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Perceived harmfulness predicts nonmedical use of prescription drugs among college students: Interactions with sensation-seeking

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Abstract

This study describes the level of perceived harmfulness of nonmedical prescription stimulant and analgesic use in a sample of college students, and examines the prospective relationship between perceived harmfulness and subsequent nonmedical use. In addition, we explore whether the association between perceived harmfulness and nonmedical use varies by level of sensation-seeking. Personal interviews, including questions on sensation-seeking and drug use, were conducted with 1,253 first-year college students. Participants were then followed-up twice at six-month intervals. Perceived harmfulness of nonmedical use of prescription drugs was assessed at six months via a web-based survey. At the 12-month follow-up interview, drug use was again assessed. Students who never had the opportunity to use prescription drugs nonmedically were excluded from all analyses. Results revealed that one in four students perceived a great risk of harm from occasional nonmedical use of prescription stimulants (25.2%) and analgesics (27.8%). As expected, low perceived harmfulness and high sensation-seeking were independently associated with increased risk of nonmedical use, holding constant demographic characteristics. The protective effect of high perceived harmfulness could be seen at all levels of sensation-seeking with one important exception: among high sensation-seekers, perceived harmfulness was not related to nonmedical use of prescription analgesics. Perceived harmfulness appears to distinguish nonmedical users from non-users, given the opportunity to use. Increasing perceived harmfulness may be a viable prevention strategy for most students, but alternative approaches might need to be developed that are tailored to high sensation-seekers.

Keywords

Nonmedical prescription drug use; college students; prevention; risk-taking; perceived harm

Late adolescence and young adulthood are peak developmental periods for illicit drug involvement. Several theoretical frameworks can be used to explain drug use during this period as a function of the interaction of a multitude of personal, familial and environmental variables. In particular, social development theory postulates that youth substance use develops as a result of the interplay between risk and resiliency factors (Catalano & Hawkins, 1996; Hawkins, Catalano, & Miller, 1992). Moreover, Bronfenbrenner's Ecology of Human Development

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Framework (1979) explains human development as a function of the interactions between the person (i.e., “host characteristics” such as personality and temperament) and the individual's micro-systems (e.g., peer and family) as well as larger macro-systems (e.g., environments that can govern drug availability). These theories inform our understanding of the dynamic, reciprocal relationship between individuals and their environments, and are critical in understanding the development of substance use problems. In this study, we are interested in advancing our understanding of nonmedical use of prescription drugs (i.e., analgesics and stimulants) among young adults, both because of the increased public health concern related to this type of drug use, and the need to better comprehend the processes that underlie early initiation of nonmedical use that could have important implications for prevention. We sharpen our focus on two potential risk factors for nonmedical drug use—namely, individual temperament characteristics (including sensation-seeking), and perceived harmfulness of drug use, both of which have been shown in prior work to be related to other types of drug use.

With regard to perceived harmfulness, a series of ecological studies based on data from Monitoring the Future (MTF) has demonstrated that historic declines in marijuana use by 12^{th} graders in the early 1980s were associated with concomitant increases in the perception of risk associated with regular marijuana use (Bachman et al., 1988). A similar study replicated these findings for cocaine (Bachman, Johnston, & O'Malley, 1990). More recent findings indicate that decreases in perceived harmfulness were associated with increases in annual marijuana use among 8^{th}-, 10^{th}-, and 12^{th}- grade students during the early 1990s (Bachman, Johnston, & O'Malley, 1998). Other smaller empirical studies have demonstrated that perceived harmfulness is a risk factor for use of alcohol, cocaine, heroin, and other drugs (Duistman & Colbry, 1995; Gonzalez & Haney, 1990).

The notion that sensation-seeking influences high-risk behavior, including drug use, has long been recognized (Donohew et al., 1990; Herman-Stahl et al., 2007; Palmgreen et al., 1991; Reyna & Farley, 2006; Zuckerman, 1994; Zuckerman, Neary, & Brustman, 1970). Sensation-seeking has been shown to be higher in males and to vary across the life span, with a peak in young adulthood (Zuckerman & Kuhlman, 2000). One small study of nonmedical use of prescription stimulants found that individuals high on sensation-seeking were more likely to use stimulants and the greatest amount of use was associated with high sensation-seeking and perfectionism (Low & Gendaszek, 2002).

While several studies have separately examined the association between these two variables and the risk for drug use, few studies have included both sensation-seeking and perceived harmfulness in the same study. The interaction between perceived harmfulness and sensation-seeking is important to consider because it is possible that sensation-seeking characteristics can influence risk perception. Romer and Hennessy (2007) recently demonstrated that risk perception was inversely related not only to alcohol and marijuana use, but it was also strongly influenced by the degree to which the individual felt they would receive emotional satisfaction from the behavior. Therefore, it follows that given the opportunity to use an illicit drug, the decision to use or not use is based on past experiences, and an evaluation of risks as well as reward. Neurodevelopmental studies suggest that sensation-seeking surges during adolescence (Chambers, Taylor, & Potenza, 2003; Nelson et al., 2002; Spear, 2000) and that decision-making is strongly influenced by affect and emotion rather than careful cognitive processing of risk information (Fuster, 2002; Krawczyk, 2002; Rolison & Scherman, 2002). It is possible that young adults who are high on sensation-seeking characteristics do not evaluate risks associated with drug use in the same way as individuals low on sensation-seeking. Namely, individuals seeking novelty or excitement may perceive drug use risk as attractive, rather than something to avoid.

