

Understanding Social Factors in Alcohol Reward and Risk for Problem Drinking

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Abstract

Researchers have long sought to capture acute rewarding effects associated with drinking alcohol with the view that a better understanding of alcohol's rewards will ultimately inform our knowledge of factors motivating problematic drinking. Importantly, however, although most everyday alcohol consumption occurs in social contexts, and drinkers report that socially enhancing effects of alcohol motivate their drinking, researchers studying alcohol's effects have often examined participants drinking alone and have neglected social elements of alcohol's impact on experience. Here, we present a program of work aimed at examining the social rewards individuals gain from alcohol consumption with the aim of achieving a more complete picture of factors that might reinforce alcohol consumption and potentially lead some to drink excessively. Using methods and measures aimed at tapping social elements of experience, we revisit questions that have been of enduring interest in the alcohol literature, including the question of what mechanisms might explain alcohol's rewarding effects, whether there exist individual differences in sensitivity to alcohol's rewards, as well as the extent to which context-level factors might moderate rewards gained from alcohol. We also explore questions left unanswered within this body of work, together with ongoing and future research directions.

Keywords: alcohol, social context, reward, emotion

“The culture of drink endures because it offers so many rewards: confidence to the shy, clarity for the uncertain, solace to the wounded and lonely, and above all, the elusive promises of friendship and love” (Hamill, 1994, p. 1).

Drinking alcohol can lead to significant problems for the individual across life domains, including health, financial, and emotional issues. Chronic alcohol overconsumption is linked to a variety of physical injuries and ailments (Rehm et al., 2010; White, Slater, Ng, Hingson, & Breslow, 2018), financial problems and lost work productivity (Bouchery, Harwood, Sacks, Simon, & Brewer, 2011; Harwood, Napolitano, Kristiansen, & Collins, 1984), and, over the long term, heavy drinking patterns are associated with anhedonia and depression (Boden & Fergusson, 2011; Hatzigiakoumis, Martinotti, Di Giannantonio, & Janiri, 2011). Yet, despite all of the problems caused by alcohol, people still continue to drink. Over half of adults in the United States drink alcohol regularly, with 27% of the adult population engaging in regular binge drinking (Substance Abuse and Mental Health Services Administration, 2015). Given the widespread popularity of alcohol consumption, it is perhaps unsurprising that alcohol is ranked as the third leading preventable cause of death in the United States (Centers for Disease Control and Prevention, 2010). And so, we are left with the question...why do people drink? Given all of the negative consequences that can accrue to the individual, and to society, as a result of drinking, what motivates people to still consume alcohol in such numbers and with such regularity?

To answer this question, alcohol researchers have often looked to the immediate rewards individuals experience from alcohol consumption—rewards that may seem familiar to many drinkers. To provide just a few examples, a beer after work can relieve the tension of the day, a

bottle of wine with a friend can conjure a sense of warmth and affiliation, and a mixed drink at a social gathering can engender feelings of elation or, alternatively, ease the stress of the occasion. In other words, drinkers report that consuming alcohol can enhance positive mood, decrease negative mood, and help them achieve motivationally-salient goals, and researchers have theorized that these acute rewards play a key role in motivating alcohol use (Brown, Goldman, & Christiansen, 1985; Cooper, 1994). It's believed that, in some individuals, alcohol's rewarding effects can ultimately contribute to the development of alcohol problems (Sher & Wood, 2005), and the notion that alcohol leads to immediate rewards lies at the heart of many modern theories of addiction (Conger, 1956; Levenson, Sher, Grossman, Newman, & Newlin, 1980; Steele & Josephs, 1990; Stritzke, Lang, & Patrick, 1996).

In an effort to better understand factors underlying problem drinking, dozens of studies, conducted over the course of several decades, have sought to capture acute rewards associated with alcohol consumption. Often examining populations of social drinkers (individuals potentially at risk for developing drinking problems) and focusing on alcohol's emotional rewards (e.g., stress-relief, enhancement of positive mood), these studies have employed a range of methods including laboratory-based alcohol-administration studies and, more recently, ambulatory paradigms permitting the examination of alcohol response in everyday contexts. This literature has contributed valuable insights to the understanding of alcohol's effects under specific conditions. Yet findings from this literature have been surprisingly mixed. In some studies, no significant rewarding effects of alcohol have emerged (Balodis, Wynne-Edwards, & Olmstead, 2011; Himle et al., 1999; Keane & Lisman, 1980; Schippers, de Boer, Van Der Staak, & Cox, 1997; Wilson, Abrams, & Lipscomb, 1980). A not insubstantial minority of these studies have in fact captured a negative effect of alcohol—i.e., alcohol seemed to make people feel

worse (Childs, O'Connor, & de Wit, 2011; Söderpalm & de Wit, 2002). And in studies where rewards from alcohol do emerge, as often as not, effects are relatively weak or small in magnitude (De Boer, Schippers, & van der Staak, 1993; Himle et al., 1999) Thus, in terms of the scientific literature examining alcohol's rewards, the question of why people drink—i.e., what do people get out of drinking that might offset all of the negative potential consequences that can accrue to the drinker?—has yet to be answered.

