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RESEARCH ARTICLE

Associations of state and trait empathy with daily alcohol use

Lakshmi Kumar[1] | Whitney R. Ringwald[2] | Aidan G. C. Wright[2] | Kasey G. Creswell[1]

[1]Department of Psychology, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA

[2]Department of Psychology, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

Correspondence
Kasey G. Creswell, Department of Psychology, Carnegie Mellon University, 5000 Forbes Avenue, Baker Hall 342c, Pittsburgh, PA 15213, USA.
Email: kasey@andrew.cmu.edu

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Abstract

Background: A growing literature documents associations between lower trait empathy and heavier alcohol use and more alcohol problems in adolescent and young adult samples. Prior work linking empathy and alcohol use/problems in these populations has thus far focused on trait rather than state empathy, and researchers often do not differentiate between cognitive and affective empathy. Further, no prior studies have examined associations between daily fluctuations in state empathy and alcohol use. The goal of the current study is to advance knowledge about the associations between state (vs. trait) and cognitive (vs. affective) empathy and alcohol use.

Methods: Adult alcohol drinkers (n = 492; M_{age} = 22.89, SD = 5.53; 53.70% female) participated in ecological momentary assessment studies for 7 to 10 days (day n = 4683). Multilevel hurdle models were used to investigate associations between day-level state empathy and daily alcohol use at the within-person level, and associations between individual differences in trait empathy and alcohol use across days at the between-person level.

Results: Higher day-level state affective empathy was not associated with the likelihood of drinking on a particular day, but it was significantly associated with a greater number of drinks consumed on alcohol-consuming days, with the latter associations remaining after controlling for day-level positive affect (PA) and negative affect (NA). No associations were found for day-level state cognitive empathy, or trait affective or cognitive empathy.

Conclusions: On drinking days, when individuals reported more affective empathy than is typical for them, they were more likely to consume a greater number of alcoholic drinks, results that remained when controlling for levels of PA and NA. Daily shifts in affective empathy may be important to consider in efforts to understand alcohol use.

KEYWORDS
alcohol, EMA, empathy

INTRODUCTION

Alcohol is one of the most widely consumed psychoactive substances in the world (Ritchie & Roser, 2018), and excessive alcohol use increases the risk of adverse health, psychological, and social consequences (Antai et al., 2014; Rehm et al., 2010). Understanding why people drink alcohol has critical implications for education and prevention efforts against the development of alcohol problems (Cooper et al., 2015). One important reason individuals choose to drink is for alcohol's social rewards (Cooper et al., 2015; Creswell, 2021; Sayette et al., 2016). Humans have a fundamental need to belong and develop relationships with others (Baumeister & Leary, 1995), and alcohol's well-documented social facilitative effects aid in fulfilling these powerful basic needs (Fairbairn et al., 2015; 2018; Goodwin & Sayette, 2022; Sayette et al., 2012). Indeed, the majority of alcohol use takes place in social settings (Fairbairn & Sayette, 2014; Skrzynski & Creswell, 2020, 2021), social facilitation is the most commonly endorsed reason for drinking (Cooper et al., 2015), and people expect alcohol to improve their social experiences (Smith et al., 1995). Notably, these social expectations and motives longitudinally predict alcohol use and alcohol problems (Patrick et al., 2011; Smith et al., 1995). Beyond this survey work, experimental lab work demonstrates that alcohol has robust social facilitative effects, increasing social bonding, sociability, and the perceived attractiveness of others (Bowdring & Sayette, 2018; Sayette et al., 2012). Alcohol's potent ability to foster relationships with others is a critical reason that individuals choose to drink with important implications for understanding AUD risk (Creswell, 2021).

One important social factor that is vital to forming and maintaining relationships and has links to alcohol is empathy (Goldstein & Winner, 2012). Empathy is typically divided into cognitive empathy (i.e., the capacity to understand another's perspective or emotional state) and affective empathy (i.e., the capacity to share another's emotional state; Riggio et al., 1989). A small but growing literature consistently shows that individuals with AUD have lower trait empathy, particularly cognitive empathy, compared to healthy controls and that, in nonclinical (e.g., adolescent and young adult) samples, lower trait empathy is linked to heavier alcohol consumption and more alcohol problems (see Kumar et al., 2022a, for meta-analyses).[1] While researchers often do not differentiate between cognitive versus affective empathy in studies on nonclinical samples (e.g., Fielding et al., 2018), some studies show stronger links between affective (vs. cognitive) empathy and heavier alcohol use and more alcohol problems (Laghi et al., 2019; Lyvers et al., 2018; but see Lannoy et al., 2020). All prior studies on empathy and alcohol use/problems in nonclinical samples have been cross-sectional, but researchers have speculated that deficits in empathy and other related socio-cognitive variables (e.g., theory of mind) may be a risk factor for alcohol problems (e.g., Kumar et al., 2022a, 2022b; Massey et al., 2018; Winters et al., 2020, 2021), in addition to chronic, heavy alcohol use (typically seen in individuals with AUD) exacerbating these deficits due to alcohol's effects on prefrontal and limbic brain regions important for cognitive and emotional processing (e.g., Oscar-Berman et al., 2014; Volkow et al., 2011).

