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Mixing Misery and Gin: The Effect of Alcohol-Administration on Ostracism Response

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Abstract

Williams's need-threat model (2009) proposes that ostracism responses are reflexive and, because of their evolutionary significance, difficult to diminish. Alcohol is widely consumed in social contexts and for reasons of coping with social stress, and major theories of alcohol propose that intoxication disrupts cognitive appraisal of environmental threats leading to stress relief. Surprisingly, though, no well-powered experimental research has examined the impact of alcohol intoxication on distress from social ostracism. In three studies across two independent laboratories (N=438), participants were randomly assigned to receive either an alcoholic or non-alcoholic (i.e., no-alcohol control or placebo) beverage and were exposed to an ostracism (or social inclusion) manipulation. Results, which emerged as remarkably consistent across all studies, indicated strong and consistent effects of ostracism on mood and needs satisfaction among both intoxicated and sober participants. Findings have important implications for ostracism theory and speak to boundary conditions for alcohol's ability to relieve stress.

Keywords

Ostracism; alcohol; social stressor; laboratory; mechanism

Ostracism, defined as the experience of being excluded and ignored, has been widely studied for its reliable and powerful impact on affect and behavior (Williams, 2007; 2009). In the temporal need-threat model of ostracism, Williams (2009) proposes that ostracism has swift, potent, and pervasive effects and, in line with the predictions of this model, research indicates ostracized individuals experience an immediate dip in mood, exhibit negative behavioral reactions, and perceive threats to their most fundamental human needs (Hales & Williams, 2021; Williams, 2009). Research employing daily-diary methods

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indicates that ostracism experiences are fairly common, with individuals reporting feeling excluded as frequently as once a day (Nezlek, Wesselmann, Wheeler, & Williams, 2012). Laboratory studies have further captured reliable ostracism responses across paradigms and experimental manipulations, including those involving both virtual and face-to-face interaction (Williams, Cheung, & Choi, 2000; Williams & Sommer, 1997). At the present time, the most commonly employed ostracism paradigm involves a 3-way computer-based game of ball toss ("Cyberball")—a paradigm that elicits a potent and well-characterized ostracism response using a manipulation that can be administered in a standardized manner (Hartgerink, Van Beest, Wicherts, & Williams, 2015; Williams & Jarvis, 2006).

One core component of Williams's temporal need-threat model (2009) is the premise that immediate responses to ostracism—i.e., affective reactions captured directly following the ostracism experience—are governed by processes that are reflexive in nature. The need-threat model draws from evolutionary theory indicating that, in social animals such as humans, integration into social groups is critical to survival, and social ostracism might result in imminent morbidity or mortality for the excluded individual (Williams, 2009). Thus, in light of the theorized centrality of social inclusion for survival, Williams hypothesizes that responses to ostracism have developed as automatic (Williams, 2009). Providing indirect support for this notion, research has shown that reactions to ostracism are swift and powerful, and seemingly resistant to a host of factors that might reasonably be thought to diminish such responses were they not vital for survival. For example, participants experience ostracism as painful even when they believe they are being excluded by members of a hated out-group (e.g., the KKK; Gonsalkorale & Williams, 2006), when they receive direct compensation for being excluded (van Beest & Williams, 2006), when the ball used in Cyberball is a bomb that could go off at any time (van Beest, Williams, & van Dik, 2011), and when being ostracized from a poor-performing group (Wirth, Turchan, Zimmerman, & Bernstein, 2014). Ostracism is a powerfully aversive interpersonal experience whose effects are difficult to mitigate.

Alcohol, which has been widely studied for its ability to alleviate affective responses to stressful situations (Greeley & Oei, 1999; Sher & Levenson, 1982), is a promising candidate for mitigating reactions to ostracism. Drinkers report that alcohol can help "take the edge off" in the face of stress (Goldman, Brown, & Christiansen, 1987) and further identify coping motives as a primary factor driving their alcohol consumption (Cooper, 1994). Given that most alcohol consumption takes place in social contexts (Creswell, 2021; Fairbairn & Sayette, 2014), researchers have been particularly interested in understanding alcohol's ability to mitigate responses to stressors that are specifically social in nature (Higgins & Marlatt, 1975; Hull, 1981). Individuals often report drinking to relieve social stress (Bartholow, Dickter, & Sestir, 2006) and drink more in stressful than in non-stressful social situations (Higgins & Marlatt, 1975). In fact, social anxiety often precedes the development of problematic drinking (Black et al., 2015; Wolitzky-Taylor et al., 2012), leading some to theorize that social anxiety contributes to the onset of alcohol problems (Kushner et al., 2000). Consistent with this, a large body of experimental work has accumulated indicating that alcohol can have robust effects on response to social stress. For example, studies have found that alcohol consumption can diminish affective responses to negative interpersonal feedback (Yankofsky, Wilson, Adler, Hay, & Vrana, 1986), relieve negative mood associated

with threat of interpersonal evaluation (Sayette, Smith, Breiner, & Wilson, 1992), and reduce discomfort within interactions among groups of strangers and distressed couples (Fairbairn & Testa, 2017; Sayette et al., 2012). While affective responses to ostracism seem to be automatic and resistant to a broad host of factors and conditions (Williams, 2009), alcohol seems especially promising in being able to dampen responses to these potent interpersonal threats. Indeed, some research has linked ostracism responses to overall drinking patterns (Bacon, Cranford, & Blumenthal, 2015; Maurage et al., 2012), and evidence from survey research indicates that affective response to ostracism significantly correlated with subjective intoxication among a sample of bar patrons (Hales et al., 2015).

Surprisingly, to our knowledge, only two laboratory studies have employed randomized alcohol-administration designs to examine the causal effects of alcohol on ostracism response (Buckingham et al., 2016; Sprunger et al., 2020). Results in both studies indicated no impact of alcohol on fundamental need-threat associated with ostracism. However, as acknowledged by the authors of both studies, there were a number of methodological limitations that limit interpretability of these null findings. The Buckingham et al. (2016) study was underpowered with a sample size of 32 hazardous drinkers, and they further administered both the inclusion and ostracism manipulations during the same experimental session. Finally, they administered a dose of alcohol (.4g/kg) not sufficiently large to induce substantial intoxication, especially in the heavy “hazardous” drinkers who were recruited for the study (Buckingham et al., 2016). This is important as researchers have theorized that alcohol’s ability to relieve stress is primarily attributable to its tendency to interfere with the cognitive appraisal and processing of environmental threats (i.e., the appraisal-disruption model; Sayette, 1993) rather than any direct effect of alcohol on mood (Curtin, Patrick, Lang, Cacioppo, & Birbaumer, 2001; Fairbairn & Sayette, 2014; Steele & Josephs, 1990). As such, we would expect alcohol to mitigate ostracism responses only when the dose of alcohol administered is sufficient to cause significant impairment across a range of cognitive domains including reasoning, perception, and appraisal processes (Sayette, 1993). While Sprunger et al. (2020) administered a larger dose of alcohol than Buckingham et al. (2016), they noted that their study should be considered preliminary, as there were only ~32 individuals in each condition of the study (i.e., alcohol, no-alcohol control, and placebo beverage conditions), all of whom were ostracized. Thus, this study was also underpowered to find an effect of alcohol on ostracism and, without an inclusion condition, results are hard to interpret.

Alcohol-administration methods have been developed that permit the simulation of an episode of binge drinking in a laboratory session, involving the administration of a dose of alcohol approximately double that administered by Buckingham and colleagues (2016) and sufficient to cause intoxication (Kirchner & Sayette, 2003; Levenson, Sher, Grossman, Newman, & Newlin, 1980; Sayette et al., 2012). The appraisal-disruption model (Sayette, 1993) proposes that such alcohol intoxication will immediately reduce stress, since initial appraisal of the stressor occurs during intoxication. According to this theory (and the evidence reviewed above showing alcohol’s ability to reduce social stress), alcohol should mitigate affective responses to ostracism when ostracism occurs during intoxication. In contrast, Williams’s need-threat model (2009) proposes that ostracism responses are reflexive and, because of the evolutionary significance of these responses, very difficult to

diminish. Therefore, a compelling competing prediction is that alcohol will not dampen affective responses to ostracism given that they are automatic and necessary for survival (Williams, 2009). Our aim was to examine the effect of alcohol on the experience of ostracism using well-powered and methodologically strong experimental designs to test these competing theoretical predictions.