Importantly, a striking feature of the literature examining rewards of drinking is the consistent neglect of social context and social elements of experience. In the present chapter, we present a program of research aimed at introducing social drinking contexts and social effects of drinking into the examination of alcohol's rewards with the view that, by integrating these social factors, we are able to better capture alcohol rewards and elucidate factors motivating problem drinking.

Social Contexts, Social Motives, and Alcohol Reward: Alcohol is a social drug. Across history (Heath, 1995), culture (MacAndrew & Edgerton, 1969), religion (Bales, 1945), and social class (Single & Wortley, 1993) people have consumed alcohol in the company of others. Some prior alcohol research has reflected the social nature of alcohol consumption by incorporating social contexts into experimental designs (e.g., Fairbairn, 2017; Fairbairn & Sayette, 2014). Importantly, however, the overwhelming majority of the empirical research literature exploring rewarding effects of alcohol has examined participants drinking alone and, where social contexts are incorporated, explicitly social elements of experience are ignored. Thus, although outside of empirical research the majority of alcohol consumption takes place in social context, within research studies, the vast majority of studies have overlooked social factors.

The general disregard for social environment among alcohol researchers may be partially attributable to widespread assumptions about the nature of social drinking and its effects—assumptions that are pervasive within both the scientific literature as well as within popular discourse. *One assumption* has been that social drinking is necessarily non-problem drinking and so not relevant to the understanding of alcohol use disorder (AUD). For example, prominent scholar E. Morton Jellinek (1946) famously observed that the majority of individuals in Alcoholics Anonymous reported drinking alcohol alone on at least one occasion, and concluded that such a practice might serve as an early sign of problematic drinking. Since Jellinek's time, correlational survey studies have tended to find that individuals who drink more heavily are more likely to drink alone than casual drinkers, providing further fuel to the conception that social drinking is non-problem drinking (Bourgault & Demers, 1997). *A second assumption* has been that social drinking motives are not powerful motives, or certainly not sufficiently powerful to explain a disease as devastating as alcohol use disorder. The general principle here is that social motives might act as motives “extrinsic” to the individual—being imposed from without by others rather than emerging as an organic motive from within—and thus have the relative impotence and inconstancy associated with such externally imposed drives. Thus, social drinking enjoys virtual impunity from public condemnation, and the term “social drinker” has become synonymous with a non-problem drinker (e.g., Vuchinich & Simpson, 1998).

Of note, neither of these assumptions has withstood empirical scrutiny. Regarding the first of these assumptions, social settings represent the most common context for alcohol consumption among all drinkers—both problem drinkers and non-problem drinkers do most of their drinking in the presence of other people (Bourgault & Demers, 1997; Cahalan, Cisin, & Crossley, 1969; Demers et al., 2002; Single & Wortley, 1993). Importantly, even the subset of

severe problem drinkers who ultimately go on to do much of their drinking alone almost all started out consuming alcohol in social contexts, and so their first experiences with alcohol were in the presence of others (Warner & White, 2003). People consistently consume more alcohol in social contexts vs. when drinking alone (Caudill & Marlatt, 1975; Sommer, 1969), and social drinking contexts are associated with some of the most severe negative consequences of drinking, including extreme binge drinking, alcohol-related aggression, and driving while intoxicated (Bushman & Cooper, 1990; Park, Sher, & Krull, 2008; G. S. Smith, Branas, & Miller, 1999). The second of these assumptions—the notion that social motives are necessarily not powerful motives—seems particularly problematic in light of the evidence. Social psychological researchers have identified the need to belong as a fundamental human motive (Baumeister & Leary, 1995; Leary, 2010). Evolutionary psychologists have postulated that the ability to form connections with other people has been critical to survival throughout human history (Baumeister & Leary, 1995), and relationship-building behaviors are among the first social acts in which human infants engage (Bowlby, 1969). Thus, social motives are among the more powerful and intrinsic that humans possess. And, consistent with the idea of social motives as powerful motives, the belief that alcohol will enhance social interaction has been identified as among the more robust predictors of later onset of alcohol use disorder (Brown et al., 1985; Christiansen, Smith, Roehling, & Goldman, 1989; Connors, O'Farrell, Cutter, & Thompson, 1986; G. T. Smith, Goldman, Greenbaum, & Christiansen, 1995)

One possibility is that prior research has been unable to consistently capture rewarding effects of alcohol because it has consistently neglected social factors. Laboratory-based studies of alcohol reward have overwhelmingly examined individuals drinking alone—a highly atypical drinking context. Ambulatory studies examining participants outside the lab have often failed to

assess social elements of the drinking context and experience. Both laboratory and ambulatory studies have focused on individual-level affective experience (e.g., reductions in stress), and have ignored elements of alcohol reward that might manifest in reference to the social environment (e.g., increased perceptions of social bonding and social cohesion). If we were to incorporate such social elements of the drinking experience, it is possible that alcohol's rewards, and thus its addictive potential, might become more apparent.

