

Social Influence and Problematic Drinking: Insights from the COVID-19 Pandemic

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Abstract

Patterns of alcohol consumption can spread from one person to the next in social networks. Yet the necessary conditions required for this social influence to occur are not clearly defined. Here we leverage the sudden and seismic shift in social life following COVID-19, a natural phenomenon that divorced social relationships from the contexts those relationships typically inhabit. Using a social network-based clustered longitudinal design, we examined alcohol use patterns among cohorts of heavy drinking friendship dyads and triads ($N=314$) traced longitudinally pre- and post-pandemic. In line with hypotheses, results indicated a disruptive effect of COVID-era on social influence effects—while friendships endured, longitudinal links between friends' and participants' problem drinking diminished significantly with COVID-19. In contrast to these *inter*-individual effects, *intra*-individual (i.e., autoregressive) links between participants' past and present drinking remained intact. Results inform the understanding of mechanisms undergirding social influence effects, pointing to a potential role for context.

Keywords: alcohol, natural intervention, social influence, social context, longitudinal design

Introduction

Scientists have long observed that drinking patterns tend to cluster within social groups (Smith & Christakis, 2008), a “network effect” that reflects among the most widely replicated findings in addiction science (Knox et al., 2019; Leung et al., 2014). Research indicates that drinking behaviors in fact spread from one individual to the next in social networks (Rosenquist, 2010), so pointing to social influence as a key factor driving problematic consumption. Yet, the necessary conditions for social influence to take place remain poorly understood. The current study takes a novel approach to addressing these enduring questions, harnessing the opportunity afforded by the COVID-19 pandemic, which induced a fundamental disruption within human social life. We report the first longitudinal study to explore the clustering of drinking patterns within peer groups over a timeframe that includes both pre- and post-pandemic eras, so moving towards a more in-depth understanding of influence effects within social networks.

Clustering of Drinking in Social Networks

Individuals tend to evidence similar drinking levels and drinking problems as others in their social network. In particular, those in close relationships (e.g., close friends) exhibit particularly pronounced similarity in their alcohol use patterns (Leung et al., 2014). In light of their robustness in predicting hazardous consumption, social networks have been identified as a key target for prevention and intervention measures aimed at stemming the development and intervening in the course of Alcohol Use Disorder (AUD; Ariss & Fairbairn, 2020; Merkouris et al., 2022). A variety of factors have been identified to help explain the clustering of drinking patterns within social groups, ranging from selection effects to shared environments. Among these, social influence has received considerable attention as a network phenomenon that has not

only been replicated broadly (Smith & Christakis, 2008) but further offers an actionable point-of-change target for alcohol use interventions (e.g., Merkouris et al., 2022; Moreira et al., 2009).

Often compared to a contagious process, social influence represents a unique network phenomenon defined as the tendency for drinking behaviors in one individual to spread and over time induce similar drinking patterns among others in that individual's social network (see Christakis & Fowler, 2013; Rosenquist, 2010; Smith & Christakis, 2008). A substantial research literature has explored these social influence effects across various health behaviors, including alcohol, substance use, eating behaviors, and others (for review, see Smith & Christakis, 2008). Within the realm of alcohol research, evidence in support of direct social influence effects is considerable, with empirical research finding that changes in peer drinking temporally precede changes in proband drinking, with longitudinal links surviving a variety of strong controls (Rosenquist, 2010). Such socially-induced "infections" can be helpful or harmful in nature. In particular, associations with light drinking networks might promote healthy consumption while links to heavy drinkers promote hazardous drinking patterns (Hallgren et al., 2017; Reid et al., 2015; Rosenquist, 2010). Social influence has been particularly widely studied in the context of friendships and peer associations—relationships that emerge as salient during the years of adolescence and young adulthood when rates of problematic drinking peak (Leung et al., 2014). While evidence supporting social influence effects in the alcohol literature is robust, yet our understanding of the necessary preconditions for transmission—the means by which these "infections" occur—is incomplete. For example, is discussing drinking in a phone call or social media post sufficient, or is a shared context for consumption necessary? In other words, is heavy drinking a "direct contact" virus, or is it "airborne"?

Social drinking motives represent one factor linked specifically to shared contexts for consumption that has long been considered relevant to the understanding of social influence effects. Drinking motives theory is based on the premise that people drink to attain valued internal and external outcomes, and such motivations can be categorized and linked to specific trajectories of use (Cooper et al., 1992). As such, drinking motives are considered the most proximal factors driving alcohol consumption. While researchers have proposed several models of drinking motives with varying numbers of factors (Grant et al., 2007), social drinking motives have consistently emerged as a distinct factor representing among the most widely endorsed reason for consuming alcohol (Kuntsche et al., 2005). Defined as the decision to drink to attain external rewards that are specifically social in nature, social motives have been linked to decisions to consume alcohol in communal contexts (Cooper et al., 1992). In contrast, coping drinking motives, defined as drinking to cope with experiences of stress and unpleasant emotion, are theorized to respond to internally sourced reasons (e.g., negative emotionality) and are more frequently associated with solitary drinking (Cooper et al., 1992; Creswell, 2021). Social drinking motives not only directly predict alcohol use and drinking problems (Bresin & Mekawi, 2021; Van Damme et al., 2013), but also play a role in facilitating social influence effects (Bartel et al., 2022; Halim et al., 2012; Hussong, 2003). Importantly, social drinking motives are notable in that they rely specifically on communal consumption contexts—they drive drinking specifically linked with a social setting for consumption. In the current study, we explore friend group clustering and social drinking motives in the context of a global pandemic with far-reaching effects, including that of divorcing peer relationships from the contexts these relationships typically inhabit, so offering a paradigm with the potential to inform our understanding of how drinking behaviors spread in social groups.

The COVID-19 Pandemic

On March 13th, 2020, the U.S. declared a national emergency concerning the novel coronavirus. Accompanied by widespread restrictions on social activity, including a period of total lockdown and protracted social distancing measures aimed at stalling the spread of the virus, the COVID-19 pandemic led to an unprecedented disruption in everyday life. The pandemic mirrors other major natural disasters in the extremity and diversity of hardship that followed in its wake, with losses for many in domains ranging from financial to physical to housing. In contrast, the COVID-19 pandemic is distinctive among other natural occurrences for its profound implications for the social fabric of everyday life. Pandemic-related restrictions, including the mandated closing of restaurants and bars and limitations placed on large gatherings, resulted in what can only be called a seismic shift in the context for social interaction. Surveys exploring drinking settings have made it possible to assign numbers to such changes, with multi-year national surveys among U.S. young and middle adults reporting that the prevalence of drinking at home increased by 7% in the year 2020 (Patrick et al., 2022), while other studies indicate drastic declines in social drinking with friends and roommates and at parties and bars (Jackson et al., 2021) and pre-gaming occasions (Wilson et al., 2022). At the same time, virtual modes of communication exploded, thus offering additional contexts for the maintenance of social ties. Users of the online video-call platform Zoom burgeoned from 10 million in December 2019 to 300 million by April 2020 (Wiederhold, 2020). Studies also indicate a spike in social media use during the pandemic for individuals to stay connected and seek social support (Marciano et al., 2022). Thus, through the months of pandemic and lockdown, opportunities for the maintenance of social ties endured, albeit separated from the in-person contexts these relationships typically inhabit.

Although consistent in reflecting a shift away from group drinking contexts, research has produced mixed findings in terms of the effects of the pandemic on the quantity of alcohol consumption and the severity of alcohol-related problems. A recent research synthesis indicated that, on average when examined globally across populations, the pandemic led to a non-significant change in average alcohol consumption, with some opting to increase whereas others decreased their drinking (Acuff et al., 2022). Research with clinical populations has indicated that the pandemic led to increases in alcohol consumption (Acuff et al., 2022; Barrio et al., 2021). In contrast, some research conducted among college students, including those with heavy drinking patterns, has pointed to a diminution of heavy drinking with the pandemic (Acuff et al., 2022). Social drinking is particularly prevalent among young adults (Kuntsche et al., 2005), thus drinking patterns in this age group may be more susceptible to change following the shift in social drinking context associated with the pandemic. Several studies provide indirect evidence for this hypothesis via research employing a single-reporter framework (i.e., indirect reporting of others' drinking), including research indicating decreased self-reports of proband social engagement (Fruehwirth et al., 2021), decreased perceptions of peer drinking (Graupensperger et al., 2021), and shifts away from peer living situation (White et al., 2020) emerging as predictors of decreased alcohol use and drinking problems following the pandemic. However, to our knowledge, no study to date has employed a multiple-reporter framework to directly trace the clustering of drinking behaviors within social groups over time, from pre- to post-pandemic.

