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Alcohol and Cannabis Co-Use and Social Context as Risk Pathways to Sexual Assault

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Abstract

Objective: Simultaneous use of alcohol in combination with cannabis (“co-use”) is common among young adults, and associated with myriad consequences. Yet no studies have examined how co-use may confer vulnerability for sexual assault (SA). Further, though both co-use and SA commonly occur in social settings, there have been no examinations of the role that co-use may play in the broader social context that leads to assault risk. This was the objective of the present study.

Method: In a community sample of young adult women, (N=174; M age=22.6), we examined risk pathways to SA, guided by Routine Activities Theory (Mustaine & Tewksbury, 2002). Using a longitudinal burst design with 27 daily assessment across 1 year, women reported on their own and others’ alcohol, cannabis, and co-use, and on social context and assault experiences.

Results: Multi-level path model results showed alcohol and cannabis co-use to confer unique risk for SA, above and beyond the influence of use of either substance alone. Intoxication and components of the co-use social context (proximity to offenders) mediated this risk. Importantly, we observed a key role for co-use by *others within the social context* in assault risk.

Conclusions: This study adds to the literature by providing a nuanced and contextual account of how cannabis-alcohol co-use may lead to assault vulnerability in young adult women. Findings underscore the need for intervention efforts that expand their focus to include the broader social context, and the role that the use and co-use behaviors of others may play within this context.

Keywords

Co-Use; sexual assault; social context; alcohol; cannabis

Introduction

Alcohol and Sexual Assault in Young Adulthood

Sexual assault (SA) is an unfortunately common experience in the lives of young adult women (Casey & Nurius, 2006; Krebs et al., 2009; Mouilso, Fischer, & Calhoun, 2012;

Smith et al., 2018). These assaults represent a significant public health concern both because of how many women are affected, and because of the numerous deleterious physical and mental health outcomes associated with them (Littleton et al., 2013; Zinzow et al., 2008). Alcohol has been implicated in sexual victimization vulnerability (Abbey et al. 2004; Abbey, 2011; Gilmore et al., 2015; Littleton et al., 2009; Testa & Livingston, 2018). Indeed, recent daily diary data show a link between amount of alcohol consumed and likelihood of sexual victimization on a given occasion (Stappenbeck et al., 2020; Wilhite et al., 2018). Drinking also has been linked to likelihood of assault perpetration (Kirwan et al., 2019; Shorey et al. 2015; Testa & Cleveland, 2017; Testa, Brown, & Wang, 2019), particularly in cases where the victim and perpetrator do not know each other well (Abbey et al., 2014; Testa, VanZile-Tamsen, & Livingston, 2004).

Beyond just substance use, intoxication is another component of SA risk. Intoxication from alcohol is associated with impaired perception and decision making, as well as with disinhibition and aggression (e.g., Crane et al., 2017; Giancola et al., 2010; Hirsh et al., 2011; Leone et al., 2018; Massa et al., 2019), and greater levels of intoxication for either or both victim and perpetrator is associated with SA likelihood (Testa, et al., 2004; Wilhite, Mallard, & Fromme, 2018). This underscores the importance of considering level of intoxication, in addition to alcohol consumption, when considering the relationship between drinking and SA vulnerability. Intoxication effects may be further exacerbated when other substances, such as cannabis, are used in conjunction with alcohol. Yet, the influence of simultaneous co-use of alcohol and cannabis on vulnerability to SA is not well understood.

Co-Use and Implications for Sexual Assault Risk

Simultaneous use of alcohol in combination with other drugs (“co-use”) – particularly cannabis - is common among young adults (SAMHSA 2013; Subbaraman and Kerr, 2015, Terry-McElrath & Patrick, 2018), with as many as ¼ of U.S. adults engaging in co-use. Moreover, for the last three decades, rates of co-use in young adults appear to be increasing (Terry-McElrath and Patrick, 2018). Co-use has been the topic of much interest in the empirical literature because it has been linked to greater intoxication (Metrik et al., 2018; Patrick et al., 2018; Sokolovsky et al., 2020), and at least in some studies, greater risk for harmful consequences on the occasions that it occurs relative to alcohol consumption alone (Egan et al., 2019; Lee et al., 2017; Mallett et al., 2017; Linden-Carmichael et al., 2019; Subbaraman & Kerr, 2015). Yet, we are unaware of research that has examined the role that co-use may play in SA risk. Given the abundant compelling evidence for a synergistic effect of co-occurring alcohol and other drug use and subsequent intoxication on deleterious outcomes, the absence of data on the link between co-use and sexual victimization - one of the most toxic outcomes associated with drinking - is a notable gap in the literature. One of the primary objectives of the current study was to address this gap. In particular, we focus on co-use of alcohol and cannabis use as these are the two most widely used drugs in young adulthood (Pearson et al., 2017; Schulenberg et al., 2020)

The contexts (e.g., bars, parties) in which young adults use alcohol and cannabis also play a critical role in SA risk. Sexual victimization in young adulthood commonly occurs in convivial and social settings, where others are present (Abbey, 2002; Blayney & Read, 2018;

Sinozich & Langton, 2014; Testa & Livingston, 2009). Alcohol and other drug use often are a part of these settings. Yet, a small emerging literature suggests that it is not only the presence of substance use in these contexts that sets the stage for SA vulnerability; other characteristics of the context also play an important role. In particular, exposure to and interactions with others in the social milieu may be central to assault risk (Blayney & Read, 2018; Blayney et al., under review; Cleveland, Testa, & Hone, 2017; Testa & Cleveland, 2017). An understanding of these contexts, and the roles played by others within these contexts, could have important implications for delineating SA risk and, ultimately, informing prevention efforts.