Our group has conducted a series of studies that provide support for this premise. In one of the largest alcohol-administration studies ever conducted (N=720), we randomly assigned participants to consume an alcoholic or a non-alcoholic beverage in a laboratory study at the University of Pittsburgh. Unlike in many prior studies, participants consumed their beverages in a group context. As participants drank, we coded their facial expressions and speech behaviors, and after they were finished drinking, we asked them to complete self-reports of their mood and social experience. In this study, we found the robust and powerful support for alcohol as a rewarding substance that had been lacking in prior research—across response modalities and levels of analysis, alcohol led to increases in positive mood and social experience (i.e., increases in self-reported happiness and individual and group level smiling) as well as reductions of negative mood and negative social experience (i.e., reductions in reported negative mood, negative facial expressions, and silence). All effects were medium to large in magnitude (Fairbairn & Sayette, 2013; Fairbairn, Sayette, Wright, et al., 2015; Sayette et al., 2012).

Our subsequent research has provided additional support for unstructured social settings as a key context for capturing alcohol reward. In a systematic review of the alcohol-administration literature, we found that laboratory studies comparing alcohol reward experienced among participants drinking in social contexts is significantly larger than alcohol reward among

participants drinking alone (Fairbairn & Sayette, 2014). In other words, in studies where participants consumed alcohol both in social contexts and also alone, observed reward from drinking was significantly larger in social contexts (del Porto & Masur, 1984; Doty & de Wit, 1995; Kirkpatrick & de Wit, 2013; Pliner & Cappell, 1974). In a subsequent empirical study, our group replicated the University of Pittsburgh laboratory study, this time using a within-subject design in which all participants participated in both alcohol and no-alcohol laboratory group drinking sessions (N=48). Participants also engaged in ambulatory assessment of alcohol use outside the laboratory, wearing transdermal alcohol monitors to continuously assess their drinking and also supplying photographs of their social surroundings and self-reports of their mood in response to random prompts. Results from the laboratory arm of the study again produced robust support for a mood-enhancing effect of alcohol in a group context (Fairbairn, Bresin, et al., 2018; Sirlanci et al., In Press, 2018). Further, results from the ambulatory arm of the study indicated that emotional rewards from alcohol were significantly larger in social contexts, and this effect did not reach significance among participants drinking alone (Fairbairn, Bresin, et al., 2018; Fairbairn, Rosen, Luczak, & Venerable, in press).

To this point, this program of work has established that empirical research can capture rewarding effects of alcohol. Put briefly, results indicate that alcohol's rewards, which emerged as notoriously weak and inconsistent in the prior empirical literature, emerge as potent in social contexts. Conceptually, this contribution does not break major ground—the notion that alcohol consumption makes people feel good is one any observant bartender might have conceived. In methodological terms, however, this contribution is considerable, as it identifies a context in which alcohol reward emerges as robust. Having identified an ecologically-valid drinking paradigm well suited to building a fundamental understanding of alcohol's rewards, we can now

go on to address more nuanced questions that have been of enduring interest to alcohol researchers. This includes the question of why alcohol enhances mood—what are the mechanisms that underlie alcohol-related reward?—who is particularly sensitive to alcohol’s reinforcing properties—how do individuals differ in the reinforcement they gain from alcohol?—and finally the question of where this alcohol reinforcement is especially pronounced—are there social contextual moderators of alcohol’s reinforcing effects? This chapter expands on our group’s research activities as they pertain to each of these three questions.

Underlying Mechanisms (Why?)

Research indicates that alcohol’s emotionally reinforcing properties are especially potent in social contexts. As reviewed above, alcohol consumption produces dramatically larger positive mood enhancing and negative mood relieving effects when it is consumed in social contexts compared to when it is consumed in isolation. This leaves open the question of why—what is it about the combination of alcohol and social interaction that can together evoke such a powerful emotional response? Researchers have long held that, if we can identify the fundamental mechanisms underlying alcohol reward, then we can ultimately understand a lot about alcohol and what makes it addictive.