Several mechanisms have been proposed explaining the link between lower trait empathy (and deficits in socio-cognitive abilities more generally [e.g., theory of mind]) and alcohol use/problems in adolescents and young adults, including that these individuals may not be aware of social cues telling them to stop drinking (Massey et al., 2018), may use alcohol to cope in social situations (Kuntsche et al., 2005), may prefer substance use over making social connections (Winters et al., 2021), or may overvalue their peers' attitudes/norms about drinking and consider drinking a way to fit in with their peers (Kumar et al., 2022, 2022b; Laghi et al., 2019). One particularly promising candidate mechanism is that individuals with relatively lower levels of trait empathy might find alcohol use in social settings to be particularly rewarding because of the relatively larger boost these individuals receive in their ability to empathize with others (Kumar et al., 2022a). Consistent with this, in a study of adult social drinkers, alcohol (vs. placebo) beverage consumption increased affective empathy for photographs with positive emotional valence, and this effect was larger for those with lower trait empathy scores (Dolder et al., 2016). Thus, individuals who typically struggle with empathic responding during social interactions while sober may be especially likely to benefit from alcohol's prosocial effects. This increased sensitivity to the rewarding social effects of alcohol might place individuals with relatively lower levels of trait empathy at elevated risk to escalate their drinking and develop alcohol problems.

The literature linking empathy to alcohol use and problems has focused almost exclusively on trait-level variables. Empathy, however, has been construed as both a between-person (trait level) and within-person (state level) construct (Nezlek et al., 2001). Trait empathy can be thought of as a general tendency for a person to show empathy, whereas state empathy can be thought of as a person's fluctuations in empathy in response to particular interpersonal interactions (Nezlek et al., 2001) or features of the social context (Zaki, 2014). The motivated model of empathy suggests that people are either driven to employ empathy or to avoid it (Zaki, 2014). Positive affect, affiliation, and social desirability typically motivate people to approach empathy, whereas competition, material costs, and cognitive costs typically motivate people to avoid empathy (Cameron et al., 2019; Zaki, 2014). Thus, though people show individual differences in average empathy (trait empathy), they can also fluctuate and shift meaningfully in their empathy across situations and social contexts (state empathy) (Nezlek et al., 2001; Ringwald & Wright, 2020).

We could find no prior studies that have examined associations between fluctuations in state empathy and alcohol use or problems. Research on related constructs highlights why this work might be important, however. For instance, fluctuating affect states, which are context dependent, have been shown to robustly influence the direction, intensity, and persistence of a wide range of human behaviors and outcomes, including alcohol consumption and alcohol problems (e.g., Gendolla, 2000; Simons et al., 2014). Additionally, meaningful within-person variability in the Big Five personality

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traits has helped to explain important trait content manifestations of everyday socially oriented or task-oriented behavior, either directly or indirectly through changes in positive and negative affect (e.g., Geukes et al., 2017; Ringwald et al., 2021). Fluctuations in state empathy levels may be similarly important in predicting alcohol use behavior, with individuals perhaps being more motivated to drink to obtain alcohol's social facilitative effects when experiencing dips in empathy. In general, more research is needed to explore associations between empathy and alcohol use and, specifically, the extent to which trait (vs. state) and affective (vs. cognitive) empathy are linked to alcohol use. Such knowledge might inform targeted prevention and intervention programs for problematic alcohol use.

The goal of the current study is to advance knowledge about the associations between both state and trait empathy and alcohol use by examining these variables in a large (n = 492) sample of adults using ecological momentary assessment (EMA) methodology. This study design allowed us to (1) collect daily reports of alcohol use, thereby eliminating recall bias, and (2) assess empathy engagement (both affective and cognitive) multiple times per day, providing a measure of aggregated daily (state-level) and average (trait-level) empathy. As such, this study provides the first opportunity to disentangle the effects of trait versus state empathy in their associations with alcohol use by determining whether empathy is implicated in the within-person process of alcohol consumption (i.e., by determining whether individuals drink more or less alcohol on days that they report lower or higher empathy) and whether it manifests in between-person differences in average levels of empathy. Additionally, the current study design will allow us to determine whether the association between empathy and alcohol use is explained by positive and/or negative affect. This is important for establishing the unique associations between empathy and alcohol because increases in state positive and negative affect are associated with increases in state empathy levels (Nezlek et al., 2001; Ringwald & Wright, 2020), and there may be associations between state-level changes in positive and negative affect and alcohol consumption (e.g., Peacock et al., 2015; Simons et al., 2014; but see Dora et al., 2022; Tovmasyan, Monk, & Heim, 2022).