Given multidimensional effects of the pandemic, comprising stressors for many extending across domains of life, studies capable of examining disruptive effects beyond social factors are required. The current study features repeated assessment of friend cohorts over time, thus permitting simultaneous assessment of both *intra*-individual (i.e., autoregressive) and *inter*-

individual (i.e., longitudinal links between peer and proband drinking), offering the potential to parse broader disruptive pandemic effects from those that emerge more selectively in the social domain.

The Current Study

Here we present a longitudinal study leveraging the opportunity afforded by the pandemic to examine domains of inter- (vs intra-) personal factors that drive similarity of drinking behaviors within social groups. More specifically, we trace associations in drinking outcomes over time within clustered cohorts of participants among whom follow-up was completed both prior to, and also following, the COVID-19 pandemic. We explore these trends in a sample of heavy social drinking young adults as a population demonstrating elevated rates of hazardous drinking patterns (Delker et al., 2016), as well as individuals among whom social network effects have been identified as particularly pronounced (Leung et al., 2014).

The aims of the current research were as follows: 1) Examine the impact of the COVID-19 pandemic on prospective associations in drinking patterns among members of friend groups. In the current study, consistent with models indicating contextually-mediated factors as being core in driving social influence effects (Prentice & Miller, 1996; Robinson et al., 2016; Stanesby et al., 2019), including among heavy-drinking friend networks (Leonard et al., 2000; Room et al., 2016), we predicted that the COVID-19 pandemic would significantly disrupt prospective associations in friend group drinking patterns, such that longitudinal associations in drinking patterns within friend group clusters would emerge as significantly stronger for participants among whom follow-up data was collected pre- vs post-pandemic. In contrast, we predicted no such effects of the pandemic on drinking in the intra-individual (autoregressive) domain; 2) Explore the role of specifically social motivations in driving post-pandemic changes in drinking.

Here, we hypothesized that the longitudinal relationship between baseline social drinking motives and drinking at follow-up would be significantly stronger (more positive) among pre-pandemic participants. Related, given the ubiquity of pandemic-related stressors and the broader goal of parsing inter- from intra-personal processes, supplemental analyses explored the effect of COVID-19 on coping-based drinking. Finally, in light of research indicating differential effects of social factors across normative vs hazardous drinking outcomes (Venerable & Fairbairn, 2020), for all aims we explored the extent to which effects were specific to outcome measures assessing problematic levels of consumption vs. generalizable to all drinking measures.

Transparency and Openness

Preregistration

All hypotheses and preliminary data analysis procedures for the current study were pre-registered at <https://doi.org/10.17605/OSF.IO/HAF4T> (for more details, see Supplementary Materials; Notes on Preregistration). Study designs for the parent study were pre-registered at ClinicalTrials.gov (identifier: NCT03449095).

Data, Materials, Code, and Online Resources

Data and code required for replicating the results of all primary models can be found at <https://doi.org/10.17605/OSF.IO/UTXS9>.

Reporting

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study. Data for this study were collected in the context of a large-scale trial aimed at exploring the role of social factors in drinking using multiple assessment methods (for more details, see Supplemental Materials; Data Collection). The current study represents the first report of longitudinal data emerging from this project. A full account of procedures for baseline

and cross-sectional arms unrelated to the current study aims can be found elsewhere (e.g., Fairbairn et al., 2022; Gurrieri et al., 2021). We report a complete list of all manipulations and measures relevant to our current overall longitudinal research aims (Supplemental Materials; Table S1).

Ethical Approval

All methods and procedures employed in the current study were approved by the Institutional Review Board at the University of Illinois at Urbana-Champaign. This study was carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki.

Methods

Participants

Recruitment and Baseline Characteristics

Participants were recruited through community flyers, online advertisements, and mass email announcements soliciting friend groups for participation in an alcohol study. Individuals responding to advertisements were asked to refer 2-7 eligible same-sex friends. Participants (both the initial respondents and their referred friends) were required to report drinking alcohol regularly (i.e., reported consuming at least 2 drinks on at least one occasion per two weeks, or at least four drinks on at least one occasion per month, over the past 12 months at the time of screening), have no history of severe AUD or alcohol treatment, and have no medical disorders and/or medications for which alcohol consumption would be contraindicated. Baseline participants consisted of 355 (54.4% female) young healthy social drinkers aged 21-30 ($M=22.05$, $SD=1.54$) with a mean of 15.61 ($SD=1.22$) years of education. The sample was 66.8% White, 26.2% Asian, 6.2% African American, and 0.9% “other” racial categories. Participants

were 14.6% Hispanic. All participants in our study met the National Institute on Alcohol Abuse and Alcoholism's criteria for heavy or "at risk" drinking at the time of phone screening (NIAAA, 2023).

Longitudinal Sample

Of the original sample of 355 participants, consisting of $k=163$ clusters of friend dyads and triads who completed baseline procedures, 88% of the clusters ($k=144$; $N=314$) were retained intact and provided a valid response to a longitudinal follow-up survey with a mean response interval of 14.46 months ($SD=3.35$) (see Procedure for more details). The final set of participants were from the 144 intact clusters comprising 314 individual participants. Those not included in this longitudinal sample—i.e., individuals who did not respond to follow-up surveys or who provided invalid responses (see Procedure)—were significantly more likely to be classified as male at baseline than responders, $p=.002$. Otherwise, non-responders did not significantly differ from responders in age, race, and baseline drinking measures, all $p's > .118$. The study sample size was determined prior to any data analyses being conducted. A sensitivity power analysis indicated that the final sample size in the present study provided 80% power to detect small to medium effect sizes ($r^2=0.04$) for within-between factors interactions assuming $\alpha=.05$.

Pre- vs. Post-COVID Cohorts

All participants completed baseline procedures before the onset of restrictions associated with the COVID-19 pandemic (i.e., prior to March 13, 2020), whereas, at follow-up, the sample included a sizable representation of those completing assessments prior to ($N=106$, 33.8%, "pre-COVID cohort") vs. after ($N=208$, 66.2%, "post-COVID cohort") the onset of COVID-19 restrictions (See Table 1; Figure 1). For the *pre-COVID cohort*, baseline data collection took

place from November 2017 to March 2019 (i.e., during *pre-COVID era*), with follow-up data collected from May 2019 to March 2020 (during *pre-COVID era*). For the *post-COVID cohort*, baseline data collection took place from February 2018 to early March 2020 (during *pre-COVID era*), with follow-up data collected from late March 2020 to April 2021 (during *post-COVID era*). Figure 1 also illustrates the data collection timeline for both cohorts.

Procedure

Baseline Assessment

Participants who met the study's inclusion criteria along with their 1-2 eligible friend(s) were invited to participate in a baseline laboratory visit and written informed consent was obtained upon arrival. We targeted friendship dyads and triads as representing the form of closer friendship tie that may be especially influential in driving alcohol use (Borsari & Carey, 2006) as well as a group size sufficiently small so as to make it feasible to maintain many groups intact across longitudinal assessment. In addition, the baseline laboratory visit served multiple purposes including, as these pertain to our current aims, a form of validity check surrounding the existence of reported friendship ties while further offering the opportunity to cement relationships between participants and our laboratory team, thus potentially bolstering follow-up compliance.

Following consent, participants completed a battery of questionnaires (see Measures and Supplementary Materials Table S1) in private laboratory rooms and then engaged in a series of tasks unrelated to the current study, including dyadic alcohol-administration (Gurrieri et al., 2021). Before leaving the laboratory, participants were informed about the follow-up procedures employed in this research. Participants also proactively signed consent for enrollment in the longitudinal study at this point.

