A Dynamic Analysis of the Effects of Alcohol on Perceptions of Physical Attractiveness

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Background and Significance. Perception of physical attractiveness (PPA) is a fundamental aspect of human relationships and a promising factor to study to understand both alcohol's rewarding and harmful effects. Yet PPA is rarely studied in relation to alcohol, and when it is tested, approaches are often sub-optimal. The present study applied psychological theories and methods not previously used in alcohol research to test a variety of questions central to understanding alcohol's effects on PPA. **Methods.** Dyads of platonic same-gender friends (n = 36) attended two lab sessions, wherein their drink conditions (alcohol vs. no-alcohol control) were randomized by dyad and counter-balanced across sessions. After consuming a portion of their beverages together, subjects completed a PPA task using a Likert scale. **Results.** While alcohol enhanced positive ($\beta = 0.26$, $p < .001$) and decreased negative ($\beta = -0.10$, $p < .001$) mood, there was no effect of perceiver ($\beta = -0.04$, $p = .69$) or target ($\beta = 0.03$, $p = .78$) drink condition on PPA. There were significant interaction effects between orientation-match (whether targets were of the gender to which the perceiver was sexually oriented) and both perceiver- ($\beta = 0.07$, $p < .001$) and target-drink condition ($\beta = 0.05$, $p < .001$), respectively, on PPA. There were not moderating effects of stimulus format (i.e., smiling vs. neutral expression faces, dynamic vs. static images) or sexual-desire alcohol expectancies on the alcohol-PPA relation. **Conclusion.** This study sought to examine the impact of alcohol on PPA and identify factors that might moderate this potential effect. Methodological constraints may have hampered observation of anticipated effects. Future research incorporating more naturalistic methods including studies that enable participants and

targets to interact may clarify the role of PPA in alcohol’s hazardous and socially rewarding effects.

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Preface

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1.0 Introduction

Alcohol consumption occurs across cultures and has persisted for centuries (Mandelbaum, 1965). Researchers have long sought to identify the processes through which alcohol is rewarding in order to better understand factors that promote and maintain problematic drinking. A similarly foundational task has been to explore the mechanisms through which alcohol use leads to negative psychosocial consequences. Certainly, the pathways to alcohol's prized and dangerous effects are often one in the same (Steele & Josephs, 1990). Scientific efforts to elucidate alcohol's rewarding and harmful effects have largely been limited to assessment of the effect of alcohol consumption on positive and negative affect (Sayette, 2017). While alcohol's capacity to enhance positive emotion and alleviate negative emotion may help to explain both alcohol's appeal and its harmful effects, there likely are other psychosocial processes relevant to drinking experiences that warrant investigation. Because alcohol is regularly consumed across a variety of social contexts (Fairbairn & Sayette, 2014), analysis of alcohol's relation to social factors encompassed by typical drinking experiences is essential to fully understanding why people drink and why drinking can have hazardous results.

A recent report highlighted that across eight alcohol reviews published in *Psychological Bulletin* since 1980, less than 5% of studies considered alcohol and its effects in social context (Fairbairn & Sayette, 2014). Even research examining the effects of alcohol on *social* anxiety has tended to test participants in isolation (e.g., Sayette & Wilson, 1991; Steele & Josephs, 1988). Notably, Pliner and Cappell (1974) found that participants who consumed alcohol in a social setting reported greater feelings of sociability and positive emotionality (e.g., friendlier, less unhappy) than did their control-beverage-consuming counterparts – a finding that did not hold when participants consumed beverages in isolation. Rather, participants who consumed alcohol in isolation reported greater physiological effects (e.g., feeling dizzier) than did those in the control condition. These findings underpin the notion that ignoring social context limits the ways in which researchers can observe and test the effects of alcohol that likely influence typical drinking occasions. Indeed, the dearth of alcohol research that incorporates social context and assesses social processes is all the more surprising in light of these findings.

Among the limited alcohol research that has incorporated social context, findings suggest that alcohol can enhance social experiences. For example, alcohol has been found to facilitate group bonding (Kirchner et al., 2006; Sayette et al., 2012), increase self-reported elation (Smith et al., 1975), and increase communication (Lindfors & Lindman, 1987). Nonetheless, extant investigations have only begun to uncover the multifaceted impact of alcohol on social experiences. Further research that identifies understudied aspects of social drinking experiences and employs novel approaches to assess these features is needed to more fully understand alcohol's effects. To begin to address this gap in the literature, I propose perception of physical attractiveness (PPA) as a key candidate for analysis of alcohol's rewarding and harmful effects, due to its inextricable influence on most social interactions.

1.1 Why study the effect of alcohol on PPA?

1.2 Significance of physical attractiveness

Perceiving others (person perception) is an integral aspect of psychosocial experience, and physical appearance is one of the most important aspects of perceiving others, as it is often the first available cue from which inferences about others can be drawn (Naumann, Vazire, Rentfrow,

& Gosling, 2009; Zebrowitz & Montepare, 2008). There is a general belief that physical appearance is indicative of internal qualities (e.g., personality) of the person being perceived (who from this point forward will be referred to as the "target") (Hassin & Trope, 2000), meaning that individuals take appearance to be much more than just skin deep. The face in particular conveys vast information that serves as the basis for many types of social judgments (Todorov, Mende-Siedlecki, & Dotsch, 2013) and it is considered to be the feature of physical appearance that has greatest influence on social interactions (Alley, 1988). There is a burgeoning literature on face-based person perception, within which attractiveness is the facet of physical appearance that has garnered most attention (Zebrowitz & Montepare, 2008).

Physical attractiveness is an extremely powerful psychological variable (Berscheid, 1980). Generally, physical attractiveness is preferred over unattractiveness (Berscheid, 1980) and such preference impacts social behaviors and psychological experiences alike (Rumsey & Harcourt, 2014). Physical attractiveness begins to influence individuals' perceptions of, and interactions with, their social worlds at infancy, with a preference for spending time with attractive peers developing in young childhood (Hoss & Langlois, 2003). Certainly, the impact of physical attractiveness on social experience continues into adolescence and adulthood (Adams & Huston, 1975; Alterovitz & Mendelsohn, 2009; Lerner et al., 1991; Smolak, 2012). A phenomenon termed the "attractiveness halo effect" refers to the tendency to judge attractive faces more positively, wherein superiority in non-physical qualities (e.g., intelligence, health, social competence) is attributed to those who are more attractive and preferential treatment is given to those individuals (Zebrowitz & Montepare, 2008). This differential treatment manifests across diverse contexts (e.g., romantic partner selection, criminal justice system, psychotherapeutic relationships, political elections) and cultures (Dion, 2002; Downs & Lyons, 1991; Schofield, 1986; Todorov, 2005; Walster, Aronson, Abrahams, & Rottman, 1966).

Importantly, the notion that "attractiveness is good" (Dion, Berscheid, & Walster, 1972) is not always evident. Exposure to attractive others can adversely affect self-esteem and public self-consciousness (Thornton & Moore, 1993). Attractiveness can also promote risky behavior, as individuals place more emphasis on physical attractiveness than on relevant risk cues when determining sexual behavior intentions (Agocha & Cooper, 1999; Lennon & Kenny, 2013). Indeed, attractiveness stimulates a myriad of positive and negative social experiences. Because alcohol may alter PPA, investigation of these positive and negative experiences promoted by PPA may contribute to a more complete understanding of alcohol's rewarding and harmful effects.

1.3 The alcohol-PPA association

Inasmuch as alcohol is regularly consumed in social contexts and physical attractiveness exerts a powerful influence on our social lives, the effect of alcohol on PPA is likely to play a considerable role in typical drinking experiences. While individual studies on the alcohol-PPA relationship to date have been sparse and their findings inconsistent, a recent systematic review of the literature established a small, significant alcohol-PPA association (Bowdring & Sayette, 2018). Individuals who had consumed alcohol reported higher ratings of others' physical attractiveness than did individuals who had not consumed alcohol, though the significance of this effect appeared to be limited to opposite-sex PPA (i.e., when perceivers and targets were of different sexes: male-female, female-male). Due to the small number of studies contributing to analyses in this review (k = 16 for overall, k = 12 for opposite-sex, and k = 7 for same-sex PPA), caution is warranted in interpreting these findings. Nonetheless, quantitative synthesis of data currently available in the literature offers support for a positive alcohol-PPA association. Importantly, the small magnitude of the observed association may have been dampened by suboptimally designed studies (e.g., use of static stimuli with neutral expressions, variable intoxication levels of perceivers). Additional research on this topic with improved methodologies is needed to better understand the role of PPA in drinking experiences.

1.4 Potential implications

Alcohol's ostensible facilitation of increased PPA has implications for clinicians and researchers alike, as this effect may contribute in multiple ways to the rewarding, yet potentially addictive nature of the drug (Parker et al., 2008). If perceiving interaction partners as attractive enhances social experiences (Snyder et al., 1977), alcohol's effect on PPA may lead individuals to derive more reward from social interactions while intoxicated. This may, in turn, reinforce alcohol use. Moreover, people prefer to initiate relationships (both platonic and romantic) with attractive, as compared to unattractive, others (Garcia et al., 1991; Lemay et al., 2010; Walster et al., 1966; Wang et al., 2010). Thus, alcohol-enhanced PPA may facilitate relationship initiation and contribute to the enhanced social bonding that occurs during drinking occasions (Sayette et al., 2012). Taken together, the alcohol-PPA association may foster a drinker's ability to achieve the fundamental social need of belongingness (Baumeister & Leary, 1995), and thereby crucially contribute to the rewarding and reinforcing nature of drinking experiences.

Alcohol-enhanced PPA may also shed light on processes underlying the major public health concern of risky sexual behavior. Alcohol's significant relation to opposite-sex attractiveness (inasmuch as it represents PPA of individuals who are of the sex to which the perceiver is sexually oriented) in particular should be of great relevance to public health professionals. Positive associations between alcohol intoxication and risky sex (intentions and behaviors) have consistently been demonstrated (Cooper, 2002; Corbin & Fromme, 2002; Davis et al., 2009; Rehm et al., 2012) and, notably, risky sexual practices are more likely when potential partners are perceived as attractive (Agocha & Cooper, 1999; Eleftheriou et al., 2016; Hennessy et al., 2007). Thus, it is possible that enhanced PPA mediates the relationship between alcohol intoxication and willingness to engage in risky sex.

It is widely held that alcohol consumption can yield both desirable and undesirable social consequences, yet further research is needed to establish the impact of these outcomes on drinking behavior and the development of alcohol use disorders (Graham, 2003). Indeed, alcohol-enhanced PPA may facilitate short-term social benefits as well as long-term personal detriments (by contributing to problem drinking and risky sexual practices). In order to realize the true magnitude of alcohol's effect on PPA and fully appreciate its impact, improved methodological approaches need be implemented in light of relevant theory.

1.5 Theoretical and methodological considerations in the study of alcohol and PPA

While research to date has offered support for a small, positive association between alcohol and PPA, previous studies have largely been atheoretical. Relatedly, their methods have seemingly fallen short of capturing the richness of PPA processes that likely accompany naturalistic drinking experiences. It may be that the contrived conditions under which participants have rated PPA in past studies have reduced the potential to observe alcohol's true effect on the PPA process. Though not exhaustive, the following section intends to outline initial theoretical considerations that highlight limitations of extant research on this topic and inform advances in methodological approaches, which were implemented in the present study. Specifically, I consider the ecological approach to person perception (Zebrowitz & Montepare, 2006), alcohol expectancy theories (e.g., Jones, Corbin, & Fromme, 2001), and feelings-as-information theory (Schwarz, 2012).

1.6 Under what conditions, for whom, and how might alcohol enhance PPA?

The *ecological approach to person perception* has been utilized to understand the impact of motivational factors on PPA (Zebrowitz, 2011). The ecological approach's claim that "perceiving is for doing" emphasizes that perception is a functional process that facilitates attainment of affordances (i.e., qualities or abilities of the target that will benefit the perceiver) (Zebrowitz, 2011). This framework pertains to alcohol's effects on PPA, particularly when considered in tandem with alcohol expectancy theories. Consistent with general processes of person perception, PPA is largely driven by behavioral affordances (e.g., potential relationships) conveyed by targets and the expectancies perceivers have about achieving them (Keating, 2002). Thus, the degree to which the attractiveness perception process enables detection of affordances conveyed by faces is likely to influence PPA. Importantly, display of affordances is greater among dynamic targets (e.g., those exhibiting facial movement, emotional expression) and those with whom the perceiver has potential to interact (Zebrowitz & Montepare, 2006). Moreover, dynamic, expressive images induce higher emotional arousal among perceivers than do static, expressive images (Wieser & Brosch, 2012). Yet most studies on the alcohol-PPA relation have instructed subjects to rate static images of neutral faces of targets with whom they would never interact

(Bowdring & Sayette, 2018). This traditional approach may have limited perceiver detection of and motivation to attain affordances, thereby reducing the potential for alcohol to affect the perception process.

Particularly relevant to alcohol's effect on PPA is that individual perceivers have unique attunements to target affordances (i.e., perceivers are sensitive to different aspects of stimulus information) (Bowdring et al., invited resubmission; Zebrowitz & Montepare, 2006) and that social goals and expectancies about targets alter perceiver attunements (Keating, 2002). *Alcohol expectancy theories* emphasize that many people hold beliefs that drinking enhances sexual desire and sexual experiences (Brown et al., 1987), which can alter how they interact with their social environments (Leigh, 1990). When these expectancies are activated by alcohol consumption or alcohol cues, individuals should be more attuned to social affordances (e.g., potential sexual relations) offered by targets and perceive targets as being more attractive. For instance, priming sober males with alcohol-related words prior to a PPA task increases PPA ratings of opposite-sex targets for perceivers with strong sexual-desire alcohol expectancies (Friedman et al., 2005). Therefore, sexual expectancies are motivation-relevant factors that ought to enhance PPA among individuals consuming alcohol, though the magnitude of their influence may vary with target presentation format (e.g., static images vs. dynamic images) and concordance between target-gender and perceiver sexual orientation.

