HHS Public Access

Author manuscript

*Addict Behav*. Author manuscript; available in PMC 2022 August 01.

Published in final edited form as:

*Addict Behav*. 2021 August ; 119: 106946. doi:10.1016/j.addbeh.2021.106946.

# Alcohol-related cognitions: Implications for concurrent alcohol and marijuana use and concurrent alcohol and prescription stimulant misuse among young adults

**Dana M. Litt**, **Ashley Lowery**, **Cassidy LoParco**, **Melissa A. Lewis**

Department of Health Behavior and Health Systems, School of Public Health, University of North Texas Health Science Center, Fort Worth, TX

## Abstract

**Introduction:** This study examined the associations between alcohol-related cognitions within the social reaction pathway of the Prototype Willingness Model and concurrent (use of two or more substances within a specified time period) use of 1) alcohol and marijuana and 2) alcohol and prescription stimulant misuse.

**Methods:** A convenience sample of 1,062 emerging adults in the U.S. (18 – 20 years old; 54.5% female) who reported past 3-month alcohol use completed a baseline survey as part of a larger randomized controlled trial.

**Results:** Results indicate that controlling for age, biological sex, race, ethnicity, and college enrollment, perceived descriptive norms and willingness to drink were associated with past 3-month concurrent alcohol and marijuana use and concurrent alcohol and prescription stimulant misuse. However, alcohol prototype similarity and alcohol-related perceived vulnerability were not associated with either concurrent use outcome examined.

**Discussion:** These findings suggest that alcohol-related perceived descriptive norms and willingness to drink are associated with concurrent substance use among young adults. Thus, it is possible that existing efficacious alcohol interventions that target descriptive norms and willingness to drink may have the added benefit of also reducing concurrent substance cognitions and ultimately use.

**CORRESPONDENCE:** Dana M. Litt, Dana.Litt@unthsc.edu.

Author CRediT Statement

Dana Litt was a Co-Investigator on the grant from which the study data was drawn and was in charge of study conceptualization, data analyses, paper writing, and coordination of authors. Ashley Lowery and Cassidy LoParco assisted with manuscript preparation. Melissa Lewis was the PI of the grant from which the study data was drawn and assisted the first author with manuscript preparation. All authors conducted multiple rounds of edits and revisions prior to submission.



Conflict of Interest

No conflict declared.

All authors have seen and approved the final version of the manuscript being submitted and verify that this is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere.

**Keywords**

Young Adults; Concurrent Substance Use; Alcohol; Cognitions; Prototype Willingness Model

## 1. Introduction

Substance use among young adults in the United States is a major public health concern (Birnbaum et al., 2011; Florence et al., 2016; Rehm et al., 2009). Despite possible consequences, young adults continue to use and/or misuse substances, including alcohol, marijuana, and prescription stimulants (National Institute of Drug Abuse [NIDA], 2015; Substance Abuse and Mental Health Services Administration [SAMHSA], 2020). Alcohol is often the first substance that adolescents and young adults experiment with prior to initiating use of other substances, including marijuana and prescription stimulants (Aiken et al., 2017; Richmond-Rakard et al., 2017; SAMHSA, 2019a). Moreover, early alcohol initiation is associated with later occurrences of abuse and dependence (DeWit et al., 2000; Grant et al., 2001; King & Chassin, 2007; Warner & White, 2003; York et al., 2004).

Despite alcohol being the most commonly used substance among young adults (SAMHSA, 2020), research indicates that many young adults who use alcohol also report using other substances including marijuana and nonmedical prescription drugs such as stimulants (Barrett et al., 2006; Derefinko et al., 2016; Pape et al., 2009; SAMHSA, 2020; Schulenberg & Maggs, 2002; Wiesner & Windle, 2004). Marijuana is the second most used substance within the U.S. (SAMHSA, 2020). Rates of marijuana use peak in young adulthood (SAMHSA, 2020) and are higher among males, racial and ethnic minorities, and those in college (Miech et al., 2016). The use of marijuana has been linked to acute effects such as impaired cognitive and motor functioning, as well as longer-term effects such as impaired memory and respiratory infections (Meier et al., 2012; Volkow et al., 2014).

Although used less frequently than alcohol or marijuana, the misuse of prescription stimulants is also problematic among young adults. Prescription stimulant misuse is typically defined as taking stimulants without a valid prescription or use of stimulants other than as prescribed, and occurs regularly in young adults (Austic, 2015; Benson et al., 2015; McCabe et al., 2014; Weyandt et al., 2013). In 2019, nearly 2% of all adults in the U.S. reported having ever misused prescription medications, with rates of use being significantly higher (nearly 6%) among young adults (SAMHSA, 2020) and those enrolled in college (between 6 – 17%; Benson et al., 2015), and lower among racial and ethnic minorities (Compton et al., 2018). Risks associated with excessive prescription stimulant use can include cardiovascular failure, irregular heartbeat, high blood pressure, and paranoia (Volkow, 2005).

Notably, research indicates that a significant portion of young adults engage in concurrent substance use, which is commonly defined as the use of two or more substances within a specified time. Concurrent substance use is particularly important to understand among young adults as this is the time when alcohol, marijuana, and prescription stimulant misuse peak (SAMSHA, 2020; Schulenberg et al., 2002). Estimates indicate that concurrent alcohol and marijuana use among young adults ranges between 34 – 75% (Haas et al., 2015; Moss et

al., 2014) and that 48.7% of young adults who use alcohol use also report misusing prescription stimulants (McCabe et al., 2015). Examining concurrent substance use during young adulthood is critical, as individuals who engage in concurrent substance use, including using alcohol with marijuana or stimulants, have an increased risk of experiencing negative health and social consequences, such as substance use disorders and negative alcohol-related consequences compared to those who are single-substance users (Conway et al., 2013; Green et al., 2016; Kelly et al., 2015; Lewis et al., under review; Moss et al., 2014; Yurasek et al., 2017). As such, it is important to identify social cognitive factors that may place one at risk for such use.

