Spring 5-22-2021

Solitary Alcohol And Cannabis Use Among College Students During The Covid-19 Epidemic: Concurrent Social And Affective Correlates And Substance-related Consequences

Amelia Victoria Wedel
Syracuse University

Abstract

Alcohol and cannabis use are remarkably prevalent among college students, with 60% reporting past-month alcohol use and 25% reporting past-month cannabis use. Emerging evidence suggests that a considerable portion of college students use alcohol or cannabis alone, and that rates of solitary use may be higher for cannabis than for alcohol. However, despite substantial evidence connecting solitary alcohol use with a number of affective and substance-related correlates, research on similar associations for solitary cannabis use remains lacking. Furthermore, no college studies to date have assessed solitary use of both alcohol and cannabis and consequently little is known about differences between solitary alcohol and cannabis use in terms of use patterns, correlates and consequences. In this cross-sectional survey study, college students who were life-time alcohol and/or cannabis users ($N = 190$) completed online questionnaires assessing solitary alcohol and cannabis use behaviors, social and affective correlates, and substance-related consequences. Solitary alcohol and cannabis use were common (40% and 42% respectively), with solitary cannabis use particularly common among more frequent users. Solitary alcohol use was associated with greater social isolation, while solitary cannabis use was associated with greater interpersonal sensitivity and pandemic-related stress. The current study adds to the scant literature of solitary substance use by extending the documented role of affective and interpersonal sensitivities from solitary alcohol research to include solitary cannabis use.

Keywords: cannabis, alcohol, solitary, consequences, COVID-19, college

Solitary Alcohol and Cannabis Use among College Students During the COVID-19 Epidemic:

Concurrent Social and Affective Correlates and Substance-Related Consequences

by

Amelia V. Wedel

B.A., Oberlin College, 2016

Thesis

Submitted in partial fulfillment of the requirements for the degree of Master of Science in

Psychology

Syracuse University

May 2021

Table of Contents

Solitary Alcohol and Cannabis Use among College Students During the COVID-19 Epidemic:

Concurrent Social and Affective Correlates and Substance-Related Consequences

College students are at high risk for alcohol and cannabis use, as well as associated consequences. A recent national survey showed that 78% of college students reported lifetime alcohol use and 60% reported past-month alcohol use; 52% reported lifetime cannabis use and 25% reported past-month cannabis use (Schulenberg et al., 2019). College students also frequently engage in substance-related risk behaviors, including risky sex (Buckner et al., 2018; Mair et al., 2016) and driving under the influence of alcohol (Hingson et al., 2009) or cannabis (Pearson et al., 2017). It is common for college students to experience consequences associated with their use, including poor academic performance and interpersonal conflicts (Arria et al., 2015; Pearson et al., 2017). In the long-term, high-quantity alcohol use in young adulthood has been linked to poorer educational attainment and lower likelihood of employment by mid-life (Sloan et al., 2011), as well as diminished physical and mental health in later life (Haber et al., 2016). Similarly, regular cannabis use throughout young adulthood has been associated with increased antisocial behavior (Washburn & Capaldi, 2015), and decline in both cognitive ability and dental health in middle adulthood (Auer et al., 2017; Meier et al., 2016). Given the grave short-term and long-term consequences of alcohol and cannabis use among college students, it is vital to elucidate specific use behaviors which contribute to the development of those consequences.

Solitary Use of Alcohol and Cannabis

While it is normative for college students to engage in social use of both alcohol and cannabis (Beck et al., 2008, 2009), a substantial subgroup use these substances while they are alone. Among young adults, 75% of drinking episodes (Skrzynski et al., 2018) and 77% of

cannabis use episodes (Buckner et al., 2015) occur in the presence of others, indicating that 23-25% of episodes may occur in solitude. Solitary use behavior may be more prevalent with cannabis than alcohol: recent research with late adolescents found that, while 17% of late adolescents use alcohol alone sometimes, 38% of cannabis users use while alone (McCabe et al., 2014). Separate studies of college students have demonstrated a similar disparity between the two substances: although prevalence rates of solitary drinking among U.S. college students remain unestablished, 10% of Korean college students indicate past-year solitary drinking (Ju et al., 2019), while 29% of U.S. cannabis users' most recent episode occurred alone (Spinella et al., 2019). However, the prevalence of solitary use of both alcohol and cannabis has yet to be evaluated within a single sample of college students. Further, given this emerging evidence for prevalence of solitary alcohol and cannabis use among college students, understanding of their correlates and patterns of use and associated negative consequences is critical.

Solitary use of either alcohol or cannabis may be uniquely elevated due to the ongoing COVID-19 pandemic. Recommendations for limiting social contact, and associated restrictions on social gatherings may have limited college students' access to social situations in which they typically use substances. Recent findings from both adults and adolescents during the pandemic suggest that, rather than cutting down on alcohol and cannabis use due to limited social access, individuals have instead used more while alone. Among college students, overall prevalence rates of alcohol and cannabis use did not appear to change from prior to during the pandemic, though individuals reported higher rates of weekly or daily use, suggesting a potential increase in use frequency among existing users (American College Health Association, 2021). It is possible that this increase in frequency may reflect a replacement of social substance use behavior with solitary substance use behavior given limited access to substance-normative social settings.

Although college students' substance use during the pandemic has not yet been reported broken down by social context, adults reported that solitary drinking made up a significantly higher percentage (40-50%) of their overall drinking habits than it had pre-pandemic (30-40%; Wardell et al., 2020). Among adolescents, 49% reportedly engaged in solitary substance use between April 4 and April 13, 2020, when social distancing was first strongly encouraged, with solitary use rates varying by substance: 67% of alcohol users reported solitary alcohol use, while 48% of cannabis users reported solitary cannabis use (Dumas et al., 2020). Across substances, solitary use during the COVID-19 pandemic was associated with greater fears of COVID-19 as well as greater depressive symptomatology (Dumas et al., 2020).

College students may use alcohol or cannabis while they are alone as a means of tension reduction. The Tension Reduction Hypothesis argues that substances are consumed to reduce psychological and physical tension (Cappell & Herman, 1972; Sher, 1999), thus negatively reinforcing substance use behavior (Farber et al., 1980). In this context, psychological "tension" may be operationalized as self-reported anxiety or negative affect, as well as internal responses to external stressors more broadly (e.g., fear, anxiety, frustration; see Cappell & Greeley, 1999). Although originally developed within the context of alcohol use, the Tension Reduction Hypothesis has since been extended for application to cannabis use (Buckner & Schmidt, 2008; de Dios et al., 2010). Both alcohol and cannabis have been shown to exhibit subjective tension reducing effects, including decreases in perceived stress (Cuttler et al., 2017), anxiety (Dvorak et al., 2018), and physical tension (de Dios et al., 2010; Treloar Padovano & Miranda, 2018). Some evidence suggests that solitary drinking occurs as a means of tension reduction. Solitary drinking has been explicitly associated with beliefs that alcohol can reduce tension (Demers & Bourgault, 1996) and regulate negative affect, even after controlling for overall frequency and quantity of

use (Tucker et al., 2006). While it has yet to be evaluated, a similar subset of cannabis users may engage in solitary cannabis use as a method of tension reduction.

Correlates of Solitary Alcohol and Cannabis Use

Solitary drinking has been associated with a number of demographic characteristics and other substance use behaviors. Adults who drink alone are more likely to be male (Creswell et al., 2014; Stickley et al., 2015) and older (Hopfer et al., 2014; Stickley et al., 2015), although it remains unclear whether findings generalize to college students. Further, college students who frequently drink alone are more likely to have initiated regular drinking at an earlier age (Keough et al., 2015) and to have become intoxicated for the first time at a younger age than those who exclusively drink socially (Creswell et al., 2014).

Solitary drinking has also been associated with a number of affective correlates, including negative affect and social anxiety. Consistent with the tension reduction hypothesis, higher rates of solitary drinking are associated with higher negative affect in college students (Bilevicius et al., 2018). Moreover, young adult solitary drinkers endorse a greater number of depressive symptoms than social drinkers (Keough et al., 2015). Among college students, solitary drinking has been associated with greater social anxiety (Keough et al., 2016), particularly for those prone to solitary "pre-drinking" (i.e., drinking alone prior to social events in order to manage anxiety associated with impending social involvement).

While yet unexplored among college students, there is evidence that among older adults, solitary use is particularly common among those who are socially isolated and interpersonally sensitive. Adult men who frequently drank alone showed significantly lower perceived social support than those who exclusively drank socially (Stickley et al., 2015). A daily diary study found that those who drank the greatest quantities while they were alone (as compared to when

drinking with others) were more interpersonally sensitive (i.e., were more emotionally reactive to interpersonal stressors; Mohr et al., 2001). Taken together, it appears that solitary alcohol use is associated with social vulnerability (i.e., interpersonal sensitivity, social isolation) and social anxiety, as well as negative affect. However, to date, no study has evaluated both social and affective correlates in relation to solitary drinking.

In contrast to the relatively solid body of research on correlates of solitary alcohol use, research exploring correlates of solitary cannabis use remains lacking and thus represents a significant gap in the literature. To date, there are no studies linking solitary cannabis use to demographic characteristics or other substance use behaviors. Currently, social anxiety is the only affective factor shown to be associated with solitary cannabis use, with more socially anxious cannabis users reporting greater solitary use (Buckner, Ecker, & Dean, 2016). Solitary cannabis use has yet to be evaluated in relation to negative affect, social isolation, or interpersonal sensitivity. Furthermore, with the aforementioned notable exception (i.e., Buckner, Ecker, & Dean, 2016) which used ecological momentary assessment, the existing literature on solitary cannabis use has relied on self-report of the most recent cannabis use episode (i.e., Spinella et al., 2019) or a single report of lifetime solitary cannabis use (i.e., Tucker et al., 2006). Current understanding of the frequency and correlates of solitary cannabis use is thus extremely limited. Additionally, samples collected during the COVID-19 pandemic have reported higher levels of negative affect, anxiety, and social isolation (American College Health Association, 2021; Horigian et al., 2021). Given associations of these affective correlates with solitary drinking, ~~it appears likely that~~ risk for solitary drinking, and potentially solitary cannabis use, may be elevated under pandemic conditions.

Consequences of Solitary Alcohol and Cannabis Use

The limited existing literature suggests that solitary cannabis and alcohol use share similar sets of grave negative psychological and substance-related consequences, albeit some consequences may be unique to each substance. Solitary drinking has been associated with increased depression and suicidal ideation in college students, particularly among those who also indicated problematic drinking (Ju et al., 2019). In contrast, solitary cannabis use has been associated with higher odds of psychosis, but not other psychiatric disorders such as depression (Spinella et al., 2019). Solitary use of either substance during adolescence appears to be associated broadly with substance-related problems, such as withdrawal symptoms, physical fighting, and interpersonal conflict in young adulthood (Keough et al., 2016; Tucker et al., 2006). Among college students, solitary drinking is associated with greater drinking problems, including overall more frequent and harmful drinking (Bilevicius et al., 2018), greater number of alcohol use disorder symptoms (Creswell et al., 2014), and severe alcohol-specific problems such as blackout drinking and driving while intoxicated (Keough et al., 2018). Similarly, solitary cannabis use among college students has been associated with greater cannabis-related problems, such as low productivity, difficulty sleeping, and interpersonal problems (Buckner, Ecker, & Dean, 2016).

Solitary alcohol and cannabis use may accentuate the relationship of negative affect and social anxiety with substance-related consequences. Independently, greater negative affectivity and social anxiety have been associated with greater consequences and drinking-related risk behaviors among college student drinkers (Schry & White, 2013; Wemm et al., 2018). Moreover, socially anxious college student users have been shown to experience a greater number of consequences from alcohol and cannabis use only when they frequently engage in solitary use (Buckner, Ecker, & Dean, 2016; Buckner & Terlecki, 2016; Keough et al., 2016). Thus, socially

anxious individuals who use alcohol or cannabis may limit their use in social situations for fear of engaging in embarrassing behavior while intoxicated, and instead consume greater quantities when alone in order to manage anxiety before and after social involvement (Buckner, Ecker, & Dean, 2016; Keough et al., 2016). While solitary alcohol use has been shown to be associated with alcohol consequences and negative affect (Bilevicius et al., 2018), similar associations with solitary cannabis use remain unexplored in the literature.

The Current Study

This cross-sectional survey study aimed: (1) to identify differences in solitary alcohol and cannabis users as a function of the demographic, affective, social, and substance-related correlates, (2) to test the current role of affective and social correlates (i.e., negative affect, social anxiety, interpersonal sensitivity, social isolation, and pandemic-related stress) in solitary alcohol or cannabis use, and (3) to test whether solitary use strengthens associations of affective, social, and substance-related risk factors with negative consequences from alcohol or cannabis use.

For the first aim, consistent with previous literature, it was hypothesized that *solitary alcohol users* would be male, older, and report earlier age of alcohol use onset, and greater levels of negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress, and more problematic alcohol use patterns. Novel to the literature, it was hypothesized that *solitary cannabis users* would likewise be male, older, and show earlier age of cannabis use onset, and greater negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress, and more problematic cannabis use patterns.

For the second aim, it was hypothesized that *solitary alcohol use* would be concurrently associated with greater levels of negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress. Similarly, it was hypothesized that *solitary cannabis use*

would be concurrently associated with greater levels of negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress.

For the third aim, it was hypothesized that, as compared to social use, *solitary alcohol use* would strengthen the relationships of negative affect and social anxiety with alcohol-related consequences. Similarly, it was hypothesized that, as compared to social use, *solitary cannabis use* would strengthen the relationships of negative affect and social anxiety with cannabis-related consequences.

Methods

Participants

Undergraduate students ($N = 198$) were recruited from the subject pool for psychology research at a private, northeastern university. Participants were considered eligible if they were English-speaking, between the ages of 18 and 25, currently enrolled part-time or full-time in university, and indicated lifetime use of alcohol and/or cannabis. Age restrictions were included to capture the age range of typical college students; according to national census data, 79% of all U.S. college students are between 18 and 25 (U. S. Census Bureau, 2018). The substance use eligibility criterion was included in order to maximize the probability of capturing the primary phenomena of interest (i.e., solitary alcohol and cannabis use). Three participants denied any lifetime alcohol or cannabis use in the survey and were excluded from the data. Additionally, five participants provided incomplete or inconsistent data on cannabis use items, such as unreasonably high numbers on questions concerning quantity of cannabis use (i.e., >=10g in a single day) or age of cannabis use onset greater than current reported age, and were consequently excluded from the data. Thus, the final sample consisted of 190 participants.

The final sample (*N* = 190) was predominantly White (67%), followed by 15% Asian or Asian-American, 6% Black or African-American, 7% Multiracial, 1% Native Hawaiian or Pacific Islander, and 4% reported either "other" race or not knowing their race (but reported Hispanic ethnicity). The sample was 47% male and 11% Hispanic. The sample was 89% straight, 6% bisexual or pansexual, and 2% lesbian/gay; 3% of participants declined to report sexual orientation. The majority (73%) of the sample reported that they currently live on campus, and 8% reported current membership in a fraternity or sorority. Participants reported having between 0 and 4 roommates, with most participants reporting that they either shared a room with one person (57%) or had a bedroom to themselves (36%).

Procedure

University institutional review board approval was obtained for all study procedures. Questionnaires were completed anonymously online from the location of students' choosing. After completing an electronic consent form, participants completed a two-part, single-wave web-based questionnaire. Surveys were divided into two parts in order to minimize participant burden and obtain the largest possible dataset for behaviors of interest (i.e., solitary alcohol and cannabis use) and associated correlates. The first part of the survey assessed demographic characteristics, substance use history, current substance use within specific social contexts, negative affectivity, social anxiety, social isolation, interpersonal sensitivity, and COVID-19-related stress and changes to substance use behavior. The second part of the survey assessed substance use history in greater detail utilizing timeline follow-back, as well as motives and expectancies for both alcohol and cannabis use. Of the 190 participants who completed the Part 1 survey, 158 (83%) also completed the Part 2 survey. Participants (*n* = 35) who did not complete the Part 2 survey reported greater frequency of solitary alcohol use (*t*[188] = 2.56, *p* = .011) and

greater alcohol consequences (t[188] = 2.16, p = .032) than participants who completed both surveys; participants did not differ on any measure of cannabis use. Students were compensated for their participation with research credit, scaled according to the number of surveys completed.

Measures

For detailed breakdown of measures by study aims, see Table 1.

General and solitary alcohol use. Participants were assessed for past-year alcohol use frequency and typical quantity using two items recommended by the National Institute on Alcohol Abuse and Alcoholism (2003). Specifically, frequency of alcohol use was assessed with the question, "During the last year, how often did you usually have any kind of drink containing alcohol? By a drink we mean half an ounce of absolute alcohol (e.g., a 12 ounce can or glass of beer or cooler, a 5-ounce glass of wine, or a drink containing 1 shot of liquor)." Visual aids for various forms of alcohol were provided. Participants responded according to a 10-point scale (0 = *I did not drink any alcohol in the past year,* 1 = *1 or 2 times in the past year,* 2 = *3 to 11 times in the past year,* 3 = *once a month,* 4 = *2 to 3 times a month,* 5 = *once a week,* 6 = *twice a week,* 7 = *3 to 4 times a week,* 8 = *5 to 6 times a week,* 9 = *Every day*). For participants who endorsed alcohol use during the past year, quantity of typical alcohol consumption was determined with the question, "During the last year, how many alcohol drinks did you have on a typical day when you drank alcohol?" Participants responded according to a 10-point scale (0 = *1 drink* to 9 = *25 or more drinks*). Individual scores of alcohol use frequency and quantity variables were used for analyses.