Nonmedical use of prescription drugs presents special challenges to drug prevention specialists for several reasons. First, the use of these drugs appears to be increasing according to several sources. Between 2000 and 2006, the lifetime prevalence of nonmedical use of any psychotherapeutic prescription drug among individuals ages 12 and older rose from 14.5% to 20.3% (Substance Abuse and Mental Health Services Administration [SAMHSA], 2001, 2007a). Nonmedical use of prescription analgesics is particularly high among young adults ages 18 to 25, with approximately one in four (25.5%) reporting lifetime use (SAMHSA, 2007a). We found that lifetime prevalence of nonmedical use of prescription stimulants and analgesics increased 300% and 85.7%, respectively from the first to the second year of college (Arria et al., In press-a).

Second, nonmedical prescription drug use encompasses a variety of different drug classes, each with different purported reasons for use and different consequences. Among college students, the major reasons for using prescription stimulants, for instance, are to increase concentration to study as well as to stay awake to party longer and drink more alcohol (Arria & Wish, 2005; Barrett et al., 2005; Low & Gendaszek, 2002; Prudhomme-White, Becker-Blease, & Grace-Bishop, 2006). Alternatively, prescription analgesics are used nonmedically primarily for their euphoric effects. These data suggest that the risk to reward ratio is most likely different for each of these drug classes and as a result, models to explain the use of these drugs should be developed separately for different classes of prescription drugs.

Third, anecdotal reports speculate that, because these drugs have been approved for medical use they are perceived to be inherently “safer” than illicit drugs (Friedman, 2006). To our knowledge, no empirical data is available to support or refute this claim. The level of perceived harmfulness of nonmedical use is therefore important to estimate and the relationship between perceived harmfulness and use is critical to understand before attempting to modify perceived harmfulness for prevention purposes.

When used under medical supervision, both stimulants and analgesics can have beneficial therapeutic effects. However, nonmedical prescription drug use is associated with at least three types of adverse consequences, all of which have been more clearly documented for prescription analgesics compared to prescription stimulants. First, the use of both prescription analgesics and stimulants carry a risk of drug dependence (Anthony, Warner, & Kessler, 1994; Miller, 2004). In 2005, the Treatment Episode Data Set reported that 64,120 admissions to treatment programs were due to a primary problem with opiates other than heroin, representing a substantial increase over years past (SAMHSA, 2007b). Second, both stimulants and analgesics and have been documented to result in acute adverse effects (United States Food and Drug Administration, 2005, 2007a, 2007b, 2007c), which in severe cases, can result in emergency department admissions. With regard to prescription stimulants, data from the Drug Abuse Warning Network (2007), estimated that 10,616 emergency-department admissions in 2005 involved central nervous system stimulant pharmaceuticals. The numbers of emergency department admissions for nonmedical use of prescription narcotic analgesics were much higher, totaling 160,363 admissions. It is notable that 55% of admissions with nonmedical use also involved another substance such as alcohol, an illicit drug or pharmaceutical. Third, use of these drugs is contraindicated for individuals who are taking other types of medications to treat a number of conditions, including some psychiatric disorders. For example, individuals taking MAO-inhibitors are cautioned against using ADHD medications to avoid potentially serious adverse physiological consequences. Although more empirical research is needed to understand the associations between nonmedical use and longer-term consequences, clearly there is evidence demonstrating the acute physiological risks.

To our knowledge, no study to date has focused on the relationship between perceived harmfulness and the nonmedical use of prescription drugs. Our understanding of potential risk

factors for nonmedical use among college students is based on several recent cross-sectional studies (Carroll, McLaughlin, & Blake, 2006; Hall et al., 2005; Low & Gendaszek, 2002; McCabe, Teter, & Boyd, 2006b; Teter et al., 2003). We know, for instance, that, relative to their non-using counterparts, nonmedical users tend to be White, male, and have a mother whose educational attainment is a bachelor's degree or more (McCabe et al., 2005a). They also tend to have greater levels of other drug involvement (Arria et al., In press-b; Barrett et al., 2005; Herman-Stahl et al., 2007; McCabe et al., 2005a; McCabe et al., 2005c), are more likely to be affiliated with Greek organizations (McCabe et al., 2005a; McCabe et al., 2005c), and have decreased academic performance (Arria et al., In press-b; McCabe et al., 2005a; McCabe, Teter, & Boyd, 2005b). However, no research has been specifically focused on the prospective relationship between perceived harmfulness and the risk of nonmedical use or whether this relationship varies by sensation-seeking. This line of research has potential implications for the delivery of information about the perceived harmfulness of prescription drugs. These types of messages might resonate more strongly with students who are low on sensation-seeking. Conversely, information about high levels of perceived harmfulness might be enticing to an adolescent who is high on sensation-seeking characteristics.

The present study used longitudinal data from a large sample of college students to: 1) describe the perceived harmfulness of prescription stimulants and analgesics relative to other drugs like alcohol, marijuana, and cocaine; 2) examine the prospective relationship between perceived harmfulness and subsequent nonmedical use of prescription stimulants and analgesics; and, 3) understand whether or not the association between perceived harmfulness and nonmedical use varies by level of sensation-seeking. We hypothesize that students with lower levels of perceived harmfulness will be more likely than others to use prescription drugs nonmedically, but that perceived harmfulness will be less strongly related to nonmedical use among individuals with high levels of sensation-seeking. Separate sets of analyses were conducted for prescription stimulants and analgesics because of the differences in reasons for use of each of these drugs and possible differences in the perception of harmfulness.

