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No evidence that alcohol intoxication impairs judgments of learning in face recognition

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Abstract

Alcohol use is frequently involved in crime, making it crucial to understand the role of alcohol in facial recognition to maximise correct perpetrator identifications. While the majority of the alcohol and face recognition research has investigated recognition with *retrospective* confidence judgments, we examined the effects of alcohol intoxication on face recognition with *prospective* metacognitive judgments. Participants (*N* = 54 university students without a history of hazardous alcohol/substance use) consumed either alcohol (mean BrAC of .06 at pre-test and .07 at post-test) or a non-alcoholic placebo drink. Participants then studied unfamiliar male and female faces and made judgments of learning (JOLs) for each face (i.e., predicted the likelihood of recognizing that face on a future memory test). After a brief distractor task, participants completed an old-new recognition test on which they attempted to distinguish the studied faces from new faces. It was found that the alcohol manipulation had minimal effect on face recognition performance or JOLs. Our results suggest that theory-based cues about the effects of alcohol might play a greater role in retrospective judgments than prospective judgments. Although not a primary focus of the study, face recognition was better for male faces than female faces, and this occurred for both female and male participants. Limitations and implications of the research are discussed.

Keywords

Alcohol, face recognition, confidence, JOLs, metacognition

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Alcohol is the most commonly used drug worldwide and is frequently implicated in crime. Between 13-50% of violent crimes involve alcohol or other drug intoxication, meaning that the offender, victim or eyewitness is intoxicated during the crime (Australian Bureau of Statistics, 2017; Evans, Schreiber Compo, & Russano, 2009; National Statistics Publication for Scotland, 2016; Palmer, Flowe, Takarangi, & Humphries, 2013). For crimes such as sexual assault, alcohol is more likely to be present than not (Abbey, 2002; Mohler-Kuo, Dowdall, Koss, & Wechsler, 2004). In these crimes—and many others—the correct identification of the perpetrator by the victim or witness can be crucial for prosecution. It is therefore important to investigate the role of alcohol intoxication in ability to correctly recognize faces. In this research, we examined the effects of alcohol intoxication on face recognition, and on prospective metacognitive judgments about face recognition (i.e., assessments of the likelihood of recognizing a face in the future).

The handful of studies investigating effects of alcohol on face recognition and identification accuracy has yielded mixed findings. In a field study by Dysart, Lindsay, MacDonald, and Wicke (2002), witness identification accuracy did not significantly vary with different intoxication levels (mean breath alcohol concentration, or BrAC, in low alcohol condition: .02%, high alcohol condition: .09%) when a target-present show-up was used, but in the target-absent condition alcohol level was found to increase false identification rates. Similarly, Yuille and Tollestrup (1990) found that witness intoxication (mean BrAC of .10%) did not affect identification accuracy of the perpetrator one week after witnessing a staged theft in a target-present simultaneous lineup. Hilliar et al. (2010) found that compared to a sober group, mildly intoxicated witnesses (mean BrAC of .05%) showed a reduced own-race bias, where alcohol intoxication had a larger negative impact on the recognition of same-race faces compared to different-race faces.

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While the majority of the research on alcohol and face recognition has involved participants acting as witnesses, some have also considered this topic from the perpetrator perspective. After committing a staged robbery, participants who were moderately intoxicated (mean BrAC of .08%) during the crime showed poorer recognition of both "intruders" (interrupted robbery; central detail) and "bystanders" (present during alcohol consumption; peripheral detail) one week later in a target-present lineup, compared to sober participants (Read, Yuille, & Tollestrup, 1992).