Perception processes likely differ according to whether targets are of the gender that the perceiver romantically desires, due to differences in affordances encompassed by these distinct PPA experiences (consider the affordance of romantic love by a female target: to a heterosexual man vs. a heterosexual woman; Zebrowitz & Montepare, 2006). Researchers have typically examined this distinction by comparing "opposite-sex" (target and perceiver sex differ) and "same-sex" (target and perceiver sex are matched) ratings, as studies to date have largely limited participant recruitment to heterosexual (or presumed heterosexual) individuals. In an effort to promote more inclusive language (Sell, 2007), we use the term "orientation-matched" to refer to ratings that are of targets of the gender(s) to which the perceiver is sexually-oriented. As the field moves to incorporate greater diversity of participant sexual orientation, this language will ensure researchers have an accurate and concise way of labeling these seemingly distinct perception experiences (e.g., orientation-matched ratings are likely more relevant to risky sexual behavior than "orientation-mismatched" ratings – i.e., ratings of individuals who are not of a gender to which the perceiver is sexually oriented). As sex-related alcohol expectancies are likely to specifically affect attunement to affordances (e.g., potential sexual relationship) of individuals of the gender to which the perceiver is sexually oriented, it would follow that alcohol's effect on PPA should be greatest during orientation-matched perceptions.

While the ecological approach to person perception highlights key features of PPA experiences (e.g., perception of dynamic targets, potential to interact) that inform methodological approaches and alcohol expectancy theories suggest which individuals may be most susceptible to alcohol's effect on PPA (i.e., those with strong sex-related expectancies), *feelings-as-information theory* identifies a potential pathway by which alcohol alters PPA. Feelings-as-information theory posits that feelings are a source of information that contribute to various judgments (Schwarz, 2012). Importantly, this theory advocates that feelings contribute to judgments regardless of whether they are elicited by the target of judgment or derived from a separate source. Further, mood may be especially likely to influence judgments when the perceiver lacks cognitive resources to engage in careful evaluation (Forgas & East, 2003). Alcohol-induced mood states therefore have potential to alter attractiveness judgments (Mehrabian & Blum, 1997), and their effects may be greatest when alcohol-reduced cognitive capacity is significant – namely, at moderate-high, as compared to low, intoxication levels.

Studies on the alcohol-PPA relation to date have tested alcohol's effects at variable intoxication levels and have, at times, failed to account for whether intoxication is increasing or decreasing. Not only would alcohol have less of an effect on cognitive capacity at lower intoxications, but alcohol less reliably induces positive moods at lower doses (e.g., < 0.05%) (Ekman, Frankenhaeuser, Goldberg, Hagdahl, & Myrsten, 1964; Persson, Sjöberg, & Svensson, 1980). Alcohol also has differential effects on mood according to whether intoxication is increasing (i.e., on the ascending limb of the blood alcohol concentration, BAC, curve) or decreasing (i.e., on the descending limb of the BAC curve) (Martin et al., 1993; Sutker et al., 1983). It is possible that some alcohol-consuming participants in past studies have been on the descending limb and were feeling down or sedated at the time of rating, rather than up and stimulated, thereby dampening alcohol's observed effect. Not only may this have occurred in naturalistic studies that had no control over alcohol consumption timing, but also in lab-based studies that always had participants complete the PPA task after completing the drinking period (such that their BACs may have begun to drop during the PPA task).

Some studies have suggested that mood is not a pathway by which alcohol impacts PPA (Attwood et al., 2012; Chen et al., 2014). However, these studies were conducted in lab settings where participants consumed alcohol in isolation. Due to the impact of social context on alcohol intoxication experiences and related mood enhancement (Doty & de Wit, 1995; Kirkpatrick & de Wit, 2013; Pliner & Cappell, 1974), testing participants in social context may be key to elucidating the role of mood in alcohol's effect on PPA. These studies also utilized static image stimuli with neutral expressions, which may have limited the potential for mood to foster alcohol's effect on

PPA as it would in more naturalistic perception experiences. That is, viewing happy facial expressions elicits feelings of happiness in the perceiver (Wild et al., 2001), and feelings-as-information theory would suggest that this enhanced happiness may increase PPA. Importantly, acute intoxication can increase recognition of happy facial expressions (albeit at low intoxication levels) (Kano et al., 2003), suggesting that intoxicated individuals may be particularly susceptible to the potential for facial expressions to enhance mood and for that enhanced mood to increase PPA. Because the impact of mood on judgments is greatest when the target is variable or complex (Forgas, 1995), utilization of dynamic, as well as expressive, stimuli may be key to assessing alcohol's effect in a way that models natural perception experiences (Penton-Voak & Morrison, 2011).

Certainly, the alcohol-PPA field requires a diversity of research paradigms (Wyer Jr. et al., 1992). In addition to lack of variability in emotional expression and motion of the stimuli presented in research on alcohol and PPA to date, the vast majority of studies fail to assess a key feature of the alcohol-PPA process as it occurs naturally – intoxication of the target. Because beverage mismatches between actors (e.g., perceivers) and partners (e.g., targets) occur outside the lab and the concordance between each individual's intoxication status can alter alcohol's effects, differentiation of these unique intoxication influences is needed to clarify the processes underlying alcohol's effects (Sayette, 2017). However, most past studies have utilized static image stimuli (Bowdring & Sayette, 2018), none of which incorporated images of intoxicated targets. Of those studies that had perceivers rate live individuals, only one systematically crossed intoxication status (i.e., sober vs. intoxicated) of target and perceiver, thereby enabling differentiation of the effects of perceiver-intoxication and target-intoxication on PPA (Kirkpatrick & de Wit, 2013). Although this study did not demonstrate an effect of target intoxication on PPA (or an interaction between target- and perceiver-intoxication), it may have been due to targets and perceivers beginning the drink period together in a sober state, and then rating the attractiveness of one another after the drink period ended. Notably, the authors also failed to detect a significant effect of perceiver-intoxication on PPA. Because alcohol appears to most reliably affect appraisal of *new* information (i.e., when information is presented after the individual has reached a state of intoxication rather than prior to it) (see Sayette, 1993), researchers may need to prevent an initial encounter between the perceiver and target *prior* to manipulating intoxication status.

Using sober participants, one study found that static, neutral-expression images of orientation-matched targets who had consumed low doses of alcohol were rated as more attractive than were images of orientation-matched sober targets (Van Den Abbeele et al., 2015). The authors proposed subtle displays of positive mood and facial coloration (e.g., subtle smiles and relaxation of muscle tone, increased redness of facial skin tone) among intoxicated targets as potential explanations for their results. Facial flushing is thought to indicate health (Re et al., 2011), which may be particularly relevant to orientation-matched ratings (Lee et al., 2013). Another reason target intoxication may be expected to yield enhanced PPA is due to alcohol's effect on personality displays. Specifically, intoxicated individuals are perceived to be more extraverted (Orehek et al., 2020) and perceived extraversion has been linked to enhanced PPA, even when perceivers do not actually interact with the targets (Fiore et al., 2008). Indeed, various factors may contribute to target-intoxication enhanced PPA. Further research is needed to first replicate this effect and to determine whether it generalizes to orientation-mismatched PPA.

In summary, the complex nature of alcohol's effects on PPA calls for careful consideration of methods to best capture the richness of experiences as they naturally occur. The use of static, neutral-expression stimuli, lack of a possibility to interact with targets, the (at times) low intoxication levels, failure to account for BAC limb, and generally socially-isolated nature of the drinking and rating experiences may have dampened alcohol's observed effects on PPA.

1.7 Present study

The present within-subjects lab-based study (*n* = 36) applied psychological theories and methods not previously used in alcohol research in an effort to further elucidate a variety of questions central to understanding alcohol's effects on PPA. I examined the effect of perceiver drink condition on perception of target physical attractiveness to extend prior research (Bowdring & Sayette, 2018) and elucidate the degree of the effect observed with the present methods. I also examined the effect of target drink condition on perceiver perception of target physical attractiveness. The study was additionally positioned to assess the respective moderating roles of: orientation-matched vs. orientation-mismatched ratings, sex-related alcohol expectancies of the perceiver, and stimulus type. Finally, this study assessed the effects of alcohol on mood and mood on PPA, in attempt to provide initial data to elucidate mood as a potential pathway by which alcohol enhances PPA (a larger study would be needed to conduct formal tests of mediation). The hypotheses for each aim were as follows:

1.8 Aim 1: To examine the effect of alcohol on PPA

1.8.1 Aim 1a: To examine the effect of perceiver drink condition on PPA

1.8.1.1 Hypothesis 1a

Participants would provide higher ratings of others' physical attractiveness after having consumed alcohol than after having consumed non-alcoholic control beverages.

1.8.2 Aim 1b: To examine the effect of target drink condition on PPA

1.8.2.1 Hypothesis 1b

Participants would provide higher ratings of others' physical attractiveness for targets whose images were captured after they had consumed alcohol than for targets whose images were captured after they had consumed non-alcoholic control beverages.

1.8.3 Aim 1c: To examine the interaction between perceiver- and target-drink condition on PPA

1.8.3.1 Hypothesis 1c

In attempt to replicate previous findings on the effect of target drink condition on PPA (Van Den Abbeele et al., 2015), in the current experiment I withheld information from perceivers about target drink condition – information which may be key in naturalistic settings to potentiate an interaction (see George, Stoner, Norris, Lopez, & Lehman, 2000). Previous studies have not tested the interaction between perceiver- and target-drink condition, which is an important oversight. However, I did not anticipate detecting a significant interaction effect under the present experimental conditions (i.e., wherein information about target intoxication status is withheld from participants and statistical power is modest). If such an effect were (unexpectedly) observed, it would provide novel data to inform future research.

1.9 Aim 2: To examine whether orientation-match of target gender and perceiver sexual orientation moderates the effect of alcohol on PPA

1.9.1 Aim 2a: To examine whether orientation-match moderates the effect of perceiver drink condition on PPA

1.9.1.1 Hypothesis 2a

The effect of perceiver drink condition on PPA would be greatest when the target is orientation-matched.

1.9.2 Aim 2b: To examine whether orientation-match moderates the effect of target drink condition on PPA

1.9.2.1 Hypothesis 2b

The effect of target drink condition on PPA would be greatest when the rating is orientation-matched.

1.10 Aim 3: To examine whether stimulus type moderates the effect of alcohol on PPA

To enhance power to detect this effect, we intended to limit this analysis to orientation-matched ratings only if aim 2a revealed that the effect of perceiver drink condition on PPA were greatest for orientation-matched ratings. We intended for the analysis to include all ratings (regardless of orientation-match) if aim 2a did not reveal a significant effect.

1.10.1 Aim 3a: To examine whether target facial expression (i.e., smiling vs. neutral expression) moderates the effect of perceiver drink condition on PPA

1.10.1.1 Hypothesis 3a

The effect of perceiver drink condition on PPA would be greater for smiling images than for neutral-expression images.

1.10.2 Aim 3b: To examine whether motion of target presentation (i.e., static vs. dynamic image) moderates the effect of perceiver drink condition on PPA

1.10.2.1 Hypothesis 3b

The effect of perceiver drink condition on PPA would be greater for dynamic images than for static images.

1.11 Aim 4: To examine whether sexual-desire alcohol expectancies moderate the effect of alcohol on PPA

1.11.1 Hypothesis 4

The effect of perceiver drink condition on PPA would be greater among perceivers with stronger sexual-desire alcohol expectancies. [This analysis was limited to orientation-matched ratings, as originally proposed.]

1.12 Aim 5: To examine the role of mood in the alcohol-PPA relationship

1.12.1 Aim 5a: To examine the effect of perceiver drink condition on mood

1.12.1.1 Hypothesis 5a

Participants would report more positive post-drink mood after consuming alcohol than after consuming a non-alcoholic control beverage.

1.12.2 Aim 5b: To examine the effect of mood on PPA

1.12.2.1 Hypothesis 5b

Individuals who report more positive post-drink mood would provide higher ratings of others' physical attractiveness.

2.0 Method

2.1 Participants

Though the present study intended to recruit 56 male participants, the final sample was 36 participants. The reduction in sample size was due to the unanticipated, mandatory suspension of all nonessential research activities at the University of Pittsburgh in response to the Covid-19 outbreak (Rutenbar et al., 2020). Participants were recruited via ads in community and city newspapers, through paper flyering in Pittsburgh neighborhoods, and on relevant online sites. Ads requested individuals call the Alcohol and Smoking Research Laboratory (ASRL) if they and a friend were social drinkers who were interested in earning money for participation in an experiment. Individuals who contacted the ASRL were screened for eligibility via telephone. [Though I am disinclined to favor recruitment of males over females in alcohol research, the sample size of the present study was modest and alcohol-related social rewards are particularly strong for male drinkers (Sayette, 2017). As our lab has done with social bonding research, were this initial study with males to show promise, I would aim to conduct a follow-up with both genders (Kirchner et al., 2006; Sayette et al., 2012).]