Longitudinal Assessment

A minimum of 12 months after baseline assessment, participants were contacted via email with an invitation to complete longitudinal follow-up surveys. We selected internet-based follow-up methods as those judged most likely to maximize convenience (thus minimize attrition) while also optimizing participant comfort in transparently reporting on behaviors surrounding which stigma can reside (e.g., adverse drinking consequences; Venerable & Fairbairn, 2020). In the context of these surveys, participants completed a similar battery of questionnaires to those completed during the baseline laboratory visits. Six attention-check items were incorporated to ensure the quality of online responses to the longitudinal follow-up surveys (Venerable & Fairbairn, 2020). As an attention check procedure, follow-up surveys with three or fewer correct answers to validation items were excluded from further data analysis. Participants were contacted for follow-up between 12 and 18 months following the date of their baseline visit, depending on the phase of data collection ($N=246$ contacted at 12 months; $N=109$ contacted at 18 months; length of follow-up assessment incorporated as a covariate into analytic models, see data analytic plan). 77.4% of participants responded to longitudinal surveys within 2 weeks of initial contact. Participants received \$100 for attending the baseline laboratory visit and \$50 for completing follow-up surveys.

Measures

All measures described below were administered at both baseline and longitudinal follow-up for both pre- and post-COVID cohorts.

Alcohol Consumption

Measures of alcohol consumption were selected to correspond with those employed in our prior research (Venerable & Fairbairn, 2020) as well as items included in the recommended drinking questionnaire set provided by (NIAAA, 2018). To assess a range of alcohol use

patterns, including variability in more normative patterns of consumption, we incorporated items aimed at assessing alcohol use frequency and quantity including: (1) *drinking days* were assessed by asking participants to report, out of the past 30 days, how many days they consumed at least one drink of alcohol (a standard drink is one 12 oz beer, a 5 oz glass of wine, or a 1.5 oz shot of liquor); (2) *drinking quantity* was assessed by asking participants to report, on the days that they did drink alcohol in the past 30 days, on average how many drinks they consumed.

Problematic Consumption

In line with measures employed in our prior work (Venerable & Fairbairn, 2020), measures of problematic consumption included: (1) *binge drinking days* were assessed by asking participants to report, in the past 30 days, on how many days they had five drinks (four drinks if female) or more in one sitting; (2) *adverse consequences associated with drinking* were assessed via the Short Inventory of Problems scale (SIP-2R) total score. The SIP-2R is a 15-item self-report measure assessing alcohol-related consequences across physical, social, intrapersonal, impulse control, and interpersonal domains. The SIP-2R also demonstrated good reliability in our baseline sample ($N=355$; Cronbach's $\alpha \geq 0.796$). Each item was rated on a 4-point Likert scale from 0 (Never) to 3 (Daily or almost daily), and the total score (0-45) was calculated and entered for data analysis. The SIP-2R has demonstrated good internal consistency as well as convergent and discriminant validity (Blanchard et al., 2003; Venerable & Fairbairn, 2020).

Drinking Motives

Drinking motives were assessed using the revised version of the Drinking Motives Questionnaire (DMQ-R; Cooper, 1994), which has been widely used in alcohol research and demonstrates good psychometric properties (Fernandes-Jesus et al., 2016; Martin et al., 2016). The DMQ-R scale adopts a four-factor model to capture individual differences in motives for

consuming alcohol – social, coping, enhancement, and conformity, consisting of twenty items with five items for each subscale. Participants rated each item on a 5-point Likert scale from 1 (Almost Never/Never) to 5 (Almost Always/Always), yielding four subscale scores ranging from 5 to 25 each. The DMQ-R demonstrated good reliability across all four subscales (Cronbach's $\alpha \geq 0.771$).

Friendship

Friendship closeness among dyads and triads was measured using the Unidimensional Relationship Closeness Scale (URCS; Dibble et al., 2012). The URCS is a 12-item self-report scale measuring the closeness of social relationships (e.g., “my relationship with (name) is close”), which has demonstrated high reliability and discriminant validity for friendships (Dibble et al., 2012). Participants rated each item of a 7-point Likert scale from 1 (Strongly Disagree) to 7 (Strongly Agree). Items are averaged to generate a single overall closeness score that ranges from 1 to 7. Due to technical issues encountered with follow-up surveys, data from 21 participants was missing at follow-up (93.3% of follow-up sample not missing for this measure). The URCS demonstrated good baseline reliability (Cronbach's $\alpha = 0.962$). *Time spent conjointly together with friend* was assessed using a one-item question, “at this current time, how often do you spend time in (name)'s company?” Participants were presented with six options ranging from “less than 1 time a month” to “every day”.

Data Analysis Plan

Multilevel models were employed in testing study aims, accounting for the clustering of drinking patterns within friend groups. Models were conducted at two levels of analysis: individual (level 1) and friend group (level 2). Analyses predicted problematic consumption patterns (binge days and adverse drinking consequences) and alcohol consumption (drinking

days and drinking quantity) at follow-up as outcomes. Corresponding baseline drinking parameters and time elapsed between baseline and follow-up assessment (“response interval”) were entered in all models as covariates. No imputation of missing data was applied.

Visual inspection of outcomes indicated that drinking days and drinking quantity approximated a normal distribution, whereas binge drinking days and adverse drinking consequences approximated a Poisson distribution (see also Venerable & Fairbairn, 2020). Thus, linear multilevel models were employed for the analysis of drinking days and drinking quantity, whereas generalized Poisson multilevel models were employed in analyses of binge drinking and adverse drinking consequences. Pandemic-era was coded as a dummy variable comparing follow-up observations collected before vs. after March 13th, 2020.¹ This cutoff was chosen as the date on which the U.S. president declared a national emergency concerning the novel coronavirus disease outbreak² (also see Figure 1). Follow-up analyses also compare lockdown (March 13, 2020 – May 29, 2020) to non-lockdown (June 1, 2020 – June 11, 2021) pandemic stages of COVID-19. For generalized models, Event Rate Ratios [$Exp(B)$] are reported as an effect size metric reflecting the factor change in the dependent variable for each unit increase in the independent variable (Cohen, 2013). Where analyses involved interactions with continuous variables, we employed standard centering techniques. Specifically, the continuous predictor was centered at one standard deviation above and below the mean and probing contrasts at each level, thus providing estimates of simple effects at both “high” and “low” levels of the continuous predictor (Aiken et al., 2010; Cohen, 2013). All analyses were performed using SAS 9.4.

¹ Supplemental models also compared lockdown (March 13, 2020 – May 29, 2020) to non-lockdown (June 1, 2020 – June 11, 2021) pandemic stages of COVID-19 (Supplemental Material; Table S2 and Table S3).

² March 13th 2020 also reflects the date on which social distancing measures were first issued in the state of Illinois, where baseline study procedures took place. All participants initially resided in the state of Illinois at baseline. The majority (around 86%, 115 out of 120) of those who completed questions on their residence at follow-up also reported living in Illinois during the COVID-era.

For primary analyses, longitudinal cross-lagged Actor-Partner Independence Models were employed (APIM; Kenny et al., 2020). Independent variables entered into APIM models included COVID-era, participants' own drinking patterns at baseline ("actor" effects), baseline drinking patterns of that individual's friends ("partner" effects), as well as terms reflecting the interaction between COVID-era and both actor and partner variables (see Figure 2). For dyads, partner effects represented individual friend baseline drinking behaviors whereas, for triads, partner effects represented baseline drinking averaged across the two friends, although supplemental models also parsed individual friends among triadic groups to explore whether results replicated. A full list of independent and dependent variables by study aim is presented in supplemental materials, together with code and data required for replicating effects <https://doi.org/10.17605/OSF.IO/UTXS9>.

Results

Descriptive Statistics and Manipulation Check

Basic descriptive statistics of drinking outcomes by COVID-19 pandemic stage are presented in Table 1, and correlations between baseline and follow-up drinking measures are presented in Supplementary Materials (Table S6). At baseline, participants reported drinking an average of 2 to 3 times per week with 4.39 ($SD=2.24$) drinks per occasion and an average of 4.5 binge days in the past month. Results indicated no overall main effect of the pandemic era on indexes of either alcohol consumption or problem consumption (see Supplementary Materials Table S2).