Methods

Sample

The data were gathered as part of the College Life Study, an ongoing longitudinal prospective study of undergraduate college students. Participants were recruited from a large, publicly-funded university in the mid-Atlantic region, with an ethnically diverse student body. The sample was ascertained in two stages. First, a screening survey was administered to 3,401 incoming first-time, first-year students, ages 17 to 19, during new-student orientation in the summer of 2004 at one large, public university in the mid-Atlantic region of the United States. The first-stage response rate was 89%. Next, a sample of students who completed the screener was selected to participate in the longitudinal portion of the study, which began with a baseline interview administered some time during their first year of college. To obtain the sample for the longitudinal cohort, purposive sampling strategies were employed to oversample students who had prior experience with illicit drug use in high school (including nonmedical use of a prescription drug), and sampling weights were computed to permit calculation of prevalence estimates for the general population of first-year students. Specifically, all students who had tried an illicit drug before entering college were eligible to participate in the longitudinal part of the study, plus a stratified random sample (40% probability) of students who had no prior drug use. The response rate at this second stage was 86%. The resulting cohort of 1,253 students was representative of the first-year class with respect to race (70.8% White), gender (48.6% Male), and socioeconomic status (73.5% whose mother attained bachelor's degree or more). A more detailed description of sampling and recruitment procedures is available elsewhere (Arria et al., In press-a).

Data from the baseline (Time 1; T_1) and two follow-up assessments are used in the current analyses. The first follow-up assessment was web-based and occurred six months after the baseline (Time 2: T_2), and the second follow-up was a personal interview that occurred 12 months after the baseline (Time 3: T_3). Figure 1 depicts which measures were used at each time point. Response rates were 72% and 91%, respectively, for T_2 and T_3). Because the baseline interviews were completed on a rolling basis throughout the first year of college (September, 2004 through May, 2005), the timing of the follow-up assessments corresponds to the baseline assessment "anniversary." Respondents received $5 for participating in the screener, $50 for completing each interview, and $20 for the web-based assessment. The study was approved by the University IRB and informed consent was obtained. A federal Certificate of Confidentiality was also obtained.

Independent Variables

Demographic characteristics—Gender was coded as observed by the interviewer at T_1. Data on race were culled from the University's administrative databases. Race was coded into a dichotomous variable (that is, White vs. non-White). Mother's educational attainment was self-reported by the student.

Sensation-seeking—Participants self-administered the Zuckerman-Kuhlman Personality Questionnaire-Short Form (ZKPQ-S) at T_1 (Zuckerman, 2002). The ZKPQ-S includes a 7-item subscale measuring impulsive sensation-seeking, and includes items pertaining to the need for excitement, unpredictability, and novelty, as well as the tendency to act quickly without thinking. Each item is scored as 1 or 0 (True or False), and summed to compute the scale score. The short version of sensation-seeking used in this study has previously demonstrated satisfactory reliability for both male and female college students (Cronbach's α=.62 and .71, respectively), similar to the original version (Zuckerman, 2002). In research using the original long form of the ZKPQ, sensation-seeking demonstrated good convergent validity with the lengthier Sensation-seeking Scale (r=.66) and consistent construct validity as a correlate of drug use, drinking, and other risky behaviors among college students (Zuckerman, 2002). The mean scale score was 3.6 (SD=2.2) and the Cronbach's α was 0.74.

Perceived harmfulness—The web-based survey at T_2 included questions modeled after the MTF surveys (Johnston, O'Malley, & Bachman, 2004). Following an explanation of the definition of nonmedical use (see description below), participants were asked "How much do you think people risk harming themselves (physically or in other ways) if they take [drug] occasionally (nonmedically)?" Separate items assessed perceived harmfulness for nonmedical use of prescription stimulants and analgesics, as well as alcohol, marijuana and cocaine, all at varying degrees of frequency (for example, once or twice, occasionally, regularly). The item pertaining to alcohol use specified having "five or more drinks once or twice every weekend." To preserve power in our regression models and facilitate interpretation of results, responses were dichotomized as low (no risk or slight risk) vs. high (moderate or great risk) levels of perceived harmfulness.

Dependent Variable

Nonmedical use of prescription drugs—Participants were assessed at T_1 and T_3 for exposure opportunity and nonmedical use of prescription stimulants and analgesics. This section of the interview consisted of an expanded set of questions that were originally modeled after the 2002 National Survey of Drug Use and Health (NSDUH). The questions began by defining nonmedical use as "using medications that were not prescribed for you or that you took only for the experience or feeling they caused," excluding any over-the-counter medications. Questions about nonmedical use were then administered separately for prescription stimulants and analgesics. At the beginning of each section, the interviewer

described what kinds of drugs were included in that section using standard definitions and color photographs of pills, similar to procedures in NSDUH (SAMHSA, 2003). Separate sets of interview questions at T_1 captured the age of first exposure opportunity ("How old were you the first time you were offered [drug]?") and age of onset ("How old were you the first time you used [drug] nonmedically"), respectively. Similarly, questions at T_3 captured the number of times they were offered (analgesics and stimulants, separately) and separate questions asked about the nonmedical use of each drug during the past year. These responses were then re-coded into a dichotomous variable denoting past-year use at T_3 (that is, at least once (1) vs. none (0). Dichotomizing these variables was advantageous for modeling nonmedical use as an outcome variable because the distributions for frequency of use were positively skewed. For example, for prescription stimulants, a large proportion of individuals reported only one or two days of use (11.5%) or no use at all (62.0%), with a maximum of 69 days and mean (*SD*) of 4.2 (10.0). The distribution was similar for prescription analgesics use frequency (15.0% used one or two days; 67.6% did not use; maximum=153 days; mean (*SD*)=3.5(15.0)).

