factor structure across groups, multiple group analysis (MGA) with confirmatory factor analysis (CFA) was applied to the data, also using MPlus statistical software Version 7 (L. K. Muthén & Muthén, 1998-2012). Following the initial scale structure analyses, the fit of the retained structure of the SFE was compared between male and female college students. Then, this structure was compared between those who had smoked less than 100 cigarettes and those who smoked 100 or more cigarettes in their lifetime.

Each of the two group comparisons proceeded in steps. In the first step, factor structures were compared between groups to determine configural invariance (i.e., the same number of factors and loading patterns across groups), while factor loadings were allowed to differ. The next step tested a metric invariance model by constraining model parameters to equivalence between groups. The same model fit criteria were used as described above for the initial CFA. To empirically determine improvements in model fit between steps, Chi-square difference tests were conducted. The alpha level was set at a

conservative $p = .01$ level for evaluating significant differences between models (Ullman, 2006).

Results

Participant Cigarette Use

Detailed smoking characteristics of the sample are presented in Table 3.1. The majority of participants reported they had smoked fewer than 100 cigarettes in their lifetimes. More than 70% had smoked three or fewer times in the preceding month, with the largest proportion reporting having smoked only once. Over 80% of participants reported smoking one to two cigarettes per smoking day.

Exploratory factor analysis

Results of the EFA (n=559) yielded one factor with an initial eigenvalue of 7.02 that accounted for 67.03% of the variance. All ten items loaded on the single factor with high loadings (range: .72-.89) with inter-item correlations between .54-.80. All items were retained for further analyses.

Confirmatory factor analysis

The CFA (n=524) revealed the single factor structure fit the data well [$\chi^2(35) = 270.91, p < .001$; CFI = 0.95; SRMR = 0.03] and the R^2 values for each item ranged from .58 to .80. Modification indices suggested substantial overlap (WITH statement MI = 90.64) in item content from the residual covariances for two items, “I would have an easier time meeting new people” and “I would feel more confident in social situations.”

Coupled with the strong correlation between these two items (.80) and similar item mean scores ($M=2.71$ $SD = 1.27$) and ($M=2.66$ $SD = 1.28$), respectively, the decision was made to exclude one item and rerun the model. The second item was chosen for deletion, given that another item also used the word confident (“I would be more confident approaching someone I didn’t know”), and the two items considered for deletion were similar in factor loadings and in the effect they would yield in reliability when deleted. The nine-item scale had excellent fit to the data [$\chi^2(27) = 170.11, p < .001$; CFI = 0.96; SRMR = 0.03] and demonstrated improved fit over the 10-item scale. The final version of the questionnaire is shown in Table 3.2.

Multiple group analyses

Sex comparisons. To establish configural invariance, the fit of the one-factor model with nine observed variables was examined across sex groups. This model fit very well statistically and descriptively in both groups, Men [$\chi^2(27) = 127.94, p < 0.0001$; CFI = .96; SRMR = 0.03] and Women [$\chi^2(27) = 276.74, p < 0.0001$; CFI = .95; SRMR = 0.03] and factor loadings in both groups were large and statistically significant (see Table 3.2). Next, to determine whether the scale differed between groups, all factor loadings (parameters) were constrained to equivalence. The metric invariance model also fit the data very well [$\chi^2(70) = 420.46, p < 0.0001$; CFI = 0.96; SRMR = 0.03]. A χ^2 difference test revealed the metric invariance model was not significantly different from the configural invariance model ($\Delta\chi^2(16) = 15.77, p > 0.01$) so the metric invariance model was considered the more parsimonious and better fitting model (i.e., the same structure can be assumed across sexes).

Smoking experience group comparisons. A second multiple group CFA was conducted to examine model fit across smoking experience groups (i.e., comparing those who had and had not smoked 100 lifetime cigarettes). While it is more common to draw comparisons between daily and nondaily smokers than between groups based upon lifetime smoking experience, we chose this approach because the current sample contained a very small proportion of daily smokers (7.9%). Additionally, using a cumulative indicator of lifetime smoking, rather than an indicator of current smoking, is consistent with a primary goal of developing a measure to examine the influence of social facilitation expectancies on the initial stages of smoking uptake and progression. Establishing invariance across lifetime smoking groups is consistent with past research suggesting a reciprocal relationship between expectancies and behavior (Sher, Wood, et al., 1996); social facilitation expectancies may develop over time such that more experience smoking in social situations may serve to strengthen or modify beliefs. To establish configural invariance, the fit of the one factor model with nine observed variables was tested. This model fit well among both groups, those who had smoked < 100 lifetime cigarettes [$\chi^2(27) = 243.31, p < 0.0001; CFI = 0.96; SRMR = 0.03$] and those who had smoked ≥ 100 lifetime cigarettes [$\chi^2(27) = 167.42, p < 0.0001; CFI = 0.93; SRMR = 0.05$] and factor loadings in both groups were large and statistically significant (see Table 3.2). Next, to determine whether the questionnaire items functioned differently between groups, parameters were constrained to equivalence. The metric invariance model fit the data adequately [$\chi^2(70) = 480.81, p < 0.0001; CFI = 0.95; SRMR = 0.05$]. A χ^2 difference test revealed the metric invariance model was

significantly different from the configural invariance model ($\Delta\chi^2(16) = 70.09, p < 0.001$) so the configural invariance model was considered the better fitting model. This suggested one or more items were interpreted differently across groups. To identify the item or items, and explore the possibility of partial metric invariance, the factor loading equivalence restraints for each of the items was sequentially released and resulting model fit was examined. Parameters for two items [If I were smoking a cigarette] “It would help my social life” and “I would be less likely to feel left out of the group” differed between groups. While the factor loadings were high for both groups (see Table 3.2) the values were lower among those who had smoked > 100 cigarettes. Parameter value equality can be assumed for all other items, suggesting the partial metric invariance model best fit the data.

Reliability and Construct Validity of the SFE

Utilizing the full sample, reliability and construct validity of the 9-item measure retained from scale structure analyses were explored. Total scores for the SFE ranged from 9 to 45 with a mean of 24.03 (SD = 9.85). The scores were normally distributed, although slightly positively skewed, and internal consistency of the measure was high (Cronbach’s alpha = .95). Greater social facilitation expectancies were endorsed among those with greater smoking experience. Those who had smoked at least 100 cigarettes in their lifetime had significantly higher mean social facilitation expectancies [M (SD) = 25.44 (8.55)] than those who had smoked < 100 lifetime cigarettes [M (SD) = 23.43 (10.27); $t(1094) = -3.20, p = .001$], indicating discriminative construct validity. The correlation between social facilitation expectancies and perceived negative social

consequences of quitting smoking was statistically significant ($r = .38, p < .001$), as was the correlation between social facilitation expectancies and perceived difficulty of not smoking in a social situation ($r = .23, p < .001$), providing further evidence for construct validity. However, the relationship between social facilitation expectancies and peer smoking [Percent of friends who smoke: Range = 10-100; $M = 38.16 (21.01)$, positively skewed], while significant, was small in magnitude (Spearman's $\rho = .13, p < .001$).

Comment

Substance use expectancies have been well established as an important influence on substance use behaviors (S. A. Brown, 1985; Marlatt & Gordon, 1985). Although widely used, existing measures of cigarette smoking expectancies provide limited assessment of perceived social facilitation benefits, which may be particularly important for young adult uptake and progression. The current study examined the psychometric properties of a new measure of cigarette smoking social facilitation expectancies among an ethnically diverse sample of young adult college students. The content of the questionnaire was selected to assess agreement with anticipated social benefits of cigarette smoking among young adults, consistent with research in this area (Hendricks & Brandon, 2005; Nichter, et al., 2010). The new measure yielded one factor pertaining to this construct. Previous research has suggested expectancies may become more differentiated with more experience (Copeland, et al., 1995; Rohsenow, et al., 2003) and there is evidence that substance use expectancies are not static over time and may be subject to multiple influences such as initiation, continuation, or cessation of the behavior (Cohen, McCarthy, Brown, & Myers, 2002; Doran, et al., 2011; Kirchner & Sayette,

2007). The single emergent factor in the SFE may reflect that the development sample was comprised of less experienced smokers and indicate the measure may be most appropriate for studies of early smoking.

We found support for the psychometric properties of the SFE through multiple steps investigating the reliability of the factor structure and establishing construct and content validity. Findings from exploratory and confirmatory factor analyses supported good to excellent fit of a nine-item single-factor measure across sexes and smoking experience groups. Additional findings provided initial support for hypotheses regarding construct validity of the SFE, specifically that social facilitation expectancies are significantly associated with smoking cessation and abstinence related cognitions, and current smoking level.

We hypothesized the same factor structure would hold for both males and females and for those who had smoked < 100 vs. > 100 cigarette in their lifetimes. The structure was consistent across sex, while seven of the nine items remained stable across smoking experience groups, with two items endorsed more strongly by those who had smoked more than 100 lifetime cigarettes, supporting use of the SFE with a young adult college student population. That the response patterns partially differed between less and more experienced smokers, contrary to our hypotheses, may indicate more refined definition of these beliefs with greater smoking experience.

These findings again lend support to the particular utility of this measure in studies of early smoking. One study investigated the use of a short form of the adult version of the SCQ among college students, comparing daily and nondaily smokers, with the authors concluding there may be a need for measures specifically developed for

occasional smoking college students (Schleicher, et al., 2008). The SFE provides a tool for investigations of the role of social facilitation expectancies in early smoking. Studies of risk for continued smoking require measures of this type, created specifically for the construct and population, rather than broad measures developed for use with the general adult population of smokers.

Subsequent analyses provide initial support for the validity of the SFE, evident from the significant, although modest, associations between the SFE and other smoking related beliefs. These findings have implications for smoking progression. Greater social facilitation expectancies are associated with greater anticipated difficulty not smoking in social situations when offered a cigarette and with greater endorsement of the belief that quitting smoking would adversely affect one's social life. As smoking is common in social situations in college (Moran, et al., 2004; Nichter, et al., 2010; Waters, et al., 2006), and college students report "peer pressure" to smoke (A. E. Brown, et al., 2011) and may be provided with cigarettes via tobacco promotions (Ling & Glantz, 2002), potential for being offered a cigarette is high. Therefore greater expectancies that smoking will enhance social interactions are likely linked with lower rates of refusal or sustained ability to refrain from smoking and higher vulnerability for continued use; however, the cross sectional data of the current study preclude testing of these hypotheses.

Surprisingly, while social facilitation expectancies and peer smoking were significantly and positively related, the strength of the association was small. A possible interpretation of this finding is that subjective anticipated social benefits from smoking may be more strongly related to other contextual and environmental factors [e.g., alcohol use; (McKee, et al., 2004)] than to the influence of individuals. Another consideration is

that proportion of friends who smoke was a current rating, whereas expectancies likely incorporate and reflect prior exposure to smoking in various contexts. As stated above, expectancies are not stable over time and are influenced by changes in individuals' behavior; however, they are formed based on prior experiences and contact with smokers as well as other images of smoking, consistent with social learning theory (Bandura, 1986).

Limitations

The current study provided preliminary support for excellent psychometric properties of the SFE. However, the current findings should be interpreted in light of a number of limitations. The sample included only recent smoking students; how this measure performs among nonsmokers and whether these cognitions contribute significantly to smoking initiation are areas for future research. Students were included in the study who have smoked < 100 cigarettes given the potential relevance of smoking facilitation expectancies to early smoking experiences, however, the Centers for Disease Control and Prevention (CDC) considers a smoker to be someone who has smoked > 100 cigarettes in their lifetime. Therefore, by this definition, not all participants would be considered current smokers. Lastly, we utilized cross-sectional survey data; this limited the variables available for validation analyses and precluded an exploration of the predictive utility of the SFE. Further research is needed to establish the ability of this measure to predict continued smoking.

Conclusions

The SFE fills a gap in smoking expectancy measurement among college students; social factors are key influences on young adult smoking behavior (Moran, et al., 2004) and we were not able to identify an existing measure of anticipated social benefits of cigarettes smoking. The SFE was tailored to measure the perceived social facilitation effects of cigarette smoking among college students, particularly those early in their smoking career or who smoke on a less than daily basis. The content of the scale, including the directions and the item wording, was selected to apply to individuals who currently smoke, as well as those who have never smoked a cigarette. The smoking rate of the current sample reflected the aim to develop this scale for use with those who may be vulnerable to smoking progression. The majority of the current sample smoked on a less than daily basis and had smoked fewer than one hundred cigarettes in their lifetime, which represents a lower level of smoking than nationwide college smoking statistics (L. D. Johnston, et al., 2011). The potential for use of the SFE in studies of smoking uptake is particularly important, given the high rates of smoking initiation during college. Studies indicate early stages of use are common among college students (Costa, Jessor, & Turbin, 2007; Everett et al., 1999; Wechsler, et al., 1998) and the college environment has been implicated as being a powerful influence on smoking uptake in particular (Tercyak, Rodriguez, & Audrain-McGovern, 2007). Therefore, young adulthood, and college matriculation specifically, represents a susceptible period for the initiation or progression of cigarette smoking, possibly due to changes in environment such as increased access and exposure to tobacco, increased alcohol use, and reduced supervision (Chassin, et al., 2000; White, et al., 2009). However, few studies have examined the contributing factors to initiation in college. The SFE will allow for investigations into the

mechanisms leading to smoking intake and progression among young adults, particularly related social smoking.

Based on the current study, a new measure of social facilitation expectancies for smoking has been established for assessing this construct among light or occasional smoking college attending young adults. This measure has sound psychometric properties and was developed using a large, ethnically diverse sample. The present results suggest social facilitation is linked to smoking behavior and other social aspects of smoking. Future research with the SFE could contribute to the literature on smoking initiation and progression in college, understudied areas of research and may provide direction for campus policies and development of content targeting these beliefs in programs aimed at preventing tobacco use.

Chapter 3, in full, is a reprint of the material as it appears in *Journal of American College Health* 2014. Schweizer, C. Amanda; Doran, Neal; Myers, Mark G. The dissertation author was the primary investigator and author of this paper.

Table 3.1: Smoking characteristics (lifetime experience, recent smoking frequency and quantity) of the sample, college student current smokers (smoked at least one cigarette in the past 30 days)

Smoking characteristic	Current Smokers N = 1096
Smoked \geq 100 cigarettes (n, % yes)	354 (32.3)
Smoking frequency in the past 30 days (n, %)	
Once	451 (41.1)
2-3 times	333 (30.4)
1-2 times per week	122 (11.1)
3-4 times per week	67 (6.1)
5-6 times per week	36 (3.3)
Every day	87 (7.9)
Number of cigarettes/smoking day in the past 30 days (n, %)	
1-2	906 (82.7)
3-5	139 (12.7)
6-10	32 (2.9)
11-15	8 (.7)
16-20	9 (.8)
more than 20	2 (.2)

Table 3.2: Factor loadings for the one-factor nine-item Social Facilitation Expectancies questionnaire across groups.

Items	Male	Female	< 100 cigs	≥ 100 cigs
1 I would have an easier time meeting new people.	.760	.799	.797	.751
2 I would like the way that I have something to do with my hands while I am in a group.	.750	.763	.779	.700
3 I would feel more included in social situations.	.853	.819	.858	.749
4 I would feel more relaxed when I am with other people.	.881	.891	.901	.850
5 It would help my social life.	.776	.789	.827	.681
6 I would feel like one of the more sophisticated members of the group.	.821	.844	.855	.788
7 It would be an enjoyable activity to do with my friends.	.848	.859	.874	.810
8 I would be less likely to feel left out of the group.	.707	.734	.767	.609
9 I would be more confident approaching someone I didn't know.	.769	.808	.812	.756

Note. Factor loading invariance was established between males and females and for seven of the nine items between lifetime smoking groups. Loadings in bold differed between lifetime smoking groups

Note 2. Items are preceded by the text: "The following questions ask what you would expect to happen if you were smoking CIGARETTES. If you have **never** smoked, answer according to your personal beliefs about smoking. Using the scale below, please rate how much you agree or disagree with each statement, depending on whether you think that smoking a cigarette would have that effect for you."

CHAPTER 4: YOUNG ADULT TOBACCO USE IS IN FLUX:
PREDICTORS OF SHORT TERM SMOKING TRAJECTORIES

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ABSTRACT

Young adults smoke cigarettes at higher rates than any other age group.