We had three hypotheses. First, consistent with studies showing that lower trait empathy is associated with heavier alcohol consumption (Kumar et al., 2022a), we hypothesized that individual differences in trait empathy would be associated with individual differences in daily drinking, such that individuals with lower trait cognitive and affective empathy would report more drinking days and more alcoholic drinks per day than individuals with higher trait empathy. Second, we hypothesized that day-level state empathy would show a similar pattern with trait empathy and would be associated with same day alcohol use, such that participants would be more likely to drink alcohol and to consume more drinks on days they reported lower empathy than what is typical for them. Third, consistent with prior studies in adolescents and young adults examining affective and cognitive trait empathy separately (Laghi et al., 2019; Lyvers et al., 2018), we hypothesized that associations between state empathy and alcohol use would be stronger for affective (vs. cognitive) empathy. As an exploratory aim that was not preregistered, we sought to determine whether associations between state empathy and same day alcohol use would be explained by state positive and negative affect.

METHODS

Participants

Data from three EMA studies (described in detail below) were collapsed to provide a large sample size with adequate power for detecting small within-person differences. Study hypotheses and the data analysis plan were preregistered on the Open Science Framework (https://osf.io/c6szn) before running any analyses. Participants in samples 1 (n = 330) and 2 (n = 426) were recruited from introductory psychology courses at the University of Pittsburgh. For inclusion, participants in samples 1 and 2 had to be over 18 years of age. Participants in sample 3 (n = 342) were recruited from the Pittsburgh community through posted flyers and online listings. For inclusion, participants in sample 3 had to be 18 to 40 years of age, use a smartphone, and not be enrolled in a full-time undergraduate program (to ensure a distinct community sample). All participants in sample 3 were prescreened to ensure a gender-balanced sample and adequate representation of trait modesty (the parent study examined narcissism; see Ringwald & Wright, 2020).

Daily alcohol use assessments and empathy measures (see below) were administered to all participants. For this study, participants were excluded if they did not report any instances of alcohol consumption during the course of the study (n = 577) or if they did not complete any empathy measures (an additional n = 1). Due to an administrative error, empathy items were not added until 13 days after the start of the study for sample 3, and participants who did not receive at least one empathy measure during that initial time period of the study were also excluded (n = 28). There were no other implications of this administrative error. The resulting pooled sample included 492 adult (18+ years) alcohol drinkers (M_{age} = 22.89, SD = 5.53; 53.70% female, 45.90% male, 0.4% nonbinary, transgender, or other). Most of the participants (90.0%) identified as White, 3.80% identified as Black, 6.50% as Asian, and 1.80% as Pacific Islander, Native American, or other.

Procedure

Participants first completed baseline questionnaires including a demographics questionnaire, questions about drug and alcohol use, and assessments related to psychological and interpersonal functioning and personality as part of a larger project (Ringwald & Wright, 2020). The EMA protocol began within a few days of the baseline questionnaires and included questions about alcohol use, empathy, and affect (the focus of the current study, see measures below), along with questions related to the larger project (e.g.,

additional questions about their social interactions). The length of the EMA protocol was 10 days for samples 1 and 3, and 7 days for sample 2. All participants viewed a video training presentation explaining the EMA procedures and instructions for downloading the MetricWire smartphone application used to collect EMA data (https://metricwire.com). Training was completed in person for participants in sample 2 and online for participants in samples 1 and 3 (for these latter participants, passing a short comprehension quiz was required).

For samples 1 and 3, empathy and affect surveys were delivered on a randomly initiated schedule between 9:00 a.m. and 9:00 p.m., with a minimum of 90 min between surveys. Push notifications alerted participants to answer each survey. Participants in samples 1 and 3 were asked if they had a social interaction since the last survey they filled out and if so, they were prompted to complete the state-level empathy and affect questions regarding their last social interaction. Social interactions were defined as real-time, direct conversations between the participant and one or more other individuals which lasted for at least 5 min. Participants in sample 1 received five surveys/day and those in sample 3 received seven surveys/day. Participants in sample 2 were instructed to self-initiate surveys immediately after having a social interaction, after which they filled out the state-level empathy and affect measures. Participants in sample 2 were asked to report on at least five social interactions each day. One time each day, either in the morning (sample 2) or at night (samples 1 and 3), participants were asked questions about their past 24-h alcohol use.[2]

Measures

Empathy

State empathy was measured using two items asking about cognitive empathy ("I considered what the person I interacted with was thinking," and "I considered what the person I interacted with was feeling"), and one item asking about affective empathy ("When the person I interacted with showed emotions, I felt their emotions inside of me") (Ringwald & Wright, 2020). Each item was rated on a slider scale from 0 ("Not at All") to 100 ("Very Much"). Bivariate correlations indicated that the two within-person cognitive empathy measures were highly correlated ($r = 0.83$), thus a composite variable was created by taking their average. Day-level measures of empathy were obtained by averaging empathy scores across each day, providing each day's level of state cognitive and affective empathy.

There were two trait-level measures of empathy. First, for participants in all three samples, we calculated a trait measure of empathy by averaging each participant's state cognitive and affect empathy scores across all days of the study (see Fleeson, 2001; Fleeson & Gallagher, 2009, for similarly calculated trait measures from experience sampling state measures). Second, in sample 2, a standardized measure of trait empathy, the Toronto Empathy Questionnaire (TEQ; Spreng et al., 2009), was administered at baseline. The TEQ is a 16-item unidimensional measure of empathy that measures empathy as a single, homogenous construct, encompassing a wide range of attributes related to theoretical facets of empathy (e.g., empathic concern and affective empathy; responses were on a 5-point scale ranging from "Never" to "Often"). Cronbach's alpha in the current sample was good ($\alpha = 0.86$).