Use, Co-Use, and the Social Context of Sexual Victimization: Routine Activities in the Daily Lives of Young Adult Women

Routine Activities Theory (RAT; Mustaine & Tewksbury, 1999; 2002) provides a framework for understanding the social context as a risk mechanism for SA. According to this theory, victimization risk occurs when the routine activities of a person's daily life expose her to potential perpetrators, and weaken individual and social protections. In the RAT framework, substance-involved SA can be understood as a crime of opportunity, with three key elements contributing to probabilistic risk exposure: (1) *a vulnerable target*, (2) *absence of capable guardianship*, and (3) *proximity to potential offenders*. Each of these 3 elements characterizes how someone may engage with the social environment in a way that increases vulnerability to victimization. These three features are ubiquitous in social contexts of young adulthood, at least in part due to the role that substance use plays in these contexts (Mustaine & Tewksbury, 2002). Intoxication plays a key part in all of these. As it has been well-established that co-use of alcohol and cannabis are associated with greater intoxication, co-use of these substances together would be expected to be more strongly implicated in this risk pathway. We describe each of these domains, and their link to assault vulnerability, below.

Vulnerable Target.—According to RAT theory, many aspects of alcohol and cannabis use and intoxication increase the likelihood of being a suitable target for SA. When intoxicated, women may be more inclined to risk taking (George et al., 2014) and less able to recognize and respond to potential risk (Davis et al., 2009). Further, when women are visibly under the influence of alcohol or other drugs, risk of SA increases (Davis et al., 2015; Parks et al., 1998; Parks, 2000). Finally, data show that perpetrators may use alcohol and other drugs as a tactic to facilitate sexual assault perpetration (Cleveland et al., 1999). Hence, co-use and related intoxication can render women vulnerable targets.

Absence of Capable Guardianship.—According to RAT, others in the assault context may act as “guardians” who can offer social protections and increase safety (Franklin, 2011; Mustaine & Tewksbury, 1999; Mustaine & Tewksbury, 2002). This may include things like keeping friends in sight and staying together as a group (Banyard, Moynihan, Cares, & Warner, 2014; Armstrong et al. 2014). Intoxication from co-use of alcohol and cannabis can compromise such guardianship. For example, when women are intoxicated, they may be more likely to become separated from friends, or to go off alone with a potential perpetrator – both known risk factors for assault (Blayney et al., 2020; Leone, Haikalas, Parrott, &

DiLillo, 2018). The substance use and intoxication of others in the environment may also contribute to this risk because the extent to which individuals in the social setting are able to provide capable guardianship will be jeopardized with more use and greater intoxication. As such, in various ways, degree of intoxication may be an important part of risk pathways to assault, because it increases the likelihood that guardianship will be compromised.

Proximity to Likely Offenders.—Another component of contextual risk for SA is proximity to likely offenders (Clodfelter et al., 2008; Mustaine & Twombsbury, 1999). Contexts that enhance the likelihood of such proximity carry greater risk. Though there is no perfect indicator of what makes someone a likely offender of sexual assault, a large literature has identified a number of factors that are strongly linked to assault perpetration. These include sexually aggressive behavior (Testa & Cleveland, 2017), hostile or negative attitudes toward women (Abbey & McAuslan, 2004; Thompson et al., 2015), or men who make efforts to isolate women from others in order to be alone with them (Abbey & Jaques-Tiura, 2011). The social settings of young adulthood provide ample opportunities for these dynamics.

The presence of alcohol and cannabis within these contexts likely augments risk for proximity to likely offenders. For potential victims, intoxication may impair recognition of some of these behavioral or attitudinal cues, or may jeopardize the ability to act to remove themselves from risky interactions or social settings (Abby et al., 2004; Davis et al., 2009; Testa & Livingston, 2018). Further, social environments in which alcohol and other drug use are present naturally bring together groups of individuals who may also be interested in engaging in casual sexual activity (Lindgren et al., 2009). The sexually-charged nature of these environments may attract predatory males or contribute to misperception of sexual intent. Thus, along with opportunities for consensual sex in these settings is an increased likelihood of interacting with potential perpetrators

Use & Co-Use by Others in the Social Context

Alcohol and cannabis use by others (e.g., friends, bystanders, other party-attendees, etc.) in the social context may be as relevant to SA as is use by the potential victim. As intoxication increases, others in the social context are less likely to act to intervene (Leone et al., 2018). This likely is because intoxication can impair perception of assault threat (Davis et al., 2009; Wiersman et al., 2020) or can compromise the ability to engage in effective preventive behavior (Fleming & Wiersma-Mosley, 2015; Pugh et al, 2016). Yet, studies examining the role of substance use in assault vulnerability have focused largely on use of the potential victim (see Testa & Livingston, 2018 for review), or on that of the perpetrator (e.g., Abbey et al., 2014; Testa & Cleveland, 2017) and have not evaluated the broader social context. Moreover, the studies that have examined substance use by others (e.g., “bystanders”; e.g., Leone et al., 2018; Melkonian, et al., 2020) have focused overwhelmingly on alcohol. We are aware of no studies that have considered how alcohol in combination with cannabis (co-use) by others present in the social context may contribute to victimization risk.

Summary and Existing Gaps in the Literature

Sexual assault is a significant problem in the lives of young adult women. Although it often occurs in social settings, (Testa & Livingston, 2009; 2018), the social context of SA, and how this may contribute to assault vulnerability, is not well understood. Alcohol has been strongly implicated in assault risk, and frequently is used concomitant to other drugs (“Co-Use”), most commonly cannabis. Such co-use is associated with greater intoxication, and perhaps relatedly, greater risk for hazardous outcomes. Yet, whether co-use is associated with SA risk has not been established. Moreover, use by others in the social context may also contribute to risk. No studies have examined how co-use (by others and the potential victim) may confer vulnerability for SA, or the unique role that co-use may play in the broader social context that leads to assault risk. A focus on these proximal contextual risk factors can shed light on targets for intervention.

