

THE CO-INGESTION OF NONMEDICAL PRESCRIPTION DRUGS AND ALCOHOL: A PARTIAL TEST OF SOCIAL LEARNING THEORY

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Over the last decade, scholars have examined simultaneous polydrug use among illicit drug users; however, the co-ingestion of nonmedical prescription drug (NMPD) use and alcohol has been largely overlooked. Also overlooked have been the incorporation and testing of theoretical explanations for this type of substance use behavior. In the current paper, we test social learning theory as an explanation for NMPD use and the co-ingestion of nonmedical prescription drugs and alcohol on a Midwest university sample using a bivariate probit equation model. Support is found for the influence of differential association, social reinforcement, and definitions of use on the co-ingestion of NMPDs and alcohol.

INTRODUCTION

Nonmedical prescription drug (NMPD) use in the U. S. has increased among the general population, especially among college students (Blanco et al., 2007; Cicero, Inciardi, & Munoz, 2005; McCabe, West, & Wechsler, 2007b, McCabe et al., 2008b; Substance Abuse and Mental Health Services Administration [SAMHSA], 2007). Recent studies indicate that young adults age 18–25 have the highest rates of NMPD use of any age group, followed by adolescents 12–17 years old (Kroutil et al., 2006; Manchikanti, 2007; Riggs, 2008; SAMHSA, 2007). National survey data reveal that

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college students may be more likely than their non-college peers to misuse both alcohol (Dawson, Grant, Stinson, & Chou, 2004) and prescription drugs, specifically prescription stimulants (Herman-Stahl, Krebs, Kroutil, & Heller, 2007; Johnston, O'Malley, Bachman, & Schulenburg, 2005). While we have a good understanding of the prevalence of NMPD use, we know less about simultaneous polydrug use, which involves nonmedical prescription drugs. Most of the research has focused on concurrent polydrug use (i.e., different drugs consumed on different occasions) rather than simultaneous polydrug use (i.e., multiple drugs consumed on a single occasion (i.e., mixing, co-ingestion). Due to the paucity of research on simultaneous drug use involving NMPD use, there has been a call for additional research in this area (Earleywine & Newcomb, 1997; McCabe, Cranford, & Boyd, 2006a, McCabe, Cranford, Morales, & Young, 2006b; Midanik, Tam, & Weisner, 2007). In response, several recent publications have appeared. However these published studies leave questions unanswered or under-researched in regard to simultaneous polydrug use.

Furthermore, published studies tend to be largely atheoretical. In particular, studies have ignored a particularly robust theory, social learning theory (Sutherland, 1939), which has stood up to empirical scrutiny in alcohol and NMPD use studies separately (Durkin, Wolfe, & Clark, 2005; Ford, 2008; Peralta & Steele, 2009a). In the present paper, we conduct a partial test of social learning theory in order to examine if sociological factors influence simultaneous polydrug use behavior (i.e., NMPD and alcohol) (Ford, 2008; Ford & Arrastia, 2008). Below, we review the epidemiological and theoretical literatures pertinent to the issue of NMPD use.

SIMULTANEOUS POLYDRUG USE: MULTIPLE DRUG USE, SAME EPISODE (MIXING, CO-INGESTION)

The focus on concurrent polydrug use can be unintentionally misleading given that concurrent and simultaneous polydrug use comprise two separate and distinct constructs (Earleywine & Newcomb, 1997). For example, using confirmatory factor analysis, Earleywine & Newcomb (1997) found that although concurrent and simultaneous polydrug use is strongly correlated, model fit was better when each construct reflected its own factor. Likewise, using a nationally representative sample, Midanik and colleagues (2007) found different correlates of concurrent and simultaneous polydrug use. Simultaneous use of alcohol and one other drug (except for marijuana) was more common among males, younger age groups, and persons of low income or socioeconomic status while sex was unrelated to concurrent polydrug use and more common among older and higher income respondents.

Moreover, the frequency and severity of outcomes differ across the two behaviors. Studies reveal that although concurrent polydrug use is a more common practice, simultaneous use is correlated with more alcohol and drug-related problems, which include blacking out, vomiting, missing class or work, and doing poorly on an exam in comparison to those not engaging in simultaneous polydrug use (McCabe

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et al., 2006b). Relatedly, McCabe, Boyd, & Teter (2009) found that individuals who simultaneously co-ingest illicit medications with alcohol were more likely to report drug-related problems and alcohol abuse and dependence compared to nonmedical prescription pain users who did not ingest multiple substances. The most notable findings included that the most common simultaneous polydrug use involved alcohol and that students were more likely to be male, White, and to have early-age initiation of alcohol use (McCabe et al., 2006b; 2009). Therefore, polydrug use research needs to differentiate between different forms of use (Earleywine & Newcomb, 1997; Grant & Hartford, 1990a; Hakkarainen & Metso, 2009; Midanik et al., 2007). To our knowledge, only two published studies of simultaneous polydrug use among college students exist that specifically focus on those students who use nonmedical prescription drugs.

