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INVITED REVIEW

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A systematic review of the acute effects of alcohol on emotion recognition of facial expressions

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Abstract

Alcohol has been linked to both positive (e.g., sociability) and negative (e.g., aggression) social outcomes, and researchers have proposed that alcohol-induced changes in emotion recognition may partially explain these effects. Here, we systematically review alcohol administration studies to clarify the acute effects of alcohol on emotion recognition. We also investigate various moderator variables (i.e., sex, study quality, study design, alcohol dosage, emotion recognition task and outcome measure). PsycINFO, PubMed and Google Scholar were searched following a pre-registered PROSPERO protocol (CRD42021225392) and PRISMA methodology. Analyses focused on differences in emotion recognition between participants consuming alcoholic and/or non-alcoholic (i.e., placebo or no-alcohol control) beverages. Nineteen unique samples ($N = 1271$ participants) were derived from 17 articles (two articles included two studies, each conducted on a unique sample). Data were extracted for sample characteristics, alcohol administration methods and emotion recognition tasks and outcomes. All studies compared an alcoholic beverage to a placebo beverage and used tasks that asked participants to identify emotions from images or videos of facial expressions. Otherwise, methodologies varied substantially across studies, including the alcohol dosage(s) tested, the specific emotion recognition task(s) used and the outcome variable(s) assessed. No consistent effects of alcohol on emotion recognition emerged for any emotion. None of the moderator variables affected the findings, except for some indication that alcohol may affect males' emotion recognition abilities more so than females. Alcohol does not appear to consistently affect positive or negative emotion recognition of facial expressions, at least with the tasks currently used in the field.

KEYWORDS
alcohol, alcohol administration, emotion expression, emotion recognition, facial expression, young adults

The first and second authors contributed equally to the manuscript.

1 | INTRODUCTION

Alcohol use has been linked to negative social outcomes (e.g., increased aggression and interpersonal violence), reflecting the extreme social costs that alcohol use can have.[1–4] However, alcohol use has also been shown to induce strong social facilitative effects,[5] reflected by increased social bonding/sociality.[6–10] These desirable social outcomes have been implicated in the development of alcohol problems, as individuals may increase their drinking because of these powerful social rewards.[9,11–13] Despite strong evidence of the existence of both negative and positive alcohol-induced social outcomes, the mechanisms contributing to these effects remain unclear.

Alcohol-induced changes in emotion recognition, or the ability to accurately identify emotions in others,[14] may contribute to the development of social problems and help to explain alcohol's ability to enhance social experiences (e.g.,[15,16]). Accurate emotion recognition plays a key role in adaptive social functioning and interactions,[17–20] is linked to psychosocial skills[14,17–19] and provides a basis for social communication and adaptive emotional functioning within relationships.[14,17–19,21–24] Thus, emotional content may have an important functional use for navigating social situations.[20] Disruptions in emotion recognition abilities due to alcohol may have important negative and positive social consequences (e.g.,[25]).

Prior research indicates that individuals with alcohol use disorder (AUD) versus healthy controls show impairments in emotion recognition of facial expressions, especially for anger and disgust, across a range of emotion recognition tasks (e.g., identification of specific emotions and differentiation between emotional expression intensities) with medium-to-large effect sizes (see[14,26] for meta-analyses). Researchers have also examined whether acute alcohol intoxication impacts emotion recognition abilities using student/community samples of adults. These laboratory experimental alcohol administration studies offer researchers a methodologically rigorous approach to investigate the acute effects of alcohol on emotion recognition. In these studies, participants are either randomly assigned to consume an alcoholic or non-alcoholic (i.e., placebo and/or control) beverage (e.g.,[15,27]) or alcoholic beverages of different dosages (i.e., between-subjects designs) (e.g.,[28]), or to consume both an alcoholic and non-alcoholic beverage (e.g.,[16,29]) or alcoholic beverages of different dosages (e.g.,[30]) (i.e., within-subjects designs). Participants' responses to facial emotion recognition tasks are then contrasted across beverages.

Commonly, researchers draw upon the appraisal–disruption model[31] and the alcohol myopia model[32] to explain the acute effects of alcohol on emotion recognition (e.g.,[15,29,33]). According to the appraisal disruption model, alcohol impairs a person's ability to encode new emotional content and impedes integration with events stored in long-term memory,[31,34] which may alter judgements and behavioural responses based on perceived emotions in others (e.g.,[29]). According to the alcohol myopia model, alcohol inhibits effortful processing and restricts attention to the most salient environmental cues,[32] which may cause individuals to focus on intense emotional expressions while missing more subtle ones, leading to misinterpretations of social–emotional cues.[32,35] However, the literature on alcohol's acute effects on emotion recognition reveals inconsistent applications of these theories and mixed findings, offering little clarity to the ways in which alcohol affects the ability to recognise emotions in others. Specifically, some researchers argue that the positive social effects of alcohol result from enhanced recognition of positive emotions and/or impaired recognition of negative emotions following intoxication (e.g.,[15,16]). These changes may lead to increases in positive affect and/or decreases in negative affect, which may facilitate social behaviours that serve as mechanisms for increased sociability.[15,36] For example, enhanced ability to detect happiness in others and/or reduced ability to identify anger in others while intoxicated may explain alcohol's socially rewarding effects, like increased social bonding (e.g.,[16,37]).

Other researchers argue that alcohol consumption may lead to an increased likelihood of inappropriate behavioural responses, like increased aggression (e.g.,[29]), due to deficits in recognition accuracy and/or misattribution of negative emotions (e.g.,[38,39]). For instance, the inability to accurately identify distress cues (e.g., sadness) in others may increase the likelihood of reacting inappropriately towards those individuals by decreasing the promotion of prosocial behaviours and increasing the likelihood of aggression.[37] Researchers have also argued that acute increases in the tendency to perceive negative emotions (e.g., anger) and/or misattribute emotions (e.g., mistaking neutrality as anger) while intoxicated may help to explain many negative social consequences of alcohol use (e.g.,[15,27,29]). Taken together, researchers have theorised that alcohol may increase and/or impair the perception of negative emotions in others, which is offered as a mechanism for undesirable social outcomes (e.g.,[29]), and increase the perception of positive emotions and/or decrease the perception of negative emotions in others, which is thought to be a mechanism for increased sociability (e.g.,[16]).[*]

Though changes in emotion recognition may contribute to both positive and negative alcohol-induced social effects (e.g.,[15]), the findings are mixed. For instance, some studies found that alcohol (vs. placebo) caused deficits in recognition of sad expressions, but not happy or angry expressions[15,27], whereas others reported an improved ability to identify happiness[16] and disgust and contempt expressions[30] after alcohol (vs. placebo) consumption. Thus, it is unclear whether alcohol reliably impacts emotion recognition and, if so, what the specific nature of alcohol's effects is.

It is also possible that alcohol's effects on emotion recognition may differ for males and females, but this too has produced mixed findings (e.g.,[29,40]). Although prior studies have shown that males and females differ in their emotion recognition abilities, with females typically demonstrating better emotion recognition than males (e.g.,[41–45]), it is unclear whether alcohol differentially affects emotion recognition

*It is important to note that alcohol's effects on the perception of positive and negative emotions may differ based on the trajectory of alcohol involvement. Here, we refer to the acute effects of alcohol on emotion recognition in adult social drinkers recruited for laboratory studies.

across sexes, which could have important clinical implications.[46] In summary, the impact of alcohol on emotion recognition remains uncertain, including the specific nature of its effects and potential differences in alcohol's effects on emotion recognition based on sex.

Given inconsistent findings in the literature, the current paper aimed to systematically review results from alcohol administration studies investigating the acute effects of alcohol on emotion recognition. A systematic review rather than a meta-analysis was conducted as studies varied substantially in their methodology (e.g., different emotion recognition tasks, range of alcohol dosages, different outcome variables).[47,48] We first provide a context for understanding alcohol's effects on emotion recognition by systematically reviewing sample characteristics, study designs, alcohol administration methods, emotion recognition tasks and outcome variables. We then aim to clarify the effects of alcohol on the recognition of positive (e.g., happiness) and negative (e.g., anger) emotions, and whether there are differences based on sex. Finally, we consider a number of other potential moderator variables (i.e., study quality, study design, alcohol dosage, emotion recognition task and outcome measure) that may affect the findings.

A systematic review of alcohol's acute effects on emotion recognition[49] was published while the current paper was under review, but we extend those findings in at least three important ways. First, we investigate whether various moderator variables (i.e., sex, study quality, study design, alcohol dosage, emotion recognition task and outcome measures) affected the findings. Of these moderator variables, only alcohol dosage was considered in the prior review. Investigation of these additional moderator variables may reveal patterns of effects that could inform our understanding of when alcohol is particularly likely to affect emotion recognition. Second, we systematically review key aspects of the alcohol administration methodologies used across studies in order to provide a critical appraisal of the rigorousness of these methodologies when testing the effects of alcohol on emotion recognition. Examples include whether placebo manipulation checks were administered, and if so, whether placebo deception was successful, whether alcohol dosages were calculated based on participants' sex and whether blood alcohol concentration (BAC) recordings were taken around the time of the emotion recognition tasks in order to verify that participants reached intended BAC levels. Finally, we systematically review an expanded set of features of the emotion recognition tasks used in each study (e.g., whether reliability estimates were calculated and the nature of the response options) in order to critically evaluate how well emotion recognition abilities have been conceptualised and assessed by alcohol researchers and to provide recommendations to help to move this research forward. By investigating whether and in what ways (i.e., improvement vs. impairment) alcohol impacts emotion recognition and whether effects depend on sex and other factors (e.g., study quality), results from this study will help to clarify whether alcohol-induced changes in emotion recognition are a possible mechanism underlying the social costs of alcohol consumption[1] and alcohol's desirable social effects.[11] This study, therefore, can inform theories of alcohol use focusing on alcohol's negative and positive social effects.

2 | METHOD

We report methodology in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[50] The full review protocol is available in the International Prospective Register for Systematic Reviews (PROSPERO); (http://www.crd.york.ac.uk/PROSPERO/, registration no. CRD42021225392). Literature searches were conducted in March 2021, February 2022 and April 2023 using PubMed, PsycINFO and Google Scholar to identify relevant studies published since 1970, with search terms including [alcohol] AND [emotion recognition OR emotion expression OR facial expression recognition]. Searches were limited for two of the databases such that keywords had to appear in the title for Google Scholar searches and in the title or abstract for PsycINFO searches. The reference lists of identified studies were scanned, and reverse searches were generated and scanned for relevant studies. To be included in the review, studies were required to use an alcohol administration protocol in a between- or within-subjects design, in which participants consumed alcoholic and/or non-alcoholic (i.e., placebo and/or control) beverage(s) and to include at least one measure of emotion recognition as an outcome variable. Exclusionary criteria included non-human animal studies, non-English language, non-peer reviewed/unpublished studies and studies conducted using clinical populations (e.g., patients with social phobia).