Cohort Effects

We first examined if there were significant baseline cohort effects differentiating participants who completed the follow-up survey pre-COVID (pre-COVID cohort) vs. post-

COVID (post-COVID cohort). Models indicated higher reported friendship closeness at baseline among participants in the post-COVID cohort, $B=5.039$, $SE(B)=2.107$, 95% *Confidence Interval* (CI)= $[0.878, 9.201]$, $p=.018$, and lower levels of adverse drinking consequences, $B=-0.258$, $Exp(B)=0.773$, $SE(B)=0.111$, 95% CI = $[-0.476, -0.040]$, $p=.021$, compared to the pre-COVID cohort. The post-COVID cohort also featured a somewhat shorter response interval to longitudinal assessment, $B=-0.155$, $SE(B)=0.034$, 95% CI = $[-0.221, -0.089]$, $p<.0001$,³ Aside from these, no significant differences between cohorts in demographics (age, gender, % racial or ethnic minority, student status, and relationship status), baseline drinking patterns, relationship characteristics, or personality emerged, p 's $>.122$.

Friendship Closeness and Time Spent Together

At baseline, participants reported an average relationship closeness score of 4.47 ($SD=1.44$) according to the Unidimensional Relationship Closeness Scale (URCS), suggesting that on average, relationships among participants were slightly stronger than those typically found in casual friendships (Dibble et al., 2012). In an exploratory analysis, we examined the extent to which friendships were maintained in the face of the pandemic, and we examined whether relationship closeness and time spent conjointly significantly shifted over time across stages of COVID-19. Results indicated that, after controlling for baseline relationship factors, there was no significant effect of COVID-era in predicting friendship closeness, $B=0.305$, $SE(B)=0.155$, 95% CI = $[-0.001, 0.611]$, $p=.051$, nor time spent together at follow-up, $B=0.373$, $SE(B)=0.225$, 95% CI = $[-0.072, 0.819]$, $p=0.100$ (see Supplemental Material; Table S5). In

³ Cohort effects of increased friendship closeness and diminished longitudinal response interval in the post-COVID cohort emerge in the opposite direction of an effect liable to represent a confound in our APIM model, as our prediction is that we would observe decreased evidence of longitudinal social influence post-COVID. Nonetheless, all results of primary models emerge as consistent in direction and significant levels when each of these variables is included in models as a covariate. (See also data analytic plan for discussion of response interval.)

sum, these analyses suggest that the COVID-19 pandemic did not exert a significant disrupting effect on relationship closeness or time spent conjointly among friends. Note that these results reflect unregistered and exploratory analyses.

Drinking Context

Drinking context was assessed for a sub-set of study participants at baseline and follow-up (see Supplementary Materials). Results for this participant sub-sample indicated that, at baseline, 95.0% of drinking episodes were social (drinking with at least one other person physically present), whereas 80.8% of drinking occasions were social post-COVID. At baseline, 35.9% of participants' drinking episodes occurred at a bar or club, whereas only 8.3% of drinking took place in bar/club settings post-COVID. Similarly, 51.3% of drinking episodes took place at home at baseline, as opposed to 77.7% during the post-COVID era. Finally, participants reported a relatively low frequency of virtual social drinking occasions, with 7.4% of drinking days reported as involving others present "virtually" in the post-COVID era. In sum, findings from these exploratory analyses indicate that pandemic shifts reported in the broader literature are also reflected in this particular participant sample, including shifts away from public/social and towards private and solitary contexts for consumption. Complete descriptive statistics are provided in Table 2. Note that these results reflect unregistered and exploratory analyses.

Aim 1: COVID-Era and Friend Group Drinking

We first explored social influence models focused on capturing more problematic patterns of consumption, including binge drinking behaviors and adverse drinking consequences. Multilevel models suggested no interaction between the "actor" coefficient (i.e., participants' own baseline drinking) and COVID-19 era (pre- vs. post-pandemic) in predicting participants' binge drinking at follow-up, $B=-0.017$, $Exp(B)=0.983$, $SE(B)=0.022$, $95\% CI=[-0.060, 0.026]$,

$p=.432$, or adverse drinking consequences, $B=-0.038$, $Exp(B)=0.963$, $SE(B)=0.023$, $95\% CI=[-0.084, 0.007]$, $p=.096$. In other words, the COVID-19 pandemic did not appear to disrupt the relationship between an individual's own past problematic consumption and that same individual's current problematic consumption patterns (i.e., autocorrelation).

In contrast, a significant interaction did emerge between the “partner” coefficient (i.e., friend baseline problematic consumption) and COVID-19 era in predicting participants' problematic consumption patterns at follow-up.⁴ Multilevel models showed that friends' baseline binge drinking (“partner” coefficient) significantly interacted with COVID-era in predicting participants' own binge drinking at follow-up, $B=-0.120$, $Exp(B)=0.887$, $SE(B)=0.024$, $95\% CI=[-0.167, -0.072]$, $p<.0001$. Specifically, among the pre-COVID cohort, a positive association emerged between friends' baseline binge drinking and participants' binge drinking at follow-up, such that a one-day per month increase in friends' binge drinking at baseline was associated with an 11% increase in participants' binge drinking days at follow-up, $B=0.101$, $Exp(B)=1.106$, $SE(B)=0.018$, $95\% CI=[0.066, 0.137]$, $p<.0001$. In contrast, among the post-COVID cohort, this relationship did not reach significance, $B=-0.018$, $Exp(B)=0.982$, $SE(B)=0.016$, $95\% CI=[-0.051, 0.014]$, $p=.263$. Further, among participants completing follow-up assessments specifically during the lockdown phase of COVID-19, disruptive pandemic-related effects on social influence processes emerged as significantly stronger, $B=-0.176$, $Exp(B)=0.839$, $95\% CI=[-0.251, -0.101]$, $p<.0001$ (see Supplementary Materials Table S4).

Given interest in understanding moderating factors driving these mixed effects, we further probed these interactions via the inverse strategy, exploring simple effects of COVID-era among those with friends exhibiting higher or lower levels of binge drinking at baseline. Among

⁴ Results remained unchanged in significance-level and direction when we repeated this model substituting individual friends' scores for averaged friends' scores in triadic group data (see data analytic plan).

participants whose friend(s) engaged in higher levels of binge drinking at baseline, post- (vs pre-) pandemic follow-up was associated with a 36% *decrease* in binge drinking, $B=-0.451$, $Exp(B)=0.637$, $SE(B)=0.175$, $95\% CI=[-0.797, -0.104]$, $p=.011$. In contrast, among participants whose friends engaged in lower levels of binge drinking at baseline, post- (vs pre-) pandemic follow-up was associated with a 50% *increase* in binge drinking, $B=0.397$, $Exp(B)=1.488$, $SE(B)=0.182$, $95\% CI=[0.037, 0.758]$, $p=.031$.

A similar pattern was seen in multilevel models examining adverse drinking consequences, with a significant interaction emerging between friends' baseline drinking ("partner" coefficient) and COVID-19 era (pre- vs. post-pandemic) in predicting participants' adverse drinking consequences at follow-up, $B=-0.065$, $Exp(B)=0.937$, $SE(B)=0.029$, $95\% CI=[-0.123, -0.007]$, $p=.029$. Specifically, among the pre-COVID cohort, a positive association emerged between friends' baseline adverse drinking consequences and participants' adverse drinking consequences at follow-up, such that each one-point increase in friends' SIP-2R score measuring adverse drinking consequences at baseline was associated with a 6% *increase* in participants' adverse drinking consequences at follow-up, $B=0.053$, $Exp(B)=1.055$, $SE(B)=0.025$, $95\% CI=[0.004, 0.103]$, $p=.034$. In contrast, among the post-COVID cohort, this relationship did not reach significance, $B=-0.011$, $Exp(B)=0.989$, $SE(B)=0.018$, $95\% CI=[-0.047, 0.025]$, $p=.537$. As for binge drinking, disruptive pandemic-related effects on social influence processes emerged as larger in magnitude during the lockdown phase of COVID-19, $B=-0.067$, $Exp(B)=0.935$, $95\% CI=[-0.147, 0.013]$, $p=.102$, although differences between lockdown and non-lockdown social influence effects did not reach significance for SIP-2R (see Supplementary Materials Table S4).