While there has been little research directly exploring how alcohol might increase social enjoyment, several theorists have offered speculations on this point. In particular, one of the more prominent models of alcohol’s effects, Steele and Joseph’s Attention Allocation Model, posits that alcohol can lead to enjoyment by narrowing attentional capacity to stimuli in the immediate environment (Steele & Josephs, 1990). Although social drinking settings may occasionally feature more explicitly threatening/stressful cues, these settings are more often casual contexts characterized by relatively positive/non-threatening elements (e.g., chatting with

friends at happy hour, dancing at a club, catching up with family over wine at dinner, meeting new acquaintances at a party). According to the Attention Allocation Model, social contexts offer a setting well suited to harnessing alcohol's rewards because drinking contexts often feature positive stimuli (e.g., a smile, a joke) and alcohol thus enhances social experience by increasing intoxicated individuals' responsiveness to these positive immediate cues. Importantly, however, casual social interactions involve not only positive stimuli, but also a range of more uncomfortable and/or ambiguous moments (e.g., a fleeting negative expression, a lull in conversation, a reduction in smiling) and, within such moments, it may be unclear whether there is a threat to self or social relationships and so a sense of anxiety may ensue. Research indicates that individuals tend to be hypervigilant to such signals, and so these ambiguous/uncertain moments may have a disproportionate influence on individuals' emotional experience in social contexts (Fairbairn & Sayette, 2014; Leary & Kowalski, 1995). Alcohol is well-known for its ability to relieve negative feelings in the context of stress, and research indicates that alcohol's anxiolytic properties are particularly potent when stressors involve an element of ambiguity and uncertainty (Moberg & Curtin, 2009; Stritzke et al., 1996). Thus, it is not implausible that alcohol acts to enhance social experiences not necessarily by making the "good times better," as the Attention Allocation Model predicts, but instead by alleviating a sense of discomfort during quieter, more uncertain social moments.

Our group has sought to capture the mechanisms that underlie alcohol's powerful socially enhancing effects through employing large-scale experimental alcohol-administration paradigms as well as a micro-analysis of behavioral-affective display. In particular, in a recent project, we aimed to examine how alcohol elicits social rewards through examining participants' response to a comedy routine in a group context (Fairbairn, Velia, Creswell, & Sayette, Under Review;

Sayette et al., in press). The social paradigm employed in this research allowed us to isolate times when distinct positive stimuli were being presented, while also reflecting a structured social experience similar to those observed in many everyday drinking contexts (e.g., viewing television or movies, attending concerts, watching sporting events, etc.; Single & Wortley, 1993). Participants (N = 513) were randomly-assigned to consume an alcoholic or non-alcoholic beverage in the laboratory and were then video-recorded during presentation of one of Jerry Seinfeld's standup comedy routines in 3-person groups. Each frame (1/30th second) of video was coded using the Facial Action Coding System (FACS; Ekman, Friesen, & Hager, 2002)—a system for analyzing and categorizing all observable muscle movements in the face. In examining rewarding effects, we focused on the Duchenne smile, a facial expression that has been widely researched as a hallmark of “true” or “felt” enjoyment (Ekman & Rosenberg, 2005). Results indicated that alcohol selectively increased Duchenne smiling during times when no humorous stimuli were being presented. In contrast, there was no significant effect of alcohol on smiling in response to the humorous stimuli themselves. Thus, results of this research did not provide support for the notion that alcohol enhances social interaction by increasing responsiveness to immediate positive stimuli, but instead were in line with theory indicating that alcohol might specifically act to enhance experience during more ambiguous social moments.

Our work has also explored how mechanisms underlying alcohol's rewards might be revealed through an examination of individual-level processes as they manifest over time. In particular, we have examined the impact of alcohol consumption on the relationship between an individual's emotions of the present moment and their emotions of the immediate past—i.e., affective shifts from one moment to the next (Fairbairn & Sayette, 2013). In one study, we examined 720 participants who were assigned to receive either an alcoholic or a non-alcoholic

beverage in a group context. Here, we were interested in the behavioral and affective variation that might manifest in response to wholly unstructured social interaction, and so participants in this study were allowed to interact freely over the course of 36 minutes as they consumed their study beverages. We measured emotional fluctuations using autocorrelation—a statistic borrowed from time-series analysis. Specifically, we examined the association between participants' Duchenne smiles as displayed from one moment to the next of the social interaction. Findings revealed that alcohol consumption significantly reduced the autocorrelation of affective display—in other words, alcohol significantly reduced the link between participants' Duchenne smiling of the present moment and that of the immediate past. Importantly, further analysis of links between present and past emotional experience indicated that the effect of alcohol on emotional display was twice as large if a participant had spent no time smiling during the previous time interval compared with if the participant had smiled continuously during the previous time interval. This finding suggests that alcohol may enhance social experience by enabling individuals to "bounce back" and experience positive emotion again after periods of low pleasure, whereas it appears to have relatively little effect when individuals are already feeling good. In other words, alcohol consumption appears to foster a form of emotional flexibility which enhances resilience following more ambiguous/less pleasurable social moments.