Here, we present the results of three separate studies across two independent laboratories, powered to find small to medium sized effects of alcohol on ostracism. Prior studies examining alcohol's effects on social stressors found medium sized effects (e.g., Fairbairn & Testa, 2017; Sayette et al., 1992), and thus our studies are the first to provide adequate power to detect an effect of alcohol on ostracism. We employ binge-simulation alcohol-administration methods in order to ensure an intoxicating dose of alcohol. We further combined this with a 3-person group drinking paradigm, thus potentially increasing the perceived realism of the ostracism experience by allowing participants to interact with their supposed "ostracizers" prior to, and also following, Cyberball. Given prior research indicating alcohol's ability to relieve some forms of social distress, and in line with predictions made by the appraisal-disruption model of alcohol and stress (Sayette, 1993), we anticipated that distress (i.e., lowered mood and needs satisfaction) in response to ostracism would be diminished, and possibly disappear, among participants receiving alcohol. In Study 1, we independently varied both alcohol (versus a no-alcohol control beverage) and inclusion (versus exclusion) within subjects, with participants engaging in drinking in groups of new acquaintances. In Study 2, we extended these findings by using a between-subjects design, and by having participants also interact with familiar others. Finally, in Study 3, we accounted for expectancy effects by comparing an alcoholic vs. a placebo beverage using a between-subjects design, with participants drinking in groups of new acquaintances. No studies in this manuscript were preregistered. We report all manipulations, measures, and exclusions in these studies.

Study 1

Methods

Participants: Participants consisted of 60 social drinkers aged 21–28 (M=22.50 years; SD=1.88) recruited via advertisements in the local community (50% female; 55% white, 12% Black, 20% Asian, 5% Hispanic). Exclusions included pregnancy in women, taking medications or having medical conditions for which alcohol consumption was contraindicated, or especially light or heavy drinking practices—see guidelines for administering alcohol to human participants (National Advisory Council on Alcohol Abuse and Alcoholism, 1989; see also Fairbairn et al., 2018).[1] Average number of drinking days in the past month was 10.30 (SD = 5.48; range 2–26), and average number of standard drinks (i.e., 14 grams pure alcohol) consumed per occasion was 4.03 (SD = 1.96; range 1–9+). Sample size was determined before data analysis.

[1]Preliminary results from this sample of participants are reported in Fairbairn et al., 2018. These findings deal only with mood ratings collected immediately post-drink and pertain in no way to Cyberball.

Procedures: The study employed a 2 [Alcohol Condition: alcohol vs. no-alcohol control] X 2 [Ostracism Condition: ostracized vs. included] within-between subjects factorial design. All participants drank alcohol and no-alcohol control beverages, and all participants were ostracized and included. Specifically, participants attended two extended laboratory sessions, which were scheduled 3 days apart. Participants attended these sessions in groups of three same-gender strangers (unacquainted prior to the first laboratory session). On one of these sessions, groups consumed an alcoholic beverage and, on the other session, they consumed a non-alcoholic (control) beverage. The order of beverage condition was counterbalanced across groups, such that half received the alcoholic beverage first and half received the no-alcohol control beverage first. Participants were informed at the start of each session whether they would receive an alcoholic or non-alcoholic control beverage. Regarding the ostracism condition, on the first session, all participants were assigned to be "included" and, on the second session, to be "ostracized"—note that, unlike the alcohol condition, the order of ostracism vs. inclusion was not counterbalanced due to ethical/human subjects concerns associated with the necessary delay in debriefing for those ostracized during the first session. (See Results section for analyses addressing confounding of the ostracism condition with session order, as well as Studies 2 and 3 for alternative experimental designs). The first two groups run in this study were excluded and later replaced due to procedural abnormalities —decisions regarding exclusion were made on the day of the laboratory session and thus before any data analyses took place. The current study provided 80% power to detect a small to medium-sized within-between factors interaction between alcohol and ostracism (Cohen's $f = .18$), assuming $\alpha = .05$—an effect size that, in light of the dose of alcohol administered, was deemed sufficient (Fairbairn & Sayette, 2014).

All participants were required to refrain from eating for 3 hours prior to the experimental session and register a 0.00% Breath Alcohol Concentration (BrAC) upon arriving in the laboratory. After completing baseline mood assessments, and consuming a weight-adjusted light meal, groups were seated together around a table and administered their study beverages. Participants were free to talk/interact, but they were asked not to discuss their level of intoxication. Alcoholic beverages were administered to groups as a cranberry-vodka cocktail in three equal parts over 36 minutes. On alcohol sessions, participants were administered a dose of alcohol that was adjusted for their weight and gender, intended to achieve a peak BrAC of approximately .08% (0.82 g/kg males/0.74 g/kg females). Thus, a 175-lb man received the equivalent of about 4.8 shots (1.5oz/shot) of 80 proof liquor over 36 minutes, and a 150-lb female received 3.8 shots (Fairbairn, Sayette, Levine, Cohn, & Creswell, 2013). On no-alcohol control sessions, groups received an isovolumic quantity of cranberry juice. A placebo manipulation was not employed in this initial study (but see Study 3 below for a test of whether any effects of alcohol on ostracism are primarily pharmacologically or expectancy based). Immediately following beverage-administration sessions, participants were brought into separate rooms where they completed a mood assessment along with a baseline Needs Satisfaction Questionnaire (see Measures below). In addition, BrACs were assessed, and participants were also asked to estimate their subjective intoxication (0–100 scale).

After an absorption period lasting approximately 40 minutes, during which participants performed other tasks unrelated to this experiment (Kang, Bresin, & Fairbairn, 2018), participants again provided breathalyzer readings and then completed the Cyberball task. Participants were informed that they would engage in an online game of ball toss with the other two participants in the lab. They were told that the purpose of the task was to examine the impact of alcohol on mental visualization—participants were instructed to create a "mental picture" of the game and the players. In the inclusion session, participants received a third of ball tosses whereas, during the ostracism session, participants were excluded from all but an initial 2–3 tosses. The game lasted approximately 3 minutes. All participants in the group started the Cyberball task at the same time. The timing of Cyberball was intended to coincide approximately with the time of peak BrAC on alcohol sessions; participants waited approximately 40 minutes to start the Cyberball task on control sessions, as well. Immediately after the Cyberball task, participants answered questions about their perceptions of the game (see Manipulation Check). Also at this time, participants completed measures assessing their needs satisfaction and mood via standard measures employed across ostracism studies (Hartgerink et al., 2015; see Measures). After a delay of 60 minutes, during which groups engaged in other tasks, participants again completed the Needs Satisfaction Questionnaire and provided mood ratings. Participants in the control condition were allowed to leave at this point whereas, in the alcohol condition, they were required to stay until BrACs dropped below .03%.

Measures: All relevant measures are reported here; a list of all other measures is included in the supplementary material (Table S1).

Needs Satisfaction Questionnaire: The Needs Satisfaction Questionnaire (Hartgerink et al., 2015) is an assessment consisting of 20 items rated on 5-point scales (1 = *not at all*, 5 = *extremely*), with 5 questions assessing each of 4 subscales. Composite subscale scores were calculated by creating summed scores, reverse scoring negative items. Subscales include belonging (e.g., "I felt like an outsider"; $\alpha = .93$), self-esteem (e.g., "My self-esteem was high"; $\alpha = .86$), meaningful existence (e.g., "I felt invisible"; $\alpha = .90$), and control (e.g., "I felt 1 had control over the course of the game"; $\alpha = .87$).