3 | DATA EXTRACTION AND CODING

We extracted information for the following variables: sample characteristics (e.g., university vs. community sample, mean age), study designs (e.g., within- or between-subjects), alcohol administration methods (e.g., alcohol dosage), comparison beverages (e.g., placebo), blinding procedures (i.e., single vs. double-blind), types of emotion recognition tasks (e.g., tasks assessing the ability to identify a specific emotion from facial expressions) and emotion recognition outcome variables (e.g., accuracy vs. reaction time). A second member of the study team independently extracted these data, and two additional members of the lab separately checked the extracted data for accuracy against the original articles. The few discrepancies that existed were reconciled by team discussion.

4 | ALCOHOL DOSAGE

Three categories of alcohol dosages (i.e., low, moderate and high) were created based on common categorisations in the literature (e.g.,[16,28,49,51]). Specifically, doses lower than 0.4 g/kg body weight were categorised as a low alcohol dose, doses between 0.4 and

0.8 g/kg were categorised as a moderate alcohol dose, and doses higher than 0.8 g/kg were categorised as a high alcohol dose.[†]

5 | QUALITY ASSESSMENT

A modified version of the Quality Assessment Tool for Quantitative Studies (QATQS) was adapted to assess study quality (see Supplementary Scale 1). Two members of the study team independently rated each study for study quality, and any differences were resolved through team discussion.

6 | RESULTS

Three hundred twenty-five articles were initially identified in the search. Seventeen articles, including 19 unique samples[‡] and 1271 individuals, were included in the systematic review (see Figure 1 for the flow diagram). The average study quality rating was 2.05 ($SD = 0.78$), suggesting moderate study quality (see Table 1). As shown in Supplementary Scale 1, examples of study characteristics that warranted a moderate quality rating included the following: information on participant selection (e.g., representativeness), description of inclusion and exclusion criteria, explanation of how alcohol dosages were calculated (e.g., accounting for sex), administration of placebo manipulation checks (if a placebo beverage was administered) and an explanation of whether placebo deception was successful, BAC recordings taken around the time of the emotion recognition task, description of the blinding procedures used and clearly stated hypotheses.

6.1 | Sample characteristics

Sample characteristics are displayed in Table 1. Across the 19 studies, final sample sizes ranged from $n = 12$[54,55] to $n = 192$,[52 (Study 2)] with five (26.32%) studies having sample sizes of ∼20 participants or fewer.[30,36,53 (Study 2),54,55] One (5.26%) study included only male participants,[36] whereas the remaining 18 (94.74%) studies included both males and females. All 19 (100%) studies included young adult social drinkers with sample mean ages ranging from 19.95 years[56] to 25.9 years.[36] For recruitment, nine (47.37%) studies recruited participants from universities and local communities,[15,27,29,37,52 (Studies 1 and 2),53 (Studies 1 and 2),57] seven (36.84%) studies recruited only from universities,[16,30,33,40,54,56,58] one (5.26%) study recruited only from the community[28] and two (10.53%) studies did not specify how participants were recruited.[36,55] For study locations, nine (47.37%) studies were conducted in the United Kingdom,[15,27–30,37,40,52 (Studies 1 and 2),57] four (21.05%) in the United States,[54–56,58] two (10.53%) in Israel,[53 (Studies 1 and 2)] one (5.27%) in Switzerland,[16] one (5.27%) in Australia,[37] one (5.27%) in Japan[36] and one (5.27%) in Germany.[33] Only five (26.32%) studies provided racial/ethnic data for participants (i.e., 100% European-Caucasian,[16] 100% Japanese,[36] 100% Anglo or White-Hispanic,[56] 100% Caucasian[54] and 66.67% Caucasian).[55]

6.2 | Comparison conditions, study designs and blinding procedures

Comparison conditions, study designs, and blinding procedures are described in Table 1. In addition to an alcoholic beverage, all 19 (100%) studies included a placebo beverage, with four (21.05%) studies implementing a balanced placebo design that additionally included a told no-alcohol but given alcohol condition.[15,27,40,58] Ten (52.63%) studies employed a between-subjects design and randomly assigned participants to consume alcohol (sometimes of varying dosages[28,40,53 [Study 1]]) or placebo beverages.[15,27,33,37,52 (Studies 1 and 2),58] The remaining nine (47.37%) studies used a within-subjects design, such that each participant was exposed to the placebo and alcohol beverage(s),[16,29,30,36,53 (Study 2)–57] with four of these nine studies including more than one alcohol dosage.[28–30,36] In addition, of these nine studies that used a within-subjects design, five counterbalanced drink orders,[16,30,36,55,57] three randomly assigned drink orders[29,54,56] and one used a fixed drink order,[53 (Study 2)] in which participants drank a placebo beverage followed by three alcoholic beverages to reach target BAC levels of 0.03%, 0.06% and 0.09% in a single session. The most common blinding technique, used by 13 (68.42%) studies, was a double-blind procedure (i.e., experimenters and participants were both blind to beverage assignment).[15,16,27–29,33,52 (Studies 1 and 2),53 (Study 1),55–57] The remaining six (31.58%) studies used single-blinding procedures (i.e., only participants were blind to beverage assignment).[16,30,36,40,53 (Study 2),54,58] Finally, six (31.58%) of the 19 studies reviewed here reported conducting power analyses to determine the required sample sizes to detect the effects of alcohol.[28,30,52,53,57] The remaining 13 (68.42%) studies did not report conducting power analyses.[15,16,27,29,30,33,36,37,40,54–56,58]

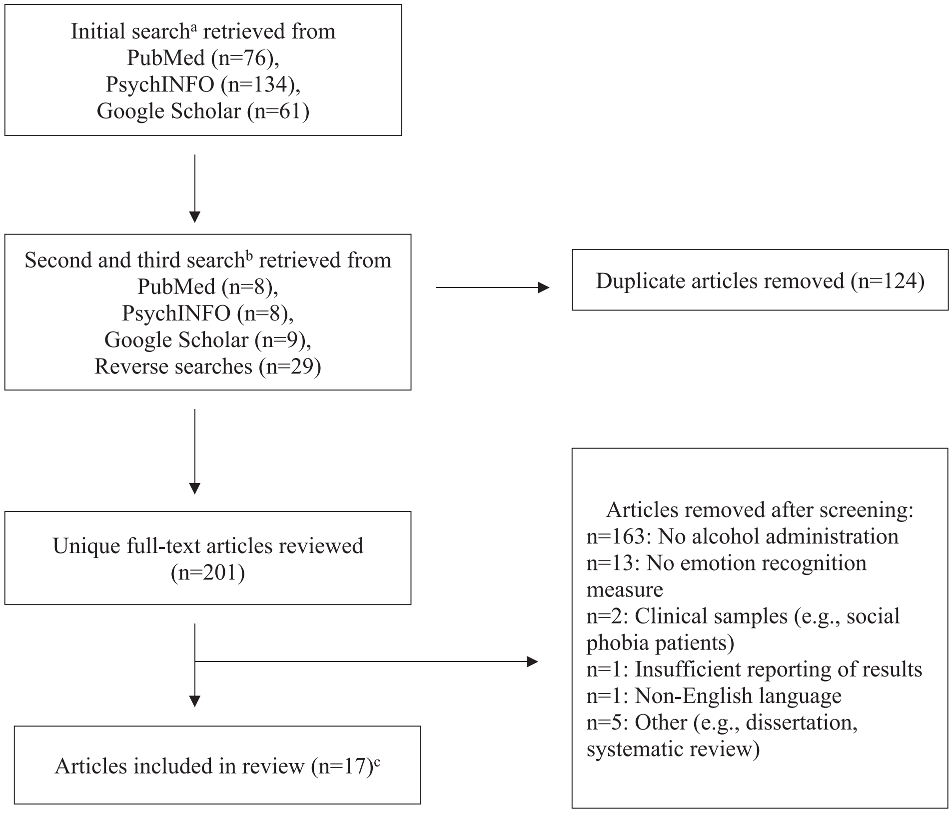
6.3 | Placebo manipulation checks

As shown in Table 1, although all 19 studies included a placebo beverage, only 11 (57.89%) studies reported conducting manipulation checks for placebo deception[15,27,28,33,37,52 (Studies 1 and 2),53 (Studies 1 and 2),57,58]; eight (42.11%) studies did not report conducting manipulation checks for placebo deception.[16,27,29,30,36,54–56] Of the 11 studies that reported conducting placebo manipulation checks, only two studies reported results clearly indicating that placebo deception was successful. Specifically, one study reported that all participants told they received alcohol believed that they did,[58] and one study reported no significant

[†]When possible (i.e., when we had enough information to do so), alcohol doses reported in metrics other than grams per kilogram (g/kg) were converted to g/kg to more clearly make comparisons across studies. Table 2 includes the original dosages as reported in each study, as well as the converted dosages.

[‡]Of the 17 articles included, 15 reported results of a single study. The remaining two articles each reported on two separate studies, carried out on independent samples,[52,53] resulting in 19 independent sets of results included.