Accordingly, in the present study, we examined risk pathways to SA using RAT as a framework to organize individual and contextual risk. We posited that, relative to either alcohol or cannabis use alone, co-use of these substances would provide incremental prediction of SA risk, marked by increased levels of intoxication, and exposure to potential perpetrators and a lack of capable guardians. A depiction of our conceptual model is provided in Figure 1. Co-use by the potential victim (own co-use) and by others’ in the context are expected to be associated with higher levels of own and others’ intoxication, respectively, which turn would be associated with absence of capable guardianship and presence of likely offenders, and subsequently assault.

Of note is that much of the research on substance use and sexual assault risk has been conducted in college samples (e.g., Blayney & Read, 2018; Howard et al., 2008; Lorenz & Ullman, 2016; Walsh et al., 2020). Though college students are an important and at-risk group for substance-related sexual assault, such a heavy focus on this group limits generalizability of knowledge of the ways in which SA risk may unfold across a variety of social contexts and settings. In this study, we used a longitudinal community sample to understand contextual risk.

Methods

Sampling Procedures.

The Daily Activities in Young Adult Social Experiences (DAYS) Study is an ongoing, longitudinal study of substance use, social contexts, and sexual assault risk in women’s daily lives (R01 AA026105). The parent study for the current study (R01DA020171) was a long-term, longitudinal investigation of adolescent substance risk. Initial recruitment for this parent study occurred from April 2007 to February 2009 in Erie County Ny when community adolescents were 11–12 years. More detail about recruitment of the parent sample is described elsewhere (Colder et al., 2013; Trucco et al., 2014). Given the focus of the DAYS project on alcohol involved sexual assault in woman, eligible participants were all females from the parent study other than 14 who explicitly asked not to be contacted for future research (N = 199 or 93% of the original 213 females at Wave 1).

Electronic (text and email) and mailed paper invitations guided prospective participants to the study URL, which included a link to a website outlining study objectives and procedures. Interested participants completed an orientation by watching an instructional video and a brief orientation survey, during which they were consented. Of the eligible 199 participants contacted, 174 (87%) were recruited into Year 1 of the DAYS project. The DAYS sample was primarily White/non-Hispanic (84%, N=146), 11% (N=19) were Black/African American, 3% (N=5) were Hispanic/Latino, 2% (N=3) Asian/Pacific Islander, and one participant identified as Native American. Average age of participants was 22.6 years (range 21 to 24). By the first assessment of the DAYS project, most the sample had completed a bachelor's degree (N=102, 59%), 27% (N=47) completed an associate's degree or some college, 9% (N=16) completed a high school degree, 4% (N=7) completed an advanced degree (master's or doctorate), one participant did not complete a high school degree, and one did not report their education level. With respect to gender identity, most of the sample identified as female (N=171, 98%), one participant identified as gender queer/nonconforming, one participant identified as questioning, and one identified as gender neutral. Most of the sample reported their sexual orientation to be straight/heterosexual (N=139, 80%) or bisexual (N=25, 14%). The remainder of the sample reported being gay/lesbian (N=6, 3%) or questioning (N=4, 2%). The University Institutional Review Board approved this study.

Data collection.

Data collection for Year 1 is complete and occurred February 2019 to February 2020. Year 2 collection is currently ongoing. All assessments were conducted via web-based surveys programmed in Qualtrics (Qualtrics, Provo, UT). Each year, assessments included an annual survey and three bursts each spanning three consecutive weeks. The three-week bursts occurred roughly three months apart, and included daily weekend assessments that were administered Friday, Saturday, and Sunday (to assess behavior and events that occurred the prior day (on Thursday, Friday, and Saturday). Thus, the daily assessments included reportage of 27 weekend days (including Thursdays) / year (nine weekend days at each of the 3 bursts). Reminder calls, emails, and texts were used to bolster retention rates. Compensation for annual assessments began at \$70 at Year 1. Participants were paid \$35 per weekly assessment (i.e., 3 daily surveys) with a bonus of \$15 if 2 of 3 the weekly assessments were completed, and a \$25 bonus for completing all 3 assessments in a burst. Those completing 7 or more of the 9 assessments in a given burst received a \$35 bonus. In the current study, we report on the 27 daily assessments from Year 1. Participation rates for the daily surveys were excellent, ranging from 90% to 98% with an average of 95%. For each daily assessment, participants were asked "On (previous day), did you go out or get together with a friend, more than 1 friend, or a romantic partner?" Because an understanding of the social context of SA was central to our study objectives, we limited our analysis to instances in which participants went out or got together with a friend, more than one friend, or romantic partner. The current analysis includes 1766 instances of going out or getting together.

Measures

Sexual Assault.—The revised sexual experiences survey (SES-R, Koss et al., 2007) was used to assess SA. The measure includes five sexual aggression and victimization experiences, including unwanted kissing and fondling, unwanted attempts at intercourse, forced oral sex, unwanted intercourse, unwanted anal penetration. We created a dichotomous indicator for each daily assessment (0=no victimization/aggression, 1=at least one victimization/aggression experience).

Own substance use.: Participants reported on their own use of alcohol (“*Did you have a drink of beer, wine, wine cooler, or liquor?*”) and cannabis (“*Did you use marijuana for non-medical purposes?*”) (Johnston, O’Malley, Bachman, & Schulenberg, 2012). These items were used to create a three-category substance use variable reflecting no use of alcohol or cannabis, use of alcohol alone or cannabis alone, or co-use (use of both alcohol and cannabis). Participants also reported on their level of intoxication if they were drinking (“*Approximately how high, buzzed, stoned or intoxicated did you feel when you were drinking?*”) or using cannabis (“*Approximately how high, buzzed, stoned or intoxicated did you feel when you were using marijuana?*”) using a six-point response scale (0=*not at all* to 5=*extremely*). If participants were using both alcohol and cannabis, then the maximum of the two intoxication items was used to represent level of intoxication.