To assess solitary alcohol use, the previous two items were additionally presented within the specific context of solitary use. Asking these questions separately for social versus solitary drinking is consistent with the approach of Gonzalez and Skewes (2013), one of the few existing

studies assessing solitary drinking frequency. For Aim 1 analyses, two dichotomized variables were created from the first item assessing solitary drinking frequency to designate presence or absence of solitary alcohol use in the past year (0 = *No past-year solitary drinking,* 1 = *Past-year solitary drinking*) and past month (0 = *No past-month solitary drinking,* 1 = *Past-month solitary drinking*). Individual scores of solitary alcohol use frequency and quantity variables in the past year were used for Aim 2 and 3 analyses.

General and solitary cannabis use. Students were asked questions adapted from the Marijuana Smoking History Questionnaire (Bonn-Miller & Zvolensky, 2009) to assess the frequency and quantity of their cannabis use during the past year. It was specified that the phrase "marijuana, cannabis, or hashish" referred only to products which contain tetrahydrocannabinol (THC), not to products consisting exclusively of cannabidiol (CBD). Due to the absence of a standard unit of cannabis, participants were also asked to quantify their cannabis use to the best of their ability using the following two questions. Participants were first asked to indicate the route of administration they typically use to consume cannabis, from the following options: joint, blunt, pipe/bowl, bong, edible, vaporizer cartridges, and concentrate (including wax, oil, rosin, capsules, and tinctures). Different routes of administration have been associated with different risks as well as varying degrees of acute impairment by virtue of higher THC potency and more efficient delivery of THC to the brain and bloodstream (Russell et al., 2018). Participants were asked to report the quantity they typically consume when using the aforementioned method of administration, measured in estimated grams. A visual aid was provided to assist participants in their estimations of quantity, depicting a range from ¼ gram, ½ gram, to a full gram of cannabis flower; typical serving size (10mg) of edible forms of cannabis; and typical serving size (10-15mg) of wax concentrate (see Appendix).

As with alcohol, the previous three items (i.e., past-year frequency, typical quantity, and route of administration) were asked an additional time within the context of solitary use, consistent with the approach given in the solitary drinking literature (i.e., Gonzalez & Skewes, 2013; Buckner & Terlecki, 2016). Parallel to alcohol, responses to the item assessing solitary cannabis use frequency were used to create two dichotomized variables designating presence or absence of solitary cannabis use within the past year (0 = *No past-year solitary cannabis use,* 1 = *Past-year solitary cannabis use*) and past month (0 = *No past-month solitary cannabis use,* 1 = *Past-month solitary cannabis use*).

Timeline follow-back. Participants were asked to complete an adapted version of the Timeline Follow-back (Sobell & Sobell, 1992) for their alcohol and cannabis use. Participants were asked to indicate how many drinks they had per day, and an estimate of how many grams of cannabis they consumed per day. They were also asked to indicate how much of each substance was consumed while they were alone on a given day.

Although participants were asked to mark their alcohol and cannabis use for the past 60 days, only 95 participants (50% of the final sample) completed the first 30 days of the Timeline Follow-back, and 33 (17% of the final sample) completed the full 60 days. Ancillary analyses indicated that those who completed the first 30 days of the Timeline Follow-back did not differ from non-completers on any alcohol use, cannabis use, sociodemographic, or psychosocial variables. To maximize sample size while minimizing missing data, past-30-day alcohol frequency and alcohol quantity overall and when alone were calculated using only the first 30 days of the Timeline Follow-back, and used in ancillary analyses.

Alcohol use consequences. Participants completed the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ), a 24-item measure of alcohol-related consequences

experienced within the past two months (Kahler et al., 2005). All items are dichotomous, and assess consequences ranging from low-harm (e.g., hangovers, embarrassment) to high-harm (e.g., risky sexual behavior, physiological dependence). A sum score (range = 0 to 24; α = .89) with a higher score indicating greater alcohol consequences, was used in analyses.

Cannabis use consequences. Students completed the Brief Marijuana Consequences Questionnaire (B-MACQ), a 21-item self-report measure of unique cannabis use consequences modeled after the YAACQ (Simons et al., 2012). Like the B-YAACQ, the B-MACQ is scored dichotomously and assesses consequences ranging from low-harm (e.g., avolition, embarrassment) to high-harm (e.g., risky sexual behavior, physiological dependence). A sum score (range = 0 to 16; α = .91) with a higher score indicating greater cannabis consequences, was used in analyses.

Demographics. Demographic variables included age, sex assigned at birth (0 = *female;* 1 = *male*), race (0 = *White;* 1 = *Black or African American;* 2 = *Asian;* 3 = *American Indian or Alaska Native;* 4 = *Native Hawaiian or Pacific Islander;* 5 = *Other;* 88 = *Don't know,* 99 = *prefer not to answer*), ethnicity (0 = Non-Hispanic, 1 = Hispanic), and sexual orientation (0 = *straight;* 1 = *gay;* 2 = *lesbian;* 3 = *bisexual*; 4 = *asexual*; 5 = *none of the above;* 99 = *prefer not to answer*). Participants were able to indicate belonging to more than one racial group; if indicated, these participants were recoded into a new Multiracial group. Due to low prevalence, American Indian/Alaska Native, Native Hawaiian or Pacific Islander, "other" and "don't know" racial groups were combined into one "other" racial group, resulting in a new categorical race variable used for regression analyses (0 = *White,* 1 = *Black or African American,* 2 = *Asian,* 3 = *Multiracial,* 4 = *Other,* 99 = *Prefer not to answer*). Due to low endorsement of some orientations, sexual orientation was dichotomized (0 = *straight,* 1 = *lesbian, gay, or bisexual*).

Participants were asked to indicate their residence type (0 = *off campus*; 1 = *on campus*), Greek affiliation (0 = *non-member*; 1 = *member*), and number of roommates or housemates. Demographic variables were selected in accordance with prior research on solitary use of either alcohol or cannabis (Buckner, Ecker, & Dean, 2016; Gonzalez & Skewes, 2013; Spinella et al., 2019).

Negative affect. Participants completed the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001), a 9-item measure of symptoms associated with depression such as "little interest or pleasure in doing things" and "feeling bad about yourself." (Kroenke et al., 2001). Participants rated how often during the past 2 weeks they felt certain things on a 4-point Likert scale ranging from 0 (*not at all*) to 3 (*nearly every day*). The PHQ-9 has been used to assess depression in association with solitary drinking during the COVID-19 pandemic (Wardell et al., 2020). A sum score (range = 0 to 27; α = .92) with higher score indicating greater negative affect, was used in analyses. Participants in this sample reported lower levels of depression (*M* = 6.35 [*SD* = 6.02]) than observed in other college samples during the pandemic (*M* = 11.61 [*SD* not reported]; Wang et al., 2020)

Social anxiety. Participants completed the Social Interaction Anxiety Scale-Short Form (Fergus et al., 2012), a 6-item assessment of social anxiety. Participants responded to questions such as "I am nervous mixing with people I don't know well" and "I am tense mixing in a group" on a 5-point scale (0 = *not at all characteristic of me* to 4 = *extremely characteristic of me*). Item scores were summed to produce a single score which captures both severity of social anxiety symptoms and the breadth of situations in which social anxiety is experienced. While the short form of this scale has not been used in studies related to substance use, the full scale has been used with samples of college students who engage in solitary alcohol or cannabis use

(Buckner, Ecker, & Dean, 2016; Buckner & Terlecki, 2016). A sum score (range = 0 to 20; α = .89) with a higher score indicating greater social anxiety, was used in analyses. The final sample's score was comparable to that of other college samples (Fergus et al., 2012)

Social isolation. Participants completed a brief version of the UCLA Loneliness Scale (Hays & DiMatteo, 1987). The UCLA Loneliness Scale-8 is an 8-item self-report measure of current perceived loneliness and social isolation. Participants responded to questions such as "I am unhappy being so withdrawn" and "I lack companionship" on a 4-point Likert scale (0 = *"I never feel this way"* to 3 = *"I often feel this way"*). The UCLA Loneliness Scale-8 has demonstrated good discriminant validity from measures of depression (Matthews et al., 2016) and social anxiety (Baltaci, 2019) among college samples. A sum score (range = 0 to 21; α = .83) with a higher score indicating greater social isolation, was used in analyses. Participants reported comparable social isolation scores to participants in prior college studies (Hays & DiMatteo, 1987).

Interpersonal sensitivity. Participants completed the interpersonal sensitivity scale from the Hopkins Symptom Checklist (SCL-90), which assesses hypersensitivity to interpersonal rejection (Derogatis et al., 1973). The interpersonal sensitivity scale of the SCL-90 has been associated with depression (Urbán et al., 2014) and social anxiety (You et al., 2019). A sum score (range = 0 to 20; α = .88) with a higher score indicating greater interpersonal sensitivity, was used in analyses.

COVID-19-related measures. Participants completed two additional questionnaires to assess the impact of the COVID-19 pandemic on their daily lives, alcohol/cannabis use patterns, and stress levels. First, participants were asked to report how the COVID-19 pandemic had affected their alcohol consumption frequency and quantity along a 5-point Likert scale (0=*I have*

been drinking much less than usual to 4=*I have been drinking much more than usual*). Parallel questions were asked regarding COVID-related changes to solitary alcohol consumption frequency and quantity. Participants were also asked similar questions about changes to their cannabis use frequency and quantity; parallel questions were asked regarding COVID-related changes to solitary cannabis use frequency and quantity.

Participants completed the Pandemic Stress Index (Harkness et al., 2020), a 3-item measure of COVID-19's impact on daily life. Participants were asked to report personal behavioral changes (e.g., self-isolating or quarantining) as well as the impact of those changes (e.g., "For how many days did you self-isolate?"). Participants reported the impact of COVID-19 on their day-to-day life on a 5-point Likert scale (1=*Not at all* to 5=*Extremely).* They were also asked to report their experiences during COVID-19, including diagnosis of COVID-19, fear for self or family, stigma or discrimination, and changes to mental health, substance use, and sexual behavior. Responses were summed to create a total measure of pandemic-related stress ($\alpha = .76$).

Ages of alcohol and cannabis use onset and regular use onset. Participants were asked at what age they first had any alcoholic drink (not including any time when they only had a sip or two from a drink). They were also asked at what age they first started to drink regularly (i.e., at least once a month, consistent with prior research on solitary alcohol use; Keough et al., 2015).

Similarly, participants were asked at what age they first tried any marijuana, cannabis, or hashish. Students were then asked at what age they began to use cannabis regularly (i.e., once a month or more). Although once-weekly use is considered the standard cut-off for "regular" cannabis use by some studies (Foster et al., 2018), once-monthly use was considered regular in this study in order to maintain congruence with measurement of alcohol use.

Alcohol and cannabis use motives. Students completed the Drinking Motives Questionnaire-Revised Short Form (Kuntsche & Kuntsche, 2009), a 12-item measure of the relative frequency of drinking for various motives such as "because it helps me enjoy a party" and "to forget about my problems" on a 5-point Likert scale (1=*Almost never/never* to 5=*Almost always, always*). Separate subscales for four drinking motives, enhancement (α = .69), social (α = .93), conformity (α = .86), and coping (α = .84), were used in analyses.

Parallel to alcohol, participants completed the short form of the Marijuana Motives Measure (Mezquita et al., 2018), a 15-item measure of the relative frequency of using cannabis for various motives such as "To get high" and "Because it improves parties and celebrations" on a 5-point Likert scale (1=*Almost never/never* to 5=*Almost always, always*). Separate subscales for five marijuana use motives, enhancement (α = .93), social (α = .90), conformity (α = .89), coping (α = .90), and expansion (α = .94), were used in analyses.

Alcohol and cannabis outcome expectancies. Participants completed the Alcohol Expectancy Questionnaire-Adolescent Brief (Stein et al., 2007), a 7-item measure assessing alcohol-related expectancies such as "Alcohol helps a person relax, feel less tense, and can keep a person's mind off of mistakes at school or work" on a 5-point Likert scale (1=*Strongly disagree* to 5=*Strongly agree)*. The scale, while developed for adolescents under 18, has since been validated for use with college students (Almeida et al., 2018). Separate sum scores for positive expectancies (such as enhancement and tension reduction; α = .48) and negative expectancies (such as cognitive impairment or embarrassment; α = .48) were used in analyses, which have demonstrated good convergent validity with alcohol consumption variables (Stein et al., 2007).

Parallel to alcohol, participants completed the Marijuana Effects Expectancy Questionnaire-Brief (Torrealday et al., 2008), a 6-item measure assessing marijuana-related expectancies such as "Marijuana makes it harder to think and do things (harder to concentrate or understand; slows you down when you move" and "Marijuana helps a person relax and feel less tense (helps you unwind and feel calm)" on a 5-point Likert scale (1=*Strongly disagree* to 5=*Strongly agree*). Separate sum scores for positive expectancies (such as creativity enhancement and tension reduction; $\alpha = .79$) and negative expectancies (such as poor concentration or negative mood alterations; $\alpha = .40$) were used in analyses, both of which have been correlated with measures of cannabis consumption (Buckner & Schmidt, 2008).

Data Analytic Strategies

Data Diagnostics

Using *Rstudio* version 1.3.1093-1 (RStudio Team, 2020), Shapiro-Wilk normality tests and graphical inspection were used to identify outliers, skewness, kurtosis, and non-normality among all study variables. For participants who reported no lifetime alcohol or cannabis use, zeroes were imputed in all alcohol or cannabis outcome variables, respectively (Bradley et al., 2007). It was expected that measures of solitary use frequency, quantity, and negative consequences of both substances would be over-dispersed (i.e., the variance would be greater than the mean) and would contain many zeroes due to the portion of the sample who uses alcohol and/or cannabis exclusively in social settings, thus requiring the use of models designed to account for excess zeroes and non-normal data distribution.

Aim 1 Analyses

Using SPSS Version 26.0 (IBM Corp., 2019), independent-samples *t*-tests for continuous variables (e.g., age), Pearson chi-square tests for categorical variables (e.g., sex, race), and

generalized linear models for count variables (e.g., alcohol consequences) were conducted to test

differences in solitary alcohol users versus non-solitary users as a function of all proposed

correlates (i.e., sex, current age, age of alcohol use onset, age of regular alcohol use onset,

negative affect, social anxiety, social isolation, interpersonal sensitivity, COVID-19-related

stress, alcohol/cannabis use motives, outcome expectancies, and alcohol consequences): see

Table 4 for past-year solitary alcohol users versus non-users, and Table 5 for past-month solitary

alcohol users versus non-users. The same set of analyses were also conducted to test differences

in solitary cannabis users versus non-solitary users as a function of all proposed correlates: see

Table 6 for past-year solitary cannabis users versus non-users, and Table 7 for past-month

solitary cannabis users versus non-users.

Aim 2 and Aim 3 Analyses

Regarding solitary alcohol use, a count outcome variable of solitary alcohol use

frequency was analyzed using zero-inflated negative binomial (ZINB) regressions. ZINB models

extend traditional negative binomial models by accounting for over-dispersed count data to

address excess zeroes (Atkins et al., 2013). ZINB models essentially test two portions of the

same model. The first portion is a logistic regression which describes the probability of a

participant endorsing either a zero or non-zero score. The second portion fits a generalized linear

model with a negative binomial distribution to both the zeroes and the non-zero scores, adjusting

the number of zeroes to fit the expected negative binomial distribution. ZINB models were

constructed in *Rstudio* version 1.3.1093-1 (*RStudio* Team, 2020) using the *pscl* package

(Jackman, 2010; Zeileis et al., 2008). Effect sizes were reported for each predictor by calculating

the odds ratios (OR) for the logit model and incidence rate ratios (IRR) for the count models.

Specifically, for the second study aim (i.e., to examine concurrent role of affective and social variables in solitary alcohol use), negative affect, social anxiety, social isolation, interpersonal sensitivity, and COVID-19-related stress were entered into a ZINB model as main effects on solitary alcohol use frequency. General (including both social and solitary) frequency of alcohol use was controlled for. Sex and age were included as covariates, as prior research has consistently identified both as significant in solitary drinking samples (Creswell et al., 2014; Stickley et al., 2015): See Table 8.

Regarding solitary cannabis use, visual inspection revealed an atypical distribution suggesting that a ZINB would be a poor fit to the data: while data did contain excess zeroes, responses were otherwise clustered around two peaks at opposing ends of the frequency spectrum (solitary use only 1-12 times in the past year vs. solitary use at least 3 times per week). Thus, solitary use frequency was transformed to an ordinal composite variable (0=*No solitary cannabis use,* 1=*Solitary cannabis use less than monthly,* 2=*Solitary cannabis use at least monthly*) and analyzed using a multinomial logistic regression. Negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress were entered into a multinomial logistic regression as main effects on solitary cannabis use frequency. Odds ratios (OR) were presented as effect sizes. Sex and age were included as covariates given prior associations with solitary cannabis use (Buckner, Ecker, & Dean, 2016): See Table 9.

For the third study aim (i.e., to test solitary use as a potential moderator for the association between social and affective variables and alcohol-related consequences), a two-way interaction of solitary alcohol use frequency with negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress were entered separately into a ZINB model along with their main effects on alcohol-related consequences. For solitary cannabis use, similar

analyses were conducted, in which a two-way interaction of solitary cannabis use frequency with negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress were entered separately into a ZINB model along with their main effects on cannabis-related consequences. Sex and age were included as covariates, as they have previously been found to account for some variance in frequency of solitary alcohol and cannabis use (Buckner, Ecker, & Dean, 2016; Creswell et al., 2014; Stickley et al., 2015).