FIGURE 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram for studies selected for the systematic review.
Note.
[a]Initial search conducted for papers published between January 1970 and March 2021.
[b]Second and third searches conducted for papers published between March 2021 and February 2022 and between February 2022 and April 2023.
[c]Two articles included experiments on two independent samples.[52,53]



difference between the placebo group and the alcohol group in guessing whether they consumed alcohol or placebo beverages.[28] The other nine studies that conducted placebo manipulation checks either did not report the results[27] or it was unclear as to whether placebo deception was entirely successful, with two studies reporting that the placebo group tended to rate the alcoholic content of their beverages as low to medium,[53 (Studies 1 and 2)] five studies reporting that fewer participants in the placebo group believed they had consumed alcohol compared to the alcohol group[15,33,52 (Studies 1 and 2),57] and one study reporting that participants in the placebo group believed they consumed fewer standard drinks than the alcohol group.[37]

6.4 | Alcohol administration procedures

Alcohol administration procedures are described in Table 2. As can be seen, alcohol dosages given to participants ranged from 0.14 g/kg[36] to ∼0.8 g/kg,[28,37,40,53 (Studies 1 and 2)] with one study administering a 1.975 g/kg[40] dosage of alcohol, which is a very high alcohol dosage. Six (31.58%) studies administered low alcohol dosages,[16,29,30,36,53 (Studies 1 and 2)] 18 (94.74%) administered moderate alcohol dosages[15,27–30,33,36,37,40,52 (Studies 1 and 2),53 (Studies 1 and 2)–58] and three (15.79%) administered high dosages of alcohol.[40,53 (Studies 1 and 2)§] To calculate alcohol dosages, two (10.53%) studies based their calculations on participants' weight, height and sex.[53 (Studies 1 and 2)] Six (31.58%) studies based their calculations on participants' weight and sex but not height.[16,30,54–56,58] One (5.26%) study based their calculation on participants' weight and height, but not sex,[37] and five (26.32%) studies based their calculations on weight only.[29,33,52 (Studies 1 and 2),57] The remaining five (26.32%) studies did not report considering weight, height or sex in their dosage calculations.[15,27,28,36,40]

As far as taking BAC recordings at least once around the time of the emotion recognition task, 12 (63.16%) studies reported doing so[16,28,30,36,37,53 (Studies 1 and 2)–58]; however, four of these 12 studies did not report the results of these recordings anywhere in the paper.[30,53 (Study 1),57,58] The remaining seven (36.84%) studies either did not report collecting BAC recordings at any point during the study[33,40] or reported BAC recordings only at baseline, in order to confirm participants did not consume alcohol prior to the start of the study.[15,27,29,52 (Studies 1 and 2)]

As shown in Table 2, the time interval between post-drink consumption and the start of the emotion recognition task ranged from 0 min[15,27,29] to 70 min,[56] with many (68.42%) studies starting the emotion recognition task within 30 min of post-beverage consumption.[16,28,30,33,36,40,52 (Studies 1 and 2),53 (Studies 1 and 2),54,57,58] However, three (15.79%) studies reported an interval ranging from 50 to 70 min post-beverage consumption,[37,55,56] and three (15.79%) studies did not report the time interval between post-drink consumption and the start of the emotion recognition task.[15,27,29] Finally, one (5.26%) study implemented a cumulative drinking design such that each participant

§The percentage total is greater than 100% because seven studies included multiple dosages of alcohol that spanned more than one category.[28–30,36,40,53 (Studies 1 and 2)]

TABLE 1 Study characteristics.

		Sample characteristics				Study design				
Authors	**Location**	*Participants*	*N (% male)*	*Age, years Mean (range)*	*Race/ethnicity*	*Design*	*Blinding*	*Placebo manipulation check*	*Power analyses*	*Study quality*
Attwood et al (2009a)[29]	United Kingdom	Individuals from the University of Bristol and the local community	40 (50%)	$M = 23$ (19–38)	Not specified	Within-subjects	Double-blind	No	No	2
Attwood et al. (2009b)[27]	United Kingdom	Individuals from the University of Bristol and the local community	96 (50%)	$M = 25$ (18–40)	Not specified	Between-subjects	Double-blind	Yes	No	2
Borrill et al. (1987)[40]	United Kingdom	Medical students, school not specified	60 (50%)	Not reported (18–28)	Not specified	Between-subjects	Single blind	No	No	1
Craig et al. (2009)[15]	United Kingdom	Individuals from the University of Bristol and the local community	100 (50%)	$M = 24$ (18–40)	Not specified	Between-subjects	Double-blind	Yes	No	1
Dolder et al. (2017)[16]	Switzerland	Individuals from the University of Basel	60 (50%)	$M = 25$ (18–43)	100% European-Caucasian	Within-subjects	Double-blind	No	No	2
Eastwood et al (2020)[57]	United Kingdom	Individuals from the University of Bristol and the local community	88 (50%)	$M = 23$ (18–39)[a]	Not specified	Within-subjects	Double-blind	Yes	Yes	3
Felisberti & Terry (2015)[30]	United Kingdom	Undergraduate students from Kingston University	21 (19.05%)	$M = 23$ (Not reported)	Not specified	Within-subjects	Single blind	No	No	1
Honan et al (2018)[37]	Australia	Individuals from the Newnham Campus of the University of Tasmania and the local community	64 (50%)	$M = 23.6$ (18–34)	Not specified	Between-subjects	Single blind	Yes	No	1
Kamboj et al. (2013)[28]	United Kingdom	Individuals from the local community	48 (50%)	$M = 23.6$ (18–35)	Not specified	Between-subjects	Double-blind	Yes	Yes	3
Kano et al. (2003)[36]	Japan	Not specified	15 (100%)	$M = 25.9$ (22–43)	100% Japanese	Within-subjects	Single-blind	No	No	1
Khouja et al. (2019): Study 1[52]	United Kingdom	Staff and students from the University of Bristol and the local community	110 (50%)	$M = 21$ (18–39)[a]	Not specified	Between-subjects	Double-blind	Yes	Yes	3
Khouja et al. (2019): Study 2[52]	United Kingdom	Staff and students from the University of Bristol and the local community	192 (50%)	$M = 22$ (18–39)[a]	Not specified	Between-subjects	Double-blind	Yes	Yes	3
Nagar et al. (2021): Study 1[53]	Israel	Individuals from Bar-Ilan University and local community	71 (40.8%)	$M = 24.3$ (Not reported)	Not specified	Between-subjects	Double-blind	Yes	Yes	2

TABLE 1 (Continued)

		Sample characteristics				Study design				
Authors	Location	*Participants*	*N (% male)*	*Age, years Mean (range)*	*Race/ethnicity*	*Design*	*Blinding*	*Placebo manipulation check*	*Power analyses*	*Study quality*
Nagar et al. (2021): Study 2[53]	Israel	Individuals from Bar-Ilan University and local community	21 (28.6%)	*M* = 24 (Not reported)	Not specified	Within-subjects	Double-blind	Yes	Yes	2
Padula et al. (2011)[54]	United States	College population (not specified)	12 (58.3%)	*M* = 23.2 (19–29)	100% Caucasian	Within-subjects	Single-blind	No	No	2
Paulus et al. (2012)[56]	United States	Students from the University of California San Diego	116 (47.4%)	*M* = 19.95 (18–25)	Anglo & White Hispanic (% not specified)	Within-subjects	Double-blind	No	No	3
Sripada et al (2011)[55]	United States	Not specified	12 (83.3%)	*M* = 23.2 (Not reported)	66.7% Caucasian; 25% Asian; 8.3% African American	Within-subjects	Double-blind	No	No	3
Tucker & Vuchinich (1983)[58]	United States	Undergraduate introductory psychology students from the University of Florida	48 (50%)	Not reported (19–26)	Not specified	Between-subjects, repeated measures	Single-blind	Yes	No	2
Walter et al. (2011)[33]	Germany	Undergraduate psychology students from the University of Bonn	102 (21.6%)	*M* = 21.6 (Not reported)	Not specified	Between-subjects, repeated measures	Double-blind	Yes	No	2

Note: Study quality: 3 = Strong; 2 = Moderate; 1 = Weak; Single blind = Only participants were blind to beverage assignment.
[a]Sample demographics are reported for the final sample used in analyses, not for the original sample collected.

TABLE 2 Alcohol administration procedures.

Reference	Beverages (alcohol dosage administered reported in g/kg)[a]	BAC level around the time of the ER task (s)	Alcohol (% by volume)	Drink consumption time (min)	Time between alcohol administration and ER task (s) (min)[b]
Attwood et al (2009a)[29]	Low dose (0.2) Moderate dose (0.4) Placebo (0.0, tonic water)	Not reported[c]	Vodka (37.5)	20	Not reported[d]
Attwood et al (2009b)[27]	Alcohol-told alcohol: Moderate dose (0.4) Alcohol-told placebo: Moderate dose (0.4) Placebo-told alcohol (0.0, tonic water) Placebo-told placebo (0.0, tonic water)	Not reported[c]	Vodka (37.5)	20	Not reported[d]
Borrill et al (1987)[40]	High dose (1.975) Moderate dose (0.79) Placebo (0.0, ginger ale)	Not reported[e]	Vodka (not reported)	Not specified	30
Craig et al (2009)[15]	Alcohol-told alcohol: Moderate dose (0.4) Alcohol-told placebo: Moderate dose (0.4) Placebo-told alcohol (0.0, tonic water) Placebo-told placebo (0.0, tonic water)	Not reported[c]	Vodka (37.5)	15	Not reported[d]
Dolder et al (2017)[16]	Low dose (0.24/0.29 females/males)[f] Placebo (0.0, non-alcoholic beer)	0.41 ± 0.1 g/L for males; 0.35 ± 0.1 g/L for females[g]	Beer (4.8)	15	15
Eastwood et al (2020)[57]	Moderate dose (0.4) Placebo (0.0, tonic water)	Not reported[h]	Vodka (37.5)	10	10
Felisberti & Terry (2015)[30]	Low dose (0.17/0.2 females/males) Moderate (0.52/0.6 females/males) Placebo (0.0, tonic water)	Not reported[h]	Vodka (37)	15	20
Honan et al. (2018)[37]	Moderate dose (Target BAC 0.08%) Placebo (0.0, soda water)	0.076 ± 0.019%	Vodka (37.5)	10	50
Kamboj et al. (2013)[28]	Moderate dose (0.4) Moderate dose (0.8) Placebo (0.0, tonic water)	Alcohol #1: 0.20 ± 0.1 g/L; Alcohol #2: 0.42 ± 0.16 g/L	Not specified (90%)[i]	30	10
Kano et al (2003)[36]	Low dose (0.14) Low dose (0.28) Moderate dose (0.56) Placebo (0.0, orange juice)[j]	Alcohol #1: 12.1 ± 0.66 mg/dL; Alcohol #2: 26.1 ± 0.85 mg/dL; Alcohol #3: 69.1 ± 1.5 mg/dL[k]	Scotch whiskey (43%)	10[l]	30
Khouja et al (2019) Study 1[52]	Moderate dose (0.4) Placebo (0.0, tonic water)	Not reported[c]	Vodka (not specified)	10	10
Khouja et al (2019) Study 2[52]	Moderate dose (0.4) Placebo (0.0, tonic water)	Not reported[c]	Vodka (not specified)	10	10
Nagar et al (2021) Study 1[53]	Low dose (Target BAC = 0.03%) Moderate dose (Target BAC = 0.06%) High dose (Target BAC = 0.09%) Placebo (0.0, water mixed with juice)[j]	Not reported[h]	Vodka (50%)	10	20

TABLE 2 (Continued)