To qualify, participants had to be male social drinkers between the ages of 21–28 (the same age range as that represented by the attractiveness stimuli, to reduce the likelihood of perceiver-target age discrepancy affecting attractiveness ratings; Foos & Clark, 2011). They had to report drinking at least one day per week and affirm that they could comfortably drink at least three drinks in 30 minutes (a cutoff used in prior studies; see Sayette et al., 2012), as well as indicate willingness to do so per study protocol. They had to report consuming approximately five or more drinks on a single occasion in the past 6 months. Participants were required to be within 20% of the ideal weight for their height (Harrison, 1985). Participants had to have a nonromantic same-sex friend with whom they regularly drank and whom they were willing to have call the laboratory to also pursue study participation.

Per past research (e.g., McCarthy, Niculete, Treloar, Morris, & Bartholow, 2012), participants were excluded if they had any medical or psychiatric conditions that ethically contradicted alcohol consumption (e.g. diabetes, bipolar disorder), were currently taking medication for which the use of alcohol was contraindicated, weighed greater than 200lb, or had ever intentionally abstained from alcohol due to either a formal diagnosis or concern about having a substance use disorder. Participants were also excluded if they denied fluency in English, as it could have reduced their ability to understand task instructions, or if they had uncorrected visual impairment, as it could have diminished their ability to perceive facial features of images being used as stimuli.

After being deemed eligible, participants were asked to identify a nonromantic same-gender friend with whom they regularly drank and to have that friend contact the ASRL to undergo the eligibility screening. Once both individuals within a dyad had been screened and deemed eligible, they were scheduled for two study sessions.

2.2 Procedure

Dyads who met eligibility criteria based on the phone screen were invited to participate in a two-session laboratory experiment. They were informed that if they chose to participate each member of the dyad would: (a) need to abstain from alcohol for 24 hours, as well as food and caffeine for four hours, prior to each session; (b) be required to provide a BAC breath sample to confirm sobriety by a zero reading on each session day, and that failure to do so would result in withdrawal from the experiment and no further monetary compensation; and (c) be required to consume alcohol during one of the sessions.[1] Dyads who agreed to the above terms and indicated interest were scheduled for two sessions, which occurred within ten days of one another (to reduce attrition) but not on consecutive days.

2.3 Session one

Upon arrival to the laboratory for session one, participants were seated in separate rooms and provided with informed consent forms, which an experimenter reviewed with them verbally. Participants who agreed to participate were weighed to inform pre-drink food amount and alcohol dosage, and to confirm that they were within the necessary weight range for their height as described during the phone screen. They were then asked to rinse their mouths with water and to provide a BAC sample. Any participant who provided a breath reading of > .003% would have been withdrawn from further participation. Participants with confirmed sobriety were seated in separate rooms to complete multiple questionnaires (e.g., baseline mood measure; see *Materials*), while they consumed a bagel (amount determined by weight) (Sayette et al., 2001). Participants used an intercom to inform the experimenter when they had completed the questionnaires, at which

[1] Participants were told that they would need to arrange transportation to and from the experimental sessions, particularly noting that they would not be permitted to drive themselves to or from the session on the day in which they will consume alcohol.

time the experimenter went into each participant's room to mix the drinks in front of the participants separately. Drink condition (alcohol vs. no-alcohol control) was randomized by dyad and counter-balanced across sessions. The drink procedure followed a protocol used in prior studies conducted at the ASRL (e.g., Sayette et al., 2012). For the alcohol condition, a 0.82g/kg dose of alcohol was provided (e.g., a 150-lb male received about five ounces of vodka) and participants were informed that their drinks contained alcohol. The drink was one part 100 proof vodka and 3.5 parts cranberry-juice cocktail. For the control condition, participants received cranberry-juice cocktail and were told that their drinks did not contain alcohol. Total beverage was isovolumetric in the alcohol and control conditions. After each drink had been mixed, the participants were brought into the same room and seated together at a circular table.

The experimenter informed participants that the next phase of the session would be the drink consumption period. Participants received one half of their beverage at minute 0 and the other at minute 18, such that they consumed the entire beverage across 36 minutes. They were asked to drink each half evenly over the 18 minute intervals. At the midway point of each of the halves (minute 9 and minute 27, respectively), the experimenter reminded participants via intercom that they should be roughly halfway done with the portion of their beverage they had been provided. Approximately five minutes after the second half was finished (minute 41), participants rinsed their mouths with water, provided another BAC breath sample, and reported their subjective intoxication.

Prior to starting the drink period, participants were informed that they were permitted to talk during the drinking period but were asked to refrain from commenting on their perceived intoxication. Participants were also told that at the midpoint of the drinking period they would begin a rating task, wherein they would view a series of images on a computer screen and be prompted to rate the attractiveness of each image. Participants were told that the images were of participants from a recent, previous study who may participate in a future study in the ASRL and that they (i.e., the present-study participants) too may be invited to participate in the future study. Participants were informed that at the end of the rating task they would be prompted to select four individuals they rated whom they would be interested in potentially interacting with during the future study (though in fact no such future study occurred). We made participants aware of this post-task prompt prior to the drink consumption period to ensure all participants were sober at the time of receiving this potentially crucial information. This use of deception, which was disclosed to participants at the end of session two, was designed to enhance participants' beliefs that they had potential to interact with the individuals whom they were rating, as PPA may differ when individuals do vs. do not have potential to interact with the targets of their perception (Zebrowitz & Montepare, 2006). As we have done in past studies (Sayette et al., 2012), participants were also told that the camera in front of them would be used during the drink consumption period to monitor beverage consumption rates from an adjoining room. During debriefing, we informed participants that the cameras were used to record their social interaction and we asked permission to retain the video footage for future research purposes (irrelevant to the present study).

2.4 Computer-based tasks

At minute 18, participants were given the second portion of their drink and began the PPA task on a desktop computer in the experimental room. They consumed the second part of their drink as they partook in the PPA task to permit assessment of alcohol's effect on PPA while BACs continued to rise steeply (Sayette, 2017). Participants were informed that the experimenter would leave the room and return upon completion of the rating task and beverage consumption. Participants viewed a series of facial image stimuli, which they rated using a scale of 1 (very unattractive) to 10 (very attractive). [Attractiveness stimuli were derived from video images of participants who participated in a previous study conducted in the ASRL (see Materials section for details regarding stimuli and rating task development).] Each participant recorded their responses using a separate keyboard that was connected to the computer. Responses were obfuscated on screen and a barrier was situated between the two keyboards to reduce participants' abilities to see each other's response entries. Participants were asked to refrain from discussing their reactions to the images but were otherwise permitted to talk during the task as they so chose. This approach was intended to create an attractiveness perception experience that more closely mirrored the social aspect of naturalistic experiences, while mitigating the likelihood that participants felt pressured to agree on a number rating (as could have been the case had the specific number ratings been permitted in discussion). The experimenter waited in a lab room next to the experimental room, wherein participants' completion of the task was monitored via camera to ensure compliance with instructions.

After completing all ratings, a screen with the static smiling stimulus for each target was displayed and subjects were prompted to select four individuals whom they would be interested in potentially interacting with in a future study. Participants used an intercom to communicate to the experimenter when they had completed the task and subsequent prompt, as well as consumed their beverages. The experimenter returned to the room and participants were asked to indicate whether they recognized any of the individuals whom they rated during the task. Any participants who affirmed recognition would have been shown a computer screen displaying static smiling images of all targets and prompted to identify which target(s) they had recognized. Ratings provided on targets who perceivers recognized would have been removed from analyses, as these ratings could be confounded by the perceiver's prior experience with and additional information about the target. No participants in the present study affirmed recognition of targets that required removal of ratings for that reason.

2.5 Post-task

Participants in the control condition were separated, provided another BAC sample, reported their subjective intoxication, provided an estimate of how many ounces of alcohol they had consumed during the session, and completed a post-drink mood measure. They were then paid a portion of their total compensation ($25 of $90), prior to being reminded of their next session date and the need to arrange transportation to and from the session, such that they would not drive themselves after the session (as they would consume alcohol during session two). They were asked to refrain from discussing their ratings with their friend and were then permitted to leave. Participants in the alcohol condition were separated, provided another BAC sample, reported their subjective intoxication, and completed the post-drink mood measure. They were then seated together, given a light meal, and waited until their BACs dropped below 0.04% (per NIAAA alcohol administration study guidelines; National Institute on Alcohol Abuse and Alcoholism, n.d.). While they were waiting, they were permitted to converse but asked to refrain from discussing their ratings. Once their BACs had sufficiently decreased, participants provided an estimate of how many ounces of alcohol they had consumed during the session, were paid a portion of their total compensation ($25 of $90), reminded of their next session date, and once they confirmed that they would not be driving themselves, permitted to leave.

2.6 Session two

Session two generally mirrored session one. Upon arrival to the laboratory, participants provided a BAC sample to confirm sobriety and were weighed again to inform beverage and pre-drink food amount. They then completed the baseline mood measure (the same baseline mood measure as in session one) and were reminded of the study timeline (i.e., drinking period, rating task, post-rating prompts). For the drinking period, participants were administered the beverage type that they did not receive in session one (i.e., dyads who received alcohol during session one received control beverages during session two, and vice versa). Participants then completed the attractiveness rating task and subsequent prompts. For the rating task, participants viewed a different set of images than they did during session one to reduce potential familiarity effects (Peskin & Newell, 2004).[2]

After task and prompt completion, participants were separated, provided a BAC sample, reported their subjective intoxication, and completed a post-drink mood measure. Then, participants completed three subsequent tasks irrelevant to the present study. All participants then completed a final task, wherein they were first prompted for what type of study they thought the people in the images (that they had viewed throughout both sessions) had been involved in. Participants were then informed that the people in the images had participated in an alcohol study. Participants then viewed an additional set of images (static, neutral images of 12 targets) and were

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[2] Image set was counterbalanced across the first and second sessions. Unfortunately, randomization of image set and drink condition was the same, such that image set 1 was always viewed during alcohol sessions and image set 2 was always viewed during control sessions. This motivated a supplemental online study (see *Supplemental Study* section).

asked to indicate whether they believed the individuals in the images were intoxicated or sober at the time the image was taken. This task provided information about whether participants were able to accurately differentiate sober from intoxicated targets.

After task and prompt completion, control-group participants completed some final questionnaires that assessed participant characteristics such as personality and their relationship with their friend. Next, participants were debriefed together and told that we did not explain earlier that their social interaction would be videotaped, as research shows that such information alters how participants respond. They then were presented with a consent form requesting their permission for the researchers to retain the videotaped footage for facial coding purposes (irrelevant to the present study). In the unlikely event that a participant objected to the video we would have deleted it in their presence.[3] As we and others have done in prior studies (e.g., Sayette et al., 2012), participants who gave their consent were presented with a consent form with six options regarding how we can use their videos (e.g., use in publications). Participants were also informed of the purpose of the study and that they would not have potential to interact with the individuals in the images that they rated. Participants were given an opportunity to ask questions, then were paid the remainder of their compensation ($65 of $90) and permitted to leave.

Participants in the alcohol condition provided another BAC sample and reported their subjective intoxication. They were then seated together, given a light meal, and remained in the lab until their BACs dropped below 0.04%. Once their BACs approached .04% (i.e., <.05%) – as measured by BAC readings every 45 minutes – participants were separated to complete the final

[3] All participants consented to having the researchers retain their videos for coding and analysis.

questionnaires. At the time their BACs dropped below .04%, they were debriefed, paid, and permitted to leave after they confirmed that they would not be driving themselves.

2.7 Materials

2.8 Attractiveness rating task

Attractiveness stimuli were derived from video footage of individuals who participated in a previous study conducted in the ASRL (see Sayette et al., 2012) and who consented to having their videos used in future research. Videos were obtained during a triadic group-formation drinking period, wherein 160 three-person groups of strangers were brought into the lab and were administered either alcoholic or non-alcoholic control beverages.[4] Three cameras were positioned to capture each participant's face. Participants were told were told the cameras were used to monitor drink consumption.

In preparation for the present alcohol study, we recently conducted a study that did not involve alcohol consumption (n = 181) testing the effect of stimulus type on attractiveness ratings (using sober participants and images derived only from the control-beverage condition from Sayette et al., 2012) to inform the type of stimuli to be used in the present study. Results of this recently completed study indicated that attractiveness ratings were higher for smiling (as opposed to neutral expression) and dynamic (as opposed to static) images (Bowdring et al., invited resubmission). These presentation styles (smiling vs. neutral, static vs. dynamic) were fully

[4] The previous study had 240 groups total, wherein 80 consumed placebo beverages. However, the present study only derived images from the alcohol and control groups, so as to mirror the drink conditions of the perceivers.

crossed such that the following four stimulus types were used in the present study: static neutral, static smiling, dynamic neutral, and dynamic smiling images. Static neutral images offered consistency with past studies of alcohol and PPA that have largely relied on this stimulus type and enabled comparison with the more ecologically valid stimulus types that incorporate emotional expression and movement, thereby informing future research. Stimuli were derived from video footage of the last 12 minutes of the drinking period in the previous ASRL alcohol study, to ensure alcohol-consuming participants were captured nearest their peak intoxication. See Appendix A for further details regarding stimulus and rating task development.

Consistent with recommendations from prior work and our own past approach, each target was presented in all four stimulus formats and viewed by every participant, to assess variability in PPA across stimulus types while controlling for baseline differences in PPA across targets (Bowdring et al., invited resubmission; Hehman et al., 2015; Okubo et al., 2015). The presentation duration of static and dynamic images was held constant at five seconds and participants were given just one opportunity to view each image. After each image presentation, a screen prompting participants to rate the image was presented until participants clicked to progress to the next image. The rating task was hosted on Qualtrics (Provo, UT).

2.9 Attractiveness ratings

Ratings were reported using a Likert scale of 1 (very unattractive) to 10 (very attractive).