Understanding the course and characteristics of cigarette use is fundamental to informing intervention. Proximal risk factors contributing to the stability of, or change in, smoking in young adulthood are not well understood. College-attending young adults (N=286) age 18-24, who smoked at least one cigarette in the month prior to baseline, were interviewed at three time points, three months apart. We used latent class growth analysis to extract distinct smoking trajectories and examine the effects of baseline and time-varying covariates (e.g., demographics) and predictors (e.g., alcohol use, percent of friends who smoke) on trajectory membership. Five smoking trajectories were identified and labeled high-frequency stable smokers (33.6%), high-frequency decreasing smokers (8.4%), moderate-frequency decreasing smokers (9.8%), low-frequency increasing smokers (10.8%), and low-frequency stable smokers (37.4%). Sex, average number of cigarettes smoked per day, nicotine dependence, and percent of friends who smoke differed between groups, whereas alcohol use did not. Surprisingly, and contrary to hypotheses, our findings suggest alcohol consumption does not potentiate smoking progression over the short-term. Having friends who smoke may be important early in the smoking career and contribute to smoking progression. Findings highlight the importance of frequent assessment of substance use during this developmental period, heterogeneity of light and intermittent smoking in young adulthood, and the shortcomings of broad classifications of “nondaily” smoking.

Introduction

Cigarette smoking among young adults is common; the Centers for Disease Control estimate approximately 20% of 18-24 year olds are current smokers [have smoked at least 100 lifetime cigarettes and smoke every day or nearly every day; (CDC, 2010)] and results from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) indicate a higher proportion of young adults smoke than any other age group (Falk, et al., 2006). Additionally, a notable percentage of adult smokers may begin smoking or progress to regular smoking during young adulthood (Chassin, et al., 2000; Freedman, et al., 2012). This is very concerning given the potential for serious health consequences from continued use, even at very low levels of smoking (USDHHS, 2006), and the challenges of intervening with this population (Murphy-Hoefer, et al., 2004; Murphy-Hoefer, et al., 2005; Prokhorov, et al., 2003; Villanti, et al., 2010).

Young Adult Smoking is in Flux.

Understanding the course of smoking during young adulthood is fundamental to the development of effective interventions. Previous research has highlighted temporal instability in young adults' use (An et al., 2009; Del Boca, Darkes, Greenbaum, & Goldman, 2004), even over very short periods of time (Schweizer, Roesch, Khoddam, Doran, & Myers, in press). Smoking on a less than daily basis (frequently termed “nondaily,” “intermittent,” “episodic” or “occasional”) is more common than regular daily smoking among young adults (Ames, et al., 2009; Moran, et al., 2004; Sutfin, et al., 2009). Longitudinal studies suggest numerous paths these inconsistent patterns of smoking may take. Nondaily smoking may lead to daily smoking and nicotine

dependence, or it may be a period of temporary experimentation (Kenford, et al., 2005), continue for extended periods of time (Brook, et al., 2008; Hassmiller, et al., 2003; Levy, et al., 2009), or individuals may transition back and forth regularly between daily and nondaily smoking (Etter, 2004; Hennrikus, Jeffrey, & Lando, 1996; Nguyen & Zhu, 2009; Zhu, Sun, Hawkins, Pierce, & Cummins, 2003; White, Bray, Fleming, & Catalano, 2009). It is clear young adult smokers who smoke on a less than daily basis are not a homogeneous group with identical trajectories; identifying the unique trajectories will aid in defining these groups. The research community has recognized a need to focus on the course of nondaily smoking in order to understand these patterns and inform intervention during this critical period of development (Chassin, et al., 2000; Klein, et al., 2013; Orleans, 2007).

Influences on Young Adult Smoking

Consistent with a biopsychosocial model of addiction (Donovan, 1988), significant contributors to young adult smoking include other substance use (particularly alcohol use), interpersonal influences, and intrapersonal factors/personality. Alcohol use is associated with both increased quantity and frequency of cigarette consumption among young adults: smoking is 2.75 times more likely to occur on a drinking day than a nondrinking day (Jackson, et al., 2010) and smoking increases threefold while drinking (Witkiewitz, et al., 2012). There is a reciprocal effect of smoking on alcohol use; alcohol consumption increases while smoking (Witkiewitz, et al., 2012) and there is some evidence nondaily smokers may be at increased risk for drinking to hazardous levels (Harrison, et al., 2008; Schweizer, et al., in press; Schweizer, et al., 2010). Alcohol use is

associated with initiation and continuation of smoking (Reed, et al., 2010; Reed, et al., 2007; Saules, et al., 2004; White, et al., 2009) and alcohol and tobacco share common risk factors (Bobo & Husten, 2000; Jackson, et al., 2010; McKee, et al., 2010; Sher, Gotham, et al., 1996). Alcohol use increases cigarette cravings (Burton & Tiffany, 1997; Piasecki, et al., 2011) and smokers are more likely to report positive reinforcement from smoking while under the influence of alcohol (McKee, et al., 2004; Piasecki, et al., 2011). However, many questions remain about how and whether smoking contributes to the progression of smoking among young adults, and college students in particular.

College students view drinking occasions and social contexts as “permission” to smoke (Nichter, et al., 2010), and report smoking primarily in social situations (Gilpin, White, & Pierce, 2005b; Waters, et al., 2006). When asked to complete the prompt “Smoking makes one _____,” college students offer adjectives such as “cool,” “fun,” and “socially acceptable” (Hendricks & Brandon, 2005). Peers’ smoking has been repeatedly shown to predict youth smoking (Abroms, Simons-Morton, Haynie, & Chen, 2005; White, et al., 2002) and smoking from adolescence into young adulthood (Ali & Dwyer, 2009). Peers’ behaviors and attitudes towards smoking may be particularly important influences on cigarette use in young adulthood (Andrews, et al., 2002; Myers, et al., 2003; Rigotti, et al., 2000), as parental influence lessens and exposure to substance use increases (Chassin, et al., 2000).

Intrapersonal variables are also relevant to young adult smoking. Negative emotionality and depression symptoms have been linked to initiation (Saules, et al., 2004), persistence and prevalence of smoking (Audrain-McGovern, et al., 2009; Bares & Andrade, 2012) as well as higher levels of Nicotine Dependence among adults (Haas, et

al., 2004; Hall, et al., 1993).

Longitudinal analytic approaches to identifying subtypes of young adult smokers

Longitudinal latent variable analytic techniques, such as growth mixture modeling (GMM) and latent class growth modeling (LCGM), assume individuals can be clustered into meaningful groups with shared trajectories (B.O. Muthén & Muthén, 2000; Nagin, 1999). These techniques, widely used in substance use research, have been applied specifically to cigarette use data to identify smoking trajectories (Brook, et al., 2008; Caldeira, et al., 2012; Chassin, et al., 2000; Costello, et al., 2008; Fuemmeler, et al., 2013; Jackson, et al., 2005; Klein, et al., 2013; Orlando, et al., 2004, 2005; White, et al., 2002). After extracting trajectories, covariates may be tested, providing evidence for who may be at risk for future smoking and informing intervention targets.

Three known smoking trajectory studies have focused on young adults (Caldeira, et al., 2012; Jackson, et al., 2005; Klein, et al., 2013), with various methodologies and predictors of interest. Caldeira and colleagues (2012) utilized past-month smoking frequency variables from four yearly assessments of college-attending young adults (participants entered the study their freshman year of college) for a mixture model. They identified five trajectories: “stable nonsmokers” (63.1%), “low-stable smokers” (16.0%), “low-increasing smokers” (8.3%), “high-decreasing smokers” (4.3%), and “high-stable smokers” (8.3%). Baseline differences were observed between low-use smoking groups and the high-stable smoking group on cigarette use characteristics (i.e., average number of cigarettes per smoking day), but were unable to distinguish between those who maintained a low level of smoking and those whose smoking increased or decreased over

the four years (Caldeira, et al., 2012). Caldeira and colleagues (2012) also tested differences between trajectories on baseline alcohol use (i.e., drank in the past year, average number of drinks per drinking day) and found differences between “stable nonsmokers” and other trajectories, but alcohol use did not discriminate between smoking groups well. No other baseline predictors and no time-varying covariates were tested. Klein and colleagues (2013) used latent class growth analysis with data collected from young adults every six months from age 18-21. Participants had smoked between 1 and 29 days during the past 30 days at age 18, defined as “nondaily smoking” (Klein, et al., 2013). Three trajectories were identified and labeled “low frequency” (47.8%), “medium frequency” (27.7%) and “high frequency” (24.5%) (Klein, et al., 2013), providing support for the persistence and heterogeneity of nondaily smoking during young adulthood, and raises questions about the stability of these smoking patterns, given the temporal instability of young adult smoking found in other studies (An, et al., 2009; Del Boca, et al., 2004). They found several differences between groups on baseline predictors, including attending college, confidence in ability to quit, and a household ban on smoking (all low vs. high); endorsement of beliefs about the benefits of smoking were mostly associated with being in the high group over the other groups, as were smoking at parties and identifying as addicted (Klein, et al., 2013). Alcohol use was not included as a predictor and time-varying covariates were not tested. Jackson and colleagues (2005) applied growth mixture modeling to longitudinal epidemiological data to model developmental trajectories of conjoint alcohol and tobacco use over a five-year period. Participants were young adults (18-26) assessed every one to two years (Jackson, et al., 2005). Although the focus of the paper was on conjoint use, an initial step in their

analytic plan identified smoking trajectories alone (Jackson, et al., 2005). They identified five smoking trajectories: “nonsmokers” (69%), “chronic smokers” (12%), “late-onset (increase) smokers” (6%), developmentally limited (decrease) smokers (6%), and moderate smokers (7%) (Jackson, et al., 2005). When estimating the conjoint trajectories the authors note there was more variability in smoking than drinking, and the chronic smokers were divided into classes distinguished by their drinking (Jackson, et al., 2005). Jackson and colleagues (2005) also investigated differences between conjoint trajectories on demographics and baseline alcohol expectancies. Their findings suggest these predictors may have an increased effect for using substances together compared to one substance alone, highlighting the necessity of including alcohol use when studying young adult tobacco use (Jackson, et al., 2005).

There are limitations to the methods used in these three studies. First, two of the three studies included individuals in the analyses who did not use tobacco (Caldeira, et al., 2012; Jackson, et al., 2005); including nonusers likely affected the emergent trajectories. While participants who are similar to each other are grouped together, there is also the possibility that nonsmokers could be placed into a smoking trajectory [and vice versa, as seen with the > 0 value given for average number of cigarettes per day for nonsmokers in Caldeira and colleagues (2012) study]. Second, although change over time was observed in trajectories identified by Jackson and colleagues (2005) and Caldeira and colleagues (2012), meaningful change may be occurring that was not detected due to the long assessment intervals. These long assessment intervals additionally make it difficult to identify proximal influences on use, which are key to informing substance use interventions (Witkiewitz & Marlatt, 2004). Previous studies have emphasized the

importance of frequent assessment for observing change in substance use over time (Del Boca, et al., 2004). An investigation of young adult smoking trajectories over a briefer time period and with more frequent assessment will allow for a more detailed analysis of the course of use.

Current Study

As noted above, existing latent variable models utilizing data collected at large intervals (e.g., yearly), may obscure more rapidly occurring fluctuations in use and limit the ability to identify proximal influences on changes in use. The current study endeavors to identify whether subtypes of smokers are detectable over short periods of time, and if so, how they are characterized and whether they are differentially influenced by risk factors. First, trajectories based on monthly tobacco use frequency data collected over six months were derived using latent class growth modeling. Next, multinomial logistic regression was used to determine differences between trajectory groups on relevant baseline predictors (sex, race/ethnicity, age, negative emotionality, desire to quit smoking). Then generalized linear models were tested to determine differences between and within groups on repeated measures of cigarette use quantity (average number of cigarettes per day), nicotine dependence, percent of friends who smoke, and alcohol use (number of heavy drinking episodes). The primary hypotheses are: 1) empirically-derived groups will represent increasing, decreasing, and stable smoking; and 2) between group differences are hypothesized such that higher use groups will have higher negative emotionality, desire to quit smoking, mean cigarette use quantity, and nicotine dependence, and groups with an increasing tobacco use trajectory will have a higher

percent of friends who smoke and higher alcohol use than groups with decreasing trajectories or low frequency smoking; 3) within group differences are hypothesized for the increasing tobacco use trajectory group, such that cigarette smoking quantity, nicotine dependence, percent of friends who smoke, and alcohol use are expected to increase over time, relative to other groups.

Method

Participants

The sample consisted of 286 current college students participating in one of two observational prospective studies of smoking self-change (PI: Mark Myers, Ph.D.). Participants were aged 18-24 years old [$M=19.85$ ($SD=1.55$)], 58.7% were male, 30.8% were non-Hispanic White/Caucasian, 43.7% were Asian, 8.4% were Hispanic/Latino, 2.8% were Pacific Islander, .7% were African-American, 10.8% identified as Mixed, and 2.8% identified as Other. The eligibility criterion for the current study was having smoked at least one cigarette in the time period of interest preceding the baseline interview (a standardized 28-day month). Additional criteria from the parent studies included age between 18-24 years old and current enrollment at one of two large public universities in San Diego for the duration of the study (six months).

Procedure

Students were recruited throughout the year via on campus flyers. Participants completed three in-person interviews held approximately three months apart and each

lasting approximately 90 minutes; trained research assistants conducted the interviews. All participants provided informed written consent for participation and the universities' Internal Review Boards approved the studies.

Measures

Demographics. Sex, race/ethnicity, and age were collected and used to compare trajectory groups.

Alcohol and Cigarette Use. Alcohol and cigarette use data were collected via the Timeline Followback Method [TLFB; (Harris, et al., 2009; L. C. Sobell, Brown, Leo, & Sobell, 1996; L. C. Sobell & Sobell, 1992; M. B. Sobell, et al., 1986)]. Calendars were completed at each interview for the previous ninety days. Given that young adult substance use increases on the weekends (Colder, et al., 2006), monthly cigarette and alcohol use summary variables (all continuous) were calculated using standardized 28-day months, (i.e., four Monday-Sunday weeks). These data were used in the latent class growth model (TLFB data collected during the 3- and 6- month follow-up interviews), to compare resulting trajectory groups on baseline characteristics (TLFB data collected at baseline), and to assess between and within group differences over time in generalized linear models (TLFB data collected at baseline and 6- month follow-up interviews). Since missing data were more common at the end of the ninety days (i.e., the days furthest back from the interview date) and standardizing the weeks resulted in unused data at the beginning of the ninety days (e.g., if a participant completed the interview on a Wednesday, the data from the Monday and Tuesday before the interview were not used), number of smoking days from four time periods (i.e., four 28 day months: Time 1, Time

2, Time 3, Time 4) were entered into the latent class growth model. The average number of cigarettes per day and the number of heavy drinking episodes [i.e., four or more drinks for women and five or more drinks for men in one day (Wechsler, et al., 1995)] for the standardized 28-day month immediately preceding baseline and six-month follow-up were entered into generalized linear models.

Negative Affect. Temperamental negative affectivity was assessed at baseline with the 12-item Negative Emotionality Scale (Buss & Plomin, 1984), a widely-used measure of negative affectivity. The NES is measured on a 5-point Likert-type scale and has been shown to have good internal consistency (Myers, Stein, & Aarons, 2002). Scores were entered into the multinomial logistic regression model comparing trajectory groups on baseline predictors.

Alcohol Use Problems. The Young Adult Alcohol Problems Severity Test [YAAPST; (Hurlbut & Sher, 1992)] was administered at baseline to assess problems resulting from alcohol use in the past year. A weighted past-year severity score was used to compare trajectory groups at baseline.

Cessation Cognitions. Participants were asked to rate at baseline how much they would like to quit smoking, from 0 = *not at all* to 10 = *very much*.

Nicotine Dependence. Nicotine Dependence was assessed at each interview with the Hooked on Nicotine Checklist (DiFranza et al., 2002). The HONC is a ten-item self-report measure rated on a dichotomous scale (yes or no) originally developed for adolescents. The HONC, scored continuously (sum of endorsed items) has been found to have good reliability and predictive validity among college student smokers (Sledjeski et

al., 2007) and to provide better discrimination at low levels of smoking (MacPherson, Strong, & Myers, 2008).