Despite the abovementioned results, the majority of findings indicate no effect of alcohol intoxication during encoding on recognition accuracy in simultaneous lineups (Flowe et al., 2017, mean BrAC = .08%; Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm Gordh, 2013, mean BrAC: low = .04%, high = .06%; Harvey, Kneller, & Campbell, 2013, mean BrAC = 0.28 mg/l ≈ .06%; Kneller & Harvey, 2016, mean BrAC = .23 mg/l ≈ .05%).). Two recently conducted field studies (Sauerland, Broers, & van Oorsouw, 2018) distinguished between different levels of intoxication regarding alcohol's effects on witness memory, with BrACs of .06-.07% marking a threshold that best discriminated accurate and inaccurate lineup identification decisions, and BrACs of .14% resulting in inaccurate decisions in 100% of cases. However, a recent field study with witness intoxication levels up to .29% suggested that alcohol does not affect facial recognition (Altman, Schreiber Compo, McQuiston, Hagsand, & Cervera, 2018). With the exception of Read and colleagues (1992), all described studies have had the encoding phase and subsequent identification part in the same sitting, i.e. participants were either intoxicated or sober during both. Findings might differ if face recognition takes place when sober again, but the effect of timing complicates interpretation of such a study.

One potential explanation for the findings that face recognition appears to be relatively unaffected by alcohol stems from the attention-allocation model. According to this

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account, alcohol limits our ability to engage in effortful cognitive processing and narrows perception to the most salient internal or external cues (Steele & Josephs, 1988). Attention to important visual objects such as human faces is suggested to be a largely automatic, involuntary process, requiring only limited attentional resources (see Yan, Young, & Andrews, 2017). According to the model then, negative effects of alcohol on the identification procedure might be counteracted in two ways: intoxication might result in a greater attentional focus devoted to faces being studied (i.e., the most central or salient information), and this might be supported by automatic attention allocation to faces. However, since the here reviewed research has largely involved moderate doses of alcohol, it is possible that attention allocation effects do not suffice to counteract intoxication effects at higher doses.

Effects of Alcohol Intoxication on Metacognition

In applied settings, there is good reason to consider the effects of alcohol intoxication not only on memory performance for recognition of faces, but also on metacognitive judgments. Metacognition involves monitoring and assessing one's memory (e.g., Flavell, 1979). Metacognitive judgments can be made retrospectively (such as confidence judgments to assess the likely accuracy of memory decisions after they are made) or prospectively. Judgments of learning (JOLs; Nelson & Dunlosky, 1991) involve predicting the likelihood of remembering a studied item in the future. If alcohol were to affect the accuracy of either retrospective or prospective metacognitive judgments, this would have important applied implications. In forensic settings, perceptions of a witness's memory accuracy can impact investigation and trial outcomes. In many cases, a witness's identification of the suspect from a police lineup is a crucial piece of evidence.

Retrospective confidence. The retrospective confidence that a witness has in the accuracy of their decision is highly influential in shaping police investigations and courtroom

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decisions (Brewer, Keast, & Rishworth, 2002; see also Wixted & Wells, 2017). This is problematic in situations where an inaccurate witness (who had misidentified an innocent suspect) is nevertheless very confident that they had made an accurate identification. It is thus important to investigate the factors that affect the confidence-accuracy (CA) relationship.

Several studies have found that alcohol intoxication has minimal effect on confidence in eyewitness identification decisions (Dysart et al., 2002; Hagsand et al., 2013; Kneller & Harvey, 2016). In contrast, Harvey et al. (2013) found that alcohol intoxication reduced confidence in identification judgments. Yuille & Tollestrup (1990) also found that intoxication reduced confidence, but this effect was specific to incorrect responses; as a result, alcohol intoxication strengthened the correlation between confidence and accuracy.

One limitation of the abovementioned alcohol studies is that the CA relationship was investigated through correlational analyses. Calibration analyses are more informative because they examine various properties of the confidence-accuracy relationship that correlations do not elucidate (Brewer & Wells, 2006; Juslin, Olsson, & Winman, 1996). These include indices of the absolute accuracy (i.e., the extent to which metacognitive judgments correspond to probability of accuracy) and relative accuracy of metacognitive judgments (i.e., the extent to which people can distinguish what they can and cannot remember). We describe these indices in more detail below.