More recently, we introduced a Social-Attributional Model of alcohol's social rewards, providing a theoretical framework for understanding how alcohol might mitigate stressful moments within social interaction (Fairbairn & Sayette, 2014). The Social-Attributional Model proposes that alcohol enhances social experiences by disabling cognitive processes that enable the anticipation and elaboration of social stressors—freeing individuals from their preoccupation with social threats and enabling them to access social rewards. More specifically, we borrow

organizing principles of "stability" and "(internal/external) locus" from attribution theory, proposing that alcohol enhances social interactions by interfering with both (a) the anticipation of future social threat when threat is perceived as unstable and (b) the perception of social threat as self-relevant. Thus, the Social-Attributional framework predicts that alcohol will enhance social interaction to the extent to which social rejection in such settings is attributed to unstable and/or internal causes. Given that many everyday social interactions foster feelings of unpredictability and uncertainty, and information received in social contexts is often interpreted as relevant to the self, this model provides a framework for understanding how alcohol leads to reward in many everyday settings.

Taken together, this body of work suggests that alcohol can enhance social interactions by enhancing enjoyment during, and increasing resilience following, the less positive moments of everyday social interaction. Alcohol is known to interfere with the anticipation and elaboration of specific types of stressors—including those linked with uncertainty/ambiguity as well as those attributable to a negative awareness of self—and unstructured, mutually reciprocal social interaction appears to represent a sort of hothouse for such stressful experiences. Thus, mutually reciprocal social interaction emerges as an ideal context for alcohol reward to emerge.

Individual Differences (Who?)

Individuals can differ dramatically in how they respond to alcohol. Two people with nearly identical drinking histories often display very different reactions to drinking—in one individual, alcohol might conjure up intense feelings of elation and relaxation while, in the other, it might simply promote a mild sense of lightheadedness or drowsiness. Importantly, etiological models of alcohol use disorder (AUD) suggest that individual differences in alcohol response are a key mechanism underlying vulnerability for alcohol problems, with those who display

heightened sensitivity to alcohol's rewarding properties being at increased risk for developing AUD (Venerable & Fairbairn, Under Review). But prior laboratory studies have often failed to produce evidence of increased alcohol reward sensitivity among those at risk, even when these same individuals report being sensitive to alcohol reward when they drink outside the lab.

In a series of studies, we employed our group drinking paradigm to explore "risky" demographic and personality traits as moderators of alcohol reward. Specifically, male gender (SAMHSA, 2015) and also extraverted personality (Sher, Trull, Bartholow, & Vieth, 1999; Stewart & Devine, 2000; Theakston, Stewart, Dawson, Knowlden-Loewen, & Lehman, 2004) are factors known to increase an individual's risk for developing a drinking problem. Men are about twice as likely as women to report symptoms of alcohol dependence (SAMHSA, 2015) and individuals higher in extraverted personality traits are more likely to drink heavily than less extraverted individuals (Sher et al., 1999). Although it has been theorized that enhanced alcohol reward may explain vulnerability to AUD among both men (Cooper, 1994; Kuntsche, Knibbe, Gmel, & Engels, 2006) and extraverted individuals (Anderson, Schweinsburg, Paulus, Brown, & Tapert, 2005; Brown & Munson, 1987; Fischer, Smith, Anderson, & Flory, 2003; Read & O'Connor, 2006), it is notable that no prior study has found evidence of increased alcohol reward sensitivity among either of these groups. One possible explanation for these null findings is that prior studies have exclusively employed solitary drinking paradigms and have examined only individual-level (vs. social) aspects of reward as outcomes.

Using our group-based alcohol-administration paradigm and dynamic indicators of social reward, we produced the first evidence for alcohol-reward sensitivity among both men and extraverted individuals in social contexts (Fairbairn, Sayette, Aalen, & Frigessi, 2015; Fairbairn, Sayette, Wright, et al., 2015). Specifically, employing nested survival models to track the

spreading of smiles from one group member to the next, we found evidence that alcohol increases the contagiousness of smiles to a greater extent among male vs. female drinkers—i.e., alcohol increases the chances that an individual will “catch” a fellow group-member’s smile more for men vs. women (Fairbairn, 2016; Fairbairn, Sayette, Aalen, et al., 2015). Further, by analyzing recordings of group conversation, we found evidence that alcohol increases acoustic indicators of social reward to a greater extent in male vs. female drinking groups (Fairbairn, Sayette, Amole, et al., 2015). Specifically, the volume of conversation in male drinking groups—a factor linked to social enjoyment—increased more with alcohol consumption than did the volume of conversation in female drinking groups. Finally, regarding “risky” personality traits, we found that extraverted individuals—those who, compared to introverts, gain particular pleasure from social sources of reward and are especially strongly motivated by social goals—report more subjective reward from alcohol than introverted individuals in a group setting. Further, results of mediated moderation analyses suggested that this alcohol-reward sensitivity among extraverts is fully mediated by alcohol-related increases in simultaneous smiling during the group drink period (Fairbairn, Sayette, Wright, et al., 2015).