Mood: Participants also answered eight mood items on 1 (*not at all*) to 5 (*extremely*) scales, regarding how they felt during the game (good, bad, friendly, unfriendly, angry, pleasant, happy, and sad; $\alpha = .94$). To be consistent with prior ostracism studies (e.g., Hartgerink et al., 2015), a composite mood score was calculated by creating a summed score, reverse scoring negative items. Supplementary analyses examined positive and negative mood separately.

Data Analysis Plan: Data were analyzed using 3-level mixed models accounting for the clustering of sessions within individuals and the clustering of individuals within 3-person groups. Consistent with recommendations for the analysis of data from dyads and small groups (Kenny, Mannetti, Pierro, Livi, & Kashy, 2002), clustering was accounted for through random intercepts. Data, analysis code, results,

and study materials for all three studies can be found here: https://osf.io/pfqsc/?view_only=545c80eead6a422b8d9c5d4227287070.

Results

Manipulation Check: Participants' BrACs on alcohol sessions, as measured immediately prior to Cyberball, averaged .073% (*SD* = .010) (this was also the highest value for average BrAC levels across the session). On sessions during which participants were ostracized (vs. included), they reported that they had been more ignored, *b* = 2.52, 95%*CI* [2.21, 2.82], *p*<.001, and excluded, *b* = 2.82, 95%*CI* [2.61, 3.03], *p*<.001, and estimated that they had received a significantly lower proportion of ball tosses, *b* = −25.97, 95%*CI* [−28.99, −22.94], *p*<.001, during the Cyberball game.

Key Hypothesis Tests: Effects of alcohol, ostracism, and their combination on needs satisfaction and mood are displayed in Table 1. As shown, ostracized (vs. included) participants reported significantly lower mood and needs satisfaction across all four domains of the Needs Satisfaction Questionnaire, but there were no main effects of alcohol. Importantly, there were no significant interactions between alcohol and ostracism in predicting any of the four needs ratings or mood. More specifically, during both alcohol sessions as well as no-alcohol control sessions, participants reported significantly lower mood, reduced sense of belongingness, self-esteem, meaningful existence, and control when they were ostracized vs. when they were included. A visual depiction of simple effects is provided in Figure 1.

Supplementary Analyses: We also conducted additional analyses designed to test the robustness of results to a range of factors. First, we tested interactive effects of the alcohol and ostracism conditions on the ostracism manipulation checks (i.e., ignored, excluded, and percent throws). None of the alcohol by ostracism interactions were significant (see Supplement Table S2). Second, given that, in this first study, participants were always included on session 1, and excluded on session 2, we wanted to examine the possibility that ostracism effects reported above are simply accounted for by differential mood ratings across the two experimental sessions. Importantly, results examining the effect of session order on responses to the Needs Satisfaction Questionnaire administered immediately post-drink (administered 40 minutes prior to Cyberball) are inconsistent with the notion that ostracism effects reported previously are an artifact of differential mood across the two laboratory sessions (see Table S3). Third, because participants' BrAC levels varied within the alcohol condition and, beyond this, individuals might sometimes experience different levels of subjective intoxication at the same BrAC, we repeated the analyses above first substituting BrAC levels for alcohol condition and then substituting subjective intoxication ratings for alcohol condition. Consistent with the above findings, there were no subjective intoxication by ostracism or BrAC by ostracism interactions (see Table S3). Fourth, although this study was mainly designed to assess the impact of alcohol on "reflexive" (not "reflective") effects of ostracism, we also assessed effects of ostracism after a 60-minute delay. Consistent with models examining immediate ostracism effects, models examining effects after a delay indicated no alcohol by ostracism interaction (see Table S4). Finally, to determine whether our composite mood measure obscured alcohol by ostracism

interaction effects for negative and/or positive mood, we repeated the above analyses examining negative and positive mood separately, as well as controlling for negative mood in positive mood models and vice versa. Consistent with models that examined a composite mood variable, no alcohol by ostracism interaction effects emerged in these additional mood models (see Table S5).

Study 1 Discussion

Results of Study 1 indicated that participants responded nearly identically to the ostracism manipulation when intoxicated vs. when sober, with no detectable differences in ostracism effect size (even given the relative power provided by a within-subjects design). However, findings from this single study may not replicate (Open Science Collaboration, 2015). Further, although the order of beverage manipulation was counterbalanced across groups, the order of ostracism manipulation was not. We therefore conducted a second study, employing a between-subjects design, to address this issue. In addition, Study 2 was designed to broaden our paradigm to extend beyond groups of strangers to encompass familiar groups as well, and further to address several more fine-grained methodological issues, including those associated with the dosing procedure.

Study 2

Methods

Participants: Participants consisted of 144 social drinkers aged 21–28 (M = 22.17 years; SD = 1.78) recruited from the local community (50% female; 44% white, 8% Black, 30% Asian, 6% Hispanic). All participants were required to refer at least two same-gender friends to the study in order to participate. The same exclusions were employed as in Study 1. Average number of drinking days in the past month was 10.58 (SD = 6.13; range 0–30), and average number of standard drinks consumed per occasion was 5.30 (SD = 2.55; range 1–13). Sample size was determined before data analysis.

Measures and Procedures: As in Study 1, the study again employed a 2 [Alcohol Condition: alcohol vs. no-alcohol control] X 2 [Ostracism Condition: ostracized vs. included] factorial design. However, in Study 2, conditions were randomly assigned without replacement at the between-subjects level. More specifically, all participants attended a single extended laboratory session, and exactly equal numbers of participants (N = 36) were randomly assigned to each of the four cells (alcohol/included, alcohol/ostracized, no-alcohol control/included, no-alcohol control/ostracized). The current study provided 80% power to detect a medium effect size (Cohen's f = .24) for the alcohol by ostracism interaction, assuming α = .05.

In an effort to generalize beyond groups of unacquainted individuals, the study was designed such that exactly half (50%) of participants were familiar with the other individuals in their 3-person groups: after completing a phone screen assessing eligibility, and providing at least two friend referrals, participants were assigned to attend the session either with two (eligible) same-gender friends or instead with two same-gender strangers. Procedures were otherwise the same as those employed in Study 1 with three exceptions. First, actual

peak BrAC in Study 1 was slightly lower than our target of .08%. Therefore, in Study 2, we employed adjusted dosing procedures involving individualized body water calculations based on formulas provided by Watson and colleagues (1981). To account for this new dose, we increased the length of the absorption period from the end of drinking to the beginning of Cyberball to approximately 60 minutes. Second, an alternative mood measure, also involving eight items (i.e., cheerful, happy, content, upbeat, sad, irritated, annoyed, bored; α = .83) rated on 1 (*not at all*) to 6 (*extremely*) scales, was used in this study. This measure was selected as one shown to be sensitive to alcohol's effects in prior studies (Fairbairn et al., 2018). A composite mood score was computed by first calculating average scores for each of the four positive and negative items, and then calculating the average of the positive mood subscale and the (inverse of) the negative mood scale. This composite mood score is thus similar to the Need-Threat Mood scale used by Williams and colleagues (Hartgerink et al., 2015; Willams, 2009). Third, in an effort to better capture "reflective" effects, two follow-up Needs Satisfaction and mood questionnaires were administered post-Cyberball—one at approximately 30-minutes and one at 60-minutes post Cyberball. Similar to Study 1, these were standard approximate wait times that applied to both alcohol and no-alcohol control participants. All relevant measures are reported here; a list of all other measures is included in the supplementary material (Table S1).

Data Analysis Plan: Data was analyzed using 2-level mixed models featuring random intercepts accounting for the clustering of individuals within 3-person groups.