A recent study by Flowe and colleagues (2017) has used calibration analysis to examine the effects of alcohol intoxication on retrospective confidence judgments in an eyewitness identification task. In their study, Accuracy for central details (i.e., face recognition) did not differ significantly between intoxicated participants and sober participants. Furthermore, while overall there was a tendency towards under-confidence at the lower accuracy levels and overconfidence at the higher accuracy levels, alcohol consumption and alcohol expectation did not worsen calibration. However, alcohol did

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reduce confidence overall (as in Harvey et al., 2013; Yuille & Tollestrup, 1990): Women who were in the sober condition reported higher confidence levels overall relative to women in the alcohol condition, regardless of identification accuracy.

Prospective metacognitive judgments. The present study focused on the effects of alcohol intoxication on prospective metacognitive judgments relating to remembering faces. This has implications for numerous applied settings in which it is important for an observer to gauge accurately whether they will be able to recognize a stranger in the future. For example, a witness observing a crime might need to attempt to identify the perpetrator from a police lineup in the future. During the crime, it is useful for the witness to gauge accurately the likelihood of recognizing the perpetrator in future. If the witness correctly judged that they were unlikely to recognize the perpetrator based on the brief view they have had, the witness might try to get a better view of the perpetrator's face if it is safe to do so.

Three previous studies have examined the effects of alcohol on prospective metacognitive judgments, although none of these involved memory for faces. Two studies found no effects of alcohol intoxication on metacognitive judgments for general knowledge questions, suggesting that alcohol does not influence metacognition for pre-existing information in semantic memory (Evans et al., 2017; Nelson, McSpadden, Fromme, & Marlatt, 1986). Of greater relevance to the present research, Nelson et al. (1998) examined the effects of alcohol on JOLs for paired-associates (i.e., word pairs). They found that alcohol consumption reduced the magnitude of JOLs and the accuracy of JOLs made immediately after studying word pairs. These results provide some evidence that alcohol might impair metacognitive judgments made soon after acquiring new memorial information. However, given the differences in processing of faces versus word pairs (e.g., Maurer, Le Grand, & Mondloch, 2002; Tanaka & Simonyi, 2016) it cannot be assumed that the effects of alcohol on JOLs found by Nelson et al. (1998) will translate to a face recognition task.

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It is important to consider how alcohol might influence different aspects of metacognitive accuracy. *Calibration* refers to the correspondence between metacognitive judgments and accuracy, with perfect calibration occurring when these align (i.e., 20% accuracy corresponds to 20% JOLs, 100% accuracy corresponds to 100% JOLs, etc.). Calibration is indexed by the *C* statistic, which ranges from zero to one, with lower values indicating better correspondence between metacognitive judgments and accuracy. *Over/under-confidence* reflects whether, on average, confidence is greater or smaller than average accuracy. The *O/U* statistic ranges from minus one (extreme under-confidence) to one (extreme overconfidence) with zero indicating neither under- or overconfidence on average. Whereas calibration and *O/U* reflect absolute metacognitive accuracy, *resolution* (or *discrimination*) indexes relative metacognitive accuracy, or the degree to which metacognitive judgements discriminate correct from incorrect decisions. This is expressed via the Adjusted Normalised Discrimination Index (*ANDI*), which ranges from zero (no discrimination) to one (perfect discrimination). Baranski and Petrusic (1994) and Yaniv, Yates, and Smith (1991) provide detailed discussion of the calculation of these statistics.

One way the CA relationship may be impacted by alcohol is by impairing resolution (i.e., a person's ability to distinguish between correct and incorrect decisions). The *optimality hypothesis* (Bothwell, Deffenbacher, & Brigham, 1987; Deffenbacher, 1980) and *memory constraint hypothesis* (Hertzog, Dunlosky, & Sinclair, 2010) suggest that metacognitive accuracy will be greater when memory is stronger (e.g., when better processing conditions enable people to make more appropriate metacognitive judgments). Relating this to alcohol research, if sober conditions are a more optimal processing condition compared to intoxication, better resolution would be expected for sober participants.