Models further explored simple effects of COVID-era among those with friends exhibiting higher or lower scores of SIP-2R at baseline. Results indicated a non-significant

decrease in adverse drinking consequences during COVID-19 among those whose friend(s) showed higher levels of adverse drinking consequences at baseline, $B=-0.049$, $Exp(B)=0.952$, $SE(B)=0.168$, $95\% CI=[-0.381, 0.283]$, $p=.772$, and a trend in the opposite direction among participants whose friend(s) exhibited lower levels of adverse drinking consequences at baseline, $B=0.350$, $Exp(B)=1.419$, $SE(B)=0.192$, $95\% CI=[-0.029, 0.729]$, $p=.070$. Taken together, results examining problematic consumption patterns in terms of binge drinking days and adverse drinking consequences indicated significant social influence between friends during the pre-pandemic era, with a significant diminution of these social influence effects emerging with the onset of the pandemic.

In contrast to models exploring more problematic consumption patterns, results of models capturing alcohol use patterns according to non-problem indicators yielded no significant interaction between the “partner” coefficient and COVID-era (pre- vs. post-pandemic) in predicting consumption. Specifically, there was no significant interaction between friends’ baseline drinking and COVID-19 era in predicting either total number of drinking days, $B=-0.113$, $SE(B)=0.117$, $95\% CI=[-0.343, 0.117]$, $p=.333$, and further no significant interaction in predicting average quantity of alcohol consumed at follow-up, $B=0.167$, $SE(B)=0.133$, $95\% CI=[-0.094, 0.428]$, $p=.210$. As with models predicting problematic consumption patterns, no significant interaction emerged between the “actor” coefficient and COVID-era in predicting drinking quantity and drinking days at follow-up, $p>.056$. Full model results are presented in Table 3. Note that the results presented in this section reflect registered and confirmatory analyses.

Aim 2: Social Drinking Motives

If social factors were at the heart of longitudinal correlations reported above, we would expect that social motives would predict participants' drinking at follow-up to a greater extent in the pre-pandemic vs. post-pandemic sample. In line with this prediction, after controlling for baseline drinking, multilevel models indicated a significant interaction between social drinking motives at baseline and the COVID-era (pre- vs. post-pandemic) in predicting binge drinking days, $B=-0.080$, $Exp(B)=0.923$, $SE(B)=0.024$, $95\% CI=[-0.127, -0.033]$, $p=.001$, and adverse drinking consequences, $B=-0.052$, $Exp(B)=0.949$, $SE(B)=0.023$, $95\% CI=[-0.098, -0.006]$, $p=.027$, (but not drinking days and quantity) at follow-up (see Table 4). Specifically, increased social drinking motives at baseline predicted a significant *increase* in binge days at follow-up in the pre-COVID cohort, $B=0.081$, $Exp(B)=1.084$, $95\% CI=[0.042, 0.120]$, $p<.0001$, but the relationship did not reach significance in the post-COVID cohort, $B=0.001$, $Exp(B)=1.001$, $95\% CI=[-0.026, 0.029]$, $p=0.919$. On the other hand, increased social drinking motives at baseline predicted a significant *decrease* in adverse consequences at follow-up in the post-COVID cohort, $B=-0.028$, $Exp(B)=0.972$, $95\% CI=[-0.055, -0.002]$, $p=0.038$ but this relationship did not reach significance in the pre-COVID cohort, $B=0.024$, $Exp(B)=1.024$, $95\% CI=[-0.014, 0.062]$, $p=.218$. Together, results indicate that the pandemic was linked with a significant attenuation in the positive relationship between baseline social motives and problem alcohol use, pointing to a potential reversal of this relationship in the case of drinking consequences. Note that the results presented in this section reflect registered and confirmatory analyses.

Unregistered and Exploratory Analyses: Coping Motives

The specificity of results yielded by Aim 1 analyses to the *inter*-personal (vs *intra*-personal/autoregressive) domain points to effects with more selective implications for the social realm, vs diffuse implications for pandemic life. Nonetheless, as is the case with many natural

experiments, effects of the pandemic were far-ranging, disrupting varied elements of everyday life, each with the potential to impact drinking behaviors. In particular, the pandemic brought with it hardship for many, accompanied by an increase in stress and a search for a means by which to cope. We therefore conducted supplementary analyses aimed at moving towards an understanding of the potential role of (*intra*-personal) stress processes in driving Aim 2 results reported above, exploring coping motives as a factor believed to act among the more proximal psychological processes driving drinking fueled by stress.

In the event that stress-processes and coping-fueled drinking underlie pandemic effects observed in the current study, we would anticipate higher levels of drinking to cope at follow-up among the post-COVID sample, and further that coping effects moderate differential effects of the pandemic on changes in drinking over time. Results indicated no effect of COVID-19 era in predicting coping drinking motives at follow-up after controlling for baseline coping motives, $B=0.277$, $SE(B)=0.408$, $95\% CI=[-0.530, 1.084]$, $p=.498$. Additionally, analyses indicated no significant interaction between coping motives at follow-up and the COVID-era (pre- vs. post-pandemic) in predicting drinking outcomes (days: $B=0.205$, $p=0.197$; quantity: $B=-0.055$, $p=0.434$; binge days: $B=-0.018$, $p=0.409$ and adverse consequences: $B=-0.014$, $p=0.504$) at follow-up (see Table 4). Together, results indicated that drinking to cope did not significantly change after the onset of COVID-19. Further, COVID-era did not significantly moderate the relationship between coping motives and drinking at follow-up.

Discussion

In this study, we harness the opportunity afforded by the COVID-19 pandemic to better understand the transmission of heavy drinking behaviors over time within social networks. Results did not point to a broad disruptive effect of COVID-era across *intra-personal* processes,

but rather indicated disruptions specifically in the *inter-personal* domain. In particular, participants' future problem drinking, measured by binge drinking and adverse drinking consequences, was consistently predicted by their own drinking in the past, irrespective of pandemic era. In contrast, results suggested that the predictive power of friends' drinking in determining participants' future problem drinking diminished significantly during COVID-19. Analyses examining participants' reported motives for drinking revealed similarly selective social effects, with prospective links between social drinking motives and problem drinking at follow-up emerging as significantly diminished during COVID-19, whereas no evidence emerged that COVID-19 increased drinking fueled by coping motives. In light of specific disruptions caused by COVID-19, and when considered together with results of prior correlational studies (Leung et al., 2014), results of the current research help move towards the identification of factors driving the clustering of drinking behaviors within social groups, pointing to a potential role for context in driving problem drinking spread.

COVID-19 and Social Influence Effects

While evidence supporting social influence effects in the alcohol literature is robust, yet our understanding of the necessary preconditions for the manifestation of social influence is incomplete. Are shared contexts for alcohol consumption required, or might communication via other means be sufficient? In other words, is drinking a "direct contact virus" or is it "airborne"? Yet these contextually and non-contextually mediated factors typically co-occur in the course of everyday social relationships, impacting researchers' ability to distinguish among their respective effects. Natural disasters and other social phenomena have historically been valued by researchers for their ability to parse variables that usually travel together (Leatherdale, 2019, 2019). In the current study we leverage the dramatic shift in social life linked with COVID-19, a

pandemic that dislocated peer relationships from the contexts these relationships typically inhabit. Specifically, while offering opportunities for enduring social influence according to specific mediums (e.g., the exchange of alcohol-related attitudes via virtual exchange), yet the pandemic yielded disruptions in social influence of a type linked to social context (e.g., shared contexts for alcohol consumption). Results of Aim 1 analyses indicated that prospective social influence effects within friend groups were in fact significantly impacted by the COVID-19 pandemic, with longitudinal social influence effects being significantly dampened for those whose period of participation spanned COVID-19. Further, such a disruptive effect of the pandemic on longitudinal social influence effects emerged as more pronounced during lockdown, when bars and restaurants were closed, and gatherings were legally prohibited.

Thus, consistent with results of prior prospective correlational studies, findings of this research capture temporal precedence in the link between social ties and increases in heavy drinking (Leung et al., 2014; Rosenquist, 2010). Unlike these past studies, however, the current research suggests the pandemic may have created a specific set of circumstances capable of disrupting this social spread over time. Results indicated these disruptions did not reflect a broader lack of opportunity to interact with friends nor a degradation in relationship quality: descriptive models indicated no significant differences in reported friendship quality and time spent conjointly among pre- and post- pandemic cohorts. Further, results indicated disruptions were unlikely attributable to broader intra-personal, stress-related effects of COVID-19: Aim 1 results indicated the relationship between an individual's own past and current drinking behavior remained intact in the face of the pandemic and supplementary models indicated no effects of pandemic era emerged with respect to coping motives to drink.