Power Analysis

A *priori* power analysis was conducted to determine sample sizes required to test both aims. Findings from Keough et al. (2015) provided an effect size for the association between internalizing symptoms and solitary alcohol use frequency ($R^2 = .15$). Power analysis results using the Poisson distribution indicated that 169 participants would be needed to achieve a threshold power of .80 at the two-tailed α level of .05 for simple effects analyses; however, power necessary to sufficiently detect interactions would have required an infeasible number of participants (potentially 14 times the number necessary to detect main effects; Simonsohn, 2014). Thus, the final sample data from 190 participants would provide sufficient power to detect main effects of solitary use, if present.

Results

Data Diagnostics

Shapiro-Wilk normality tests found solitary alcohol and cannabis use frequency, quantity, and consequences to have abnormally distributed residuals at $p < .001$. Kurtosis scores calculated with the *e1071* package (Meyer et al., 2018) found kurtosis scores to be within an acceptable range (kurtosis < |2|) for most variables, with the exceptions of cannabis consequences (kurtosis = 2.98), solitary drinking frequency (kurtosis = 4.57), solitary drinking quantity (kurtosis =

18.24), and both general cannabis use quantity (kurtosis = 14.21) and solitary cannabis use

quantity (kurtosis = 24.47), which all demonstrated leptokurtic residual distributions. Dispersion

tests conducted with the *AER* package (Kleiber & Zeileis, 2008) demonstrated significant over-

dispersion and excess zeroes, consistent with previous studies assessing substance-related count

variables in non-clinical samples (Crawford et al., 2019; Regan et al., 2020). Graphical

inspection of solitary cannabis use frequency revealed a high number of weekly and daily

solitary cannabis users (*n*=41) in addition to the high number of zero scores (*n*=94), precluding

the use of typical approaches (i.e., zero-inflated negative binomial regression; see below) to

testing zero-inflated data.

Bivariate correlations among study variables (i.e., Pearson's correlation coefficients for

two continuous variables, and Spearman's coefficients for continuous and dichotomous

variables) were computed for all study variables (see Table 2 for alcohol related variables and

Table 3 for cannabis use related variables).

Aim 1: Characterizing Solitary Alcohol and Cannabis Using College Students During

COVID-19

Characterizing Solitary Alcohol Users

All participants reported lifetime alcohol use, with 95% reporting alcohol use within the

past year and 79% reporting alcohol use within the past month. Among past-year drinkers, 40%

reported drinking alone within the past year, while 13% reported past-month solitary alcohol use,

meaning that 33% of past-year solitary drinkers were also past-month solitary drinkers. Solitary

drinkers most often reported drinking alone 1-2 times in the past year (41%), 3-11 times in the

past year (25%) or once a month (15%), and reported drinking 1.44 drinks on average when

drinking alone. On average, participants reported a slight increase in overall alcohol use frequency since the start of the pandemic ($M = 2.09$ [$SD = 1.07$]), with 36% reporting increases and 23% reporting decreases in drinking frequency, but no change in overall alcohol quantity consumption ($M = 2.00$ [$SD = 1.04$]). Solitary drinkers' changes in alcohol use patterns did not differ from non-solitary users (all ps > .05). Among past-year solitary drinkers, 40% reported an increase in solitary drinking frequency, while 26% reported an increase in solitary drinking quantity since the start of the pandemic.

Compared to exclusively social drinkers, participants who reported past-year solitary drinking were older and more likely to be in a fraternity or sorority. They reported being more socially isolated than exclusively social drinkers. Lastly, past-year solitary drinkers reported greater positive drinking expectancies, greater enhancement motives for drinking, and greater alcohol-related consequences than exclusively social drinkers. Group differences between past-year solitary drinkers and purely social drinkers are reported in Table 4.

When solitary drinking was restricted to past-month solitary drinking only, solitary drinkers were more likely to live off-campus and to belong to a fraternity or sorority. Past-month solitary drinkers did not differ from non-past-month solitary or exclusively social drinkers on any other measures. Group differences between past-month solitary drinkers and non-past-month solitary or purely social drinkers are reported in Table 5.

Characterizing Solitary Cannabis Users

In total, 87% of the sample reported lifetime cannabis use. Of these, 77% reported cannabis use within the past year, and 48% reported cannabis use within the past month; cannabis users reported using 1.14 grams of cannabis on average. Among cannabis users, 42% reported solitary cannabis use within the past year, while 29% reported solitary cannabis use

within the past month, meaning that 69% of past-year solitary cannabis users had also used within the past month. Most frequently, solitary cannabis users reported using cannabis alone every day (20%), 1-2 times in the past year (17%), 3-11 times in the past year (14%), 3-4 times a week (14%). Solitary cannabis users reported using a mean quantity of 1.22 grams when using cannabis alone. On average, cannabis users reported slight increases in overall cannabis use frequency ($M = 2.08$ [$SD = 1.26$]) and slight decreases in overall cannabis use quantity ($M = 1.95$ [$SD = 1.20$]) since the start of the pandemic. However, solitary users were more likely to report increases in both frequency ($\chi^2[4] = 71.82$, $p < .001$, Cramer's $V = .66$) and quantity ($\chi^2[4] = 57.02$, $p < .001$, Cramer's $V = .59$) since the start of the pandemic, while non-solitary users were more likely to report using cannabis much less often and at much lower quantities than prior to the pandemic (both ps $< .001$). Among solitary cannabis users, 62% reported an increase in solitary cannabis use frequency and 52% reported an increase in solitary cannabis use quantity since the start of the pandemic.

Compared to exclusively social cannabis users, past-year solitary cannabis users were more likely to report lesbian, gay, or bisexual orientation, and a greater number of roommates. They also reported greater negative affect and greater pandemic-related stress. Past-year solitary cannabis users reported earlier age of cannabis use onset and regular (i.e., at least monthly) cannabis use onset; they also reported greater positive expectancies for cannabis use, greater coping, enhancement, social, and expansion motives, and greater cannabis-related consequences than exclusively social users. Group differences between past-year solitary cannabis users and purely social cannabis users are reported in Table 6.

When solitary use was restricted to past-month solitary cannabis use only, past-month solitary cannabis users reported greater negative affect, greater interpersonal sensitivity, and

greater pandemic-related stress than non-past-month solitary or exclusively social cannabis users. They also reported earlier age of cannabis use onset, later age of regular cannabis use onset, greater positive cannabis expectancies, greater coping, enhancement, social, and expansion motives, and greater cannabis consequences. Group differences between past-month solitary cannabis use and non-past-month solitary or purely social cannabis use are reported in Table 7.

Aim 2: Affective and Social Correlates of Solitary Use

Solitary Alcohol Use Models

A stepwise regression approach was taken to test concurrent associations of demographic, social, and affective factors with solitary alcohol use frequency. As shown in Table 8, regarding the solitary alcohol use frequency portion of the model, overall drinking frequency was positively associated with solitary alcohol use frequency. Regarding the solitary alcohol use (versus non-use) portion of the model, social isolation, older age, and greater overall drinking frequency were all positively associated with higher odds of drinking alone.

Alternate models were run with age of any drinking onset and age of regular drinking onset entered in place of participant age; in both of these models, both social isolation and overall drinking frequency increased odds of any solitary drinking (ps < .05), but neither age of onset variable was associated with higher odds of solitary drinking.

Solitary Cannabis Use Models

In place of zero-inflated negative binomial regression, a multinomial logistic regression was run, in which sex, age, negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic stress were all entered as predictors of either past-year (no past-month) solitary cannabis use, or past-month solitary cannabis use (with no solitary cannabis use as a

comparison group). Due to high multicollinearity with solitary cannabis use frequency (Spearman's r_s = .78, p < .001), overall cannabis use frequency was excluded from the model. As shown in Table 9, male sex and greater pandemic-related stress increased odds of past-year (but no past month) solitary cannabis use, while male sex, greater interpersonal sensitivity, and greater pandemic-related stress increased odds of past-month solitary cannabis use.

When age of cannabis use onset was entered in place of age, results changed somewhat; greater pandemic-related stress (OR = 1.39 [1.14, 1.70], p = .001) and male sex (OR = 3.24 [1.03, 10.17], p = .044) still increased odds of past-year solitary cannabis use. However, greater interpersonal sensitivity was no longer associated with higher odds of past-month solitary cannabis use (p = .101). Older age of cannabis use onset decreased odds of past-month solitary use (OR = 0.65 [0.48, 0.87], p = .005), while greater pandemic-related stress (OR = 1.30 [1.12, 1.52], p = .001) and male sex (OR = 2.89 [1.14, 7.32], p = .026) increased odds of past-month solitary cannabis use.

Aim 3: Solitary Use as a Moderator for Associations between Consequences and Affect

Models for Alcohol Use Consequences

Negative affect. No interaction was observed between solitary drinking frequency and negative affect on alcohol use consequences. After controlling for the interaction term, only negative affect (IRR = 1.03, p = .025) was associated with greater alcohol-related consequences.

Social Anxiety. No interaction was observed between solitary drinking frequency and social anxiety on alcohol use consequences. After controlling for the interaction term, greater solitary drinking frequency (IRR = 1.14, p = .026), greater social anxiety (IRR = 1.04, p = .006), and older age (IRR = 1.10, p = .043) were associated with greater negative alcohol-related consequences.

Interpersonal Sensitivity. Solitary drinking frequency attenuated the effect of interpersonal sensitivity on alcohol use consequences (IRR = 0.98, p = .024), such that greater interpersonal sensitivity was associated with greater alcohol consequences only among those who did not drink alone or who drank alone infrequently (see Figure 1).

Social Isolation. Neither interaction nor main effect was observed on alcohol use consequences in the model assessing the interaction between solitary drinking frequency and social isolation.

Pandemic-related Stress. No interaction was observed between solitary drinking frequency and pandemic-related stress on alcohol-related consequences. After accounting for the interaction, solitary drinking frequency was associated with greater alcohol-related consequences (IRR = 1.23, p = .049).

All Interactions Simultaneously. When all interactions were entered into one model simultaneously, no interactions were observed between solitary drinking frequency and any affective or social correlate on alcohol-related consequences. Older age was associated with greater drinking consequences (IRR = 1.11, p = .035).

Models for Cannabis Use Consequences

Negative affect. No interaction was observed between solitary cannabis use and negative affect on cannabis-related consequences. After accounting for solitary cannabis use, negative affect was associated with greater cannabis-related consequences (IRR = 1.07, p = .023). Individuals who experienced at least one cannabis-related consequence were likely to be older (OR = 2.36, p = .042).

Social Anxiety. No interaction was observed between solitary cannabis use and social anxiety on cannabis-related consequences. Individuals who experienced at least once cannabis-

related consequence reported lower social anxiety (OR = 0.80, *p* = .006). No main effects for solitary cannabis use frequency were observed in either part of the model.

Social Isolation. No interaction was observed between solitary cannabis use and social isolation on cannabis-related consequences. Individuals who experienced at least one cannabis use consequence were likely to be less lonely (OR = 0.38, *p* = .039) and older (OR = 6.67, *p* = .045).

Interpersonal Sensitivity. No interaction was observed between solitary cannabis use and interpersonal sensitivity on cannabis-related consequences. After accounting for the interaction, solitary cannabis use frequency (IRR = 1.11, *p* = .028) was associated with greater cannabis use consequences.

Pandemic-Related Stress. No interaction was observed between solitary cannabis use and pandemic-related stress on cannabis-related consequences. After controlling for the interaction, both solitary cannabis use frequency (IRR = 1.21, *p* = .025) and pandemic-related stress (IRR = 1.12, *p* = .008) were associated with greater cannabis-related consequences.

All Interactions Simultaneously. When all interactions were entered into one model simultaneously, solitary cannabis use attenuated associations of pandemic-related stress with presence of cannabis-related consequences (OR = 0.38, *p* = .049), such that greater pandemic-related stress was associated with higher odds of any cannabis consequences among past-month solitary users and non-solitary users, but not non-past-month solitary users (see Figure 2).

Ancillary Analyses of Past-30-day Alcohol and Cannabis Use from Timeline Follow-Back

Due to missing or incomplete data, analyses using data from Timeline Follow-back were performed with the subset of participants who completed the first 30 days of the Timeline Follow-back (*n* = 95). Of completers, 42% reported any alcohol use and 9% reported any solitary

drinking, while 13% reported any cannabis use and 4% reported solitary cannabis use. Of those who drank in the past 30 days, 15% reported any solitary drinking, ranging from 1 to 15 drinks over 1 to 2 solitary drinking days. Of those who reported cannabis use, 35% reported solitary cannabis use, ranging from an eighth to 3 full grams of cannabis used alone over 1 to 11 days.

Small sample sizes of values greater than zero ($n < 10$ for all solitary alcohol and cannabis use variables on the Timeline Follow-back) precluded analyses of associations between number of solitary drinking/cannabis use days, total number of solitary drinks/grams of cannabis consumed, or mean number of solitary drinks/grams of cannabis consumed and proposed affective and substance-related correlates.

Discussion

Despite substantial evidence that solitary drinking is associated with negative affect (Bilevicius et al., 2018; Keough et al., 2015), social vulnerability (Keough et al., 2016; Mohr et al., 2001; Stickley et al., 2015), and greater substance-related consequences (Creswell et al., 2014; Keough et al., 2018), parallel associations with solitary cannabis use remain under-researched. This single-wave online survey study of 190 college students replicated and extended findings from the solitary alcohol use literature and added to the scant literature on solitary cannabis use by (a) examining associations of solitary alcohol and cannabis use frequency with affective, social, and substance-related correlates previously established in the alcohol literature, and (b) testing solitary alcohol and cannabis use as potential moderators of the relationship between key psychosocial factors (i.e., negative affect, social anxiety, social isolation, interpersonal sensitivity, and pandemic-related stress) and specific substance-related consequences. Altogether, findings suggest that greater social isolation increases odds of solitary drinking, while greater interpersonal sensitivity and pandemic-related stress increase odds of

solitary cannabis use, all while previously documented psychosocial correlates (i.e., negative affect, social anxiety) are controlled for. Contrary to hypotheses, neither solitary drinking nor solitary cannabis use frequency was found to moderate associations of psychosocial correlates with substance-specific consequences, with two exceptions: at least monthly frequency of solitary drinking attenuated associations of interpersonal sensitivity with negative drinking consequences, and less than monthly solitary cannabis use attenuated associations of pandemic-related stress with negative cannabis consequences. Findings altogether suggest that solitary alcohol and cannabis use are uniquely associated with social and affective correlates which may require concurrent attention in clinical settings, and that solitary use of either alcohol or cannabis may be indicative of riskier alcohol/cannabis use.

Alcohol Findings

Consistent with hypotheses, solitary drinking was concurrently associated with older age and greater alcohol consequences when dichotomized. Also consistent with hypotheses, social isolation was found to increase odds of any solitary drinking, replicating prior findings (Stickley et al., 2015) from an adult male sample in Eastern Europe. However, this association with social isolation is novel to the literature on college students' solitary drinking, and contrasts previous null associations of social isolation with overall alcohol use among college students (Richardson et al., 2017). This result suggests that interventions aimed at reducing feelings of social isolation (for example, befriending schemes and social skills interventions; Smith & Lim, 2020) may help to protect against frequent solitary drinking. While social isolation is likely exacerbated by the social restrictions imposed by the COVID-19 epidemic (Smith & Lim, 2020), emerging evidence suggests that social isolation is both common and associated with mental health problems among college students (Moeller & Seehuus, 2019; Richardson et al., 2017). Future research should

continue to explore associations of social isolation with college students' mental health and substance use behaviors.

Inconsistent with hypotheses and prior literature (Bilevicius et al., 2018; Buckner & Terlecki, 2016), no associations were observed between negative affect or social anxiety and solitary drinking (both dichotomized and frequency). Null associations of negative affect and social anxiety with solitary drinking may in part be due to low variability in solitary drinking frequency within this sample (i.e., 66% of past-year solitary drinkers used alone less than once per month); while prevalence of solitary drinking (40% of past-year drinkers) was higher than that observed in pre-pandemic samples of college students (10%; Ju et al., 2019), the majority of solitary drinkers in this sample reportedly drank alone once a month or less.

Also inconsistent with hypotheses, solitary drinking was not found to strengthen associations of negative affect and social anxiety with alcohol consequences. While this is not surprising given null associations of solitary drinking frequency with negative affect, social anxiety, and alcohol consequences independently, this result contrasts prior findings that solitary drinking explains associations of depression and social anxiety with negative alcohol consequences (Buckner & Terlecki, 2016; Keough et al., 2015). Also unexpectedly, solitary drinking attenuated effects of interpersonal sensitivity on alcohol consequences, such that interpersonally sensitive participants were likely to have *fewer* alcohol consequences if they drank alone more frequently. While unexpected given the tension-reduction and social learning frameworks common to most solitary drinking literature (e.g., Keough et al., 2015; Creswell et al., 2014), this finding is consistent with the social attributional framework for alcohol use (Fairbairn & Sayette, 2014). Fairbairn & Sayette (2014) argue that alcohol is most rewarding in situations where social rejection is perceived as both possible and unpredictable; solitary

drinking would therefore be a situation in which alcohol is not inherently rewarding, potentially

preventing drinking heavy enough to be associated with greater drinking consequences.

Cannabis Findings

Consistent with hypotheses, solitary cannabis use was found to be concurrently

associated with greater negative affect, interpersonal sensitivity, and pandemic-related stress.