Interpersonal Influences on Smoking. Interpersonal influences on smoking were estimated at each interview with estimated number of friends who smoke (0-100%). Ratings from the baseline and six month interviews were entered into generalized linear models.

Analyses

Latent class growth analysis [LCGA; (Jung & Wickrama, 2008; B.O. Muthén, 2004; Nagin, 1999)] was used to identify distinct clusters of individual tobacco use trajectories within a latent growth model context with MPlus version 7.1 (B.O. Muthén & Muthén, 2005). Latent intercepts (starting level) and slopes (rate of change over time), were estimated for each trajectory (class). Repeated measures (i.e., number of smoking days from Times 1-4) were entered into sequential LCGA models. By utilizing data from follow-up interviews, we were able to subsequently test hypotheses of baseline (Time 0) predictors on group membership in a true prospective model. Latent growth models specifying 2-7 classes were tested and final selection was based on the sample size adjusted Bayesian information criterion (sBIC, Schwartz, 1978), the Akaike information criterion [AIC (Akaike, 1987)], entropy, the Lo-Mendell-Rubin adjusted likelihood ratio test (Lo, et al., 2001) and the Bootstrapped Parametric Likelihood Ratio Test [BLRT(McLachlan & Peel, 2000), per recommendations for selecting number of classes in latent variable models (Hu & Bentler, 1999; Jung & Wickrama, 2008; Nylund, et al., 2007). Differences in parameters across groups are modeled and the probability of

membership for each participant for each class is given (values range from 0-1). Class prevalence is shown based on the highest probability for each participant. Classes were identified based on the mean of the growth factors alone (i.e., variances were constrained to equal across classes) and slope variances were set to zero, primarily because not setting these values to zero led to model non-convergence. This assumes classes are “pure” and each individual in the class follows the same growth pattern. This type of analysis utilizes full-information maximum likelihood estimation with robust standard errors, which uses all available data from each participant and assumes missing data are missing at random (B.O. Muthén & Muthén, 2005).

Once the best fitting model was selected, participants were classified to the most likely trajectory class. To examine the influence of baseline (Time 0) predictors on trajectory group membership, multinomial logistic regression was applied with trajectory class as dependent variable within the latent variable context. Baseline manifest variables (sex, race/ethnicity, age, negative emotionality, history of alcohol use problems, desire to quit smoking) were tested using multinomial logistic regression with each variable entered into the model sequentially. A final model with all significant predictors was estimated (constrained to have the same number of profiles as found in the initial trajectory identification step), following accepted procedures for model building with latent class growth analysis (Delucchi, Matzger, & Weisner, 2004; Nagin, 1999). Next, to test the hypotheses related to time-varying covariates, a set of generalized linear models were estimated in SPSS Version 21. Predictors were variables measured at baseline and six-month follow up and included number of HDE in a month, average number of

cigarettes smoked per day in a month, HONC score, and percent of friends who smoke cigarettes.

Results

On average, smoking frequency (# of smoking days) decreased over the course of the study, Time 0 (Baseline) $M = 18.83$ ($SD = 9.12$); Time 1 $M = 15.27$ ($SD = 10.78$); Time 2 $M = 14.75$ ($SD = 10.87$); Time 3 $M = 13.74$ ($SD = 11.25$); Time 4 $M = 13.38$ ($SD = 11.42$). The large standard deviations suggest differing growth patterns among individuals.

Identification of Latent Trajectories

Models specifying 2-7 classes were fit using LCGA with number of smoking days measured at four time points as manifest variables. Fit statistics for each model are presented in Table 4.1. According to the AIC and BIC, model fit continued to improve up to 7 classes, however, improvements beyond 5 classes were negligible. The highest entropy values were obtained from the 5- and 6-class models, and the Lo-Mendel-Rubin LRT indicated the 5-class model had improved fit over the 4-class model, but the 6-class model was not a significant improvement over the 5-class model. The BLRT did not distinguish between tested models well. Fit statistics, coupled with examination of the mean posterior probabilities and substantive coherence of the models, led to the selection of the 5-class model. The identified trajectories were labeled as high-frequency stable smokers (33.6%), high-frequency decreasing smokers (8.4%), moderate-frequency decreasing smokers (9.8%), low-frequency increasing smokers (10.8%), and low-

frequency stable smokers (37.4%); Figure 4.1 presents mean smoking days from Times 1 – 4 by trajectory class. Models with quadratic terms were tested and failed to converge.

Baseline Variables

Means and percentages of demographics, negative emotionality, alcohol use history, and desire to quit smoking, collected at baseline, are shown in Table 4.2. When differences between groups on each predictor were estimated separately, groups could be distinguished by sex and ethnicity only, they did not significantly differ by age, negative emotionality, severity of past-year alcohol use problems, or desire to quit smoking. Those in the low-frequency increasing group were significantly more likely to be female than those in all other groups except the moderate-frequency decreasing group [vs. high-frequency stable OR = 2.775 (1.20, 6.44), $p = .017$; vs. high-frequency decreasing OR = 4.416 (1.40, 13.91), $p = .011$; vs. low-frequency stable OR = 2.81 (1.23, 6.47), $p = .015$]. Race/ethnicity significantly differed between two groups. The low-frequency stable smokers were more likely [OR = 4.05 (1.003, 16.33), $p = .049$] to be Hispanic/Latino than those in the high-frequency stable group. When sex and race/ethnicity were entered into the model together, only the effect of sex remained. Therefore, sex was retained in the latent variable context [paths were specified between sex and the categorical latent class variable, as well as the latent intercept and slope variables (see Figure 4.2)]. In re-estimating the LCGA model with sex, although group labels and proportions held, slope and intercept values changed slightly and a few participants were reclassified into a different trajectory. The groups yielded from the model with sex were used in subsequent analyses.

Time-varying covariates and predictors

To establish differences between and within trajectory group on relevant time-varying repeated measures, including alcohol and cigarette use variables, nicotine dependence, and percent of friends who smoke, time x group interactions were tested using generalized linear models controlling for sex. Means for each variable by group (overall) are given in Table 4.2. For cigarette use quantity (average number of cigarettes smoked per day in a month), there was a significant main effect of time ($F, 1 = 5.42, p = .021$), with cigarette use generally decreasing over time, and trajectory ($F, 4 = 29.36, p < .001$), but not sex ($F, 1 = .52, p = .471$). There was a significant trajectory x time interaction ($F, 4 = 6.73, p < .001$), with use changing in the expected directions (i.e., trajectory groups with decreasing smoking frequency also had decreased smoking quantity from baseline to six months), and no significant trajectory x time x sex interaction ($F, 4 = 1.023, p = .396$). For nicotine dependence, there was a significant main effect of time ($F, 1 = 5.82, p = .017$), indicating an overall increase in nicotine dependence over time, and trajectory ($F, 4 = 16.27, p < .001$), with higher use groups obtaining higher scores, but not sex ($F, 1 = 1.80, p = .181$). There was no significant trajectory x time interaction ($F, 4 = 1.61, p = .173$), or trajectory x time x sex interaction ($F, 4 = .66, p = .623$). For interpersonal influences, there were no significant main effects of time ($F, 1 = .006, p = .941$), however, there were significant main effects of trajectory ($F, 4 = 3.63, p = .007$), and sex ($F, 1 = 5.06, p = .025$). While males' ratings, on average, stayed flat, females' scores, on average, increased from baseline to six months. There was no significant trajectory x time interaction ($F, 4 = 2.10, p = .082$) and there was a

significant trajectory x sex interaction ($F, 4 = 2.54, p = .040$). A post-hoc multinomial logistic regression with trajectory group as dependent variable (with the low-frequency increasing group as the comparison group) and baseline and six-month percentage of friends who smoke as independent variables, controlling for gender, revealed at six months higher percent of friends who smoke predicted membership in the low-frequency increasing trajectory over the low-frequency stable trajectory [OR = 2.80 (1.19, 6.59), $p = .018$]. For alcohol use (number of heavy drinking episodes per month), there were no significant main effects of time ($F, 1 = .168, p = .682$) or trajectory ($F, 4 = .64, p = .634$) or sex ($F, 1 = 1.42, p = .235$), no significant trajectory x time interaction ($F, 4 = 1.14, p = .350$), nor group x time x sex three-way interaction ($F, 4 = .111, p = .978$).

Discussion

Smoking rates are highest among young adults (L. D. Johnston, et al., 2011), but young adults are not a homogeneous group with identical courses of use. Being able to characterize those at risk for continuing and increasing their tobacco use will serve to inform interventions tailored to specific populations. The goals of the present study were to identify and describe trajectories of young adult smoking and examine the role alcohol use, interpersonal, and intrapersonal factors play in differentiating each trajectory. Within a sample of college-attending young adult smokers, five distinct trajectories of past-month cigarette use frequency were identified: high-frequency stable smokers (33.6%), high-frequency decreasing smokers (8.4%), moderate-frequency decreasing smokers (9.8%), low-frequency increasing smokers (10.8%), and low-frequency stable smokers (37.4%). Frequency of smoking for the majority of the sample (71%) remained stable

over time, at high levels, but also at low levels, adding to the growing body of literature (e.g., (Klein, et al., 2013; Levy, et al., 2009) demonstrating young adults may smoke at a very low level for an extended period (without progression or discontinuation of use). The remainder of the sample, a substantial portion, comprised the three trajectories indicating changing use, including a group who appear to be progressing in their tobacco use and two, with different initial smoking frequencies and rates of change over time, that appear to be decreasing their use. We hypothesized we would find increasing, decreasing, and stable trajectories. However, the landscape of the trajectories was not entirely anticipated. Previous studies identified three to four smoking trajectories among young adults [a fifth trajectory of “nonsmokers” was also identified in two studies (Caldeira, et al., 2012; Jackson, et al., 2005)]. Where other studies had one (Caldeira, et al., 2012; Jackson, et al., 2005) or zero (Klein, et al., 2013) decreasing groups, we identified two. As with previous studies (Caldeira, et al., 2012; Jackson, et al., 2005), we found an increasing group who may be at risk for progressing to a heavier, more regular pattern of smoking, potentially increasing their difficulty with quitting. Utilizing more frequent assessments than in previous studies, as well as using detailed time-line calendar based data (in contrast to a single-item smoking frequency question), may account for the additional trajectory. Our measurement provides a more detailed and nuanced picture of smoking behaviors during young adulthood, a period representing transition and change (White, et al., 2009). Also, differences between samples may contribute to differences in trajectory characteristics between the current study and previous studies; data for the present study were collected throughout the school year from a diverse population of current college students between the ages of 18-24, at baseline participants could be at

any point in their college career (as opposed to data collection beginning during the first year of school).

Although our predictive hypotheses were largely unsupported, we found some differences between trajectories on baseline predictors and time-varying covariates. With regard to demographics, sex differed between groups such that a higher proportion of the low-frequency increasing smokers group was female (the only group in which females were the majority). Males continue to smoke at higher rates than females and college smoking initiation studies suggest males may be more likely than females to initiate smoking during young adulthood (Myers, et al., 2009; Reed, et al., 2007). However, the current finding suggests women may be at increased risk for smoking progression during college. As this sex difference was not reported in previous studies, further research is needed to replicate and understand this finding. We did not find differences based on race/ethnicity (when controlling for gender), age, desire to quit, past-year alcohol use problems, or negative emotionality.

We found some support for our hypotheses related to time-varying covariates. Significant differences were observed in cigarette smoking quantity between groups and over time; cigarette use frequency and cigarette use quantity appear to be changing in the same direction. Similarly, nicotine dependence score (measured with the HONC, a questionnaire not dependent on smoking level for ratings) differed between groups and appeared to increase over time, but at a similar rate for all groups. Although it was not a significant difference, the largest increase between baseline and six-month follow-up on nicotine dependence score was observed in the low-frequency increasing group. These findings are as hypothesized (higher frequency groups have higher average smoking

quantity and higher nicotine dependence) and provide validation for trajectory groups. We also found a difference between groups on peer influence (i.e., having friends who smoke), which has been shown in the past to predict adolescent smoking (Abrams, et al., 2005; Ali & Dwyer, 2009; Mayhew, Flay, & Mott, 2000; White, et al., 2002). We were particularly interested in whether having more friends who smoked was predictive of being in the low-frequency increasing trajectory relative to other groups. We found having more friends who smoked at baseline did not predict membership in this trajectory over the others, but significant differences between those whose smoking increased and those who continued to smoke at a low level were present by the six-month follow-up. No significant differences were found between the low-frequency increasing smokers trajectory and the higher use trajectories at either baseline or six months. These findings suggest a social contribution to increasing cigarette smoking (we would hypothesize increased exposure to cigarette smoking contributed to the increase in smoking in this group rather than increased smoking leading to acquisition of new friends who smoke), and provide support for “social smoking.” Social smoking may mean self-identify as a “social smoker” (Levinson, et al., 2007; Moran, et al., 2004) or smoking primarily with other people present (Gilpin, White, et al., 2005b; Waters, et al., 2006). Both definitions are associated with smoking on a less than daily basis, low motivation to quit, high confidence in ability to quit, low scores on measures of nicotine dependence, and initiating tobacco use at a later age than those who smoke daily or identify as regular smokers (Moran, et al., 2004; Song & Ling, 2011; Waters, et al., 2006). While college students report smoking more on the weekends and during holidays, when socializing is more likely to occur (Colder, et al., 2006), the findings in the current study can not be

accounted for by weekend or holiday smoking. We standardized the number of weekends included in each of the timepoints, and participant recruitment and data collection occurred throughout the school year.

There is a strong relationship between alcohol and tobacco use in the literature, with researchers suggesting identifying those in need for alcohol intervention by using current smoker status (McKee, et al., 2007; McKee & Weinberger, 2013), however, studies have been mixed on the relationship between alcohol use and young adult smoking. The vast majority of college student smokers drink (Weitzman & Chen, 2005) and alcohol use has been identified as a predictor of initiation and progression (Reed, et al., 2010; Wetter, et al., 2004; White, et al., 2009), but has not been reliably found to differ between levels of smoking (Caldeira, et al., 2012; Reed, et al., 2007). It remains unclear whether alcohol potentiates smoking progression and establishment of nicotine dependence. We hypothesized alcohol use would be associated with smoking progression, however, we did not find support for this hypothesis. We did not find any differences between groups on recent heavy drinking and frequency of heavy drinking did not change over time, even among groups whose smoking changed. This may be because of the ubiquity of drinking in college (in our sample, 92.3% drank and 66.5% had at least one heavy drinking episode in the last month at baseline) and how often smoking and drinking go together (for the low-frequency stable smokers, on average, 43.8% of smoking days occurred on drinking days). In young adulthood, and college in particular, smoking and drinking may be occurring in the same environmental context (Nichter, et al., 2010) and the influence of this context may be greater than the effect of each substance on the other. Another explanation for the null findings in the present study is

including participants who have a wide range of smoking histories may occlude the influence alcohol may have during the earliest development of smoking experiences. Examining trajectories of those who have recently initiated smoking may provide further insight into whether alcohol use is playing a role beyond shared context in smoking progression. Likely of equal importance to selection of the sample is the method of data collection. Although we standardized the number of weekend days included in each month of data, it may be necessary to examine the interrelationship of the trajectories of these behaviors and their contexts on a daily rather than monthly basis.

Limitations

The current study provides support for differing trajectories of young adult smoking and for differences across groups. However, these findings should be interpreted in light of a few limitations. First, the sample size of the current study may have limited our ability to detect differences between groups. Second, data were collected from college students in San Diego and may not generalize to college students in other geographic areas or to young adults who do not attend college. However, the sample was ethnically diverse and participants were from two universities with different sociodemographic profiles, reducing the likelihood that the findings were site specific. Third, results of latent class growth analysis are based on mean responses to manifest variables and individual variability exists within groups, so the smoking of a small number of individuals in each group will not be well represented by the mean values. Lastly, although we consider the short-term duration of the study to be a strength, it limits our ability to predict future behaviors and course of smoking.