Alternatively, alcohol intoxication could affect metacognition due to the *hard-easy effect* (Gigerenzer, Hoffrage, & Kleinbölting, 1991), a robust finding in confidence research

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that occurs when a manipulation affects accuracy but affects metacognitive judgments to a lesser extent. Specifically, people tend to exhibit greater overconfidence for increasingly difficult conditions, and vice versa. To the extent that alcohol consumption makes face recognition more difficult, overconfidence in metacognitive judgments may be expected in intoxicated compared to sober individuals.such as alcohol intoxication. However, if a person believes that alcohol intoxication impairs memory, they might adjust metacognitive judgments accordingly (e.g., Palmer, Brewer, Weber, & Nagesh, 2013); but if memory is not impaired for the task in question, then such adjustments might be unwarranted. This may be the case for the current context, given that much of the literature has produced null effects of alcohol on person recognition (e.g., Flowe et al., 2017; Hagsand et al., 2013; Harvey et al., 2013; Kneller & Harvey, 2016). Thus, alcohol intoxication might influence over/under-confidence even in the absence of any effects on face recognition performance.

The Current Study

We tested whether alcohol intoxication affects prospective metacognitive judgments in a face recognition task. Participants consumed either alcohol or a non-alcoholic placebo drink, and then studied unfamiliar faces and made JOLs for each face (i.e., predicted the likelihood of recognizing that face on a future memory test). After a brief distractor task, participants completed an old-new recognition test on which they attempted to distinguish the studied faces from new faces.

Given the mixed findings in the literature, several outcomes were considered possible. If alcohol does impair face recognition memory, then it could increase overconfidence in JOLs (i.e., produce a hard-easy effect; e.g., Gigerenzer et al., 1991). Alternatively, it could reduce resolution/discrimination, as per the optimality and memory constraint hypotheses (Deffenbacher, 1980; Hertzog et al., 2010). Finally, it could have no effect on metacognitive

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accuracy, consistent with the idea that people take into account their beliefs about alcohol impairing memory when making JOLs (e.g., Palmer et al., 2013).

Method

Participants

Fifty-four participants (22 female) aged 19 to 37 years (*M* = 23.3, *SD* = 4.1) were recruited from the University of Tasmania, either as participants from the first-year psychology subject pool for course credit, or recruited from the wider university cohort with a movie voucher for reimbursement. We excluded data from two additional participants who responded "no" to all faces on one of the face recognition tests. The sample size was based on a target minimum of 20 participants per cell (see Simmons, Nelson & Simonsohn, 2011).

This study was embedded in a larger series of studies on the role of alcohol intoxication in emotion perception. Details of that study and inclusion criteria for participants (e.g., no history of alcohol or substance abuse) are reported in Honan, Skromanis, Johnson, and Palmer (2018).

Materials and Procedure

All procedures were approved by the institutional ethics board at the University of Tasmania. As described elsewhere (Honan et al., 2018), participants were instructed to refrain from eating four hours prior to the study; from consuming caffeine eight hours prior to the study; and from alcohol, over-the-counter medication, nicotine, and illicit substances for 24 hours prior to the study. Participants were also instructed to consume a light meal prior to the four-hour fast and consumed two pieces of toast one hour prior to participation. A breath alcohol concentration (BrAC) reading was taken using a calibrated Andatech Alcolmeter 'Prodigy' hand held device to ensure participants had not consumed alcohol as instructed.

Alcohol manipulation. Participants were quasi-randomly (to balance gender in each group) assigned to the alcohol or placebo condition. There were minimal differences between

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the alcohol and control groups in mean age (alcohol: M = 23.7 years, SD = 4.46 vs. control: M = 22.9 years, SD = 3.71), $t < 1$, d = 0.20, and the proportion of female participants (alcohol: .43 vs. control: .39), $\chi^2 < 0.1$, Cramer's V = .04.