Statistical Analyses

Although experienced drug users were oversampled in this cohort, because the probability of selection was known, we were able to calculate case weights to yield a weighted sample size representing of the entire population of screened first-year students enrolled at this university. Details of this procedure are presented elsewhere (Arria et al., In press-a).

To describe the prevalence of perceived harmfulness among the entire first-year class, weighted frequencies were tabulated for perceived harmfulness associated with each type of prescription drug. To provide a basis for comparison, weighted frequencies were also computed for alcohol, marijuana, and cocaine. Next, the association between perceived harmfulness and nonmedical use was tested in a series of logistic regression models, using unweighted data, separately for stimulants and analgesics. For these analyses, the sample was restricted to students who had exposure opportunity at least once in their lives by T_3. (To test the robustness of the findings, analyses were also repeated for the entire sample, regardless of exposure opportunity, but the results presented herein are restricted to the more conservative sample). Testing the hypothesized relationships illustrated in Figure 1, logistic regression analyses modeled past-year nonmedical use at T_3 as a dichotomous dependent variable, with the dichotomized perceived harmfulness variable measured at T_2 as the predictor. To further test the explanatory power of perceived harmfulness, sensation-seeking was entered as a second variable, with the addition of prior nonmedical use (that is, before T_1) as a control variable. The interaction between perceived harmfulness and sensation-seeking was also tested in the full model. All models held constant the effects of gender, race, and mother's education.

To correct for sampling and attrition bias, we replicated our regression models based on a doubly-weighted sample, incorporating both sampling weights and non-response weights. Because the results did not appreciably differ, the regression models shown below are based on unweighted data.

Results

Perceived Harmfulness of Nonmedical Prescription Drugs Relative to Other Forms of Illicit Drug Use

Table 1 shows a striking similarity between the perceived harmfulness of the "occasional nonmedical use" of analgesics and stimulants. Namely, $25.2\%_{wt}$ and $27.8\%_{wt}$ of students attributed a "great risk" to occasional nonmedical use of prescription stimulants and analgesics, respectively. To place these results in context, Table 1 compares these estimates with the proportion who endorsed "great risk" for occasional use of other drugs. These comparisons

show that prescription drugs were perceived as less risky than cocaine (72.2%$_{wt}$) but more risky than marijuana (7.2%$_{wt}$), and more risky than drinking five or more alcoholic beverages every weekend (17.4%$_{wt}$).

We then constructed a dichotomous variable to define two levels of perceived harmfulness. Namely, ”high perceived harmfulness” was defined as either “moderate” or “great risk” (67.4%$_{wt}$ of the sample for stimulants, and 70.2%$_{wt}$ for analgesics) and “low perceived harmfulness” was defined as “slight” or “no risk” (26.0%$_{wt}$ of the sample for stimulants and 22.8%$_{wt}$ for analgesics). Students who provided an answer of “can't say” were excluded from further analyses.

Overall Sample Characteristics and Descriptive Analyses related to Perceived Harmfulness

Table 2 presents sample characteristics for the total sample and subsamples with low and high perceived harmfulness for nonmedical users of prescription analgesics and prescription stimulants, separately. As can be seen in Table 2, the level of perceived risk was largely unrelated to demographics, with the exception that whites were slightly overrepresented among students with low perceived harmfulness for stimulants. Prior nonmedical use was also associated with low perceived harmfulness for both types of drug.

Logistic Regression Models Predicting Nonmedical Use

Table 3 presents the results of the logistic regression models predicting past year nonmedical use of prescription stimulants and analgesics, restricted to students who had been offered the opportunity to try either drug. After controlling for the effects of demographics and other covariates, students with low perceived harmfulness of prescription stimulants were 10.3 times (*95% CI*=3.2-33.0) more likely to use stimulants nonmedically in the past year compared to students with high perceived harmfulness. Results for prescription analgesics were quite similar: individuals with low perceived harmfulness were 9.6 times (*95% CI*=2.1-44.0) more likely to use prescription analgesics nonmedically, as compared to those with high perceived harmfulness. The confidence intervals were substantially smaller in bivariate models that evaluated the association between perceived harmfulness and nonmedical use. With the addition of several explanatory variables into the multivariate models, the model complexity increases the uncertainty of the coefficient of perceived harmfulness, resulting in larger confidence intervals.

In both models, a significant interaction effect was observed between perceived harmfulness and sensation-seeking. Interestingly, the hypothesized predictors accounted for more variance in the model for nonmedical use of prescription stimulants than the model for prescription analgesics (R^2 =.19 vs. R^2 =.09).