In summary, there are important varying demographic profiles and findings for simultaneous versus concurrent polydrug users and the greater potential for serious consequences in simultaneous use. It is problematic that research on polydrug use ignores: (1) the nature of simultaneous polydrug use among college students who are an at-risk population and (2) theoretical explanations for co-ingestion. Our study addresses both of these gaps directly.

SOCIAL LEARNING THEORY (SLT)

One of the foremost theories on substance use is social learning theory (Akers, 1998). Social learning theory rests on four core elements: differential association, definitions, differential reinforcement, and imitation. The foundation for this criminological theory arose out of Edwin Sutherland's (1939; 1947) piece on differential association theory which specified that deviant behaviors are learned through interactions with others in intimate groups. According to Sutherland (1939), those individuals with a relatively high level of interaction with deviant others are more likely to engage in deviance, compared to those with relatively fewer interactions with deviant individuals. More specifically, an individual's probability of deviance directly reflects the intensity, frequency, duration, and priority of associations with deviant others (Sutherland, 1947). Although Sutherland's proposition was groundbreaking in its original premise that deviance is a learned behavior developed from interaction, it failed to explain the details involved in the learning process. Burgess and Akers (1966), building on Sutherland's differential association theory, addressed this limitation by describing learning as a function of differential reinforcement (i.e., both social and nonsocial reward processes). In Burgess and Akers' refinement of the theory, they also described how group and individual definitions influenced individual behavior. These "definitions," or attitudes about general deviance, morality, and specific acts of criminality have been shown to influence the commission of deviant behavior.

THE CONVERGENCE OF ALCOHOL USE AND NMPD USE: DIFFERENTIAL ASSOCIATION

Social learning theory, and more specifically differential association, has been empirically supported across populations and different forms of illicit drug use in comparison to other sociological theories such as social control theory (Haynie, 2002; Jaquith, 1981; Johnson, Marcos, & Bahr, 1987; Wood, Gove, Wilson, & Cochran, 1997). In fact, social learning theory explains drug desistance and avoidance as well as use (Winfree, Sellers, & Clason, 1993). While only a limited number of studies examine the co-ingestion of NMPDs with alcohol, we can draw on social learning theory and the specific concept of differential association to examine simultaneous NMPD use among college students given its strong support in studies of heavy episodic alcohol use (Durkin et al., 2005; LaBrie et al., 2007).

Though social learning theory has enjoyed particularly strong support in explaining NMPD and alcohol use, it has not been used in examining the simultaneous use of these drugs (Ford, 2008). For example, past research shows that one's proportion of delinquent friends, or differential association, is a critical aspect of social learning theory (Haynie, 2002). Having friends who engage in NMPD use predicts self-reported NMPD use among college students (Peralta & Steele, 2009a) and adolescents (Ford, 2008; Triplett & Payne, 2004). Studies on college substance use and differential association often include Greek-affiliation as a predictor of use (Durkin et al., 2005; Lo & Globetti, 1995). This is because Greek organizations are important primary groups that act as critical socialization agents to encourage substance use, such as alcohol and NMPD use (Cashin, Presley, & Meilman, 1998; McCabe, Teter, & Boyd, 2005a; McCabe, Knight, Teter, & Wechsler, 2005b; Sher et al., 2001; Wechsler, Dowdall, Davenport, & Castillo, 1995). Despite the accumulation of support, no study to date has employed social learning theory as an explanation for simultaneous NMPD and alcohol use among college students.

DIFFERENTIAL DEFINITIONS IN SOCIAL LEARNING THEORY AND CONNECTIONS TO SOCIALIZATION

Past learning, involving family and adolescent peer influence, may also play a role in predisposing college students to substance use, including simultaneous NMPD use. For example, family networks are important precursors to later peer network formation. Families differ in the attitudes and expectations they hold for young members as well as in the types of social support and financial aid they can offer. Parents tend to socialize their children to achieve at least comparable status, although parents with more financial resources tend to have higher achievement expectations for their child(ren) (Caspi, Bradley, Wright, Moffitt, & Silva, 1998). Social learning theory suggests that this socialization is linked to learning via the formation of definitions or acquired attitudes. As social groups, families and peer groups hold a range of definitions and normative expectations about social behavior which then gets transmitted to children and adolescents with lasting effects. Children,

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whose socialization experiences include inconsistent or weakly communicated attitudes on expected behavior (or more deviant definitions of behavior) have a higher probability of developing definitions favorable to crime and deviance. In general, a youth's position within the overall social structure will influence the probability that he or she will or will not develop views or definitions favorable to drug use (Matsueda, 1988) and subsequently act on such views.