Results of Aim 2 analyses further support a potential role of context in driving clustering effects, indicating that the predictive power of baseline social motives in forecasting future problem drinking significantly diminished post-pandemic. Considered among the more proximal factors driving consumption, social motives are also a drinking determinant linked specifically with the drinking context itself (i.e., drinking to enhance social spaces). In other words, results point to the possibility that the pandemic created a unique environment less hospitable for the transmission of problem drinking behaviors, characterized specifically by reduced availability of social drinking contexts. Supporting such a premise, descriptive analyses of drinking contexts in a participant sub-sample from the current study pointed to a 4-fold reduction in frequency of drinking in bars and clubs, and a more than 50% increase in home-based consumption, linked with COVID-19. These findings mirror those reported in the broader literature, where studies indicate the prevalence of drinking alone increased approximately 50% among young adults in the year 2020 (Patrick et al., 2022). Of note, although the current study identifies social contexts themselves as a potentially necessary pre-condition for social influence in alcohol consumption, it does not identify the exact process by which contextually-mediated influence might occur—e.g., via direct behavioral modelling, provision of alcohol, or instead via socially mediated access to a specific context of risk (e.g., invitation to late night clubbing scene, parties at a specific fraternity, etc.) Further, time spent drinking conjointly among co-participant friends at follow-up is not directly assessed in the current research, and thus, although multiple indirect context measures are integrated, the most direct manipulation check is lacking. However, considered in conjunction with prior self-report correlational studies that directly assess conjoint drinking (Leung et al., 2014), results of this natural intervention provide converging support indicating a

role for drinking contexts in driving social influence effects. Future research should further investigate specific contextual elements as vehicles for the social transmission of drinking.

Further probing of Aim 1 interactions point to potential factors underlying aggregate non-significant main effects of COVID-19 on drinking observed in the broader research literature (Acuff et al., 2022). Results indicated both mitigating and exacerbating pandemic effects on problem drinking, dependent on characteristics of participants' social groups. Specifically, results indicated a 36% *decrease* in binge drinking with pandemic onset among those whose friends displayed high levels of drinking at baseline, whereas the pandemic was linked with a 50% *increase* in binge drinking among those with lighter drinking friends, pointing to both risk and protective factors associated with friend groups. This finding largely corroborates what has been consistently identified as the "bidirectional effects" of social networks on drinking, suggesting that both positive (e.g., light drinking/abstinence) and negative (e.g., heavy drinking) health behaviors can spread within social networks (Rosenquist, 2010; Smith & Christakis, 2008). One possible understanding of the current findings is that the pandemic not only disrupted the spread of problem drinking behaviors but also hindered access to the potential protective effects of peer networks in promoting healthy behaviors among friends, leading to challenges for some individuals who used to benefit from their light-drinking networks before the pandemic. Specifically, pandemic-related disruptions may curtail access to protective social resources (Lee, 2022; Rosenbaum, 2006), including those linked with in-person social contexts and direct behavioral modeling (Stice et al., 1998). For example, a light drinking friend might suggest going to a movie theater instead of a bar together or model measured consumption in pub contexts pre-COVID, whereas post-COVID access to such shared contexts would be curtailed. This finding also aligns with research examining clinical samples, where participants can

demonstrate difficulty regulating their drinking during stressful times in the absence of social support (Barrio et al., 2021). Importantly, these findings underscore the potential of harnessing social network effects to prevent AUD development among young adults, pointing to potential avenues for future research in social network-based prevention and intervention programs.

Findings for measures capturing problematic patterns of consumption, including measures of binge drinking and adverse drinking consequences, did not always mirror those that emerged with respect to measures encompassing more normative levels of drinking. Specifically, in the present research, we found no significant interaction between friends' drinking and COVID-era in predicting either the frequency of non-binge drinking, or the average quantity of alcohol consumed per drinking occasion—a selective pattern of significance that also mirrors findings observed in our research with prior longitudinal samples (Venerable & Fairbairn, 2020). One possible explanation of these findings is that the pandemic exerted its most remarkable disruptive effects primarily in the domain of social contexts associated with risky or heavy drinking practices, such as fraternity/sorority parties (Glindemann & Geller, 2003), pregame events (Graupensperger et al., 2023), contexts involving drinking games (Wilson et al., 2022), and situations with large friend groups (Stanesby et al., 2019). On the other hand, while social opportunities may have been restricted, access to alcohol (even home delivery) was not and may have even been facilitated in certain cases (Grossman et al., 2020). This may help explain the observed continuity between baseline and longitudinal drinking quantity and frequency for both pre- and post-COVID cohorts. Another possibility presented by prior research is that, in light of cultural norms surrounding heavy drinking practices among youth, hazardous drinking behaviors are more “transmissible” within young adult populations (Hepworth et al., 2016), and thus social

influence effects emerge as most prominent when assessed using measures capturing problematic patterns of use.

Results of the current study carry potential implications across conceptual, prevention, and intervention domains. Conceptually, these results clarify boundary conditions required for social influence effects to manifest, pointing to a key role for in-vivo social contexts. Moreover, findings further indicate that such contexts may act as a double-edged sword when it comes to drinking, at times promoting and at others protecting against hazardous consumption, dependent on characteristics of the drinker's specific social network. In the realm of prevention, a large body of correlational and longitudinal research has linked specific in-person drinking contexts, including public drinking establishments and large-group settings, to hazardous patterns of consumption (Fairbairn, 2017; Gurrieri et al., 2021; Halonen et al., 2013). Yet evidence has been lacking surrounding a potential causal role for such contexts in facilitating alcohol use and its social spread. Results of the current study represent a step forward in establishing causality in the context-consumption link, pointing to the potential utility of organizational (e.g., university-based) and public policy initiatives that integrate preventative action at not only the individual but also the contextual/neighborhood level. Finally, in the realm of intervention, researchers have long leveraged the potentially protective effects of social networks within alcohol treatment programs, intentionally modifying networks by harnessing peer or family support to facilitate drinking reduction (Ariss & Fairbairn, 2020) as well as by creating new social networks grounded in sobriety (Groh et al., 2008). Findings of the current study indicate access to in-person social contexts as a core factor in both exacerbating and mitigating problem drinking risk, indicating the utility of intentional, shared in-person activities (without drinking) as a potentially effective behavioral change target for substance use intervention.

Limitations

While natural experiments represent a powerful inferential tool, these studies are not true experiments in that they lack a randomization device (Dunning, 2008). While we examined a variety of variables to assess any potential cohort effects, it remains a possibility that unmeasured parameters might influence the results. Furthermore, several assumptions were made regarding the magnitude of the disruption exerted by the pandemic on participants' complete social networks as well as on social behaviors in general. As our study was not initially designed to track these changes over time, we were unable to account for the endogeneity of friend network evolution, nor draw definite conclusions about what specific social behavior changes caused by the pandemic influenced drinking. Related, our examination of drinking context extended only to a subset of participants, and we therefore draw on descriptives from large-scale samples aside from this one by way of supplement. As such, in this as with all longitudinal survey studies, firm causal claims regarding specific social influence processes are unwarranted. Second, it is important to acknowledge that the post-COVID era does not represent a uniform period but rather an evolving landscape. Although our supplemental analyses parse effects of the post-COVID lockdown era, indicating that social influence effects were disrupted to an even greater extent during this no-contact period, there are doubtless other post-COVID phases experienced by all or subpopulations of our participants that our analyses are not capable of addressing. Third, our sample consists of individuals who are heavy social drinkers, many of whom were enrolled as students at baseline. This population did not exhibit serious drinking problems or severe AUD symptoms during the time interval specifically covered by our research. Investigating the generalizability of social influence mechanisms within clinical populations and alternative age and demographic groups represents an important avenue for future research.

Conclusion

When a virus with high mortality began spreading rapidly around the globe, governments enacted a series of restrictions on social life that were unprecedented in their scope. Results of the current study indicate that measures aimed at containing the spread of pathogens within societies may have exerted effects on contagious processes beyond the physical realm, disrupting behavioral influence within social networks. Findings from the current research contribute to the understanding of social influence effects, offering insights for change processes within network-based prevention and intervention measures aimed at stemming problematic drinking in young adults.