Conclusions

The current study contributes to the growing body of evidence for heterogeneity in level and course of use among young adults who smoke on a less than daily basis. We found five distinct trajectories of current smoking among young adults, one more than found in previous studies, which may be due to increased information from our measurement tools and more frequent assessment periods. There is a lack of consensus in the literature as to how to classify those who smoke on a nondaily basis; but the need to distinguish different levels within this group has been highlighted (Klein, et al., 2013). In the current study, as in previous studies, descriptive statistics from the trajectory with the highest use indicated it was not comprised solely of those who smoke everyday (i.e., in our study the mean level of use at all time points was less than 28 days). This indicates the practice of classifying young adults who smoke one day less than every day with those who smoke only a few days a month is inappropriate and problematic. At the very minimum, there appear to be two “nondaily smoking” groups (low and moderate), with multiple potential trajectories (stable, increasing, decreasing). The sample for the current study was ethnically diverse and included only recent smokers, in line with the study aims. Replication of these groups in other samples is necessary to attain consensus regarding classification levels. However, given the rapid changes we observed, as others have previously noted (An, et al., 2009; Colder, et al., 2006), this will remain a challenge best achieved with longitudinal data and multiple indicators of use.

Young adult smoking is a mutable behavior, however, an effective treatment for smoking cessation in this age group has not been well-established (Villanti, et al., 2010).

We did not find differences between trajectory on desire to quit smoking, suggesting both those who smoke at high levels and those who smoke at low levels (even those whose smoking frequency is increasing) want to change and may be open to smoking cessation intervention. Although young adults want to quit smoking, difficulty lies in identifying those who would benefit; understanding further what characterizes the different trajectories of low level smoking will guide how to best intervene. The current findings implicate the role of both individual characteristics and environmental context. Future research on young adult smoking trajectories will build upon these findings to contribute to our understanding of smoking progression in young adulthood, identify those most at risk, and inform intervention. There is urgency to intervening with cigarette use in young adulthood before behaviors are entrenched; intervention while smoking behaviors are still forming will prevent some of the costs associated with continued use.

Chapter 4, in part, is currently being prepared for submission for publication of the material. Schweizer, C. Amanda; Doran, Neal; Roesch, Scott C.; Myers, Mark G. The dissertation author was the primary investigator and author of this paper.

Table 4.1: Goodness of fit for the latent class growth models.

No. classes	AIC	sBIC	Entropy	L-M-R Adjusted LRT	BLRT
2	7282.46	7287.30	.904	$p < .0001$	$p < .0001$
3	7151.52	7157.82	.877	<i>ns</i>	$p < .0001$
4	6944.92	6952.68	.909	$p = .022$	$p < .0001$
5	6878.87	6888.08	.913	$p = .045$	$p < .0001$
6	6843.06	6853.73	.913	<i>ns</i>	$p < .0001$
7	6820.02	6832.15	.912	<i>ns</i>	$p < .0001$

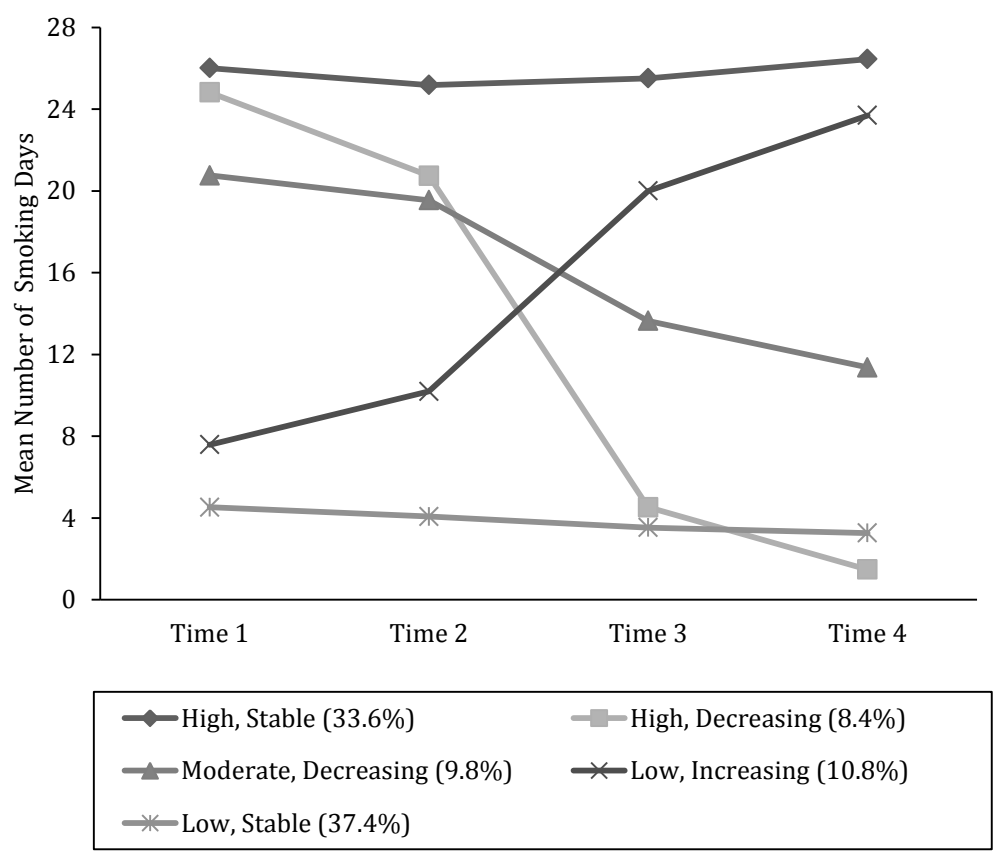
Note. AIC = Akaike's information criteria (Akaike, 1987); sBIC = sample-size adjusted Bayesian information criteria (Tofighi & Enders, 2007); L-M-R Adjusted LRT = Lo-Mendell-Rubin Adjusted Likelihood Ratio Test (Lo, et al., 2001); BLRT = Bootstrapped Parametric Likelihood Ratio Test (McLachlan & Peel, 2000).

Note 2. Model in bold was retained.

Table 4.2: Means and proportions of time invariant baseline predictors and relevant repeated measures across tobacco use frequency trajectory groups.

Predictor	High, Stable	High, Decreasing	Moderate, Decreasing	Low, Increasing	Low, Stable
Baseline Variables					
Sex (% male)	60.4	70.8	60.7	35.5	60.7
Age	19.90 (1.57)	19.67 (1.63)	20.36 (1.57)	19.58 (1.47)	19.79 (1.52)
Ethnicity					
Asian	44.8	66.7	39.3	51.6	36.4
Hispanic/Latino	3.1	4.2	7.1	3.2	15.9
White/Caucasian	36.5	16.7	39.3	25.8	28.0
Other	15.6	12.5	14.3	19.4	19.6
NES	1.56 (.71)	1.45 (.59)	1.58 (.66)	1.44 (.77)	1.35 (.64)
YAAPST	24.44 (17.76)	16.57 (16.98)	22.61 (17.26)	22.94 (16.15)	23.19 (15.71)
Desire to quit	2.77 (1.20)	2.77 (1.23)	2.75 (1.42)	3.07 (1.14)	2.77 (1.10)
Repeated Measures					
Time 0 HDE	3.21 (3.54)	2.52 (3.36)	2.75 (2.81)	3.87 (4.31)	3.31 (3.26)
Time 4 HDE	3.04 (3.77)	3.14 (3.81)	2.92 (3.23)	2.53 (3.42)	2.61 (3.25)
Time 0 Cigs/day	6.23 (4.15)	5.55 (4.01)	3.62 (2.72)	3.22 (1.71)	2.60 (2.66)
Time 4 Cigs/day	6.71 (5.60)	.79 (1.06)	3.19 (2.22)	4.67 (4.01)	1.31 (1.55)
Time 0 HONC	5.99 (2.94)	5.42 (2.69)	4.57 (2.62)	3.47 (2.65)	2.98 (2.91)
Time 4 HONC	6.21 (2.78)	5.87 (2.72)	5.33 (2.87)	4.24 (2.53)	2.81 (2.69)
Time 0 Friends	51.15 (27.05)	57.83 (26.66)	44.80 (28.45)	47.50 (23.24)	42.13 (26.81)
Time 4 Friends	52.86 (27.86)	51.24 (27.43)	50.80 (25.15)	49.50 (23.94)	37.41 (26.14)

Note. Proportions are presented for sex and ethnicity and means are presented for age, negative emotionality score (NES), past-year alcohol use problems severity score (YAAPST), desire to quit, heavy drinking episodes (HDE), average number of cigarettes per day (Cigs/day), nicotine dependence score (HONC), and percent of friends who smoke (Friends).



Note. Past month tobacco use frequency was calculated for standardized 28-day months (i.e., the total smoking days from four Monday to Sunday weeks) at each of the four time points.

Figure 4.1: Latent trajectories of young adult tobacco use frequency.

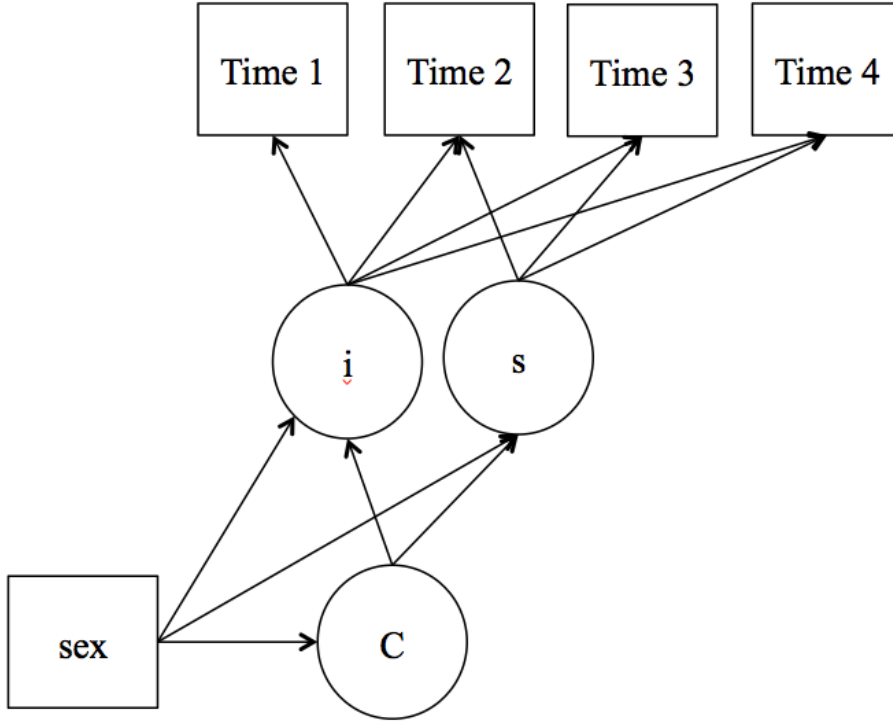


Figure 4.2: Latent class growth model of smoking frequency with sex as a covariate.

CHAPTER 5: DISCUSSION

Despite the high prevalence of smoking among young adults (CDC, 2010), higher than any other age group, evidence-based smoking cessation interventions for this population are scant and may produce short-term effects at best (Murphy-Hoefer, et al., 2005; Villanti, et al., 2010). The majority of young adults smokes on a less than daily basis and may smoke irregularly (Sutfin, McCoy, et al., 2012); smoking cessation interventions designed for use with the general population of adult smokers, typically developed with heavy smokers, may not be appropriate for young adults (Villanti, et al., 2010). Although some promising pilot data are available (Schane, Prochaska, & Glantz, 2013), interventions specifically for nondaily smoking have not been established. Researchers have highlighted the need to focus on the characteristics and risk factors of this pattern of smoking (termed “nondaily,” “intermittent,” “episodic,” or “occasional” smoking) to inform treatment development and delivery (Coggins, Murrelle, Carchman, & Heidbreder, 2009; Wortley, Husten, Trosclair, Chrismon, & Pederson, 2003).

A first step is to be able to classify and describe longitudinal patterns (i.e., stability or change) of nondaily tobacco use in young adulthood. Previous research has approached classification in a few ways. Mostly typically, either all young adult smokers are analyzed together or classifications are driven by the data collection method rather than by the behavior (White, et al., 2002). An example of this would be grouping all less than daily smokers together into one “nondaily” smoking group for comparison to a “daily” smoking group (and perhaps a “nonsmoking” group) However, young adult smokers who do not smoke everyday are not a homogeneous “nondaily” group (Sutfin, et al., 2009) and so classifying this way limits identification of those who may be most in

need of intervention. Fewer researchers have used empirically-derived groups, which are key to understanding heterogeneity in a behavior, identifying those whose substance use deviates from the mean, and detecting intra-individual change over time (Mayhew, et al., 2000; White, et al., 2002).

Studies aimed at characterizing stability and change in smoking from adolescence to young adulthood have made important contributions to our understanding of long-term growth patterns [e.g. (Brook, et al., 2008; Chassin, et al., 2000; Chassin, Presson, Rose, & Sherman, 1996; White, et al., 2002)], but few studies have focused solely on identifying young adult smoking trajectories (Caldeira, et al., 2012; Jackson, et al., 2005; Klein, et al., 2013). Methods such as latent transition analysis (Collins et al., 1994) or latent growth curve analyses (B.O. Muthén, 2004) have been used for these questions, primarily with survey data collected at long intervals (e.g., yearly). This, coupled with the limited information available from single-item smoking variables, as are commonly used in wide-scale surveys, may be obscuring change and limiting our ability to detect significant predictors of change. Further, researchers have noted risk factors for smoking progression may also change over time (Mayhew, et al., 2000) and well-specified models should likely include time-varying covariates and predictors.

Both study 1 and study 3 contribute to the literature aimed at characterizing the course of young adult tobacco use. We applied longitudinal latent variable analytic methods to detailed calendar-based longitudinal substance use data in order to identify profiles of use and estimate change over short periods of time. The purpose of the first study (Schweizer, et al., in press) was to gain a better understanding of the short-term stability of alcohol and tobacco co-use. We used latent profile analysis to extract three

profiles of alcohol and tobacco co-use (based on past-month smoking and drinking quantity and frequency manifest variables) at three different time points, three months apart. Characteristics of the profiles varied somewhat between time points, but each profile solution includes groups reflecting heavy drinking with nondaily smoking and nondaily smoking with low drinking. After identifying the profiles, we used latent transition analysis to estimate the probability of individuals' movement between profiles between time points. While there was some stability in co-use, considering all three time points together, change in both alcohol and tobacco use over the six-month period was more common than stability in use, particularly among those who do not smoke daily. The purpose of study 3 (in preparation) was to identify and describe trajectories of young adult smoking and examine the role alcohol use, interpersonal, and intrapersonal factors play in differentiating each trajectory. With four waves of detailed past-month smoking frequency data from a six-month period (drawn from the same sample as study 1, however a different method was used to calculate substance use data, as described in chapter 4), we identified five distinct trajectories of cigarette use frequency: high-frequency stable smokers, high-frequency decreasing smokers, moderate-frequency decreasing smokers, low-frequency increasing smokers, and low-frequency stable smokers. Subsequent analyses examined the role of both baseline and time-varying covariates and predictors, discussed later in this chapter.

Notably, in both studies, our groups do not reflect the standard "daily/nondaily" classifications. While a group best labeled as "daily" emerged in each tested model, the mean use statistics for these groups do not reach the maximum frequency allotted by the time period (i.e., 30 days for study 1, 28 days for study 3). This indicates the practice of

classifying young adults who smoke just one day less than every day with those who smoke only a few days a month (e.g., those who smoke just one day a month are grouped with those who smoke 29 days a month) is inappropriate and problematic. By that method high frequency smokers are grouped with lower rate smokers rather than the true “everyday” smokers (e.g., those who smoked 30 out of 30 days in a month), with whom they appear to be more alike. Further, at the very minimum, there appear to be two “nondaily” smoking groups, which, although smoking rates differ somewhat between our groups and theirs, has been previously suggested (Klein, et al., 2013).

Our findings diverge with those of Klein and colleagues (2013) in an important way. Their profiles are suggestive of largely stable smoking over their two-year study period, while we observe both instability and stability. This is likely due to our more frequent assessment, as well as the added information available from detailed calendar-based data. Instability of use was demonstrated in a few ways, including the lack of consistency in profile solutions in study 1 and, in study 3, the three emergent trajectories with significant increasing or decreasing rates of change. Stability in our sample manifests as smoking on a very low level or smoking on a daily or nearly daily basis. Our findings contribute to the growing body of evidence for heterogeneity in level and course of use among young adults who smoke on a less than daily basis (Caldeira, et al., 2012; Klein, et al., 2013), instability of both smoking and drinking over short periods (Colder, et al., 2006; Del Boca, et al., 2004), and evidence that some may smoke at low levels of smoking for extended periods (Hassmiller, et al., 2003). The emergence of smoking groups for whom use is unstable over the short-term highlights the need to identify the proximal risk factors influencing rates of change during this time.