However, inconsistent with hypotheses and prior literature (Buckner, Ecker, & Dean, 2016), no

associations were observed between social anxiety and solitary cannabis use. Null associations of

social anxiety with solitary cannabis use may in part reflect limited social exposure during the

pandemic. While social anxiety appears to have risen since the start of the COVID-19 pandemic

(Thompson et al., 2021), social anxiety-motivated cannabis use is often highest in anticipation of

social activity (e.g., "pre-gaming" prior to attending a party; Davis et al., 2020) which may be

easy to avoid during the pandemic.

Novel to the limited literature on solitary cannabis use, this study found that greater

interpersonal sensitivity was associated with higher odds of past-month solitary cannabis use.

This novel finding may have several explanations. First, interpersonal sensitivity has been

robustly associated with paranoia (Meisel et al., 2018), which is a common aversive side effect

of cannabis use (LaFrance et al., 2020). Interpersonally sensitive cannabis users may be more

prone to social paranoia when smoking, thus deterring them from using in social settings.

Second, chronic cannabis use appears to impair interpersonal emotional processing over time

(Hindocha et al., 2014), potentially resulting in cannabis users' misinterpretation of social cues

as rejection. Greater interpersonal sensitivity among high-frequency solitary cannabis users may

then become a self-perpetuating problem: cannabis users anticipate social exclusion, smoke

cannabis as a means of reducing rejection-related negative affect, but over time become less and

less able to correctly discern rejection. This, coupled with the aforementioned paranoia, simultaneously reinforces frequent cannabis use and discourages use in social settings, where individuals may be particularly attuned to perceived rejection.

Also novel to the literature, this study found that greater pandemic-related stress was associated with higher odds of at least monthly solitary cannabis use. While this finding's generalizability is limited to the current global pandemic, it is consistent with the idea that solitary cannabis use is motivated by tension reduction, particularly among those who use more frequently (Hyman & Sinha, 2009). It has been hypothesized that chronic cannabis use may affect stress systems and thus make stress-related motivation to use cannabis more salient over time (Hyman & Sinha, 2009). While the cross-sectional nature of the current data precludes testing such a theory, the observed association between a novel stressor (pandemic-related stress) and more frequent solitary cannabis use, which appears to occur more often among more experienced users given the earlier age of cannabis use onset, supports this notion.

Inconsistent with prior literature (e.g., Buckner, Ecker, & Dean, 2016), in this sample, solitary cannabis use did not appear to be directly associated with social anxiety, suggesting that socially anxious cannabis users may not be pre-gaming (as observed among college solitary alcohol users; Keough et al., 2016) but instead use heavily in social settings in order to manage anxiety in the moment (Walukevich-Dienst et al., 2020). Significant associations of both social anxiety (e.g., Walukevich-Dienst et al., 2020) and solitary cannabis use with cannabis consequences suggest two parallel paths to cannabis-related risk: one via maladaptive coping during social situations, and one occurring either before or after social situations in an effort to manage misappraisals of rejection.

Hypotheses that solitary cannabis use frequency would strengthen associations of negative affect and social anxiety with negative cannabis use consequences were not supported. Ancillary analyses testing solitary cannabis use frequency as a moderator of associations of social isolation, interpersonal sensitivity, and pandemic-related stress with negative cannabis use consequences also found no significant interactions. However, solitary cannabis use frequency attenuated associations of pandemic-related stress with cannabis consequences when interactions with all other affective correlates (e.g., negative affect, social anxiety, social isolation, and interpersonal sensitivity) were accounted for, such that less-than-monthly solitary cannabis users had lower odds of any cannabis use consequences when experiencing greater pandemic-related stress. This unexpected finding may reflect some unexplored protective factor present among less frequent solitary cannabis users, which may explain both a) their less frequent solitary use and b) their lower susceptibility to stress-related influences on substance use behavior. One potential explanation would be social support, which has been shown to buffer against pandemic-related stress (Szkody et al., 2020) and may also act as a buffer against solitary use.

Similarities and Differences between Solitary Alcohol and Cannabis Use

Several similarities and differences between solitary alcohol and solitary cannabis use within this sample are noteworthy. First, solitary drinking was only modestly correlated with overall drinking ($r = .34$), while solitary cannabis use was strongly correlated with overall cannabis use ($r = .83$), suggesting that solitary cannabis use may be a natural and common progression among cannabis users. Consistent with this notion, monthly solitary drinking was uncommon in this sample; only 33% of past-year solitary drinkers had also drunk alone within the past month. By contrast, 69% of past-year solitary cannabis users had also used cannabis alone within the past month. Moreover, effect sizes for differences between solitary and non-

solitary users were generally larger for analyses of solitary cannabis use (Cohen's $d = 0.41$-1.60) than solitary alcohol use (Cohen's $d = 0.29$-0.49; see Tables 3-6), suggesting stronger associations of solitary cannabis use with affective and social correlates. Similarly, effect sizes associating solitary use with substance-related consequences were stronger for solitary cannabis use (IRR = 2.87; see Table 5) than for solitary alcohol use (IRR = 1.50; see Table 3) and were notably nonsignificant for alcohol when solitary use was restricted to past-month rather than past-year use, suggesting solitary use may be a stronger indicator of risk among cannabis users than alcohol users. However, these findings may have been driven by the greater frequency of solitary cannabis use (relative to solitary alcohol use) observed in this sample, as solitary drinking evidenced comparatively little variability.

With regard to proposed affective correlates, solitary drinking was associated with greater social isolation, while solitary cannabis use was associated with greater negative affect (when solitary cannabis use was dichotomized), interpersonal sensitivity, and pandemic-related stress; implications of these disparate findings have already been discussed above. Taken together, however, findings suggest that college students may preferentially use one substance over another in different circumstances, preferring alcohol to cope with certain feelings (in this sample, social isolation) and cannabis to cope with others (i.e., interpersonal sensitivity, pandemic-related stress). This pattern of substitutive use is consistent with prior findings that alcohol and cannabis are used separately in the context of tension reduction (O'Hara et al., 2016).

Clinical Implications

The results of this study have important clinical implications. The considerable prevalence of solitary alcohol and cannabis use in this college sample, and their direct

associations with greater negative alcohol and cannabis-related consequences, respectively, suggests that solitary use should be routinely screened for in university students. While experimentation with substances is normative in college students, it is typically done as a means of social facilitation or mood enhancement (Beck et al., 2009; Gonzalez & Skewes, 2013). Findings from this study are consistent with emerging evidence suggesting that solitary alcohol and cannabis use are high-risk behaviors that are associated with greater consequences than social use (Bilevicius et al., 2018; Spinella et al., 2019). Screening for solitary use of either substance may identify those at greater risk for problematic use before their use and associated problems worsen. Identifying high-risk groups such as solitary users is vital both for prevention and intervention efforts (Gonzalez et al., 2009; Spinella et al., 2019).

Novel to the literature, findings from this study implicate social isolation as a risk factor for solitary drinking among college students. Previous work with older adult men has shown that greater social isolation predicts greater solitary drinking (Stickley et al., 2015), and that lonelier male college students drink more overall (Knox et al., 2007), but no research to date has found associations between social isolation and solitary drinking in a population of college students. College students who report solitary alcohol use may benefit from interventions targeting social isolation, such as social cognitive behavioral therapy (for a review, see Cacioppo et al., 2015).

Also novel to the literature, this study identified interpersonal sensitivity as a risk factor for solitary cannabis use. Interpersonal sensitivity may be a key target for intervention on solitary cannabis use and associated consequences, as individuals in substance use treatment typically respond poorly to standard cessation treatment when they have concurrent affective problems (Kushner et al., 2005). Improving solitary users' ability to navigate relationships and social situations should reduce some of their internal distress and improve social support, which is

known to improve substance use treatment outcomes (McHugh et al., 2010). Although there are

currently no published therapies focused on improving interpersonal sensitivity, a recent pilot

study (Bell & Freeman, 2014) of cognitive behavioral therapy for interpersonal sensitivity (CBT-

IPS) showed promising results in reducing not only interpersonal sensitivity but also paranoid

ideation. Solitary cannabis users with high interpersonal sensitivity may benefit from an

approach to treatment integrating features of CBT-IPS (such as psychoeducation and behavioral

testing) with reduction of false safety behaviors (i.e., cannabis use; Buckner, Ecker, Beighley, et

al., 2016). Prior similar approaches focused on severing associations of social anxiety with

cannabis use have shown significant reductions in both cannabis use and the associated affective

factor (Buckner, Ecker, Beighley, et al., 2016).

Limitations

Findings from this study should be considered in light of several limitations. First, data

collected were cross-sectional, precluding causal analyses or conclusions. Second, sample size

was relatively small; while the collected sample size exceeded that indicated by the main effects

power analysis ($N = 169$), a larger sample may have been better powered to detect interaction

effects between solitary use and affective/social correlates with substance-related consequences.

Recommendations for two-way interactions often suggest sample size at least twice that required

for main effects, and in the case of expected partial attenuation, up to 14 times the sample size

for simple effects (Simonsohn, 2014). Third, this study relied on self-reported substance use,

which may be susceptible to memory error and social desirability bias. Additionally,

retrospective self-report data (i.e., Timeline Follow-back) was collected online with no penalty

for incomplete data; consequently, only a small percentage of the sample completed the 60-day

Timeline Follow-back self-report of substance use, preventing more fine-grained analyses of

individuals' substance use patterns. Fourth, participants were recruited from a non-clinical sample of college students; results may not generalize to a non-college population of young adults or to a population with clinically significant alcohol or cannabis use problems. Fifth, this study did not specifically recruit for solitary users of either substance. While this allowed for estimation of prevalence within this population during the COVID-19 pandemic, it limited the size of solitary sub-samples. Finally, data were collected during a global pandemic in which social contact was prohibited, limiting generalizability of results to the current pandemic context.

Future Directions

This study's findings, particularly those pertaining to solitary cannabis use frequency and associated consequences, open several avenues for future research. The high prevalence of solitary cannabis use among cannabis users within this sample, and the high frequency of solitary cannabis use among solitary users, suggests that this behavior warrants further study. Consistent associations with interpersonal sensitivity and pandemic-related stress suggest that solitary cannabis use is more common among those with greater need to cope. Future research should further explore associations of solitary cannabis use, interpersonal sensitivity, and cannabis use consequences in order to better elucidate the role solitary cannabis use plays. More fine-grained data, such as that collected via daily diary or ecological momentary assessment, may shed light on whether solitary cannabis use is more frequent on days where interpersonal sensitivity is elevated (consistent with alcohol findings reported by Mohr et al., 2001).

Conclusions

This study replicates and extends prior findings assessing solitary alcohol use among college students by associating it with social isolation and expands scant literature on solitary cannabis use by associating it with interpersonal sensitivity, pandemic-specific stress, and

negative cannabis consequences. Although replication and further explication of some findings is needed, current findings suggest that solitary use of either alcohol or cannabis should be screened for on college campuses as a potential indicator of substance use problems, and that identified solitary users receive tailored intervention programming to address under-represented social affective factors, namely social isolation and interpersonal sensitivity.

Table 1

Measures and Covariates by Study Aims

Measure	Aim 1: Differences by Solitary Use vs. Non-Use	Aim 2: Differences by Solitary Use Frequency	Aim 3: Interactions of Measure with Solitary Use
Solitary Alcohol Use (dichotomized)	✓		
Solitary Cannabis Use (dichotomized)	✓		
Solitary Alcohol Use Frequency		✓	✓
Solitary Cannabis Use Frequency		✓	✓
Alcohol Use Consequences	✓		✓
Cannabis Use Consequences	✓		✓
Negative Affect	✓	✓	✓
Social Anxiety	✓	✓	✓
Social Isolation	✓	✓	✓
Interpersonal Sensitivity	✓	✓	✓
Pandemic Stress Index	✓	✓	✓
Alcohol Expectancies	✓		
Alcohol Use Motives	✓		
Cannabis Expectancies	✓		
Cannabis Use Motives	✓		
Covariates			
Age	✓	✓	✓
Sex	✓	✓	✓
Age of drinking onset	✓	✓[e]	
Age of monthly drinking onset	✓	✓[e]	
Age of cannabis use onset	✓	✓[e]	
Age of monthly cannabis use onset	✓	✓[e]	
Race	✓		
Ethnicity	✓		
Sexual orientation	✓		
Greek affiliation	✓		

Note. Measures marked with an e superscript were included in exploratory analyses for this aim.

Table 2

Bivariate Correlations of Demographic, Psychosocial, and Alcohol-Related Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Age	-												
2. Male sex	.06	-											
3. Negative affect	-.01	**-.18**	-										
4. Social anxiety	-.07	**-.15**	**.33**	-									
5. Social isolation	.06	-.001	**.51**	**.50**	-								
6. Interpersonal sensitivity	.08	**-.26**	**.35**	**.52**	**.43**	-							
7. COVID-19 stress	.08	**-.31**	**.24**	**.17**	.08	**.20**	-						
8. Age of drinking onset	**.15**	.13	-.10	**-.23**	-.10	-.14	**-.27**	-					
9. Age of regular drinking onset	**.27**	.11	-.002	-.04	**-.002**	-.08	**-.21**	**.67**	-				
10. General drinking frequency	.10	-.12	-.04	.04	**-.04**	.08	**.38**	**-.35**	**-.39**	-			
11. General drinking quantity	-.04	**.27**	-.11	-.02	**-.11**	-.06	.04	**-.23**	**-.29**	**.40**	-		
12. Solitary drinking frequency	**.15**	.04	.14	.06	.14	.10	.05	-.03	**-.16**	**.34**	.10	-	
13. Solitary drinking quantity	-.13	**.24**	.11	.13	.11	.17	-.12	-.11	-.15	.05	**.27**	.09	-
14. Alcohol consequences	**.14**	-.10	.05	**.17**	.05	.14	**.25**	**-.27**	**-.17**	**.32**	**.23**	**.17**	-.09

Note. $N = 190$. Pearson's r correlation statistics are reported for two continuous variables (i.e., age and all alcohol variables). Spearman's r_s correlation statistics are reported for continuous variables and a dichotomous variable (i.e., sex). Significant correlations at $p < .05$ are denoted in bold.

Table 3

Bivariate Correlations of Demographic, Psychosocial, and Cannabis-Related Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. Age	-												
2. Male sex	.06	-											
3. Negative affect	-.01	**-.18**	-										
4. Social anxiety	-.07	**-.15**	**.33**	-									
5. Social isolation	.06	-.001	**.51**	**.50**	-								
6. Interpersonal sensitivity	.08	**-.26**	**.35**	**.52**	**.43**	-							
7. COVID-19 stress	.08	**-.31**	**.24**	**.17**	.08	**.20**	-						
8. Age of cannabis use onset	.15	-.03	-.05	-.05	-.002	-.11	**-.23**	-					
9. Age of regular cannabis use onset	**.27**	-.04	.04	.04	.17	.02	**-.18**	**.68**	-				
10. Cannabis use frequency	.03	.05	.10	.04	-.06	**.14**	**.38**	**-.30**	**-.24**	-			
11. Cannabis use quantity	.05	.06	.08	**.21**	.12	.12	-.01	.04	.09	.11	-		
12. Solitary cannabis use frequency	.01	.01	**.15**	.08	.03	**.23**	**.31**	**-.27**	**-.30**	**.83**	.09	-	
13. Solitary cannabis use quantity	.08	.02	.23	.23	**.29**	.10	-.16	.15	-.01	.04	**.81**	.07	-
14. Cannabis consequences	-.04	.03	**.24**	.14	.09	**.16**	**.32**	**-.26**	**-.23**	**.68**	.15	**.61**	.13

Note. $N = 190$. Pearson's *r* correlation statistics are reported for two continuous variables (i.e., age and all cannabis variables). Spearman's r_s correlation statistics are reported for continuous and a dichotomous variable (i.e., sex). Significant correlations at $p < .05$ are denoted in bold.