Author Contributions

Conceptualization: J. Han and C. Fairbairn; Methodology: J. Han, K. Creswell and C. Fairbairn; Formal Analysis: J. Han with supervision from C. Fairbairn; Investigation: W.J. Venerable; Visualization: J. Han; Writing – Original Draft Preparation: J. Han; Writing – Review & Editing: J. Han, C. Fairbairn, K. Creswell, and W.J. Venerable.

Conflicts of Interest

The authors declare that there were no conflicts of interest with respect to the authorship or the publication of this article.

Funding

This research was supported by National Institute of Health (NIH) grants R01AA025969 and R01AA028488 to Catharine E. Fairbairn, and F31AA031614 to Jiaxu Han.

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Table 1*Descriptive Statistics*

Variable	Pre-Pandemic Cohort (N = 106, 29.9%)		Post-Pandemic Cohort (N = 208, 58.6%)		No Follow-up (N = 41, 11.5%)
Mean Age (SD)	22.1 (1.6)		22.0 (1.7)		22.1 (1.6)
Female	63 (59.45%)		117 (56.3%)		13 (31.7%)
English as First Language	84 (79.2%)		160 (76.9%)		31 (75.6%)
Follow-up Survey Response Interval [Mean months (SD)]	16.1 (3.3)		13.6 (3.0)		-
<u>Race</u>					
White	63 (59.4%)		150 (72.1%)		24 (58.5%)
African American/Black	13 (12.3%)		8 (3.8%)		1 (2.4%)
Asian	30 (28.3%)		48 (23.1%)		15 (36.6%)
American Indian, Native Hawaiian or Other Pacific Islander	0 (0%)		2 (1%)		1 (2.4%)
<u>Ethnicity</u>					
Hispanic/Latino	9 (8.5%)		34 (16.3%)		9 (22%)
Not Hispanic/Latino	97 (91.5%)		174 (83.7%)		32 (78%)
<u>Drinking Outcomes</u>					
<u>Mean (SD) [Range]</u>	<u>T1</u>	<u>T2</u>	<u>T1</u>	<u>T2</u>	<u>T1</u>
Drinking days	9.4 (5.6) [0 – 29]	8.1 (5.5) [0 – 25]	9.0 (5.3) [1 – 26]	7.3 (5.9) [0 – 28]	8.8 (6.0) [1 – 30]
Drinking quantity	4.5 (2.4) [0 – 13]	3.5 (2.4) [0 – 13]	4.3 (2.2) [1 – 13]	3.3 (2.3) [0 – 15]	4.5 (2.3) [2 – 12]
Binge days	4.5 (3.6) [0 – 15]	3.3 (3.6) [0 – 23]	4.6 (3.7) [0 – 22]	2.8 (2.7) [0 – 20]	4.1 (3.6) [0 – 15]
Adverse drinking consequences	3.8 (3.6) [0 – 15]	3.7 (3.6) [0 – 17]	3.4 (3.1) [0 – 17]	3.3 (3.8) [0 – 24]	3.3 (3.6) [0 – 15]
<u>Student Status</u>					
Not a student	11 (10.4%)	56 (52.8%)	11 (5.3%)	117 (56.3%)	2 (4.9%)
Part-time student	5 (4.7%)	6 (5.7%)	5 (2.4%)	9 (4.3%)	3 (7.3%)
Full-time student	90 (84.9%)	44 (41.5%)	192 (92.3%)	82 (39.4%)	36 (87.8%)
<u>Relationship Status</u>					
Married	1 (0.9%)	4 (3.8%)	3 (1.4%)	3 (1.4%)	0 (0.0%)
In a committed relationship	28 (26.4%)	44 (41.5%)	46 (22.1%)	88 (42.3%)	16 (39.0%)
In an open relationship	0 (0.0%)	1 (0.9%)	2 (1.0%)	2 (1.0%)	0 (0.0%)

Dating	19 (17.9%)	25 (23.6%)	45 (21.6%)	38 (18.3%)	4 (9.8%)
Single (not actively dating)	58 (54.7%)	32 (30.2%)	111 (53.4%)	77 (37.0%)	20 (48.8%)
Other	0 (0.0%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	1 (2.4%)
<u>Years of Education [Mean (SD)]</u>	15.7 (1.2)	16.5 (1.1)	15.6 (1.2)	16.5 (1.3)	15.6 (1.2)
<u>Highest Grade in School Completed</u>					
1 st year college	0 (0.0%)	0 (0.0%)	1 (0.5%)	1 (0.5%)	4 (9.8%)
2 nd year college	6 (5.7%)	0 (0.0%)	11 (5.3%)	4 (1.9%)	21 (51.2%)
3 rd year college	53 (50.0%)	3 (2.8%)	123 (59.1%)	11 (5.3%)	10 (24.4%)
4 th + year college	31 (29.2%)	76 (71.7%)	45 (21.6%)	136 (65.4%)	3 (7.3%)
1 year grad school	8 (7.5%)	9 (8.5%)	16 (7.7%)	21 (10.1%)	2 (4.9%)
2 years grad school	3 (2.8%)	10 (9.4%)	2 (1.0%)	19 (9.1%)	1 (2.4%)
3 years grad school	1 (0.9%)	2 (1.9%)	2 (1.0%)	2 (1.0%)	0 (0.0%)
4+ years grad school	4 (3.8%)	6 (5.7%)	8 (3.8%)	14 (6.7%)	0 (0.0%)

Note. $N=355$. T1 = data collected at baseline; T2 = data collected at longitudinal follow-up. Drinking days = number of days / past 30 days participants reported on having had at least one drink of alcohol; Drinking quantity = average number of drinks participants usually have per drinking day / past 30 days; Binge days = number of days / past 30 days participants reported on having had five drinks (four drinks if female) or more in one sitting; Adverse drinking consequences = total score on the Short Inventory of Problems (Blanchard et al., 2003). Note that heavy drinking status of the participants were determined at the time of the phone screening and drinking outcomes at baseline were assessed during their first laboratory visit.

Table 2*Drinking Context and Settings in Pre- and Post-COVID era.*

<i>Pre-COVID era</i>		
<u>Drinking Settings</u>	<u>Drinking Episodes [%]</u>	<u>Mean # of drinks (SD)</u>
At a bar or club	222 [35.9%]	2.995 (2.132)
At a restaurant	10 [1.6%]	2.333 (1.414)
At home	196 [31.7%]	1.834 (1.787)
At work or school	33 [5.3%]	4.152 (5.832)
In someone else's home (private residence not my own)	121 [19.6%]	2.008 (1.660)
In transit (in a car/bus/train)	4 [0.6%]	3.250 (2.217)
Outside	14 [2.3%]	2.462 (1.854)
Other	18 [2.9%]	3.412 (1.734)
<u>Drinking Context</u>	<u>Drinking Episodes [%]</u>	<u>Mean # of drinks (SD)</u>
There are no other people around	31 [5.0%]	2.548 (2.976)
There are other people around	587 [95.0%]	2.489 (2.344)
<i>Post-COVID era</i>		
<u>Drinking Settings</u>	<u>Mean days [% drinking days]</u>	<u>Standard Deviation [Range (days)]</u>
At a bar or club	0.546 [8.3%]	1.133 [0 – 6]
At a restaurant	0.563 [8.5%]	1.039 [0 – 4]
At my own home	3.328 [50.4%]	4.195 [0 – 17]
At work or school	0.059 [0.9%]	0.418 [0 – 4]
In someone else's home (private residence not my own)	1.798 [27.3%]	2.165 [0 – 12]
Outside	0.261 [3.9%]	0.786 [0 – 4]
Other	0.042 [0.6%]	0.302 [0 – 3]
<u>Drinking Context</u>	<u>Mean days [% drinking days]</u>	<u>Standard Deviation [Range (days)]</u>
While alone (no one else present, physically, or virtually)	0.782 [11.8%]	2.171 [0 - 13]
While others present only virtually via video, but no others present physically	0.487 [7.4%]	1.358 [0 – 10]
While at least one other person was physically present	5.323 [80.8%]	4.011 [0 – 20]

Note. A subsample ($N=44$) of pre-COVID cohort completed a 14-day intensive ambulatory assessment period measuring their drinking contexts, yielding a total of 618 drinking episodes. A subsample ($N=119$) of the post-COVID cohort responded to questions regarding drinking contexts which were added post-COVID in an effort to capture the dramatic shift in settings associated with the onset of the pandemic.