Results

Manipulation Check: Participants' BrAC, as measured immediately prior to Cyberball, averaged .078% (*SD* = .012). As in Study 1, this was also the highest value for average BrAC levels across the session. Participants assigned to be ostracized (vs. included) reported that they had been significantly more ignored, $b = 2.44$, 95%*CI* [2.11, 2.78], $p<.001$, and excluded, $b=2.56$, 95%*CI* [2.24, 2.87], $p<.001$, and estimated that they had received a significantly lower proportion of ball tosses, $b = -25.43$, 95%*CI* [−28.10, −22.76], $p<.001$, during the Cyberball game.

Key Hypothesis Tests: Effects of alcohol, ostracism, and their combination on needs satisfaction and mood are displayed in Table 2. Results mirrored those in Study 1. Ostracized (vs. included) participants reported significantly lower mood and lower needs satisfaction across all four domains of the Needs Satisfaction Questionnaire, but there were no main effects of alcohol. Importantly, and in line with results from Study 1, there were no significant interactions between alcohol and ostracism in predicting any of the four needs ratings or mood. More specifically, alcohol and no-alcohol control participants reported significantly lower mood, reduced sense of belongingness, self-esteem, meaningful existence, and control when they were ostracized vs. when they were included. A visual depiction of simple effects is provided in Figure 2.

Supplementary Analyses: We also conducted additional analyses designed to test the robustness of results to a range of factors. First, since the current study examined groups of both strangers and friends, we examined whether the effects of ostracism varied across

levels of familiarity and alcohol. It did not; ostracism led to consistently lower needs satisfaction and mood across strangers and friend groups, with no significant ostracism by familiarity (friends vs. strangers) interactions and no significant three-way interactions between ostracism, alcohol, and familiarity (see Table 3). Second, as in Study 1, we tested for alcohol by ostracism interactions on the ostracism manipulation checks. No significant effects emerged (see Table S6). Third, as in Study 1, we repeated the analyses above substituting subjective intoxication ratings and BrAC levels for alcohol condition (see Table S7). Although significant interactions between both subjective intoxication and ostracism, as well as BrAC and ostracism, emerged in predicting feelings of a meaningful existence,[2] there were otherwise no ostracism by subjective intoxication or ostracism by BrAC level interactions. Fourth, we assessed effects of ostracism after a 30 and a 60-minute delay. Consistent with models examining immediate ostracism effects, models examining effects after both 30 and 60-minute delays indicated no alcohol by ostracism interactions (Table S8). Finally, as in Study 1, we repeated the above analyses examining negative and positive mood separately, as well as controlling for negative mood in positive mood models and vice versa. Consistent with models that examined a composite mood variable, no alcohol by ostracism interaction effects emerged in these additional mood models (see Table S9).

Study 2 Discussion

Study 2 used a between-subjects design and included groups of strangers and friends. Results replicated those of Study 1; participants responded nearly identically to the ostracism manipulation when intoxicated vs. sober, and when with strangers vs. friends. However, Studies 1 and 2 did not include a placebo beverage condition, and thus cannot disentangle pharmacological vs. expectancy effects of alcohol. We therefore conducted a third study, employing a placebo condition. Further, as theory predicts that individuals may enter the “reflective” stage of ostracism response within a matter of minutes (Hales & Williams, 2021), we incorporated a more intermediate follow-up assessment (i.e., 10-min post Cyberball) in order to better assess the impact of alcohol (vs. placebo) on the rapidity of ostracism recovery.

Study 3

Methods

Participants: Participants consisted of 234 heavy social drinkers aged 21–29 (M = 22.40; SD = 1.96) recruited from the local community (62.4% female; 77% white; 6% Black, 11% Asian, 0.5% Native Hawaiian or other Pacific Islander; 5.5% more than one race) taking part in an ongoing study aiming to predict the development of alcohol problems from alcohol’s effects in a laboratory social setting. Inclusion criteria included drinking at least one day per week and binge drinking at least four times in the past month, defined as consuming 5+/4+ drinks (for males/females) during one occasion. Exclusion criteria were similar to Study 1. Average number of drinking days in the past month was 12.81 (SD = 4.93; range 4–30),

[2]Simple ostracism effect for those low in subjective intoxication: b = −8.00, 95%CI [−9.60, −6.40], p<.001. Simple ostracism effect for those high in subjective intoxication: b = −6.43, 95%CI [−7.57, −5.30], p<.001. Simple ostracism effect for those with low BAC: b = −8.34, 95%CI [−10.00, −6.69], p<.001. Simple ostracism effect for those with high BAC: b = −6.10, 95%CI [−7.66, −4.54], p<.001.

and average number of standard drinks consumed per occasion was 4.48 (SD = 1.48; range 0–26). Sample size was determined before data analysis.

Measures and Procedures: This study employed a 2 [Alcohol Condition: alcohol vs. placebo] X 2 [Ostracism Condition: ostracized vs. included] between-subjects design. To satisfy power requirements of the parent project, alcohol (versus placebo) participants were oversampled in a 2.4:1 design, resulting in 165 alcohol participants and 69 placebo participants (randomly assigned). Approximately 48% of alcohol participants and 41% of placebo participants were ostracized (randomly assigned). The current sample provided 80% power to detect a medium effect size (Cohen's f = .27) for the alcohol by ostracism interaction, assuming α = .05.

Procedures were the same as those employed in Study 2 with three exceptions. First, for participants drinking the placebo beverage, the vodka bottle contained flattened tonic water. To increase credibility in the placebo-beverage condition, we smeared participants' glasses with vodka and presented false BrAC readings that ranged from 0.041% to 0.043% (randomly assigned) immediately after drinking (Creswell et al., 2012). A BrAC of 0.043% is the highest credible reading for participants in alcohol studies who have been given placebo beverages (Martin & Sayette, 1993). In the current study, placebo deception was 100% effective; all placebo participants reported a non-zero rating for subjective intoxication after drinking, and all placebo participants estimated that they drank at least 1 oz of vodka at the conclusion of the study. Second, similar to Study 2, Cyberball began at approximately 60 minutes post-drink for all participants and the alternative 8-item mood measure form was used (with 0–100 scales and the same method used in Study 2 to create a composite mood score). Third, to further refine our understanding of "reflective effects", the follow-up needs satisfaction and mood questionnaires were administered at approximately 10-minutes post-Cyberball. All relevant measures are reported here; a list of all other measures is included in the supplementary material (Table S1).

Data Analysis Plan: Data was analyzed using 2-level mixed models featuring random intercepts accounting for the clustering of individuals within 3-person groups.

Results

Manipulation Check: Alcohol participants' BrAC, as measured immediately prior to Cyberball, averaged .068% (SD = .009). As in Studies 1 and 2, this was also the highest value for average BrAC levels across the session. Participants assigned to be ostracized (vs. included) reported that they had been significantly more ignored, b = 2.09, 95%CI [1.82, 2.35], p<.001, and excluded, b = 2.25, 95%CI [1.98, 2.51], p<.001, and estimated that they had received a significantly lower proportion of ball tosses, b = −29.00, 95%CI [−30.48, −27.52], p<.001, during the Cyberball game.

Key Hypothesis Tests: Effects of alcohol, ostracism, and their combination on needs satisfaction and mood are displayed in Table 4. In line with results from Studies 1 and 2, ostracized (vs. included) participants reported significantly lower mood and lower needs satisfaction across all four domains of the Needs Satisfaction Questionnaire, but there were

no main effects of alcohol. Importantly, mirroring results from Studies 1 and 2, there were no significant interactions between alcohol and ostracism in predicting mood, sense of belongingness, meaningful existence, or control. For the measure of self-esteem, there was a tendency for ostracism effects to be larger in the placebo vs. alcohol condition.[3] A visual depiction of simple effects is provided in Figure 3.