Interaction of Perceived Harmfulness with Sensation-Seeking

Figure 2 depicts the interaction between sensation-seeking and perceived harmfulness in predicting nonmedical use of prescription stimulants, prescription analgesics and marijuana use. For ease of presentation, students were grouped into quartiles according to their sensation-seeking score, and then results were graphed as a separate line for each quartile. The simple slopes of perceived harmfulness within each sensation-seeking quartile were also tested for significance in the regression models. (Due to power limitations, we reduced the models to include only perceived harmfulness and sensation-seeking.) As can be seen in the graph pertaining to prescription stimulants, high perceived harmfulness is associated with lower prevalence of nonmedical prescription stimulant use at all levels of sensation-seeking (all at $p<.05$). The same is true for the nonmedical use of prescription analgesics, with one important exception—in the highest quartile of sensation-seeking, perceived harmfulness has no relationship to use ($p=.92$). For both types of prescription drugs, the prevalence of use is quite

similar when perceived harmfulness is low, regardless of sensation-seeking level. The observed pattern of results suggests that students who perceive nonmedical use as relatively safe are more likely to use, regardless of their level of sensation-seeking. Conversely, high perceived harmfulness might function as a protective factor against nonmedical use, but its influence is less potent among high sensation-seekers, especially in the case of prescription analgesics. A post-hoc analysis was conducted to place these results in context with marijuana use. As can be seen in Figure 2, the result for marijuana is strikingly similar to that of prescription stimulants. For all three drugs, the steepest slope is observed among individuals with the lowest level of sensation-seeking.

We conducted additional tests to understand the degree of overlap between high sensation-seeking and low perceived harmfulness. Results indicate that although perceived harmfulness and sensation-seeking are significantly negatively correlated in this sample ($r(n = -0.18$ (695) for occasional use of prescription stimulants and ($r(n) = -0.13$ (694) for occasional use of prescription analgesics, individuals with low perceived harmfulness were in the minority at nearly all levels of sensation-seeking. In other words, in this sample, high sensation-seeking and high perceived harmfulness are not mutually exclusive, raising the possibility that perceived harmfulness might be a viable target for intervention among individuals at any level of sensation-seeking.

In a series of post-hoc analyses, the results were replicated using the original four-level categorical variables for perceived harmfulness for prescription analgesics and stimulants separately. Results were similar to the models where perceived harmfulness was dichotomized, with one exception: in the model predicting nonmedical prescription stimulant use, the sensation-seeking-perceived harmfulness interaction only approached significance (p=.06). Otherwise, the regression coefficients for each level of perceived harmfulness were consistent with an inverse association in which the likelihood of use increased incrementally as the level of perceived harm decreased. For example, in the model on stimulants, with “great risk” as the reference category, individuals who perceived “no risk” were the most likely to use stimulants (b=3.4, p<.01), followed by whose perceived risk was “slight” (b=2.8, p<.01) or “moderate” (b=0.9, p=.11). The corresponding results in the model on analgesics were as follows: “no risk” (b=3.1, p<.01), “slight” (b=2.5, p<.01), “moderate” (b=0.3, p=.5).

Because our sample included some individuals who had already used prescription drugs nonmedically prior to the study outset, it was of interest to determine the extent to which their levels of perceived harmfulness may have been influenced by prior use. To that end, we conducted a second post-hoc analysis aimed at testing the hypothesis that perceived harmfulness might mediate the relationship between prior use and subsequent use. Using a model comparisons approach, we replicated the original models with and without prior use and perceived harmfulness, and tested new models for the association between prior use and perceived harmfulness. Results differed for the two types of drugs. For prescription stimulants, no evidence of mediation was observed, although prior use significantly predicted low perceived harmfulness (b=−1.1, p<.01). For prescription analgesics, however, the statistical significance of the relationship between prior use and subsequent use was somewhat reduced by the inclusion of perceived harmfulness (b=1.2 vs. b=.96, both at p<.01), thereby providing modest support for the hypothesis that perceived harmfulness partially mediates the relationship between prior use and subsequent use.

Discussion

In this cohort of college students, most students associated occasional nonmedical use of prescription stimulants and/or analgesics with a high degree of harmfulness. Only one in four students had low perceived harmfulness (that is, “slight” or “no risk”) regarding stimulants

(26.0%$_{wt}$) or analgesics (22.8%$_{wt}$). By comparison, the level of perceived harmfulness was higher for cocaine, but lower for marijuana and having five or more drinks once or twice every weekend. To our knowledge, this is the first study to describe college students' perceptions about the potential harmfulness of nonmedical use of prescription drugs.

This study also provides evidence that low perceived harmfulness is an important risk factor for nonmedical use. Consistent with our hypothesis, low perceived harmfulness independently predicted nonmedical use, even controlling for demographics and sensation-seeking. For both types of prescription drugs, individuals with low perceived harmfulness were approximately 10 times more likely to engage in nonmedical use, as compared to those with high perceived harmfulness. This finding can be seen as particularly robust considering that the models also controlled for prior nonmedical use. Moreover, in post-hoc analyses the association between perceived harmfulness and nonmedical use was essentially unchanged when the models were replicated with the entire sample, regardless of prior opportunity to use. This finding extends prior evidence demonstrating that low perceived harmfulness is an important risk factor for other forms of illicit drug use (Bachman et al., 1998).