Affect

Affect was assessed alongside the cognitive and affective empathy measures and asked how the participants felt during the social interaction they were reporting on (e.g., "How happy did you feel during the interaction?"). Participants rated the degree to which they felt three positive affect (PA) items (happy, excited, and relaxed) and three negative affect (NA) items (nervous, sad, and angry) derived from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Each item was rated on a slider scale from 0 ("Not at All") to 100 ("Extremely"). Composite PA and NA scores for each survey were calculated by taking an average of the PA and NA items, respectively. Day-level state measures of PA and NA were obtained by averaging the composite PA and NA values across each day. Trait measures of PA and NA were obtained by averaging each participant's state PA and NA scores across all days of the study.

Alcohol

Daily alcohol use was measured by assessing how many standard drinks participants consumed each day (in whole numbers); this was the day-level alcohol outcome measure. Rarely (0.009% of the days), participants reported drinks in nonwhole numbers (e.g., 4.5 drinks). These values were rounded up to the nearest whole number in order to conduct the hurdle model analyses (described below). Additionally, and also rarely (0.004% observations), nine participants reported drinking more than 20 standard drinks in a day. These outlier values were replaced with 20 drinks, the next most extreme score that was not clearly disconnected from the rest of the distribution based on visual inspection of histograms (Tabachnick et al., 2007). For trait-level models, alcohol outcome measures were obtained by calculating the proportion of days participants drank versus did not drink across all study days, and by averaging the total number of standard drinks that each participant drank on drinking days.[3]

Data analysis

Given the hierarchical structure of the data (i.e., days nested within individuals; daily empathy and alcohol measures nested within individuals), mixed effects or multilevel modeling (Raudenbush & Bryk, 2002) was used to model associations between day-level state empathy and daily alcohol use at the

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TABLE 1 Correlations among study variables at the within-person level ($n = 4683$) and between-person level ($n = 492$).

	Cognitive empathy	Affective empathy	Positive affect	Negative affect	Alcohol use (yes/no)	Number of drinks
Cognitive empathy		0.62**	0.41**	−0.16**	−0.02	−0.04
Affective empathy	0.61**		0.30**	0.11*	−0.07	0.01
Positive affect	0.41**	0.34**		−0.16**	−0.06	0.03
Negative affect	−0.16**	0.04*	−0.26**		−0.07	0.11*
Alcohol use (yes/no)	0.01	0.01	0.05**	−0.05**		0.58**
Number of drinks	−0.00	0.04*	0.07**	0.03	0.65**	
Mean (SD)	64.78 (14.46)	50.34 (21.11)	55.05 (12.51)	14.75 (12.35)	0.35 (0.20)[a]	1.15 (1.14)[b]

[a]Proportion of drinking days.

[b]Mean alcohol consumed across the study: Obtained by dividing the total number of drinks each participant consumed by the total number of days they participated in the study.

*$p < 0.05$; **$p < 0.01$. Within-person correlations are reported below the diagonal and between-person correlations are reported above the diagonal.

within-person level, and associations between individual differences in empathy and alcohol use at the between-person level. Multi-level modeling allowed us to distinguish the effects of individual differences in empathy from the effects of daily-level shifts from one's mean empathy. The threshold for significance for all analyses was set to $p < 0.05$.

At the within-person level, a continuous measure of the number of standard drinks participants consumed per day was examined as the primary outcome variable. R was used to model associations between empathy and daily alcohol use (R Core Team, 2022). Hurdle models (Cragg, 1971) were fit using the glmmTMB package in R (Brooks et al., 2017) to account for this highly skewed count data.[4] Multilevel hurdle models allowed us to examine whether drinking behavior occurred (yes/no) and continuous information about the number of standard drinks the participants reported consuming on a drinking day. For these hurdle models, day-level state cognitive and affective empathy were included at level 1 as the predictors of interest. At the between-person level, person-means for trait cognitive and affective empathy were added at level 2 as trait-level predictors. Day of the week was included as a level 1 covariate (0 = weekday, 1 = weekend). Gender (1 = female, 0 = nonfemale),[5] age, and sample were included as level 2 covariates. Two dummy variables were created for sample number (sample 2; 1 = yes, 0 = no and sample 3; 1 = yes, 0 = no, with 0s on both dummy variables referencing sample 1). To determine whether any day-level effects observed for empathy were explained by PA or NA, exploratory models were run including day-level state and between-person PA and NA as level 1 covariates.

To replicate findings from previous studies on trait empathy using questionnaire measures, we additionally ran multilevel hurdle models to examine associations between trait empathy assessed by the TEQ (the predictor variable) and whether drinking behavior occurred (yes/no) and the number of standard drinks participants reported consuming on a drinking day in sample 2. Gender, age, and day of the week were included as covariates. Additionally, to compare how similar the two trait empathy measures were, bivariate correlations were run to examine associations between the TEQ total score and the person-means for affective and cognitive empathy assessed across days of the study.