### 1.1 Prototype Willingness Model

The Prototype Willingness Model (PWM) posits that risk behavior among young adults operates through two pathways: a more planful and reasoned pathway and a social reaction pathway wherein risk behaviors are conceptualized as behaviors that are not planned but instead are reactions to risk-conducive environments (Gerrard et al., 2008; Gibbons et al., 2003). Although both the reasoned and social reaction pathways have utility in predicting risk behavior, the social reaction pathway is more predictive of behavior among adolescents and young adults (Gerrard et al., 2008; Pomery et al., 2009) and as such is the primary focus of the present paper. The PWM social reaction pathway is comprised of descriptive norms, prototypes, perceived vulnerability, and behavioral willingness (Gerrard et al., 2008). Descriptive norms, or perceptions of the quantity and frequency of a behavior among others (Cialdini et al., 1991; Reno et al., 1993), are a key part of the PWM social reaction pathway. In addition, prototypes are images of the type of person who engages in specific behaviors (e.g., typical drinker their age) and are often conceptualized as being two constructs, prototype favorability (i.e., perception that the prototype is associated with positive and/or negative attributes) and prototype similarity (i.e., perception of oneself as similar to the prototype)(Gerrard et al., 2008). However, recent research indicates that prototype similarity, but not favorability, is a stronger predictor of adolescent and young adult alcohol use when examining heavy-episodic drinking (Litt et al., 2020; Teunnisen et al., 2017). Perceived vulnerability is the perceived chance an individual has of experiencing negative consequences if they were to engage in a risky behavior (Gerrard et al., 2008). Finally, behavioral willingness is an openness to engage in a risk behavior under certain circumstances (Gerrard et al., 2008).

PWM social reaction pathway risk cognitions such as descriptive norms, prototype similarity, perceived vulnerability, and willingness are often established well before a behavior occurs (Ajzen 1985; Fishbein & Ajzen 1975; Gerrard et al., 2008). Therefore, cognitions related to a specific health behavior may also be described as having a predisposition to engage in that behavior. For example, endorsing riskier alcohol-related cognitions has consistently been found to be significantly associated with greater alcohol use (Andrews et al., 2008; Gerrard et al., 2002; Pomery et al., 2009; Rivis et al., 2006). Although less studied than alcohol use, research indicates that the PWM social reaction pathway is an appropriate model to apply to young adult marijuana use (Hampson et al., 2008; Lewis et al., 2018) and prescription stimulant misuse (Molloy et al., 2019; Stock et al., 2013).

Despite clear associations between PWM social reaction pathway alcohol-related cognitions and alcohol use, no research to date has examined whether these same cognitions are associated with *engagement* in other substance use, such as marijuana and prescription stimulant misuse. Given that alcohol is often the first substance initiated among adolescents and young adults (Grant et al., 2001; King & Chassin, 2007; York et al., 2004), determining what specific PWM social reaction pathway alcohol-related cognitions may be associated with concurrent use of other substances is important when determining when and on what factors to intervene. For example, alcohol is the most common prevention target for substance use among colleges and medical providers (Blevins & Khanna, 2016; SAMHSA, 2019b). Therefore, knowing whether certain PWM social reaction pathway alcohol-related cognitions are associated with concurrent use of other substances among current drinkers is one way to reduce screening burden as one may be able to determine whether current drinkers may also be at risk for concurrent substance use based on known associations between alcohol-related risk cognitions and the use of other substances. Thus, the present study aimed to determine whether alcohol-related PWM social reaction pathway cognitions are associated with concurrent substance use.

Based on the extant literature, we hypothesized that when controlling for important covariates (i.e., age, biological sex, race, ethnicity, and college enrollment), alcohol-related PWM social reaction pathway cognitions (descriptive norms, prototype similarity, perceived vulnerability, and willingness) would be associated with 1) concurrent use of alcohol and marijuana and 2) concurrent use of alcohol and prescription stimulant misuse over the past 3 months among young adult drinkers age 18 – 20.

## 2. Method

### 2.1 Participants and Procedures

Participants for the present study included 1,065 18–20-year-old young adults who were participating in a larger study evaluating an intervention for alcohol-related risky sexual behavior. Data for the present analyses come from the baseline assessment. Demographics for the baseline sample include a mean age of 19.17 years old ($SD = 0.79$) and 54.5% were female. Ethnic and racial representation of the baseline sample was as follows: 15.1% Hispanic/Latino; 70.5% White, 10.3% Other/More than one race, 9.7% Asian, 7.9% African American, 1.2% American Indian/Alaska Native, and 0.4% Native Hawaiian/Pacific Islander. College enrollment for the sample was 72.70% attending a 4-year university, 11.20% not enrolled in any form of schooling, 7.56% attending a community college, 1.87% attending high school, 0.69% attending a technical/vocational college, and 0.49% attending a graduate/professional school. Participants for this study were recruited nationally through various methods (e.g., social media advertisements, flyering, and newspaper ads) and were asked to complete a five-minute web-based screening survey to determine if they met inclusion criteria for the longitudinal study. Eligibility criteria included: age 18 – 20; not be in a monogamous relationship, or be in a monogamous relationship for less than three months and be open to having a sexual relationship with someone other than a monogamous partner; have had sex in the past three months; and have had an alcoholic drink at least twice a month on average over the past 3 months. Of those participants who completed the

eligibility survey ($N$ = 17,899), 1,144 participants were eligible and were invited to complete the baseline survey and longitudinal study.

Upon receiving the baseline survey invitation, participants were presented with a full information statement. Of the participants invited to the baseline survey, 1,065 (93.1%) completed the survey. Three participants were removed from analyses as they did not report any alcohol use at baseline, despite having reported past 3-month alcohol use at screening; thus, the final analytic sample consisted of 1,062 participants. Participants who completed the baseline survey received a $25 gift certificate. A Federal Certificate of Confidentiality was obtained to help ensure privacy of research participants. All study procedures were approved by the University's Institutional Review Board, and no adverse events were reported.