One important contribution of this study is the finding that individuals with low or moderate sensation-seeking tendencies were particularly susceptible to the influence of perceived harmfulness. This finding comports with evidence from one recent study of adolescents, which suggested that higher levels of sensation-seeking change the way adolescents weigh information about the risks and benefits of using a drug (Romer & Hennessy, 2007). In that study, sensation-seeking peaked during the late teen years, thereby raising the possibility that students might become better equipped to make appropriate risk appraisals as they mature into their college years. The present findings tend to support that expectation, based on the fact that for most students, perceived harmfulness may have had an influence on behavior, except among those whose sensation-seeking remained high.

The two sets of regression analyses presented were restricted to individuals who had the opportunity to use prescription stimulants and analgesics, respectively. It is important to note that when students are included regardless of whether they had the opportunity to use the drug, the results of the regression models are similar to restricted models. The main exception is that sensation-seeking is significantly associated with use, even controlling for the perceived-risk-sensation-seeking interaction. If opportunity is then added to the model, sensation-seeking becomes non-significant. These results are not surprising given the increase in sample size and the fact that that sensation-seeking and opportunity covary significantly (r=.25, p<.0001). Comparing our analysis sample (e.g., those with opportunity) to students without opportunity reveals important differences. Namely, students without opportunities to use stimulants and analgesics were significantly different from those with an opportunity to use with respect to race (67% vs. 79% White for stimulants and 67% vs. 83% for analgesics); mean sensation-seeking score (2.6 vs. 3.9 for stimulants and 2.7 vs. 4.1 for analgesics). Gender was not significantly associated with opportunity to use.

The findings of this study must be viewed in light of several limitations. Because participants in this study were recruited from one university, results may have limited generalizability to other populations of college students or young adults. Also, findings rely heavily on the self-reporting of socially undesirable behaviors, and although we have no indication that underreporting occurred, we cannot rule it out. Furthermore, by dichotomizing the outcome variables for this study (that is, past-year use vs. non-use), we used a relatively crude measure of nonmedical use, and although we did control for prior history of nonmedical use, we did not differentiate between individuals who used only once and those who used more heavily. Other studies with this cohort and similar populations indicate that most nonmedical use of prescription drugs occurs sporadically (Arria et al., In press-b; McCabe, Teter, & Boyd,

2006a; Prudhomme-White et al., 2006). Nevertheless, it is possible that the hypothesized risk factors would perform differently in predicting different levels of intensity of use.

Because this study involved a two-stage sampling design and multi-modal longitudinal followup, the estimates are subject to sampling bias and non-response/attrition bias. Although the response rates were fairly high overall, there is evidence for attrition bias. Namely males, students with higher levels of sensation-seeking and drug users were less likely to participate in each wave. Response rates did not differ significantly by race or mother's education. Applying statistical weights to adjust for both sampling and attrition bias did not change the results appreciably.

Another limitation is that sensation-seeking was measured at T_1, prior to the measurement of the primary predictor variable at T_2, instead of following the convention to measure these two variables concurrently. The reason for this is that we only became aware of the lack of national data regarding perceived harmfulness of nonmedical prescription drug use after we had started the longitudinal followup. Therefore, questions were then added to the six-month assessment. Moreover, there is a possibility that nonmedical prescription drug use might have occurred prior to the assessment of perceived harmfulness for some individuals because of the timeframe covered by the questions. Even though the timeframes are very close, it is possible that earlier nonmedical use of prescription drugs may influence the later development of attitudes, beliefs, and perceptions.

Finally, our analyses were limited to a focused set of predictor variables, namely perceived harmfulness and sensation-seeking. Once additional longitudinal data become available from this cohort study, analyses in the future can use more sophisticated modeling approaches and will include a broader set of independent variables such as family relationships, academic performance, and mental health.

In this cohort of college students, four out of five students associated a high risk of harm with occasional nonmedical use of prescription stimulants and/or analgesics. This finding is inconsistent with anecdotal evidence that most high school and college students think it is safe to use prescription drugs nonmedically (Friedman, 2006; Low & Gendaszek, 2002). Our findings are in need of replication, as there is little other empirical data available to gauge students' perception of the harmfulness of nonmedical drug use. If our findings are replicated on a larger scale, a strong case could be made for education regarding the consequences associated with unsupervised use of prescription medications. Initiatives that effectively raise the perceived harmfulness of prescription drug abuse, such as those created by NIDA in 2000 to spread information about the risks of ecstasy (Vincent, 2005; Zickler, 1999) could be an important informational component of a comprehensive drug prevention strategy.

Based on the present findings, educating students about the potential harm that can result from nonmedical use of prescription drugs may be a promising strategy for reducing college students' current and future risk for this behavior. On the other hand, individuals with high sensation-seeking—a high-risk population for drug use in general—may not benefit as much from this type of intervention. If these findings are confirmed, it might be prudent to identify effective alternative prevention strategies tailored to the needs of subpopulations that differ on sensation-seeking characteristics. For example, interventions aimed at substituting other novel and exciting activities for drug use have been suggested as a possible means of displacing high sensation-seekers' need to stimulate the dopamine system (Romer & Hennessy, 2007). Some evidence suggests that perceived harmfulness is but one of several health beliefs that change during the transition to young adulthood, and that other health beliefs such as a personal value for good health may be more directly responsible for the reduction in risky behaviors seen in adulthood (Chassin et al., 2001). Therefore, it may be productive for drug prevention

interventions with college students to have multiple components to address multiple risk factors, rather than perceived harmfulness alone.