Missing data

There was a total of 4683 days of participant data, 4401 day-level observations of cognitive empathy and 4373 day-level observations of affective empathy, 4527 day-level observations of positive and negative affect, and 3804 day-level observations of alcohol use (i.e., whether participants drank alcohol or not on a particular day and if so, the number of standard drinks participants consumed). Missing data refer to when there was data for one variable on a given day but not another or several other variables. Multiple imputation (Little & Rubin, 1987; Robitzsch & Grund, 2020) was used to create five sets of replacement values for the multivariate missing data, where each incomplete variable was imputed by a separate model.[6] Results are reported using the multiply imputed datasets.

RESULTS

Table 1 displays bivariate correlations among study variables at the within-person level ($n = 4683$) and between-person level ($n = 492$). Additionally, it shows descriptive statistics for the empathy, affect, and alcohol variables. Table S1 displays participant characteristics and descriptive statistics separately across the three samples.[7] As shown, at the within-person and between-person levels, cognitive and affective empathy were strongly positively correlated, and PA and NA were weakly negatively correlated. At both levels, PA was moderately positively correlated with cognitive empathy and weakly positively correlated with affective empathy, and NA was weakly positively correlated with affective empathy and weakly negatively correlated with cognitive empathy. Also, at both levels, cognitive empathy was not significantly correlated with either alcohol measure (i.e., alcohol consumed each day (yes/no) or number of drinks

consumed each day), but affective empathy was weakly positively correlated with number of drinks consumed each day at the within-person level. PA was weakly positively correlated with both alcohol measures only at the within-person level. NA was weakly negatively correlated with whether alcohol was consumed each day at the within-person level and with the number of drinks consumed at the between-person level.

Table 2 displays the results of the hurdle models. The hurdle submodel uses logistic regression to estimate the probability of not drinking (0) relative to drinking, with a positive estimate indicating a higher chance of no alcohol use. The count submodel uses Poisson regression to test the effect of predictors on the amount drank if drinking occurred. We first summarize the results of the hurdle submodel followed by the results of the count submodel.

As shown in the Main Model (which did not include affect as a covariate), for the hurdle submodel at the within-person level, there was no association between day-level state cognitive or affective empathy and whether alcohol use occurred on a given day. At the between-person level, there was also no association between trait cognitive or affective empathy and whether alcohol use occurred.

TABLE 2 Hierarchical hurdle models for number of drinks consumed ($n = 492$).

	Main model		Exploratory model	
	Count submodel			
	Coefficient	**SE**	**Coefficient**	**SE**
Intercept	**1.76*** **	**0.28**	**1.37*** **	**0.34**
Female gender	**−0.33*** **	**0.08**	**−0.32*** **	**0.08**
Age	−0.02	0.01	−0.02	0.01
Sample 2	−0.19	0.10	−0.18	0.10
Sample 3	−0.26	0.13	−0.22	0.12
Trait cognitive empathy	−0.00	0.00	−0.00	0.01
Trait affective empathy	−0.01	0.00	−0.01	0.00
Trait positive affect			−0.00	0.00
Trait negative affect			0.00	0.00
Weekend	**0.22*** **	**0.04**	**0.21*** **	**0.04**
State cognitive empathy	−0.00	0.00	−0.00	0.00
State affective empathy	**0.01** *	**0.00**	**0.01***	**0.00**
State positive affect			**0.01***	**0.00**
State negative affect			0.00	0.00
	Hurdle submodel			
	Coefficient	**SE**	**Coefficient**	**SE**
Intercept	**1.29*** **	**0.23**	**1.30*** **	**0.29**
Female gender	**0.20***	**0.08**	**0.20***	**0.08**
Age	**−0.02***	**0.01**	**−0.02***	**0.01**
Sample 2	−0.12	0.11	−0.14	0.11
Sample 3	**−0.46*** **	**0.12**	**−0.47*** **	**0.12**
Trait cognitive empathy	0.01	0.00	0.00	0.01
Trait affective empathy	0.00	0.00	−0.00	0.00
Trait positive affect			**0.01***	**0.01**
Trait negative affect			0.01	0.01
Weekend	**−0.83*** **	**0.08**	**−0.81*** **	**0.08**
State cognitive empathy	−0.00	0.00	0.00	0.00
State affective empathy	−0.01	0.00	−0.00	0.00
State positive affect			**−0.02*** **	**0.00**
State negative affect			−0.00	0.00

Note: Count submodel: number of drinks consumed on drinking days; Hurdle submodel: whether alcohol was consumed on a given day. Bold text indicates state (within-person) level variables. Bold numerical values indicate significant effects.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

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When including day-level state and between-person trait PA and NA (see Exploratory Model), state PA had a significant negative and trait PA had a significant positive association with whether alcohol use occurred. On days when PA was higher, alcohol use was more likely to occur ($b = -0.02$, $p = <0.001$). Individuals with higher trait PA were less likely to drink on a given day ($b = 0.01$, $p = <0.05$).