In order to control for alcohol expectancy effects, participants were (1) advised that they would be asked to consume either alcohol or placebo beverages for the experiment, and (2) given a 150mL beverage including 10mL lime syrup, four drops of Angostura® aromatic bitters, and soda water. To create an alcohol scent, 4mL of vodka was floated on top of the beverage, and a light mist of vodka was sprayed around the inside edge of the cup. Following consumption of this beverage, participants consumed a 750-mL alcoholic or placebo beverage over a 10-minute period. Both beverages contained 90mL lime syrup and 5ml Angostura® aromatic bitters to mask flavour, and equal parts soda and still water. The alcohol beverage included enough vodka to reach peak BrAC 0.08% following absorption. Dose was based on an individually calculated Widmark equation dose of alcohol (Dry, Burns, Nettelbeck, Farquharson, & White, 2012).

All participants were then placed in a separate room to view a neutral nature video while alcohol absorption occurred. No engaging activities were permitted during this absorption period and water consumption > 250mL was not permitted for the entire experimental session. Participants undertook the face recognition task 20 minutes following the consumption of the alcohol or placebo beverage. This timing places participants within the range of the ascending limb of alcohol intoxication (i.e., intoxication levels may still be increasing at this point); during this phase participants often expect more stimulant, rather than sedative effects of alcohol (Earleywine & Martin, 1993).

Face recognition task. Participants completed a recognition task for male faces followed by a recognition task for female faces. Each task comprised a study phase, a distractor task, and a test phase. Stimuli comprised 96 male faces and 96 female faces. From

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these sets, 48 male faces and 48 female faces were randomly selected to serve as target faces, with the remainder serving as lures during the test phase.

During each study phase, participants were shown the 48 target faces one-at-a-time, for 2 sec each. At the end of the 2 sec, the face disappeared and participants were asked to provide a JOL for that face (i.e., rate the likelihood of recognizing that face in the future on a scale from 0-100%) before moving on to view the next face. Participants provided JOLs by typing their response into a text box. Following the study phase, participants completed a 3-min distractor task that involved solving math equations (e.g., $7 \times 2 + 9 = ?$) and then began the test phase.

Each test phase comprised 96 trials. On each trial, participants viewed a face and were asked whether that face had appeared on the list studied earlier (Y/N). Half the trials involved target faces that appeared during the study phase and half involved lure faces. To ensure that participants were recognizing the faces presented at study rather than specific pictures (Bruce, 1982), the images of target faces used at study and test differed slightly in factors such as lighting and hairstyle (see Figure 1). As noted above (under "participants"), we excluded data from two participants who responded "no" to all 96 faces on one of the face recognition tests. After completing the face recognition task, participants completed an unrelated emotion perception task as part of the experimental session (see Honan et al., 2018 for details).

[figure 1 approximately here]

Manipulation checks. Participants' BrAC levels were recorded before and after the face recognition task, using a tested and calibrated breathalyser. At the end of the experimental session, participants completed the Beverage Rating Scale (BRS; Fillmore & Vogel-Sprott, 2000) which assesses subjective perceived levels of intoxication. Participants indicated the number of alcoholic drinks which best represented their perceived peak level of

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intoxication during the experimental session on a scale ranging from zero to 10 bottles of beer (4.8 percent alcohol per unit) in increments of 0.5 bottles.

Analyses. The central research questions concerned the extent to which alcohol intoxication affected face recognition performance and the accuracy of prospective JOLs. Face recognition performance was indexed by signal detection measures of discriminability (d') and response bias (c). Discriminability indicates the extent to which participants could distinguish target faces seen during study from lure faces, with zero indicating no ability to distinguish and higher scores indicating better performance. Response bias indicates the tendency to respond "yes" versus "no" to faces on the recognition test. Zero indicates unbiased responding, with positive values indicating conservative responding (a tendency to favour "no" responses) and negative values indicating lenient responding (a tendency to favour "yes" responses).

To address our questions, we conducted a series of 2 (alcohol condition) × 2 (sex of participant) × 2 (sex of target faces) mixed ANOVA, with sex of target face as a within-subjects factor. Dependent measures were discriminability and response bias (to index recognition performance) and discrimination, calibration, and over/under-confidence (to index the accuracy of JOLs).