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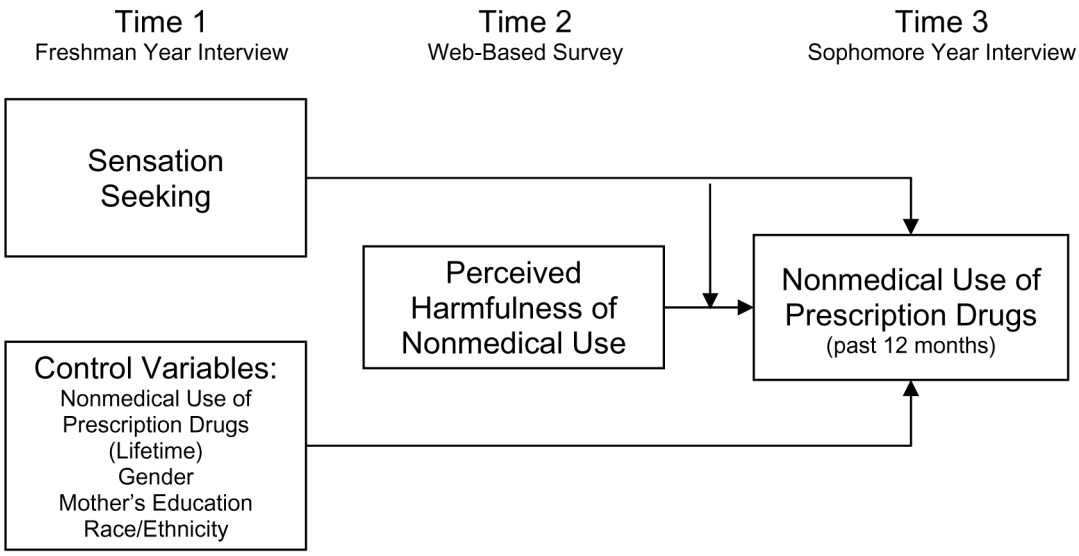

Figure 1.

Conceptual model predicting nonmedical use of prescription drugs on the basis of sensation-seeking, perceived harmfulness, and background variables using data collected prospectively during three assessments.[a]

[a] All variables shown were included in the prospective model as explanatory variables. Hypothesized relationships are depicted by arrows.

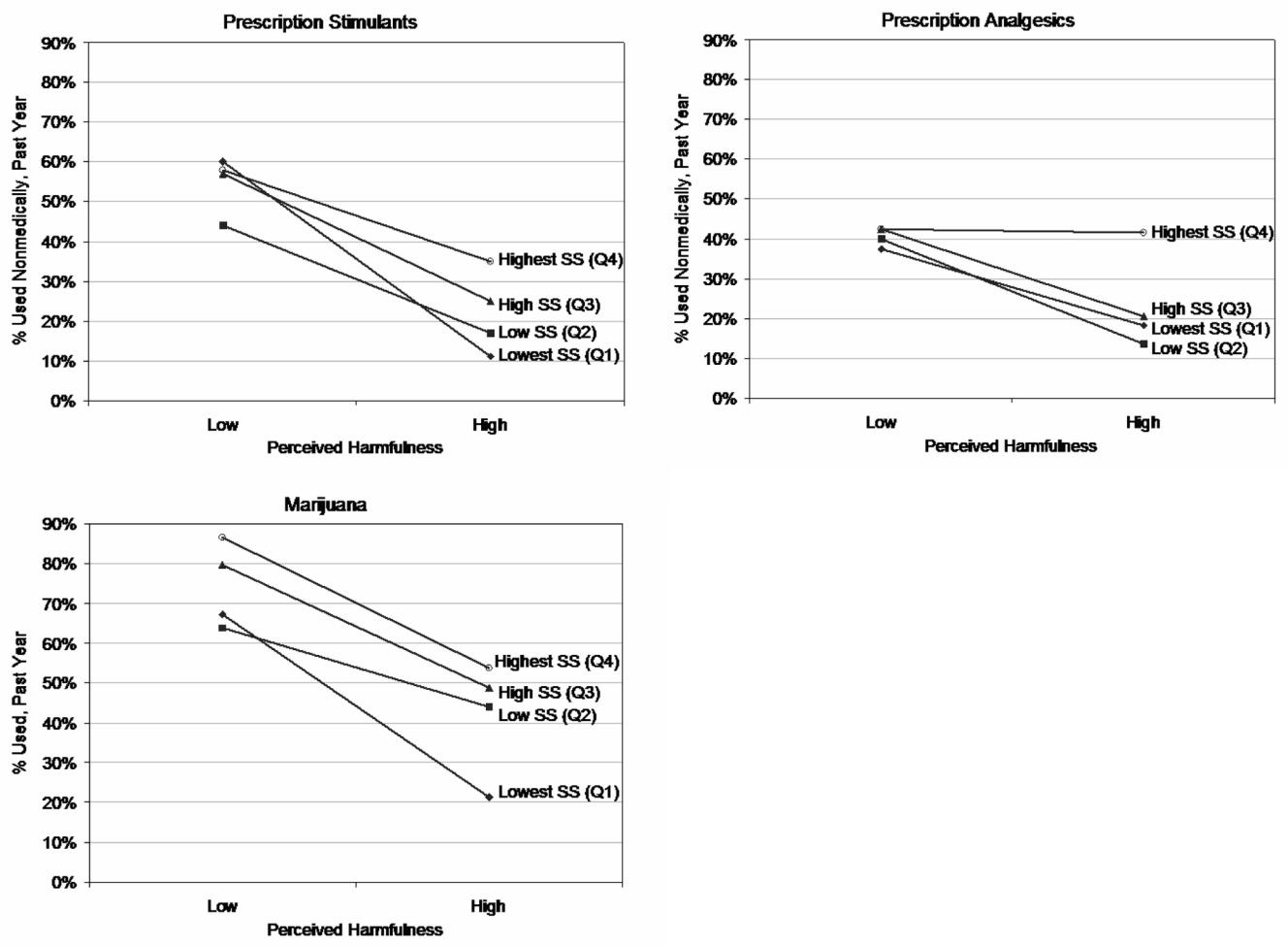

Figure 2.