## 2.2 Measures

**2.2.1 Alcohol Use—**Participants were asked to report, "On average, during the past 3 months, how often have you consumed alcohol" and responded on an 11-point scale ranging from 0 (Never) to 11 (Every Day; Collins et al., 1985).

**2.2.2 Marijuana Use—**In an item parallel to the alcohol use item, participants were asked "Within the past 3 months, how often have you used marijuana or cannabis" and responded on an 11-point scale ranging from 0 (Never) to 11 (Every day).

**2.2.3 Prescription Stimulant Misuse—**Participants reported how many times they used prescription stimulants (e.g., Ritalin, Adderall, Concerta, methylphenidate) either without a prescription or in a way not prescribed in the past 3 months. Responses were open-ended but capped at 90 times.

**2.2.4 Concurrent Use—**Because all participants in the sample reported alcohol use within the past 3 months, any use of either marijuana or prescription stimulant misuse in the same time frame (i.e., past 3 months) was considered to be concurrent use in the present study. To create the concurrent alcohol and marijuana use outcome variable, descriptive statistics were conducted for those participants who reported any marijuana use. Among those with at least 1 day of marijuana use, the median days used was 10 days, which was used as the cut-off to delineate lower frequency marijuana use from higher frequency marijuana use. Thus, concurrent alcohol and marijuana use was coded into three categories which represented alcohol only (past 3 months any alcohol use and no use of marijuana), alcohol and lower frequency of marijuana use (past 3 months any alcohol use and 10 or fewer days of marijuana use), and alcohol and higher frequency marijuana use (past 3 months of any alcohol and 11 or more days of marijuana use). Because of lower base rates of prescription stimulant misuse, concurrent alcohol and prescription stimulant misuse was dichotomized into two categories which represented alcohol only (past 3 months any alcohol use and no prescription stimulant misuse) and concurrent alcohol and prescription stimulant misuse (past 3 months any alcohol use and past 3 months any prescription stimulant misuse).

**2.2.5 Perceived Descriptive Drinking Norms—**A single item from the Drinking Norms Rating Form (DNRF; Baer et al., 1991) was used to assess perceived peer drinking

over the past 3 months with the question, “How often do you think a typical male/female your age consumes alcohol? Responses were on a scale ranging from 0 (Never) to 11 (Every Day).

**2.2.6 Prototype Similarity—**Based on previous research indicating that prototype similarity, but not favorability, is associated with heavy drinking (Litt et al., 2020; Teunnisen et al., 2017), only prototype similarity was utilized in the present study. Prototype similarity was assessed with the item “How similar are you to the typical male/female your age who drinks 4/5 or more drinks in about 2 hours?” (Litt et al., 2020). Responses ranged from 1 (Not at All Similar) to 7 (Very Similar).

**2.2.7 Perceived Vulnerability—**Perceived vulnerability was assessed with four items (Litt & Lewis, 2016) in response to a stem that read “How much do you think drinking alcohol at the varying levels (i.e., having 1 – 2 drinks nearly every day, having 1 – 2 drinks each weekend, having 3 – 4 drinks each weekend, and having 5 – 6 drinks each weekend) might cause you risk?” Response options ranged from 0 (Very Unlikely) to 5 (Very Likely). Responses were mean scored ($\alpha$ = .78).

**2.2.8 Willingness to Drink—**Participants were presented with the following hypothetical scenario (Gerrard et al., 2008; Litt & Lewis, 2016): “Suppose that you are at a party. After two drinks you are beginning to feel that you may have had enough, and you are getting ready to leave. A friend you haven’t seen for a while starts talking to you and offers to get you another drink. How willing would you be to do each of the following?”: “choose a non-alcoholic drink instead” (reverse scored), “stay and have one more drink”, “stay and continue to drink 2/3 (based on birth sex) or more drinks”, “say no to the drink offer” (reverse scored), and “leave the party to reduce pressure to drink from others” (reverse scored). Responses ranged from 0 (Not at all Willing) to 4 (Completely Willing). The mean of the five questions ($\alpha$ = .85) was used to represent a participant’s willingness to drink.

**2.2.9 Covariates—**Age, biological sex (Female = 0, Male = 1), race (0 = Non-White, 1 = White), ethnicity (0 = Non-Hispanic, 1 = Hispanic) and college enrollment (0 = Not enrolled in 4-year college, 1 = Enrolled in 4-year college) were included as covariates based on associations with substance use (Schulenberg et al., 2020).

## 2.3 Data Analytic Plan

Because of the ordinal nature of the marijuana use outcome variable (0 = alcohol only, 1 = alcohol and lower frequency of marijuana use, and 2 = alcohol and higher frequency of marijuana use), an ordered logistic regression model evaluated concurrent alcohol and marijuana use. For the model evaluating past 3-month concurrent alcohol and prescription stimulant misuse (0 = alcohol only, 1 = alcohol and prescription stimulant misuse), a logistic regression model was used. All models controlled for age, birth sex, race, ethnicity, and college enrollment.

# 3. Results

## 3.1 Descriptive Statistics and Correlations

Participants reported drinking, on average, nearly twice per week ($M = 5.82$, $SD = 1.72$). On average, participants reported using marijuana a little more than twice per month ($M = 4.34$, $SD = 3.76$) and prescription stimulants were misused on an average of 1.19 ($SD = 5.38$) occasions in the past 90 days. Over the past 3 months, 14.5% of participants only used alcohol, 85% of the sample reported concurrent alcohol and marijuana use, 24% reported concurrent alcohol and prescription stimulant misuse, while 25.3% used all three substances. Correlation analyses (Table 1) indicate that both concurrent alcohol and marijuana use and concurrent alcohol and prescription stimulant misuse were positively associated with being male, White, enrolled in 4 year college, and having higher perceived descriptive norms and willingness to drink. All correlation results should be interpreted cautiously due to the large sample size.