In more recent research, we have begun investigating the role of individual differences in attachment styles as they relate to alcohol reinforcement and vulnerability to addiction. In a series of studies, we have examined the possibility that individuals with poor quality close relationships might gain more social reinforcement from alcohol and, through this and other processes, have greater risk of subsequently developing AUD. Stated differently, we have begun examining the premise that individuals who naturally struggle to form close relationships with others might gain more from alcohol’s socially rewarding effects and thus look more to alcohol as a means of forming and maintaining such relationships. Providing initial support for this

premise, in research employing laboratory-based couples interaction and alcohol-administration methods, we found evidence that individuals who reported low-quality relationships with their romantic partners gained more social-enhancement from alcohol (Fairbairn & Testa, 2016) and, in research combining laboratory couples interaction and a prospective study design, we found that negative social interactions with spouses longitudinally predicted drinking outcomes in a sample of alcoholics (Fairbairn & Cranford, 2016). These effects remained significant even after controlling for indicators of more general mood/life satisfaction beyond close relationships (i.e., measures of depression; Fairbairn & Cranford, 2016; Fairbairn & Testa, 2016)

In a later review of 34 longitudinal samples (total N=56,721), we conducted the first meta-analysis to examine the temporal precedence of addiction and attachment processes. Much of the research to-date has conceptualized substance use as an antecedent to low quality relationships, taking the premise that substance use likely exerts a destructive effect on close social relationships (Leonard & Eiden, 2007; Newcomb, 1994; Whisman, 1999). Our meta-analysis examined attachment as a risk factor for substance use, but also incorporated an examination of temporal precedence in the attachment-substance use link—explicitly exploring the extent to which insecure attachments precede substance use and, inversely, the extent to which substance use precedes insecure attachments. Results of cross-lagged models revealed that insecure attachment styles temporally preceded substance use and substance use problems, emphasizing the importance of considering interpersonal factors in the understanding of individual differences in addiction risk (Fairbairn, Briley, et al., 2018).

In sum, individuals differ widely in their drinking patterns, with some individuals being at substantially higher risk for developing AUD than others. Our research has taken the view that some portion of this risk might be understood through a closer consideration of social

relationships and the rewards that individuals gain from alcohol in social contexts. Using methods and measures that consider social elements of experience, we produced the first evidence of alcohol reward sensitivity among men and also extraverted individuals, and further conducted a series of studies indicating low quality close relationships as a potentially important factor in alcohol reward and the subsequent development of AUD.

Contextual Factors (Where?)

Historically, addiction researchers in the psychological and medical disciplines have focused overwhelmingly on characteristics of the individual in examining alcohol reinforcement and susceptibility to addiction. While this focus on the individual has led to valuable insights about drinking behaviors, it nonetheless ignores the substantial variation in drinking that occurs as a function of typical social drinking context, variation that can be mapped both across cultures around the world as well as within cultures over time. Our group has conducted research that merges perspectives drawn from sociology and public health, which have historically emphasized contextual factors in understanding substance use, with an alcohol-reinforcement framework, which understands problem drinking in terms of alcohol's rewarding effects, to examine how social contextual factors can inform the understanding of AUD risk. More specifically, we have conducted the first studies examining how alcohol's reinforcing properties vary as a function of differentiable elements of social drinking context that map to real-life drinking settings.

Although our research has covered several contextual elements as moderators of alcohol reward sensitivity (e.g., Fairbairn, Sayette, Levine, Cohn, & Creswell, 2013; Kang, Bresin, & Fairbairn, 2018), our examination to this point has focused mainly on variation in level of social familiarity across drinking settings. Importantly, a considerable body of evidence has

accumulated to indicate a link between regular drinking in unfamiliar drinking contexts and AUD risk. Specifically, habitual drinking in unfamiliar contexts (e.g., with strangers) has been linked to risk for subsequent AUD (Brown, 1985; Casswell & Zhang, 1997; Senchak, Leonard, & Greene, 1998; Shih et al., 2015), whereas drinking among highly familiar individuals has been identified as a protective factor (Ahlström-Laakso, 1976; Reboussin, Song, & Wolfson, 2012; Roberts & Leonard, 1998; Room & Makela, 2000). Although such associations might have critical implications for prevention and intervention, little research has sought to directly examine associations between contextual familiarity and mechanisms of AUD risk. Within our Social-Attributional Model of alcohol's effects (Fairbairn & Sayette, 2014), we proposed that links between drinking in unfamiliar context and AUD might be explained by enhanced alcohol-related reinforcement in unfamiliar contexts—in other words, that people would gain more alcohol-related stress relief and positive mood enhancement when interacting with strangers vs. with familiar individuals.