Table 4

Group Differences Between <u>Past-year</u> Solitary Drinkers and Exclusively Social Drinkers

	Total Sample (N = 190)	Past-Year Solitary Drinkers (n = 75)	Social-Only Drinkers (n = 115)	Test Statistic	Effect Size
Sociodemographics					
Age	**18.71 (1.06)**	**18.95 (1.24)**	**18.57 (0.90)**	***t*(186) = 2.491***	***d* = 0.36**
Sex (% male)	47%	49%	46%	χ^2(1) = 0.119	Φ = .03
White race	67%	65%	69%	χ^2(1) = 0.233	Φ = .04
Black race	6%	3%	9%	χ^2(1) = 2.789	Φ = .12
Asian race	15%	17%	13%	χ^2(1) = 0.665	Φ = .06
Multiracial race	7%	5%	4%	χ^2(1) = 0.098	Φ = .02
Native Hawaiian/Pacific islander	1%	1%	0%	χ^2(1) = 1.541	Φ = .09
Unknown race	2%	3%	1%	χ^2(1) = 0.943	Φ = .07
Other race	2%	1%	3%	χ^2(1) = 0.358	Φ = .04
Hispanic ethnicity	12%	8%	14%	χ^2(1) = 1.527	Φ = .09
Straight sexuality	89%	87%	90%	χ^2(1) = 0.656	Φ = .06
On-campus living	73%	65%	77%	χ^2(1) = 3.320	Φ = .13
Greek membership	**8%**	**17%**	**3%**	**χ^2(1) = 12.762*****	***Φ* = .26**
# roommates	0.75 (0.67)	0.73 (0.64)	0.74 (0.70)	*t*(188) = -0.231	*d* = 0.01
Psychosocial Correlates					
Negative affect	6.42 (6.01)	7.28 (6.45)	5.85 (5.66)	*t*(188) = 1.608	*d* = 0.24
Social anxiety	5.73 (4.64)	6.32 (5.22)	5.34 (4.20)	*t*(188) = 1.428	*d* = 0.21
Social isolation	**9.14 (4.80)**	**10.29 (4.78)**	**8.38 (4.69)**	***t*(188) = 2.725****	***d* = 0.40**
Interpersonal sensitivity	5.30 (4.66)	5.93 (4.72)	4.89 (4.60)	*t*(188) = 1.517	*d* = 0.22
COVID-19 stress	6.68 (3.16)	7.08 (3.22)	6.43 (3.11)	*t*(188) = 1.378	*d* = 0.21
Alcohol-related variables					
Alcohol use onset age	15.89 (1.43)	15.76 (1.45)	15.98 (1.41)	*t*(188) = -1.053	*d* = 0.15
Regular drinking onset age	**16.99 (1.30)**	**16.75 (1.40)**	**17.17 (1.19)**	***t*(165) = -2.089***	***d* = 0.33**
Positive expectancies	**11.01 (2.44)**	**11.73 (2.06)**	**10.59 (2.56)**	***t*(156) = 2.910****	***d* = 0.49**
Negative expectancies	11.31 (2.13)	11.54 (1.93)	11.17 (2.24)	*t*(156) = 1.057	*d* = 0.17
Coping motives	6.23 (3.18)	6.75 (3.14)	5.93 (3.19)	*t*(156) = 1.567	*d* = 0.26
Enhancement motives	**8.50 (3.11)**	**9.22 (2.87)**	**8.07 (3.18)**	***t*(156) = 2.281***	***d* = 0.38**
Social motives	10.02 (3.54)	10.44 (3.01)	9.77 (3.82)	*t*(156) = 1.156	*d* = 0.19
Conformity motives	5.70 (3.19)	5.69 (3.31)	5.71 (3.14)	*t*(156) = -0.023	*d* = 0.01
Alcohol consequences	**5.83 (4.89)**	**7.39 (5.22)**	**4.81 (4.41)**	***B*(156) = 0.338****	**IRR = 1.50 (1.21, 1.87)**

Note. Significant differences between social-only and solitary drinkers are denoted in bold and with asterisks. Analyses for categorical variables (e.g., sex, sexual orientation) were conducted with Pearson chi-squares; analyses for continuous variables (e.g., age of cannabis use onset) were conducted using independent-samples t-tests; analyses for count variables (cannabis consequences) were conducted using zero-inflated negative binomial regression.
*p < .05, **p < .01, ***p < .001

Table 5

Group Differences Between <u>Past-Month</u> Solitary Drinkers and Exclusively Social/Non-Past-Month Solitary Drinkers

	Total Sample (N = 190)	Past-Month Solitary Drinkers (n = 24)	Social-Only or Non-Past Month Solitary Drinkers (n = 165)	Test Statistic	Effect Size
Sociodemographics					
Age	18.71 (1.05)	18.96 (1.02)	18.67 (1.06)	$t(186) = 1.208$	$d = 0.28$
Sex (% male)	47%	58%	46%	$\chi^2(1) = 1.395$	$\Phi = .09$
White race	67%	60%	69%	$\chi^2(1) = 0.711$	$\Phi = .06$
Black race	6%	8%	6%	$\chi^2(1) = 0.138$	$\Phi = .03$
Asian race	15%	20%	14%	$\chi^2(1) = 0.635$	$\Phi = .06$
Multiracial race	7%	4%	5%	$\chi^2(1) = 0.035$	$\Phi = .01$
Native Hawaiian/Pacific islander	**1%**	**4%**	**0%**	$\mathbf{\chi^2(1) = 6.635*}$	$\mathbf{\Phi = .19}$
Unknown race	2%	0%	2%	$\chi^2(1) = 0.462$	$\Phi = .05$
Other race	2%	0%	2%	$\chi^2(1) = 0.619$	$\Phi = .05$
Hispanic ethnicity	12%	0%	12%	$\chi^2(1) = 3.775$	$\Phi = .14$
Sexuality (% Straight)	89%	16%	10%	$\chi^2(1) = 0.717$	$\Phi = .06$
On-campus living	73%	**56%**	**75%**	$\mathbf{\chi^2(1) = -4.006*}$	$\mathbf{\Phi = .15}$
Greek membership	**8%**	**28%**	**6%**	$\mathbf{\chi^2(1) = 14.310***}$	$\mathbf{\Phi = .27}$
# roommates	0.74 (0.67)	0.72 (0.54)	0.75 (0.69)	$t(188) = -0.217$	$d = 0.05$
Psychosocial Correlates					
Negative affect	6.42 (6.01)	6.12 (6.06)	6.46 (6.02)	$t(188) = -0.264$	$d = 0.06$
Social anxiety	5.73 (4.64)	6.00 (4.71)	5.68 (4.64)	$t(188) = 0.316$	$d = 0.07$
Social isolation	9.14 (4.80)	9.12 (4.32)	9.14 (4.89)	$t(188) = -0.019$	$d = 0.004$
Interpersonal sensitivity	5.30 (4.66)	5.84 (4.44)	5.22 (4.70)	$t(188) = 0.620$	$d = 0.14$
COVID-19 stress	6.68 (3.16)	6.28 (3.59)	6.75 (3.10)	$t(188) = -0.694$	$d = 0.14$
Alcohol-related variables					
Alcohol use onset age	15.89 (1.43)	15.72 (1.40)	15.92 (1.43)	$t(188) = -0.657$	$d = 0.14$
Regular drinking onset age	16.99 (1.30)	16.68 (1.55)	17.04 (1.25)	$t(165) = -1.289$	$d = 0.26$
Positive expectancies	11.01 (2.44)	10.81 (1.94)	11.04 (2.50)	$t(156) = -0.345$	$d = 0.10$
Negative expectancies	11.31 (2.13)	10.88 (2.03)	11.36 (2.15)	$t(156) = -0.860$	$d = 0.23$
Coping motives	**6.23 (3.18)**	**8.13 (3.26)**	**6.02 (3.11)**	$\mathbf{t(156) = 2.550*}$	$\mathbf{d = 0.66}$
Enhancement motives	8.50 (3.11)	8.94 (2.67)	8.45 (3.16)	$t(156) = 0.593$	$d = 0.17$
Social motives	10.02 (3.54)	9.94 (2.82)	10.03 (3.62)	$t(156) = -0.097$	$d = 0.03$
Conformity motives	5.70 (3.19)	6.25 (3.59)	5.64 (3.15)	$t(156) = 0.723$	$d = 0.18$
Alcohol consequences	5.83 (4.89)	7.28 (5.46)	5.61 (4.78)	$B(156) = 0.115$	IRR = 1.30 (0.94, 1.79)

Note. Significant differences between social/non-past-month solitary and past-month solitary drinkers are denoted in bold and with asterisks. Analyses for categorical variables (e.g., sex, sexual orientation) were conducted with Pearson chi-squares; analyses for continuous variables (e.g., age of cannabis use onset) were conducted using independent-samples t-tests; analyses for count variables (cannabis consequences) were conducted using zero-inflated negative binomial regression.

$*p < .05$, $***p < .001$

Table 6

Group Differences between Past-Year Solitary Cannabis Users and Exclusively Social Cannabis

Users

	Total Sample (N = 190)	Past-Year Solitary Cannabis Users (n = 71)	Social-Only Cannabis Users (n = 97)	Test Statistic	Effect Size
Sociodemographics					
Age	18.71 (1.05)	18.72 (0.94)	18.71 (1.12)	$t(165) = 0.619$	$d = 0.01$
Sex (% male)	47%	51%	47%	$\chi^2(1) = 0.240$	$\Phi = .04$
White race	67%	69%	71%	$\chi^2(1) = 0.088$	$\Phi = .02$
Black race	6%	7%	6%	$\chi^2(1) = 0.049$	$\Phi = .02$
Asian race	15%	9%	11%	$\chi^2(1) = 0.376$	$\Phi = .05$
Multiracial race	7%	6%	5%	$\chi^2(1) = 0.019$	$\Phi = .01$
Native Hawaiian/Pacific islander race	1%	1%	0%	$\chi^2(1) = 1.685$	$\Phi = .09$
Unknown race	2%	3%	1%	$\chi^2(1) = 1.118$	$\Phi = .08$
Other race	2%	1%	3%	$\chi^2(1) = 0.267$	$\Phi = .04$
Hispanic ethnicity	12%	19%	10%	$\chi^2(1) = 2.967$	$\Phi = .14$
Sexuality (% Straight)	89%	**83%**	**94%**	**$\chi^2(1) = 4.921$***	**$\Phi = .17$**
On-campus living	73%	79%	71%	$\chi^2(1) = 1.289$	$\Phi = .09$
Greek membership	8%	14%	6%	$\chi^2(1) = 2.968$	$\Phi = .13$
# roommates	**0.74 (0.67)**	**0.93 (0.76)**	**0.62 (0.59)**	**$t(166) = 2.803$****	**$d = 0.46$**
Psychosocial Correlates					
Negative affect	**6.42 (6.01)**	**7.75 (5.99)**	**5.32 (5.85)**	**$t(166) = 2.627$****	**$d = 0.41$**
Social anxiety	5.73 (4.64)	6.04 (5.04)	5.47 (4.51)	$t(166) = 0.767$	$d = 0.12$
Social isolation	9.14 (4.80)	9.10 (5.25)	9.09 (4.32)	$t(166) = 0.008$	$d = 0.002$
Interpersonal sensitivity	5.30 (4.66)	5.90 (4.84)	4.81 (4.68)	$t(166) = 1.464$	$d = 0.23$
COVID-19 stress	**6.68 (3.16)**	**8.15 (2.99)**	**4.77 (2.84)**	**$t(166) = 5.243$*****	**$d = 1.16$**
Cannabis-related variables					
Cannabis use onset age	**16.42 (1.92)**	**15.77 (1.45)**	**16.90 (2.09)**	**$t(166) = -3.894$*****	**$d = 0.63$**
Regular cannabis use onset age	**17.18 (1.45)**	**16.87 (1.22)**	**17.63 (1.65)**	**$t(115) = -2.848$****	**$d = 0.52$**
Positive expectancies	**11.05 (2.67)**	**12.49 (1.93)**	**10.43 (2.56)**	**$t(137) = 5.209$*****	**$d = 0.91$**
Negative expectancies	9.81 (2.29)	9.69 (1.97)	9.85 (2.45)	$t(137) = -0.401$	$d = 0.07$
Coping motives	**6.15 (3.48)**	**8.07 (3.72)**	**5.29 (2.80)**	**$t(137) = 5.029$*****	**$d = 0.84$**
Enhancement motives	**8.63 (4.23)**	**12.07 (2.61)**	**7.08 (3.54)**	**$t(137) = 9.143$*****	**$d = 1.60$**
Conformity motives	4.69 (2.64)	4.59 (2.46)	5.06 (2.89)	$t(137) = -1.007$	$d = 0.18$
Social motives	**6.39 (3.40)**	**8.02 (3.41)**	**5.79 (3.05)**	**$t(137) = 4.049$*****	**$d = 0.69$**
Expansion motives	**6.63 (3.95)**	**9.17 (3.82)**	**5.40 (3.26)**	**$t(137) = 6.262$*****	**$d = 1.06$**
Cannabis consequences	**2.53 (3.90)**	**5.52 (4.60)**	**0.81 (1.78)**	**$B(166) = 1.06$*****	**IRR = 2.87 (1.89, 4.37)**

Note. Significant differences between social-only and solitary cannabis users are denoted in bold and with asterisks. Analyses for categorical variables (e.g., sex, sexual orientation) were conducted with Pearson chi-squares; analyses for continuous variables (e.g., age of cannabis use onset) were conducted using independent-samples t-tests; analyses for count variables (cannabis consequences) were conducted using zero-inflated negative binomial regression.

$*p < .05, **p < .01, ***p < .001$

Table 7

Group Differences between <u>Past-Month</u> Solitary Cannabis Users and Exclusively Social or Non-Past-Month Solitary Users

	Total Sample Mean (SD) or % (*N* = 190)	Past-Month Solitary Cannabis Users (*n* = 49)	Social-Only or Non-Past Month Solitary Cannabis Users (*n* = 119)	Test Statistic	Effect Size
Sociodemographics					
Age	18.71 (1.05)	18.69 (0.94)	18.65 (0.97)	*t*(165) = 0.252	*d* = 0.04
Sex (% male)	47%	47%	49%	χ²(1) = 0.068	*Φ* = 0.02
White race	67%	65%	72%	χ²(1) = 0.805	*Φ* = 0.07
Black race	6%	6%	7%	χ²(1) = 0.020	*Φ* = 0.01
Asian race	15%	8%	11%	χ²(1) = 0.291	*Φ* = 0.04
Multiracial race	7%	8%	4%	χ²(1) = 1.074	*Φ* = 0.08
Native Hawaiian/Pacific islander	1%	2%	0%	χ²(1) = 2.893	*Φ* = 0.12
Unknown race	2%	4%	1%	χ²(1) = 2.661	*Φ* = 0.12
Other race	2%	1%	2%	χ²(1) = 0.001	*Φ* = 0.00
Hispanic ethnicity	12%	21%	11%	χ²(1) = 3.260	*Φ* = 0.14
Sexuality (% Straight)	89%	14%	9%	χ²(1) = 0.922	*Φ* = 0.07
On-campus living	73%	80%	72%	χ²(1) = 0.977	*Φ* = 0.08
Greek membership	8%	14%	8%	χ²(1) = 1.820	*Φ* = 0.10
# roommates	0.74 (0.67)	0.86 (0.61)	0.72 (0.70)	*t*(166) = 1.172	*d* = 0.21
Psychosocial Correlates					
Negative affect	**6.42 (6.01)**	**8.12 (6.38)**	**5.61 (5.73)**	***t*(166) = 2.494***	***d* = 0.41**
Social anxiety	5.73 (4.64)	6.39 (5.09)	5.44 (4.58)	*t*(166) = 1.184	*d* = 0.20
Social isolation	9.14 (4.80)	9.61 (5.31)	8.88 (4.46)	*t*(166) = 0.911	*d* = 0.21
Interpersonal sensitivity	**5.30 (4.66)**	**7.00 (5.10)**	**4.56 (4.46)**	***t*(166) = 3.087****	***d* = 0.51**
COVID-19 stress	**6.68 (3.16)**	**8.20 (2.95)**	**6.19 (3.02)**	***t*(166) = 3.945*****	***d* = 0.67**
Cannabis Factors					
Cannabis use onset age	**16.42 (1.92)**	**15.69 (1.56)**	**16.72 (1.98)**	***t*(166) = -3.242****	***d* = 0.58**
Regular cannabis use onset age	**17.18 (1.45)**	**16.73 (1.23)**	**17.49 (1.52)**	***t*(115) = -2.881****	***d* = 0.56**
Positive expectancies	**11.05 (2.67)**	**12.80 (1.88)**	**10.70 (2.50)**	***t*(137) = 4.793*****	***d* = 0.95**
Negative expectancies	9.81 (2.29)	9.32 (2.17)	9.97 (2.27)	*t*(137) = -1.538	*d* = 0.27
Coping motives	**6.15 (3.48)**	**8.95 (3.68)**	**5.46 (2.88)**	***t*(137) = 5.952*****	***d* = 1.06**
Enhancement motives	**8.63 (4.23)**	**12.63 (2.36)**	**7.81 (3.72)**	***t*(137) = 7.588*****	***d* = 1.55**
Conformity motives	4.69 (2.64)	4.85 (2.72)	4.87 (2.73)	*t*(137) = -0.037	*d* = 0.01
Social motives	**6.39 (3.40)**	**8.73 (3.43)**	**5.93 (3.03)**	***t*(137) = 4.742*****	***d* = 0.87**
Expansion motives	**6.63 (3.95)**	**10.33 (3.42)**	**5.66 (3.34)**	***t*(137) = 7.415*****	***d* = 1.38**
Cannabis consequences	**2.53 (3.90)**	**6.24 (4.95)**	**1.39 (2.43)**	***B*(166) = 0.82*****	**IRR = 2.28 (1.60, 3.25)**

Note. Significant differences between social-only/non-past month solitary and past-month solitary cannabis users are denoted in bold and with asterisks. Analyses for categorical variables (e.g., sex, sexual orientation) were conducted with Pearson chi-squares; analyses for continuous variables (e.g., age of cannabis use onset) were conducted using independent-samples t-tests; analyses for count variables (cannabis consequences) were conducted using zero-inflated negative binomial regression.

*p < .05, **p < .01, ***p < .001

Table 8

Zero-inflated Negative Binomial Model Predicting Solitary Drinking Frequency

Negative binomial regression portion (solitary alcohol use frequency)		
	IRR (95% CI)	*p*
Negative affect	1.00 (0.95, 1.06)	.882
Social anxiety	0.97 (0.90, 1.05)	.484
Social isolation	0.99 (0.92, 1.07)	.814
Interpersonal sensitivity	1.04 (0.95, 1.13)	.396
Pandemic-related stress	0.95 (0.87, 1.05)	.315
Age	1.01 (0.99, 1.03)	.298
Sex	1.06 (0.59, 1.92)	.846
Overall drinking frequency	**1.27 (1.03, 1.57)**	**.025**
Logistic regression portion (solitary drinker status)		
	OR (95% CI)	*p*
Negative affect	1.00 (0.94, 1.07)	.937
Social anxiety	1.02 (0.93, 1.11)	.685
Social isolation	**1.10 (1.01, 1.21)**	**.035**
Interpersonal sensitivity	0.99 (0.90, 1.08)	.775
Pandemic-related stress	0.95 (0.84, 1.07)	.398
Age	**1.39 (1.01, 1.91)**	**.045**
Sex	1.18 (0.56, 2.48)	.656
Overall drinking frequency	**1.69 (1.36, 2.10)**	**<.001**

Note. $N = 190$. Results significant at $p < .05$ are shown in bold font.