## 3.2 Concurrent Alcohol and Marijuana Use

Results of the ordered logistic regression indicated that while neither age nor ethnicity were associated concurrent alcohol and marijuana use, being male, White, and a current 4-year college student were associated with increases in the ordered log odds of concurrent alcohol and marijuana use. Higher descriptive norms and willingness to drink were also associated with increases in the ordered log odds of concurrent alcohol and marijuana use, whereas there were not significant associations for prototype similarity or perceived vulnerability. See Table 2.[1]

## 3.3 Concurrent Alcohol and Prescription Stimulant Misuse

Biological sex, age, ethnicity, and college enrollment were not associated with concurrent alcohol and prescription stimulant misuse. Being White was associated with greater odds of concurrent alcohol and prescription stimulant misuse. Similar to marijuana use, while prototypes and perceived vulnerability were not associated with concurrent alcohol and prescription stimulant misuse, results indicated that having greater descriptive normative perceptions and being more willing to use alcohol were associated with having a greater odds of concurrent alcohol and prescription stimulant misuse in the past 3 months. See Table 3.

# 4. Discussion

The current findings suggest that, beyond being associated with cognitions about other substances (Andrews et al., 2008; Blanton et al., 1997; Gibbons et al., 2004), several alcohol-related PWM social reaction pathway cognitions are also associated with the actual concurrent use of alcohol with marijuana and prescription stimulant misuse. Results of the

[1]A linear regression analysis was conducted examining associations between PWM social reaction pathway risk cognitions and past 3-month alcohol use frequency with the same covariates included in the primary statistical models. Results indicated that all PWM social reaction pathway risk cognitions (descriptive norms: $\beta = 0.12$, $t = 3.86$, $p < .001$; prototype similarity: $\beta = 0.15$, $t = 5.15$, $p < .001$; perceived vulnerability: $\beta = -0.18$, $t = -6.06$, $p < .001$; willingness: $\beta = 0.16$, $t = 5.40$, $p < .001$) were associated with alcohol use frequency in the expected directions.

study indicate that in particular, perceived descriptive norms and willingness to drink are associated with both concurrent alcohol and marijuana use and concurrent alcohol and prescription stimulant misuse among current drinkers. Given that for drinking, perceived descriptive norms and willingness to drink have been shown to be some of the strongest predictors of alcohol use in comparison to other drinking cognitions (Litt & Lewis, 2016; Neighbors et al., 2007), it is not surprising that in this sample they were associated with the likelihood of engaging in concurrent alcohol and marijuana use and concurrent alcohol and prescription stimulant misuse.

Contrary to hypotheses, neither prototype similarity nor perceived vulnerability were associated with either concurrent use outcome. Although it is unclear why we did not find associations between prototype similarity and concurrent substance use, one possibility is that there are unique images about someone who concurrently uses substances that cannot be captured by alcohol prototypes alone, and thus young adults may not consider alcohol prototype similarity when deciding to engage in concurrent substance use. Further, it is possible that the heavy episodic drinker prototype was not salient for the participants in the present study. Related to the lack of significant findings for perceived vulnerability, it is unclear why perceived vulnerability for alcohol was not associated with concurrent substance use outcomes. This surprising finding should be further explored.

### 4.1 Clinical Implications

Results of the present study suggest that interventions aiming to reduce specific alcohol-related risk cognitions may also lead to reductions in concurrent use of alcohol with both marijuana and prescription stimulant misuse. Although the current data cannot speak to directionality, based on prior literature (Lewis et al., 2014) it is possible that providing personalized feedback related to risk cognitions for one behavior may also reduce risky cognitions for a related health behavior. These findings indicate that there are likely social cognitive similarities in the underlying mechanism behind substance use in young adults, *regardless of the type of substance*. Given that alcohol use, marijuana use, and prescription stimulant misuse may be comorbid (Moss et al., 2014; Schuckit, 2009; Whiteford et al., 2013), it is important for researchers to further investigate the associations between the use of various substances and how cognitions about one substance may impact the concurrent use of other substances. Thus, interventions targeting cognitions associated with concurrent use prior to concurrent use starting would be an important area for future research to explore, especially among adolescents.

### 4.2 Limitations and Future Directions

Although the current study consisted of a large national sample of young adults aged 18 – 20 years old, there are a few limitations to consider. First, given the select inclusion criteria of the original study to include young adults age 18 – 20 based on both drinking and sex criteria, the authors caution generalizing these results to those outside of these criteria. Compared to recent estimates by the U.S. Census Bureau (2020) for those age 18–24, our sample had fewer males (51% versus 45.5%) as well as fewer White (73% versus 70.5%), African-American (15% versus 7.9%), American Indian/Alaska Native (1.5% versus 1.2%) and Hispanic/Latino (23% versus 15.1%) participants. However, our sample contained

greater percentages of Asian (6% versus 9.7%) participants as well as those who identified as other/more than race (4% versus 10.3%). Thus, our results may not generalize to the U.S population as a whole. Future studies should also be conducted among different age groups to test if these associations still hold at younger and older ages, due to cognitions becoming less reactive and more rational as an individual ages (Gerrard et al., 2008; Pomery et al., 2009). In addition, because of the cross-sectional nature of this study, directionality between study variables cannot be tested nor can it provide a thorough understanding of the mechanisms related to how past behavior may influence subsequent social reaction pathway PWM cognitions and future behavior. Thus, future longitudinal and/or daily-level research is needed to understand associations between alcohol-related PWM social reaction pathway cognitions and concurrent substance use. Further, it is possible that PWM social reaction pathway cognitions specific to marijuana use and/or prescription stimulant misuse may be associated with concurrent substance use above and beyond alcohol cognitions, and thus research should determine which substance-related cognitions are the most predictive of concurrent use. Finally, research should examine the utility of alcohol cognitions in predicting simultaneous use (i.e., use with overlapping effect) as well as engagement in alternative categories of concurrent substance use, including concurrent alcohol and tobacco use, as many young adults engage in this behavior (Gubner et al., 2018; McKee & Weinberger, 2013).

### 4.3 Conclusion

The current study extends the literature related to the associations between alcohol cognitions and health-risk behavior by providing evidence that two alcohol-related PWM social reaction pathway cognitions, perceived descriptive norms and willingness, are not only associated with alcohol use as shown in a variety of other studies (e.g., Blanton et al., 1997; Litt & Stock, 2011; Pomery et al., 2009), but also the concurrent use of alcohol and other substances including marijuana and prescription stimulant misuse.