Alcohol Use and Social Factors

Identifying proximal risk factors, while considering distal variables, is key to intervention development (Witkiewitz & Marlatt, 2004). Alcohol use has been associated with smoking initiation and continued use (Reed, et al., 2010) and ecological momentary assessment studies have demonstrated a same-day association between alcohol and tobacco use (Jackson, et al., 2010; Piasecki, et al., 2011). Social factors, including both the social environment and expectations for social reinforcement for smoking have also been implicated in young adult smoking, particularly less than daily smoking (Nichter, et al., 2010; Song & Ling, 2011; Waters, et al., 2006). Both alcohol use and social factors are hypothesized to play an important role in the formation of smoking behaviors during young adulthood. However, how they contribute to the course of smoking is not well understood even with increased attention to these associations. Focusing on the short-term relationships between these factors using prospective data and methodology specifically designed for this population are strategies vital to teasing out the characteristics of each, as well as how they interact.

In the literature there is a long and robust history of the relationship between alcohol and tobacco use (Shiffman & Balabanis, 1995); individuals who smoke are more likely to drink than nonsmokers and individuals who drink are more likely to smoke than nondrinkers (Falk, et al., 2006). Rates of co-use (i.e. use of both substances in a given time period) for men and women are highest in young adulthood (Falk, et al., 2006). Results from large survey data suggest greater alcohol involvement (Jones, Oeltmann, Wilson, Brener, & Hill, 2001), particularly problematic alcohol use (Weitzman & Chen,

2005), is associated with greater risk of using cigarettes in young adulthood. More specifically, heavy alcohol use is associated with smoking initiation and continued smoking in college (Reed, et al., 2010; Wetter, et al., 2004; White, et al., 2009), and tobacco use in adolescence is a predictor of later alcohol use problems (Jensen et al., 2003). Alcohol and tobacco are also linked on a daily basis with use of one highly correlated with same day use of the other (Dierker, et al., 2006; Jackson, et al., 2010; Piasecki, et al., 2011), but significance wanes when correlations are examined across days (Dierker, et al., 2006). Complicating the picture is evidence the link between alcohol and tobacco may hold different strengths across level of smoking. Some suggest the link may be weaker among infrequent smokers (Dierker, et al., 2006), while others suggest individuals who smoke on a nondaily basis (compared to nonsmokers and everyday smokers) may be at greatest risk for problematic drinking (Harrison, et al., 2008). In contrast, although alcohol use is consistently found to be higher among smokers than nonsmokers, it does not reliably differ between levels of smoking (Caldeira, et al., 2012; Reed, et al., 2007). Findings appear to be affected by sample, time frame, and how level of smoking was measured and defined. Taken together, we can broadly conclude that in young adulthood: a) using tobacco puts an individual at greater risk for alcohol use problems, however, for which tobacco users this is most pronounced is not clear, and b) using alcohol is associated with greater risk of using tobacco, however, whether alcohol potentiates smoking progression or continued smoking over the short term is not clear. Studies 1 and 3 contribute to the young adult tobacco and alcohol co-use literature by focusing on the relationship between the two over a short period of time, but likewise, do not provide a clear understanding for how changes in alcohol and tobacco use are related.

When looking at quantity and frequency of alcohol and tobacco use together, as noted above, results from study 1 suggest for a large number of young adults co-use is unstable. While alcohol and tobacco co-use was common (we didn't identify profiles suggestive of single use), the co-use profiles were not stable over the three waves of data. This makes it difficult to make definitive conclusions as to how alcohol and tobacco are clustering together in the short term.

Putting our findings into the context of previous research, similar to the long-term co-use trajectories found by Jackson and colleagues (2005) our profiles appear be driven more by differences in drinking than differences in smoking (e.g., at baseline profiles were similar on tobacco use frequency but differed widely by drinking). Also, in both studies, groups represent a range of possible combinations of alcohol and tobacco use and are not suggestive of an exclusively linear relationship between the two (i.e., heavy drinking did not only occur with heavy smoking). This is consonant with research indicating it may be the young adults who smoke on a nondaily basis who are at the highest risk for drinking problems (Harrison, et al., 2008). In our study, it appears that those who smoke on a moderate basis (compared to lower and higher smoking profiles) may be most at risk for co-occurring risky drinking. At no point did a group emerge with moderate smoking and low drinking and at two time points the groups with moderate smoking had the highest level of drinking. While the mean use values for these moderate smoking and high drinking groups were not equivalent across time in study 1, a similar profile emerged with a different sample using cross-sectional latent profile analysis (Schweizer, et al., 2010). However, when latent groups were based on tobacco use alone, as in study 3, we did not find evidence for this relationship. Surprisingly, in study 3,

contrary to our hypotheses that increasing tobacco use would be predicted, and accompanied, by more frequent heavy drinking than decreasing or stable tobacco use, frequency of heavy alcohol use was similar across smoking trajectories and across time points.

Although our predictive hypotheses were not supported in study 3 and study 1 did not provide clear, replicated profiles of alcohol and tobacco co-use, null findings provide useful information for informing future research and highlighting the role sample may play in examining this relationship. Our participants represented a cross section of college student smokers (i.e., they were not all freshman or recently initiated) in contrast to previous studies including only first-year college students (Colder, et al., 2006; Dierker, et al., 2006). It is possible lifetime smoking experience affects the proximal relationship between tobacco and alcohol and the variability in experience in our sample masked a relationship only present during the earliest smoking experiences. Also, for those who primarily smoke in alcohol use situations, as is common among nondaily smokers (Harrison & McKee, 2008), we would expect the relative influence of alcohol on future smoking to be stronger than for those whose smoking occurs to a larger extent outside of the use of alcohol. Therefore, it may be the ubiquity of alcohol use among college student smokers (Weitzman & Chen, 2005), that makes it difficult to detect differences across smoking groups. The majority of the participants in study 1 and 3 had at least one heavy drinking episode and >90% had at least one drinking day in the month prior to baseline. Another consideration is that while it is well-established alcohol use is associated with increased smoking within the same context (Witkiewitz, et al., 2012), alcohol use may influence the occurrence of later smoking only for a subset of people (Dierker, et al.,

2006), contingent on level of drinking and establishment of nicotine dependence (Goodwin et al., 2013). Once nicotine dependent, individuals may be primarily motivated to smoke for relief of withdrawal symptoms (Baker, et al., 2004). Examining profiles and trajectories of those who have recently initiated smoking and selecting a sample with more variability in drinking will provide further insight into whether alcohol use is playing a role in smoking progression.

Our findings also support the importance of a common context for smoking and drinking, including the immediate environment of use (Witkiewitz, et al., 2012), young adults expectations for using tobacco and alcohol together (Nichter, et al., 2010), and temperament and mood state (Magid, Colder, Stroud, & Nichter, 2009; Witkiewitz, et al., 2012). The influence of this context may be greater than the effect of each substance on the other. For example, event-level data presented by Magid and colleagues (2009) found negative affect to be a robust correlate of smoking among college students, above and beyond the effect of alcohol, and Wikiewitz and colleagues (2012) found co-use was more likely in times of stress, with other people present, and at parties, bars, or clubs. Both peer use and perceptions of social approval may effect change for both smoking and alcohol use (Andrews, et al., 2002; Moran, et al., 2004; Myers & MacPherson, 2008; Yanovitzky, et al., 2006) and individual level variables may differentially predict change in use for those at lower levels than those for whom smoking and drinking is more established (Wetter, et al., 2004). Social factors and expectancies may more strongly influence those who use at lower levels, while internal cues and physiological dependence may account for continued heavy use.

Young adults smoke socially (Moran, et al., 2004) and believe smoking projects a positive image (Hendricks & Brandon, 2005). Having friends who smoke; which has been shown in the past to predict adolescent smoking (Abroms, et al., 2005; Ali & Dwyer, 2009; Mayhew, et al., 2000; White, et al., 2002) is also likely key in young adult smoking, given the high rates of identity as a “social smoker” as well as smoking with other people present (Song & Ling, 2011). In two of the current studies we directly measured facets of social influence on smoking. In study 2 (Schweizer, Doran, & Myers, 2014), in recognition of the importance of the social environment and the effect positive smoking expectancies (anticipatory beliefs about positive outcomes for smoking) have on future smoking, particularly for light and intermittent smokers (Wetter, et al., 2004), we created a measure of social facilitation expectancies for smoking (SFE). Existing measures of cigarette smoking expectancies provide limited assessment of perceived social facilitation benefits and none were specifically designed for young adults, particularly those who smoke on a less than daily basis (Schleicher, et al., 2008). The content of the SFE assesses agreement with anticipated social benefits of cigarette smoking, consistent with research in this area (Hendricks & Brandon, 2005; Nichter, et al., 2010). Exploratory and confirmatory factor analyses were used to establish a nine-item one-factor structure, which was validated across sexes and smoking experience groups. Scores on this measure were associated with greater anticipated difficulty not smoking in social situations when offered a cigarette and with greater endorsement of the belief that quitting smoking would adversely affect one’s social life, as well as with percent of friends who smoke, although modestly so. In study 3, we included percent of friends who smoke as a time-varying covariate (measured at baseline and the six-month follow-up) for smoking

trajectory and found having more friends who smoke at the six-month follow-up increased the odds of being in the low-frequency increasing smokers group over the low-frequency stable smokers group. Together our findings support the role of the social environment in young adult smoking, both cognitions about social benefits of smoking as well as exposure to cigarette smoking by influential peers, particularly for those whose smoking is not well-established.

The results from all three studies also provide further evidence for “social smoking” and implicate the role of social factors in smoking progression during young adulthood. Social smoking may mean self-identify as a “social smoker” (Levinson, et al., 2007; Moran, et al., 2004) or smoking primarily with other people present (Gilpin, White, et al., 2005b; Waters, et al., 2006). Both definitions are associated with smoking on a less than daily basis, low motivation to quit, high confidence in ability to quit, low scores on measures of nicotine dependence, and initiating tobacco use at a later age than those who smoke daily or identify as regular smokers (Moran, et al., 2004; Song & Ling, 2011; Waters, et al., 2006). In study 1 and study 3, groups emerged for whom smoking may be contextually restricted (suggested by the low rates of use) and in study 3, exposure to cigarette smoking friends appears to increase along with increases in smoking. In study 2, greater social facilitation expectancies were associated with greater smoking and with a greater proportion of friends who smoke. It was surprising in study 2 that while social facilitation expectancies and peer smoking were significantly and positively related, the strength of the association was small. This may be because percent of friends who smoke is a current rating, while expectancies likely incorporate and reflect prior experiences and contact with smokers and images of smoking, consistent with social learning theory

(Bandura, 1986). Nonetheless, the two may work in concert to contribute to future smoking. Smoking is common in social situations in college (Moran, et al., 2004; Nichter, et al., 2010; Waters, et al., 2006), college students report “peer pressure” to smoke (A. E. Brown, et al., 2011), and may be provided with cigarettes via tobacco promotions (Ling & Glantz, 2002), so potential for being offered a cigarette is high. Therefore, greater expectancies that smoking will enhance social interactions and increased exposure to friends’ smoking are likely linked with lower rates of refusal or sustained ability to refrain from smoking and higher vulnerability for continued use. This is supported by the changing rating of percent of friends’ who smoke in study 3 among those in the low-frequency increasing smokers group. It is possible the relationship between increased exposure to smoking and smoking progression is mediated by social facilitation expectancies, however we were not able to test this hypothesis with the current data.

Along with the proximal risk of alcohol use and social factors, of additional consideration are the static individual predictors of change common to both alcohol and tobacco use, including personality and emotional factors (e.g., negative emotionality, anxiety), family history of alcoholism, and demographic variables (Borsari, et al., 2007; Emmons, et al., 1998; Wechsler, et al., 1998; Wetter, et al., 2004). We were able to include a few key variables in our growth model in study 3. Sex differed between groups such that a higher proportion of the low-frequency increasing smokers group was female (the only group with a female majority), however, we did not find differences between groups on race/ethnicity (when controlling for sex), age, or negative affectivity. Males continue to smoke at higher rates than females and college smoking initiation studies suggest males may be more likely than females to initiate smoking during young

adulthood (Myers, et al., 2009; Reed, et al., 2007). However, a qualitative investigation reveals college students may perceive gender differences in smoking context and patterns [see “party smoking is a girl thing” in (Nichter, et al., 2006)] and the current finding suggests women may be at increased risk for smoking progression during college. As this sex difference was not reported in previous quantitative studies, further research is needed to replicate and understand this finding.

Limitations

This series of studies makes an important contribution to the literature on young adult smoking, but results should be considered in light of a few limitations. While some additional limitations are noted in the discussion sections for each individual study, there are several that apply to the studies as a whole. Most notably are the limitations to generalizability. First, the samples were drawn from the young adult college attending population and how well the findings apply to non-college attending young adults is unknown. Although the college environment poses particular risk for increasing substance use (Choi, Harris, Okuyemi, & Ahluwalia, 2003), young adults who are not in college may smoke more than young adults who do attend college (L. D. Johnston, et al., 2011). Environmental contexts of substance use may differ between those who are in college and those young adults who are not, and so this will be an important area for further inquiry. Second, although there was substantial diversity in the samples, lending to the generalizability of the findings, at times sample size restricted our ability to empirically compare findings across racial/ethnic groups. Previous research has suggested differing smoking patterns between racial and ethnic groups (Ames, et al.,

2009; Ling, Neilands, & Glantz, 2009; Wortley, et al., 2003), while others have noted differences did not emerge when controlling for gender, as we observed in study 3. Third, our participants reside in a limited geographic area and results may not apply to young adults in other areas, however, individuals were from two college campuses with differing socio-economic profiles so findings are not likely to be site specific. Fourth, the foci of the current studies on smoking progression and relevance to early smoking experiences led to the inclusion criteria pertaining to recent smoking and not lifetime smoking. Individuals were included who have smoked < 100 cigarettes, however, the Centers for Disease Control and Prevention (CDC) considers a smoker to be someone who has smoked > 100 cigarettes in their lifetime. Therefore, by this definition, not all participants would be considered current smokers. Fifth, external factors we did not measure (e.g., holidays, examinations), may affect college student substance use, however, recruiting participants throughout the school year reduces the likelihood these factors affected the current findings.

Conclusions and Future Directions

This series of studies addresses gaps in the literature by examining stability and change in profiles of tobacco and alcohol co-use over time, presenting a new questionnaire specifically to measure expectancies regarding social facilitation benefits from smoking, and testing a prediction model of short-term trajectories of young adult tobacco use including recent alcohol use and social exposure to smoking. Significant contributions include the use of sophisticated methodologies, including complex analytic techniques, prospective data, shorter assessment periods, and more detailed measurement,

as well as a more ethnically diverse sample, than in previous studies. Our findings add to knowledge on young adult alcohol and tobacco co-use, implicate social facilitation expectancies and exposure to friends who smoke in early smoking and smoking progression, and highlight the instability of young adult smoking during young adulthood and the shortcomings of grouping all young adult nondaily smokers together.

While these studies make contributions to the literature, taken within the context of previous studies on tobacco use in young adulthood our findings also raised numerous questions and potential areas for further inquiry. We were able to demonstrate social facilitation expectancies for smoking and exposure to peer smoking are relevant for those who currently smoke at low levels; how these factors contribute to smoking initiation and continued smoking during college is an important area for future study. Young adulthood represents a susceptible period for the initiation or progression of cigarette smoking (Tercyak, et al., 2007), possibly due to changes in environment such as increased access and exposure to tobacco, increased alcohol use, and reduced supervision (Chassin, et al., 2000; White, et al., 2009). However, there are few studies on smoking initiation during college. Future research with the SFE, particularly using latent variable growth modeling, could contribute to the literature on smoking initiation, social smoking, and smoking progression in college.