2.10 Breath alcohol concentration (BAC)

Participants' BACs were assessed using DataMaster Breath Alcohol tester (National Patent Analytical Systems, Mansfield, Ohio). These breathalyzer readings are accurate to +/-0.003 g/dL.

2.11 Demographics

Participants reported their demographic information prior to the drinking period at session one. Pertinent to analyses was reported sexual orientation, which was used to classify data for analyses involving orientation-match. See Appendix B for full demographic questionnaire.

2.12 Mood

2.13 Baseline mood

Baseline mood was assessed prior to the drink period at each session using the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988), which includes 10 items for positive and negative mood subscales, respectively. This was used to ensure no baseline differences existed between participants' pre-drink mood states on session one and session two. Items were rated on a scale of 1 (very slightly or not at all) to 5 (extremely).

2.14 Post-drink mood

As the ASRL has done in prior studies, I assessed post-drink positive and negative mood using a different mood measure than the baseline assessment to mitigate potential anchoring effects and facilitate reports that better reflect current mood states (Fairbairn & Sayette, 2013). Specifically, participants completed an eight-item mood measure that the ASRL has previously found to be sensitive to alcohol's effects (Fairbairn, Sayette, Wright, et al., 2015). The measure consists of four items for positive (cheerful, upbeat, happy, content) and negative (annoyed, sad, irritated, bored) subscales. Participants indicated the degree to which they currently felt each mood state using a Likert scale ranging from 0 (not at all) to 5 (extremely).

2.15 Alcohol expectancies

Consistent with prior work assessing the effect of sexual desire alcohol expectancies on PPA (Friedman et al., 2005), alcohol expectancies were measured using the Sexual Effects of Drinking Questionnaire (SEDQ; Skinner, 1992). Participants responded to the prompt, "Having a few drinks would increase or decrease your feelings of sexual…," with the six item stems of: arousal, interest, enjoyment, excitement, pleasure, and desire (George et al., 2000). Participants rated the extent to which they expected each of these six feelings on a scale of 1 (decrease a lot) to 5 (increase a lot). This measure yields two factors of alcohol expectancies about feelings during sex (items 3-5) and desire to have sex (items 1, 2, 6), respectively. To mirror prior approaches (Friedman et al., 2005), we limited analyses to the "desire" factor.

2.16 Subjective intoxication

Participants reported their subjective intoxication using a likert scale, ranging from 0 (*not at all intoxicated*) - 100 (*the most intoxicated I have ever been)*. This scale has been used in past studies to assess the magnitude of perceived intoxication induced among alcohol consuming participants (e.g., Kirchner et al., 2006).

2.17 End estimate of alcohol consumed

As has been done in past ASRL studies to assess whether or not participants believed they had consumed alcohol (Sayette et al., 2012), participants were asked to estimate how many ounces of vodka they had consumed during the session.

2.18 Characteristics of friendship

Because the characteristics of friendships (which could influence participants' experiences of the drinking period) could have differed between dyads, participants responded to a series of questions assessing: how long they have known their friend, how close they feel toward their friend, how often they drink together (per month), and whether they live or work together. This measure was adapted from a measure used in a previous ASRL smoking study using dyads of same-sex friends (Dimoff et al., 2019).

2.19 Perception of target intoxication

2.20 Qualitative response

Participants were prompted with, “All of the facial images that you have viewed today were taken from participants in a previous study in our lab. If you had to guess what the study might have been about, what would you say?” Qualitative responses were coded for whether or not alcohol consumption by the targets was referenced (e.g., “social interaction and effect of alcohol”).

2.21 Target rating

Participants viewed an additional set of images and were asked to indicate whether they believed the individuals in the images were intoxicated or sober at the time the image was taken. I coded these responses as either correct (target drink condition and participant response were concordant) or incorrect (target drink condition and participant response were discordant). This yielded a dichotomous variable that reflected participant accuracy in perceiving target intoxication.

2.22 Analytic plan

All statistical analyses were conducted using R (Team, 2013). Mixed effects models were assessed using the lme4 and lrtest extensions (Bates et al., 2014; Zeileis & Hothorn, 2002). Per recommendations by Aguinis et al. (2013), outlier detection was based on both visual and quantitative techniques. All primary analyses were conducted with and without outliers included (for variables that had outliers) and, unless noted in the results section, results can be assumed to not have meaningfully differed between these analyses. See *Appendix C* for further details on outlier, skew, and kurtosis management. Analyses and hypotheses as outlined below were pre-registered, though with a larger intended (pre-Covid-19) sample size (available at: https://osf.io/bhr9f and https://osf.io/bdn48). Significance cutoffs were set at $p < .05$ for all tests. After checking study design assumptions (e.g., that alcohol-consuming participants felt intoxicated and believed they consumed alcohol, that pre-drink mood was consistent within participants across sessions), data were analyzed using a series of mixed effects models in line with the set of aims.[5]

2.23 Aim 1: To examine the effect of alcohol on PPA

2.24 Aim 1a: To examine the effect of perceiver drink condition on PPA

To examine the effect of perceiver drink condition on PPA, the model was entered as follows: Aim1a.model = lmer(PPA ~ PercieverDrink + (1|Perciever:Dyad) + (1|Target), data=aim1a). As illustrated, I entered perceiver drink condition ("PerceiverDrink") as a fixed effect. I entered intercepts for perceivers (nested within dyads) and targets as random effects, to account for non-independence of responses within each grouping. A likelihood ratio test was used to compare the full model with the main effect of drink condition against a model with the effect of drink condition removed. The *p*-value yielded by the model comparison was assessed to

[5] For all analyses, order of drink condition was entered as a covariate, but removed if it did not significantly increase model fit.

determine if the effect of drink condition was significant. [Subsequent models incorporated the same random effects, while the fixed effects differed according to the variable of interest.]

2.25 Aim 1b: To examine the effect of target drink condition on PPA

To examine the effect of target drink condition on PPA, the model was entered as follows: Aim1b.model = lmer(PPA ~ TargetDrink + (1|Perceiver:Dyad) + (1|Target), data=aim1b). I entered target drink condition ("TargetDrink") as a fixed effect. A likelihood ratio test was used to assess the significance of the main effect.

2.26 Aim 1c: To examine the interaction between perceiver- and target-drink condition on PPA

To examine the interaction between perceiver- and target-drink condition on PPA, the model was entered as follows: Aim1c.model = lmer(PPA ~ PerceiverDrink + TargetDrink + PereiverDrink*TargetDrink + (1|Perceiver:Dyad) + (1|Target), data=aim1c), wherein "PerceiverDrink*TargetDrink" represents the interaction between perceiver drink condition and target drink condition, entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect.

2.27 Aim 2: To examine whether orientation-match of target gender and perceiver sexual orientation moderates the effect of alcohol on PPA

2.28 Aim 2a: To examine whether orientation-match moderated the effect of perceiver drink condition on PPA

To examine whether orientation-match moderated the effect of perceiver drink condition on PPA, the model was entered as follows: Aim2a.model = lmer(PPA ~ PerceiverDrink + OrientationMatch + PerceiverDrink*OrientationMatch + (1|Perceiver:Dyad) + (1|Target), data=aim2a), wherein "PerceiverDrink*OrientationMatch" represents the interaction between perceiver drink condition and orientation-match of the rating (i.e., orientation-matched vs. orientation-mismatched), entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect.

2.29 Aim 2b: To examine whether orientation-match moderated the effect of target drink condition on PPA

To examine whether orientation-match moderated the effect of target drink condition on PPA, the model was entered as follows: Aim2b.model = lmer(PPA ~ TargetDrink + OrientationMatch + TargetDrink*OrientationMatch + (1|Perceiver:Dyad) + (1|Target), data=aim2b), "TargetDrink*OrientationMatch" represents the interaction between target drink condition and orientation-match of the rating, entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect.

2.30 Aim 3: To examine whether stimulus type moderates the effect of alcohol on PPA

To enhance power to detect this effect, we intended to limit this analysis to orientation-matched ratings only if aim 2a revealed that the effect of perceiver drink condition on PPA were greatest for orientation-matched ratings. We intended for the analysis to include all ratings (regardless of orientation-match) if aim 2a did not reveal a significant effect.

2.31 Aim 3a: To examine whether target facial expression (i.e., smiling vs. neutral expression) moderated the effect of perceiver drink condition on PPA

To examine whether target facial expression (i.e., smiling vs. neutral expression) moderated the effect of perceiver drink condition on PPA, the model was entered as follows: Aim3a.model = lmer(PPA ~ PerceiverDrink + TargetExpression + PerceiverDrink*TargetExpression + (1|Perceiver:Dyad) + (1|Target), data=aim3a), wherein "PerceiverDrink*TargetExpression" represents the interaction between perceiver drink condition and target facial expression (smiling vs. neutral expression) of the rating, entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect.

2.32 Aim 3b: To examine whether motion of target presentation (i.e., static vs. dynamic image) moderated the effect of perceiver drink condition on PPA

To examine whether motion of target presentation (i.e., static vs. dynamic image) moderated the effect of perceiver drink condition on PPA, the model was entered as follows: Aim3b.model = lmer(PPA ~ PerceiverDrink + TargetMotion + PerceiverDrink*TargetMotion + (1|Perceiver:Dyad) + (1|Target), data=aim3b), wherein "PerceiverDrink*TargetMotion" represents the interaction between perceiver drink condition and motion of target presentation (static vs. dynamic) of the rating, entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect.

2.33 Aim 4: To examine whether sexual-desire alcohol expectancies moderated the effect of alcohol on orientation-matched PPA

To examine whether sexual-desire alcohol expectancies moderated the effect of alcohol on orientation-matched PPA, the model was entered as follows: Aim4.model = lmer(PPA ~ PerceiverDrink + SexualExpectancies + PerceiverDrink*SexualExpectancies + PerceiverDrink+ (1|Perceiver:Dyad) + (1|Target), data=aim4), wherein "PerceiverDrink*SexualExpectancies" represents the interaction between perceiver drink condition and perceiver sexual-desire alcohol expectancies, entered as a fixed effect. A likelihood ratio test was used to assess the significance of the interaction effect. We planned to limit this analysis to orientation-matched ratings regardless of aim 2a findings, as sexual-desire expectancies would not be expected to alter PPA for orientation-mismatched ratings.

2.34 Aim 5: To examine the role of mood in the alcohol-PPA relationship

2.35 Aim 5a: To examine the effect of perceiver drink condition on mood

To examine the effect of perceiver drink condition on mood, the model was entered as follows: Aim5a.model = lmer(Mood ~ PerceiverDrink + (1|Perceiver:Dyad), data=aim5a). A likelihood ratio test was used to assess the significance of the main effect of perceiver drink condition on mood.

2.36 Aim 5b: To examine the effect of mood on PPA

To examine the effect of mood on PPA, the model was entered as follows: Aim5b.model = lmer(PPA ~ Mood + (1|Perceiver:Dyad) + (1|Target), data=aim5b). A likelihood ratio test was used to assess the significance of the main effect of mood on PPA. To enhance power, as was planned for Aim 3, we planned to limit this analysis to orientation-matched ratings if Aim 2a revealed the effect of perceiver intoxication on PPA was greatest for orientation-matched ratings. We planned to include all ratings (regardless of orientation-match) if Aim 2a did not reveal a significant effect.

2.37 Power analysis

A power analysis was conducted to determine the sample size necessary to detect the main effect in aim 1a (i.e., the effect of perceiver intoxication on PPA), using GLIMMPSE (Kreidler et al., 2013). Power was set at .8 (Cohen, 1988). Alpha was set at the traditional cutoff of .05 and the more conservative cutoff of .01. An estimated intraclass correlation coefficient (ICC) was needed to account for the relatedness of within-dyad responses (i.e., responses among participants in the same dyad may be more similar than those among participants in different dyads). As there was no prior work to directly inform which ICC value to use, ICC values for self-report and behavioral data from prior group-based alcohol work in the ASRL (e.g., Sayette, Creswell et al., 2012) were examined. The ICCs of self-report data (e.g., subjective intoxication) and most facial expressions were about .1, though ICCs for some responses (e.g., smiling) were closer to .5. Thus, power analyses were conducted with ICC estimates of .1 and .5, respectively. Estimated PPA means per drink condition were based on the standardized difference in means from studies previously reviewed (Bowdring & Sayette, 2018). Within participant variability (i.e., correlation between responses from each drink condition within each participant) was based on data from the two within-subjects studies (Kirkpatrick & de Wit, 2013; Mitchell et al., 2015) encompassed by the previous review, yielding an estimation of $r = .82$. Variability across responses was estimated as .7, based on standard deviations observed in previous studies of this topic.

Based on these analyses, the sample size needed to detect a small effect (Cohen's $d = .19$) (Cohen, 1988) ranged from 36 to 73 participants (according to stringency of the alpha cutoff and magnitude of the ICC). I initially proposed to recruit 56 subjects, which was greater than the sample size required for all but the most stringent test (in which alpha was set at .01 and ICC was set at .5). Importantly, this power analysis indicated that 36 participants would provide adequate power (greater than or equal to .80) to detect an effect of alcohol of the magnitude noted above. Thus, while we were unable to recruit the intended sample size of 56 participants, we were still powered to conduct the planned analyses based on data from the 36 participants we did recruit.