## Acknowledgments

Data collection and manuscript preparation were supported by a grant from the National Institute on Alcohol Abuse and Alcoholism (R01AA021379) awarded to Dr. Melissa A. Lewis. The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Alcohol Abuse and Alcoholism or the National Institutes of Health.

## References

Aiken A, Clare PJ, Wadolowski M, Hutchinson D, Najman JM, Slade T, Bruno R, McBride N, Kypri K, & Mattick RP (2018). Age of alcohol initiation and progression to binge drinking in adolescence: A prospective cohort study. Alcoholism, Clinical and Experimental Research, 42(1), 100–110. 10.1111/acer.13525

Ajzen I (1985). From intentions to actions: A theory of planned behavior. In: Kuhl J, Beckmann J (Eds.) Action Control. SSSP Springer Series in Social Psychology. Springer, Berlin, Heidelberg. 10.1007/978-3-642-69746-3_2

Andrews JA, Hampson SE, Barckley M, Gerrard M, & Gibbons FX (2008). The effect of early cognitions on cigarette and alcohol use in adolescence. Psychology of Addictive Behaviors, 22(1), 96–106. 10.1037/0893-164X.22.1.96 [PubMed: 18298235]

Austic EA (2015). Peak ages of risk for starting nonmedical use of prescription stimulants. Drug and Alcohol Dependence, 152, 224–229. 10.1016/j.drugalcdep.2015.03.034 [PubMed: 25908322]

Baer JS, Stacy A, & Larimer M (1991). Biases in the perception of drinking norms among college students. Journal of Studies on Alcohol, 52(6), 580–586. 10.15288/jsa.1991.52.580 [PubMed: 1758185]

Barrett SP, Darredeau C, & Pihl RO (2006). Patterns of simultaneous polysubstance use in drug using university students. Human Psychopharmacology 21(4), 255–263. 10.1002/hup.766 [PubMed: 16783813]

Benson K, Flory K, Humphreys KL, & Lee SS (2015). Misuse of stimulant medication among college students: A comprehensive review and meta-analysis. Clinical Child and Family Psychology Review, 18(1), 50–76. 10.1007/s10567-014-0177-z [PubMed: 25575768]

Birnbaum HG, White AG, Schiller M, Waldman T, Cleveland JM, & Roland CL (2011). Societal costs of prescription opioid abuse, dependence, and misuse in the United States. Pain Medicine, 12(4), 657–667. 10.1111/j.1526-4637.2011.01075.x [PubMed: 21392250]

Blevins D, & Khanna S (2016). Clinical implications of substance abuse in young adults. Psychiatric Times, 33(1), 14–16.

Cialdini RB, Kallgren CA, & Reno RR (1991). A focus theory of normative conduct: A theoretical refinement and reevaluation for the role of norms in human behavior. Advances in Experimental Social Psychology, 24, 201–234. 10.1016/S0065-2601(08)60330-5

Compton WM, Han B, Blanco C, Johnson K, & Jones CM (2018). Prevalence and correlates of prescription stimulant use, misuse, use disorders, and motivations for misuse among adults in the United States. The American Journal of Psychiatry, 175(8), 741–755. 10.1176/appi.ajp.2018.17091048 [PubMed: 29656665]

Conway KP, Vullo GC, Nichter B, Wang J, Compton WM, Iannotti RJ, & Simons-Morton B (2013). Prevalence and patterns of polysubstance use in a nationally representative sample of 10th graders in the United States. The Journal of Adolescent Health, 52(6), 716–723. 10.1016/j.jadohealth.2012.12.006 [PubMed: 23465320]

Derefinko KJ, Charnigo RJ, Peters JR, Adams ZW, Milich R, & Lynam DR (2016). Substance use trajectories from early adolescence through the transition to college. Journal of Studies on Alcohol and Drugs, 77(6), 924–935. 10.15288/jsad.2016.77.924 [PubMed: 27797694]

DeWit DJ, Adlaf EM, Offord DR, & Ogborne AC (2000). Age at first alcohol use: A risk factor for the development of alcohol disorders. American Journal of Psychiatry, 157(5), 745–750. 10.1176/appi.ajp.157.5.745

Fishbein M, & Ajzen I (1975). Belief, attitude, intention, and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley.

Florence C, Luo F, Xu L, & Zhou C (2016). The economic burden of prescription opioid overdose, abuse and dependence in the United States, 2013. Medical Care, 54(10), 901–906. 10.1097/MLR.0000000000000625 [PubMed: 27623005]

Gerrard M, Gibbons FX, Houlihan AE, Stock ML, & Pomery EA (2008). A dual-process approach to health risk decision making: The Prototype Willingness Model. Developmental Review, 28(1), 29–61. 10.1016/j.dr.2007.10.001

Gerrard M, Gibbons FX, Reis-Bergan M, Vande Lune LS, & Buunk B (2002). Inhibitory effects of drinker and nondrinker prototypes on adolescent alcohol consumption. Health Psychology, 21(6), 601–609. 10.1037//0278-6133.21.6.601 [PubMed: 12433013]

Gibbons FX, Gerrard M, & Lane DJ (2003). A social reaction model of adolescent health risk. In Suls J & Wallston KA (Eds.), Blackwell series in health psychology and behavioral medicine. Social psychological foundations of health and illness (p. 107–136). Blackwell Publishing. 10.1002/9780470753552.ch5

Grant BF, Stinson FS, & Harford TC (2001). Age at onset of alcohol use and DSM-IV alcohol abuse and dependence: A 12-year follow-up. Journal of Substance Abuse, 13(4), 493–504. 10.1016/s0899-3289(01)00096-7 [PubMed: 11775078]

Green KM, Musci RJ, Johnson RM, Matson PA, Reboussin BA, & Ialongo NS (2016). Outcomes associated with adolescent marijuana and alcohol use among urban young adults: A prospective study. Addictive Behaviors, 53, 155–160. 10.1016/j.addbeh.2015.10.014 [PubMed: 26517712]