In the count submodel of the Main Model (which did not include affect as a covariate) at the within-person level, there was no association between day-level state cognitive empathy and the number of standard drinks consumed, but a positive association between day-level state affective empathy and the number of standard drinks consumed. On days with higher day-level state affective empathy, more standard drinks were consumed ($b = 0.01$, $p = <0.05$). At the between-person level, there was no association between trait cognitive or affective empathy and the number of standard drinks consumed. When including day-level state and between-person trait PA and NA (see Exploratory Model), state PA had a significant positive association with the number of standard drinks participants consumed each day. On days with higher state PA, more standard drinks were consumed ($b = 0.01$, $p = <0.05$). In post hoc analyses, sample did not moderate any associations between day-level state empathy or person-level trait empathy and number of standard drinks consumed per day, except for sample 3 and trait cognitive empathy (see Appendix S1 for results).

Table 3 displays results, for sample 2 ($n = 127$), of the hurdle model, examining the association between trait empathy assessed by the TEQ and whether drinking behavior occurred (yes/no) and the number of standard drinks participants reported consuming on a drinking day. As shown, there was no association between TEQ scores and whether alcohol use occurred (hurdle submodel) or number of standard drinks consumed (count submodel). Additionally, there was a small positive association between the TEQ total score and person-mean cognitive empathy ($r = 0.20$, $p = 0.025$) but not affective empathy.

DISCUSSION

Alcohol is most often consumed in social settings (Fairbairn & Sayette, 2014; Sayette et al., 2012; Skrzynski & Creswell, 2020, 2021), and social factors play a key role in alcohol use and the development of alcohol problems (Cooper et al., 2015; Creswell, 2021; Goodwin & Sayette, 2022). Empathy is likely to play an important role in alcohol use in social settings (Laghi et al., 2019), and increased sensitivity to the rewarding social effects of alcohol might place individuals with lower trait empathy at elevated risk to escalate their drinking and develop alcohol problems (Dolder et al., 2016). In fact, previous studies have linked lower trait empathy to greater alcohol use and problems (e.g., Lannoy et al., 2020; Maurage et al., 2011; see Kumar et al., 2022a for a meta-analysis), but none have differentiated between trait and state empathy, and all were cross-sectional with retrospective recall of alcohol use over several weeks or months. The current study is the first to examine associations between state and trait empathy (both cognitive and affective) and daily alcohol use using EMA methodology.

We found that day-level state affective empathy was associated with the number of standard alcoholic drinks participants consumed. In contrast to our hypothesis, we found that individuals consumed more drinks on days when they reported greater-than-average state affective empathy levels. Notably, the associations between higher day-level state empathy and number of standard drinks consumed remained after controlling for PA and NA. Prior work has shown that increases in state affect are associated with increases in state empathy levels (Nezlek et al., 2001; Ringwald & Wright, 2020) and alcohol consumption (e.g., Peacock et al., 2015; Simons et al., 2014; but see Dora et al., 2022; Tovmasyan, Monk, & Heim, 2022). Therefore, controlling for PA and NA in this study helped us to establish unique links between state affective empathy and alcohol use that were not explained by affect.

These findings on state affective empathy are in contrast to previous results reported for trait affective empathy in adolescents and adults, in which lower trait affective empathy was associated with greater alcohol use and problems (Laghi et al., 2019; Lyvers et al., 2018). These disparate findings may be due to differences between trait versus state empathy in predicting outcomes or differences in the measurement of empathy. Prior alcohol studies have almost exclusively focused on trait empathy, asking participants to complete questionnaires about their typical engagement in empathy. Participants in the current study, in contrast, reported on their empathy levels in real time and with regard to specific social interactions. Our findings suggest that there may be differential associations between state and trait empathy and alcohol use, but future research is needed to confirm this.

We did not find significant associations between day-level state cognitive empathy and alcohol use, which is consistent with previous studies in adolescents and young adults that assessed trait cognitive empathy and alcohol use (Laghi et al., 2019; Lyvers et al., 2018). This suggests that affective empathy may be more important in explaining alcohol use and misuse (e.g., Maurage et al., 2011). Future work is needed, however, to explore the relative importance of cognitive versus affective empathy in the prediction of alcohol use and problems in nonclinical samples, especially given recent meta-analytic findings suggesting that individuals with AUD show deficits in cognitive but not affective empathy (Kumar et al., 2022a).

We found associations between PA, but not NA, and daily alcohol use. Specifically, as day-level state PA increased, participants were more likely to drink alcohol on a given day and consumed more standard drinks. These findings are consistent with recent meta-analyses of daily diary and EMA studies showing that people are more likely to drink and consume more drinks on days that they experience higher PA but not higher NA (Dora et al., 2022; Tovmasyan, Monk, & Heim, 2022). Additionally, as person-level trait PA increased, individuals were less likely to drink alcohol on a given day in general. These findings are consistent with prior work demonstrating that trait PA is negatively associated with proportion of drinking days and alcohol dependence symptoms (e.g., Simons et al., 2014). These findings

TABLE 3 Hierarchical hurdle models for number of drinks consumed in sample 2 ($n = 127$): Trait Empathy Questionnaire.