Others’ substance use.: For each daily assessment, on occasions when respondents reported having gone out or gotten together with friends/romantic partner, they received a series of questions about the context where they spent most of their time. Of interest to the current study are questions pertaining to substance use and intoxication in the social context. Specifically, participants reported on whether the people or person in that setting was/were drinking alcohol or using cannabis, or both. All individuals who went out were asked to report on the substance use of the people (person) with whom they went out. In the case that the participant went out with only one other person, they reported on whether the “other” was drinking and whether they were using cannabis. For occasions when the participant was out with more than one person, the participant reported whether any of the people they were out with were (a) drinking and (b) using cannabis. Responses to these items were used to create a three-category Others’ Use variable (0=no use of either alcohol or cannabis, 1=use of alcohol or cannabis alone, 2=use of both alcohol and marijuana).

Participants also reported on the level of intoxication of others in the social context.

When the participant went out with one person, they reported how drunk/high the other person was from alcohol and from cannabis using a six-point response scale (0=not at all drunk/high to 5=very drunk/high). We took the maximum of these two items as a measure of intoxication of others. In the case where the participant went out with more than one person, they were asked to estimate, on average, how drunk/high the people in the group were (one item) using the same six-point response scale. This item was used as a measure of Others’ Intoxication.

Risky Routine Activities

Proximity to likely offenders.: We wrote four items to reflect presence of likely offenders consistent with the Mustaine and Tewksbury (2002) model. Items were based on prior literature regarding the types of interactions with individuals in the social context that may place them in close proximity to a potential offender (Abbey & McAuslan, 2004; Kingree & Thompson, 2013; Testa & Cleveland, 2017; Thompson et al., 2015). This included the following items: “*Did anyone at this event make efforts to be alone with you, or to draw you away from the group?*”; “*To your knowledge, were there men there who you know to have, or who were showing, negative attitudes toward women (e.g., telling sexist jokes, making derogatory comments about women)?*”; “*Were there men there who are known as “players?”*”; “*Were you around men who were behaving in a way that was sexually aggressive toward women?*”. Response options were dichotomous (0=no, 1=yes). A sum of endorsed items was computed. This sum score was skewed (82.8% reported no presence of likely offenders) and so we dichotomized this measure for analysis (0=not to all four items, 1=yes to at least one item).

Absence of capable guardianship.: Based on the RAct model (Mustaine and Tewksbury, 2002), we wrote five items to reflect absence of capable guardianship. These items included, “*I found myself going along with someone I just met or didn’t know very well*”, “*I stayed at a party/social gathering/bar/etc. after my friends left*”, “*I got separated from my friends*”, “*My friends were too intoxicated to be capable of helping me if I needed it*”, and “*I left a bar/party/social gathering/etc. with someone I didn’t know very well*”. Participants indicated whether each occurred or not (0=no, 1=yes), and items were summed to form an absence of capable guardianship score. However, on most occasions of going out, participants did not report an absence of capable guardianship (90.4%), and so this variable was dichotomized to indicate the absence of capable guardianship (0=no to all items, 1= yes to at least one item).

We computed alpha using the within-level correlation matrix because this is the level of assessment of most relevance for our analysis. Cronbach’s Alphas were strong (.89 for absence of Absence of Capable Guardianship and .87 for Proximity to Likely Offender). Strong internal consistencies were consistent with results from a multilevel confirmatory factor analysis specifying two factors (likely offender and absence of capable guardianship) at each level. Factor loadings were constrained to be equal across the two levels and the model provided an excellent fit to the data (model $\chi^2(66) = 81.31, p = .10$, Root Mean Square Error of Approximation (RMSEA) = .011, Comparative Fit Index (CFI) = .98). All factor loadings were statistically significant ($p < .05$) and standardized loadings were substantial (ranging from .69 to .90 at the within level and .65 to .96 at the between level). R^2 values were also high as one would expect given the substantial factor loadings (ranging from .47 to .89 at the within level, and from .42 to .89 at the between level).

Analytic Plan—Our hypotheses were tested using multilevel path models with two levels to account for the nested structure of the data (repeated assessments nested within participants). The models were estimated in MPlus software Version 8.3 (Muthén & Muthén, 1998–2017) using robust maximum likelihood (MLR) with Monte Carlo integration to accommodate the binary nature of several of our endogenous variables (presence of likely

offenders, absence of capable guardianship, and SA). We created orthogonal contrasts to examine the incremental effect of co-use relative to use of cannabis or alcohol alone. The contrasts were applied to our three-category substance use variable. The first contrast, *any use*, compared no use vs any use (no use = -2 vs alcohol or cannabis use alone = 1 and co-use=1). The second contrast, *co-use*, compared use of alcohol or cannabis alone vs co-use (no use =0, and alcohol or cannabis alone = -1 vs co-use = 1). Our main model included paths depicted in Figure 2 estimated at both level 1 (within-person) and level 2 (between-person), and included variance and mean/intercepts for all variables at level 1 and 2 as suggested by Preacher, Zyphur, and Zhang (2010). Indirect effects were tested with the R-web-based Monte Carlo calculator developed by Selig and Preacher (2008, June) that was extended to test 4-variable serial mediation. We specified 100,000 replications for the simulations. In reporting results, we focus on level 1 (within-person) associations, as we were most interested in time-varying effects of context and behavior on incidents of SA, but briefly summarize between-person associations in our final model.

Before estimating our full mediational model, we first summarize descriptive statistics (e.g., means, level one or within-person correlations) to help contextualize results, and then proceeded to estimate a series of preliminary multilevel path models to assess effects of other and own substance use on proposed mediators and outcome: 1). Other and own substance use and co-use predicting intoxication; 2). Other and own substance use and co-use predicting absence of capable guardianship and presence of likely offenders; 3). Other and own substance use and co-use predicting assault. These preliminary models provided an opportunity to evaluate unadjusted associations with co-use.