Gubner NR, Thrul J, Kelly OA, & Ramo DE (2018). Young adults report increased pleasure from smoking cigarettes when drinking alcohol but not when using marijuana. Addiction Research & Theory, 26(1), 71–76. 10.1016/j.addbeh.2019.01.011 [PubMed: 29371859]

Haas AL, Wickham R, Macia K, Shields M, Macher R, & Schulte T (2015). Identifying classes of conjoint alcohol and marijuana use in entering freshmen. Psychology of Addictive Behaviors, 29(3), 620–626. 10.1037/adb0000089 [PubMed: 26168228]

Hampson SE, Andrews JA, & Barckley M (2008). Childhood predictors of adolescent marijuana use: Early sensation-seeking, deviant peer affiliation, and social images. Addictive Behaviors, 33(9), 1140–1147. 10.1016/j.addbeh.2008.04.010 [PubMed: 18547739]

Kelly AB, Chan GCK, Mason WA, & Williams JW (2015). The relationship between psychological distress and adolescent polydrug use. Psychology of Addictive Behaviors, 29(3), 787–793. 10.1037/adb0000068 [PubMed: 26415064]

King KM, & Chassin L (2007). A prospective study of the effects of age of initiation of alcohol and drug use on young adult substance dependence. Journal of Studies on Alcohol and Drugs, 68(2), 256–265. 10.15288/jsad.2007.68.256 [PubMed: 17286344]

Lewis MA, Litt DM, King KM, Garcia TA, Waldron KA, & Lee CM (2018). Consideration of future consequences as a moderator of the willingness-behavior relationship for young adult marijuana use and consequences. Addictive Behaviors, 87, 8–16. 10.1016/j.addbeh.2018.06.010 [PubMed: 29940391]

Lewis MA, Patrick ME, Litt DM, Atkins DC, Kim T, Blayney JA, Norris J, George WH, & Larimer ME (2014). Randomized controlled trial of a web-delivered personalized normative feedback intervention to reduce alcohol-related risky sexual behavior among college students. Journal of Consulting and Clinical Psychology, 82(3), 429–440. 10.1037/a0035550 [PubMed: 24491076]

Lewis MA, Zhou Z, Parks K, Evan-Polce R, Litt DM, Fairlie A, LoParco CR, McCabe SE The role of polysubstance use in experiencing alcohol-related negative sexual consequences. Manuscript submitted for publication.

Litt DM, & Lewis MA (2016). Examining a social reaction model in the prediction of young adult alcohol use. Addictive Behaviors, 60, 160–164. 10.1016/j.addbeh.2016.04.009 [PubMed: 27155242]

Litt DM, Lewis MA, Fairlie AM, & Head-Corliss M (2020). Determining the predictive utility of prototype favorability and prototype similarity related to young adult risky behavior. Emerging Adulthood, 8, 168–174. 10.1177/2167696818790827

Litt DM, & Stock ML (2011). Adolescent alcohol-related risk cognitions: The roles of social norms and social networking sites. Psychology of Addictive Behaviors, 25(4), 708–713. 10.1037/a0024226 [PubMed: 21644803]

McCabe SE, West BT, Schepis TS, & Teter CJ (2015). Simultaneous co-ingestion of prescription stimulants, alcohol and other drugs: A multi-cohort national study of US adolescents. Human Psychopharmacology, 30(1), 42–51. 10.1002/hup.2449 [PubMed: 25370816]

McCabe SE, West BT, Teter CJ, & Boyd CJ (2014). Trends in medical use, diversion, and nonmedical use of prescription medications among college students from 2003 to 2013: Connecting the dots. Addictive Behaviors, 39(7), 1176–1182. 10.1016/j.addbeh.2014.03.008 [PubMed: 24727278]

McKee SA, & Weinberger AH (2013). How can we use our knowledge of alcohol-tobacco interactions to reduce alcohol use? Annual Review of Clinical Psychology, 9, 649–674. 10.1146/annurev-clinpsy-050212-185549

Meier MH, Caspi A, Ambler A, Harrington H, Houts R, Keefe RS, McDonald K, Ward A, Poulton R, & Moffitt TE (2012). Persistent cannabis users show neuropsychological decline from childhood to midlife. Proceedings of the National Academy of Sciences of the United States of America, 109(40), E2657–E2664. 10.1073/pnas.1206820109 [PubMed: 22927402]

Miech RA, Johnston LD, O'Malley PM, Bachman JG, & Schulenberg JE (2016). Monitoring the Future national survey results on drug use, 1975–2015: Volume I, Secondary school students. Ann Arbor: Institute for Social Research, The University of Michigan. http://monitoringthefuture.org/pubs.html#monographs

Molloy BK, Stock ML, Dodge T, & Aspelund JG (2019). Predicting future academic willingness, intentions, and nonmedical prescription stimulant (NPS) use with the Theory of Reasoned Action

and Prototype/Willingness Model. Substance Use & Misuse, 54(14), 2251–2263. 10.1080/10826084.2019.1645175 [PubMed: 31359819]

Moss HB, Chen CM, & Yi HY (2014). Early adolescent patterns of alcohol, cigarettes, and marijuana polysubstance use and young adult substance use outcomes in a nationally representative sample. Drug and Alcohol Dependence, 136, 51–62. 10.1016/j.drugalcdep.2013.12.011 [PubMed: 24434016]

National Institute on Drug Abuse. (2015). Drug facts: Nationwide trends. https://www.drugabuse.gov/publications/drugfacts/nationwide-trends

Neighbors C, Lee CM, Lewis MA, Fossos N, & Larimer ME (2007). Are social norms the best predictor of outcomes among heavy-drinking college students? Journal of Studies on Alcohol and Drugs, 68(4), 556–565. 10.15288/jsad.2007.68.556 [PubMed: 17568961]

Pape H, Rossow I, & Storvoll EE (2009). Under double influence: Assessment of simultaneous alcohol and cannabis use in general youth populations. Drug and Alcohol Dependence, 101(1–2), 69–73. 10.1016/j.drugalcdep.2008.11.002 [PubMed: 19095380]

Pomery EA, Gibbons FX, Reis-Bergan M, & Gerrard M (2009). From willingness to intention: Experience moderates the shift from reactive to reasoned behavior. Personality and Social Psychology Bulletin, 35(7), 894–908. 10.1177/0146167209335166 [PubMed: 19429884]

Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, & Patra J (2009). Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. The Lancet, 373(9682), 2223–2233. 10.1016/S0140-6736(09)60746-7.