Results

Manipulation Checks

BrAC. For participants in the alcohol condition, mean BrAC levels were .062 at pre-test (*SD* = .01, min = .031, max = .093) and .070 at post-test (*SD* = .01, min = .045, max = .107). On average, BrAC levels were higher at post-test than pre-test, indicating that participants were on the ascending arm of blood alcohol absorption during the recognition task, $t(28) = 4.22$, $p < .001$, $d = 0.80$. Participants in the placebo control group recorded zero BrAC levels at baseline.

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Subjective intoxication. Ratings on the BRS indicated that ratings of subjective intoxication were higher for participants in the alcohol condition (*M* = 4.16, *SD* = 1.95) than the placebo condition (*M* = 1.87, *SD* = 1.17), $t(53) = 5.21$, $p < .001$, $d = 1.41$.

Effects of Alcohol on Face Recognition

The alcohol manipulation had minimal effect on face recognition performance. Overall, *d′* did not differ substantially between the alcohol (*M* = 0.58, *SD* = 0.31) and control groups (*M* = 0.67, *SD* = 0.56). Numerically, recognition was better for the control group than the alcohol group, but this difference was small and statistically non-significant $F(1, 50) = 1.89$, $p = .176$, $d = 0.28$.

Discriminability was greater for male faces (*M* = 0.72, *SD* = 0.40) than female faces (*M* = 0.56, *SD* = 0.42), $F(1, 50) = 5.52$, $p = .023$, $d = 0.34$. (Cohen's *d* values for within-subjects comparisons were corrected for the correlation between scores; Morris & DeShon, 2002). This pattern did not vary between male and female participants, $F < 1$, $p = .423$.[1] This is not atypical of the face recognition literature, which shows inconsistent evidence of an own-sex bias (e.g., Herlitz & Lovén, 2013).

The alcohol intoxication manipulation also had minimal effect on response bias. Overall, response bias did not differ substantially between the alcohol (*M* = 0.37, *SD* = 0.53) and control groups (*M* = 0.39, *SD* = 0.35), $F(1, 50) = 0.07$, $p = .793$, $d = 0.04$.

Effects of Alcohol on JOLs

Mean JOLs. Although our focus was on the effects of alcohol on the accuracy of JOLs (i.e., the extent to which JOLs corresponded to recognition performance) we also report effects on mean JOLs. There was minimal difference in mean JOLs between the alcohol (*M* =

[1] None of the effects of alcohol on face recognition performance (*d′* or response bias) or metacognition (mean JOLs, ANDI, O/U, and C) were moderated by sex of participant, sex of face, or the interaction between these variables. None of these analyses yielded patterns of results that were statistically significant or theoretically relevant. We report only the non-significant interaction between sex of participant and sex of face, which is relevant for theories of own-group bias in face recognition.

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49.23, *SD* = 18.60) and control condition (*M* = 44.92, *SD* = 17.71), *F* < 1, *p* = .436, *d* = 0.24. Overall, JOLs were higher for male faces (*M* = 49.0, *SD* = 18.0) than female faces (*M* = 45.3, *SD* = 19.3), *F*(1, 50) = 9.74, *p* = .003, *d* = 0.43. Inspection of the patterns of individual cell means provided no evidence that alcohol intoxication reduced the magnitude of JOLs in any condition; JOLs were numerically higher for alcohol conditions than control conditions.

Relative accuracy. The alcohol manipulation had minimal effect on participants' ability to distinguish between faces they would remember and those they would not (i.e., the relative accuracy of JOLs). Overall, ANDI values were 0.03 (*SD* = 0.06) for the alcohol condition and 0.04 (SD = 0.04) for the control condition, *F*(1, 50) = 0.52, *p* = .476, *d* = 0.22.

Absolute accuracy. Alcohol intoxication had little effect on the absolute accuracy of JOLs in terms of over/under-confidence or calibration. Overall, *O/U* values were 0.00 (*SD* = 0.23) for the alcohol condition and -0.04 (*SD* = 0.20) for the control condition, *F*(1, 50) = 0.39, *p* = .537, *d* = 0.20. In *C* statistic values, there was little difference overall between the alcohol (*M* = 0.10, *SD* = 0.09) and control conditions (*M* = 0.07, *SD* = 0.07), *F*(1, 50) = 1.73, *p* = .194, although we note that the associated effect size was small-to-moderate, *d* = 0.39.