Indeed, college students and adolescents whose parents approve of alcohol use are slightly more likely to engage in alcohol use (Borsari & Carey, 2001; Ford, 2008; Wechsler et al., 1995; Weitzman, Nelsen, & Wechler, 2003) and NMPD use (Blanco et al., 2007; Collins, Ellickson, & Bell, 1998). Earlier adolescent peer socialization (prior to college) also plays a role in later college substance use (Wood, Read, Mitchell, & Brand, 2004). Interestingly, in both alcohol and NMPD studies, adolescents who attended private high school appear to be more likely to engage in heavy episodic drinking (Valois, Thatcher, Drane, Reininger, 1997) and nonmedical stimulant use while in college (White, Becker-Blease, & Grace-Bishop, 2006). This is perhaps due to a greater availability of financial resources and relatively lower levels of police surveillance for students attending private institutions. From a peer socialization standpoint, students may perceive substance use as an acceptable way of having fun or coping with problems due to peer reinforcement. However, less understood is whether parental socialization and past reinforcements fades or is replaced by peer influence (or whether both sources continue to exert comparable effects).

Perceptions about alcohol use on campus also may establish positive or negative definitions about substance/alcohol use, hence socializing college students about the acceptability of heavy episodic drinking. Studies suggest that students who perceive excessive alcohol use to be a normative occurrence or believe that a majority of students participate in heavy and frequent drinking are more likely to drink heavily (Borsari & Carey, 2001; Lo, 1995; Perkins & Wechsler, 1996). Given the literature, the present paper accounts for whether college student beliefs about NMPD use on campus influence NMPD use.

GLOBAL RISK BEHAVIORS AND DIFFERENTIAL REINFORCEMENT

It is important for policy and prevention purposes to understand the association of co-ingestion with other risk behaviors, such as driving under the influence of drugs. In college student samples, NMPD users and heavy episodic drinkers (separately measured) are more likely to report a range of other risky behaviors such as driving under the influence of illicit drugs, cigarette smoking, risky sexual behavior and riding in a car with a drunk driver (McCabe et. al., 2005a, 2005b; Wechsler et al., 1995). Although an increase in all types of risk behavior is associated with NMPD use, many college students believe that NMPD use (McCabe, 2008a) and heavy

episodic alcohol use (Norman, Bennett, & Lewis, 1998) are actually “less risky” and more “common” on campus, thus overestimating the level of consumption among the general student body.

It is of interest that it is not so much the ignorance or denial of negative aspects of risk, but positive attitudes toward drug use that can be associated with increased use among college students. Recent research has found that frequent heavy episodic drinkers and NMPD users tend to have more positive attitudes about their drug use than their non-using peers (Arria et al., 2008; Ford & Arrastia, 2008; Norman et al., 1998). There are pro-social motivations for NMPD use including: facilitating “partying” (e.g., used to party longer), promoting weight loss, enhancing the ability to drink greater quantities of alcohol, increasing energy, increasing alertness, and enhancing the ability to focus on academics (Arria et al., 2008; Hall et al., 2005; Low & Gendaszek, 2002; White et al., 2006).

Research indicates that a wide range of risk behaviors and risk perceptions (e.g., global attitudes about use) can predict substance use. For example, Fabricius, Nagoshi, & Mackimom, (1993) found that college students who engaged in alcohol use perceived other drugs to be significantly less harmful than did nonusers of alcohol, even when the respondent had not ever tried the particular substance in question. Likewise, Copeland, Kulesza, Patterson, & Terlecki (2009) found that college students who smoked cigarettes regularly saw other risky behaviors (risky sexual behavior, involvement in high-risk sports, illegal drug use) as more beneficial and less risky than nonsmoking respondents. This pattern may reflect that risk behaviors can alter beliefs. Both attitudes about substance use and the use of substances might reflect changing views due to new emerging definitions regarding risk. Given previous research, we examine both perceived harm or risk and positive motivation as variables of interest in our study on simultaneous drug use.

THE PRESENT STUDY

Because of the direct and indirect social and health implications of simultaneous polydrug use, a theoretically grounded empirical analysis is needed to understand the extent to which different aspects of social learning theory can explain co-ingestion among college students. Indeed, broader survey research on NMPD use and especially heavy episodic drinking among college students, suggest that all of these factors may play an important role in encouraging or discouraging substance use. To date, however, no studies have examined all of these factors among college students who engage in polydrug use behavior (i.e., simultaneous NMPD use and alcohol use). Furthermore, most studies treat alcohol use and NMPD use as independent processes in the statistical sense; we address this problem methodologically by using a bivariate probit model. Because alcohol use has been found to be most closely and consistently associated with polydrug use (i.e., heroin, cocaine) and has

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been associated with NMPD use in studies for over a decade, we limit the scope of our analysis to simultaneous use of nonmedical prescription drugs and alcohol use (Earleywine & Newcomb, 1997; Grant & Hartford, 1990b; Martin, Clifford, & Clapper, 1992).