Reno RR, Cialdini RB, & Kallgren CA (1993). The transsituational influence of social norms. Journal of Personality and Social Psychology, 64(1), 104–112. 10.1037/0022-3514.64.1.104

Richmond-Rakerd LS, Slutske WS, & Wood PK (2017). Age of initiation and substance use progression: A multivariate latent growth analysis. Psychology of Addictive Behaviors 31(6), 664–675. 10.1037/adb0000304 [PubMed: 28805408]

Rivis A, Sheeran P, & Armitage CJ (2006). Augmenting the theory of planned behaviour with the prototype/willingness model: Predictive validity of actor versus abstainer prototypes for adolescents' health-protective and health-risk intentions. British Journal of Health Psychology, 11(Pt 3), 483–500. 10.1348/135910705X70327 [PubMed: 16870057]

Schuckit MA (2009). Alcohol-use disorders. The Lancet, 373(9662), 492–501. 10.1016/S0140-6736(09)60009-X

Schulenberg JE, Johnston LD, O'Malley PM, Bachman JG, Miech RA & Patrick ME (2020). Monitoring the Future national survey results on drug use, 1975–2019: Volume II, College students and adults ages 19–60. Ann Arbor: Institute for Social Research, The University of Michigan. Available at http://monitoringthefuture.org/pubs.html#monographs

Schulenberg JE, & Maggs JL (2002). A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. Journal of Studies on Alcohol, Supplement, (14), 54–70. 10.15288/jsas.2002.s14.54 [PubMed: 12022730]

Stock ML, Litt DM, Arlt V, Peterson LM, & Sommerville J (2013). The prototype/willingness model, academic versus health-risk information, and risk cognitions associated with nonmedical prescription stimulant use among college students. British Journal of Health Psychology, 18(3), 490–507. 10.1111/j.2044-8287.2012.02087.x [PubMed: 23013235]

Substance Abuse and Mental Health Services Administration. (2019a). Key substance use and mental health indicators in the United States: Results from the 2018 National Survey on Drug Use and Health (HHS Publication No. PEP19–5068, NSDUH Series H-54). https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHNationalFindingsReport2018/NSDUHNationalFindingsReport2018.pdf

Substance Abuse and Mental Health Services Administration. (2019b): Substance Misuse Prevention for Young Adults (Publication No. PEP19-PL-Guide-1). https://store.samhsa.gov/sites/default/files/d7/priv/pep19-pl-guide-1.pdf

Substance Abuse and Mental Health Services Administration. (2020). Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health (HHS Publication No. PEP20-07-01-001, NSDUH Series H-55). https://www.samhsa.gov/

data/sites/default/files/reports/rpt29393/2019NSDUHFFRPDFWHTML/2019NSDUHFFR090120.htm

Teunissen HA, Spijkerman R, Kuntsche E, Engels RC, & Scholte RH (2017). Cool or fool? The association between drinker prototypes and alcohol consumption using multiple time-point diary assessments in adolescent males. Substance Use & Misuse, 52, 656–665. 10.1080/10826084.2016.1253743 [PubMed: 28139157]

U.S. Census Bureau (2020). 2019 Population Estimates by Age, Sex, race, and Hispanic origin. Retrieved from https://www.census.gov/newsroom/press-kits/2020/population-estimates-detailed.html

Volkow ND (2005). Prescription drugs: Abuse and addiction. National Institute on Drug Abuse. http://venturacountylimits.org.s94613.gridserver.com/resource_documents/rrprescription.pdf

Volkow ND, Baler RD, Compton WM, & Weiss SR (2014). Adverse health effects of marijuana use. New England Journal of Medicine, 370(23), 2219–2227. 10.1056/NEJMra1402309

Warner LA, & White HR (2003). Longitudinal effects of age at onset and first drinking situations on problem drinking. Substance Use & Misuse, 38(14), 1983–2016. 10.1081/JA-120025123 [PubMed: 14677779]

Weyandt LL, Marraccini ME, Gudmundsdottir BG, Zavras BM, Turcotte KD, Munro BA, & Amoroso AJ (2013). Misuse of prescription stimulants among college students: a review of the literature and implications for morphological and cognitive effects on brain functioning. Experimental and Clinical Psychopharmacology, 21(5), 385–407. 10.1037/a0034013 [PubMed: 24099359]

Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, Charlson FJ, Norman RE, Flaxman AD, Johns N, Burstein R, Murray CJ, & Vos T (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. Lancet, 382(9904), 1575–1586. 10.1016/S0140-6736(13)61611-6 [PubMed: 23993280]

Wiesner M, & Windle M (2004). Assessing covariates of adolescent delinquency trajectories: A latent growth mixture modeling approach. Journal of Youth and Adolescence, 33(5), 431–442. 10.1023/B:JOYO.0000037635.06937.13

York JL, Welte J, Hirsch J, Hoffman JH, & Barnes G (2004). Association of age at first drink with current alcohol drinking variables in a national general population sample. Alcoholism: Clinical and Experimental Research, 28(9), 1379–1387. 10.1097/01.ALC.0000139812.98173.A4

Yurasek AM, Aston ER, & Metrik J (2017). Co-use of Alcohol and Cannabis: A Review. Current Addiction Reports, 4(2), 184–193. 10.1007/s40429-017-0149-8 [PubMed: 32670740]

## Highlights

- A large number of young adults age 18–20 engage in concurrent substance use.
- Certain alcohol-related cognitions are associated with concurrent substance use.
- Reducing alcohol-related cognitions may help reduce concurrent substance use.