Results

In Table 1, we characterize the social settings of “going out” among the participants. Table 2 presents the within-person correlations of model variables. No significance values are reported as Mplus does not report significance levels for within or between correlations. Instead, we adopted an effect size perspective and indicated medium correlations, those .30 or greater but less than .50, and large correlations, those .50 or greater. To provide ease of interpretation of correlations, for the purposes of Table 2, we created two dummy coded substance use variables reflecting no use of either alcohol or cannabis (0) vs. any use (1), and no use or alcohol/cannabis use alone (0) vs. co-use (1).

As shown in Table 1, rates of going out increased from Thursday to Saturday, and women mostly went to a friend’s residence, a bar, or some other place. The majority of the contexts were characterized by going out with one person or a small group. When going out with one other person, this was typically with a male romantic partner. If women went out with a group, the group typically included both men and women. Although not shown in Table 1, most women drank at least once when going out (N=156, 90%). A substantial number also reported at least one instance of cannabis use (N=58, 34%) or co-use of alcohol and cannabis (N=51, 30%). As shown in table 2, own and others’ co-use of alcohol and cannabis use was relatively rare compared to any use across the 1766 instances. Absence of capable guardianship was not very prevalent, but the presence of likely offenders was more common. Assault was rare, with 28 instances across 1,763 nights out (3 instances of the total 1766

were missing the assault variable). Turning to correlations, when participants engaged in use or co-use, this occurred in contexts where others were also using or co-using. Similarly, participants' levels of intoxication were strongly correlated with levels of intoxication of others in the context. Own and other's intoxication were positively related to absence of capable guardianship and presence of likely offenders, but these associations were modest. Correlations with assault were small.

Preliminary Multilevel Path Models

Results from the preliminary path models are presented in Table 3. Both any substance use (using alcohol or cannabis alone or co-use) and co-use were associated with levels of own and others' intoxication. Any use by the participant (but not their co-use) was associated with absence of capable guardianship, whereas others' co-use (but not others' any use) was associated with absence of capable guardianship. Both any use and co-use by others was associated with the presence of likely offenders, whereas participants' own use (either any use or co-use) were not associated with the presence of likely offenders. Only co-use by others had a direct association with assault. In sum, with respect to the critical question of whether co-use provides incremental prediction above and beyond use of either alcohol or cannabis alone, the answer is yes. Findings suggest that co-use provided incremental prediction for levels of intoxication (Model 1), absence of capable guardianship (Model 2), presence of likely offenders (Model 3) and assault (Model 4).

Mediation Path Model

Results from the full mediational path model are presented in Figure 2. Consistent with the preliminary models, others' co-use and the participants' own co-use were associated with increased level of others' and participants' own intoxication, respectively. Others' intoxication was, in turn, associated with increased likelihood of the absence of capable guardianship. The association of own intoxication with absence of capable guardianship was marginally significant. Only others' intoxication was associated with the increased likelihood of the presence of likely offenders. Finally, of the two proposed proximal predictors of assault, only the presence of likely offenders (not the absence of capable guardianship) was associated with increased likelihood of assault. At level-2, the only significant paths were from own use and co-use to own intoxication ($b=.99$ and 1.00 , respectively, $ps<.01$), from others' use and co-use to others' intoxication ($b=.87$ and $.88$, respectively, $ps < .01$), and from own intoxication and others' any use to presence of likely offenders ($bs=.08$ and $.06$, respectively, $p<.05$).

Results suggest the possibility of two hypothesized level-1 indirect effects and one additional indirect effect that involved co-use but not intoxication: 1). own co-use \rightarrow own intoxication \rightarrow presence of likely offenders \rightarrow assault and 2). others' co-use \rightarrow others' intoxication \rightarrow presence of likely offenders \rightarrow assault, and 3). others' co-use \rightarrow presence of likely offenders \rightarrow assault (not hypothesized). The indirect effect from own co-use also was not statistically significant: 95% CI $[-0.197, 0.2145]$, whereas the indirect effect from others' co-use that operated through others' intoxication and likely offender was statistically significant: 95% CI $[0.0290, 0.4231]$. Being in a context where other people were co-using was associated with increased intoxication in the context, which in turn, was

associated with higher likelihood of the presence of offenders and subsequently assault. Own co-use followed a similar indirect path, albeit a weaker one. The indirect path from others' co-use that operated directly through presence of likely offenders (not involving others' intoxication) was also statistically significant: 95% CI [0.0161, 0.7609].

Discussion

Though there have been a few examinations of unwanted sexual experiences as one of a variety of harmful outcomes of co-use (e.g., Egan et al., 2019; Sokolovsky et al., 2020), this is the first study to our knowledge to explicitly examine how co-use may be associated with the full spectrum of sexual victimization experiences. Importantly, our study also sought to delineate the *processes* by which co-use may be associated with assault risk, including both own and others' intoxication and the social context (i.e., risky routine activities). The result is a fine-grained analysis not only of whether co-use is a risk factor for SA, but also of how such risk may unfold in social contexts. Our findings point to co-use of alcohol and cannabis as a unique risk factor for SA, above and beyond the influence of use of either substance alone. We also found components of the social context of co-use to be a mediator of this risk. As we expected, this risk was partly a function of the increased levels of intoxication associated with co-use. Importantly, findings revealed the important role of co-use by *others within the social context* in assault risk. We elaborate on these findings below.