METHODS

THE SAMPLE

This study utilizes a cross-sectional self-administered survey conducted with 465 participants from a Midwestern university after Institutional Review Board approval was obtained. Potential respondents were informed that the study was about nonmedical prescription drug use. NMPD use was defined as “The use of prescription drugs for non-prescription purposes, specifically recreational use (which includes drug use to aid in studying, test taking, and getting high or a buzz).” The primary author attended the beginning of randomly selected classes and invited students over the age of eighteen to participate. Participants were instructed not to identify themselves on the survey. To further assure confidentiality, a cover page was added to provide privacy. Students did not receive any monetary compensation or course credit for their volunteer-based participation. Table one provides descriptive statistics of the sample.¹

DEPENDENT VARIABLES

Nonmedical Prescription Drug Use in the Last Year (NMPD use) was assessed by asking respondents to choose from a list of the 30 most common names of opiates, stimulants, and depressants as indicated by the National Institute of Drug Abuse (NIDA, 2006). An open ended slot was also allotted for students to insert names of unlisted drugs. Individuals completing the questionnaire were reminded in the survey and verbally that questions only pertained to their recreational use of prescription drugs for which they did not have a prescription. Respondents were then asked to indicate the number of occasions in the last year they engaged in NMPD use. This scale was quite similar to previous research on NMPD use and included the following options: (1) never (2) 1–2 occasions (3) 3–5 occasions (4) 6–9 occasions (5) 10–19 occasions (6) 20–30 occasions (7) more than 30 occasions (Boyd, McCabe, & Teter, 2006; McCabe et al., 2005a; McCabe, Teter, & Boyd, 2006c; Teter, McCabe, Boyd, & Gouthrie, 2003; Teter, McCabe, Cranford, Boyd, & Guthrie, 2005). These responses were collapsed into a dichotomous variable (any use=1) for analysis due to the skewed distribution.

Simultaneous Co-ingestion of Prescription Drugs and Alcohol was measured by asking respondents “How many times in the last 30 days have you mixed prescription drugs with alcohol for recreational purposes?” Response choices were 0, 1–2, 3–5,

6–9, and 10–19 (or more). These responses were also collapsed into a dichotomous variable (co-ingestion=1) for analysis due to the skewed distribution.

INDEPENDENT VARIABLES

DIFFERENTIAL ASSOCIATION

The following four questions asked of all respondents regarding college social networks were used to gauge differential association: *having friends that mix NMPD and alcohol*; being in an *intimate relationship with a NMPD user*; the likelihood of *using friends to obtain prescription drugs*; and *Greek membership*. We created a dummy variable for having friends who co-ingest. This variable was obtained from the question “How many of your close friends mix prescription drugs with alcohol for the purposes of obtaining a better buzz or high?” This was coded 1 if one-fourth or more close friends reported mixing. The “one-fourth of friends” cut-off was based on comparability with prior research on social learning and binge drinking among college students which used the same parameters (Durkin et al., 2005). A second dummy variable, obtained from the question “If you chose to access prescription drugs without a prescription from a doctor, the easiest way to obtain your drug of choice would be,” had a value of 1 if the simplest way for the respondent to obtain NMPD drugs was through a friend: 75% of participants chose this category. Alternative answers were “family members, drug dealer, a member of an organization you belong to (Greek life, intramural sports, etc.), the internet, or other sources such as coworkers” (for this question, more than one category could be chosen). Responses to the final two questions, “While in college have you ever been involved in an intimate relationship with someone who has taken prescription drugs without a prescription?” and “Do you belong to a fraternity or sorority?” were each dichotomized (Yes=1).

ESTABLISHED DEFINITIONS OF BEHAVIOR

Socialization prior to college, via parents and peers, likely shaped college students’ decisions to use NMPD at some point over the previous year. Parental socialization toward drug use is operationalized as respondents’ perception of parental response to NMPD use, more generally. Respondents were asked “Hypothetically, how would your family react if they found out you were using or had used prescription drugs for recreational purposes?” with five categories of responses ranging from “very negatively” to “very positively.” This was recoded as a dummy variable (Yes=1) (i.e., “Family upset about NMPD drug use”) if respondents answered “very negatively.” Research suggests that past peer socialization may differ on the basis of whether respondents attended a *private versus public high school*.² We therefore account for public versus private differences. Also important is respondents’ perceptions of peer NMPD usage on their college campus which was obtained via the question, “In

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your opinion, is the use of prescription drugs, for recreational or academic purposes, popular on campus?" A dummy variable for the question (Yes=1) indicates low perceived campus use.

DIFFERENTIAL REINFORCEMENT AND RISK BEHAVIOR

As noted earlier, it is theoretically possible that attitudes and perceptions about risk behaviors associated with the likelihood of NMPD substance use may, in turn, increase the likelihood of co-ingestion. We therefore explore long-term individual patterns of global risk behaviors and a range of positive/negative social reinforcement in a series of measures. We first differentiate those with an early life course timing of NMPD use behavior, as *first NMPD use age 16 or earlier* (dichotomy, yes=1). Age of onset at age 16 or earlier was included in the risk perceptions and behaviors because those who engage in NMPD use at an earlier age likely have a higher propensity to engage in more riskier activities (e.g., simultaneous use) in comparison to other young adults the same age.