3.0 Results

3.1 Participants

Participants' ages ranged from 21-27 (mean = 22.69, sd = 1.67). The majority of participants were White (n = 20 White, 14 Asian, 2 Black), heterosexual (34 heterosexual, 1 gay, 1 bisexual), and not in a romantic relationship (n = 20 not in a romantic relationship, 16 in a romantic relationship). Participants reported drinking 2.28 days per week (sd = 0.88) and consuming 4.14 drinks per occasion (sd = 1.94). Participants reported knowing the friend with whom they participated for 3.51 years (sd = 2.36). They reported drinking with their friend 3.88 times per month (sd = 2.08) and, on a scale of 0 (not at all close) to 10 (very close), they reported their feelings of closeness with their friend to be 8.09 (sd = 1.27).

No participants were excluded for having pre-drink readings over .003%. No participants affirmed recognition of targets that required target rating removal from analyses. One dyad was excluded after signing the consent form as one of the participants' weight was measured as outside of the required range for their height (the other participant was given the opportunity to identify another friend with whom to participate at another time, though he chose not to). Data from two dyads are not included in analyses as these dyads only completed one session each prior to the suspension of data collection due to COVID-19. Analyses are based on 36 participants clustered in 18 dyads that completed both sessions.

3.2 Study design effectiveness

3.3 Drink condition effectiveness check

On the alcohol session, BACs approximately 5-minutes post-drink were .065% (sd = .01), approximately 50-minutes post-drink were .070% (sd = .01), and approximately 95-minutes post-drink were .063% (sd = .01). All participants who estimated how many ounces of alcohol they had consumed at the end of the alcohol session reported nonzero estimates (mean = 5.29, sd = 1.36).[6] On the non-alcohol session, all but one participant (who estimated two ounces) reported believing they had consumed zero ounces of alcohol. In terms of post-drink subjective intoxication, the mean of the alcohol session was 46.23 (sd = 15.97) and the mean of the non-alcohol session was 1.23 (sd = 2.92). To assess differences in post-drink subjective intoxication between the two sessions, a mixed effects model predicting post-drink subjective intoxication by participants nested within dyads was compared using a likelihood ratio test to a model that included drink condition. As expected, drink condition significantly enhanced model fit [X^2 (1, N = 36) = 114.28, p = .001], which, when considered with the descriptive statistics, indicates that participants reported experiencing significantly higher post-drink subjective intoxication on the alcohol session than the non-alcohol session.[7]

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[6] Data were missing on this measure for two participants, in different dyads, on the alcohol session.

[7] Post-drink subjective intoxication data were missing for one participant on the alcohol and non-alcohol sessions, respectively. All but four participants reported zero for pre-drink subjective intoxication. On the non-alcohol session, two participants reported 1 and 2, respectively, and on the alcohol session, two participants reported 5 and 100, respectively. We suspect the participant who reported 100 misunderstood the question.

3.4 Pre-drink mood assumption check

In order to accurately assess the effect of drink condition on post-drink mood (Aim 5), it was necessary to establish consistency in pre-drink mood among participants across sessions and drink conditions, and to control for this factor if consistency were not observed. To assess differences in pre-drink positive mood between the two sessions and drink conditions, likelihood ratio tests were used to compare a mixed effects model predicting pre-drink positive mood by participants nested within dyads to a model that included session and a model that included drink condition, respectively. Pre-drink positive mood significantly differed by session [X^2 (1, N = 36) = 6.85, $p < .01$], but not by drink condition [X^2 (1, N = 36) = 2.04, $p = .15$]. Because participants reported greater positive pre-drink mood on session 1 (mean = 30.69, SD = 5.12) than session 2 (mean = 28.66, SD = 7.48), pre-drink positive mood was added as a covariate in all analyses of the primary aims, but only retained and reported if it significantly enhanced model fit.

The same model comparisons were repeated for testing differences in pre-drink negative mood between the two sessions and drink conditions, respectively. Pre-drink negative mood significantly differed by session [X^2 (1, N = 36) = 13.80, $p < .01$] and drink condition [X^2 (1, N = 36) = 8.01, $p < .01$]. Because participants reported lower pre-drink negative mood on session 1 (mean = 11.43, SD = 1.39) than session 2 (mean = 11.86, SD = 3.38) and lower pre-drink negative mood on the control session (mean = 11.37, SD = 2.03) than the alcohol session (mean = 11.91, SD = 3.02), pre-drink negative mood was added as a covariate in all analyses of the primary aims, but only retained and reported if it significantly enhanced model fit.

3.5 Perception of target intoxication

At the end of the second session I sought to test whether participants were able to accurately differentiate sober from intoxicated targets, which would inform aims related to the effect of target drink condition on PPA. First, participants were asked to guess the aim of the study in which targets had participated. Only six of the 36 participant responses included reference to alcohol, suggesting the drink condition of targets was likely not salient to participants as they were completing the main PPA task. Next, participants viewed 12 neutral-expression, static images (split evenly by gender and drink condition) and were asked to guess whether the target in each image had consumed either an alcoholic or non-alcoholic beverage. Participants (50% of whom had consumed alcohol and 50% of whom had consumed control beverages prior to this task) correctly identified the drink condition of targets in 60.4% of their responses. A two-tailed binomial test was significant [$p < .001$; 95% CI (0.56, 0.65)], suggesting that participants were able to guess target drink condition correctly at a rate greater than would be expected by chance (i.e., probability = 0.5). Accuracy was consistent across perceiver drink condition ($p = .35$), with correct responses recorded for 56.9% and 63.8% of ratings provided by participants who had and had not consumed alcohol, respectively. Accuracy was also consistent across target drink condition ($p = .95$), with correct responses recorded for 60.2% and 60.7% of ratings of targets who had and had not consumed alcohol, respectively.

3.6 Primary aims

For each of the primary models, I report conditional R^2, which represents the proportion of variance explained by both the fixed and random factors, and marginal R^2, which represents the proportion of variance explained solely by the fixed factors (Nakagawa & Schielzeth, 2013). With the exception of Aims 1c, 2a, 2b, and 5a, hypotheses were not supported.

3.7 Aim 1: To examine the effect of alcohol on PPA

3.8 Aim 1a: To examine the effect of perceiver drink condition on PPA

Aim 1a was to examine the effect of perceiver drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.03, p < .001]. Contrary to the hypothesis, perceiver drink did not significantly affect PPA [X^2 (1, N = 36) = 0.02, p =.90]. Conditional R^2 = 0.59 and marginal R^2 = 0.01. See Table 1 for full model results.

Table 1. Regression Coefficients for Aim 1a: The Effect of Perceiver Drink Condition on PPA

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	4.32	-0.02	0.31	13.86	.00
Perceiver alcohol (vs. control)	-0.15	-0.04	0.37	-0.40	.69
Pre-drink negative mood***	4.89	0.06	1.38	3.54	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.07		1.03		
Residual	1.53		1.24		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

The mean PPA among participants consuming alcohol was 4.20 (sd = 1.92) and among participants consuming non-alcohol control beverages was 4.33 (sd = 1.90). A post-hoc power analyses revealed that our power to detect an effect of this size was .15 and that we would have needed 330 participants in order to detect an effect of this size (Cohen's *d* = .06).

3.9 Aim 1b: To examine the effect of target drink condition on PPA

Aim 1b was to examine the effect of target drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 14.99, $p <$ .001]. Contrary to the hypothesis, target drink did not significantly affect PPA [X^2 (1, N = 36) = 0.10, p =.76]. Conditional R^2 = 0.59 and marginal R^2 = 0.00. See Table 2 for full model results

Table 2. Regression Coefficients for Aim 1b: The Effect of Target Drink Condition on PPA

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	4.20	-0.02	0.31	13.44	.00
Target alcohol (vs. control)	0.11	0.03	0.37	0.29	.78
Pre-drink negative mood***	4.88	0.06	1.38	3.54	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.07		1.03		
Residual	1.53		1.24		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

3.10 Aim 1c: To examine the interaction between perceiver- and target-drink condition on PPA

Aim 1c was to examine the interaction between perceiver- and target-drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.03, $p < .001$]. As hypothesized, there was not a significant interaction effect between perceiver and target drink condition on PPA [X^2 (1, N = 36) = 3.53, p =.06]. Conditional R^2 = 0.59 and marginal R^2 = 0.03. See Table 3 for full model results.

Table 3. Regression Coefficients for Aim 1c: The Interaction Effect of Perceiver- and Target-Drink Condition on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	3.99	-0.02	0.40	9.89	.00
Perceiver alcohol (vs. control)	0.41	-0.04	0.52	0.80	.43
Target alcohol (vs. control)	0.66	0.03	0.52	1.29	.20
Perceiver drink : target drink	-1.12	-0.15	0.73	-1.53	.13
Pre-drink negative mood***	4.89	0.06	1.38	3.55	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.05		1.03		
Residual	1.53		1.24		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

3.11 Aim 2: To examine whether orientation-match of target gender and perceiver sexual orientation moderates the effect of alcohol on PPA

3.12 Aim 2a: To examine whether orientation-match moderates the effect of perceiver drink condition on PPA

Aim 2a was to examine whether orientation-match moderates the effect of perceiver drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.10, $p < .001$]. Contrary to the hypothesis, there was not a significant interaction between perceiver drink and orientation-match on PPA [X^2 (1, N = 36) = 1.14, p =.29]. Conditional R^2 = 0.60 and marginal R^2 = 0.01. See Table 4 for full model results.

Table 4. Regression Coefficients for Aim 2a: The Interaction Effect of Perceiver Drink Condition and Orientation-Match on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	4.45	-0.02	0.33	13.47	.00
Perceiver alcohol (vs. control)	-0.21	-0.04	0.40	-0.53	.60
Orientation-matched (vs. -mismatched)	-0.26	-0.05	0.13	-1.93	.05
Perceiver drink : orientation-match	0.12	0.02	0.19	0.68	.50
Pre-drink negative mood***	4.90	0.06	1.38	3.55	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.19		1.09		
Residual	1.53		1.24		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

After conducting this analysis as planned, we recognized that retaining the random effect of target, "(1|Target)," greatly restricted our ability to detect a potential orientation-match effect. Because all participants were male (as planned) and all but two were heterosexual, the variance explained by the orientation-match variable was essentially overlapping with variance explained by target gender, as subsumed by the target effect. While we acknowledge removing the random effect of target precludes us from accounting for the non-independence of responses within each target, we believed doing so was necessary to clarify the potentially divergent effects of alcohol between orientation-matched vs. -mismatched ratings.

Rerunning the model with the target effect removed indicated that, consistent with the hypothesis, there was a significant interaction between orientation-match and perceiver drink on PPA: [X^2 (1, N = 36) = 30.22, $p < .001$]. Conditional $R^2 = 0.38$ and marginal $R^2 = 0.09$. See Table 5 for full model results.

Table 5. Regression Coefficients for Revised Aim 2a: The Interaction Effect of Perceiver Drink Condition and Orientation-Match on PPA (Without the Target Effect

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	3.90	-0.02	0.18	21.93	.00
Perceiver alcohol (vs. control)***	-0.41	-0.04	0.07	-6.35	<.001
Orientation-matched (vs. -mismatched)***	0.82	0.28	0.06	12.84	<.001
Perceiver drink : orientation-match***	0.52	0.07	0.09	2.98	<.001
Pre-drink negative mood**	4.94	0.06	1.66	5.77	<.01
Random Effects	Variance		SD		
Perceiver : dyad	1.06		1.03		
Residual	2.24		1.50		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$. ** indicates the predictor was statistically significant at $p < .01$.

Though alcohol's effect did not reached significance when analyses were conducted within each orientation-match condition separately, examination of group means revealed that among orientation-matched ratings, participants consuming alcohol reported slightly higher PPA than did participants consuming control beverages. Among orientation-*mis*matched ratings, however, participants consuming alcohol reported slightly lower PPA than did participants consuming control beverages (see Table 6 for descriptive statistics).[8]

[8] As noted in the *Analytic Plan* section, we intended for analyses of Aims 3 and 5 to be limited to orientation-matched ratings if Aim 2a revealed the effect of perceiver drink condition on PPA was greatest for orientation-matched ratings. While results trended in this direction, a significant effect of alcohol was not observed within the orientation-matched condition and the interaction effect was largely driven by the orientation-mismatched condition. Thus, both orientation-matched and -mismatched ratings were retained in analyses for Aims 3 and 5.

Table 6. PPA Ratings by Orientation-Match and Perceiver Drink

Orientation-Matched	*Mean*	*SD*
Alcohol	4.87	1.77
Control	4.76	1.87
Orientation-Mismatched	*Mean*	*SD*
Alcohol	3.49	1.81
Control	3.88	1.83

Note. SD = standard deviation.

3.13 Aim 2b: To examine whether orientation-match moderates the effect of target drink condition on PPA

Aim 2b was to examine whether orientation-match moderates the effect of target drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.02, p < .001]. Contrary to the hypothesis, there was not a significant interaction between target drink and orientation-match on PPA [X^2 (1, N = 36) = 1.50, p =.21]. Conditional R^2 = 0.60 and marginal R^2 = 0.01. See Table 7 for full model results.

Table 7. Regression Coefficients for Aim 2b: The Interaction Effect of Target Drink Condition and Orientation-Match on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	4.30	-0.02	0.33	12.97	.00
Target alcohol (vs. control)	0.10	0.03	0.40	0.24	.81
Orientation-matched (vs. -mismatched)	-0.21	-0.05	0.13	-1.55	.12
Target drink : orientation-match	0.02	0.00	0.18	1.03	.92
Pre-drink negative mood***	4.88	0.06	1.38	3.54	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.20		1.09		
Residual	1.53		1.24		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

For the same reasons noted above for Aim 2a, we reran this analysis with the target effect removed. This revealed a significant interaction between orientation-match and target drink on PPA: [X^2 (1, N = 36) = 17.36, $p < .001$]. Conditional $R^2 = 0.38$ and marginal $R^2 = 0.09$. See Table 8 for full model results.