Reference	Beverages (alcohol dosage administered reported in g/kg)[a]	BAC level around the time of the ER task (s)	Alcohol (% by volume)	Drink consumption time (min)	Time between alcohol administration and ER task (s) (min)[b]
Nagar et al (2021) Study 2[53]	Low dose (Target BAC = 0.03%) Moderate dose (Target BAC = 0.06%) High dose (Target BAC = 0.09%) Placebo (0.0, water mixed with juice)[m]	Alcohol #1: 0.03 ± 0.01%; Alcohol #2: 0.06 ± 0.03%; Alcohol #3: 0.09 ± 0.02%	Vodka (50%)	10	20
Padula et al (2011)[54]	Moderate dose (0.55/0.61; 0.68/0.75 ml/kg females/males)[n] Placebo (0.0, diet soda)	M = 0.070 ± 0.017%	Ethanol (95%)[o]	8	30
Paulus et al (2012)[56]	Moderate dose (0.57/0.61; 0.7/0.75 ml/kg females/males)[p] Placebo (0.0, carbonated soda)	M = 0.06 ± 0.02%	Ethanol (95%)[o]	10	70
Sripada et al (2011)[55]	Moderate dose (0.8) Placebo (0.0, Kool-Aid)	0.091 ± 0.014%	Ethanol (95%)[o]	13	55
Tucker & Vuchinich (1983)[58]	Alcohol-told alcohol: Moderate dose (0.5/0.55 females/males) Alcohol-told placebo (0.0, tonic water) Placebo-told alcohol: Moderate dose (0.5/0.55 females/males) Placebo-told placebo (0.0, tonic water)	Not reported[h]	Vodka (40%)	15	20
Walter et al (2011)[33]	Moderate dose (0.4) Placebo (0.0, non-alcoholic sparkling wine)	Not reported[e]	Sparkling wine (not specified)	Not specified	10

Abbreviations: BAC, blood alcohol content; ER, emotion recognition.
[a]Dosage categories are as follows: low = dosages < 0.4 g/kg; moderate = dosages between 0.4 g/kg and 0.8 g/kg; high = dosages > 0.8 g/kg.
[b]The minutes between finishing drink consumption and starting the emotion recognition task.
[c]Breathalyzer readings were reported only for the baseline assessment to confirm participants did not consume alcohol prior to the drinking session.
[d]The ER task was started after completion of other questionnaires (e.g., Alcohol Urges Questionnaire and Biphasic Alcohol Effects Scale) but no timeframe reported.
[e]BAC readings were not reported at any time point in the study.
[f]Dosage was calculated based on sex and body weight to achieve a target BAC of 0.4 g/L.
[g]BAC readings were collected using an intravenous catheter.
[h]Breathalyzer readings were collected around the time of the ER task, but values were not reported.
[i]The alcoholic beverage consisted of 90% vol/wt diluted with tonic water.
[j]The authors did not report whether the beverage was a placebo or no-alcohol control beverage. Most other researchers have interpreted it to be placebo.[28,30,46]
[k]BAC readings collected 20 min after completion of the ER task.
[l]Participants consumed beverages at their own pace, and all participants finished within 10 minutes.
[m]The placebo beverage was mixed with vodka extract.
[n]Original dosage reported as 0.68/0.75 ml/kg (females/males).
[o]Final drink consisted of 20% alcohol[54,56] and 16% alcohol.[55]
[p]Original dosage reported as 0.7/0.75 ml/kg (females/males).

received a total of four beverages consumed in sequential order (i.e., target BACs = 0.0% [placebo], 0.03%, 0.06% and 0.09%) during a single drinking session, and completed an emotion recognition task 20 min after each beverage.[53 (Study 2)] The remaining 18 (94.74%) studies implemented a single-dosage procedure, such that each participant consumed a single beverage during one study session.

6.5 | Emotion recognition tasks, outcomes and reliability estimates

Emotion recognition tasks are described in Table 3. All 19 (100%) studies used tasks that asked participants to identify emotions from images or videos of facial expressions. Ten (52.63%) studies presented stimuli with both male and female actors displaying the emotions,[15,16,27–29,33,36,37,53 (Study 1)] four (21.05%) used only male actors,[30,52 (Studies 1 and 2),57] one (5.26%) used only female actors[58] and the remaining four (21.05%) did not report the sex of the facial actors.[40,54–56] Only three (15.79%) studies provided information on the race of the actors used to display emotions. Two studies reported that the actors were Caucasian,[30,37] and one reported they were Japanese.[36]

As shown in Table 3, two types of emotion recognition tasks were employed. The first type, used by 18 (94.74%) studies, captured an individual's ability to *identify a specific emotion* (e.g., happy) from facial expressions.[15,16,28–30,33,36,37,40,52 (Studies 1 and 2),53–58 (Studies 1 and 2)] Of these 18 studies, one varied the presentation of facial expressions by time, such that following a static neutral expression, a static micro-expression (i.e., 200 ms presentation) or a static longer expression (i.e., 400 ms presentation) of an emotion (e.g., sadness) was shown.[30] The outcomes measured by this study included *accuracy* (i.e., score for correct emotion identifications) and *reaction times* (i.e., amount of time between when the stimulus was first presented and when an emotion was identified). Another one of these 18 studies presented images of facial expressions as mounted photographs and required participants to identify the emotion displayed using an emotion checklist, where the outcome was *error percentage* (i.e., proportion of incorrect identifications of a facial expression).[40] Yet another of these 18 studies displayed the images as unmixed (i.e., same emotion presented in the top and bottom of the face) or mixed (i.e., different emotions presented in the top and bottom of the face) expressions, where the outcome was accuracy.[58] Three of these 18 studies utilised a task originally created for functional magnetic resonance imaging (fMRI) scans, such that participants were presented with a test facial expression and asked to select the emotion displayed in the test from two additional facial expressions, where the outcomes were accuracy and reaction times.[54–56] Finally, the remaining 12 of these 18 studies that asked participants to identify a specific emotion presented emotions according to a morphed continuum/sequence of faces,[15,16,28,29,33,36,37,52 (Studies 1 and 2),53 (Studies 1 and 2),57] in which the emotional exemplars (e.g., happy) gradually increased in intensity. Three of these 12 studies presented the sequences as video clips.[28,33,37] The remaining nine of these 12 studies presented the sequences as static images of facial expressions.[15,16,29,36,52 (Studies 1 and 2),53 (Studies 1 and 2),57] In addition, nine of these 12 studies that presented emotions according to a morphed continuum/sequence showed facial expressions that increased in intensity from a neutral expression (i.e., stimulus with no emotional content) to a full emotional exemplar (e.g., happy).[15,16,28,29,33,36,37,53 (Studies 1 and 2)] Outcomes measured for these tasks included the following: accuracy ($n = 5$),[28,33,37,53 (Studies 1 and 2)] reaction times ($n = 3$),[28,33,36] *threshold detection* (i.e., point at which an emotion is identified from stimuli containing varying amounts of emotional content) ($n = 3$),[15,16,29] *false alarms* (i.e., the number of incorrect identifications of an absent emotion) ($n = 1$),[28] *neutral response errors* (i.e., incorrect identification of a specific emotion [e.g., sad] as neutral) ($n = 1$),[28] *response sensitivity* (i.e., ability to discriminate the presence of a specific emotion from a stimulus) ($n = 1$),[28] *response bias* (i.e., tendency to see a specific emotion even when it is not there) ($n = 1$)[28] and *error ratios* (i.e., proportion of correct and incorrect responses for identifying a specific emotion from facial expressions) ($n = 1$).[36] The remaining three of these 12 studies that used a morphed continuum/sequence presented facial expressions that increased in intensity from an ambiguous expression (i.e., composite image averaging exemplars for each emotional expression) to a full emotional exemplar (e.g., anger).[52 (Studies 1 and 2),57] Outcomes measured by these tasks included: response sensitivity ($n = 1$),[57] response bias ($n = 1$),[57] accuracy ($n = 2$)[52 (Studies 1 and 2)] and false alarms ($n = 2$).[52 (Studies 1 and 2)]

As shown in Table 3, the second type of emotion recognition task employed by researchers captured *emotion recognition biases*, or the tendency to see a specific emotion (e.g., happy) over another emotion (e.g., anger), employed by three (15.79%) studies.[27,52 (Study 2),57¶] All three studies employed a task that presented facial expressions ranging from one emotional endpoint (e.g., anger) to a second emotional endpoint (e.g., happy), and required participants to classify the expression using emotion labels. The outcome for this task is called the *balance point*, or the point along the continuum where a subject is equally likely to identify an image as either of the two emotional endpoints (e.g., anger/happiness). Balance points that fall close to one end of the spectrum (e.g., a threshold closer to anger vs. a threshold closer to happiness) rather than the middle range (i.e., 50%) indicate a recognition bias for that emotion.

Notably, across the 19 studies, only one (5.26%) study reported reliability estimates for the emotion recognition task outcome used,[28] such that reliability for *reaction times* to identify different facial expressions was estimated to be ($\alpha = 0.97–0.98$). Reliability estimates were not reported for any of the outcome measures in the remaining 18 (94.74%) studies.[15,16,27,29,30,33,36,37,40,52 (Studies 1 and 2),53 (Studies 1 and 2),54–58]

¶Emotion recognition task percentages total more than 100% due to two studies employing both types of tasks.[52 (Study 2),57]

TABLE 3 Emotion recognition tasks.