Our first risk behavior is heavy episodic drinking which is operationalized by the standard most researchers use, which is five or more drinks in a single occasion over the last two weeks before receiving the survey (Wechsler & Nelson, 2001). A single drink was defined as "one twelve-ounce beer or wine cooler, one mixed drink/wine glass 6-8oz, or one shot of liquor 1.3oz" (Wechsler & Nelson, 2001; Wechsler & Wuethrich, 2002). Respondents' choices for drinking occasions were 0, 1-2, 3-5, 6-9, 10-19, and 20-30. Heavy episodic drinking was recoded according to 3 commonly used classifications: frequent heavy drinkers, occasional heavy drinkers, and non-heavy drinkers and abstainers (see Wechsler & Nelson, 2001).

Next, a global risk behavior scale was developed out of the following four questions: (1) "While in college have you ever driven under the influence of an illegal substance? (e.g., Marijuana, coke, ecstasy)"; (2) "Have you ever used marijuana?"; (3) "Have you ever used any other illegal drugs other than marijuana or prescription drugs?" Responses to all of these questions were either no (0) or yes (1). The fourth indicator was (4) "How often do you smoke cigarettes?" Responses to the tobacco use question were 0=never and 1=sometimes/occasionally (a pack or less per a day).³ The sum for the complete global risk scale ranged from 1-4 with a Cronbach alpha=.74.

Positive and negative reinforcement (risk perceptions) pertaining to NMPD use were also examined. These indicators are drawn from a section of the questionnaire that asked "Please indicate, by checking the box, how likely you think each of these would be to happen to you personally if you were to use prescription drugs that were not prescribed to you by a doctor." The response options that assessed perceived negative risk include: (1) will become sick, (2) get arrested, (3) if arrested severely punished, (4) develop an addiction, (5) suffer a serious physical side effect that can

affect one's health, (6) suffer from a serious mental side effect that can affect one's mental health. Response options ranged from 1=very unlikely to 4=very likely. For respondents with missing values on the negative reinforcement variables, we substituted the average score of their own reported responses to fill in the missing value(s). Eleven respondents had one or two missing responses filled in this manner; three respondents with missing values on all responses were deleted from the sample. Summed responses (cumulative total with substitution) range from 6–24. The Cronbach's Alpha was .78.

Positive reinforcement for NMPD use were assessed by inquiring about the following: (1) fit into social group better, (2) improve focus, (3) lose weight or look more attractive, (4) feel buzzed or high, (5) achieve better grades, (6) relief from boredom, and (7) have a good time. Response scales ranged from 1=very unlikely to 4=very likely. For respondents with missing values on the positive reinforcement variables, we again substituted the average score of their own reported responses in this domain to fill in the missing value(s). Fifteen respondents had one, two or three missing responses filled in this manner; four respondents with missing values on all responses were deleted from the sample. Summed responses (cumulative total with substitution) range from 7–28. The Cronbach's Alpha was .72.

ANALYTIC STRATEGY

Most studies of NMPD use among college students are based on cross-sectional data. However, this type of research design poses a problem: some respondents in the college sample likely have a higher propensity to use illicit substances. But their propensity to use or not use substances may also play a role in their *pattern of use*, such as simultaneous polydrug use (e.g., the decision to use NMPD and to co-ingest may not be independent decision processes). Indeed, social learning theory suggests that due to prior learned definitions of behavior and differential socialization, some students have significantly greater propensities to use NMPD than other students. These key predisposing factors of NMPD use may then promote simultaneous drug use. If so, conflating the two non-independent processes (NMPD use and co-ingestion) in a single equation is likely to lead to inconsistent or biased estimates (Dow & Norton, 2003; Greene, 1997). There is a need to examine whether and how non-independence in processes may be at work.

It is also important to note that cross-sectional data are not ideal; unmeasured subgroup heterogeneity and individual-level changes in behavior over time may also underlie use vs. non-use patterns in reporting. Preferably, longitudinal data could be used to explore subgroup use and individual decision-making over time. Given the general lack of longitudinal data in this area and the data constraints in the present study—that NMPD use or non-use had been established by the time of the survey—our specific problem is to ascertain whether students' propensity

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to use or not use NMPD is independent of the patterns of use of simultaneous co-ingestion with alcohol. We examine this using a bivariate probit model, which allows for the testing of whether *use* and *co-ingestion* are independent processes, with one equation modeling history of NMPD use (in the last year) and a second modeling recent *co-ingestion* (sequential, independent decision-making). We test for independence by examining coefficient ρ , of equation correlation: if equations are indeed correlated, one can conclude that the use of NMPD and simultaneous use are interrelated behaviors.