Table 8. Regression Coefficients for Revised Aim 2b: The Interaction Effect of Target Drink Condition and Orientation-Match on PPA (Without the Target Effect

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	3.75	-0.02	0.18	21.04	.00
Target alcohol (vs. control)	-0.11	0.03	0.06	-1.64	.10
Orientation-matched (vs. -mismatched)***	0.87	0.28	0.06	13.66	<.001
Target drink : orientation-match***	0.41	0.05	0.09	4.52	<.001
Pre-drink negative mood*	4.18	0.05	1.65	2.54	<.05
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.03		
Residual	2.25		1.50		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$. * indicates the predictor was statistically significant at $p < .05$.

Examination of group means indicated mean differences in the same directions for target drink condition as was observed for perceiver drink condition in Aim 2a (see Table 9 for descriptive statistics).

Table 9. PPA Ratings by Orientation-Match and Target Drink

Orientation-Matched	*Mean*	*SD*
Alcohol	4.96	1.78
Control	4.66	1.85
Orientation-Mismatched	*Mean*	*SD*
Alcohol	3.63	1.76
Control	3.73	1.90

Note. SD = standard deviation.

The effect of target drink condition did not reach significance when follow-up analyses were conducted separately within each orientation-match condition.

3.14 Aim 3: To examine whether stimulus type moderates the effect of alcohol on PPA

3.15 Aim 3a: To examine whether target facial expression (i.e., smiling vs. neutral expression) moderates the effect of perceiver drink condition on PPA

Aim 3a was to examine whether target facial expression (i.e., smiling vs. neutral expression) moderates the effect of perceiver drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.07, $p < .001$]. Contrary to the hypothesis, there was not a significant interaction between perceiver drink and target facial expression on PPA [X^2 (1, N = 36) = 2.53, p =.11]. Conditional R^2 = 0.59 and marginal R^2 = 0.01. See Table 10 for full model results.

Table 10. Regression Coefficients for Aim 3a: The Interaction Effect of Perceiver Drink Condition and Target Expression on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	4.25	-0.02	0.31	13.59	.00
Perceiver alcohol (vs. control)	-0.18	-0.04	0.37	-0.49	.62
Target smile (vs. neutral)**	0.14	0.05	0.05	2.58	<.01
Perceiver drink : target smile	0.07	0.01	0.07	0.92	.36
Pre-drink negative mood***	4.89	0.06	1.38	3.55	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.07		1.03		
Residual	1.53		1.23		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$. ** indicates the predictor was statistically significant at $p < .01$.

3.16 Aim 3b: To examine whether motion of target presentation (i.e., static vs. dynamic image) moderates the effect of perceiver drink condition on PPA

Aim3b was to examine whether motion of target presentation (i.e., static vs. dynamic image) moderates the effect of perceiver drink condition on PPA. Pre-drink negative mood was retained in the model as it significantly enhanced model fit [X^2 (1, N = 36) = 15.09, p < .001]. Contrary to the hypothesis, there was not a significant interaction between perceiver drink and target motion on PPA [X^2 (1, N = 36) = 3.30, p =.07]. Conditional R^2 = 0.59 and marginal R^2 = 0.01. See Table 11 for full model results.

Table 11. Regression Coefficients for Aim 3b: The Interaction Effect of Perceiver Drink Condition and Target Motion on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	4.23	-0.02	0.31	13.52	.00
Perceiver alcohol (vs. control)	-0.16	-0.04	0.37	-0.43	.67
Target dynamic (vs. static)***	0.18	0.05	0.05	3.49	.00
Perceiver drink : target smile	0.02	0.00	0.07	0.29	.78
Pre-drink negative mood***	4.89	0.06	1.38	3.55	.00
Random Effects	Variance		SD		
Perceiver : dyad	1.07		1.04		
Target	1.07		1.03		
Residual	1.52		1.23		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at p < .001.

3.17 Aim 4: To examine whether sexual-desire alcohol expectancies moderate the effect of alcohol on PPA

Aim 4 was to examine whether sexual-desire alcohol expectancies moderate the effect of alcohol on PPA. Pre-drink positive mood [X^2 (1, N = 36) = 6.41, $p < .05$] and pre-drink negative mood [X^2 (1, N = 36) = 6.37, $p < .05$] were both retained in the model as they each significantly enhanced model fit. Contrary to the hypothesis, there was not a significant interaction between perceiver drink and perceiver sexual-desire alcohol expectancies on PPA [X^2 (1, N = 36) = 3.77, p =.05].[9] Conditional $R^2 = 0.61$ and marginal $R^2 = 0.01$. See Table 12 for full model results.

[9] Significance of the perceiver drink and perceiver sexual-desire alcohol expectancies was tested in a series of models representing each of eight possible combinations of PPA, pre-drink positive mood, and pre-drink negative mood, with and without their outliers included. In all but one model (wherein PPA outliers were excluded but pre-drink mood outliers were retained), the interaction effect was not significant. Because the vast majority of results were consistent with the model comparison in which all outliers were retained, as was the case in each of the previous aims, we report results from the model including all outliers.

Table 12. Regression Coefficients for Aim 4: The Interaction Effect of Perceiver Drink Condition and Sexual Desire Alcohol Expectancies on PPA

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	4.19	-0.30	0.35	11.98	.00
Perceiver alcohol (vs. control)	0.58	0.04	0.57	1.01	.31
Sexual-desire alcohol expectancies	0.02	0.00	0.10	0.24	.81
Perceiver drink : Sexual-desire alcohol expectancies	-0.04	-0.02	0.03	-1.14	.25
Pre-drink positive mood	-0.01	-0.04	0.01	-1.46	.14
Pre-drink negative mood	3.75	0.05	1.92	1.95	.05
Random Effects	Variance		SD		
Perceiver : dyad	0.82		0.91		
Target	1.41		1.19		
Residual	1.46		1.21		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Sexual-desire alcohol expectancies, pre-drink positive mood, and pre-drink negative mood were mean-centered to facilitate interpretation of the intercept.

3.18 Aim 5: To examine the role of mood in the alcohol-PPA relationship

3.19 Aim 5a: To examine the effect of perceiver drink condition on mood

Aim 5a was to examine the effect of perceiver drink condition on mood. Analyses were conducted for post-drink positive mood and post-drink negative mood separately. Session [X^2 (1, N = 36) = 594.63, p < .001], pre-drink positive mood [X^2 (1, N = 36) = 315.91, p < .001], and pre-drink negative mood [X^2 (1, N = 36) = 139.5, p < .001] were all retained in the post-drink positive mood model as they each significantly enhanced model fit. As hypothesized, perceiver drink significantly affected post-drink positive mood [X^2 (1, N = 36) = 1121, p < .001], such that perceivers reported higher post-drink positive mood on the alcohol session (M = 14.91, SD = 3.03) than on the control session (M = 13.03, SD = 3.96). Conditional $R^2 = 0.79$ and marginal $R^2 = 0.15$. See Table 13 for full model results.

Table 13. Regression Coefficients for Aim 5a: The Effect of Alcohol on Post-Drink Positive Mood

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	14.69	-0.02	0.50	29.71	.00
Perceiver alcohol (vs. control)***	1.86	0.26	0.05	35.84	<.001
Pre-drink positive mood***	0.06	0.10	0.01	6.21	<.001
Pre-drink negative mood***	25.35	0.17	1.91	13.25	<.001
Session***	-1.31	-0.18	0.06	-22.95	<.001
Random Effects	Variance		SD		
Perceiver : dyad	8.66		2.94		
Residual	3.59		1.89		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink positive mood and pre-drink negative mood were mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

Session [X^2 (1, N = 36) = 18.64, $p < .001$], pre-drink positive mood [X^2 (1, N = 36) = 6.75, $p < .01$], and pre-drink negative mood [X^2 (1, N = 36) = 9.08, $p < .01$] were all retained in the post-drink negative mood model as they each significantly enhanced model fit. As hypothesized, perceiver drink significantly affected post-drink negative mood [X^2 (1, N = 36) = 137.08, $p < .001$], such that perceivers reported lower post-drink negative mood on the alcohol session (M = 1.37, SD = 1.61) than on the control session (M = 1.83, SD = 1.69). Conditional $R^2 = 0.76$ and marginal $R^2 = 0.01$. See Table 14 for full model results.

Table 14. Regression Coefficients for Aim 5a: The Effect of Alcohol on Post-Drink Negative Mood

Fixed Effects	B	*β*	SE	*t*-Value	*p*-Value
Intercept	1.72	0.03	0.26	6.69	.00
Perceiver alcohol (vs. control)***	-0.32	-0.10	0.03	-12.03	<.001
Pre-drink positive mood	-0.00	-0.01	0.01	-0.54	.59
Pre-drink negative mood*	2.50	0.04	0.98	2.54	.01
Session**	0.08	0.02	0.03	2.68	<.01
Random Effects	Variance		SD		
Perceiver : dyad	2.24		1.50		
Residual	0.73		0.86		

Note. B = unstandardized coefficient. *β* = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink positive mood and pre-drink negative mood were mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$. ** indicates the predictor was statistically significant at $p < .01$.

3.20 Aim 5b: To examine the effect of mood on PPA

Aim 5b was to examine the effect of mood on PPA. Analyses were conducted for post-drink positive mood and post-drink negative mood separately. Pre-drink negative mood [X^2 (1, N = 36) = 17.35, $p < .001$] was retained in the post-drink positive mood model as it significantly enhanced model fit. Inclusion of perceiver post-drink positive mood significantly enhanced model fit [X^2 (1, N = 36) = 7.27, $p < .01$], but, contrary to what was hypothesized, it was not significant as an individual predictor ($p = .80$) and the association between PPA and post-drink positive mood trended negative. Conditional $R^2 = 0.59$ and marginal $R^2 = 0.01$. See Table 15 for full model results.

Table 15. Regression Coefficients for Aim 5b: The Effect of Post-Drink Positive Mood on PPA

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	4.23	-0.04	0.25	16.74	.00
Post-drink positive mood	-0.00	-0.01	0.01	-0.26	.80
Pre-drink negative mood***	5.44	0.07	1.41	3.85	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.12		1.06		
Target	1.04		1.02		
Residual	1.54		1.24		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink positive mood and pre-drink negative mood were mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

Pre-drink negative mood was retained in the post-drink negative mood model as it significantly enhanced model fit [X^2 (1, N = 36) = 16.56, $p < .01$]. Contrary to the hypothesis, post-drink negative mood was positively associated with PPA (i.e., those who reported higher post-drink negative mood reported higher PPA), but post-drink negative mood did not significantly enhance model fit [X^2 (1, N = 36) = 1.24, p =.27].[10] Conditional $R^2 = 0.59$ and marginal $R^2 = 0.01$. See Table 16 for full model results.

[10] Post-drink negative mood did significantly enhance model fit in analyses that excluded outliers for post-drink negative mood or post-drink negative mood and pre-drink negative mood (but no other variables). Because similar inferences are drawn based on the results of these models and the one reported in text and because there is not clear reason to exclude the outliers, I do not report results of these models in text or elaborate on them further.

Table 16. Regression Coefficients for Aim 5b: Effect of Post-Drink Negative Mood on PPA

Fixed Effects	B	β	SE	*t*-Value	*p*-Value
Intercept	4.16	-0.04	0.26	16.29	.00
Post-drink negative mood*	0.05	0.04	0.02	2.14	.03
Pre-drink negative mood***	5.22	0.07	1.39	3.75	<.001
Random Effects	Variance		SD		
Perceiver : dyad	1.12		1.06		
Target	1.04		1.02		
Residual	1.54		1.24		

Note. B = unstandardized coefficient. β = standardized coefficient. SE = standard error. SD = standard deviation. Pre-drink negative mood was mean-centered to facilitate interpretation of the intercept. *** indicates the predictor was statistically significant at $p < .001$.

4.0 Supplemental Study

In the dissertation proposal, we planned to have both drink condition (alcohol vs. non-alcohol) and image set randomized and counterbalanced across sessions 1 and 2. Unfortunately, once 36 participants' data had been collected, we realized that the randomization for these two factors (drink condition and image set) was the same, such that image set 1 was presented on each alcohol session and image set 2 was presented on each control session. Following consultation with the committee, we planned to present inverse pairings (image set 2 on the alcohol session and image set 1 on the control sessions) for the final 20 participants from whom we had intended to collect data. Due to Covid-19, however, all nonessential research activities at the University of Pittsburgh were mandatorily suspended (Rutenbar et al., 2020) and the final 20 participants' data could not be collected. Consequently, it was necessary to consider other approaches to disentangle an effect of drink condition from an effect of the image set. That is, although an alcohol effect was not observed in the main study, it was possible that if image set 1 were simply less attractive than image set 2, a positive effect of alcohol would have been masked in the analyses reported above. Thus, I conducted a supplemental study with new participants (*n* = 34) via an online platform, to assess differences in attractiveness ratings between the two image sets and to facilitate clearer interpretation of results from the main study.

4.1 Supplemental study aim

The aim of the supplementary study was to examine the effect of image set on PPA. It was hypothesized that PPA would not significantly differ by image set.

4.2 Method

4.3 Participants

Participants were recruited via an online participant recruitment platform, Prolific (www.prolific.co; last accessed 6/1/2020). To ensure consistency with the main study, eligible participants had to be male, between the ages of 21–28, report English fluency, and deny having uncorrected visual impairment. Participants also were required to complete the survey on a desktop, laptop, or tablet, as survey formatting was not compliant with phones. Participants were prescreened automatically via Prolific.co, which requests users enter basic demographic information.