Reference	ER task(s)	ER outcome(s)	Emotions measured
Attwood et al (2009a)[29]	Two Alternate Forced Choice (2AFC): neutral-full emotional exemplar	Detection threshold	Happiness Sadness Anger
Attwood et al (2009b)[27]	Two Alternate Forced Choice (2AFC) two conditions: angry-happy, angry-disgust	Balance point	Happiness Anger Disgust
Borrill et al (1987)[40]	44 mounted photographs of facial expressions depicting a single emotion; participants identified emotions from a checklist of seven emotions	Error percentage	Happiness Sadness Anger Disgust/Contempt[a] Fear Surprise
Craig et al (2009)[15]	Two Alternate Forced Choice (2AFC): neutral-full emotional exemplar	Detection threshold	Happiness Sadness Anger
Dolder et al (2017)[16]	Facial Expression Recognition Test (FERT): neutral-full emotional exemplar	Detection threshold	Happiness Sadness Anger Disgust Fear Surprise
Eastwood et al (2020)[57]	Six Alternate Forced Choice (6AFC): ambiguous-full emotional exemplar Two Alternate Forced Choice (2AFC) two conditions: happy-angry, happy-sad	Response sensitivity; Response bias; Balance point	Happiness Sadness Anger Disgust Fear Surprise
Felisberti & Terry (2015)[30]	Two Six Alternate Forced Choice (6AFC) tasks modified for image duration (micro-expressions, longer-expressions): neutral-full emotional exemplar	Accuracy scores; Reaction times	Happiness Sadness Anger Disgust Fear Contempt
Honan et al (2018)[37]	Emotion Recognition Task (ERT): neutral-full emotional exemplar	Accuracy scores	Happiness Sadness Anger Disgust Fear Surprise
Kamboj et al (2013)[28]	Dynamic Emotion Expression Recognition Task (DEER-T): neutral-full emotional exemplar	Accuracy scores; Reaction times; False alarms; Neutral response errors; Response sensitivity; Response bias	Happiness Sadness Anger Disgust Fear
Kano et al (2003)[36]	Two Alternate Forced Choice (2AFC): neutral-full emotional exemplar	Reaction times; Error ratios	Happiness Sadness Anger Surprise
Khouja et al (2019) Study 1[52]	Six Alternate Forced Choice (6AFC): ambiguous-full emotional exemplar	Total hits (accuracy)[b]; False alarms	Happiness Sadness Anger Disgust Fear Surprise

(Continues)

TABLE 3 (Continued)

Reference	ER task(s)	ER outcome(s)	Emotions measured
Khouja et al. (2019) Study 2[52]	Six Alternate Forced Choice (6AFC): ambiguous-full emotional exemplar Two Alternate Forced Choice (2AFC): happy-angry	Total hits (accuracy)[b]; False alarms; Balance point	Happiness Sadness Anger Disgust Fear Surprise
Nagar et al. (2021) Study 1[53]	Emotional Facial Expression Recognition Task (EFERT): neutral-full emotional exemplar	Accuracy scores	Happiness Sadness Anger Fear
Nagar et al. (2021) Study 2[53]	Emotional Facial Expression Recognition Task (EFERT): neutral-full emotional exemplar	Accuracy scores	Happiness Sadness Anger Fear
Padula et al. (2011)[54]	Hariri Emotion Face Assessment Task (HEFAT)	Accuracy scores; Reaction times	Happiness Anger Fear
Paulus et al (2012)[56]	Hariri Emotion Face Assessment Task (HEFAT)	Accuracy scores; Reaction times	Happiness Anger Fear
Sripada et al (2011)[55]	Hariri Emotion Face Assessment Task (HEFAT): non-threat versus threat expressions[c]	Accuracy scores; Reaction times	Happiness (non-threat) Anger (threat) Fear (threat)
Tucker & Vuchinich (1983)[58]	28 photographs depicting facial expressions of varying intensities and combinations: 14 unmixed versus 14 mixed expressions[d]; participants identified emotions from a checklist of seven emotions	Accuracy scores	Happiness Sadness Anger Disgust Fear Surprise Contempt
Walter et al. (2011)[33]	Dynamic Emotion Recognition Test: neutral-full emotional exemplar	Accuracy scores; Reaction times	Happiness Sadness Anger Disgust Fear Surprise

Abbreviation: ER, emotion recognition.
[a]Expressions for disgust and contempt were grouped together in a single category, and results were reported for both emotions as a single category.
[b]Incorrect responses were removed to obtain the total number of correct emotion identifications to capture accuracy in emotion recognition.
[c]Happy expressions categorised as a control, non-threat condition; angry and fearful expressions categorised as a threat condition (i.e., expressions that serve as social cues for threat). Results reported as non-threat versus threat condition rather than results for specific emotions.
[d]Facial stimuli presented as unmixed (i.e., same emotion presented in the top and bottom of the face) or mixed (i.e., different emotion presented in the top and bottom of the face). Results reported as unmixed versus mixed expressions rather than results for specific emotions.

6.6 | Effects of alcohol on recognition of happiness

Table 4 summarises the main results of the studies.[#,‖] As shown, 16 (84.21%) studies examined happiness. Two studies found that recognition of happy expressions significantly improved following a low[16] and a moderate[52] (Study 1) dosage of alcohol compared to placebo. Another study found that a moderate dosage of alcohol significantly improved recognition of happy expressions compared to a low dosage.[36] Two studies found the opposite effect, such that happiness recognition significantly worsened following a moderate[57] and a high[53] (Study 1) dosage of alcohol compared to placebo. One article[53] (Study 2) reported on a second study that used a cumulative drinking design. When comparing results across studies (i.e., single dosage procedure vs. cumulative dosage procedure), they found that participants who consumed a single high dosage of alcohol were significantly less accurate on happiness recognition than participants assigned to the cumulative drinking procedure who eventually drank to a high dosage of alcohol.[53] (Study 2) The remaining 11 studies found no effect of any dose of alcohol on the recognition of happiness

[#]See Supplementary Table 1 for more detailed results for each individual study and each emotion recognition outcome.
[‖]When comparing emotion recognition abilities across conditions, we report findings contrasting the alcohol condition with the placebo condition and contrasting higher alcohol dosages with lower alcohol dosages.

TABLE 4 Alcohol effects on emotion recognition outcomes: significance and direction of effects.

		Recognition							Bias		
Reference	Alcohol group(s) (g/kg)	Happy	Anger	Sad	Disgust	Fear	Surprise	Contempt	Angry-happy	Angry-disgust	Happy-sad
Attwood et al (2009a)[29]	Alcohol #1 (0.2) vs placebo	O	O	O							
	Alcohol #2 (0.4) vs. placebo	O	O	O							
	Alcohol #2 (0.4) vs Alcohol #1 (0.2)	O	O	O							
Attwood et al. (2009b)[27]	Alcohol (0.4) vs placebo								O	O	
Borrill et al. (1987)[40]	Alcohol #1 (0.79) versus placebo	O	O	O	O[a]	O	O	O[a]			
	Alcohol #2 (1.975) versus placebo	O	✓ (impairment)	O	✓[a] (impairment)	O	O	✓[a] (impairment)			
	Alcohol #2 (1.975) versus Alcohol #1 (0.79)	O	O	O	O[a]	O	O	O[a]			
Craig et al. (2009)[15]	Alcohol (0.4) versus placebo	O	O	✓ (impairment)							
Dolder et al. (2017)[16]	Alcohol (0.24/0.29 females/males) versus placebo	✓ (improvement)	O	O	O	O	O				
Eastwood et al. (2020)[57]	Alcohol (0.4) versus placebo	✓ (impairment)	O	✓ (impairment)	O	✓ (impairment)			O		O
Felisberti & Terry (2015)[30]	Alcohol #1 (0.17/0.2 females/males) versus placebo	O	O	O	O	O		O			
	Alcohol #2 (0.52/0.6 females/males) versus placebo	O	O	O	✓ (improvement)	O		✓ (improvement)			
	Alcohol #2 (0.52/0.6 females/males) versus Alcohol #1 (0.17/0.2 females/males)	O	O	O	✓ (improvement)	O		✓ (improvement)			
Honan et al. (2018)[37]	Alcohol (0.8; Target BAC 0.08%) versus placebo	O	O	✓ (impairment)	O	✓ (impairment)	O				
Kamboj et al. (2013)[28]	Alcohol #1 (0.4) versus placebo	O	O	O	O	O					
	Alcohol #2 (0.8) versus placebo	O	O	O	O	O					
	Alcohol #2 (0.8) versus Alcohol #2 (0.2)	O	O	✓ (improvement)	O	O					
Kano et al. (2003)[36]	Alcohol #1 (0.14) versus placebo	O	O	O			O				
	Alcohol #2 (0.28) versus placebo	O	O	O			O				
	Alcohol #3 (0.56) versus placebo	O	O	O			O				
	Alcohol #2 (0.28) versus Alcohol #1(0.14)	O	O	O			O				
	Alcohol #3 (0.56) versus Alcohol #1 (0.14)	✓ (improvement)	O	O			O				
	Alcohol #3 (0.56) versus Alcohol #2 (0.28)	O	O	O			O				
Khouja et al. (2019) Study 1[52]	Alcohol (0.4) versus placebo	✓ (improvement)	✓ (impairment)	O	O	O	O				
Khouja et al. (2019) Study 2[52]	Alcohol (0.4) versus placebo	O	O	O	O	O	O		O		
	Alcohol #1 (0.3; Target BAC = 0.03%) versus placebo	O	O	O		O					
	Alcohol #2 (0.6, Target BAC = 0.06%) versus placebo	O	O	O		O					

(Continues)

TABLE 4 (Continued)

Reference	Alcohol group(s) (g/kg)	Recognition: Happy	Anger	Sad	Disgust	Fear	Surprise	Contempt	Bias: Angry-happy	Angry-disgust	Happy-sad
Nagar et al. (2021) Study 1[53]	Alcohol #3 (0.9; Target BAC = 0.09%) versus placebo	✓ (impairment)	O	O		✓ (impairment)					
	Alcohol #2 (0.6; Target BAC = 0.06%) vs. Alcohol #1 (0.3, Target BAC = 0.03%)	O	O	O		O					
	Alcohol #3 (0.9; Target BAC = 0.09%) vs. Alcohol #1 (0.3; Target BAC = 0.03%)	O	O	O		O					
	Alcohol #3 (0.9, Target BAC = 0.09%) vs. Alcohol #2 (0.6; Target BAC = 0.06%)	O	O	O		O					
Nagar et al. (2021) Study 2[53b]	Alcohol #1 (0.3; Target BAC = 0.03%) versus placebo										
	Alcohol #2 (0.6, Target BAC = 0.06%) versus placebo										
	Alcohol #3 (0.9; Target BAC = 0.09%) versus placebo										
	Alcohol #2 (0.6; Target BAC = 0.06%) vs. Alcohol #1 (0.3, Target BAC = 0.03%)										
	Alcohol #3 (0.9; Target BAC = 0.09%) vs. Alcohol #1 (0.3; Target BAC = 0.03%)										
	Alcohol #3 (0.9, Target BAC = 0.09%) vs. Alcohol #2 (0.6; Target BAC = 0.06%)										
Padula et al. (2011)[54]	Alcohol (0.53652/0.5925 females/males) versus placebo	O	O			O					
Paulus et al. (2012)[56]	Alcohol (0.5525/0.5925 females/males) versus placebo	O	O			O					
Sripada et al. (2011)[55]	Alcohol (0.8) versus placebo	O[c]	O[c]			O[c]					
Tucker & Vuchinich (1983)[58]	Alcohol (0.5/0.55 females/males) versus placebo	O[d]	O[d]	O[d]	O[d]	O[d]	O[d]	O[d]			
Walter et al. (2011)[33]	Alcohol (0.4) versus placebo	O	O								

Note: ✓ = significant difference; O = non-significant difference; blank = not tested or not reported. Main effects are reported here—see Supplemental Table 1 for more detailed results on the study findings. As we do in the main text, when comparing emotion recognition abilities across conditions, we report findings contrasting the alcohol condition with the placebo condition and contrasting higher alcohol dosages with lower alcohol dosages.