RESULTS

THE PREVALENCE AND CORRELATES OF NMPD USE AND CO-INGESTION

Table 1 provides means, standard errors and correlations of all of the variables including our dependent variables. The mean age of the college sample is 20.4 years; 43% is male. Approximately 38% of respondents reported having used prescription drugs for nonmedical reasons in the last year. Approximately 9% ($n=41$) of respondents stated they had used prescription drugs for nonmedical reasons within the past 30 days. Of those individuals who co-ingested prescription drugs and alcohol, 20 respondents mixed alcohol with depressants, 30 respondents mixed alcohol with stimulants, and 30 respondents mixed alcohol with opiates. The sample characteristics that are correlated with NMPD use (Column 3 Table 1) and co-ingestion (Column 4, Table 1) are as follows: males and older respondents are more likely to be NMPD users, but these groups are not necessarily (not significantly more likely) to be mixers. Parental socialization toward use (negative parental views about drugs, past peer socialization in the context of private schooling and perception of low campus drug use are negatively associated with NMPD use. However, only negative parental views are negatively associated with simultaneous co-ingestion. Current differential associations are associated with both NMPD use and co-ingestion, although somewhat different elements are linked to each. High levels of risk behavior across behavioral domains, and high levels of both positive (motivational) and negative risk perceptions are positively associated with both NMPD use and co-ingestion. The age of onset of NMPD use, which is correlated with current use, is not correlated with co-ingestion.

MULTIVARIATE RESULTS

The bivariate probit model in Table 2 above predicts the likelihood of *NMPD use in the last year* (Model 1) and *co-ingestion* (Model 2), respectively. The first equation in Table 2 presents the estimates of the *NMPD user / non-user* model. This dichotomous variable is regressed on key demographic characteristics and prior socialization processes (i.e., positive or negative definitions about behavior), which collectively are influences emerging prior to college entry and/or survey

TABLE 1. VARIABLE STATISTICS AND INTERCORRELATIONS

	<u>Descriptive Statistics</u>		<u>First Order Correlations</u>	
	Variable Mean/Proportion	SD	NMPD User	Mixed Last 30 Days
<u>Demographic Background</u>				
White (Other=0)	0.90	---	0.010	0.019
Male (Female=0)	0.43	---	0.094*	0.031
Age at Survey	20.37	1.47	0.213***	- 0.005
<u>Definitions</u>				
Private vs. Public HS	0.17	---	- 0.091+	0.015
Low perceived campus use	0.25	---	- 0.175***	- 0.074
Family negative views	0.73	---	- 0.298***	- 0.246***
<u>Differential Associations</u>				
Greek (Y=1)	0.20	---	0.073	0.107*
Intimate rel w/user (Y=1)	0.24	---	0.310***	0.231***
Friends co-ingest (Y=1)	0.28	---	0.352***	0.377***
Would obtain from friend (Y=1)	0.75	---	0.108*	0.051
Senior (Y=1)	0.30	---	0.148**	- 0.004
GPA	4.70	0.98	- 0.141**	- 0.087+
<u>Differential Reinforcement and Risk Behavior</u>				
Age NMPD use onset <=16	0.07	---	0.350***	0.031
Heavy episodic drinking	1.26	0.84	0.291***	0.239***
Global risk behavior	1.50	1.34	0.600***	0.348***
Positive reinforcement	16.06	3.67	0.341***	0.322***
Negative reinforcement	15.62	3.56	0.308***	0.183***
<u>Dependent Variables</u>				
User of prescription drugs (Y=1)	0.31	-	-	0.380***
Mixed last 30 days (Y=1)	0.09	-	0.380***	-

+ $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

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TABLE 2. BIVARIATE PROBIT MODEL: MODEL 1 USER VS. NON-USER;
MODEL 2 CO-INGESTION-NMPD & ALCOHOL

	<u>Model 1</u>		<u>Model 2</u>	
	b	S.E.	b	S.E.
<u>Demographic Background</u>				
Male	0.183	0.130	0.187	0.281
Age	0.166***	0.044	- 0.286*	0.157
White	- 0.018	0.221	---	
<u>Definitions</u>				
Private secondary school	- 0.360*	0.176	---	
Family negative views	- 0.727***	0.147	---	
Low perceived campus use	- 0.429**	0.157	---	
<u>Differential Associations</u>				
Current Greek membership (Y=1)	---		0.427	0.292
Intimate rel w/user (Y=1)	---		0.335	0.270
Friends co-ingest (Y=1)	---		1.035***	0.275
Would obtain from friend (Y=1)	---		- 0.386	0.317
Senior (Y=1)	---		0.601	0.451
GPA	---		0.165	0.133
<u>Differential Reinforcement and Risk Behavior</u>				
Age NMPD use onset <=16	---		- 1.466**	0.467
Heavy episodic drinking	---		0.628*	0.306
Global risk behavior	---		0.325*	0.134
Positive reinforcement	---		0.211***	0.055
Negative reinforcement	---		0.046	0.043
Intercept	- 3.090***	0.933	- 3.572	3.247
Rho			0.563***	0.170
-2 Log Likelihood	624.30			
AIC	668.30			
BIC	758.20			

* p < 0.1 ** p < 0.05 *** p < 0.001

participation. This model also taps respondents' beliefs about the prevailing use of NMPD on their campus.