	Count submodel	
	Coefficient	**SE**
Intercept	1.50	0.71
TEQ	−0.00	0.01
Female gender	−0.24	0.15
Age	−0.02	0.03
Weekend	0.03	0.10
	Hurdle submodel	
	Coefficient	**SE**
Intercept	0.70	0.57
TEQ	0.01	0.01
Female gender	0.14	0.16
Age	−0.01	0.03
Weekend	**−0.34*** **	**0.19**

Note: Count submodel: number of drinks consumed on drinking days; Hurdle submodel: whether alcohol was consumed on a given day. Bold text indicates state (within-person) level variables. Bold numerical values indicate significant effects.

Abbreviation: TEQ, Trait Empathy Questionnaire.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

suggest that individuals who feel better, on average, drink less, but when individuals are feeling better than average, they may drink alcohol to enhance that feeling. Taken together, our findings indicate associations between PA and alcohol consumption may differ at the within- and between-person levels, and results add to a growing literature demonstrating the importance of PA in understanding alcohol use, at least in nonclinical samples.

It is important to note that the timing of alcohol consumption in relation to when the state empathy and state affect measures were completed was not recorded. Although empathy and affect measures were collected multiple times each day and were time stamped, alcohol use was collected once each day (in the morning or evening) and referred to drinking in the past 24 h. As such, empathy and affect measures could have been filled out before, during, or after participants consumed alcohol. Previous research has shown that alcohol consumption can lead to acute increases in affective empathy, positive affect, and social bonding (Dolder et al., 2016; Sayette et al., 2012). If participants consumed alcohol before filling out empathy and affect measures, this could have increased empathy and affect and influenced the strength and direction of the relationships between empathy and alcohol use. However, since most of the empathy and affect measures were completed during the day and most alcohol use takes place in the evening (e.g., Coffman et al., 2007), this concern is somewhat mitigated. Nonetheless, future studies should assess empathy, affect, and alcohol use in real time.

We also found that trait empathy measured by the TEQ in sample 2 was not significantly associated with whether alcohol use occurred on a given day or the number of standard drinks participants reported consuming on a drinking day. In contrast, previous studies have shown that deficits in trait empathy, assessed using the Interpersonal Reactivity Index (IRI) and Empathy Quotient (EQ), are linked to greater alcohol use and problems (e.g., Laghi et al., 2019; Maurage et al., 2011), respectively. Future studies are indicated to determine why some empathy measures may be more associated with alcohol use and problems than others. Further, the TEQ is a unidimensional measure of empathy, and it, therefore, does not give separate scores for affective and cognitive empathy, which have been shown to differ in the strengths of their associations with alcohol use in this study and others (e.g., Maurage et al., 2011). Future EMA studies should include measures of trait empathy that capture the multidimensionality of empathy (e.g., the IRI; Davis, 1980).

Contrary to expectations, trait empathy measured by averaging cognitive and affective state empathy responses across the study was not significantly associated with individual differences in overall alcohol use consumed on drinking days. Averaging state cognitive and affective empathy responses across days for each participant may have provided an accurate representation of a person's typical empathy based on real-time assessments of their day-to-day experiences. Indeed, many researchers have suggested that averaging across state measures can serve as an approximation for trait measures (e.g., Fleeson, 2001; Ringwald et al., 2021). However, daily reports of empathy gathered over 7 to 10 days may not be long enough to capture a true estimate of trait empathy, and these scores may not directly correspond to scores on typically used trait-level empathy questionnaires, which could explain our null findings. Indeed, the size of the associations between the TEQ and averaged daily state affective and cognitive empathy were small (r_s of 0.16 and 0.20, respectively). Standard trait empathy measures refer to validated self-report or computer-based empathy tasks that capture overall empathic tendencies. In this study, we averaged over state measures of empathy to derive a trait empathy score, which is not a standardized empathy measure used in prior studies. Future research is indicated to compare the validity of trait empathy captured by averaging multiple assessments of state empathy with that of standard one-time trait empathy questionnaires.

The present study has limitations. As mentioned above, it was unclear whether the empathy and affect measures were completed before, during, or after drinking alcohol. While most of the empathy and affect measures in this study were collected during the day, presumably before alcohol consumption took place, future EMA research should assess when alcohol was consumed in relation to when empathy and affect surveys were completed to draw stronger conclusions about the direction of the associations. Second, information about the social context of drinking was not collected; this information should be included in future studies given work showing that social context influences alcohol consumption and problems (Creswell, 2021; Creswell et al., 2022; Skrzynski & Creswell, 2020, 2021; Waddell et al., 2021), as well as empathy levels (Cameron et al., 2019) and affect (Geukes et al., 2017). Third, the three samples combined in this study