In this study, we examined the mechanistic role of the social context in co-use-related assault risk, guided by RAT (Mustaine & Tewksbury, 1999; 2002). The mediated risk pathway that we observed flowed through one of our two hypothesized RAT-based contextual risk mechanisms, Proximity to Likely Offenders. This points to the centrality of *who* is a part of the social context (e.g., men acting in sexually aggressive ways) in considering how assault vulnerability may emerge within the context of co-use.

This finding has important intervention implications. For example, information about risk associated with proximity to likely offenders, what such risk may look like, and the effects that co-use may have on such proximity could be shared in the context of motivationally-based or other types of brief intervention geared toward the amelioration of assault risk (Clinton-Sherrod et al., 2011; Gilmore, Bountress, Selmanoff, & George, 2018). This information could also be used in skills-based interventions that focus on self-protection within higher risk contexts. Specifically, a small literature has examined the how specific types of protective behaviors may help to reduce SA risk. Though some of these protective behaviors are oriented solely around reducing substance use, which may indirectly or incidentally help to reduce assault risk (Moorer et al., 2013; Ray et al., 2009), others have been designed to target the social context. This includes things like attending to the substance use of others in the social milieu, making safety plans with others who are a part of the social group, planning for "escape routes" and back up plans, etc. (Blayney et al., 2020; Mallet et al., 2015; Moore & Waterman, 1999; Scaglione et al., 2015; Sell et al., 2016). With knowledge derived here regarding the specific types of contexts and activities (e.g. greater proximity to potential perpetrators) that are linked to assault at the daily level, interventions could help women to build skills around identifying contextual risk, and employing protective behaviors accordingly. Such interventions could make use of

current technologies to deliver just-in-time intervention as risk emerges (e.g., Lewis et al., 2018; Suffoletto et al., 2017).

Interestingly, the absence of capable guardianship did not emerge as a proximal predictor of assault vulnerability. A few factors may explain this. First, several studies in recent years have reported that women engage naturalistically in mutual safety and protective behaviors to guard against SA (Armstrong et al., 2014; Banyard et al., 2014; Blayney et al., 2020; Katz et al., 2015). As such, it may be that on occasions when alcohol and cannabis use and co-use and subsequent intoxication are occurring, women naturally deploy these protection efforts and thus guardianship is not compromised. Another possibility pertains to the prevalence of this risky contextual factor in our sample. That is, reports of the absence of capable guardianship were low, and this may have reduced predictive power. Related to this is that approximately a third of “going out” occasions in this sample were with just one other person, and the majority of these occasions were with a current or former romantic partner (i.e., a date). In these cases, several of the guardianship items would be less likely to be endorsed, as they are most apt to contexts where friends are in a larger group (e.g., *I got separated from my friends; I left a bar/party/social gathering/etc. with someone I didn't know very well; I found myself alone with someone I just met or don't know very well*). Though there certainly is assault vulnerability in social occasions that involve just a single romantic partner, guardianship as a protective strategy is less relevant. In other at-risk samples, such as college women, where socializing patterns are more often marked by larger group gatherings (Blayney & Read, 2018), capable guardianship may be a more reliable and important predictor of assault.

Our findings also point to the key role that use, co-use, and resulting intoxication by others in the social context play in processes that underlie SA. Specifically, it was not only the co-use by potential victims that was associated with risk, but that of others in the social setting as well. Indeed, this was the more potent predictor in our models. As noted, to date this is an area that has not been well examined in the literature. Instead, existing studies have focused largely on victim use and intoxication. Our data show that the use and intoxication of others may be an even more important piece of the puzzle. This information may be valuable when considering effective protective behaviors, which can include being aware of the substance use and co-use of others in the social context.

As noted, co-use of alcohol and cannabis is associated with greater intoxication than use of one drug or the other alone (Metrik et al., 2018; Soklovsky et al., 2020). Findings here suggest that when others (e.g., friends, bystanders, other party-attendees, etc.) in the social context are co-using, the associated intoxication may play a crucial role by increasing assault potential due to drug effects on both perpetrators who are in the social context (Abbey et al., 2014; Abbey et al., 2004; Testa & Livingston, 2018) and decreasing the likelihood that others will intervene to prevent assault (Davis et al., 2009; Fleming & Wiersma-Mosley, 2015; Leone et al., 2018).

Limitations and Future Directions

This study had limitations that should be considered when interpreting its findings. The first of these pertains to our sample. A strength of this study was that we examined these

risk processes in a community sample of young adult women between the ages of 21 and 24. Other studies of substance use and SA have been conducted largely in college student samples. Our study contributes to the field's understanding of how young women navigate social contexts and encounter assault risk beyond the college campus. Yet this sample may also pose some limitations. Specifically, we observed relatively low rates of assault, which may have made prediction difficult. College-attendance has been documented to be a risk factor for SA and these women are not in college. In addition, the women in our sample are a bit older than the typical college sample. As such, their risk for assault may be lower than would be expected in college samples.

The women in our sample identified predominantly as White/Non-Hispanic. Data examining how race and ethnicity may influence sexual assault risk have yielded mixed findings (e.g., Coulter et al., 2017; Gross et al.; 2006; Kalour, 2000; Koss et al., 1987; Cantor et al. 2015). Further, examinations of mechanisms associated with risk, and whether these mechanisms may vary based on sociodemographic factors such as race have been rare. This is an important direction for future research. For now, it should be borne in mind that our findings speak only to socio-contextual assault risk for a particular subset of young adult women, and may not generalize beyond that.

Examination of these associations at the daily level was an innovation of this work, and it provided us an opportunity to consider the myriad contexts in which woman typically go out. However, the daily assessments naturally limited the amount of detail that we could gather about these environmental contexts. That is, in order to minimize participant burden and maximize retention, our assessment of these constructs included only a few items. Findings here suggest that there is more work to be done in understanding how environmental context influences SA risk. Intriguing avenues for future investigation include questions about the size and gender constitution of social groups, relationship to those in the group (e.g., close friends vs. others), and specific types of contexts where socializing occurs. Examination of these aspects of the social contexts as potential moderators of co-use effects will allow for a more nuanced understanding of these contexts, and will provide more refined direction for intervention.