[a]Expressions for disgust and contempt were grouped together in a singular category; results reported for both emotions as a singular category.

[b]Results reported comparing emotion recognition abilities between those who consumed alcohol by a cumulative drinking design[53 (Study 2)] versus a single-dose drinking design[53 (Study 1)]; results comparing an alcoholic dose versus placebo or another alcohol dose are not reported in this paper–see Supplemental Table 1 for more detailed results.

[c]Results reported as non-threat (i.e., happy expressions) versus threat (i.e., angry and fearful expressions) rather than results for specific emotions–see Supplemental Table 1 for more detailed results.

[d]Results reported as unmixed (i.e., same emotion on the top and bottom of facial expressions) versus mixed (different emotions on the top and bottom of facial expressions) expressions rather than results for specific emotions—see Supplemental Table 1 for detailed results.

expressions.[15,28–30,33,37,40,52 (Study 2),54–56] In summary, of the 16 studies that tested alcohol's effects on happiness recognition, three (18.75%) found an improvement, two (12.5%) found an impairment, and 11 (68.75%) found no change in happiness recognition.

6.7 | Effects of alcohol on recognition of anger

Sixteen (84.21%) studies examined anger. Two studies found that anger recognition significantly worsened following a moderate[52 (Study 1)] and high[40] dosage of alcohol compared to placebo. Thirteen studies found no effect of any dose of alcohol on anger recognition.[15,16,28–30,33,36,37,52 (Study 1),53 (Study 1),54,56,57] One of these 13 studies that found no effect of alcohol on anger recognition actually combined anger and fear into a single category as a representation of a 'threat emotion expression' and found no effect of alcohol (vs. placebo) in recognising these threat expressions (i.e., anger and fear).[55] Another one of these 13 studies that did not find main effects of several dosages of alcohol (i.e., target BACs of 0.03%, 0.06% and 0.09%) (vs. placebo) on anger recognition[53 (Study 2)] conducted a second study and found that participants who consumed a single moderate dosage (target BAC = 0.06%) of alcohol were significantly less accurate on anger recognition than participants who continuously consumed alcohol to a target BAC of 0.06%.[53 (Study 2)] In summary, of the 16 studies that tested alcohol's effects on anger recognition, none (0%) found an improvement, two (12.5%) found an impairment, and 14 (87.5%) found no change in anger recognition.

6.8 | Effects of alcohol on recognition of sadness

Twelve (63.16%) studies examined sadness. Three studies found that sadness recognition significantly worsened following moderate dosages of alcohol compared to placebo.[15,37,57] Another study that did not find an effect of moderate dosages of alcohol (vs. placebo) on sadness recognition, found that a higher moderate dosage (i.e., 0.8 g/kg) of alcohol significantly improved sadness recognition compared to a lower moderate dosage (i.e., 0.4 g/kg) of alcohol.[28] The remaining eight studies found no effect of any dosage of alcohol on sadness recognition.[16,29,30,36,40,52 (Studies 1 and 2),53 (Study 1)] In summary, of the 12 studies that tested alcohol's effects on sadness recognition, one (8.33%) found an improvement, three (25%) found an impairment and eight (66.67%) found no change in sadness recognition.

6.9 | Effects of alcohol on recognition of disgust

Eight (42.12%) studies examined disgust. One study[30] found that disgust recognition significantly improved following a moderate dosage of alcohol compared to placebo and a low dosage of alcohol among micro-expressions (i.e., expressions displayed for 200 ms). For longer expressions (i.e., expressions displayed for 400 ms), disgust recognition again significantly improved following a moderate dosage of alcohol compared to placebo; however, disgust recognition of longer expressions at a low dosage of alcohol did not significantly differ from placebo. One of these nine studies combined disgust and contempt into a single category because of overlap in certain photographs used in the emotion recognition task.[40] This study found an impairment in disgust/contempt recognition following a high dosage of alcohol compared to placebo. Six studies found no effect of any dosage of alcohol on disgust recognition.[16,28,37,52 (Studies 1 and 2),57] In summary, of the eight studies that tested alcohol's effects on disgust, one (11.11%) found an improvement, one (11.11%) found an impairment and six (77.78%) found no change in disgust recognition.

6.10 | Effects of alcohol on recognition of fear

Twelve (63.16%) studies examined fear. Three studies found that fear recognition significantly worsened following moderate[37,57] and high[53 (Study 1)] dosages of alcohol compared to placebo. In a second study, participants who consumed a single dosage (i.e., target BACs = 0.03%, 0.06% or 0.09%) of alcohol were significantly less accurate on fear recognition than participants who continuously consumed alcohol to these dosages.[53] Nine studies found no effect of any dosage of alcohol on fear recognition.[16,28,30,40,52 (Studies 1 and 2),54–56] As noted above for anger recognition, one of these nine studies combined anger and fear into one category and found no effect of alcohol (vs. placebo) on these threat expressions.[55] In summary, of the 12 studies that tested alcohol's effects on fear recognition, none (0%) found an improvement, three (25%) found an impairment and nine (75%) found no change in fear recognition.

6.11 | Effects of alcohol on recognition of surprise

Six (31.58%) studies examined surprise[16,36,37,40,52 (Studies 1 and 2)] and none (0%) found an effect of any dosage of alcohol on surprise recognition.

6.12 | Effects of alcohol on recognition of contempt

Two (10.53%) studies examined contempt. One study found for both micro- (i.e., 200 ms) and longer expressions (i.e., 400 ms), a moderate dosage of alcohol resulted in significantly improved contempt recognition compared to placebo.[30] For micro-expressions, the moderate dosage of alcohol resulted in significantly greater accuracy for contempt recognition compared to a low dosage. For longer expressions, accuracy scores for contempt recognition for a low dosage of alcohol were not significantly different from placebo. As mentioned above for disgust recognition, the other study combined disgust and contempt into one category[40] and found an impairment in disgust/contempt recognition at a high dosage of alcohol compared to placebo. In summary, of the two studies that tested contempt recognition, one (50%)

found an improvement and one (50%) found an impairment in contempt recognition.

6.13 | Effects of alcohol on mixed and unmixed faces

As mentioned above, one study (5.26%) employed a balanced placebo design and an emotion recognition task that presented different combinations and intensities of seven basic emotions on the face.[58] The task included both unmixed facial expressions (i.e., the same emotion displayed on the top and bottom of the face) and mixed facial expressions (i.e., different emotions displayed on the top and bottom of the face). This study reported results for overall emotion recognition rather than individual emotions. Participants who consumed a moderate dosage of alcohol were less able to identify unmixed faces than those who did not consume a moderate dosage of alcohol. Moreover, participants who were given a moderate dosage of alcohol and informed they were given alcohol were significantly less able to identify unmixed faces than those who were given a moderate dosage of alcohol and informed they were not given alcohol. There were no significant differences between a moderate dosage of alcohol and placebo in correctly identifying mixed faces. Finally, participants who consumed a moderate dosage of alcohol had significantly lower total summary scores (i.e., combining unmixed and mixed facial expressions) than those not consuming alcohol.

6.14 | Effects of alcohol on emotion recognition biases for angry–happy expressions

Three (15.79%) studies compared participants' responses while consuming a moderate dosage of alcohol (vs. placebo) on emotion recognition biases along the spectrum from angry to happy expressions,[27,52 (Study 2),57] and none (0%) found an effect of alcohol on emotion recognition bias.

6.15 | Effects of alcohol on emotion recognition biases for angry–disgust

One (5.26%) study compared participants' responses while consuming a moderate dosage of alcohol (vs. placebo) on emotion recognition biases along the spectrum from angry to disgust expressions and found no significant effect of alcohol on emotion recognition bias.[27]

6.16 | Effects of alcohol on emotion recognition biases for happiness-sadness

One (5.26%) study compared participants' responses while consuming a moderate dosage of alcohol (vs. placebo) on emotion recognition biases along the spectrum from happy to sad expressions and found no significant effect of alcohol on emotion recognition bias.[57]

6.17 | Main and interactive effects of sex

Seven studies (36.8%) tested for main effects of sex (i.e., sex effects independent of alcohol) and for sex by alcohol interaction effects on emotion recognition.[15,27–29,33,40,58] Three of these seven studies found a main effect of sex on emotion recognition, such that females performed better than males,[15,28,40] whereas the remaining four studies found no main effect of sex on emotion recognition.[27,29,33,58] Specifically, one study found that females had faster reaction times (i.e., enhanced recognition) than males for happy, sad, angry, disgusted and fearful expressions.[28] The second study similarly found that males showed higher threshold values (i.e., worse recognition) for sad and angry expressions compared to females,[15] and the third study found that males tended to make more accuracy errors than females.[40]

Four of the seven studies that tested for it found significant interactions between participant sex and alcohol on emotion recognition,[27,29,40,58] whereas the remaining three studies that tested for it did not.[15,28,33] In one study, males had significantly higher threshold values (i.e., worse recognition) for sad expressions compared to females at a moderate dosage of alcohol but not for a low dosage of alcohol or a placebo beverage.[29] In another study, males who consumed a moderate dosage of alcohol were more likely to judge disgusted faces as angry compared to males who consumed a placebo beverage, though there were no significant differences for females.[27] In the third study, males who consumed alcohol had more accuracy errors on disgust/contempt recognition than females who consumed alcohol.[40**] Finally, the fourth study found a significant interaction between sex and alcohol condition on an emotion recognition task using mixed (i.e., faces with discrepant emotions on the top and bottom half of the face) and unmixed expressions. Using a balanced placebo design, this study found that males who were told they were given alcohol had lower accuracy scores for mixed faces than females told they were given alcohol and males who were told they were not given alcohol.[58]

6.18 | Dose–response effects of alcohol on emotion recognition

<u>Positive Emotions.</u> As shown in Supplemental Table 2, no discernable patterns emerged for dose–response effects of alcohol (comparing low, moderate and high dosages of alcohol) on positive (i.e., happy) emotion recognition.[††] Of the 16 studies that examined positive emotion recognition, 15 studies included a moderate dosage of alcohol and found mixed results, with two studies finding an improvement in positive emotion recognition,[36,52 (Study 1)] two studies finding an impairment in positive emotion recognition[53 (Study 1),57] and the remaining 11 finding no effects of a moderate dosage of alcohol on positive emotion recognition.[15,28–30,33,37,40,52 (Study 2),54–56] Two out

**This study included two dosages of alcohol, but the authors do not clearly report if the significant sex by alcohol interaction occurred at a moderate and/or high dosage of alcohol.