4.4 Procedure

Participants who were deemed eligible via Prolific screening tools were directed to the PPA survey hosted on Qualtrics (Provo, UT). The survey began with questions regarding basic demographic information, which facilitated validation of participants' response to the Prolific prescreen. Participants were then sequentially presented with the two images sets and asked to rate the attractiveness of each image within each set. To control for order effects, half the participants (*n* = 17) were presented with image set 1 followed by image set 2, while the other half were presented with image set 2 followed by image set 1. Once participants completed the survey, they were redirected to the Prolific website and were paid $7.50 for their survey completion.

4.5 Materials

4.5.1 Attractiveness rating task

The attractiveness rating task and specific image sets were the same as those used in the main study.

4.5.2 Attractiveness ratings

Ratings were reported using a Likert scale of 1 (very unattractive) to 10 (very attractive).

4.6 Demographics

Participants reported their demographic information prior to the start of the rating task.

4.7 Analytic plan

The analytic strategy for the supplemental study mirrored that of the main study with regard to software used, and model assumption assessments. The PPA variable had no error outliers, and good skewness (0.18) and kurtosis (-0.40). All PPA ratings of 10 were outliers based on the standard deviation analysis. Analyses described below did not differ based on inclusion of outliers, thus, results are reported based on analyses in which outliers were retained.

To examine the effect of image set on PPA, the model was entered as follows: Supplemental.model = lmer(PPA ~ Set + (1|SubID:StudyVersion) + (1|TargetID), data=supplemental). As illustrated, I entered image set ("Set") as a fixed effect. I entered intercepts for perceivers nested within study versions (wherein study version represented the two possible orderings of the image sets) and targets as random effects, to account for non-independence of responses within each grouping. A likelihood ratio test was used to compare the full model with the main effect of image set against a model with the effect of image set removed. The *p*-value yielded by the model comparison was assessed to determine if the effect of image set was significant.

4.8 Results and discussion

4.9 Participants

The supplementary study sample consisted of 34 eligible participants.[11] Participants' ages ranged from 21-28 (mean = 23.24, sd = 1.96). The majority of participants were White (n = 26 White, 2 Asian, 2 Black, 4 more than one race) and heterosexual (27 heterosexual, 7 bisexual).

4.10 Supplemental study aim

Consistent with the hypothesis, image set did not significantly affect PPA [X^2 (1, N = 34) = 0.41, p =.52]. The mean PPA among image set 1 was 4.61 (sd = 2.02) and the mean PPA among image set 2 was 4.43 (sd = 2.15). I additionally tested the effect of study version to account for potential order effects. While there was not a main effect of study version [X^2 (1, N = 34) = 3.04, p =.08], the interaction between study version and image set significantly enhanced model fit [X^2 (1, N = 34) = 34.82, p <.001]. As seen in Table 17, PPA ratings were comparable across image sets among participants who viewed image set 1 prior to image set two.

[11] One additional participant signed up but was not permitted to complete the survey due to him not affirming his consent in participating. Thus, 35 participants total were recruited to reach the goal of having 34 participants with usable data.

Table 17. Supplemental Study PPA ratings by Image Set and Study Version

Study Version 1: Image set 1 Rated First	*Mean*	*SD*
Image Set 1	4.86	2.24
Image Set 2	4.94	2.32
Study Version 2: Image set 2 Rated First	*Mean*	*SD*
Image Set 1	4.37	1.73
Image Set 2	3.91	1.83

Note. SD = standard deviation.

Most pertinent to the present research, the difference in PPA by image sets among participants rating image set 2 prior to image set 1 suggested a trend that would have made it *more* likely to observe an effect of alcohol in the primary study (i.e., the image set rated in the alcohol condition received higher ratings than that rated in the non-alcohol condition in the primary study). Taken together, the data from this supplementary study suggest I can rule out the methodological explanation that a positive effect of alcohol on PPA in the primary study was simply masked by participants rating a less attractive image set on the alcohol session as compared to the control sessions. That is, the null finding of alcohol on PPA in the main study cannot be explained due to unbalanced image sets.

5.0 Discussion

Despite conventional wisdom that alcohol increases PPA, and in turn that these enhanced attractiveness perceptions may underlie both drinking motivation and hazardous consequences of alcohol use, this topic has received surprisingly limited empirical scrutiny. Further, existing studies have typically been atheoretical and their methods largely suboptimal (e.g., inducing low levels of intoxication, solely using static neutral expression stimuli). Building off of a recent meta-analysis on the relationship between alcohol and PPA (Bowdring & Sayette, 2018), the present study aimed to leverage theoretically-driven methods to advance this line of research, which seeks to offer a fresh perspective on the enduring questions of why people drink and why drinking can have harmful consequences for many people.

The present study sought to improve upon past alcohol-PPA methods by accounting for the social context of the drinking experience, systematically manipulating the drinking status of perceivers and targets, and controlling for perceiver intoxication and position on the BAC curve. To my knowledge, it was the first alcohol-PPA study to manipulate facial expressiveness and motion of target presentation. These advances aimed to help determine the conditions most critical to fostering alcohol's effect on PPA and inform future research. Moreover, I believe this was the first study to test whether sexual-desire alcohol expectancies would moderate the effect of alcohol on PPA, serving as an initial step in identifying those who may be most vulnerable to the potential consequences of alcohol-enhanced PPA.

Participants reported greater positive mood and less negative mood after consuming alcohol than after consuming control beverages. While this is generally consistent with decades of alcohol research (see Sayette, 2017), two points should be noted. First, despite a large literature examining alcohol's effects on mood, the vast majority of studies have tested social drinking participants (who rarely drink alone) while they were isolated (Fairbairn & Sayette, 2014). Second, among the much smaller (albeit, growing) body of experimental alcohol research that has incorporated social context, participants have scarcely been tested when drinking with familiar others (i.e., most have examined individuals drinking with strangers). A recent meta-analysis identified just five such studies, all of which assessed alcohol's social-emotional effects among romantic partners (Fairbairn, 2017). Accordingly, I believe the present research is the first lab-based study to demonstrate alcohol's effects on mood among individuals drinking with platonic friends. Considering (both light and heavy) drinking regularly occurs in social contexts comprised of platonic friends (Astudillo et al., 2013; Clapp & Shillington, 2001), such studies may be useful to inform both social and pathological drinking.

Given the effect of alcohol on mood, the present study would seem to provide a fair test of feelings-as-information theory, which emphasizes that feelings have the capacity to influence judgments (Schwarz, 2012) and suggests that alcohol-induced mood states may alter attractiveness judgments (Mehrabian & Blum, 1997). Despite the effects of alcohol on mood and contrary to the hypotheses, however, PPA did not differ according to drink condition of either perceivers or targets. This could be interpreted as damaging evidence for the ability of feelings-as-information theory to explain alcohol-enhanced PPA in naturalistic settings. I stop short of confidently drawing this conclusion, however, due to the significant effect of pre-drink mood on PPA. That is, although alcohol-induced mood (i.e., post-drink mood) did not reliably alter PPA in the present study, the significant association between *pre*-drink mood and PPA does suggest that mood (if not alcohol-*induced* changes in mood) might influence PPA. Under different conditions, a stronger effect of alcohol-enhanced mood on PPA may be observed (see *Future Directions* section).

Interestingly, a significant interaction effect between orientation-match and drink condition (for both perceivers and targets, separately) was observed. This interaction effect was driven by orientation-matched ratings yielding higher PPA in the alcohol condition than control condition and orientation-mismatched ratings yielding lower PPA in the alcohol condition than control condition. Importantly, the small drink-condition effect sizes (and perhaps combined with low power) meant that the effect of alcohol was not significant when follow-up analyses were conducted within each orientation-match condition separately. Though caution is warranted in interpreting the nonsignificant PPA differences between drink conditions within each orientation-match condition separately, the direction of the effect among orientation-matched ratings is consistent with prior work (Bowdring & Sayette, 2018; Van Den Abbeele et al., 2015). Among the small body of extant alcohol-PPA research, only seven studies have tested the effect of alcohol on PPA among orientation-*mis*matched ratings (Bowdring & Sayette, 2018). Notably, the aggregate results of these orientation-mismatched studies have been inconclusive with regard to the direction of alcohol's effect. Further work will be needed to clarify differences between orientation-matched and -mismatched PPA among individuals consuming alcohol. Additionally, due to all participants in the present sample being male and nearly all being heterosexual, the present study could not disentangle the variance in PPA explained by orientation-match from that explained by target-gender. That is, for all but one participant, orientation-matched ratings referred to ratings of female targets, while orientation-mismatched ratings referred to ratings of male targets. Future studies using samples encompassing more diverse perceiver genders and sexual orientations will be in better position to explicate the effect of orientation-match on the alcohol-PPA relation.

Perhaps unsurprisingly given the absence of a main effect of alcohol on PPA, neither target expressiveness, target motion, nor perceiver alcohol-expectancies significantly moderated an alcohol-PPA relation in the present study. Altogether, in spite of the methodological advances employed, hypotheses in the present study were largely unsupported (see Aims 1c, 2a, 2b, and 5a for exception). One might conclude based on the present data that a causal relation between alcohol intoxication and PPA simply does not exist. Such a position would run counter to a recent meta-analysis (Bowdring & Sayette, 2018), qualitative reports (Carey et al., 2019; Coleman & Cater, 2005; Palamar et al., 2018), and conventional wisdom. While most studies can point to limitations, in this instance I believe that, despite my best efforts to capture the effects of alcohol on PPA, methodological limitations may have hampered observation of a PPA effect. Below I consider limitations that may have influenced our findings.

5.1 Limitations

5.2 Confound between drink condition and stimulus set

One potential confound in this study was the identical randomization schedule of drink condition and image set, which precluded the disentanglement of the effects of these two factors on PPA in the primary study. Accordingly, the hypothesized positive effect of alcohol might have been masked by this randomization confound. Specifically, if the alcohol-session image set were less attractive than the control-session image set, then the contrast between alcohol and control sessions would have been biased against the hypothesized finding. Importantly, the supplemental study alleviated this concern by demonstrating that the alcohol-session image set was not less attractive than the control-session image set. If in fact alcohol does enhance PPA, it therefore is instead likely that, despite efforts to leverage relevant social psychological and alcohol theories to improve upon past alcohol-PPA methods, our execution of these approaches fell short of fostering alcohol-PPA experiences that mirrored the richness of those that occur outside of the lab.

5.3 Potential to interact with targets

While the confound between drink condition and stimulus set was unlikely to obscure an effect of alcohol on PPA, the possible inability to generate a belief in raters that they might actually interact with targets is more concerning. The ecological approach to person perception suggests that potential to interact with targets is key to perception processes, as it enhances motivation to detect and attain affordances offered by those targets (e.g., potential relationships; Zebrowitz & Montepare, 2006). For example, when perceivers wish to socially bond (platonically or romantically) and have the possibility of bonding with the target of perception, that target offers an affordance that the perceiver seeks, which enhances the target's attractiveness more than if bonding with the target is not possible. Research indicates that the desire to form connections conflicts with the fear of encountering rejection (Murray, Holmes, & Collins, 2006). Moreover, doubting a target's receptivity to social interaction reduces the perceiver's desire for that target (Greitemeyer, 2010). Because alcohol reduces fear of rejection, augments the perceived receptiveness of targets, and enhances social and sexual expectancies related to drinking (Brown et al., 1987; Fairbairn & Sayette, 2014; Farris et al., 2010), motivation to bond should be increased among individuals consuming alcohol. In turn, the influence of the social bonding affordance on PPA should be greater and PPA should be enhanced among individuals consuming alcohol when they have the opportunity to attain that affordance. The present study took a first step toward accounting for this perceived ability to interact with targets within a lab setting by informing participants that they might be invited to partake in a future study with some of the targets they had viewed.

While this approach aimed to create a PPA experience that better modeled those in naturalistic settings, it nevertheless still may have lacked the degree of ecological validity necessary to capture the key elements (e.g., desire to bond, fear of rejection) that often exist in real world "beer-goggles" situations. Research on perceived opportunity to consume food and drugs, respectively, has highlighted that the immediacy of the consumption opportunity alters judgments of those substances. Specifically, when participants are exposed to substance cues, greater craving for and appeal of the substance – as well as increased neural activation in regions associated with reward, motivation, and cue-reactivity – is demonstrated among participants who soon have the opportunity to consume the substance compared to those who do not (Blechert et al., 2016; Wertz & Sayette, 2001; Wilson et al., 2012). To the extent that attractiveness perceptions are similar to perceptions of these other environmental (i.e., substance, food) cues, (Gibson, 1979; Zebrowitz, 2006), the belief that one can soon attain affordances of the attractiveness targets may be crucial in order for alcohol to enhance PPA. Additionally, testing in a context where the affordances can be achieved would enable researchers to explore whether alcohol-enhanced PPA fosters approach behaviors (e.g., initiating social interaction) and subsequent bonding that has been previously observed during intoxicated social interactions (Sayette et al., 2012).

Participants in the present study were not led to believe that they would interact with targets in the immediate future (i.e., not while completing the present study). Moreover, during the debriefing, at least three dyads asked the experimenter how long ago the PPA images had been taken and, when prompted for their guess, at least two dyads estimated it had been approximately five to ten years (indeed, the images were generated 10-12 years ago). It may be that additional participants also questioned their potential to interact, but did not explicitly share their doubts with the experimenter. Thus, despite our best efforts, at least some participants may not have believed that they would have the possibility of interacting with some of the targets. While attainment of affordances via potential to interact is likely not the only pathway through which alcohol enhances PPA, to the degree that it is one pathway, the null effect of alcohol on PPA in the present study may have been partially due to the use of methods that were suboptimal in stimulating this mechanism. Future research will benefit from presenting more recently developed target images, ideally of individuals with whom perceivers can soon interact (e.g., two groups of perceivers could rate images of each other in separate lab rooms prior to being brought together for a social interaction).