We have conducted a series of studies that provide initial support for the notion of social familiarity as a moderator of alcohol reward. In a questionnaire study (N=400), we tested familiarity as a moderator of individuals' beliefs about alcohol's effects. Specifically, in a study of undergraduate student participants, subjects were randomly assigned to read scenarios describing common drinking contexts that featured either familiar individuals or (otherwise identical) scenarios featuring strangers and were asked to rate their expectations regarding alcohol's effects in each of these situations. Participants who read scenarios depicting drinking in settings in which they were unfamiliar with other individuals present expected significantly more social enhancement and tension reduction from alcohol than those who read scenarios depicting familiar drinking contexts (Fairbairn & Bresin, 2017). These effects emerged as significant

across male and female participants, although some analyses indicated that the relationship between stranger drinking contexts and enhanced reward expectancies were particularly pronounced among men—potentially reflecting safety concerns associated with unfamiliar drinking contexts for female participants (Fairbairn & Bresin, 2017). In order to expand our investigation to encompass alcohol’s “actual” effects (vs. participants beliefs about alcohol’s effects), we next employed meta-analytic methods, examining effect sizes among those laboratory-based alcohol-administration studies that have featured social interaction between participants. Although the sample of studies featuring interaction between familiar study participants is limited ($k=5$), and so results are only preliminary, meta-analytic moderation analyses did indicate familiarity as a significant moderator of alcohol-related reinforcement across studies (Fairbairn, 2017). Specifically, the socially enhancing effects of alcohol—measured via self-reports of mood and social experience taken following social interaction—were more pronounced in studies that featured interactions between unfamiliar vs. familiar study participants.

In order to better understand the role of social familiarity in alcohol reinforcement, we have begun combining laboratory investigations of alcohol-response with methods that gauge experience outside the lab (see also above). In our recent ambulatory research, we employed novel methods and measures that helped us bring some of the precision of the laboratory into the real world—combining transdermal alcohol biosensing technology, data from which can be translated into estimates of blood alcohol concentration (BAC), with real-time photographic-capture methods for assessing elements of participants’ everyday social contexts. More specifically, heavy drinking participants ($N=48$) wore transdermal alcohol monitors outside the lab for seven days, during which time they also took photographs of their social surroundings

and completed mood surveys in response to random prompts on their smartphones (Fairbairn, Bresin, et al., 2018). On the final day of the study, participants completed a custom photo-cued self-report task, within which they viewed all photographs they had taken during the study and rated their level of acquaintance with each individual at the time the photograph was taken. Of note, when data from transdermal monitors was synced with self-reports of mood and social familiarity, results revealed that the positive mood enhancing and negative mood relieving effects of alcohol emerged as significantly more pronounced in everyday drinking contexts featuring strangers vs. familiar individuals. Additionally, the number of strangers present in social contexts predicted participants' estimated BAC during alcohol episodes, with estimated BAC increasing by approximately .01% with the introduction of each stranger into the drinking context¹.

Taken together, results from these studies provide preliminary support for the notion that alcohol-reward may be enhanced in unfamiliar vs. familiar social contexts and that unfamiliar social settings might further drive heavy drinking behaviors. However, results of this research are as yet purely correlational, and those empirical studies that have been conducted feature small samples of participants. Further, sample sizes of both our empirical (Fairbairn, Bresin, et al., 2018) and meta-analytic (Fairbairn, 2017) studies in this area tended to be small, and so results will require replication in larger samples. It is also worth noting that other prominent models of alcohol's effects (specifically, Steele and Josephs' Attention Allocation Model) might explicitly predict the opposite of our Social-Attributional Model—since familiar individuals are typically viewed more positively than unfamiliar individuals, and alcohol enhances responsiveness to immediate environmental cues, the Attention Allocation Model would predict

¹ Note that BACs tended to be higher in stranger drinking contexts across both male and female participants

that alcohol reward will be enhanced in *familiar* social contexts. Given that much (although not all) drinking does take place in familiar social contexts, this prediction of Attention Allocation might also have implications for understanding the development of AUD, albeit not via the mechanism of differential contextual exposure. Future research employing larger samples of participants and also experimental designs—wherein participants are randomly assigned to familiar and unfamiliar contexts—will be required to parse apart these competing predictions and better understand the role of social familiarity in alcohol reward.