Future areas of research may build upon the present demonstration of the temporal instability of young adult smoking through adjusted assessment schedules and considered inclusion of predictors. While our prospective data were collected at more frequent assessment periods than in previous trajectory studies, it may be that creating monthly summary variables still does not allow for the amount of detail necessary to

understanding the risk alcohol and the social environment confer upon smoking progression. It was surprising, and contrary to hypotheses that, even though these behaviors frequently co-occurred in our sample, our results suggest alcohol use does not potentiate smoking progression over the short-term. It is possible, as suggested previously (Colder, et al., 2006), that relationships between these factors differ between weekend and weekday. Conducting smoking trajectory studies using data from a daily or by-weekend basis may provide the information necessary to observe these nuanced relationships. Previous research using alcohol data (Greenbaum, et al., 2005) lends to the feasibility of such an endeavor. Additionally, social influence on smoking extends to both proximal and distant relationships (Christakis & Fowler, 2008), and so assessing the setting of use and presence of smoking and nonsmoking friends, as well as the attitudes towards smoking of key people who may not be present will be important for identifying those at risk.

Our findings also raise issues related to clinical intervention and prevention research and practice. In study 3 there were no differences across trajectory in desire to quit smoking, in line with previous research demonstrating young adult nondaily smokers want to quit (Pinsker et al., 2013), yet may lack the belief they need assistance and may be reluctant to engage in treatment seeking (Berg, Sutfin, Mendel, & Ahluwalia, 2012; Sutfin, McNamara, et al., 2012). Some young adult nondaily smokers will transition out of this behavior without intervention (Levy, et al., 2009), while others will continue to smoke at low levels for long periods or progress to a heavier level of smoking. The instability we observed in studies 1 and 3 point to the malleability of this behavior. For those using on an episodic basis, smoking has not become automatized and is subject to

environment and external cues. There is urgency to intervening with young adults before behavior becomes entrenched. It is crucial to find content and delivery method that appeal to this group of smokers. However, the difficulty of engaging those who would benefit from intervention points to broad public health campaigns, rather than individually-administered interventions, as most viable for delivery. Given the common practice of alcohol and tobacco co-use and the role of the social environment in light and intermittent smoking, our findings, as well as the tendency of less than daily smokers to minimize health risks for smoking (Hyland, Rezaishiraz, Bauer, Giovino, & Cummings, 2005), support the development of interventions targeting social consequences (Schane, et al., 2013). In particular, social facilitation expectancies for smoking, exposure to smoking, and alcohol use may be modifiable risk factors and targets for intervention and prevention of cigarette smoking.

REFERENCES

- Abroms, L., Simons-Morton, B., Haynie, D. L., & Chen, R. (2005). Psychosocial predictors of smoking trajectories during middle and high school. *Addiction, 100*(6), 852-861.
- Acosta, M. C., Eissenberg, T., Nichter, M., Nichter, M., Balster, R. L., & Tern. (2008). Characterizing early cigarette use episodes in novice smokers. *Addictive Behaviors, 33*(1), 106-121.
- Akaike, H. (1987). Factor analysis and AIC. *Psychometrika, 52*, 317-332.
- Ali, M. M., & Dwyer, D. S. (2009). Estimating peer effects in adolescent smoking behavior: a longitudinal analysis. *Journal of Adolescent Health 45*(4), 402-408.
- Aloise-Young, P. A., Graham, J. W., & Hansen, W. B. (1994). Peer influence on smoking initiation during early adolescence: a comparison of group members and group outsiders. *Journal of Applied Psychology, 79*(2), 281-287.
- Ames, S. C., Stevens, S., Schroeder, D., Werch, C. E., Carlson, J., Kiros, G. E., Kershaw, J., Patten, C., Ebbert, J., & Offord, K. (2009). Nondaily tobacco use among Black and White college undergraduates: A comparison of nondaily versus daily tobacco users. *Addiction Research and Theory, 17*(2), 191-204.
- Ames, S. C., Stevens, S. R., Werch, C. E., Carlson, J. M., Schroeder, D. R., Kiros, G. E., Kershaw, J., Patten, C. A., Ebbert, J. O., & Offord, K. P. (2010). The association of alcohol consumption with tobacco use in Black and White college students. *Substance Use and Misuse, 45*(7-8), 1230-1244.
- An, L. C., Berg, C. J., Klatt, C. M., Perry, C. L., Thomas, J. L., Luo, X., Ehlinger, E. & Ahluwalia, J. S. (2009). Symptoms of cough and shortness of breath among occasional young adult smokers. *Nicotine and Tobacco Research, 11*(2), 126-133.
- Andrews, J. A., Tildesley, E., Hops, H., & Fuzhong, L. (2002). The Influence of Peers on Young Adult Substance Use. *Health Psychology, 21*(4), 349-357.
- Asotra, K. (2005). Hooked on hookah? *Burning Issues: Tobacco-Related Disease Research Program Newsletter, 7*, 1-11.
- Audrain-McGovern, J., Rodriguez, D., & Kassel, J. D. (2009). Adolescent smoking and depression: evidence for self-medication and peer smoking mediation. *Addiction, 104*(10), 1743-1756.

- Auerbach, K. J., & Collins, L. M. (2006). A multidimensional developmental model of alcohol use during emerging adulthood. *Journal of Studies on Alcohol and Drugs*, 67(6), 917-925.
- Baker, T. B., Brandon, T. H., & Chassin, L. (2004). Motivational influences on cigarette smoking. *Annual Review of Psychology*, 55, 463-491.
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bares, C. B., & Andrade, F. H. (2012). Racial/ethnic differences in the longitudinal progression of co-occurring negative affect and cigarette use: from adolescence to young adulthood. *Addictive Behaviors*, 37(5), 632-640.
- Berg, C. J., Sutfin, E. L., Mendel, J., & Ahluwalia, J. S. (2012). Use of and interest in smoking cessation strategies among daily and nondaily college student smokers. [Research Support, Non-U.S. Gov't]. *Journal of American College Health*, 60(3), 194-202.
- Bobo, J. K., & Husten, C. (2000). Sociocultural influences on smoking and drinking. *Alcohol Research and Health*, 24(4), 225-232.
- Borders, T. F., Xu, K. T., Bacchi, D., Cohen, L., & SoRelle-Miner, D. (2005). College campus smoking policies and programs and students' smoking behaviors. *BMC Public Health*, 5, 74.
- Borsari, B., Murphy, J. G., & Barnett, N. P. (2007). Predictors of alcohol use during the first year of college: implications for prevention. *Addictive Behaviors*, 32(10), 2062-2086.
- Boulos, D. N., Loffredo, C. A., El Setouhy, M., Abdel-Aziz, F., Israel, E., & Mohamed, M. K. (2009). Nondaily, light daily, and moderate-to-heavy cigarette smokers in a rural area of Egypt: a population-based survey. [Research Support, N.I.H., Extramural]. *Nicotine and Tobacco Research*, 11(2), 134-138.
- Brandon, T. H., & Baker, T. B. (1991). The Smoking Consequences Questionnaire. *Psychological Assessment*, 3, 484-491.
- Brook, D. W., Brook, J. S., Zhang, C., Whiteman, M., Cohen, P., & Finch, S. J. (2008). Developmental trajectories of cigarette smoking from adolescence to the early thirties: personality and behavioral risk factors. *Nicotine and Tobacco Research*, 10(8), 1283-1291.
- Brown, A. E., Carpenter, M. J., & Sutfin, E. L. (2011). Occasional smoking in college: who, what, when and why? *Addictive Behaviors*, 36(12), 1199-1204.

- Brown, S. A. (1985). Expectancies versus background in the prediction of college drinking patterns. *Journal of Consulting and Clinical Psychology, 53*(1), 123-130.
- Brown, S. A., Goldman, M. S., Inn, A., & Anderson, L. R. (1980). Expectations of reinforcement from alcohol: Their domain and relation to drinking patterns. *Journal of Consulting and Clinical Psychology, 48*, 419-426.
- Brownell, K. D., Marlatt, G. A., Lichtenstein, E., & Wilson, G. T. (1986). Understanding and preventing relapse. *American Psychologist, 41*, 765-782.
- Buckley, T. C., Kamholz, B. W., Mozley, S. L., Gulliver, S. B., Holohan, D. R., Helstrom, A. W., Walsh, K., Morissette, S. B., & Kassel, J. D. (2005). A psychometric evaluation of the Smoking Consequences Questionnaire-Adult in smokers with psychiatric conditions. *Nicotine and Tobacco Research, 7*(5), 739-745.
- Burton, S. M., & Tiffany, S. T. (1997). The effect of alcohol consumption on craving to smoke. *Addiction, 92*(1), 15-26.
- Buss, A. H., & Plomin, R. (1984). *Temperament: Early developing personality traits*. Hillsdale, NJ: Erlbaum.
- Caldeira, K. M., O'Grady, K. E., Garnier-Dykstra, L. M., Vincent, K. B., Pickworth, W. B., & Arria, A. M. (2012). Cigarette smoking among college students: longitudinal trajectories and health outcomes. [Research Support, N.I.H., Extramural]. *Nicotine and Tobacco Research, 14*(7), 777-785.
- CDC. (2008). Smoking-attributable mortality, years of potential life lost, and productivity losses - United States, 2000-2004. *Morbidity and Mortality Weekly Report, 57*(45), 1226-1228.
- CDC. (2010). Centers for Disease Control and Prevention Vital Signs: Current Cigarette Smoking Among Adults Aged ≥ 18 Years—United States, 2005–2010. *Morbidity and Mortality Weekly Report 2011, 60*(33), 1207-1212.
- Cepeda-Benito, A., & Ferrer, A. R. (2000). Smoking Consequences Questionnaire--Spanish. *Psychology of Addictive Behaviors, 14*(3), 219-230.
- Chassin, L., Fora, D. B., & King, K. M. (2004). Trajectories of alcohol and drug use and dependence from adolescence to adulthood: the effects of familial alcoholism and personality. *Journal of Abnormal Psychology, 113*(4), 483-498.
- Chassin, L., Presson, C. C., Pitts, S. C., & Sherman, S. J. (2000). The natural history of cigarette smoking from adolescence to adulthood in a midwestern community

- sample: multiple trajectories and their psychosocial correlates. *Health Psychology*, *19*(3), 223-231.
- Chassin, L., Presson, C. C., Rose, J. S., & Sherman, S. J. (1996). The natural history of cigarette smoking from adolescence to adulthood: demographic predictors of continuity and change. *Health Psychology*, *15*(6), 478-484.
- Chassin, L., Presson, C. C., Sherman, S. J., & Edwards, D. A. (1991). Four pathways to young-adult smoking status: Adolescent social-psychological antecedents in a midwestern community sample. *Health Psychology*, *10*, 409-418.
- Choi, W. S., Harris, K. J., Okuyemi, K., & Ahluwalia, J. S. (2003). Predictors of smoking initiation among college-bound high school students. *Annals of Behavioral Medicine*, *26*(1), 69-74.
- Christakis, N. A., & Fowler, J. H. (2008). The collective dynamics of smoking in a large social network. *New England Journal of Medicine*, *358*(21), 2249-2258.
- Chung, H., Park, Y., & Lanza, S. T. (2005). Latent transition analysis with covariates: pubertal timing and substance use behaviours in adolescent females. *Statistics in Medicine*, *24*(18), 2895-2910.
- Clapp, J. D., Whitney, M., & Shillington, A. M. (2002). The reliability of environmental measures of the college alcohol environment. *Journal of Drug Education*, *32*(4), 287-301.
- Coggins, C. R., Murrelle, E. L., Carchman, R. A., & Heidbreder, C. (2009). Light and intermittent cigarette smokers: a review (1989-2009). *Psychopharmacology*, *207*(3), 343-363.
- Cohen, L. M., McCarthy, D. M., Brown, S. A., & Myers, M. G. (2002). Negative affect combines with smoking outcome expectancies to predict smoking behavior over time. *Psychology of Addictive Behaviors*, *16*(2), 91-97.
- Colder, C. R., Lloyd-Richardson, E. E., Flaherty, B. P., Hedeker, D., Segawa, E., & Flay, B. R. (2006). The natural history of college smoking: Trajectories of daily smoking during the freshman year. *Addictive Behaviors*, *31*(1), 2212-2222.
- Collins, L. M. (2006). Analysis of longitudinal data: the integration of theoretical model, temporal design, and statistical model. *Annual Review of Psychology*, *57*, 505-528.
- Collins, L. M., Graham, J. W., Rousculp, S. S., Fidler, P. L., Pan, J., & Hansen, W. B. (1994). Latent transition analysis and how it can address prevention research questions. *National Institute on Drug Abuse - Research Monographs*, *142*, 81-111.

- Copeland, A. L., & Brandon, T. H. (2000). Testing the causal role of expectancies in smoking motivation and behavior. *Addictive Behaviors, 25*(3), 445-449.
- Copeland, A. L., Brandon, T. H., & Quinn, E. P. (1995). The Smoking Consequences Questionnaire-Adult: Measurement of smoking outcome expectancies of experienced smokers. *Psychological Assessment, 7*, 484-494.
- Copeland, A. L., Diefendorff, J. M., Kendzor, D. E., Rash, C. J., Businelle, M. S., Patterson, S. M., & Williamson, D. A. (2007). Measurement of smoking outcome expectancies in children: the Smoking Consequences Questionnaire-Child. *Psychology of Addictive Behaviors, 21*(4), 469-477.
- Costa, F. M., Jessor, R., & Turbin, M. S. (2007). College student involvement in cigarette smoking: the role of psychosocial and behavioral protection and risk. *Nicotine and Tobacco Research, 9*(2), 213-224.
- Costello, D. M., Dierker, L. C., Jones, B. L., & Rose, J. S. (2008). Trajectories of smoking from adolescence to early adulthood and their psychosocial risk factors. *Health Psychology, 27*(6), 811-818.
- Del Boca, F. K., Darkes, J., Greenbaum, P. E., & Goldman, M. S. (2004). Up close and personal: temporal variability in the drinking of individual college students during their first year. *Journal of Consulting and Clinical Psychology, 72*(2), 155-164.
- Delucchi, K. L., Matzger, H., & Weisner, C. (2004). Dependent and problem drinking over 5 years: a latent class growth analysis. *Drug and Alcohol Dependence, 74*(3), 235-244.
- Dierker, L. C., Donny, E., Tiffany, S., Colby, S. M., Perrine, N., & Clayton, R. R. (2007). The association between cigarette smoking and DSM-IV nicotine dependence among first year college students. *Drug and alcohol dependence, 86*(2-3), 106-114.
- Dierker, L. C., Lloyd-Richardson, E., Stolar, M., Flay, B., Tiffany, S., Collins, L., Bailey, S., Nichter, M., Nichter, M., & Clayton, R. (2006). The proximal association between smoking and alcohol use among first year college students. *Drug and Alcohol Dependence, 81*(1), 1-9.
- DiFranza, J. R., Savageau, J. A., Fletcher, K., Ockene, J. K., Rigotti, N. A., McNeill, A. D., Coleman, M., & Wood, C. (2002). Measuring the loss of autonomy over nicotine use in adolescents: The DANDY (Development and Assessment of Nicotine Dependence in Youths) study. *Archives of Pediatrics and Adolescent Medicine, 156*(4), 397-403.

- Donovan, D. M. (1988). Assessment of addictive behaviors: Implications of an emerging biopsychosocial model. In D. M. Donovan & G. A. Marlatt (Eds.), *Assessment of Addictive Behaviors* (pp. 3 - 50). New York: Guilford.
- Doran, N., Myers, M. G., Luczak, S. E., Carr, L. G., & Wall, T. L. (2007). Stability of heavy episodic drinking in Chinese- and Korean-American college students: effects of ALDH2 gene status and behavioral undercontrol. *Journal of Studies on Alcohol and Drugs*, 68(6), 789-797.
- Doran, N., Schweizer, C. A., & Myers, M. G. (2011). Do expectancies for reinforcement from smoking change after smoking initiation? *Psychology of Addictive Behaviors*, 25(1), 101-107.
- Emmons, K. M., Wechsler, H., Dowdall, G., & Abraham, M. (1998). Predictors of smoking among US college students. *American Journal of Public Health*, 88(1), 104-107.
- Etter, J. F. (2004). The psychological determinants of low-rate daily smoking. [Research Support, Non-U.S. Gov't]. *Addiction*, 99(10), 1342-1350.
- Everett, S. A., Husten, C. G., Kann, L., Warren, C. W., Sharp, D., & Crossett, L. (1999). Smoking initiation and smoking patterns among US college students. *Journal of American College Health*, 48(2), 55-60.
- Falk, D. E., Yi, H. Y., & Hiller-Sturmhofel, S. (2006). An epidemiologic analysis of co-occurring alcohol and tobacco use and disorders: findings from the National Epidemiologic Survey on Alcohol and Related Conditions. *Alcohol Research and Health*, 29(3), 162-171.
- Flay, B. R., Hu, F. B., Siddiqui, O., Day, L. E., Hedeker, D., Petraitis, J., . . . Sussman, S. (1994). Differential influence of parental smoking and friends' smoking on adolescent initiation and escalation of smoking. *Journal of Health and Social Behavior*, 35(3), 248-265.
- Fleming, R., Leventhal, H., Glynn, K., & Ershler, J. (1989). The role of cigarettes in the initiation and progression of early substance use. *Addictive Behaviors*, 14(3), 261-272.
- Freedman, K. S., Nelson, N. M., & Feldman, L. L. (2012). Smoking initiation among young adults in the United States and Canada, 1998-2010: a systematic review. *Preventing Chronic Disease*, 9, E05.
- Fromme, K., & Dunn, M. E. (1992). Alcohol expectancies, social and environmental cues as determinants of drinking and perceived reinforcement. *Addictive Behaviors*, 17(2), 167-177.