††For detailed dose–response effects for positive emotion recognition, see Supplemental Table 2.

of the 16 studies that examined positive emotion recognition included a high dosage of alcohol and also found mixed results, with one study finding an impairment in positive emotion recognition[53 (Study 1)] and the other study finding no effect of a high dosage of alcohol on positive emotion recognition.[40] Finally, five out of the 16 studies that examined positive emotion recognition included a low dosage of alcohol and similarly found mixed results, with one study finding an improvement in positive emotion recognition[16] and the remaining four studies finding no effect of a lower dosage of alcohol on positive emotion recognition.[29,30,36,53 (Study 1)]

Negative Emotions. As depicted in Supplemental Table 2, no discernable patterns emerged for dose–response effects of alcohol on negative emotion recognition (i.e., anger, sadness, disgust, fear and contempt) either.[‡‡] Of the 16 studies that examined negative emotion recognition, 15 studies included a moderate dosage of alcohol and found mixed results, with two finding an improvement to negative emotion recognition,[28,30] five finding impairments to negative emotion recognition[15,37,40,52 (Study 1),57] and the remaining eight finding no effects of moderate dosage of alcohol on negative emotion recognition.[29,33,36,52 (Study 2),53 (Study 1),54–56] Two of the 16 studies that examined negative emotion recognition included a high dosage of alcohol. Although both studies found impairments to negative emotion recognition, one of these two studies found a high dosage of alcohol-impaired recognition of anger and disgust/contempt (and not sadness or fear),[40] whereas the second study found a high dosage of alcohol-impaired recognition of fear (and not sadness or anger)[53 (Study 1)] (see Supplemental Tables 1 and 2). Finally, five of the 16 studies that examined negative emotion recognition included low dosages of alcohol, with all five studies finding no effects of a low dosage of alcohol on negative emotion recognition.[16,29,30,36,53 (Study 1)] Taken together, there do not appear to be consistent dose–response effects of alcohol on emotion recognition for positive or negative emotion recognition.

6.19 | Other moderator variables that may contribute to significant effects versus null findings

When considering the other moderator variables (i.e., study quality, study design, emotion recognition task and outcome measure), no clear trends were found for studies that did and did not find significant effects of alcohol on emotion recognition (see Supplementary Tables 2 and 3). For instance, high-quality studies both did (e.g., for happiness[52 [Study 1],57]) and did not (e.g., for happiness[28,55]) find effects of alcohol on emotion recognition. A similar trend occurred for study designs, where a mix of between- and within-subjects designs were used across studies that reported significant effects of alcohol (e.g., for sadness, between-subjects:[15,37]; within-subjects:[57]) and those that did not (e.g., for sadness, between-subjects:[52 (Studies 1 and 2)]; within-subjects:[16,36]).

‡‡For detailed dose–response effects for each specific negative emotion, see Supplemental Table 2.

There were two main types of emotion recognition tasks used across studies (i.e., identifying a specific emotion vs. identifying emotion recognition biases). Although significant results were found on occasion for the former type of task (used in 18 studies), no significant effects were ever found for the latter task (used in three studies).[27,52 (Study 2),57] Emotion recognition task features also varied greatly across studies, but there were no clear trends for which task features consistently produced significant effects within studies or across studies. For example, studies that used unmorphed sequences of expressions (i.e., tasks that presented individual images of facial expressions) both did[40] and did not[54–56] find effects of alcohol on emotion recognition. Further, studies that used morphed sequences of expressions (i.e., presented images of facial expressions as a continuum increasing in intensity from a neutral or ambiguous expression to a full emotional exemplar) were used across studies that did (e.g.,[16,52 [Study 1]]) and did not (e.g.,[28,33]) find effects of alcohol on emotion recognition. Among studies that used morphed sequences, no clear trends emerged between studies that began the image sequence with neutral versus ambiguous expressions. For example, studies that found effects of alcohol for fear recognition used morphed-sequence tasks that ranged from either neutral[37,53 (Studies 1 and 2)] or ambiguous[57] expressions to a full emotional exemplar of fear. Still, studies reporting no change in fear recognition also used these tasks (e.g.,[16,52 [Studies 1 and 2]]). Results also did not depend on whether video clips or static images were used to display facial expressions. For instance, studies that used video clips to display expressions revealed no effects of alcohol on happiness, anger, disgust and surprise[28,33,37]; however, significant results were found for sad[28,37] and fear[37] recognition using video clips. Further, tasks that presented static images of facial expressions were used across studies that did (e.g.,[40,52 [Study 1]]) and did not (e.g.,[16,52 [Study 2],57]) find effects of alcohol on emotion recognition. Regarding response options, most (16 out of 19) studies required participants to identify emotions from emotion labels provided,[15,16,27–30,33,36,37,40,52 (Studies 1 and 2),53 (Studies 1 and 2),57,58] whereas few (three out of 19) studies required participants to identify emotions by selecting a matching facial expression image.[54–56] Within studies, those that provided emotion labels both did (e.g., for disgust[30,40]) and did not (e.g., for disgust[16,57]) find effects of alcohol on emotion recognition for specific emotions. However, among the studies that required selection of matching facial expressions, all three found no effects of alcohol on emotion recognition[54–56] (which we discuss in more detail below).

Finally, there were no clear patterns for which outcome measures were most sensitive to detecting effects of alcohol on any emotion tested. For example, in the case of happiness recognition, significant effects of alcohol were found for threshold detection,[16] accuracy scores,[53 (Study 1)] false alarms,[52 (Study 1)] reaction times[36] and response bias.[57] However, some studies reporting no effect of alcohol on happiness recognition measured these same outcomes (e.g.,[15,29,30]). Taken together, study quality, study design, emotion recognition task features and outcome measure types do not seem to moderate the effects of alcohol on emotion recognition.

7 | DISCUSSION

Understanding the mechanisms underlying alcohol's negative social consequences (e.g., increased aggression[25]) and social rewards (e.g., increased social bonding[7]) may inform prevention and intervention efforts targeting alcohol-induced social problems and support theories focused on explaining alcohol's social facilitative and deleterious effects. The current paper systematically reviewed 19 alcohol administration studies to clarify the effects of alcohol on the recognition of positive and negative emotions and attempted to identify potential moderating variables (e.g., sex, alcohol dosage and study quality) contributing to whether effects of alcohol were found. Overall, there was little evidence that alcohol consistently affected emotion recognition of positive or negative emotions, calling into question whether alcohol-induced changes in the ability to recognise emotions in others explain the social consequences of alcohol use.

Two main types of emotion recognition tasks were used. The first captured the ability to identify a specific emotion (e.g., happiness) from facial expressions, employed by all but one[27] of the 19 studies. The most common feature of this kind of task, used by 12 of the 18 studies, displayed morphed facial expressions from a neutral or ambiguous expression to a full emotional exemplar (e.g., fear). The second main type of emotion recognition task captured the tendency to see a specific emotion (e.g., happiness) over another emotion (e.g., anger), employed by three of the 19 studies.[27,52 (Study 2),57] Examples included presenting facial expressions that gradually morphed from one emotional endpoint (e.g., happiness) to a second (e.g., anger). Results from these two types of tasks are summarised in the following sections.

7.1 | Effects of alcohol on emotion recognition abilities

The majority of studies using tasks that measured the ability to identify a specific emotion (e.g., happiness) from facial expressions found no effect of any dosage of alcohol on the recognition of any emotion tested. Specifically, no effects of alcohol were found for 68.75% of studies examining happiness recognition,[15,28–30,33,37,40,52 (Study 2),54–57] 87.5% of studies examining anger recognition [15,16,28–30,33,36,37,52 (Study 1), 53 (Study 1),54,56,57], 66.7% of studies examining sadness recognition,[16,29,30,36,40,52 (Studies 1 and 2),53 (Study 1)] 77.78% of studies examining disgust recognition,[16,28,37,52 (Studies 1 and 2),57] 75% of studies examining fear recognition[16,30,44,52 (Studies 1 and 2),54,56,57] and 100% of studies examining surprise recognition. Further, in the few ($k = 5$) studies that found effects of alcohol on happiness recognition, the results were mixed, with three studies finding an improvement[16,36,52 (Study 1)] and two studies finding an impairment[53,57] of alcohol on happiness recognition. Although the effects of alcohol seem to be more consistent for negative emotions, with studies finding that alcohol impaired the recognition of anger,[40,52 (Study 1)] sadness,[15,37,57] fear[37,53 (Study 1),57] and disgust/contempt,[40] and only two studies finding that alcohol improved the recognition of sadness[28] and disgust and contempt,[30] these significant effects of alcohol need to be interpreted in the context of most studies reporting non-significant results for each negative emotion examined or inconsistent results for a specific emotion across studies (e.g., for anger and fear[40,53 [Study 1]]). In general, there is little evidence that alcohol consistently affects emotion recognition for any specific emotion, at least with the emotion recognition tasks used currently in the field. These findings suggest that alcohol-induced changes to the recognition of emotions may not be a key mechanism explaining positive or negative social outcomes of alcohol consumption.

7.2 | Effects of alcohol on emotion recognition biases

None of the studies that used tasks that measured the ability to see one emotion over another emotion (i.e., emotion recognition bias) found significant effects of any dosage of alcohol (vs. placebo) on any emotion spectrum used. Specifically, no significant differences between alcohol and placebo beverages were found among studies that used a spectrum from anger to happiness,[27,52 (Study 2),57] happiness to sadness[57] or anger to disgust.[27] Taken together, there is no evidence that alcohol affects the likelihood of perceiving one emotion over another in these tasks.