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were quite heterogeneous. Specifically, two of the studies used randomly timed prompts to sample empathy throughout the day, while one study used event-contingent prompts to assess empathy in the context of social interactions specifically. There were also differences in the length of the EMA protocols (i.e., 7- vs. 10-day protocols), and two studies were limited to college students, while the other included a community sample of adults up to age 40. Although this study allowed us to examine state empathy and daily alcohol use in a large sample of social drinkers, and while sample type generally did not moderate any of the findings reported here, future studies should replicate these findings in a more homogenous sample. Fourth, while the 7 to 10-day EMA periods used in these studies are commonly used EMA timeframes in alcohol research (e.g., Tovmasyan, Monk, Qureshi, et al., 2022), we were unlikely to capture more than a few drinking episodes per participant in these non–daily drinkers. Future EMA studies should be longer and/or be conducted over multiple weekends to capture more drinking episodes. Fifth, the empathy questions we used gave no "not applicable" option for participants. Although expression of emotions or affect is assumed to be present in all social interactions to some degree, it is conceivable that only expressions beyond some thresholds are readily detectable by participants. Future studies may wish to examine threshold effects when assessing for empathy. Sixth, the majority of the sample was White, which may limit the generalizability of the findings, and future studies should replicate these findings in more diverse samples. Finally, only one sample included a questionnaire measure of trait empathy, but it was a unidimensional scale that did not allow us to look separately at affective and cognitive empathy. Future work should include trait measures that decompose empathy into cognitive and affective components.

The present study also has several strengths. First, state empathy was measured across diverse daily situations over several days, and these scores were averaged to give a more representative measure of trait empathy. Second, alcohol use was reported daily rather than asking participants to recall their alcohol use over several weeks, which likely increased the reliability of the alcohol use data. Third, multilevel modeling allowed us to separate out the effects of state versus trait empathy on alcohol use. Results revealed the novel finding that state affective empathy was positively associated with daily drinking and that this association remained after controlling for positive and negative affect.

In summary, this study is the first to assess both trait and state affective and cognitive empathy and alcohol use using EMA methodology. The results indicated a positive association between state affective empathy and number of standard drinks consumed. These findings add to a growing body of work highlighting the importance of social factors in alcohol use and misuse (e.g., Creswell, 2021; Fairbairn & Sayette, 2014; Fairbairn et al., 2015; Goodwin & Sayette, 2022; Kumar et al., 2022a, 2022b). Future research is needed to replicate these findings and explore possible mechanisms for the link between higher state affective empathy and increased alcohol use, as well as individual difference factors (e.g., drinking refusal self-efficacy, impulsivity; Creswell et al., 2019; Laghi et al., 2019) that might moderate the association between state affective empathy and alcohol use.

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CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest.

ORCID

Lakshmi Kumar https://orcid.org/0000-0002-4541-4771
Kasey G. Creswell https://orcid.org/0000-0002-6659-0651

ENDNOTES

[1] There is a well-established association between clinically low levels of empathy (i.e., callous unemotional traits often present in conduct disorder; Hyde & Dotterer, 2022) and alcohol problems (Wymbs et al., 2012). We are referring to normative variation in empathy levels as assessed, for example, by the Interpersonal Reactivity Index questionnaire (Davis, 1980).

[2] Compliance rates were 68.71% (sample 1) and 62.95% (sample 3) for the cognitive empathy surveys, 62.66% (sample 1) and 62.50% (sample 3) for the affective empathy surveys, and 68.86% (sample 1) and 66.88% (sample 3) for the affect surveys. There are no compliance rates to report for empathy and affect surveys for sample 2, as participants were instructed to self-initiate these surveys immediately after having social interaction. Compliance rates were 79.23% (sample 1), 69.42% (sample 2), and 88.72% (sample 3) for the alcohol surveys.

[3] An additional item assessed current alcohol use at baseline, but it was not a standardized measure of alcohol use and thus was not used in analyses. This decision was preregistered and made prior to obtaining the study data. Participants were asked about their current alcohol use with the following response options: 0 = "I have never used alcohol"; 1 = "I used to drink but do not drink now"; 2 = "I drink socially but never to excess"; 3 = "I sometimes drink to the point of feeling high"; 4 = "I usually drink moderately but will often drink more than I should"; 5 = "I often use alcohol to excess"; 6 = "I have had serious problems with my drinking"; and 7 = "I consider myself an alcoholic." Across samples, most (92.6%) of the participants endorsed option 2 (47.9%), 3 (24.8%), or 4 (19.9%).

[4] Two alcohol use measures were preregistered as the primary outcomes at the within-person level—a binary variable indicating whether participants drank alcohol or not on a particular day, and a continuous measure of the number of standard drinks participants consumed per day. Hierarchical generalized linear models were planned to model these associations (Breslow & Clayton, 1993). Specifically, we planned to use a Bernoulli sampling model and logit link to model whether participants drank alcohol on a particular day or not, and a hierarchical Poisson regression to model number of drinks consumed.

However, based on reviewer feedback, a more parsimonious approach was employed (i.e., hurdle models (Cragg, 1971), described throughout the manuscript). Results for preregistered models are included in Table S2.

[5] Three individuals indicated a non-binary gender descriptor and were coded as non-females to retain them in the analysis.

[6] There were no days with completely missing data used to impute multiple datasets. Multiple imputation allows for missing data to occur on several variables, as it uses the underlying distribution of the variable and information from variables for each participant to impute missing values.

[7] Average number of drinking days across participants in sample 1 was 2.67 (SD = 1.37), in sample 2 was 2.62 (SD = 1.19), and in sample 3 was 4.12 (SD = 2.17).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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