- Fromme, K., Stroot, E., & Kaplan, D. (1993). Comprehensive Effects of Alcohol: Development and psychometric assessment of a new expectancy questionnaire. *Psychological Assessment, 5*, 19-26.
- Fuemmeler, B., Lee, C. T., Ranby, K. W., Clark, T., McClernon, F. J., Yang, C., & Kollins, S. H. (2013). Individual- and community-level correlates of cigarette-smoking trajectories from age 13 to 32 in a U.S. population-based sample. *Drug and Alcohol Dependence, 132*(1-2), 301-308.
- Gilpin, E. A., Cavin, S. W., & Pierce, J. P. (1997). Adult smokers who do not smoke daily. *Addiction, 92*(4), 473-480.
- Gilpin, E. A., Lee, L., & Pierce, J. P. (2005). How have smoking risk factors changed with recent declines in California adolescent smoking? *Addiction, 100*(1), 117-125.
- Gilpin, E. A., White, V. M., & Pierce, J. P. (2005a). How effective are tobacco industry bar and club marketing efforts in reaching young adults? *Tobacco Control, 14*(3), 186-192.
- Gilpin, E. A., White, V. M., & Pierce, J. P. (2005b). What fraction of young adults are at risk for future smoking, and who are they? *Nicotine and Tobacco Research, 7*(5), 747-759.
- Goodwin, R. D., Kim, J. H., Weinberger, A. H., Taha, F., Galea, S., & Martins, S. S. (2013). Symptoms of alcohol dependence and smoking initiation and persistence: a longitudinal study among US adults. *Drug and Alcohol Dependence, 133*(2), 718-723.
- Greenbaum, P. E., Del Boca, F. K., Darkes, J., Wang, C. P., & Goldman, M. S. (2005). Variation in the drinking trajectories of freshmen college students. *Journal of Consulting and Clinical Psychology, 73*(2), 229-238.
- Guo, J., Collins, L. M., Hill, K. G., & Hawkins, J. D. (2000). Developmental pathways to alcohol abuse and dependence in young adulthood. *Journal of Studies on Alcohol and Drugs, 61*(6), 799-808.
- Haas, A. L., Munoz, R. F., Humfleet, G. L., Reus, V. I., & Hall, S. M. (2004). Influences of mood, depression history, and treatment modality on outcomes in smoking cessation. *Journal of Consulting and Clinical Psychology, 72*(4), 563-570.
- Hall, S. M., Munoz, R. F., Reus, V. I., & Sees, K. L. (1993). Nicotine, negative affect, and depression. *Journal of Consulting and Clinical Psychology, 61*(5), 761-767.

- Harris, K. J., Golbeck, A. L., Cronk, N. J., Catley, D., Conway, K., & Williams, K. B. (2009). Timeline follow-back versus global self-reports of tobacco smoking: a comparison of findings with nondaily smokers. *Psychology of Addictive Behaviors, 23*(2), 368-372.
- Harrison, E. L., Desai, R. A., & McKee, S. A. (2008). Nondaily smoking and alcohol use, hazardous drinking, and alcohol diagnoses among young adults: findings from the NESARC. *Alcoholism: Clinical and Experimental Research, 32*(12), 2081-2087.
- Harrison, E. L., Hinson, R. E., & McKee, S. A. (2009). Experimenting and daily smokers: episodic patterns of alcohol and cigarette use. *Addictive Behaviors, 34*(5), 484-486.
- Harrison, E. L., & McKee, S. A. (2008). Young adult non-daily smokers: patterns of alcohol and cigarette use. *Addictive Behaviors, 33*(5), 668-674.
- Hassmiller, K. M., Warner, K. E., Mendez, D., Levy, D. T., & Romano, E. (2003). Nondaily smokers: who are they? *American Journal of Public Health, 93*(8), 1321-1327.
- Hendricks, P. S., & Brandon, T. H. (2005). Smoking expectancy associates among college smokers. *Addictive Behaviors, 30*(2), 235-245.
- Henrikus, D. J., Jeffery, R. W., & Lando, H. A. (1996). Occasional smoking in a Minnesota working population. *American Journal of Public Health, 86*(9), 1260-1266.
- Hines, D., Fretz, A. C., & Nollen, N. L. (1998). Regular and occasional smoking by college students: personality attributions of smokers and nonsmokers. *Psychological Reports, 83*(3 Pt 2), 1299-1306.
- Hingson, R. W., Heeren, T., Zakocs, R. C., Kopstein, A., & Wechsler, H. (2002). Magnitude of alcohol-related mortality and morbidity among U.S. college students ages 18-24. *Journal of Studies on Alcohol and Drugs, 63*(2), 136-144.
- Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods, 6*(1), 53-60.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. [Article]. *Structural Equation Modeling-a Multidisciplinary Journal, 6*(1), 1-55.
- Hurlbut, S. C., & Sher, K. J. (1992). Assessing alcohol problems in college students. *Journal of American College Health, 41*(2), 49-58.

- Husten, C. G. (2009). How should we define light or intermittent smoking? Does it matter? *Nicotine Tob Res*, *11*(2), 111-121.
- Hyland, A., Rezaishiraz, H., Bauer, J., Giovino, G. A., & Cummings, K. M. (2005). Characteristics of low-level smokers. *Nicotine and Tobacco Research*, *7*(3), 461-468.
- Jackson, K. M., Colby, S. M., & Sher, K. J. (2010). Daily patterns of conjoint smoking and drinking in college student smokers. *Psychology of Addictive Behaviors*, *24*(3), 424-435.
- Jackson, K. M., Sher, K. J., Gotham, H. J., & Wood, P. K. (2001). Transitioning into and out of large-effect drinking in young adulthood. *Journal of Abnormal Psychology*, *110*(3), 378-391.
- Jackson, K. M., Sher, K. J., & Schulenberg, J. E. (2005). Conjoint developmental trajectories of young adult alcohol and tobacco use. *Journal of Abnormal Psychology*, *114*(4), 612-626.
- Jensen, M. K., Sorensen, T. I., Andersen, A. T., Thorsen, T., Tolstrup, J. S., Godtfredsen, N. S., & Gronbaek, M. (2003). A prospective study of the association between smoking and later alcohol drinking in the general population. *Addiction*, *98*(3), 355-363.
- Jiang, N., & Ling, P. M. (2011). Reinforcement of smoking and drinking: tobacco marketing strategies linked with alcohol in the United States. *American Journal of Public Health*, *101*(10), 1942-1954.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2006). Monitoring the Future national survey results on drug use, 1975-2005. Volume II, College students and adults ages 19-45. Bethesda, MD: National Institute on Drug Abuse.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2011). *Monitoring the Future national survey results on drug use, 1975-2010: Volume II, College students and adults ages 19-50*. Ann Arbor: Institute for Social Research, The University of Michigan.
- Jones, S. E., Oeltmann, J., Wilson, T. W., Brener, N. D., & Hill, C. V. (2001). Binge drinking among undergraduate college students in the United States: implications for other substance use. *Journal of American College Health*, *50*(1), 33-38.

- Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass*, 2(1), 302-317.
- Kahler, C. W., Strong, D. R., Papandonatos, G. D., Colby, S. M., Clark, M. A., Boergers, J., Niaura, R., Abrams, D. B., & Buka, S. L. (2008). Cigarette smoking and the lifetime alcohol involvement continuum. *Drug and Alcohol Dependence*, 93(1-2), 111-120.
- Kenford, S. L., Wetter, D. W., Welsch, S. K., Smith, S. S., Fiore, M. C., & Baker, T. B. (2005). Progression of college-age cigarette samplers: what influences outcome. *Addictive Behaviors*, 30(2), 285-294.
- King, A. C., & Epstein, A. M. (2005). Alcohol dose-dependent increases in smoking urge in light smokers. [Clinical Trial]. *Alcoholism, clinical and experimental research*, 29(4), 547-552.
- Kirchner, T. R., & Sayette, M. A. (2007). Effects of smoking abstinence and alcohol consumption on smoking-related outcome expectancies in heavy smokers and tobacco chippers. *Nicotine and Tobacco Research*, 9(3), 365-376.
- Klein, E. G., Bernat, D. H., Lenk, K. M., & Forster, J. L. (2013). Nondaily smoking patterns in young adulthood. *Addictive Behaviors*, 38(7), 2267-2272.
- Krukowski, R. A., Solomon, L. J., & Naud, S. (2005). Triggers of heavier and lighter cigarette smoking in college students. *Journal of Behavioral Medicine*, 28(4), 335-345.
- Lanza, S. T., Patrick, M. E., & Maggs, J. L. (2010). Latent transition analysis: Benefits of a latent variable approach to modeling transitions in substance use. *Journal of Drug Issues*, 40(1), 93-120.
- Levinson, A. H., Campo, S., Gascoigne, J., Jolly, O., Zakharyan, A., & Tran, Z. V. (2007). Smoking, but not smokers: identity among college students who smoke cigarettes. *Nicotine and Tobacco Research*, 9(8), 845-852.
- Levy, D. E., Biener, L., & Rigotti, N. A. (2009). The natural history of light smokers: a population-based cohort study. *Nicotine and Tobacco Research*, 11(2), 156-163.
- Lewis-Esquerre, J. M., Rodrigue, J. R., & Kahler, C. W. (2005). Development and validation of an adolescent smoking consequences questionnaire. *Nicotine and Tobacco Research*, 7(1), 81-90.

- Ling, P. M., & Glantz, S. A. (2002). Why and how the tobacco industry sells cigarettes to young adults: evidence from industry documents. *American Journal of Public Health, 92*(6), 908-916.
- Ling, P. M., & Glantz, S. A. (2004). Tobacco industry research on smoking cessation. Recapturing young adults and other recent quitters. *Journal of General Internal Medicine, 19*(5 Pt 1), 419-426.
- Ling, P. M., Neilands, T. B., & Glantz, S. A. (2009). Young adult smoking behavior: a national survey. *American Journal of Preventive Medicine, 36*(5), 389-394 e382.
- Lo, Y. T., Mendell, N., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika, 88*(3), 767-778.
- MacPherson, L., Strong, D. R., & Myers, M. G. (2008). Using an item response model to examine the nicotine dependence construct as characterized by the HONC and the mFTQ among adolescent smokers. *Addictive Behaviors, 33*(7), 880-894.
- Magid, V., Colder, C. R., Stroud, L. R., & Nichter, M. (2009). Negative affect, stress, and smoking in college students: unique associations independent of alcohol and marijuana use. *Addictive Behaviors, 34*(11), 973-975.
- Marlatt, G. A., & Gordon, J. R. (1985). *Relapse Prevention: Maintenance Strategies in the Treatment of Addictive Behaviors*. New York: Guilford Press.
- Martin, R. A., Velicer, W. F., & Fava, J. L. (1996). Latent transition analysis to the stages of change for smoking cessation. *Addictive Behaviors, 21*(1), 67-80.
- Mayhew, K. P., Flay, B. R., & Mott, J. A. (2000). Stages in the development of adolescent smoking. *Drug and Alcohol Dependence, 59 Suppl 1*, S61-81.
- McKee, S. A., Falba, T., O'Malley, S. S., Sindelar, J., & O'Connor, P. G. (2007). Smoking status as a clinical indicator for alcohol misuse in US adults. *Archives of Internal Medicine, 167*(7), 716-721.
- McKee, S. A., Harrison, E. L., & Shi, J. (2010). Alcohol expectancy increases positive responses to cigarettes in young, escalating smokers. *Psychopharmacology (Berlin), 210*(3), 355-364.
- McKee, S. A., Hinson, R., Rounsaville, D., & Petrelli, P. (2004). Survey of subjective effects of smoking while drinking among college students. *Nicotine and Tobacco Research, 6*(1), 111-117.

- McKee, S. A., & Weinberger, A. H. (2013). How can we use our knowledge of alcohol-tobacco interactions to reduce alcohol use? *Annual Review of Clinical Psychology*, 9, 649-674.
- McLachlan, G., & Peel, D. (2000). *Finite Mixture Models*. New York: Wiley.
- Moran, S., Wechsler, H., & Rigotti, N. A. (2004). Social smoking among US college students. *Pediatrics*, 114(4), 1028-1034.
- Morley, K. I., Hall, W. D., Hausdorf, K., & Owen, N. (2006). 'Occasional' and 'social' smokers: potential target groups for smoking cessation campaigns? *Australia and New Zealand Journal of Public Health*, 30(6), 550-554.
- Morrell, H. E., Cohen, L. M., Bacchi, D., & West, J. (2005). Predictors of smoking and smokeless tobacco use in college students: a preliminary study using web-based survey methodology. *Journal of American College Health*, 54(2), 108-115.
- Murphy-Hoefer, R., Alder, S., & Higbee, C. (2004). Perceptions about cigarette smoking and risks among college students. *Nicotine and Tobacco Research*, 6 Suppl 3, S371-374.
- Murphy-Hoefer, R., Griffith, R., Pederson, L. L., Crossett, L., Iyer, S. R., & Hiller, M. D. (2005). A review of interventions to reduce tobacco use in colleges and universities. *American Journal of Preventive Medicine*, 28(2), 188-200.
- Muthén, B. O. (2004). Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In D. Kaplan (Ed.), *Handbook of Quantitative Methodology for the Social Sciences* (pp. 345-368). Thousand Oaks, CA: Sage.
- Muthén, B. O., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, 24(6), 882-891.
- Muthén, B. O., & Muthén, L. K. (2005). *Mplus User's Guide*. Los Angeles, CA: Muthen & Muthen.
- Muthén, L. K., & Muthén, B. O. (1998-2012). *MPlus User's Guide. Seventh Edition*. Los Angeles, CA: Muthen & Muthen.
- Muthén, L. K., & Muthén, B. O. (2007). *Mplus: statistical analysis with latent variables: user's guide*. Los Angeles, CA: Muthén & Muthén.
- Myers, M. G., Doran, N. M., Edland, S. D., Schweizer, C. A., & Wall, T. L. (2013). Cigarette smoking initiation during college predicts future alcohol involvement: a

- matched-samples study. [Research Support, Non-U.S. Gov't]. *Journal of Studies on Alcohol and Drugs*, 74(6), 909-916.
- Myers, M. G., Doran, N. M., Trinidad, D. R., Wall, T. L., & Klonoff, E. A. (2009). A prospective study of cigarette smoking initiation during college: Chinese and Korean American students. *Health Psychology*, 28(4), 448-456.
- Myers, M. G., & MacPherson, L. (2008). Adolescent reasons for quitting smoking: initial psychometric evaluation. *Psychology of Addictive Behaviors*, 22(1), 129-134.
- Myers, M. G., McCarthy, D. M., MacPherson, L., & Brown, S. A. (2003). Constructing a short form of the Smoking Consequences Questionnaire with adolescents and young adults. *Psychological Assessment*, 15(2), 163-172.
- Myers, M. G., Stein, M. B., & Aarons, G. A. (2002). Cross validation of the Social Anxiety Scale for Adolescents in a high school sample. *Journal of Anxiety Disorders*, 16(2), 221-232.
- Myers, M. G., & Wagner, E. F. (1995). The temptation-coping questionnaire: development and validation. *Journal of Substance Abuse*, 7(4), 463-479.
- Nagin, D. S. (1999). Analyzing developmental trajectories: A semi-parametric group-based approach. *Psychological Methods*, 4, 139-157.
- Naimi, T. S., Brewer, R. D., Mokdad, A., Denny, C., Serdula, M. K., & Marks, J. S. (2003). Binge drinking among US adults. *Jama*, 289(1), 70-75.
- Nelson, T. F., & Wechsler, H. (2003). School spirits: alcohol and collegiate sports fans. *Addictive Behaviors*, 28(1), 1-11.
- Nguyen, Q. B., & Zhu, S. H. (2009). Intermittent smokers who used to smoke daily: a preliminary study on smoking situations. [Research Support, N.I.H., Extramural]. *Nicotine Tob Res*, 11(2), 164-170.
- Nichter, M., Carkoglu, A., & Lloyd-Richardson, E. (2010). Smoking and drinking among college students: "it's a package deal". *Drug and Alcohol Dependence*, 106(1), 16-20.
- Nichter, M., Nichter, M., Lloyd-Richardson, E. E., Flaherty, B., Carkoglu, A., & Taylor, N. (2006). Gendered dimensions of smoking among college students. *Journal of Adolescent Research*, 21(3), 215-243.
- Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo

simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, 14, 535-569.