[Table 1 about here]

Discussion

This research is the first to examine the effects of alcohol intoxication on prospective metacognitive judgments for a face recognition task. The results of this study support two main conclusions. First, we found no evidence that alcohol intoxication impaired face recognition performance. There were minimal differences between the alcohol and control conditions in terms of ability to distinguish target faces from lure faces, or the propensity to deem faces as targets or lures on the recognition test. These results align with previous research; although there is some evidence that alcohol can impair face recognition (e.g., Read, Yuille, & Tollestrup, 1992), the majority of studies on this topic have found little

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difference in face recognition performance between intoxicated and sober participants (e.g., Flowe et al., 2017; Hagsand et al., 2013; Harvey et al., 2013; Kneller & Harvey, 2016). As noted in the introduction, this might result from attention-allocation effects: If intoxication causes a narrowing of attentional focus to faces being studied, this could mitigate any negative effects of intoxication on cognition (Steele & Josephs, 1988; Zoethout et al., 2011). Diminished attentional focus as predicted by this account is in line with findings by Zoethout, Delgado, Ippel, Dahan, and van Gerven (2011), establishing focused attention as a sensitive biomarker for alcohol intoxication, as people display impairments on such tests in a dose-dependent manner (see also Hildebrand Karlén, 2018, for a review of these findings in an eyewitness context).

However, despite the consistency in null findings in the literature, it is important to consider that most of this research involved moderate levels of intoxication. Although the manipulation check in the current study suggested that there were in fact differences in alcohol levels between the alcohol and placebo groups, future research may consider higher intoxication levels. Another possible explanation for the null effects of the current study relate to task difficulty: it is possible that the task was difficult enough to obscure differences between the two groups. However, given floor effects were not observed this is considered to be unlikely.

Second, the major new contribution from this research is that alcohol intoxication had little effect on the accuracy of JOLs. This applied to the relative accuracy (i.e., the ability of participants to distinguish faces they would recognize from faces they would not) and absolute accuracy of JOLs (i.e., the extent to which predicted likelihood of recognition corresponded to actual likelihood of recognition). This extends research on the effects of alcohol on metacognition. Previous work examined the effects of alcohol intoxication on the accuracy of retrospective confidence judgments in face recognition (e.g., Flowe et al., 2017;

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Kneller & Harvey, 2016; Yuille & Tollestrup, 1990), and one study found that intoxication impaired the accuracy of prospective JOLs for word pairs (Nelson et al., 1998). However, it cannot be assumed that such results would translate to prospective JOLs in face recognition, due to differences between memory for faces and words (e.g., Tanaka & Simonyi, 2016), and in the cues that affect JOLs versus retrospective confidence (e.g., Rhodes, 2016).

In terms of theoretical implications of our results, the null effect of alcohol intoxication on face recognition performance provides no evidence for mechanisms based on the hard-easy effect or optimality hypothesis, because such mechanisms hinge on differences in memory performance. However, our data do point to conclusions regarding the role of theory-based cues. Although some previous research has shown that alcohol reduced the magnitude of retrospective confidence judgments (Flowe et al., 2017; Harvey et al., 2013; Yuille & Tollestrup, 1990), there was no evidence in the present study that alcohol intoxication reduced the magnitude of JOLs. The differences were not clear cut, but JOLs were numerically higher for the alcohol conditions than control conditions for female and male participants' judgments about female and male faces. This runs contrary to the notion that participants may have adjusted their JOLs to consider beliefs about alcohol impairing performance on memory and cognition tasks.