The pattern of bivariate findings in Table 1 suggests that older or male respondents are more likely to be NMPD users. However respondents whose parents disapproved of NMPD use, or who attended a private school are less likely to be NMPD users in college. Most of these influences carried over into their college lives and are confirmed in Table 2, with the exception of the non-significance of sex, net of controls. Social learning processes with regard to parental disapproval reduces NMPD use; but, and perhaps the most interesting finding in this table, is that there is a direct association between perceived campus NMPD use and self-reported use. This suggests that low campus use beliefs appear to negatively influence self-reported NMPD use in the previous year and thereby effects individual definitions of acceptability.

Model 2 in Table 2 provides estimates of the second part of the bivariate probit model where *co-ingestion* is regressed on the current social learning, differential association and reinforcement variables. The pattern of bivariate findings in Table 1 suggested that no demographic variables, and, among the differential association variables, only Greek membership, intimate partner use and friend's co-ingestion are associated with individual *co-ingestion*. These findings are partly confirmed in Model 2. Respondents whose friends mix NMPD and alcohol are more likely to simultaneously use NMPD and alcohol themselves. In a model without the risk factor cluster of variables (not shown) respondents whose intimate partners are NMPD users are also more likely to co-ingest NMPDs and alcohol ($p < .05$). However, being a member of a fraternity or sorority does not significantly impact the likelihood of co-ingestion. Also, net of all other variables in the model, age seems to discourage co-ingestion (marginally significant). GPA does not influence co-ingestion in our models.

The significant *rho* in the bivariate probit findings allows us to reject a hypothesis of independence in the use of NMPD and simultaneous co-ingestion with alcohol. Moreover, simultaneous ingestion reflects, in addition to an interrelated "carry-over" of a propensity to illicit use, direct influences of differential association (e.g., having friends who use drugs) and differential reinforcement (e.g., risky behaviors and perceived risk/benefits). An age of onset of NMPD use at or under age 16 decreases co-ingestion. Heavy episodic drinking, higher levels of risk behavior across various domains and greater positive reinforcement to use NMPDs increase the probability of co-ingestion. Of interest, greater negative reinforcement or respondent beliefs about negative consequences of risk does not significantly impact co-ingestion behavior while greater positive reinforcement promotes co-ingestion behavior.

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SUMMARY AND CONCLUSIONS

Only a handful of studies have examined the simultaneous use of prescription drugs and alcohol, a behavior which can be particularly dangerous due to the pharmaceutical side effects of prescription drugs and the toxic interaction these chemicals can produce when combined. Our research seeks to fill important gaps in the substance use literature. Our efforts specifically expand the science of substance use by conducting a partial test of social learning theory on an emerging social problem: NMPD use and simultaneous use of NMPDs and alcohol.

First, our findings build on existing knowledge about the life stage timing and demographic correlates of NMPD and alcohol use. In accordance with previous research, we have found that there is an “aging out” effect for simultaneous polydrug use (Midanik et al., 2007). Older individuals are less likely to co-ingest alcohol and NMPDs. Our results regarding sex, however, are more complicated. Studies on NMPD use and sex have produced conflicting results in the last several years (McCabe et al., 2005a, 2005b; Simoni-Wastila, Ritter, & Stickler, 2004; Simoni-Wastila & Strickler 2004; White et al., 2006). Our study finds that NMPD use and simultaneous polydrug use is not significantly associated with sex. Perhaps prescription drug use among college students, as a fairly modern occurrence, is not steeped in a gendered historical context as has been the case with alcohol.

Our study provides one of the first studies that examine simultaneous polydrug use with the inclusion of NMPDs analyzed from a social learning framework. Our findings demonstrate that peers who engage in simultaneous polydrug use significantly influence respondents’ own co-ingestion. Additionally, respondents whose intimate partners are NMPD users are more likely to co-ingest. Surprisingly, earlier social learning effects in family and school environments are often excluded from studies on NMPD use. Upon addressing this gap, we find that there are lingering social learning influences on later life use/non-use decisions (among college students). Individuals may become predisposed to use and/or mix substances in an environment that fosters pro-use attitudes. As hypothesized, stronger parental attitudes against NMPD use significantly predicted respondents’ lower probability of NMPD use; this is consistent with other studies (Borsari & Carey, 2001; Ford, 2008; Wechsler et al., 1995; Weitzman et al., 2003). Likewise, respondents who believed NMPD use was not very popular on campus were less likely to engage in NMPD use. Additionally, respondents who attended private high school were less likely to engage in NMPD use. This is surprising given that at least one study found stimulant use was more common among college students who attended private high school (White et al., 2006).