Our daily level assessments inquired each day about substance use and social activities from the day before. These assessments were taken multiple times a week in 3-week bursts over the course of a year. Though they provide fine-grained information about patterns of use, co-use, and social activity over a year's time, this design nonetheless does not allow us to disentangle associations between use, context, and assault at the momentary level. As such, it is possible that the risk context predicted use and intoxication, rather than the other way around.

Further, this is the first study that we are aware of to examine not only one's own co-use/intoxication as a vulnerability factor for SA, but the co-use/intoxication of others as well. Yet, it should be borne in mind that our index of "others' use" was provided by the participants and not by the others themselves. As such, this index reflects only perceived estimation, and could be subject to reporting bias.

Finally, we are aware of no measures that have been developed to reflect constructs outlined by RAT. Thus, we created our own. Further, given that RAT is a general theory of crime and was not derived to be specific to sexual victimization, the items that we used to reflect these constructs were created with the specific crime of SA in mind. Correlations with related constructs suggest concurrent validity, and alpha coefficients from the within-level correlation matrix, and multilevel confirmatory factor analyses support the reliability of our measurement approach. Still, this is only a first step. Further development with these measures is needed in order to bolster confidence in the degree to which they aptly capture contextual risk consistent with the theoretical model.

Summary & Conclusions

Even with these limitations, the present study adds important new information to the current knowledge base, by providing a nuanced and contextual account of how both alcohol and cannabis use alone, and their co-use, may lead to assault vulnerability for young adult women. Most crucially, these findings underscore the need for intervention efforts that expand their focus to include the broader social context, and the role that the substance use and co-use behaviors of others may play within this context.

Our findings regarding the role of others' use and co-use may help to shift the conversation away just from a potential victim's own substance use, instead beginning to consider alcohol and cannabis co-use as part of a larger social risk factor. Such a shift has the potential to reduce blame and stigma of the victim herself, to expand the understanding of SA to the more general public health issue that it is. Like many public health issues, responsibility for change lies not within individuals, but within the collective.

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Public Health Significance:

This study of community young adult women shows co-use to be related to sexual assault risk. The social context is an important part of this risk. Findings underscore the need for intervention efforts that expand their focus to include the broader social context

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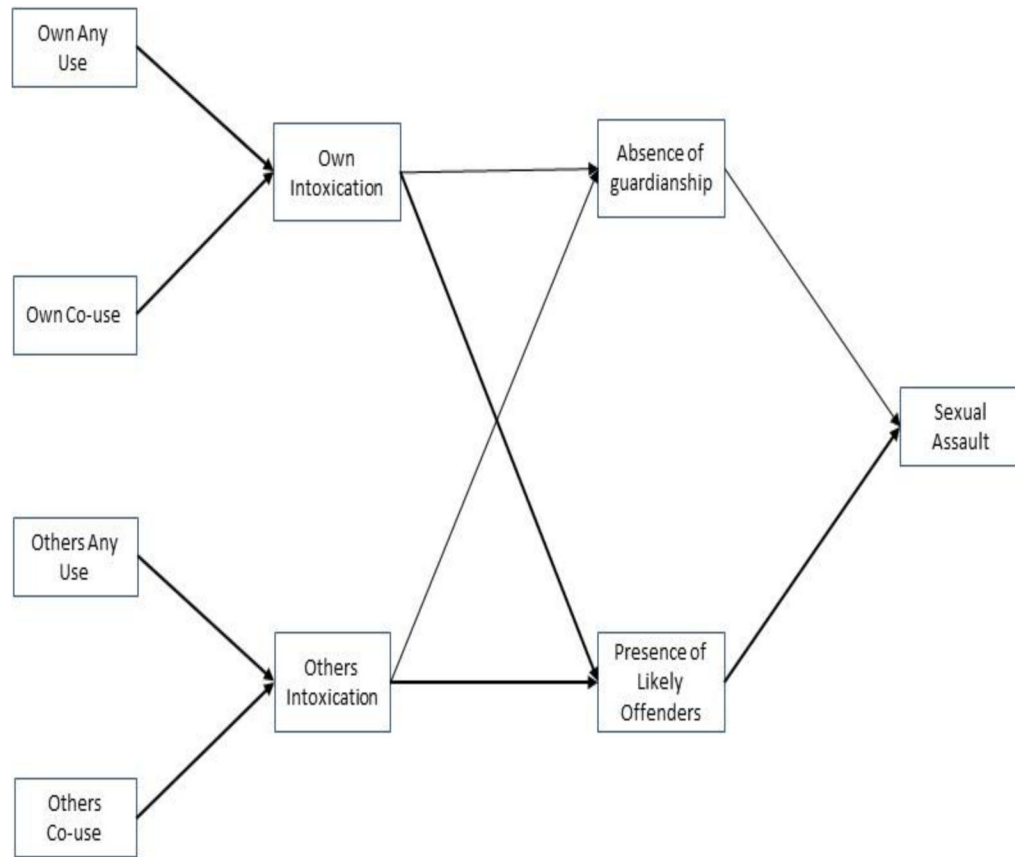