*$p < .05$, **$p < .01$, ***$p < .001$

Table 9

Multinomial Logistic Model Predicting Solitary Cannabis Use Patterns

	As Compared to No Solitary Cannabis Use (*n* = 94)	
	Past-year, no past-month solitary cannabis use (*n* = 22)	Past-month solitary cannabis use (*n* = 49)
	OR (95% CI)	*OR* (95% CI)
Age	1.27 (0.77, 2.10)	0.96 (0.63, 1.44)
Sex (versus female)	**3.48 (1.11, 10.87)***	**2.98 (1.22, 7.25)***
Negative affect	1.09 (0.98, 1.21)	1.07 (0.98, 1.16)
Social anxiety	1.06 (0.92, 1.23)	0.98 (0.88, 1.09)
Social isolation	0.88 (0.76, 1.01)	0.92 (0.82, 1.03)
Interpersonal sensitivity	0.90 (0.77, 1.06)	**1.12 (1.00, 1.24)***
Pandemic-related stress	**1.41 (1.15, 1.72)****	**1.34 (1.15, 1.55)*****

Note. *N* = 165. Significant results at *p* < .05 are denoted in bold font.

p < .05, ***p* < .01, ****p* < .001

Figure 1

Interaction between Solitary Drinking Frequency and Interpersonal Sensitivity on Alcohol
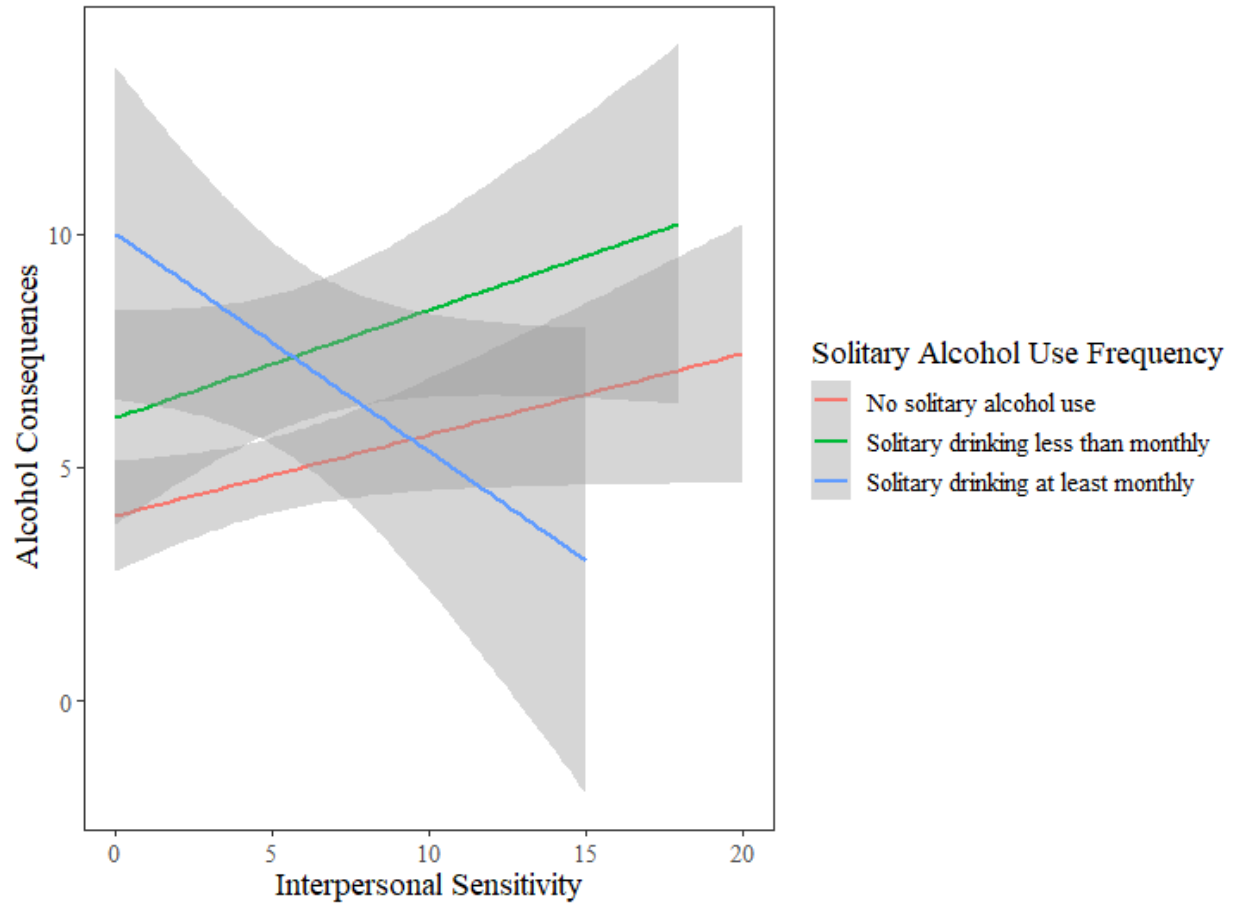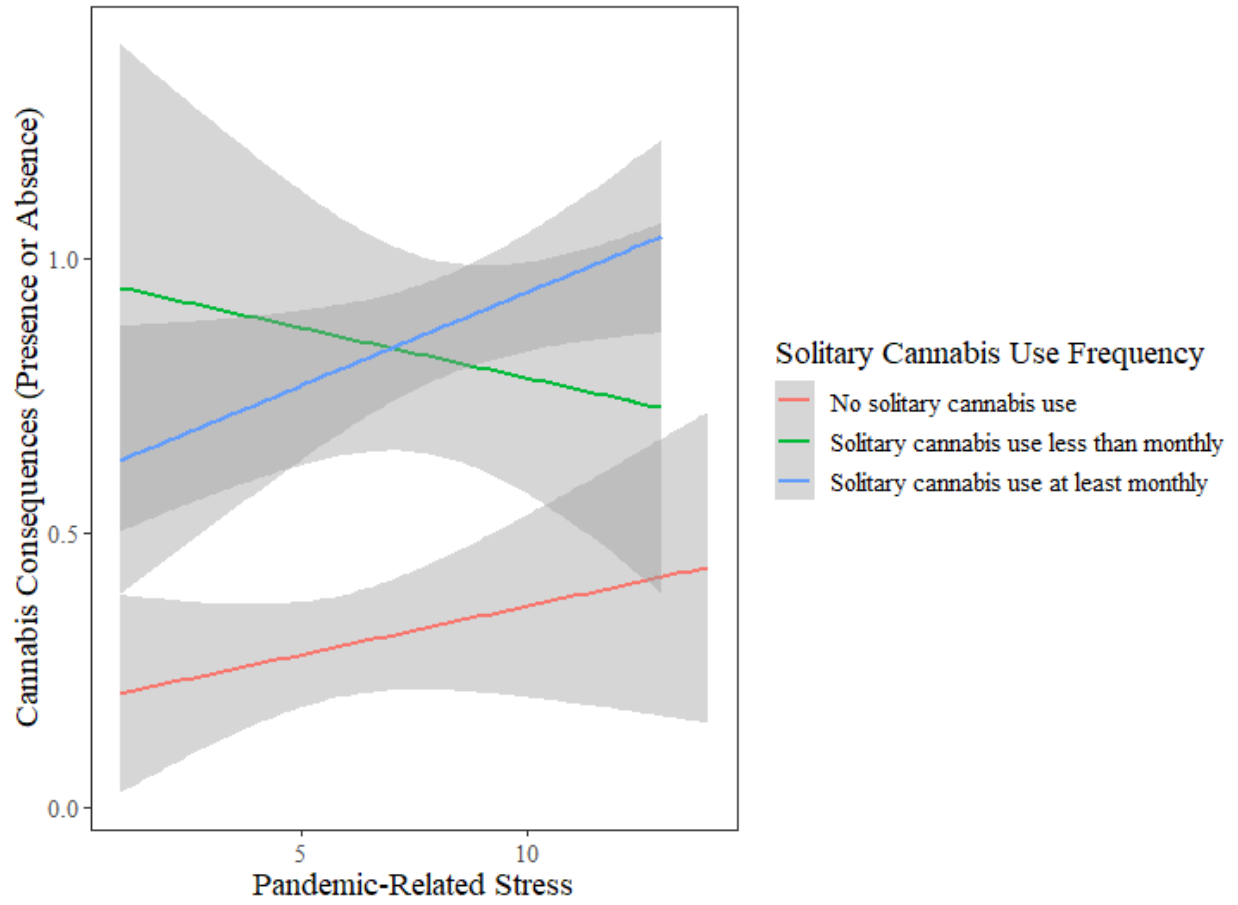
Consequences

Figure 2

Interaction between Solitary Cannabis Frequency and Pandemic-Related Stress on Cannabis Consequence Status

References

Almeida, L. S., Fuentes, M. C. P., Casanova, J. R., Linares, J. J. G., & Jurado, M. M. M. (2018). Alcohol Expectancy-Adolescent Questionnaire (AEQ-AB): Validation for Portuguese college students. *Health and Addictions*, *18*(2), 155–163. https://doi.org/10.21134/haaj.v18i2.389

American College Health Association. (2021). *American College Health Association-National College Health Assessment III: Undergraduate Student Reference Group Data Report Fall 2020*. American College Health Association. https://www.acha.org/documents/ncha/NCHA-III_Fall_2020_Undergraduate_Reference_Group_Data_Report.pdf

Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2015). The academic consequences of marijuana use during college. *Psychology of Addictive Behaviors*, *29*(3), 564–575. https://doi.org/10.1037/adb0000108

Atkins, D. C., Baldwin, S. A., Zheng, C., Gallop, R. J., & Neighbors, C. (2013). A tutorial on count regression and zero-altered count models for longitudinal substance use data. *Psychology of Addictive Behaviors*, *27*(1), 166–177. https://doi.org/10.1037/a0029508

Auer, R., Vittinghoff, E., Yaffe, K., Künzi, A., Kertesz, S. G., Levine, D. A., Albanese, E., Whitmer, R. A., Jacobs, D. R., Sidney, S., Glymour, M. M., & Pletcher, M. J. (2017). *Association between Lifetime Marijuana use and Cognitive Function in Middle Age: The Coronary Artery Risk Development in Young Adults (CARDIA) Study*. 21.

Baltaci, O. (2019). The predictive relationships between the social media addiction and social anxiety, loneliness, and happiness. *International Journal of Progressive Education*, *15*(4), 74–82. https://doi.org/10.29329/ijpe.2019.203.6

Beck, K. H., Arria, A. M., Caldeira, K. M., Vincent, K. B., O'Grady, K. E., & Wish, E. D.

(2008). Social context of drinking and alcohol problems among college students.

American Journal of Health Behavior, *32*(4), 420–430.

https://doi.org/10.5555/ajhb.2008.32.4.420

Beck, K. H., Caldeira, K. M., Vincent, K. B., O'Grady, K. E., Wish, E. D., & Arria, A. M.

(2009). The social context of cannabis use: Relationship to cannabis use disorders and

depressive symptoms among college students. *Addictive Behaviors*, *34*(9), 764–768.

https://doi.org/10.1016/j.addbeh.2009.05.001

Bell, V., & Freeman, D. (2014). A pilot trial of cognitive behavioural therapy for interpersonal

sensitivity in individuals with persecutory delusions. *Journal of Behavior Therapy and

Experimental Psychiatry*, *45*(4), 441–446. https://doi.org/10.1016/j.jbtep.2014.06.001

Bilevicius, E., Single, A., Rapinda, K. K., Bristow, L. A., & Keough, M. T. (2018). Frequent

solitary drinking mediates the associations between negative affect and harmful drinking

in emerging adults. *Addictive Behaviors*, *87*, 115–121.

https://doi.org/10.1016/j.addbeh.2018.06.026

Bonn-Miller, M. O., & Zvolensky, M. J. (2009). An Evaluation of the Nature of Marijuana Use

and Its Motives among Young Adult Active Users. *American Journal on Addictions*,

18(5), 409–416. https://doi.org/10.3109/10550490903077705

Bradley, K. A., DeBenedetti, A. F., Volk, R. J., Williams, E. C., Frank, D., & Kivlahan, D. R.

(2007). AUDIT-C as a brief screen for alcohol misuse in primary care. *Alcoholism:

Clinical & Experimental Research*, *31*(7), 1208–1217. https://doi.org/10.1111/j.1530-

0277.2007.00403.x

Buckner, J. D., Ecker, A. H., Beighley, J. S., Zvolensky, M. J., Schmidt, N. B., Shah, S. M., & Carroll, K. M. (2016). Integrated Cognitive Behavioral Therapy for Comorbid Cannabis Use and Anxiety Disorders. *Clinical Case Studies*, *15*(1), 68–83. https://doi.org/10.1177/1534650115590857

Buckner, J. D., Ecker, A. H., & Dean, K. E. (2016). Solitary cannabis use frequency mediates the relationship between social anxiety and cannabis use and related problems: Solitary Cannabis Use. *The American Journal on Addictions*, *25*(2), 99–104. https://doi.org/10.1111/ajad.12339

Buckner, J. D., Lewis, E. M., Shah, S. M., & Walukevich, K. A. (2018). Risky sexual behavior among cannabis users: The role of protective behavioral strategies. *Addictive Behaviors*, *81*, 50–54. https://doi.org/10.1016/j.addbeh.2018.01.039

Buckner, J. D., & Schmidt, N. B. (2008). Marijuana effect expectancies: Relations to social anxiety and marijuana use problems. *Addictive Behaviors*, *33*(11), 1477–1483. https://doi.org/10.1016/j.addbeh.2008.06.017

Buckner, J. D., & Terlecki, M. A. (2016). Social anxiety and alcohol-related impairment: The mediational impact of solitary drinking. *Addictive Behaviors*, *58*, 7–11. https://doi.org/10.1016/j.addbeh.2016.02.006

Buckner, J. D., Zvolensky, M. J., Crosby, R. D., Wonderlich, S. A., Ecker, A. H., & Richter, A. (2015). Antecedents and consequences of cannabis use among racially diverse cannabis users: An analysis from Ecological Momentary Assessment. *Drug and Alcohol Dependence*, *147*, 20–25. https://doi.org/10.1016/j.drugalcdep.2014.12.022

Cacioppo, S., Grippo, A. J., London, S., Goossens, L., & Cacioppo, J. T. (2015). Loneliness: Clinical Import and Interventions. *Perspectives on Psychological Science*, *10*(2), 238–249. https://doi.org/10.1177/1745691615570616

Cappell, H., & Greeley, J. (1999). Alcohol and Tension Reduction: An Update on Research and Theory. In K. E. Leonard & H. T. Blane (Eds.), *Psychological Theories of Drinking and Alcoholism* (2nd ed., pp. 15–50). The Guilford Press.

Cappell, H., & Herman, C. P. (1972). Alcohol and tension reduction: A review. *Journal of Studies on Alcohol*, *33*, 33–36. https://doi.org/10.1016/0306-4603(89)90007-5

Crawford, L. A., Novak, K. B., & Jayasekare, R. R. (2019). Volunteerism, Alcohol Beliefs, and First-Year College Students' Drinking Behaviors: Implications for Prevention. *The Journal of Primary Prevention*, *40*(4), 429–448. https://doi.org/10.1007/s10935-019-00558-z

Creswell, K. G., Chung, T., Clark, D. B., & Martin, C. S. (2014). Solitary Alcohol Use in Teens Is Associated With Drinking in Response to Negative Affect and Predicts Alcohol Problems in Young Adulthood. *Clinical Psychological Science*, *2*(5), 602–610. https://doi.org/10.1177/2167702613512795

Cuttler, C., Spradlin, A., Nusbaum, A. T., Whitney, P., Hinson, J. M., & McLaughlin, R. J. (2017). Blunted stress reactivity in chronic cannabis users. *Psychopharmacology*, *234*(15), 2299–2309. https://doi.org/10.1007/s00213-017-4648-z

Davis, J. P., Christie, N. C., Pakdaman, S., Hummer, J. F., DeLeon, J., Clapp, J. D., & Pedersen, E. R. (2020). Multifaceted impulsivity as a moderator of social anxiety and cannabis use during pregaming. *Journal of Anxiety Disorders*, *76*, 102320. https://doi.org/10.1016/j.janxdis.2020.102320

de Dios, M. A., Hagerty, C. E., Herman, D. S., Hayaki, J., Anderson, B. J., Budney, A. J., & Stein, M. (2010). General Anxiety Disorder Symptoms, Tension Reduction, and Marijuana Use Among Young Adult Females. *Journal of Women's Health*, *19*(9), 1635–1642. https://doi.org/10.1089/jwh.2010.1973

Demers, A., & Bourgault, C. (1996). Changing society, changing drinking: Solitary drinking as a non-pathological behaviour. *Addiction*, *91*(10), 1505–1516.

Derogatis, L. R., Lipman, R. S., & Covi, L. (1973). SCL-90: An outpatient psychiatric rating scale--preliminary report. *Psychopharmacology Bulletin*, *9*(1), 13–28.