Although we have empirically documented patterns of co-ingestion of alcohol and NMPDs, there are limitations to our study. The sample size was relatively small and

the study was conducted at a single university. Due to the cross-sectional nature of this research, generalization is problematic in light of regional and other demographic differences potentially associated with nonmedical prescription drug use. Studies, for example, have found that NMPD use may cluster at non-commuter and “party” colleges (McCabe et al., 2005b, 2007b). Likewise Cicero and colleagues (2005) found that NMPD use was concentrated in certain regions of the country such as rural areas. It is also problematic that the sample was largely composed of white students. More research is needed to understand the dynamics of substance use in the context of racialized social structures given the significant variations found in substance use by race and ethnicity (Morris, Wood, & Dunaway, 2006; Peralta, 2005; Peralta & Steele, 2009b). Next, our study is only a partial test of social learning theory in that a measure of imitation was not used here. Relatedly, the measures for definitions of positive and negative reinforcement only measure NMPD use and not the co-ingestion of NMPD with alcohol. However it could be argued that respondents with negative views of NMPD use probably also have negative views of co-ingestion of nonmedical prescription drugs and alcohol.

A final but important limitation is that our study only includes the examination of individuals who *do not* have a prescription for the drugs they are abusing/misusing. We do not have data for those who obtain prescription drugs legitimately from physicians for abusive purposes. If we consider private high school attendance as a proxy for social class, it is plausible that these individuals that are advantaged by social class may be able to obtain prescription drugs for the purposes of misuse through legitimate medical channels. Also, respondents from higher income families might be in a better position to engage in methods such as “doctor shopping” or seeking simultaneous care from multiple doctors to obtain more medication for recreational purposes. At least one study has found that “doctor shoppers” tend to be concentrated in higher income areas (Hall et al., 2008). These social class factors may explain the nonsignificant association between Greek affiliation and polydrug use in the present study. Future research should thus examine misuse and co-ingestion with alcohol for individuals that were prescribed medication by a physician in addition to those who obtain prescription drugs through illegitimate means to better understand the complex paths to NMPD misuse.

Despite the limitations of this study, our research design has several methodological strengths. First, while we cannot generalize our findings with confidence, the present sample was similar to the overall student population at both the university in question and national universities as a whole. Next, many researchers use categorical options where respondents must choose from a limited set of prescription drug types. This type of survey design may limit instrument validity and reliability. Respondents may not know what drug category (i.e., stimulants,

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versus depressants, versus opiates) their drugs of use belong to thus increasing the probability of skipped questions. In order to overcome this possible data collection problem, we used a formula-name categorical approach to drug use data collection and provided respondents the opportunity to write in the names of drugs used, but not listed. The survey's listing of common prescription drug names may have reduced recall bias by triggering the respondents' memory that he/she did in fact use a particular drug.⁴ We also examined simultaneous use by treating use / non-use and co-ingestion as two separate but potentially correlated processes (bivariate probit formulation). We find support for the two equation bivariate probit model, which suggests that these behaviors are interrelated and need to be studied in the context of one another.

Given our findings, the impact of NMPD involved simultaneous polydrug use should be considered in future research. Researchers should expand data collection to include social learning contexts and investigate possible confounding factors between intimate partnerships, sex, and risk. For example, the two variables "would obtain from a friend" and "motivation to use" yielded some unexpected results. We found that those individuals who engaged in simultaneous polydrug use were not significantly more likely to obtain NMPDs from a friend in the multivariate analyses (Table 2). This is inconsistent with studies on NMPD use which find that college students are more likely to obtain NMPDs from a friend more than any other source. Perhaps simultaneous polydrug use occurs in different situational contexts than NMPD use.

In conclusion, nonmedical prescription drug use and mixing NMPDs with alcohol can lead to serious health consequences, including serious physical harm and mortality. Particularly troubling are the increased reports of emergency room visits due to NMPD use and the co-ingestion of other substances, as indicated by the DAWN reporting system (Riggs, 2008; SAMHSA, 2004). This particularly risky behavior likely contributes to alcohol-related deaths on college campuses and should, therefore, be considered in the design of future substance abuse studies (Majors, 2009; Spice & Haggerty, 2009; Stevens, 2009). Therefore, there is a pressing need for collective attention on this drug issue from researchers, policy makers, college administrators, and health professionals alike.

NOTES

1. Information on income and marital status were collected; however, they were excluded from analysis due to low response variation.
2. In a comparison of private versus public high schools in South Carolina, Valois (1997) found that heavy episodic alcohol use was slightly more prevalent among private school adolescents than public school adolescents. There were no significant differences in marijuana or cocaine use, however. Additionally,

- White et al., (2006) found that nonmedical stimulant use while in college was more prevalent among individuals who previously attended a private high school.
3. The original survey response options for smoking were 0=never, 1=sometimes, 2=occasionally, 3=often. However “sometimes” and “occasional” smokers were combined due to a skewed low response. No one reported using “often.”
 4. The list method with an open answer option also allows for researchers to become aware of developing trends in NMPD use. For example, a majority of studies on NMPD use have not asked about particular drugs such as Fentanyl. In a recent qualitative study of police, regulatory officials, drug dealers and users in Delaware, the Fentanyl transdermal patch was found to be the most highly desirable prescription opioid on the street because of its potency (Inciardi, Surratt, Cicero, & Beard, 2009).

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