Supplementary Analyses: As in Studies 1 and 2, we examined interactive effects of the alcohol and ostracism conditions on ostracism manipulation checks. No significant effects emerged (see Table S10). Similar to Studies 1 and 2, we also repeated the analyses above substituting subjective intoxication ratings and BrAC levels for alcohol condition. No significant interactions between ostracism and subjective intoxication or ostracism and BrAC levels emerged (see Table S11). We also assessed effects of ostracism after a 10-minute delay. Consistent with models examining immediate ostracism effects, models examining effects after a 10-minute delay indicated no alcohol by ostracism interactions (see Table S11). Finally, as in Studies 1 and 2, we repeated the above analyses examining negative and positive mood separately, as well as controlling for negative mood in positive mood models and vice versa. Consistent with models that examined a composite mood variable, no alcohol by ostracism interaction effects emerged in these additional mood models (see Table S12).

Study 3 Discussion

Study 3 used a between-subjects design and included a placebo condition. Results replicated those of Studies 1 and 2; participants responded nearly identically to the ostracism manipulation when intoxicated vs. sober.

Aggregated Analyses—Participant-level data aggregation is possible across Studies 2 and 3, as both used between-subjects designs and random assignment to examine the effect of alcohol (vs. a no-alcohol control or placebo beverage) on ostracism responses. We thus combined the participants from these two studies and re-ran the key analyses using this larger sample size (N=378). Notably, this combined sample provided 80% power to detect a small effect size (Cohen's f=.18) for the alcohol by ostracism interactions, assuming α = .05. Consistent with the results from the individual studies, there were no significant interactions between alcohol and ostracism in predicting any of the four needs ratings or mood (see Table S13).

All three studies included here examined the same overarching research question. Thus, in a final analysis, we aggregated effect sizes across the three studies. Specifically, for each outcome we calculated Cohen's d scores representing the effect of ostracism vs. inclusion within both alcohol and no-alcohol (i.e., control and placebo) conditions. Effects were coded such that negative Cohen's d values represented lower mood and lower needs-satisfaction among ostracized vs. included participants, and positive values represented the inverse. We performed random effects meta-analysis and, in line with recommendations by Lakens (2017), calculated 90% confidence intervals for each aggregated effect. Within both alcohol,

[3]Simple ostracism effect within the alcohol condition: b = −4.60, 95%CI [−6.08, −3.12], p<.001. Simple ostracism effect within the placebo condition: b = −6.97, 95%CI [−8.73, −5.20], p<.001 (see Figure 3).

d = −1.71, 90%CI [−2.06, −1.36], and no-alcohol conditions, d = −1.88, 90%CI [−2.16, −1.60], effect sizes for ostracism were large in magnitude with overlapping confidence intervals. When effects were subdivided according to specific outcome (i.e., the mood and needs satisfaction subscales), effect sizes for ostracism were consistently large in magnitude across alcohol and no-alcohol conditions (see Table S14).

General Discussion

Williams's need-threat model (2009) proposes that ostracism responses are reflexive and difficult to diminish because of their evolutionary significance. Despite dozens of studies designed to mitigate reflexive ostracism responses from Cyberball (e.g., Gonsalkorale & Williams, 2006; van Beest & Williams, 2006), we are unaware of one manipulation that has successfully decreased self-reported pain from being excluded, providing support for Williams' theory. However, no prior studies have used well-powered randomized research to examine the impact of an intoxicating dose of alcohol on response to ostracism. We provide results for three such studies here. In line with the appraisal-disruption model, which proposes that an intoxicating dose of alcohol will dampen subsequent responses to stress by disrupting the cognitive appraisal and processing of such stressors (Sayette, 1993), and given prior research pointing to the power of alcohol to relieve distress in some social contexts (Fairbairn & Testa, 2017; Yankofsky et al., 1986), we hypothesized that alcohol consumption would dampen, and potentially eliminate, distress due to ostracism. Importantly, the dose of alcohol administered across these three studies was sufficient to cause significant impairment across a range of domains, including reasoning, perception, and appraisal processes (Calhoun et al., 2004; Curtin & Fairchild, 2003; Kirchner & Sayette, 2003; Sayette, 1993) and, contrary to prior studies, our sample sizes provided power to detect small to medium sized effects of alcohol on ostracism.

Despite these methodological strengths, our hypothesis was not supported. In results that emerged as remarkably consistent across three large independent samples employing both between- and within-between subject designs, as well as both control and placebo conditions, findings indicated strong and consistent effects of ostracism on needs satisfaction and mood among both intoxicated and sober participants. Results were similar when examining both BrAC levels and subjective intoxication ratings, and findings held when aggregating results across studies. Thus, the ostracism experience appears to have been sufficiently potent to cut through any alcohol-related fogginess and lead to distress.

Our findings provide compelling evidence for Williams's need-threat model (2009), indicating that ostracism responses are automatic and seemingly immune to mitigation given their evolutionary significance, even when individuals are under the influence of alcohol. In contrast, our results are inconsistent with both the appraisal-disruption model of alcohol and stress (Sayette, 1993) and prior research indicating alcohol's ability to relieve some social stress (e.g., Fairbairn & Testa, 2017; Sayette et al., 1992), including one prior correlational study that showed that subjective intoxication ratings (but not BrAC levels) were associated with higher positive affect (significantly) and needs satisfaction (marginally) after being ostracized (Hale et al., 2015). Given the small sample size and correlational design of that study, however, results should be interpreted with caution. The current methodologically

strong studies suggest that alcohol is unable to mitigate the immediate painful effects of being ostracized, demonstrating potential boundary conditions for alcohol's effects on stress.

It is noteworthy that alcohol also did not impact the reflective stage of ostracism response in any of the three studies. Theory predicts that individuals may enter the reflective stage of ostracism response within a matter of minutes of being ostracized (Hales & Williams, 2021). We assessed reflective responses at 10-, 30-, and 60-minutes post Cyberball in the current studies, all of which are within the window of when ostracized individuals are still recovering (Buelow, Okdie, Brunell, & Trost, 2015). Williams (2009) argues the reflective stage, as individuals recover from being ostracized, may be more amenable to moderation by individual differences and situational factors than the reflexive stage. For example, studies demonstrate moderation of reflective stage effects by personality traits (e.g., social anxiety; Zadro et al., 2006) and situational factors (e.g., group membership; Wirth & Williams, 2009). In contrast to these studies, though, the current results suggest that alcohol did not impact the rapidity of ostracism recovery, even when assessments were taken across three time points of the reflective stage.

Results are also interesting to consider in light of the recent social-attributional model of alcohol response (Fairbairn & Sayette, 2014). Although the social-attributional model was intended to explain alcohol's effects within the context of live (face-to-face) interaction, and so this model did not directly inform our original hypotheses concerning this virtual exclusion paradigm, the model may nonetheless be informative to consider given its potential relevance for understanding alcohol's broad social effects. In particular, the social-attributional model posits that, contrary to conventional wisdom, alcohol consumption will not in fact enhance mood and experience across all social settings (Fairbairn & Sayette, 2014). Instead, it proposes that alcohol will enhance mood in social contexts where negative interpersonal outcomes, such as rejection or exclusion, are perceived to be directly relevant to the self or to vary in an unpredictable manner. Although ostracism experiences do appear to have down-stream consequences for self-esteem, studies indicate that distress experienced in response to ostracism is not explained by the perceived self-relevance of exclusion (e.g., ostracism is still painful even when it is delivered by a computer; Zadro, Williams, & Richardson, 2004). Thus, in light of prior research indicating that perceptions of self-relevance tend not to mitigate immediate ostracism responses, results of this study are generally consistent with the social-attributional model. Future research might combine alcohol-administration manipulations with paradigms in which the level of predictability and self-relevance of ostracism experiences are systematically varied.