Okuyemi, K. S., Harris, K. J., Scheibmeir, M., Choi, W. S., Powell, J., & Ahluwalia, J. S. (2002). Light smokers: issues and recommendations. *Nicotine and Tobacco Research*, 4 Suppl 2, S103-112.

Orlando, M., Tucker, J. S., Ellickson, P. L., & Klein, D. J. (2004). Developmental trajectories of cigarette smoking and their correlates from early adolescence to young adulthood. *Journal of Consulting and Clinical Psychology*, 72(3), 400-410.

Orlando, M., Tucker, J. S., Ellickson, P. L., & Klein, D. J. (2005). Concurrent use of alcohol and cigarettes from adolescence to young adulthood: an examination of developmental trajectories and outcomes. *Substance Use and Misuse*, 40(8), 1051-1069.

Orleans, C. T. (2007). Helping young adult smokers quit: The time is now. *American Journal of Public Health*, 97, 1353.

Piasecki, T. M., Jahng, S., Wood, P. K., Robertson, B. M., Epler, A. J., Cronk, N. J., Rohrbaugh, J. W., Heath, A. C., Shiffman, S., & Sher, K. J. (2011). The subjective effects of alcohol-tobacco co-use: an ecological momentary assessment investigation. *Journal of Abnormal Psychology*, 120(3), 557-571.

Pinsker, E. A., Berg, C. J., Nehl, E. J., Prokhorov, A. V., Buchanan, T. S., & Ahluwalia, J. S. (2013). Intent to quit among daily and non-daily college student smokers. *Health Education Research*, 28(2), 313-325.

Prokhorov, A. V., Warneke, C., de Moor, C., Emmons, K. M., Mullin Jones, M., Rosenblum, C., Hudmon, K. S., & Gritz, E. R. (2003). Self-reported health status, health vulnerability, and smoking behavior in college students: implications for intervention. *Nicotine and Tobacco Research*, 5(4), 545-552.

Prokhorov, A. V., Yost, T., Mullin-Jones, M., de Moor, C., Ford, K. H., Marani, S., Kilfoyl, B. A., Hein, J. P., Hudmon, K. S., & Emmons, K. M. (2008). "Look at your health": outcomes associated with a computer-assisted smoking cessation counseling intervention for community college students. *Addictive Behaviors*, 33(6), 757-771.

Rash, C. J., & Copeland, A. L. (2008). The Brief Smoking Consequences Questionnaire-Adult (BSCQ-A): Development of a short form of the SCQ-A. *Nicotine and Tobacco Research*, 10(11), 1633-1643.

Reed, M. B., McCabe, C., Lange, J. E., Clapp, J. D., & Shillington, A. M. (2010). The Relationship between alcohol consumption and past-year smoking initiation in a

- sample of undergraduates. *The American Journal of Drug and Alcohol Abuse*, 36, 202-207.
- Reed, M. B., Wang, R., Shillington, A. M., Clapp, J. D., & Lange, J. E. (2007). The relationship between alcohol use and cigarette smoking in a sample of undergraduate college students. *Addictive Behaviors*, 32(3), 449-464.
- Reig-Ferrer, A., & Cepeda-Benito, A. (2007). Smoking expectancies in smokers and never smokers: an examination of the smoking Consequences Questionnaire-Spanish. *Addictive Behaviors*, 32(7), 1405-1415.
- Rigotti, N. A., Lee, J. E., & Wechsler, H. (2000). US college students' use of tobacco products: results of a national survey. *Journal of the American Medical Association*, 284(6), 699-705.
- Rigotti, N. A., Moran, S. E., & Wechsler, H. (2005). US college students' exposure to tobacco promotions: prevalence and association with tobacco use. *American Journal of Public Health*, 95(1), 138-144.
- Rohsenow, D. J., Abrams, D. B., Monti, P. M., Colby, S. M., Martin, R., & Niaura, R. S. (2003). The Smoking Effects Questionnaire for adult populations. Development and psychometric properties. *Addictive Behaviors*, 28(7), 1257-1270.
- Rose, J. E., Brauer, L. H., Behm, F. M., Cramblett, M., Calkins, K., & Lawhon, D. (2002). Potentiation of nicotine reward by alcohol. *Alcoholism: Clinical and Experimental Research*, 26(12), 1930-1931.
- Rose, J. S., Chassin, L., Presson, C., Sherman, S. J., Stein, M. D., & Col, N. (2007). A latent class typology of young women smokers. *Addiction*, 102(8), 1310-1319.
- Rose, J. S., Chassin, L., Presson, C. C., & Sherman, S. J. (1996). Prospective predictors of quit attempts and smoking cessation in young adults. *Health Psychology*, 15(4), 261-268.
- Sargent, J. D., & Dalton, M. (2001). Does parental disapproval of smoking prevent adolescents from becoming established smokers? *Pediatrics*, 108(6), 1256-1262.
- Saules, K. K., Pomerleau, C. S., Snedecor, S. M., Mehringer, A. M., Shadle, M. B., Kurth, C., & Krahn, D. D. (2004). Relationship of onset of cigarette smoking during college to alcohol use, dieting concerns, and depressed mood: results from the Young Women's Health Survey. *Addictive Behaviors*, 29(5), 893-899.
- Schane, R. E., Prochaska, J. J., & Glantz, S. A. (2013). Counseling nondaily smokers about secondhand smoke as a cessation message: a pilot randomized trial. *Nicotine and Tobacco Research*, 15(2), 334-342.

- Schleicher, H. E., Harris, K. J., Catley, D., Harrar, S. W., & Golbeck, A. L. (2008). Examination of a brief Smoking Consequences Questionnaire for college students. *Nicotine and Tobacco Research, 10*(9), 1503-1509.
- Schorling, J. B., Gutgesell, M., Klas, P., Smith, D., & Keller, A. (1994). Tobacco, alcohol and other drug use among college students. *Journal of Substance Abuse, 6*(1), 105-115.
- Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics, 6*, 461-464.
- Schweizer, C. A., Doran, N., & Myers, M. G. (2014). Social facilitation expectancies for smoking: psychometric properties of a new measure. *Journal of American College Health, 62*(2), 136-144.
- Schweizer, C. A., Doran, N., Roesch, S. C., & Myers, M. G. (2011). Progression to problem drinking among Mexican American and White European first-year college students: a multiple group analysis. *Journal of Studies on Alcohol and Drugs, 72*(6), 975-980.
- Schweizer, C. A., Roesch, S. C., Khoddam, R., Doran, N., & Myers, M. G. (in press). Examining the stability of young-adult alcohol and tobacco co-use: a latent transition analysis. *Addiction Research and Theory*.
- Schweizer, C. A., Roesch, S. C., & Myers, M. G. (2010). A Latent profile analysis of young adult alcohol and cigarette users. [Abstract]. *Alcoholism: Clinical and Experimental Research, 34*(6, Supplement 2), 183A.
- Sher, K. J., Gotham, H. J., Erickson, D. J., & Wood, P. K. (1996). A prospective, high-risk study of the relationship between tobacco dependence and alcohol use disorders. *Alcoholism: Clinical and Experimental Research, 20*(3), 485-492.
- Sher, K. J., Wood, M. D., Wood, P. K., & Raskin, G. (1996). Alcohol outcome expectancies and alcohol use: a latent variable cross-lagged panel study. *Journal of Abnormal Psychology, 105*(4), 561-574.
- Shiffman, S. (2009). Light and intermittent smokers: background and perspective. *Nicotine and Tobacco Research, 11*(2), 122-125.
- Shiffman, S., & Balabanis, M. (1995). Associations between alcohol and tobacco. In J. B. Fertig & J. P. Allen (Eds.), *National Institute of Alcohol Abuse and Alcoholism Research Monograph No. 30: Alcohol and tobacco: From basic science to clinical practice*. (Vol. NIH publication 95-3931, pp. 17-36). Bethesda, MD: National Institutes of Health.

- Sledjeski, E. M., Dierker, L. C., Costello, D., Shiffman, S., Donny, E., & Flay, B. R. (2007). Predictive validity of four nicotine dependence measures in a college sample. *Drug and Alcohol Dependence*, *87*(1), 10-19.
- Sobell, L. C., Brown, J., Leo, G. I., & Sobell, M. B. (1996). The reliability of the Alcohol Timeline Followback when administered by telephone and by computer. *Drug and Alcohol Dependence*, *42*(1), 49-54.
- Sobell, L. C., & Sobell, M. B. (1992). Time-line follow-back: A technique for assessing self-reported alcohol consumption. In R. Z. Litten & J. P. Allen (Eds.), *Measuring Alcohol Consumption: Psychosocial and Biochemical Methods* (pp. 73-98). Totowa, NJ: Pergamon Press.
- Sobell, M. B., Sobell, L. C., Klajner, F., Pavan, D., & Basian, E. (1986). The reliability of a timeline method of assessing normal drinker college students' recent drinking history: Utility for alcohol research. *Addictive Behaviors*, *11*, 149-161.
- Song, A. V., & Ling, P. M. (2011). Social smoking among young adults: investigation of intentions and attempts to quit. *American Journal of Public Health*, *101*(7), 1291-1296.
- Sutfin, E. L., McCoy, T. P., Berg, C. J., Champion, H., Helme, D. W., O'Brien, M. C., & Wolfson, M. (2012). Tobacco use by college students: a comparison of daily and nondaily smokers. *American Journal of Health Behavior*, *36*(2), 218-229.
- Sutfin, E. L., McNamara, R. S., Blocker, J. N., Ip, E. H., O'Brien, M. C., & Wolfson, M. (2012). Screening and brief intervention for tobacco use by student health providers on college campuses. *Journal of American College Health*, *60*(1), 66-73.
- Sutfin, E. L., Reboussin, B. A., McCoy, T. P., & Wolfson, M. (2009). Are college student smokers really a homogeneous group? a latent class analysis of college student smokers. *Nicotine and Tobacco Research*, *11*(4), 444-454.
- Tercyak, K. P., Rodriguez, D., & Audrain-McGovern, J. (2007). High school seniors' smoking initiation and progression 1 year after graduation. *American Journal of Public Health*, *97*(8), 1397-1398.
- Thomas, J. L., Bronars, C. A., Stewart, D. W., Okuyemi, K. S., Befort, C. A., Nazir, N., Mayo, M. S., Jeffries, S. K., & Ahluwalia, J. S. (2009). Psychometric properties of a Brief Smoking Consequences Questionnaire for Adults (SCQ-A) among African American light smokers. *Substance Abuse*, *30*(1), 14-25.
- Tofghi, D., & Enders, C. K. (2007). *Identifying the correct number of classes in growth mixture models*. . Greenwich, CT: Information Age.

- Trinidad, D. R., Gilpin, E. A., Lee, L., & Pierce, J. P. (2004). Do the majority of Asian-American and African-American smokers start as adults? *American Journal of Preventive Medicine*, 26(2), 156-158.
- Tucker, J. S., Orlando, M., & Ellickson, P. L. (2003). Patterns and correlates of binge drinking trajectories from early adolescence to young adulthood. *Health Psychology*, 22(1), 79-87.
- Ullman, J. B. (2006). Structural equation modeling: reviewing the basics and moving forward. *Journal of Personality Assessment*, 87(1), 35-50.
- USDHHS. (2006). *The health consequences of involuntary exposure to tobacco smoke: A report of the surgeon general*. Atlanta, GA.
- Velicer, W. F., Martin, R. A., & Collins, L. M. (1996). Latent transition analysis for longitudinal data. *Addiction*, 91 Suppl, S197-209.
- Vidrine, J. I., Vidrine, D. J., Costello, T. J., Mazas, C., Cofta-Woerpel, L., Mejia, L. M., & Wetter, D. W. (2009). The Smoking Consequences Questionnaire: Factor structure and predictive validity among Spanish-speaking Latino smokers in the United States. *Nicotine and Tobacco Research*, 11(11), 1280-1288. doi: 10.1093/ntr/ntp128
- Villanti, A. C., McKay, H. S., Abrams, D. B., Holtgrave, D. R., & Bowie, J. V. (2010). Smoking-cessation interventions for U.S. young adults: a systematic review. *American Journal of Preventive Medicine*, 39(6), 564-574.
- Waters, K., Harris, K., Hall, S., Nazir, N., & Waigandt, A. (2006). Characteristics of social smoking among college students. *Journal of American College Health*, 55(3), 133-139.
- Wechsler, H., Dowdall, G. W., Davenport, A., & Rimm, E. B. (1995). A gender-specific measure of binge drinking among college students. *American Journal of Public Health*, 85(7), 982-985.
- Wechsler, H., Rigotti, N. A., Gledhill-Hoyt, J., & Lee, H. (1998). Increased levels of cigarette use among college students: a cause for national concern. *Journal of the American Medical Association*, 280(19), 1673-1678.
- Wechsler, H., Seibring, M., Liu, I. C., & Ahl, M. (2004). Colleges respond to student binge drinking: reducing student demand or limiting access. *Journal of American College Health*, 52(4), 159-168.

- Weitzman, E. R., & Chen, Y. Y. (2005). The co-occurrence of smoking and drinking among young adults in college: National survey results from the United States. *Drug and Alcohol Dependence, 80*, 377-386.
- Wetter, D. W., Kenford, S. L., Welsch, S. K., Smith, S. S., Fouladi, R. T., Fiore, M. C., & Baker, T. B. (2004). Prevalence and predictors of transitions in smoking behavior among college students. *Health Psychology, 23*(2), 168-177.
- White, H. R., Bray, B. C., Fleming, C. B., & Catalano, R. F. (2009). Transitions into and out of light and intermittent smoking during emerging adulthood. *Nicotine and Tobacco Research, 11*(2), 211-219.
- White, H. R., Pandina, R. J., & Chen, P. H. (2002). Developmental trajectories of cigarette use from early adolescence into young adulthood. *Drug and Alcohol Dependence, 65*(2), 167-178.
- Witkiewitz, K., Desai, S. A., Steckler, G., Jackson, K. M., Bowen, S., Leigh, B. C., & Larimer, M. E. (2012). Concurrent drinking and smoking among college students: An event-level analysis. *Psychology of Addictive Behaviors, 26*(3), 649-654.
- Witkiewitz, K., & Marlatt, G. A. (2004). Relapse prevention for alcohol and drug problems: that was Zen, this is Tao. *The American Psychologist, 59*(4), 224-235. doi: 10.1037/0003-066X.59.4.224
- Wortley, P. M., Husten, C. G., Trosclair, A., Chrismon, J., & Pederson, L. L. (2003). Nondaily smokers: a descriptive analysis. *Nicotine and Tobacco Research, 5*(5), 755-759.
- Yanovitzky, I., Stewart, L. P., & Lederman, L. C. (2006). Social distance, perceived drinking by peers, and alcohol use by college students. *Health Communication, 19*(1), 1-10.
- Zacny, J. P. (1990). Behavioral aspects of alcohol-tobacco interactions. *Recent Developments in Alcoholism 8*, 205-219.
- Zhu, S. H., Sun, J., Hawkins, S., Pierce, J., & Cummins, S. (2003). A population study of low-rate smokers: quitting history and instability over time. *Health Psychology, 22*(3), 245-252.