Current and Future Directions

Our ongoing research aims to further explore the role of social contexts and social reward in alcohol consumption, with a particular focus on attachment processes and contextual familiarity. In a large-scale ongoing study (target N = 600), we recruit young heavy drinking participants in groups of friends. Participants are asked to report on the quality of their relationships with their friends, and they are then randomly assigned to consume alcohol either with their own friends or instead with individuals who are unfamiliar to them. A subsample of participants are also asked to participate in an ambulatory study outside the laboratory, in which they wear transdermal alcohol monitors and take photographs of their social surroundings over the course of 14 days. Thus, by leveraging a large sample of participants and combined experimental-ambulatory design, we aim to get a better sense for the role of contextual familiarity and also attachment processes in drinking behaviors.

While continuing our previous line of work employing laboratory-based group drinking paradigms and also ambulatory designs to examine alcohol-reinforcement, we have recently begun to leverage new methods and measures in order to better capture the mechanisms that might explain alcohol's rewarding effects in social contexts. Cognitive and emotional responses

may often take place outside of conscious awareness—inaccessible to the individual—and such unconscious responses may be particularly common in social contexts, which frequently feature diffuse and rapid stimulus presentation coupled with action-demands on the individual. Thus, to better capture cognitive and emotional processes in social contexts, we have sought out measures that move beyond self-report in order to examine these elements of responding that may be inaccessible in conscious awareness. Specifically, together with collaborators at the University of Illinois, we recently integrated an electroencephalography (EEG) task into our ongoing group alcohol-administration trial. For this research, all participants in our study are photographed upon their arrival in the laboratory and, following beverage-administration, participants in both alcohol and no-alcohol conditions are shown photographs of individuals they just drank with while their brain activity is recorded using EEG. Responses time-locked to these photographs—i.e., event-related potentials (ERPs)—can reveal sensory, attentional, and evaluation-based processes that precede or are unavailable to self-report, allowing us to target mechanisms by which people’s response to friends or strangers might be modulated by alcohol use. In future iterations of this task, we plan to integrate simultaneous 2-person EEG recording in order to further compare responding of intoxicated vs. sober participants within the context of live social interaction.

In addition to this research exploring mechanisms underlying alcohol’s social rewards, another important direction for our ongoing research involves the examination of drinking trajectories over time. Of note, prior research exploring acute reward from alcohol has nearly exclusively employed cross-sectional methods. Thus, although conjectures have been made about a key role for emotional and social rewards in predicting drinking patterns over time (King, de Wit, McNamara, & Cao, 2011; King, McNamara, Hasin, & Cao, 2014), and a wealth

of indirect evidence would support this supposition (Schuckit, 1994; Schuckit & Smith, 1996; Schuckit et al., 2011), this premise has not been directly tested. In order to fill this gap, we recently integrated longitudinal follow-ups into all our ongoing laboratory and ambulatory research. Initial results from a pilot sample of 60 participants provide evidence that emotional rewards from alcohol in social contexts, examined both via laboratory alcohol-administration as well as via ambulatory methods, significantly predict drinking problems at 1.5 year follow-up (Venerable & Fairbairn, under review).

At bottom, the most important aim of our program of work would be to inform measures aimed at helping people prevent and treat problematic alcohol use. We believe that a more precise knowledge of the factors that drive excessive drinking—i.e., an answer to the question of why people drink—will ultimately play a key role in informing more effective prevention and intervention measures. Importantly, however, findings from research exploring basic social and emotional processes in addiction are often poorly reflected in addiction interventions and, as a result, these interventions may not be as effective as they might otherwise be. Our group has recently begun research aimed at bridging the gap between basic and applied alcohol research with the goal of improving interventions for problem drinking. Beginning in the realm of research synthesis, we have conducted meta-analyses that tap into transdiagnostic processes in addiction treatment, exploring the impact of interventions for substance use disorders on emotion outcomes (Kang, Fairbairn, & Ariss, Under Review) and have further conducted research examining the impact of integrating significant others into interventions for substance use (Ariss, Fairbairn, & Venerable, In Prep). We would ultimately aim to bring this research into the empirical realm, building on existing interventions and also developing new interventions that

more effectively leverage a drinker's social support system and "natural" social rewards in order to help stem problematic alcohol use.

Summary and Conclusions

In sum, results of prior research seeking to capture alcohol reward, and thus inform the understanding of factors motivating drinking, has produced mixed results. The tendency to neglect social contexts and ignore social elements of experience is one explanation for these inconclusive findings. Our research suggests that robust social and emotional rewards from alcohol emerge in group drinking contexts, and that these rewards are significantly larger than rewards from alcohol experienced among participants drinking alone. Through understanding the rewarding properties of alcohol in social settings—contexts in which the majority of alcohol consumption takes place—we aim to move towards an understanding of the mechanisms of AUD development and, ultimately, towards informing more effective prevention and intervention measures.

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