Additional directions for future research should be noted. As alcohol's primary effects tend to be in the domain of cognition, it would be interesting to examine the extent to which alcohol impacts ostracism response where the task of perceiving ostracism is more or less difficult (e.g., some ostracism cues, such as reduced eye contact, may be more subtle than others; Wirth, Sacco, Hugenberg, & Williams, 2010). Further, the current research was intended to assess alcohol's effects at the time of peak BrAC. Although pronounced alcohol effects do certainly emerge at the peak of the BrAC curve, some of alcohol's most marked stimulative effects occur at earlier points of the drinking episode, while BrAC is steeply ascending (Sayette et al., 2012). Future research might explore alcohol's impact

on ostracism response across various positions on the BrAC curve, including while BrAC is ascending. It's also worth noting that, although the dose of alcohol administered in the current study is certainly a substantial one by most standards, in the realm of alcohol-administration research, this dose is in fact considered "moderate" (Sayette et al., 2012). Some alcohol-administration studies have administered more extreme doses—and certainly some individuals drink at more extreme levels outside the lab (Creswell et al., 2020; Hingson, Zha, & White, 2017)—and so future research might explore the generalizability of our findings across higher alcohol doses. Finally, it will be important to test whether other drugs are able to dull the pain of social exclusion in the context of Cyberball. For example, participants who reported relatively more frequent marijuana use also reported decreased amounts of threatened needs after being excluded in Cyberball compared to those who reported relatively less frequent marijuana use (Deckman, DeWall, Way, Gilman, & Richman, 2014). Further, participants who were randomly assigned to take a daily dose of acetaminophen for three weeks prior to playing Cyberball exhibited reduced brain activity in regions associated with social pain (i.e., the dorsal anterior cingulate cortex and anterior insula) when excluded, although they did not report lower levels of distress in response to exclusion (DeWall, MacDonald, Webster, Masten, Baumeister, Powell et al., 2010). It will be interesting to see which, if any, drugs are able to dull the pain of social exclusion, and at what dosage such effects occur.

In sum, Williams proposes that responses to ostracism are driven by automatic or reflexive processes that are difficult to mitigate. In line with this theory, prior studies indicate that individuals experience ostracism-related distress across a range of circumstances that might be reasonably expected to eliminate it. In the first well-powered randomized studies, the current research adds drunkenness to this list. An intoxicating dose of alcohol was not able to provide protection against the pain of exclusion. In more general terms, the current research further builds our theoretical understanding of ostracism, as well as suggesting boundary conditions for alcohol's ability to relieve stress.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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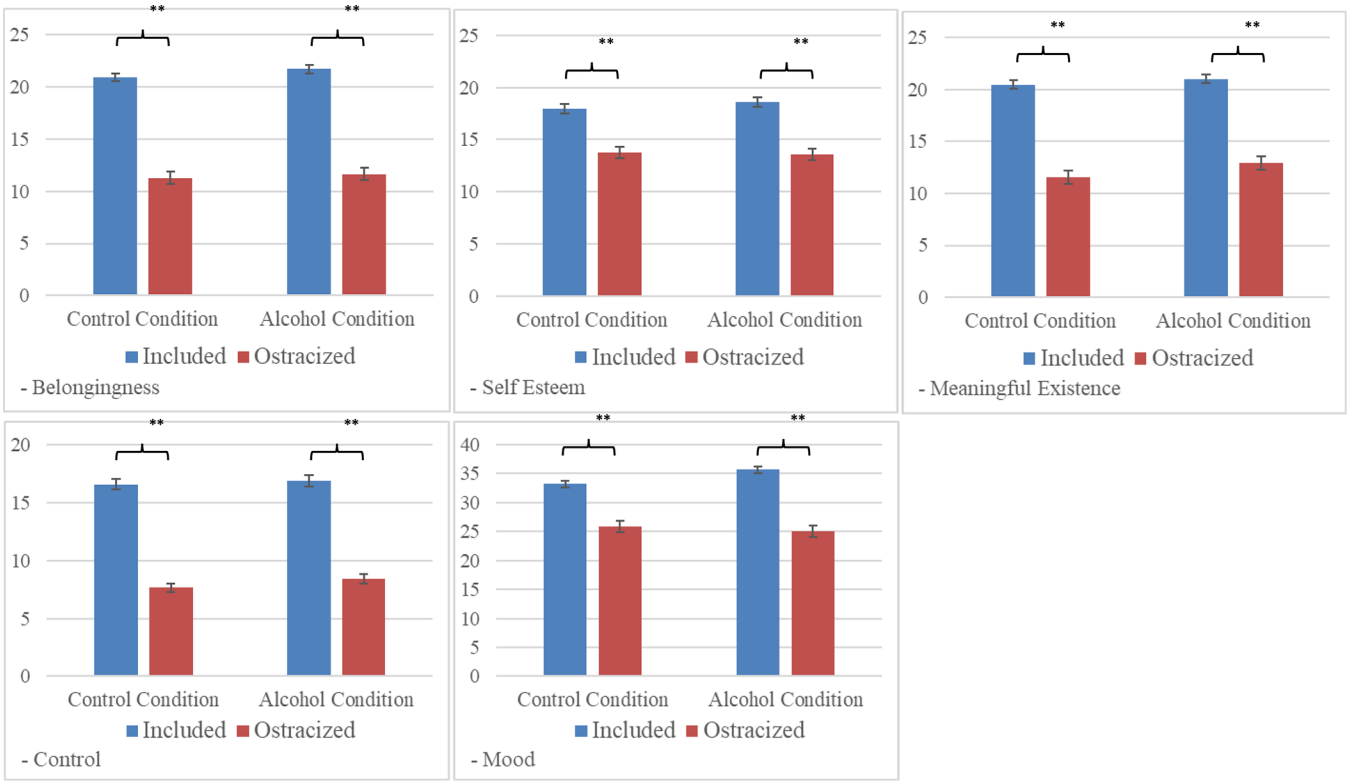

Figure 1.

Effect of alcohol and ostracism on needs satisfaction and mood in Study 1. Bars reflect standard errors.