Dumas, T. M., Ellis, W., & Litt, D. M. (2020). What Does Adolescent Substance Use Look Like During the COVID-19 Pandemic? Examining Changes in Frequency, Social Contexts, and Pandemic-Related Predictors. *Journal of Adolescent Health*, *67*(3), 354–361. https://doi.org/10.1016/j.jadohealth.2020.06.018

Dvorak, R. D., Stevenson, B. L., Kilwein, T. M., Sargent, E. M., Dunn, M. E., Leary, A. V., & Kramer, M. P. (2018). Tension reduction and affect regulation: An examination of mood indices on drinking and non-drinking days among university student drinkers. *Experimental and Clinical Psychopharmacology*, *26*(4), 377–390. https://doi.org/10.1037/pha0000210

Fairbairn, C. E., & Sayette, M. A. (2014). A Social-Attributional Analysis of Alcohol Response. *Psychological Bulletin*, *140*(5), 1361–1382. https://doi.org/10.1037/a0037563

Farber, P. D., Khavari, K. A., & Douglass, F. M. (1980). A factor analytic study of reasons for drinking: Empirical validation of positive and negative reinforcement dimensions. *Journal of Consulting and Clinical Psychology*, *48*(6), 780–781. https://doi.org/10.1037/0022-006X.48.6.780

Fergus, T. A., Valentiner, D. P., McGrath, P. B., Gier-Lonsway, S. L., & Kim, H.-S. (2012).

> Short Forms of the Social Interaction Anxiety Scale and the Social Phobia Scale. *Journal*
>
> *of Personality Assessment*, *94*(3), 310–320.
>
> https://doi.org/10.1080/00223891.2012.660291

Foster, K. T., Arterberry, B. J., Iacono, W. G., McGue, M., & Hicks, B. M. (2018). Psychosocial

> functioning among regular cannabis users with and without cannabis use disorder.
>
> *Psychological Medicine*, *48*(11), 1853–1861.
>
> https://doi.org/10.1017/S0033291717003361

Gonzalez, V. M., Collins, R. L., & Bradizza, C. M. (2009). Solitary and social heavy drinking,

> suicidal ideation, and drinking motives in underage college drinkers. *Addictive*
>
> *Behaviors*, *34*(12), 993–999. https://doi.org/10.1016/j.addbeh.2009.06.001

Gonzalez, V. M., & Skewes, M. C. (2013). Solitary heavy drinking, social relationships, and

> negative mood regulation in college drinkers. *Addiction Research & Theory*, *21*(4), 285–
>
> 294. https://doi.org/10.3109/16066359.2012.714429

Haber, J. R., Harris-Olenak, B., Burroughs, T., & Jacob, T. (2016). Residual Effects: Young

> Adult Diagnostic Drinking Predicts Late-Life Health Outcomes. *Journal of Studies on*
>
> *Alcohol and Drugs*, *77*(6), 859–867. https://doi.org/10.15288/jsad.2016.77.859

Harkness, A., Behar-Zusman, V., & Safren, S. A. (2020). Understanding the impact of COVID-

> 19 on Latino sexual minority men in a US HIV hot spot. *AIDS & Behavior*.
>
> https://doi.org/10.1007/s10461-020-02862-w

Hays, R. D., & DiMatteo, M. R. (1987). A Short-Form Measure of Loneliness. *Journal of*

> *Personality Assessment*, *51*(1), 69–81.

Hindocha, C., Wollenberg, O., Carter Leno, V., Alvarez, B. O., Curran, H. V., & Freeman, T. P. (2014). Emotional processing deficits in chronic cannabis use: A replication and extension. *Journal of Psychopharmacology (Oxford, England)*, *28*(5), 466–471. https://doi.org/10.1177/0269881114527359

Hingson, R. W., Zha, W., & Weitzman, E. R. (2009). Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18-24, 1998-2005. *Journal of Studies on Alcohol and Drugs*, *Supplement*(16), 12–20.

Hopfer, S., Tan, X., & Wylie, J. L. (2014). A Social Network–Informed Latent Class Analysis of Patterns of Substance Use, Sexual Behavior, and Mental Health: Social Network Study III, Winnipeg, Manitoba, Canada. *American Journal of Public Health*, *104*(5), 834–839. https://doi.org/10.2105/AJPH.2013.301833

Horigian, V. E., Schmidt, R. D., & Feaster, D. J. (2021). Loneliness, Mental Health, and Substance Use among US Young Adults during COVID-19. *Journal of Psychoactive Drugs*, *53*(1), 1–9. https://doi.org/10.1080/02791072.2020.1836435

Hyman, S. M., & Sinha, R. (2009). Stress-Related Factors in Cannabis Use and Misuse: Implications for Prevention and Treatment. *Journal of Substance Abuse Treatment*, *36*(4), 400–413. https://doi.org/10.1016/j.jsat.2008.08.005

Ju, Y. J., Kim, W., Oh, S. S., & Park, E.-C. (2019). Solitary drinking and the risk of depressive symptoms and suicidal ideation in college students: Findings from a nationwide survey in Korea. *Journal of Affective Disorders*, *257*, 710–715. https://doi.org/10.1016/j.jad.2019.07.080

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward Efficient and Comprehensive Measurement of the Alcohol Problems Continuum in College Students: The Brief Young

Adult Alcohol Consequences Questionnaire: *Alcoholism: Clinical & Experimental Research*, *29*(7), 1180–1189. https://doi.org/10.1097/01.ALC.0000171940.95813.A5

Keough, M. T., Battista, S. R., O'Connor, R. M., Sherry, S. B., & Stewart, S. H. (2016). Getting the party started — Alone: Solitary predrinking mediates the effect of social anxiety on alcohol-related problems. *Addictive Behaviors*, *55*, 19–24. https://doi.org/10.1016/j.addbeh.2015.12.013

Keough, M. T., O'Connor, R. M., Sherry, S. B., & Stewart, S. H. (2015). Context counts: Solitary drinking explains the association between depressive symptoms and alcohol-related problems in undergraduates. *Addictive Behaviors*, *42*, 216–221. https://doi.org/10.1016/j.addbeh.2014.11.031

Keough, M. T., O'Connor, R. M., & Stewart, S. H. (2018). Solitary drinking is associated with specific alcohol problems in emerging adults. *Addictive Behaviors*, *76*, 285–290. https://doi.org/10.1016/j.addbeh.2017.08.024

Knox, D., Vail-Smith, K., & Zusman, M. (2007). The lonely college male. *International Journal of Men's Health*, *6*(3), 273–280.

Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, *16*(9), 606–613. https://doi.org/10.1046/j.1525-1497.2001.016009606.x

Kuntsche, E., & Kuntsche, S. (2009). Development and Validation of the Drinking Motive Questionnaire Revised Short Form (DMQ–R SF). *Journal of Clinical Child & Adolescent Psychology*, *38*(6), 899–908. https://doi.org/10.1080/15374410903258967

Kushner, M. G., Abrams, K., Thuras, P., Hanson, K. L., Brekke, M., & Sletten, S. (2005). Follow-up study of anxiety disorder and alcohol dependence in comorbid alcoholism

treatment patients. *Alcoholism: Clinical & Experimental Research*, *29*(8), 1432–1443. https://doi.org/10.1097/01.alc.0000175072.17623.f8

LaFrance, E. M., Stueber, A., Glodosky, N. C., Mauzay, D., & Cuttler, C. (2020). Overbaked: Assessing and predicting acute adverse reactions to Cannabis. *Journal of Cannabis Research*, *2*. https://doi.org/10.1186/s42238-019-0013-x

Mair, C., Ponicki, W. R., & Gruenewald, P. J. (2016). Reducing Risky Sex Among College Students: Prospects for Context-Specific Interventions. *AIDS and Behavior*, *20 Suppl 1*, S109-118. https://doi.org/10.1007/s10461-015-1147-2

Matthews, T., Danese, A., Wertz, J., Odgers, C. L., Ambler, A., Moffitt, T. E., & Arseneault, L. (2016). Social isolation, loneliness and depression in young adulthood: A behavioural genetic analysis. *Social Psychiatry and Psychiatric Epidemiology*, *51*(3), 339–348. https://doi.org/10.1007/s00127-016-1178-7

McCabe, S. E., West, B. T., Veliz, P., Frank, K. A., & Boyd, C. J. (2014). Social Contexts of Substance Use Among U.S. High School Seniors: A Multicohort National Study. *Journal of Adolescent Health*, *55*(6), 842–844. https://doi.org/10.1016/j.jadohealth.2014.06.017

McHugh, R. K., Hearon, B. A., & Otto, M. W. (2010). Cognitive Behavioral Therapy for Substance Use Disorders. *Psychiatric Clinics of North America*, *33*(3), 511–525. https://doi.org/10.1016/j.psc.2010.04.012

Meier, M. H., Caspi, A., Cerdá, M., Hancox, R. J., Harrington, H., Houts, R., Poulton, R., Ramrakha, S., Thomson, W. M., & Moffitt, T. E. (2016). Associations Between Cannabis Use and Physical Health Problems in Early Midlife: A Longitudinal Comparison of Persistent Cannabis vs Tobacco Users. *JAMA Psychiatry*, *73*(7), 731. https://doi.org/10.1001/jamapsychiatry.2016.0637

Meisel, S. F., Garety, P. A., Stahl, D., & Valmaggia, L. R. (2018). Interpersonal processes in

   paranoia: A systematic review. *Psychological Medicine*, *48*(14), 2299–2312.

   https://doi.org/10.1017/S0033291718000491

Mezquita, L., Ruiz-Valero, L., Martínez-Gómez, N., Ibáñez, M. I., & Ortet, G. (2018).

   Desarrollo y validación de la versión breve del cuestionario de motivos de consumo de

   marihuana (MMM SF). *Adicciones*, *31*(2), 106. https://doi.org/10.20882/adicciones.979

Moeller, R. W., & Seehuus, M. (2019). Loneliness as a Mediator for College Students' Social

   Skills and Experiences of Depression and Anxiety. *Journal of Adolescence*, *73*, 1–13.

   https://doi.org/10.1016/j.adolescence.2019.03.006

Mohr, C. D., Armeli, S., Tennen, H., Carney, M. A., Affleck, G., & Hromi, A. (2001). Daily

   Interpersonal Experiences, Context, and Alcohol Consumption: Crying in Your Beer and

   Toasting Good Times. *Journal of Personality and Social Psychology*, *80*(3), 489–500.

O'Hara, R. E., Armeli, S., & Tennen, H. (2016). Alcohol and cannabis use among college

   students: Substitutes or complements? *Addictive Behaviors*, *58*, 1–6.

   https://doi.org/10.1016/j.addbeh.2016.02.004

Pearson, M. R., Liese, B. S., & Dvorak, R. D. (2017). College student marijuana involvement:

   Perceptions, use, and consequences across 11 college campuses. *Addictive Behaviors*, *66*,

   83–89. https://doi.org/10.1016/j.addbeh.2016.10.019

Regan, T., Tubman, J. G., & Schwartz, S. J. (2020). Relations among Externalizing Behaviors,

   Alcohol Expectancies and Alcohol Use Problems in a Multi-Ethnic Sample of Middle

   and High School Students. *Substance Abuse: Research and Treatment*, *14*,

   117822182092842. https://doi.org/10.1177/1178221820928427

Richardson, T., Elliott, P., & Roberts, R. (2017). Relationship between loneliness and mental

    health in students. *Journal of Public Mental Health*, *16*(2), 48–54.

    https://doi.org/10.1108/JPMH-03-2016-0013

RStudio Team. (2020). *RStudio: Integrated development for R* [R]. RStudio, Inc.

    https://www.rstudio.com

Russell, C., Rueda, S., Room, R., Tyndall, M., & Fischer, B. (2018). Routes of administration for

    cannabis use – basic prevalence and related health outcomes: A scoping review and

    synthesis. *International Journal of Drug Policy*, *52*, 87–96.

    https://doi.org/10.1016/j.drugpo.2017.11.008

Schry, A. R., & White, S. W. (2013). Understanding the relationship between social anxiety and

    alcohol use in college students: A meta-analysis. *Addictive Behaviors*, *38*(11), 2690–

    2706. https://doi.org/10.1016/j.addbeh.2013.06.014

Schulenberg, J., Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Miech, R. A. (2019).

    Monitoring the Future: National Survey Results on Drug Use, 1975-2018: Volume II,

    College students and adults ages 16-90. University of Michigan Institute for Social

    Research.

Sher, K. J. (1999). Stress Response Dampening. In K. J. Sher (Ed.), *Psychological Theories of*

    Drinking and Alcoholism (2nd ed., pp. 227–264). Guilford Press.

Simons, J. S., Dvorak, R. D., Merrill, J. E., & Read, J. P. (2012). Dimensions and severity of

    marijuana consequences: Development and validation of the Marijuana Consequences

    Questionnaire (MACQ). *Addictive Behaviors*, *37*(5), 613–621.

    https://doi.org/10.1016/j.addbeh.2012.01.008

Simonsohn, U. (2014, March 12). *No-way Interactions*. datacolada.org/17

Skrzynski, C., Creswell, K. G., Bachrach, R. L., & Chung, T. (2018). Social discomfort

    moderates the relationship between drinking in response to negative affect and solitary

    drinking in underage drinkers. *Addictive Behaviors*, *78*, 124–130.

    https://doi.org/10.1016/j.addbeh.2017.11.009

Sloan, F. A., Costanzo, P. R., Belsky, D., Holmberg, E., Malone, P. S., Wang, Y., & Kertesz, S.

    (2011). Heavy drinking in early adulthood and outcomes at mid life. *Journal of*

    Epidemiology & Community Health, *65*(7), 600–605.

    https://doi.org/10.1136/jech.2009.102228

Smith, B. J., & Lim, M. H. (2020). How the COVID-19 pandemic is focusing attention on

    loneliness and social isolation. *Public Health Research & Practice*, *30*(2).

    https://doi.org/10.17061/phrp3022008

Sobell, L. C., & Sobell, M. B. (1992). Timeline follow-back: A technique for assessing self-

    reported alcohol consumption. In R. Z. Litten & J. P. Allen (Eds.), *Measuring alcohol*

    consumption: Psychosocial and biochemical methods (pp. 41–72). Humana Press.

Spinella, T. C., Stewart, S. H., & Barrett, S. P. (2019). Context matters: Characteristics of

    solitary versus social cannabis use. *Drug and Alcohol Review*, *38*(3), 316–320.

    https://doi.org/10.1111/dar.12912

Stein, L. A. R., Katz, B., Colby, S. M., Barnett, N. P., Golembeske, C., Lebeau-Craven, R., &

    Monti, P. M. (2007). Validity and Reliability of the Alcohol Expectancy Questionnaire-

    Adolescent, Brief. *Journal of Child & Adolescent Substance Abuse*, *16*(2), 115–127.

    https://doi.org/10.1300/J029v16n02_06

Stickley, A., Koyanagi, A., Roberts, B., Murphy, A., Kizilova, K., & McKee, M. (2015). Male

    solitary drinking and hazardous alcohol use in nine countries of the former Soviet Union.

Drug and Alcohol Dependence, *150*, 105–111.

https://doi.org/10.1016/j.drugalcdep.2015.02.017

Szkody, E., Stearns, M., Stanhope, L., & McKinney, C. (2020). Stress-Buffering Role of Social
Support during COVID-19. *Family Process*. https://doi.org/10.1111/famp.12618

Thompson, C., Mancebo, M. C., & Moitra, E. (2021). Changes in social anxiety symptoms and
loneliness after increased isolation during the COVID-19 pandemic. *Psychiatry
Research*, *298*, 113834. https://doi.org/10.1016/j.psychres.2021.113834

Torrealday, O., Stein, L. A. R., Barnett, N., Golembeske, C., Lebeau, R., Colby, S. M., & Monti,
P. M. (2008). Validation of the Marijuana Effect Expectancy Questionnaire-Brief.
Journal of Child & Adolescent Substance Abuse, *17*(4), 1–17.
https://doi.org/10.1080/15470650802231861

Treloar Padovano, H., & Miranda, R. (2018). Subjective cannabis effects as part of a developing
disorder in adolescents and emerging adults. *Journal of Abnormal Psychology*, *127*(3),
282–293. https://doi.org/10.1037/abn0000342

Tucker, J. S., Ellickson, P. L., Collins, R. L., & Klein, D. J. (2006). Does solitary substance use
increase adolescents' risk for poor psychosocial and behavioral outcomes? A 9-year
longitudinal study comparing solitary and social users. *Psychology of Addictive
Behaviors*, *20*(4), 363–372. https://doi.org/10.1037/0893-164X.20.4.363

U. S. Census Bureau. (2018). *Postsecondary enrollment before, during, and since the Great
Recession*. U. S. Department of Commerce.

Urbán, R., Kun, B., Farkas, J., Paksi, B., Kökönyei, G., Unoka, Z., Felvinczi, K., Oláh, A., &
Demetrovics, Z. (2014). Bifactor structural model of symptom checklists: SCL-90-R and

Brief Symptom Inventory (BSI) in a non-clinical community sample. *Psychiatry Research*, *216*(1), 146–154. https://doi.org/10.1016/j.psychres.2014.01.027

Walukevich-Dienst, K., Lewis, E. M., & Buckner, J. D. (2020). Cannabis-Related Impairment and Social Anxiety: The Role of Use to Manage Negative and Positive Affect in Social Situations. *Substance Use & Misuse*, *55*(2), 271–280. https://doi.org/10.1080/10826084.2019.1664590

Wang, X., Hegde, S., Son, C., Keller, B., Smith, A., & Sasangohar, F. (2020). Investigating Mental Health of US College Students During the COVID-19 Pandemic: Cross-Sectional Survey Study. *Journal of Medical Internet Research*, *22*(9), e22817. https://doi.org/10.2196/22817

Wardell, J. D., Kempe, T., Rapinda, K. K., Single, A., Bilevicius, E., Frohlich, J. R., Hendershot, C. S., & Keough, M. T. (2020). Drinking to Cope During COVID-19 Pandemic: The Role of External and Internal Factors in Coping Motive Pathways to Alcohol Use, Solitary Drinking, and Alcohol Problems. *Alcoholism: Clinical and Experimental Research*, *44*(10), 2073–2083. https://doi.org/10.1111/acer.14425

Washburn, I. J., & Capaldi, D. M. (2015). Heterogeneity in men's marijuana use in the 20s: Adolescent antecedents and consequences in the 30s. *Development and Psychopathology*, *27*(1), 279–291. https://doi.org/10.1017/S0954579414000686

Wemm, S. E., Ernestus, S. M., Glanton Holzhauer, C., Vaysman, R., Wulfert, E., & Israel, A. C. (2018). Internalizing Risk Factors for College Students' Alcohol use: A Combined Person- and Variable-Centered Approach. *Substance Use & Misuse*, *53*(4), 629–640. https://doi.org/10.1080/10826084.2017.1355385

You, Z., Zhang, Y., Zhang, L., Xu, Y., & Chen, X. (2019). How does self-esteem affect mobile

phone addiction? The mediating role of social anxiety and interpersonal sensitivity.