Table 3*Actor-Partner Interdependence Model (APIM)*

Predictors	Dependent Variables						
	<i>Problematic Consumption Patterns</i>			<i>Normative Drinking Patterns</i>			
		T2 Binge days			T2 Adverse drinking consequences		
	<i>B (SE)</i>	<i>95% CI</i>		<i>p</i>	<i>B (SE)</i>	<i>95% CI</i>	
T1 drinking (actor)	0.085 (0.017)	[0.051, 0.119]		<.001	0.162 (0.017)	[0.128, 0.196]	
T1 drinking (partner)	0.101 (0.018)	[0.066, 0.137]		<.001	0.053 (0.025)	[0.004, 0.103]	
Response interval	-0.028 (0.016)	[-0.060, 0.003]		0.079	-0.006 (0.017)	[-0.040, 0.028]	
COVID-era	0.510 (0.195)	[0.125, 0.894]		0.010	0.376 (0.199)	[-0.017, 0.770]	
T1 drinking (actor) × COVID-era	-0.017 (0.022)	[-0.060, 0.026]		0.432	-0.038 (0.023)	[-0.084, 0.007]	
T1 drinking (partner) × COVID-era	-0.120 (0.024)	[-0.167, -0.072]		<.001	-0.065 (0.029)	[-0.123, -0.007]	
		T2 Drinking days			T2 Drinking quantity		
	<i>B (SE)</i>	<i>95% CI</i>		<i>p</i>	<i>B (SE)</i>	<i>95% CI</i>	
T1 drinking (actor)	0.559 (0.091)	[0.380, 0.738]		<.001	0.529 (0.101)	[0.331, 0.727]	
T1 drinking (partner)	0.151 (0.093)	[-0.032, 0.334]		0.106	0.052 (0.103)	[-0.149, 0.254]	
Response interval	-0.023 (0.091)	[-0.203, 0.157]		0.803	-0.140 (0.037)	[-0.212, -0.067]	
COVID-era	0.607 (1.390)	[-2.135, 3.349]		0.663	-0.109 (0.592)	[-1.279, 1.061]	
T1 drinking (actor) × COVID-era	0.001 (0.113)	[-0.221, 0.223]		0.995	-0.241 (0.126)	[-0.489, 0.006]	
T1 drinking (partner) × COVID-era	-0.113 (0.117)	[-0.343, 0.117]		0.333	0.167 (0.133)	[-0.094, 0.428]	

Note. T1 = data collected at baseline; T2 = data collected at longitudinal follow-up. COVID-era = a dummy code indicating pre-pandemic era (0) and post-pandemic era (1). CI = Confidence Interval. Drinking days = number of days / past 30 days participants reported on having had at least one drink of alcohol; Drinking quantity = average number of drinks participants usually have per drinking day / past 30 days; Binge days = number of days / past 30 days participants reported on having had five drinks (four drinks if female) or more in one sitting; Adverse drinking consequences = total score on the Short Inventory of Problems (Blanchard et al., 2003). T1 drinking = baseline drinking predictors corresponding to the specific outcome examined (e.g., models predicting drinking days at follow-up controlled for baseline drinking days).

Table 4

The Interplay of Drinking Motives and the COVID-era in Predicting Longitudinal Drinking Outcomes

<i>Social Drinking Motive</i>												
Predictors	Dependent Variables											
	T2 Drinking days			T2 Drinking quantity			T2 Binge days			T2 Adverse consequences		
	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>
Response interval	-0.010	-0.11	0.911	-0.117	-2.98	0.003	-0.034	-2.14	0.034	-0.009	-0.55	0.584
Baseline drinking	0.580	11.07	<.0001	0.427	7.56	<.000	0.058	5.13	<.000	0.138	11.67	<.0001
T1 Social motives	0.015	0.11	0.912	0.066	1.12	0.265	0.081	4.14	<.000	0.024	1.24	0.218
COVID-era	0.859	0.27	0.784	0.651	0.47	0.637	1.357	2.82	0.005	0.983	2.10	0.038
T1 Social motives × COVID-era	-0.068	-0.43	0.670	-0.055	-0.78	0.434	-0.080	-3.33	0.001	-0.052	-2.23	0.027
<i>Coping Drinking Motive</i>												
Predictors	Dependent Variables											
	T2 Drinking days			T2 Drinking quantity			T2 Binge days			T2 Adverse consequences		
	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>	<i>B</i>	<i>t</i>	<i>p</i>
Response interval	-0.016	-0.17	0.864	-0.117	-2.98	0.003	-0.031	-1.99	0.049	-0.010	-0.60	0.547
Baseline drinking	0.577	11.03	<.0001	0.427	7.56	<.000	0.060	5.37	<.000	0.128	10.87	<.0001
T2 Coping motives	-0.039	-0.30	0.763	0.066	1.12	0.265	0.051	2.97	0.004	0.093	5.52	<.0001
COVID-era	-2.546	-1.48	0.140	0.651	0.47	0.637	0.007	0.03	0.979	0.098	0.38	0.701
T2 Coping motives × COVID-era	0.205	1.30	0.197	-0.055	-0.78	0.434	-0.018	-0.83	0.409	-0.014	-0.67	0.504
<i>T2 Coping motives</i>												
	<i>B</i>	<i>t</i>	<i>p</i>									
Response interval	0.034	0.59	0.554									
T1 Coping motives	0.471	9.75	<.0001									
COVID-era	0.277	0.68	0.498									

Note. *N*=314. T1 = data collected at baseline; T2 = data collected at longitudinal follow-up. Drinking days = number of days / past 30 days participants reported on having had at least one drink of alcohol; Drinking quantity = average number of drinks participants usually have per drinking day / past 30 days; Binge days = number of days / past 30 days participants reported on having had five drinks (four drinks if female) or more in one

sitting; Adverse consequences = total score on the Short Inventory of Problems (Blanchard et al., 2003). COVID-era = a dummy code indicating pre-pandemic era (0) and post-pandemic era (1).

Figure 1*Timeline of Baseline and Follow-up Data Collection for Pre- vs. Post-pandemic Cohorts*

Note. This figure demonstrates the data collection timeline for both baseline and longitudinal follow-up in the pre- vs. post-pandemic cohorts. Participants reported their drinking behaviors over the past 30 days at the time of assessment, and cohort assignment was determined based on whether the majority (>15 days) of the past 30 days preceding the follow-up assessment fall into the pre- (before March 13th, 2020) or post-pandemic (after March 13th, 2020) era. Each vertical line in the figure corresponds to the data collection time point for an individual participant. Strict stay-at-home orders (illustrated as the dark purple block in the figure) were implemented from March 21st, 2020, to May 29th, 2020, in the state of Illinois (State of Illinois Coronavirus Response, n.d.). From May 29th to June 11th, 2021 (illustrated as the light purple block), the state of Illinois implemented a series of dynamic policies affecting the capacity and indoor services of bars and restaurants that adjusted over time to adapt to the labile infection rates in different regions of Illinois (State of Illinois Coronavirus Response, n.d.). Drinking outcomes = days, quantity, binge drinking days, and adverse drinking consequences. URCS = Unidimensional Relationship Closeness Scale. DMQ-R = Drinking Motives Questionnaire.

Figure 2

Diagram of The Actor-Partner Independence Model (APIM) to Examine Social Influence of Drinking Among Friends

Note. The diagram was adapted from Cook & Kenny (2005). Friend₁ = drinking outcomes for person A; Friend₂ = drinking outcomes for person B; T₁ = Baseline; T₂ = Longitudinal Follow-up; e₁ = residual (unexplained) portion of person A's follow-up score; e₂ = residual for person B's follow-up score. Single-headed arrows indicate predictive paths. Double-headed arrows indicate correlated variables. Paths labelled as "a" indicate actor effects and paths labelled as "p" indicate partner effects. Light blue arrows indicate moderation effects.