Figure 1.
Conceptual Figure of Pathways from Co-Use to Sexual Assault

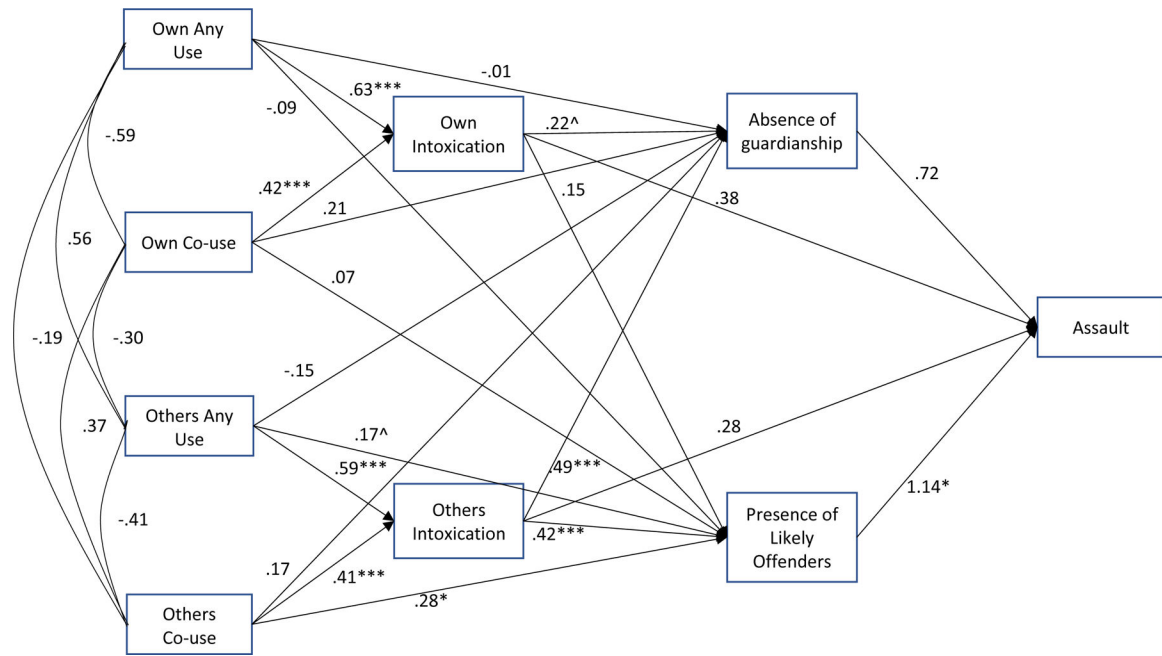


Figure 2.
 Level 1 results from Multilevel Path Model
 Note: Unstandardized coefficients are presented. ***p < .001. **p < .01. *p < .05. ^p < .10.

Table 1

Characteristics of Social Contexts on Nights Went Out (N = 1766)

Variable	Percent
Night went out	
Thursday	26.2
Friday	35.1
Saturday	38.7
Where you spent most of your time	
Friends' residence	24.2
Someone else's residence	8.2
Party	6.0
Bar	24.4
Someplace else	37.2
Who were you with	
One other person	36.6
Small group (2–5 people)	35.6
Medium group (6–15 people)	19.4
If you went out with one other person:	
Gender of person	
Male	71.3
Female	28.7
Relationship to you	
Romantic partner	61.1
Ex-romantic partner	2.5
Friend	34.7
Casual acquaintance	1.7
If you went out with a group of people:	
Gender composition of the group	
All men (Participant was only woman)	5.1
Mostly men	9.0
About even numbers of men and women	59.7

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Variable	Percent
Mostly women	15.3
Entirely women (No men were in the group)	10.9

Table 2

Level 1 Correlations of Model Variables (N = 1766)

Variables	1	2	3	4	5	6	7	8	9
1. Own use ¹	1.000	0.124	0.563	0.157	0.586	0.462	0.089	0.114	0.077
2. Own co-use ²	0.124	1.000	0.114	0.382	0.231	0.157	0.099	0.083	0.089
3. Other use ¹	0.563	0.114	1.000	0.208	0.377	0.529	0.068	0.146	0.069
4. Other co-use ²	0.157	0.382	0.208	1.000	0.268	0.368	0.138	0.177	0.099
5. Own intoxication	0.586	0.231	0.377	0.268	1.000	0.673	0.205	0.214	0.129
6. Other intoxication	0.462	0.157	0.529	0.368	0.673	1.000	0.236	0.273	0.120
7. Absent guardianship	0.089	0.099	0.068	0.138	0.205	0.236	1.000	0.256	0.116
8. Likely offenders	0.114	0.083	0.146	0.177	0.214	0.273	0.256	1.000	0.130
9. Assault	0.077	0.089	0.069	0.099	0.129	0.120	0.116	0.130	1.000
Mean	0.637	0.090	0.686	0.150	1.409	1.492	0.096	0.138	0.016
Std Dev	0.481	0.286	0.463	0.356	1.624	1.575	0.295	0.345	0.126

Note. Correlations were computed after variables were group-mean centered. Means, variances, and standard deviations were computed using uncentered data. Correlations from 0.30 and less than 0.50 are italicized. Correlations of 0.50 or greater are bolded.

¹Use is dummy coded for the descriptive table (no use=0 vs any use of alcohol or marijuana=1).

²Co-Use is dummy coded for the descriptive table (no use, and use of alcohol or marijuana alone=0 vs co-use of alcohol and marijuana=1).

Table 3

Preliminary Path Model Analysis Level-1 Results

Model	DV	IV	Regression Coefficient
1	Own intoxication	Own any use	0.630 *** (0.030)
		Own co-use	0.423 *** (0.052)
	Other intoxication	Other any use	0.591 *** (0.026)
		Other co-use	0.410 *** (0.041)
2	Absent guardianship	Own any use	0.305* (0.131)
		Own co-use	0.231 (0.215)
	Likely offenders	Other any use	0.181 (0.119)
		Other co-use	0.406** (0.143)
3	Assault	Own any use	0.141 (0.104)
		Own co-use	0.109 (0.155)
		Other any use	0.500 *** (0.116)
		Other co-use	0.502 *** (0.114)

Note.

*** $P < .001$.

** $P < .01$.

* $P < .05$. Numbers in parentheses are standard errors.