** $p < .001$

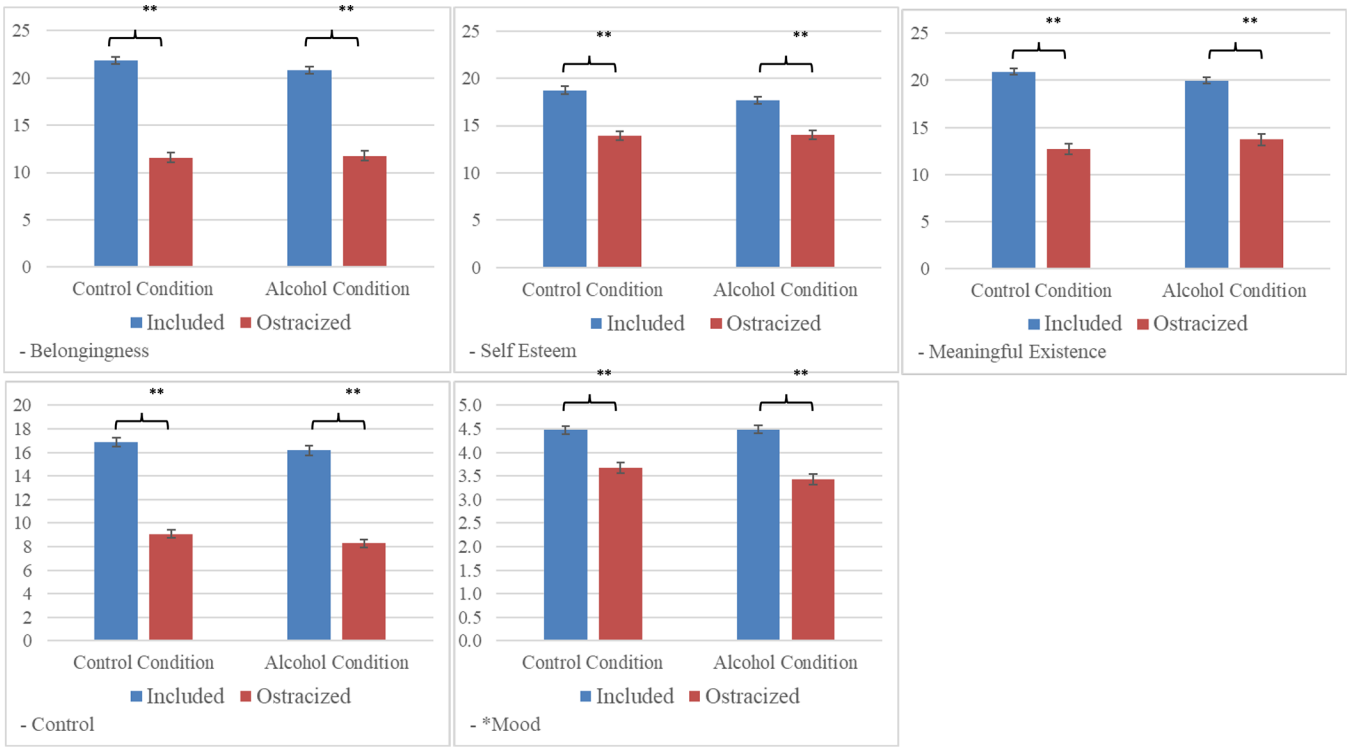

Figure 2.

Effect of alcohol and ostracism on needs satisfaction and mood in Study 2. Bars reflect standard errors.

* In Study 2, mood was measured using an 8-item mood inventory.

** $p < .001$

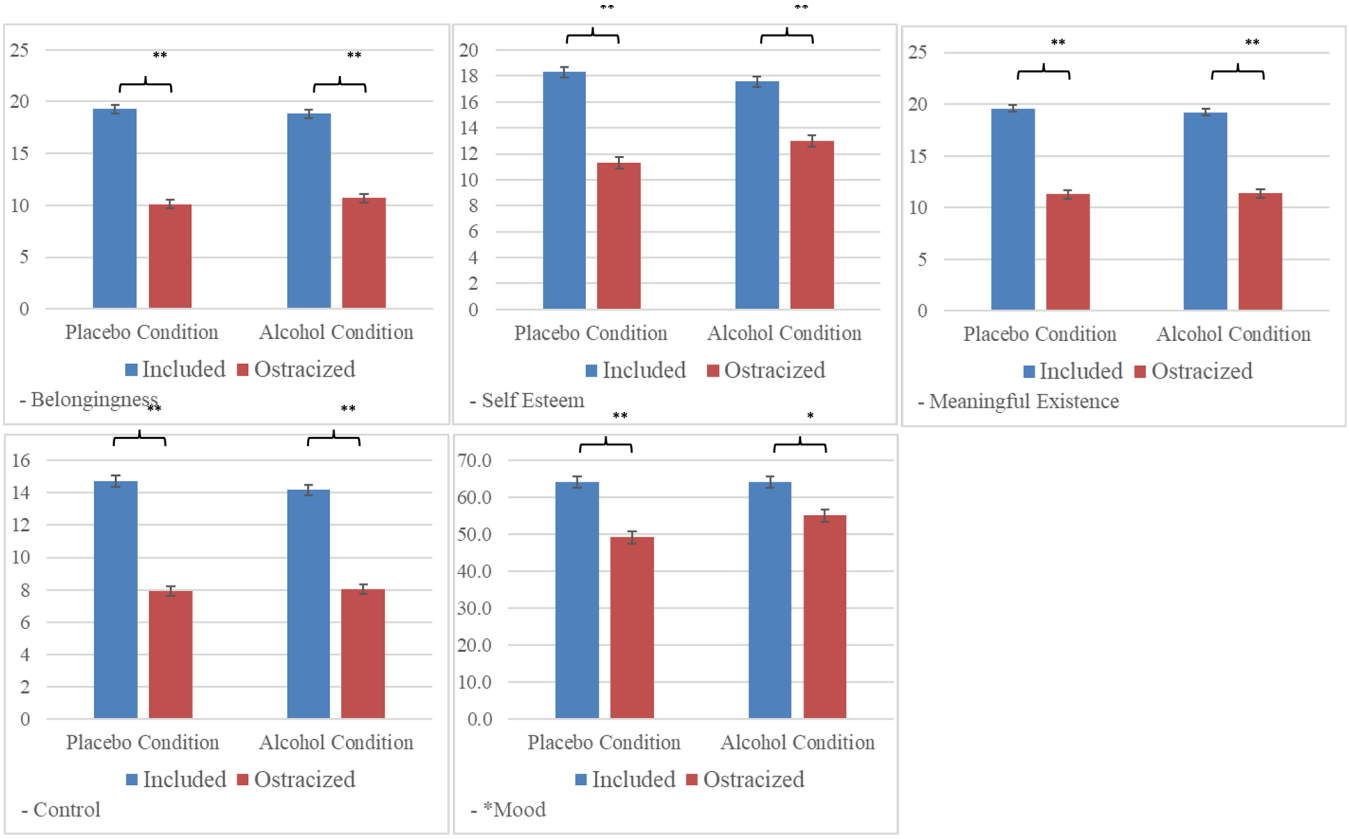

Figure 3.

Effect of alcohol and ostracism on needs satisfaction and mood in Study 3. Bars reflect standard errors.

* In Study 3, mood was measured using an 8-item mood inventory.

** $p < .001$ * $p < .01$

Table 1.

Needs Satisfaction Questionnaire and Mood as a Function of Ostracism and Alcohol Condition in Study 1

	Alcohol Conditions			**Ostracism Conditions**			**Alcohol X Ostracism**
	Alcohol *M* (*SD*)	**Control *M* (*SD*)**	**Main Effect Alcohol**	**Included *M* (*SD*)**	**Ostracized *M* (*SD*)**	**Main Effect Ostracism**	**Interaction**
Belongingness	16.7 (6.2)	16.1 (6.4)	b= 0.58, 95%CI [−0.86, 2.02], p=.424	21.3 (3.1)	11.5 (4.6)	b= −9.85, 95%CI [− 11.29, −8.41], p<.001	b=−.43, 95%CI [− 3.82, 2.95], p=.800
Self Esteem	16.1 (4.5)	15.9 (4.5)	b= 0.25, 95%CI [−1.01, 1.51], p=.695	18.3 (3.6)	13.7 (4.1)	b= −4.58, 95%CI [− 5.84, −3.32], p<.001	b=−.83, 95%CI [− 4.43, 2.76], p=.647
Meaningful Existence	17.0 (5.4)	16.0 (6.3)	b= 0.97, 95%CI [−0.19, 2.12], p=.100	20.7 (3.1)	12.2 (4.8)	b= −8.50, 95%CI [− 9.66, −7.34], p<.001	b=.87, 95%CI [−2.34, 4.07], p=.593
Control	12.6 (5.2)	12.1 (5.8)	b= 0.53, 95%CI [−0.53, 1.60], p=.322	16.7 (3.6)	8.0 (3.0)	b= −8.70, 95%CI [− 9.76, −7.64], p<.001	b=.47, 95%CI [−2.34, 3.27], p=.742
Mood	30.4 (8.0)	29.5 (7.6)	b= 0.83, 95%CI [−1.08, 2.74], p=.388	34.4 (4.5)	25.5 (7.9)	b= −8.97, 95%CI [− 10.88, −7.06], p<.001	b=−3.40, 95%CI [− 9.14, 2.34], p=.243
Control	12.6 (5.2)	12.1 (5.8)	b= 0.53, 95%CI [−0.53, 1.60], p=.322	16.7 (3.6)	8.0 (3.0)	b= −8.70, 95%CI [− 9.76, −7.64], p<.001	b=.47, 95%CI [−2.34, 3.27], p=.742
Mood	30.4 (8.0)	29.5 (7.6)	b= 0.83, 95%CI [−1.08, 2.74], p=.388	34.4 (4.5)	25.5 (7.9)	b= −8.97, 95%CI [− 10.88, −7.06], p<.001	b=−3.40, 95%CI [− 9.14, 2.34], p=.243
Control	12.6 (5.2)	12.1 (5.8)	b= 0.53, 95%CI [−0.53, 1.60], p=.322	16.7 (3.6)	8.0 (3.0)	b= −8.70, 95%CI [− 9.76, −7.64], p<.001	b=.47, 95%CI [−2.34, 3.27], p=.742
Mood	30.4 (8.0)	29.5 (7.6)	b= 0.83, 95%CI [−1.08, 2.74], p=.388	34.4 (4.5)	25.5 (7.9)	b= −8.97, 95%CI [− 10.88, −7.06], p<.001	b=−3.40, 95%CI [− 9.14, 2.34], p=.243

Note. Scores were summed for each subscale of the Needs Satisfaction Questionnaire. Statistics for main effects and interactions were derived from 3-level mixed models accounting for clustering of observations within individuals and 3-person groups.