5.4 Future directions

Given the lack of support for alcohol's ability to enhance PPA, future research might continue to evaluate research paradigms that reliably capture this effect. [Notably, although a meta-analysis revealed a small *aggregate* effect of alcohol on PPA, consistent with the present study, the majority of studies reviewed failed to reveal significant effects (Bowdring & Sayette, 2018).] In addition to incorporating social context, inducing moderate-to-high BACs, and assessing PPA while perceivers are on the ascending limb of the BAC curve, I would encourage future studies to more effectively convince participants that they will have an immediate opportunity to interact with targets. In moving toward more naturalistic approaches, a wealth of methodological decisions related to the social context of the study arises.

5.5 Social context

Social drinking experiences often occur among individuals who are acquainted (Sayette et al., 2015), and friends with whom an individual regularly drinks have a particularly strong influence on one's own alcohol outcomes (e.g., frequency of drinking, alcohol-related problems; Lau-Barraco, Braitman, Leonard, & Padilla, 2012; Lau-Barraco & Linden, 2014). The present study began to address the need for research on the effects of alcohol consumed among friends (by testing alcohol's effect on PPA when alcohol consumption occurs in the presence of a platonic friend). Though I believed recruiting friends rather than strangers would be more reflective of naturalistic alcohol-PPA experiences (e.g., friends going to a bar together and scanning the room for potential romantic partners), alcohol's effect on mood may be greater among individuals drinking in the presence of strangers as compared to among those drinking in the presence of familiar others (Fairbairn, 2017; Fairbairn et al., 2018). Thus, future studies may be able to enhance the potential alcohol-induced mood effect on PPA by having perceivers drink in a social context with unfamiliar others. In addition, future research might examine the impact of alcohol on PPA when perceivers and targets are previously acquainted.

Similar to alcohol's subjective effects, alcohol expectancies also differ according to drinking context (Wolkowicz et al., 2019). Prior work has demonstrated that positive expectancies, including arousal and social/sexual enhancement, are greater when drinking occurs in sexual contexts (e.g., drinking with a romantic partner or date) than other types of social contexts (drinking with friends or family) (MacLatchy-Gaudet & Stewart, 2001). Expectancies attune perceivers to certain affordances (e.g., platonic or romantic social relations), which in turn influence the perception process (Zebrowitz, 2006). Moreover, the capacity for alcohol to increase sexual arousal (Wilson, 1981) and for sexual arousal to increase PPA (Ditto et al., 2006), underlines the need to consider whether the study context frees up participants to experience their sexual arousal in a way that they naturally would outside of study parameters. Indeed, the social and sexual expectancies, as well as sexual arousal, that arise in bar (or simulated bar) settings likely differ from those that arise when drinking in a lab (Monk & Heim, 2013; Wall et al., 2000). Such concerns speak to the utility of considering naturalistic evaluations of alcohol and PPA outside of the laboratory.

Gender composition of the social context is another factor that may alter the alcohol-PPA experience. Future work is indicated that also includes perceivers beyond those whose gender identity is male. Because prior work suggests males are particularly susceptible to alcohol's social effects (Sayette, 2017), recruitment was limited to males in the present study in an effort to enhance the likelihood of detecting effects given fixed resources limiting our sample size. A larger study would be needed to examine the respective moderating roles of perceiver-gender and concordance of gender within the social drinking group on the alcohol-PPA relation. Visual attention differs according to gender and gender composition of the social context – namely, there is greater attention directed toward females' than males' appearance, and this effect is exacerbated when females are the minority gender in the viewing context (Amon, 2015). Consistent with alcohol myopia theory suggesting that intoxication leads already salient information to become *more* salient (Steele & Josephs, 1990), the appearance of female targets may become even more salient when consuming alcohol and potentially contribute to a moderating role of gender in the alcohol-PPA relation.

In sum, future research that includes observations of actual social encounters between perceivers and targets may be optimally suited to capture the role of both cognitive (e.g., expecting a potential interaction) and behavioral (e.g., engaging in approach behaviors and experiencing responsiveness from targets) components of the alcohol-PPA relation. It also will be useful to incorporate a greater diversity of social contexts (e.g., differing levels of familiarity and group-gender composition), as well as of individual perceivers and targets (e.g., race and age representation) to capture the richness of naturalistic alcohol-PPA experiences and, in turn, to help explain the reinforcing nature of social drinking experiences.

5.6 Conclusion

The present study aimed to advance the methods used in prior studies of alcohol and PPA in a variety of ways in order to assess the effects of alcohol on PPA and to examine a key individual difference factor (alcohol expectancies related to sexual desire) that might moderate this effect. Results indicated that alcohol enhanced mood among the platonic friend pairs but largely had no impact on PPA. While the present study did not yield anticipated findings for PPA, theoretical and methodological considerations outlined above may be useful in progressing this area of study, which pertains to (a) alcohol researchers interested in social mechanisms underlying alcohol reward, (b) public health researchers seeking to understand the link between alcohol and risky sexual behavior, and (c) clinicians addressing problem drinking practices and maladaptive social patterns. Future research is needed to better model naturalistic PPA experiences in order to elucidate the true magnitude of the effect of alcohol on PPA, as well as mechanisms and consequences of the relationship. Doing so will allow researchers to expand the breadth of existing alcohol theories, and to more generally enhance our understanding of individuals' motivations for and consequences of alcohol consumption.

Appendix A Attractiveness Rating Task

Appendix A.1 Stimuli development

Videos were previously coded using Paul Ekman's Facial Action Coding System (FACS; Ekman & Friesen, 1978), which is the gold standard for measuring visible facial movements thought to be related to emotion. This coding, as well as previously coded speech and beverage sipping behaviors, informed the frames of video extracted for stimuli creation. Stimuli from videos of control-beverage consuming participants were previously extracted for a study with sober participants using the following criteria (Bowdring et al., invited resubmission), and alcohol-consuming participant stimuli were extracted using the same criteria. Each stimulus type was defined by the following:

1. Static images were single frames of video.
    a. Static neutral: absence of AUs (P. Ekman & Friesen, 1978).
    b. Static smiling: presence of the genuine, "Duchenne," smile – AUs 6 (cheek raiser) + 12 (lip corner puller) – (Ekman & Friesen, 1982), along with AU 25 (lips part), as open mouth criteria has been applied in previous research and has been shown to increase smile authenticity (compared to closed-mouth Duchenne smiles; Korb, With, Niedenthal, Kaiser, & Grandjean, 2014; Krumhuber, Manstead, Cosker, Marshall, & Rosin, 2009).

2. Dynamic images were five-second periods of video in which the target was talking[12], as has been done in past research in order to capture facial dynamics that are typical of perception experiences in natural social interactions (Parker et al., 2008; Rennels & Kayl, 2015).
    a. Dynamic neutral: absence of AUs.
    b. Dynamic smiling: presence of AUs 6 (cheek raiser) + 12 (lip corner puller) + 25 (lips part), wherein AU 6 was not present at the start of the clip but occurred at some point and remained present through end of the clip (such that the image displayed the onset, but not offset, of the Duchenne smile, as the onset of a smile encompasses a key component of the social signal; Cohn & Schmidt, 2004; Leonard et al., 1991)

Frames from each stimulus type were non-overlapping with one another (e.g., the static smiling stimulus presented a different smile than did the dynamic smiling stimulus for a given target; Rennels & Kayl, 2015; Roberts et al., 2009). Sipping behavior and presence of the cup were absent from all images. Eye gaze in each frame of stimuli was directed away from the camera, as eye-gaze can alter PPA (Jones, DeBruine, Little, Conway, & Feinberg, 2006) and our

[12] Our previous study using sober participants found no main effect of audio-accompaniment on attractiveness ratings (Bowdring et al., invited resubmission), which may be in part due to considerable variability in the content and quality (e.g., volume, clarity) of vocalizations. Thus, because inclusion of audio would likely be confounded and because the present study focuses on alcohol's effect on perceptions of *physical* attractiveness (Post et al., 2012), dynamic images will be audio-free. Because acoustics can be altered by alcohol (Fairbairn, Sayette, Amole, et al., 2015) and because vocal cues can alter perceptions of attractiveness (Raines et al., 1990), incorporation of audio into PPA stimuli may be a direction of interest for future research.

video dataset did not have sufficient images available to extract stimuli in which eye gaze was directed toward the camera.

Appendix A.2 Task set up

To facilitate completion of the PPA task within the time course of the drinking period (i.e., within 18 minutes), participants rated 64 images per session (128 total, derived from 32 targets).[13] This, to my knowledge, was the largest facial image stimulus set used in a study of alcohol and PPA. Images were evenly split by target gender (male, female), target drink condition (alcohol, control beverage), and stimulus type (static neutral, static smiling, dynamic neutral, dynamic smiling), and distributed evenly across sessions. I randomized the 32 targets into separate session sets, the presentation of which was intended to be counterbalanced across sessions and drink-condition order (i.e., half the session one control drink dyads would view set one during session one, while the other half would view set two during session one). The 64 images within a set (four stimulus types per 16 targets) were presented in random order for each dyad (Okubo et al., 2015).

[13] Estimated completion time is based on the prior study using sober participants, which took about ten seconds per stimulus, while accounting for additional time that may result from discussion within the dyad (six to eight additional seconds per stimulus).

Appendix B Demographic Questionnaire

1. Highest school grade completed (circle one):

1 2 3 4 5 6 7 8 9 10 11 12

College: 1 2 3 4 4+ **Graduate:** 1 2 3 4 4+

2. Racial background (check one): American Indian/Alaska Native________
Asian________
Black or African American________
Native Hawaiian/Pacific Islander________
White________
More Than One Race________

3. Ethnic background (check one): Hispanic or Latino________
Not Hispanic or Latino________

4. Sexual Orientation? Bisexual
Gay or Lesbian
Prefer not to say
Straight/Heterosexual
Prefer to self-describe _________________

5. Is English your first language? Yes No

6. Age:

7. Date of Birth:

8. Are you colorblind? Yes No

9. Do you have an uncorrected visual impairment? Yes No

(If you have visual impairment that is corrected by glasses or contacts, circle “No”)

10. Have you ever been involved in any research involving alcohol? Yes N0

If YES, please describe:____

Appendix C Outlier Detection and Management

Unless noted below variables can be assumed to have no outliers and for those involved in analyses based on assumptions of normality, they can also be assumed to have acceptable skewness (values between +/- 2) and kurtosis (values between +/- 7) (Kim, 2013; West et al., 1995). Skew and kurtosis were assessed using the psych extension (Revelle, 2014). Boxplots were used to facilitate visual inspection of outliers. Quantitative inspection of outliers was based on standard deviation analysis, wherein z-scores were calculated for each variable and data points +/- 2.24 standard deviations away from the mean of the relevant variable were considered to be outliers (Aguinis et al., 2013). In cases where visual and quantitative inspection of outliers diverged, data points detected by either approach were considered outliers (Aguinis et al., 2013).

Skewness and kurtosis are not reported for variables that were only assessed with descriptive statistics. Variables of this type that did have outliers included: pre-drink subjective intoxication (four outliers: one, two, five, 100); end estimate of alcohol consumed (two outliers: 60 and 150); frequency of drinking with friend per month (two outliers: two tens); years of friendship (four outliers: two tens, 12, 13); closeness of friendship (one outlier: three). Any reported descriptive statistics of these variables are based on outliers being excluded. Outlier, skew, and kurtosis management for the remaining variables were based on the approaches described below.

Appendix C.1 Permanent removal of outliers required

Outlier removal was required for error outliers, specifically, those lying outside the possible range of values for a variable. Error outliers were only detected for the PPA variable. Seven PPA entries of zero (across three participants and five targets) were treated as missing in all relevant analyses, as these values were outside of the PPA scale range.

Appendix C.2 Neither transformation nor permanent removal of outliers required

For variables that had acceptable skew and kurtosis but had outliers, analyses were run with and without outliers included to assess their level of influence. Results reported in text are based on analyses including outliers which, unless otherwise noted, can be assumed to not meaningfully differ from analyses excluding outliers. Variables for which this was the case included: pre-drink positive mood (PANAS, positive subscale; two outliers: 11 and 45), PPA after error outliers were removed (34 non-error outliers: 27 nines and eight tens), post-drink positive mood (eight-item mood measure – positive subscale; two outliers: zero and four), and post-drink negative mood (eight-item mood measure, negative subscale; six outliers: five, four sixes, and seven).

Appendix C.3 Transformation required

Only one variable involved in analyses based on assumptions of normality, pre-drink negative mood (PANAS – negative subscale), had unacceptable skew (3.29) and kurtosis (13.85). Pre-drink negative mood also had three outliers (17, 26, and 21). Because the variable was right-skewed, the following transformations were applied, such that transformations of increasing magnitude were applied when prior transformations failed to yield acceptable skew and kurtosis: square root, cube root, logarithmic, and negative reciprocal root.[14] Skew remained unacceptable for the square root through logarithmic transformations, and kurtosis was not acceptable until the final transformation. Thus, the negative reciprocal root transformation was maintained for analyses involving pre-drink negative mood (three outliers, skew = 1.75, and kurtosis = 4.05). Analyses were run with and without outliers included to assess their level of influence. Results reported in text are based on analyses wherein outliers were included. Any descriptive statistics of these variables are based on the untransformed versions of the variables.

[14] The negative reciprocal root transformation was made negative to maintain the relative ranking of data (Pereira-Maxwell, 2018).

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