Relationship between perceived harmfulness and impulsive sensation-seeking in predicting past-year nonmedical use of prescription stimulants, analgesics, and marijuana. Graphed lines represent results for each quartile (Q1, Q2, Q3, Q4) of sensation-seeking (SS). The level of perceived harmfulness is represented as “low” (no risk or slight risk) vs. “high” (moderate or great risk). The sample was restricted to individuals who were offered the drug at least once in their lives, participated in all three assessments, and had nonmissing data for all variables in the logistic regression models (*unweighted n*=347 for prescription stimulants, *unweighted n*=253 for prescription analgesics, *n*=697 for marijuana).

Table 1

Perceptions about the risk of harm from nonmedical use of prescription drugs and other substances, among college students (Weighted *N*=2,271).

	Percent of Students (Weighted) reporting Level of Risk				
	No Risk	**Slight Risk**	**Moderate Risk**	**Great Risk**	**Can't Say**
Prescription Stimulants	4.0%	22.0%	42.2%	25.2%	6.6%
Prescription Analgesics	2.0%	20.8%	42.4%	27.8%	7.0%
Marijuana	14.8%	47.1%	29.9%	7.2%	1.0%
Cocaine	0.8%	2.9%	22.0%	72.2%	2.1%
Alcohol	8.4%	35.2%	38.4%	17.4%	0.7%

Perceived harmfulness was assessed at Time 2. Frequencies were computed for 862 students who participated in all three assessments, and weighted to represent the general population of screened first year students (N_{wt}=2,271). Rows sum to 100% within rounding error. With the exception of alcohol, frequencies correspond to the perceived harmfulness associated with "occasional" nonmedical use of each drug. Perceived harmfulness of alcohol refers to having 5 or more drinks once or twice each weekend.

Table 2

Comparison of sample characteristics in the total sample and by level of perceived harmfulness of nonmedical use of prescription stimulants and prescription analgesics.

	Total Sample (*n*=390)	Students with opportunity to nonmedically use prescription stimulants (*n*=347)		*p*	Students with opportunity to nonmedically use prescription analgesics (*n*=253)		*p*
		Low perceived harmfulness (*n*=155)	High perceived harmfulness (*n*=192)		Low perceived harmfulness (*n*=97)	High perceived harmfulness (*n*=156)	
% Male	46.2	49.7	42.2	.16	46.4	49.4	.65
% White	79.2	84.5	74.5	.02	84.5	82.1	.61
Mother's education				.96			.28
% Less than 4 years of college	23.6	22.6	23.4		20.6	23.7	
% 4-year college degree	40.0	40.7	41.2		36.1	43.0	
% Graduate degree	36.4	36.8	35.4		43.3	33.3	
Mean (*SD*) Sensation-seeking score	3.8 (2.2)	4.0 (2.2)	3.7 (2.1)	.20	4.4 (2.1)	3.9 (2.2)	.08
% ever used prescription stimulants nonmedically by Time 1	23.3	36.8	16.2	<.01			
% ever used prescription analgesics nonmedically by Time 1	21.8				40.2	26.9	.03

Analyses were restricted to participants who were offered the drug at least once in their lives by Time 3 and participated in all three assessments (unweighted *n*=347 for prescription stimulants, unweighted n=253 for prescription analgesics). The “total sample” column describes the 390 individuals who were ever offered either drug. Data on perceived risk of harm from occasional nonmedical use were dichotomized as low (“no risk” or “slight risk”) vs. high (“moderate risk” or “great risk”).

Table 3

Results of logistic regression predicting nonmedical use of prescription drugs during the past year (Time 3), among those with opportunity to use.

	Prescription Stimulants		Prescription Analgesics	
	AOR (95% CI)	*p*	*AOR (95% CI)*	*p*
Low Perceived Harmfulness (Ref.=High)	10.3 (3.2-33.0)	<.0001	9.6 (2.1-44.0)	0.004
Sensation-Seeking	1.1 (1.0-1.2)	0.189	1.1 (0.9-1.3)	0.240
First-Order Interaction (Perceived Harmfulness*Sensation-Seeking)	0.8 (0.6-1.0)	0.034	0.7 (0.5-1.0)	0.023
Prior Nonmedical Use	4.6 (2.6-8.4)	<.0001	2.6 (1.4-5.0)	0.003

Analyses were restricted to participants who were offered the drug at least once in their lives by Time 3 and participated in all three assessments (*unweighted n*=347 for prescription stimulants, *unweighted n*=253 for prescription analgesics). Adjusted odds ratios indicate the likelihood of nonmedical use associated with having a lower level of perceived harm (“no risk” or “slight risk”), as compared to higher levels (“moderate” or “great risk”). All models held constant race, sex, and mother's education.