7.3 | Sex and other moderator variables

We tested whether alcohol affects emotion recognition differently for males and females, given prior conflicting findings (e.g.,[29,33]) and research suggesting that males and females differ in their (1) social cognition abilities, with females typically demonstrating better emotion recognition abilities than males, (e.g.,[41–45]) and in their (2) alcohol consumption patterns, with males typically consuming more alcohol on average than females.[59] Seven of the 19 studies examined whether sex exerted a main and interactive effect with alcohol on emotion recognition outcomes. Consistent with prior research,[60,61] three of these seven studies found that females performed better than males, independent of drink assignment, in the recognition of fear[40] and sad and angry[15,28] expressions. The remaining four (out of seven) studies did not find main effects of sex on emotion recognition.[27,29,33,58] Additionally, four of the seven studies found a significant interaction between participant sex and alcohol dosage. In one study, males had significantly worse recognition of sad expressions compared to females at a moderate dosage of alcohol (but not at a low dosage of alcohol).[29] The second study found that males who consumed a moderate dosage of alcohol were more likely to judge disgusted faces as angry than males who consumed a placebo, but there were no differences for females.[27] The third study found that males who consumed alcohol made more errors in recognising disgust/contempt than females.[40§§] Finally, one study that used a balanced placebo design

§§This study included two dosages of alcohol, where the authors do not clearly report if this effect occurred at a moderate and/or high dosage of alcohol.

found that males who were told they were given alcohol had lower accuracy scores for mixed faces than females who were told they were given alcohol and males who were told they were not given alcohol.[58] The remaining three (out of seven) studies did not find interaction effects between sex and alcohol on emotion recognition.[15,28,33] Overall, there was some indication that alcohol may affect males' emotion recognition abilities more so than females, but more research is needed given the few studies that tested for these interactions and the fewer still that actually found significant interaction effects.

We also examined alcohol dosage as a moderator of alcohol's effects on emotion recognition. Importantly, in contrast to Baltariu and colleagues'[49] conclusion that alcohol facilitated emotion recognition at lower doses and worsened emotion recognition at higher doses, we found no compelling evidence of such moderation effects. Indeed, in the studies that tested different dosages of alcohol within the same study, results were often opposite to Baltariu and colleagues'[49] conclusion. For instance, one study found that a higher moderate dosage (0.8 g/kg) of alcohol significantly improved sadness recognition compared to a lower moderate dosage (0.4 g/kg) of alcohol.[28] Another study found that recognition of disgust and contempt micro-expressions was significantly better at a moderate dosage compared to a low dosage of alcohol.[30] Finally, one study found that a moderate dosage of alcohol significantly improved recognition of happy expressions compared to a low dosage.[36] Comparing results across studies that used different dosages of alcohol similarly revealed no evidence of consistent dose–response effects for any emotion. Thus, although we used the same coding scheme as Baltariu and colleagues[49] for categorising alcohol dosages as being low, moderate or high, our conclusions differ.

We also considered other moderator variables (i.e., study quality, study design, emotion recognition task and outcome measure), but no discernable patterns emerged across studies that did and did not find significant effects of alcohol on the recognition of facial expressions for any of these other variables either. Although one study examined alcohol administration procedure as a moderator of alcohol's effects on emotion recognition and found significant effects,[53 (Study 2)] these findings could be accounted for by learning/practice effects. Specifically, the authors found that single-dosage procedures (i.e., consumption of one alcoholic dosage in a single session: target BACs = 0.03%, 0.06% or 0.09% of alcohol) significantly worsened recognition of happy, angry and fearful expressions compared with cumulative-dosing procedures (i.e., consumption of multiple alcoholic dosages in a single session: target BAC = 0.03%, 0.06% and 0.09% of alcohol). However, participants in the cumulative dosing procedure completed the emotion recognition task after each beverage, so it is possible that learning/practice effects may explain these results. In summary, there is little evidence that any of the moderator variables reviewed here affected the findings, except for some indication that alcohol may affect males' emotion recognition abilities more so than females in a small number of studies (i.e., four out of seven) that tested for sex by alcohol interactions.

7.4 | Limitations and future directions

We systematically reviewed alcohol administration studies examining emotion recognition outcomes and considered several potential moderator variables, but there are important limitations to consider. First, we opted to do a qualitative systematic review rather than a meta-analysis. As such, we were not able to provide quantitative estimates of effect sizes, which provides a more objective conclusion about the association between variables. However, there was substantial variability in study designs and outcome variables, both of which limit the usefulness and appropriateness of formal meta-analysis (e.g.,[62–64]). Second, only six of the 19 studies reviewed here reported conducting power analyses to determine required sample sizes to detect effects of alcohol,[28,52 (Studies 1 and 2),53 (Studies 1 and 2),57] and it is thus possible that some of the studies reviewed here were under-powered to find effects. Indeed, several (five) of the studies had very small sample sizes (e.g., *Ns* of ~20 participants or fewer[30,36,53 [Study 2]–55]). Future studies that report power analyses can enhance the interpretation of results. Third, alcohol's impact on emotion recognition may depend on individual difference factors (e.g., light vs. heavy drinkers, learned alcohol expectancies and trait social cognitive abilities[16,65,66]) or features of the social context in which alcohol is consumed (e.g., with friends vs. strangers[67]). Only one of the 19 studies reviewed here considered high- versus low-trait aggression in impacting emotion recognition abilities following a moderate dosage of alcohol (vs. placebo) but found no evidence of trait aggression impacting emotion recognition abilities (i.e., no main or interaction effects).[57] Future research could benefit from examining the role of individual differences and contextual factors as moderators of alcohol's effects on emotion recognition, as well as investigating potential mediating mechanisms (e.g., interoceptive pathways[68]) that might explain alcohol's effects on emotion recognition. Fourth, the majority (16 out of 19) of studies were conducted on Caucasian Western populations (e.g., British and German), which may limit the generalisability of the findings to individuals of other racial/ethnic and cultural groups (e.g., due to cultural differences in how emotions and social–cognitive processes are valued and expressed[69,70] or variations in patterns of alcohol consumption due to cultural[71] and/or racial/ethnic differences in alcohol metabolism).[72] Future research on more diverse samples is needed.

Fifth, some further considerations are warranted regarding the rigorousness of the alcohol administration methods used in the studies reviewed here. For instance, whereas all 19 studies administered a placebo beverage, only 11 studies reported conducting manipulation checks for placebo deception,[15,28,33,37,52 (Studies 1 and 2),53 (Studies 1 and 2),57,58] one of which did not report the results of the manipulation check[27] and only two of which reported results clearly indicating that placebo deception was successful.[28,58] Future studies should consistently perform manipulation checks when including a placebo beverage and consistently report results that clearly indicate whether placebo deception was successful (e.g., reporting the number of participants in the placebo condition who believed they consumed some amount of alcohol).[7] Efforts should also be focused on increasing successful placebo deception. Regarding this, it is noteworthy that of the nine studies that used a within-subjects repeated-session design, eight studies either counterbalanced the order of placebo and alcohol sessions or used a random order. However, there is evidence that a within-subjects repeated-session design, in which participants receive a placebo during a session that follows one in which they drink alcohol, is problematic.[73] Notably, after experiencing true alcohol in the lab, participants can reliably detect that the placebo beverage does not contain alcohol. In contrast, the placebo deception works fairly well if participants have not previously been exposed to alcohol in the lab,[73] but this design does not control for order effects. Future studies testing the effects of alcohol (vs. placebo) on emotion recognition should consider using between-subjects designs (if resources permit).

Another concern related to alcohol administration methodology is whether the emotion recognition tasks occurred on the ascending limb of alcohol absorption, when the effects of alcohol are thought to be most pronounced.[9] Although 13 studies appeared to administer the emotion recognition task on the ascending limb (i.e., within 30 min of post-beverage consumption), it was unclear whether the emotion recognition tasks occurred on the ascending limb, at peak BAC, or on the descending limb of alcohol absorption for the remaining six studies.[15,27,29,37,55,56] Notably, 11 studies did not report BAC levels around time the of the emotion recognition task, and thus, we have no information in these studies about whether targeted BAC levels were reached.[15,27,29,30,33,40,52 (Studies 1 and 2),53 (Study 1),57,58] Future studies should clearly state when the emotion recognition task is administered (ideally on the ascending limb or at peak BAC) and record BAC levels before and/or after the emotion recognition task. Further, it is notable that most (84.21%) studies did not test high dosages of alcohol. Future studies that test high dosages of alcohol may reveal more consistent effects of alcohol on emotion recognition, given that higher dosages of alcohol are more likely to affect cognitive processing than lower dosages.[60] Finally, 11 of the 19 studies appeared not to consider participants' sex when calculating alcohol dosages.[15,27–29,33,36,37,40,52 (Studies 1 and 2),57] However, there are sex-based differences in average body water content and alcohol metabolism,[74,75] and identical alcohol dosages given to males and females can yield different BAC levels. It is thus important to consider sex when calculating alcohol dosages, and future studies should consistently do this. Future research might also consider examining whether BAC curves and timing of peak alcohol levels differ between males and females and, if there are differences, efforts should be made to ensure that emotion recognition tasks are given at comparable locations on the BAC curve across males and females.

Sixth, and finally, there are concerns worth noting about the emotion recognition tasks used across all of the studies. Only one of the 19 studies reported reliability estimates for the emotion recognition outcome variables,[28] and thus, we have virtually no information on how reliable emotion recognition outcomes are in general and whether some outcome measures are more reliable than others. Future studies should consistently report reliability estimates for emotion recognition outcome variables. Further, most (16 of the 19) studies used emotion recognition tasks that asked participants to categorise facial expressions by choosing from a list of emotion labels, but these tasks have been criticised for ignoring the importance of language in affecting emotion perception.[46,76–78] Future studies should consider using emotion recognition tasks that avoid emotion labels as response options, although it is interesting that none of the three studies that used alternate (i.e., non-language-based) response options (e.g., matching facial expression images) found effects of alcohol on emotion recognition.[54–56] Finally, and perhaps most importantly, the emotion recognition tasks used across all 19 of these studies have been criticised for lacking ecological validity. These tasks do not require participants to actually interact with other people but to rather sit alone in a laboratory room and make inferences based on pictures or videos of facial expressions, which is not how alcohol consumption[11,12] or emotion recognition[46,78,79] works in the real world. Future studies that assess the effects of alcohol on emotion recognition during real-time social encounters are needed.[80]

8 | CONCLUSIONS

Many researchers have hypothesised that alcohol's effects on positive and negative social behaviours are mediated by alcohol-induced changes in emotion recognition (e.g.,[15,16,29,52 [Studies 1 and 2]]). We systematically reviewed alcohol administration studies and found no consistent effects of any dosage of alcohol on recognition of any emotion. Further research is needed to clarify the underlying mechanisms explaining alcohol's effects on positive and negative social behaviours (e.g., changes in empathy and/or theory of mind).[46,81,82]

AUTHOR CONTRIBUTIONS

L. Kumar, B. Sanov, and K.G. Creswell developed the study concept. B. Sanov and L. Kumar performed literature searches, data extractions, and data extraction verifications, under the supervision of K. G. Creswell. B. Sanov wrote the first manuscript draft. K. G. Creswell and L. Kumar provided feedback and edits. All authors approved the final version of the manuscript for submission.

CONFLICT OF INTEREST STATEMENT

The authors of this manuscript have no conflicts of interest.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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

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