Table 2.

Needs Satisfaction Questionnaire and Mood as a Function of Ostracism and Alcohol Condition in Study 2

	Alcohol Conditions			Ostracism Conditions			Alcohol X Ostracism
	Alcohol *M* (*SD*)	**Control *M* (*SD*)**	**Main Effect Alcohol**	**Included *M* (*SD*)**	**Ostracized *M* (*SD*)**	**Main Effect Ostracism**	**Interaction**
Belongingness	16.3 (6.3)	16.7 (6.2)	*b*= −0.43, 95%*CI*[−1.61, 0.75], *p*=.467	21.4 (3.1)	11.7 (4.6)	*b*= −9.68, 95%*CI*[− 10.86, −8.50,], *p*<.001	*b*=1.25, 95%*CI*[− 1.09, 3.59], *p*=.287
Self Esteem	15.8 (4.0)	16.3 (4.4)	*b*=−0.50, 95%*CI*[−1.59, 0.59], *p*=.362	18.2 (3.3)	14.0 (3.9)	*b*= −4.25, 95%*CI*[−5.34, −3.16], *p*<.001	*b*=1.17, 95%*CI*[− 0.99, 3.33], *p*=.283
Meaningful Existence	16.8 (5.3)	16.8 (5.4)	*b*=0.00, 95%*CI*[−1.20, 1.20], *p*=1.000	20.4 (2.7)	13.2 (4.8)	*b*=−7.22, 95%*CI*[−8.42, −6.03], *p*<.001	*b*=1.89, 95%*CI*[− 0.44, 4.22], *p*=.109
Control	12.2 (4.8)	13.0 (5.1)	*b*= −0.75, 95%*CI*[−1.68, 0.18], *p*=.110	16.5 (3.3)	8.7 (2.7)	*b*=−7.83, 95%*CI*[−8.76, −6.91], *p*<.001	*b*=−0.11, 95%*CI*[− 1.97, 1.74], *p*=.905
Mood *	4.0 (1.1)	4.1 (0.8)	*b*= −0.12, 95%*CI*[−0.38, 0.14], *p*=.360	4.5 (0.7)	3.6 (0.9)	*b* −0.93, 95%*CI*[−1.19, 0.66], *p*<.001	*b*=−0.25, 95%*CI*[− 0.76, 0.27], *p*=.342

Note.

* In Study 2, mood was measured using an 8-item mood inventory. Reported statistics for main effects and interactions were derived from 2-level mixed models accounting for clustering within 3-person groups.

Table 3.

Needs Satisfaction Questionnaire and Mood as a Function of Ostracism and Familiarity Condition in Study 2

Belongingness	***b***	**95% *CI***		***p***
Intercept	21.19	20.35	22.04	<.001
Ostracism	−9.81	−11.28	−8.33	<.001
Friends	0.33	−1.10	1.77	0.642
Ostracism*Friends	0.25	−2.11	2.61	0.832
Self-Esteem				
Intercept	17.75	16.71	18.79	<.001
Ostracism	−3.50	−5.08	−1.92	<.001
Friends	0.92	−0.60	2.44	0.230
Ostracism*Friends	−1.50	−3.66	0.66	0.169
Meaningful Existence				
Intercept	20.11	19.39	20.83	<.001
Ostracism	−6.44	−8.26	−4.63	<.001
Friends	0.67	−0.40	1.73	0.213
Ostracism*Friends	−1.56	−3.91	0.79	0.189
Control				
Intercept	16.28	15.29	17.26	<.001
Ostracism	−7.44	−8.76	−6.13	<.001
Friends	0.47	−1.05	1.99	0.534
Intercept	16.28	15.29	17.26	<.001
Ostracism	−7.44	−8.76	−6.13	<.001
Friends	0.47	−1.05	1.99	0.534
Ostracism*Friends	−0.78	−2.67	1.11	0.412
*Mood				
Intercept	3.45	3.26	3.65	<.001
Ostracism	−0.93	−1.29	−0.58	<.001
Friends	0.05	−0.33	0.43	0.784
Ostracism*Friends	0.02	−0.51	0.54	0.947

Note. *CI*=Confidence Interval; Ostracism=Coded 1 if ostracism condition and 0 if inclusion condition; Friends=Coded 1 for friend groups and 0 for stranger groups; Mood was measured using an 8-item mood inventory.

Table 4.

Needs Satisfaction Questionnaire and Mood as a Function of Ostracism and Alcohol Condition in Study 3

	Alcohol Conditions			Ostracism Conditions			Alcohol X Ostracism
	Alcohol *M* (*SD*)	**Placebo *M* (*SD*)**	**Main Effect Alcohol**	**Included *M* (*SD*)**	**Ostracized *M* (*SD*)**	**Main Effect Ostracism**	**Interaction**
Belongingness	14.9 (5.8)	15.6 (6.2)	*b*= −0.01, 95%*CI* [− 1.19, 1.16], *p*=.984	19.0 (4.2)	10.5 (4.2)	*b*=−8.42, 95%*CI* [− 9.54, −7.31], *p*<.001	*b*=1.04, 95%*CI* [−1.37, 3.44], *p*=.396
Self Esteem	15.3 (5.0)	15.5 (5.3)	*b*= 0.29, 95%*CI* [− 0.92, 1.50], *p*=.629	17.8 (4.4)	12.5 (4.4)	*B*=−5.30, 95%*CI* [− 6.50, −4.11], *p*<.001	*b*=2.36, 95%*CI* [0.06, 4.67], *p*=.044
Meaningful Existence	15.4 (5.7)	16.2 (5.6)	*b*= −0.18, 95%*CI* [− 1.21, 0.85], *p*=.729	19.3 (3.6)	11.3 (4.4)	*b*= −8.00, 95%*CI* [− 9.12, −6.87], *p*<.001	*b*=0.43, 95%*CI* [−1.79, 2.64], *p*=.704
Control	11.2 (4.7)	12.0 (4.7)	*b*= −0.27, 95%*CI* [− 1.12, 0.59], *p*=.540	14.4 (3.8)	8.0 (2.9)	*b*= −6.32, 95%*CI* [− 7.23, −5.41], *p*<.001	*b*=0.68, 95%*CI* [−1.18, 2.53], *p*=.472
Mood *	59.8 (18.3)	58.1 (16.6)	*b*= 2.56, 95%*CI* [− 2.35, 7.46], *p*=.303	64.2 (16.5)	53.6 (17.5)	*b*= −10.87, 95%*CI* [− 15.23, −6.50], *p*<.001	*b*=5.06, 95%*CI* [−2.33, 12.45], *p*=.178

Note.

* In Study 3, mood was measured using an 8-item mood inventory. Reported statistics for main effects and interactions were derived from 2-level mixed models accounting for clustering within 3-person groups.