**Table 1**

Correlations and Descriptive Information Among Key Study Variables

| Statistic/Measure | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Correlations | | | | | | | | | | | |
| 1. Age | - | | | | | | | | | | |
| 2. Biological Sex | 0.10 | - | | | | | | | | | |
| 3. Race | 0.09** | 0.05 | - | | | | | | | | |
| 4. Ethnicity | 0.01 | 0.01 | −0.09** | - | | | | | | | |
| 5. College Enrollment | 0.03 | 0.04 | 0.02 | 0.08** | - | | | | | | |
| 6. Alcohol Descriptive Norms | 0.09** | 0.25** | −0.02 | −0.05 | −0.01 | - | | | | | |
| 7. Alcohol Prototypes | 0.06* | −0.13** | 0.14** | −0.04 | −0.12* | 0.03 | - | | | | |
| 8. Alcohol Perceived Vulnerability | −0.09** | −0.12** | −0.09** | 0.08** | −0.01 | −0.20** | −0.12* | - | | | |
| 9. Alcohol Willingness | −0.02 | 0.13** | 0.07* | 0.04 | −0.03 | 0.17** | 0.24** | −0.22** | - | | |
| 10. Concurrent Alcohol and Marijuana Use | −0.05 | 0.10** | 0.10** | 0.01 | 0.07* | 0.09* | 0.05 | −0.04 | 0.12** | - | |
| 11. Concurrent Alcohol and Prescription Stimulant Misuse | 0.02 | 0.07* | 0.89* | 0.02 | 0.07* | 0.14** | 0.09** | −0.09** | 0.17** | 0.25** | - |
| Mean (*SD*) | 19.17 (0.79) | 0.45 (0.50) | 0.71 (0.45) | 0.15 (0.36) | 72.73 (0.44) | 5.86 (1.78) | 4.01 (1.59) | 2.44 (0.66) | 2.09 (0.89) | 1.19 (0.72) | 0.24 (0.43) |
| Range | 18–20 | 0–1 | 0–1 | 0–1 | 0–1 | 0–11 | 1–7 | 1–4 | 1–4 | 1–3 | 0–1 |

Note. N = 1,062;

* p < .01

** p < .001;

Biological sex coded 0 (female) and 1 (male). Race coded 0 (non-White) and 1 (White). Ethnicity coded (0 = Non-Hispanic, 1 = Hispanic). College Enrollment coded 0 (not enrolled in 4-year college) and 1 (enrolled in 4-year college). Point-biserial correlations are presented for correlations among the dichotomous outcomes (age, race, ethnicity, concurrent alcohol and prescription stimulant misuse) and all other key variables; all other correlations are Pearson correlations.

**Table 2**

Ordered Logistic Regression Results of Alcohol-Related Cognition Predictors of Concurrent Alcohol and Marijuana Use

| Predictor | *B* | *SE* | Wald $\chi^2$ | Odds Ratio (95% CI) |
|---|---|---|---|---|
| Biological Sex | 0.34 | 0.14 | 6.14* | 1.41 (1.07, 1.85) |
| Age | −0.14 | 0.08 | 2.94 | 0.86 (0.74, 1.02) |
| Race | 0.42 | 0.15 | 8.56** | 1.53 (1.15, 2.04) |
| Ethnicity | −0.02 | 0.18 | 0.01 | 0.98 (0.70, 1.41) |
| College Enrollment | 0.38 | 0.15 | 6.04* | 1.46 (1.08, 1.98) |
| Alcohol Descriptive Norms | 0.02 | 0.01 | 7.21** | 1.02 (1.00, 1.03) |
| Alcohol Prototype Similarity | 0.01 | 0.05 | 0.01 | 1.00 (0.92, 1.10) |
| Alcohol Perceived Vulnerability | 0.03 | 0.11 | 0.08 | 1.03 (0.83, 1.28) |
| Alcohol Willingness | 0.22 | 0.08 | 8.29** | 1.25 (1.07, 1.45) |

Note. N = 1,062;

* $p < .05$;

** $p < .01$.

Biological sex coded 0 (female) and 1 (male). Race coded 0 (non-White) and 1 (White). Ethnicity coded (0 = Non-Hispanic, 1 = Hispanic). College Enrollment coded 0 (not enrolled in 4-year college) and 1 (enrolled in 4-year college).

**Table 3**

Logistic Regression Results of Alcohol-Related Cognition Predictors of Concurrent Alcohol and Prescription Stimulant Misuse

| Predictor | *B* | *SE* | Wald $\chi^2$ | Odds Ratio (95% CI) |
|---|---|---|---|---|
| Biological Sex | 0.25 | 0.10 | 2.32 | 1.29 (0.93, 1.78) |
| Age | −0.02 | 0.10 | 0.04 | 0.98 (0.81, 1.20) |
| Race | 0.50 | 0.19 | 6.79* | 1.65 (1.13, 2.41) |
| Ethnicity | 0.05 | 0.23 | 0.04 | 1.05 (0.67, 1.63) |
| College Enrollment | 0.14 | 0.18 | 0.59 | 0.87 (0.61, 1.24) |
| Alcohol Descriptive Norms | 0.02 | 0.01 | 8.91** | 1.02 (1.01, 1.04) |
| Alcohol Prototype Similarity | 0.09 | 0.05 | 2.73 | 1.09 (0.98, 1.21) |
| Alcohol Perceived Vulnerability | −0.12 | 0.13 | 0.87 | 0.89 (0.70, 1.14) |
| Alcohol Willingness | 0.35 | 0.10 | 13.26** | 1.41 (1.17, 1.72) |

Note. N = 1,062;

* $p < .05$;

** $p < .01$.

Biological sex coded 0 (female) and 1 (male). Race coded 0 (non-White) and 1 (White). Ethnicity coded (0 = Non-Hispanic, 1 = Hispanic). College Enrollment coded 0 (not enrolled in 4-year college) and 1 (enrolled in 4-year college).