Psychiatry Research, *271*, 526–531. https://doi.org/10.1016/j.psychres.2018.12.040

Amelia V. Wedel

Department of Psychology
Syracuse University
430 Huntington Hall, Syracuse, NY 13210
awedel@syr.edu | (650) 861-0935

EDUCATION

Doctor of Philosophy   expected 2024
Clinical Psychology (APA Full Accreditation)
Syracuse University, Syracuse, NY
Advisor: Aesoon Park, Ph.D.

Master of Science   2021
Psychology (APA Full Accreditation)
Syracuse University, Syracuse, NY
Advisor: Aesoon Park, Ph.D.
Current GPA: 3.97
Thesis: *Solitary Alcohol and Cannabis Use among College Students during the COVID-19
Epidemic: Concurrent Social and Affective Correlates and Substance-Related Consequences*

Bachelor of Arts   2016
Oberlin College, Oberlin, OH
Psychology with High Honors
GPA: 3.6
Thesis: *Vaping to Lose Weight: Predictors of Adult E-Cigarette Use for Weight Management*

HONORS AND AWARDS

Departmental High Honors in Psychology   2016
Oberlin College
> Awarded for GPA and quality of research in undergraduate honors thesis

Raymond H. Stetson Award in Psychology and Psychobiology ($500)   2016
Oberlin College
> Awarded for quality of research in undergraduate honors thesis

Inducted into Sigma Xi as an Associate Member   2016

RESEARCH INTERESTS
- Progression from recreational cannabis use to cannabis use disorder
- Role of social relationships and social isolation in substance use

- Intensive longitudinal designs and advanced statistical techniques for measurement and modeling of temporal associations between social behavior and substance use

PUBLICATIONS

Peer-Reviewed Journal Publications

Morean, M. E., & **Wedel, A. V.** (2017). Vaping to lose weight: Predictors of adult e-cigarette use for weight management. *Addictive Behaviors, 66,* 55-59. doi:10.1016/j.addbeh.2016.10.022. PMID:27875790.

Wedel, A. V., Stevens, E. M., Molina, N., Leavens, E. L. S., Roberts, C., & Wagener, T. L (2018). Examining pregnant smokers' attitudes toward cessation aids and electronic nicotine delivery systems. *Journal of the Oklahoma State Medical Association, Vol. 111*(8), 812-818. PMID:31404418

Stevens, E. M., Cohn, A. M., Villanti, A. C., Leshner, G., **Wedel, A.**, & Wagener, T. L. (2019). Perceived effectiveness of anti-marijuana messages in adult users and non-users: An examination of responses to messages about marijuana's effects on cognitive performance, driving, and health. *Journal of Studies on Alcohol and Drugs, 80*(4), 415-422. PMID: 31495378

Manuscripts under Review

Wedel, A. V., Goodhines, P. A., Zaso, M. J., & Park, A. (2021). Prospective Associations of Discrimination with Alcohol and Cannabis Use in Adolescents: Differences by Race and LGB Status. [Manuscript submitted for publication].

Patterson, J. G., Keller-Hamilton, B., **Wedel, A. V.,** Wagener, T. L., & Stevens, E. M. (2021). Young adult sexual minority women's responses to e-cigarette health messages: Assessing the influence of message theme and format. [Manuscript submitted for publication].

Publications in Preparation

Goodhines, P. A., **Wedel, A. V.,** Dobani, F., Zaso, M. J., Gellis, L. A., & Park, A. (2021). Self-medication for sleep among racially-diverse urban adolescents: Concurrent and prospective associations with mood, sleep and substance use. [Manuscript in preparation].

Keller-Hamilton, B., Stevens, E. M., **Wedel, A. V.,** LaPolt, D., Miranda, A., Wagener, T. L., & Patterson, J. G. (2021). Tobacco messaging exposures and tobacco use among bisexual women: Evaluating differences by race and ethnicity. [Manuscript in preparation].

Wedel, A. V., Cabot, E. P., & Park, A. (2021). Progression through alcohol and cannabis use milestones in racially diverse urban adolescents. [Manuscript in preparation].

PRESENTATIONS

Oral Presentations (Peer-reviewed)

Wedel, A. V., & Morean, M. E. (2016, May). *Vaping to lose weight: Predictors of adult e-cigarette use for weight management* [Symposium]. Oberlin College Senior Symposium, Oberlin, OH, United States.

Wedel, A. V., & Ansell, E. B. (2019, July 26-28). *Solitary cannabis use moderates the relationship between use frequency and hazardous cannabis use* [Symposium]. 2019 Meeting for the Research Society of Marijuana, Vancouver, WA, United States.

Stevens, E. M., Johnson, A., Wander, N., Mehta, T., Smith, C., **Wedel, A.,** Tackett, A. P., Leavens, E. L. S., Leshner, G., & Wagener, T. L. (2020, May). *Influence of Regulated vs. Unregulated E-Cigarette Advertising on E-Cigarette Use: A Laboratory Vaping Lapse Task Study* [Paper presentation]. 2020 Annual Conference of the International Communication Association, Gold Coast, Australia. (Conference canceled)

Wedel, A. V., & Park, A. (2021, May 26-27). *Solitary cannabis use mediates associations of pandemic-related stress with cannabis use consequences* [Virtual flash talk]. 2021 Association for Psychological Science Virtual Convention.

National Poster Presentations (Peer-reviewed)
*denotes undergraduate or mentored junior student co-author

Wedel, A. V., & Morean, M. (2016, March 2-5). *E-juice or fruit juice: A novel, forced-choice product paradigm based on health, weight concerns, and price* [Poster session]. 22nd Annual Meeting for the Society of Research on Nicotine and Tobacco, Chicago, IL, United States.

Wedel, A. V., Leavens, E. L., Wagener, T. L., & Molina, N. (2017, March 8-11). *Examining pregnant smokers' interest in using electronic nicotine delivery systems, smoking cessation medications, and nicotine replacement during and after pregnancy to reduce or quit smoking* [Poster session]. 23rd Annual Meeting for the Society of Research on Nicotine and Tobacco, Florence, Italy.

Shaikh, R., Mowls, D., Leavens, E. L., **Wedel, A. V.**, Molina, N., Beebe, L., & Wagener, T. L. (2017, March 8-11). *Vape shop location: Neighborhood socio-demographic characteristics and proximity to schools* [Poster session]. 23rd Annual Meeting for the Society of Research on Nicotine and Tobacco, Florence, Italy.

Shaikh, R., Leavens, E. L., **Wedel, A. V.**, Molina, N., Driskill, L., & Wagener, T. L. (2017, March 8-11). *Point-of-sale marketing and practices in vape shops* [Poster session]. 23rd Annual Meeting for the Society of Research on Nicotine and Tobacco, Florence, Italy.

Shaikh, R., Carroll, D., Leavens, E. L., **Wedel, A. V.**, Molina, N., Beebe, L., & Wagener, T. L. (2018, February 21-24). *Are there differences in vape shop point-of-sale marketing as a function of proximity to schools?* [Poster session]. 24th Annual Meeting for the Society of Research on Nicotine and Tobacco, Baltimore, MD, United States.

Joseph, V.*, Sun, R., **Wedel, A. V.**, & Ansell, E. B. (2019, July 26-28). *Childhood emotional abuse and hazardous use of cannabis and alcohol: The mediating role of emotion dysregulation* [Poster session]. 2019 Meeting for the Research Society of Marijuana, Vancouver, WA, United States.

Wedel, A. V., Zhao, J., & Park, A. (2020, June 20-24). *Everyday discrimination experiences exacerbate LGBTQ adolescents' alcohol consumption* [Poster session]. 43ʳᵈ scientific meeting for the Research Society on Alcoholism, New Orleans, LA, United States. (Conference canceled)

Cabot, E. P.*, **Wedel, A. V.,** & Park, A. (2021, May 26-27). *Progression through alcohol use milestones in urban adolescents: Associations with race, alcohol expectancies and family deviancy* [Virtual poster session]. 2021 Association for Psychological Science Virtual Convention, online.

Zhao, J., **Wedel, A. V.,** Goodhines, P. A., & Park, A. (2021, May 26-27). *Race and neighborhood conditions prospectively associated with adolescent risky behaviors* [Virtual poster session]. 2021 Association for Psychological Science Virtual Convention, online.

Wedel, A. V., & Park, A. (2021, July 23). *Solitary cannabis use among college students during the COVID-19 pandemic: Associations with affect, social factors, and pandemic-related stress* [Virtual poster session]. 2021 Meeting of the Research Society for Marijuana, online. [Submitted for presentation].

Local Poster Presentations
Wedel, A. V., Rodgers, C., & Steinberg, E. (2015, May). *Attachment style and perceptions of social support in adolescent romantic relationships* [Poster session]. Annual meeting of the Cleveland Psychological Association, Cleveland, OH, United States.

Wedel, A. V., & Park, A. (2021, May 26-27). *Solitary cannabis use mediates associations of pandemic-related stress with cannabis use consequences* [Virtual poster session]. 2021 Syracuse University Neuroscience Research Day.

RESEARCH EXPERIENCE

Doctoral Student of Clinical Psychology   2019 – Present
Syracuse University, Syracuse, NY
Primary advisor: Aesoon Park, Ph.D.   *NIH Grant 1R01AA027677-01*

Master's Thesis Research   2020
Syracuse University, Syracuse, NY
Primary Advisor: Aesoon Park, Ph.D.
    Project: "Social Context of College Substance Use During the COVID-19 Pandemic"
- Collected online survey data to characterize solitary (as opposed to social) alcohol and cannabis use during the COVID-19 pandemic
- Investigated associations of depression, anxiety, loneliness, and pandemic-related stress with solitary alcohol/cannabis use patterns and alcohol/cannabis consequences

Research Assistant   2018 – 2019
Syracuse University, Syracuse, NY
Principle Investigator: Emily Ansell, Ph.D.   *NIH Grant 5R01DA039924-03*

Project: "Ecological Momentary Assessment of Cannabis Use Effects in Young Adults"
- Administered assessment interviews (SCID-5, SCID-5-PD, WASI-II) and heat sensitivity tasks to assess pain threshold and tolerance
- Organized and maintained ecological momentary assessment database using MetricWire software

Research Technician   2016 – 2018
Oklahoma Tobacco Research Center, Oklahoma City, OK
Principle Investigator: Francesco Versace, Ph.D.   *NIH Grant 7R21DA038001-02*
  Project: "Neurobehavioral Assessment of Reward Sensitivity in Young Smokers"
- Recruited and screened adolescent and adult participants both in-person and over the phone for research studies on smoking and health behaviors
- Collected and entered data using psychophysiological measures (i.e., EEG, skin conductance, and heart rate)

Principle Investigator: Theodore Wagener, Ph.D.   *NIH Grant 5R01CA194158-02*
  Project: "Examination of First and Second-Generation E-Cigarettes"
- Collected and prepared biological samples (i.e., blood, cheek swab, urine, spirometry) for analysis and/or shipment
- Provided counseling for transition to e-cigarette use and basic motivational instruction for participants in a study assessing biological and behavioral differences associated with cigarette and e-cigarette use in a population of long-term cigarette smokers
- Assisted in study design and data collection for research on user perceptions of marijuana and vaporizer marketing under the mentorship of Drs. Elise Stevens and Raees Shaikh (postdoctoral fellows)

Summer Scholar   2016
Oklahoma Tobacco Research Center, Oklahoma City, OK
Primary Mentor: Theodore Wagener, Ph.D.
- Collected point-of-sales survey data from e-cigarette and vaporizer shops in the Oklahoma City metro area
- Analyzed behavioral economic data on the role of flavor preferences and dependence on hookah use
- Analyzed self-report data from a survey of low-income pregnant smokers' interest in cessation products

Honors Research in E-Cigarette Use for Weight Management   2015 – 2016
Oberlin College, Oberlin, OH
Research Advisor: Meghan Morean, Ph.D.
- Collected self-report data from 600 adult Amazon MTurk workers that assessed vaping, flavor preferences, and eating pathology
- Analyzed data to determine adults' e-juice flavor preferences and the role of eating pathology in vaping patterns and preferences

Research Assistant in Adolescent Developmental Psychology   2014
Oberlin College, Oberlin, OH
Principle Investigator: Nancy Darling, Ph.D.
- Observed and coded video data of peer interactions in adolescent romantic relationships

- Analyzed data using hierarchical linear modeling to relate social support and conflict-resolution reactions to attachment style and demographic factors

Research Mentorship
Syracuse University Undergraduates
Vanessa Joseph   2018 – 2019

STATISTICAL SKILLS

Statistical Training & Advanced Coursework
Statistics & Research Design I & II   2018 – 2019
Courses taught by David Kellen, Ph. D.
Syracuse University

Introduction to Structural Equation Modeling   2020
Course taught by Aesoon Park, Ph.D.
Syracuse University

Software Skills
Statistical languages: R (tidyverse); introductory fluency in Python
Software: RStudio, SPSS, Excel, MPlus
Research and Data Management: RedCap, Qualtrics, MetricWire
Citation management: EndNote, Zotero

CLINICAL EXPERIENCE

Graduate Student Therapist   2020-2021
Psychological Services Center, Syracuse University
Supervisors: Drs. Emily Ansell, Afton Kapuscinski, Sarah LaFont, Steve Maisto, Shannon
        Sweeney, Kevin Antshel, Katherine Kidwell
Population: undergraduate and graduate students, adult outpatients
- Conduct integrative (neuropsychological and personality) psychological assessments
- Conduct weekly client intakes and ascertain initial diagnostic impressions
- Conduct weekly psychotherapy sessions using integrative treatment modalities
- Consult and integrate care with other treatment providers, including neurologists, primary care providers, and psychologists
- Competency in conducting teletherapy and emergency transition to telehealth service during the COVID-19 pandemic
- Competency in conducting ADHD and personality assessments via telehealth

Psychotherapy Training
        Client-centered therapy
        Cognitive-behavioral therapy
        Dialectical behavior therapy
        Motivational interviewing
        Short-term psychodynamic therapy

Assessments Administered

       Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV)
       Wechsler Intelligence Scale for Children – Fifth Edition (WISC-V)
       Wechsler Individual Achievement Test – Third Edition (WIAT-III)
       Minnesota Multiphasic Personality Inventory – Second Edition (MMPI-2)
       Personality Assessment Inventory (PAI)
       Continuous Performance Task – Gordon Diagnostic System (GDS)
       Continuous Performance Task – Conners
       Structured Clinical Interview for DSM-5 (SCID-5)
       Structured Clinical Interview for DSM-5 – Personality Disorders (SCID-PD)
       Test of Memory Malingering (TOMM)
       Behavioral Assessment Schedule for Children – Third Edition (BASC-3)
       QBCheck Remote Assessment for ADHD

Clinical Training Workshops and Coursework

Assessment I & II   2018 – 2019
Courses taught by Kevin Antshel, Ph.D., & Emily Ansell, Ph.D.

Practicum in Psychotherapy   2019 – 2020
Courses taught by Kevin Antshel, Ph.D., & Afton Kapuscinski, Ph.D.

Dynamic Deconstructive Psychotherapy   2019
Seminar presented to Syracuse University Psychology Department by Robert Gregory, Ph.D.

Group Psychotherapy and Interpersonal Processes   2020
Seminar presented to Syracuse University Psychology Department by Sangmoon Kim, Ph.D.

Intensive Short-term Dynamic Psychotherapy: State of Evidence and Video Illustration   2020
Grand Rounds presentation to Upstate Medical University by Allan Abbass, M. D.

Clinical Suicidology   October 2020
Seminar provided by National Register of Health Service Psychologists

Perspectives on Being a Culturally Responsive Psychologist: Insights for Research and Clinical Practice   April 2021
Seminar presented to Syracuse University Psychology Department by Jessica Desalu, Ph.D.

Cognitive Behavioral Therapy for Cannabis Use Disorders   April 2021
Seminar presented to Association for Behavioral and Cognitive Therapies by Igor Yakovenko, Ph.D.

TEACHING EXPERIENCE

Courses Taught

| Health Psychology | PSY 382 | Summer 2019 |
| | | Summer 2020 |

Teaching Assistantships
| <u>Psychology of Childhood</u> | PSY 335 | 2019 – 2020 |

PROFESSIONAL AND DEPARTMENTAL AFFILIATION

<u>Professional Affiliation</u>

Sigma Xi, Associate member	2016 – 2017
Research Society on Marijuana, Student member	2019 – Present
Association for Behavioral and Cognitive Therapies, Student member	2020 – 2021
Association for Psychological Science, Student member	2021 – Present

<u>Departmental Affiliation</u>

Women in Science and Engineering (by faculty nomination), Student member	2019 – Present
Future Professoriate Program, Student member	2019 – Present
Committee for Diversity and Inclusion, Student member	2020 – Present