In light of the above findings for retrospective confidence, our results suggest that belief-based cues (i.e., inferences based on beliefs about the effects of alcohol might play a greater role in retrospective judgments than prospective judgments. That is, people might be more likely to adjust metacognitive judgments downward to take effects of alcohol into account when the judgment is about a past recognition decision rather than a future one. There are several plausible reasons why this might occur. For example, it could arise from a tendency to be less mindful of the effects of alcohol on a future memory task than a current one, or from a tendency to attribute the subjective difficulty of a recent face recognition

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decision to being intoxicated during encoding. However, given that the current study is the first to examine the effects of alcohol intoxication on prospective metacognitive judgments for face recognition, such conclusions remain speculative until these results have been replicated.

Our results have implications from an applied viewpoint. There are many situations in which it is important to be able to recognize a face in the future, including social settings (e.g., meeting people at a networking function) alongside forensic settings. Our data indicate that alcohol intoxication does not undermine the accuracy of such metacognitive judgments. Thus, to the extent that our results generalize to applied settings, mild-to-moderate alcohol intoxication should have little effect on people's ability to gauge the likelihood of recognizing faces of unfamiliar others.

In this study, participants in the intoxication condition consumed alcohol to the extent that their BrAC levels were—on average—beyond the legal limit for driving in Australia of .05. Although our results provide evidence that face recognition and associated JOLs are unimpaired by intoxication to a level beyond the legal limit for driving, we cannot assume the same for higher levels of intoxication. However, it is also possible that the study was underpowered, thus increasing the likelihood of a Type II error. In addition, some effects of alcohol intoxication on cognition vary depending on whether blood alcohol levels are ascending or descending (e.g., Jones & Vega, 1972; Pihl, Paylan, Gentes-Hawn, & Hoaken, 2003). Because participants in our study were tested on the ascending limb, our results are most applicable to situations in which people are in the process of becoming intoxicated, as opposed to having reached or passed peak intoxication levels. Different effects might emerge at different stages of the intoxication curve. For example, on the descending limb, subjective ratings of intoxication tend to decline faster than actual intoxication levels, suggesting that

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people have the impression that they are sobering up faster than they really are (Martin & Earleywine, 1990). Therefore, future research could consider whether metacognitive judgments might differ between ascending and descending limbs of the intoxication curve.

In addition, although the face recognition tasks used in our study had several advantages (e.g., including many trials with photographs of real faces), there were some aspects of the task that differed from face recognition in applied settings. In our task, participants studied faces with no meaningful context in which to place them. In contrast, a more realistic scenario might involve attempting to not only remember a face, but also associate that face with the name of the person and other contextual information, such as information they shared during a conversation. It is possible that alcohol intoxication might affect recognition performance and associated metacognitive judgments in such realistic tasks.

Despite these limitations, the current research adds to a growing literature suggesting that alcohol intoxication does not undermine face recognition ability. Our results extend existing knowledge by providing no evidence that intoxication impairs prospective judgments about the likelihood of recognizing faces.

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Table 1. Descriptive statistics for the dependent variables of interest for the alcohol and control conditions

		Male faces		Female faces		Overall	
		Alcohol	Control	Alcohol	Control	Alcohol	Control
d'	Mean	0.633	0.810	0.548	0.569	0.579	0.669
	SD	0.363	0.427	0.370	0.479	0.309	0.344
c (response bias)	Mean	0.383	0.337	0.376	0.454	0.367	0.385
	SD	0.482	0.363	0.679	0.419	0.532	0.351
Accuracy	Mean	0.599	0.633	0.578	0.584	0.593	0.613
	SD	0.060	0.065	0.067	0.062	0.053	0.050
ANDI	Mean	0.053	0.037	0.065	0.046	0.026	0.037
	SD	0.085	0.050	0.131	0.077	0.057	0.039
C statistic (calibration)	Mean	0.112	0.077	0.116	0.080	0.098	0.066
	SD	0.098	0.058	0.099	0.088	0.092	0.071
OU	Mean	0.013	-0.064	-0.017	-0.026	-0.001	-0.045
	SD	0.230	0.183	0.264	0.232	0.231	0.198
JOLs	Mean	50.656	47.251	47.802	42.598	49.229	44.925
	SD	18.470	17.618	20.270	18.201	18.600	17.709

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Figure 1. Examples of male and female faces shown at study (left panels) and test (right panels).

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