

# The Influence of Alcohol and Weapon Presence on Eyewitness Memory and Confidence

Short title: Alcohol, Weapon Presence and Eyewitness Memory

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The data that support the findings of this study are available from the corresponding author upon reasonable request.

### **Abstract**

In this quasi-experimental field study, bar drinkers (.00 – .23 BAC%) viewed a photographic sequence in which a male took a laptop from a helpdesk assistant, either on loan or at gunpoint. Following a brief retention period, participants answered 20 multiple-choice questions about the male, his actions and details of the scene, then attempted to identify him from a simultaneous target-present or target-absent line-up. Alcohol was associated with a reduction in correct identifications and an increase in false identifications. Surprisingly, the presence of a weapon in the scene enhanced identification accuracy, though wider scene memory was not influenced by alcohol or the weapon. Findings offer some support for the view that alcohol restricts face encoding, perhaps through the narrowing of attention to salient external features (e.g. hair). We also suggest that curiosity about mock-crime perpetrators may produce weapon focus reversals, although the factors that might elicit such curiosity remain unclear.

Due to the public nature of many violent crimes (e.g., assault, affray) law agencies encounter high numbers of drunken eyewitnesses. Following an extensive US police survey, Evans, Schreiber Compo and Russano (2009) found 73% of officers regularly encounter intoxicated witnesses. In a similar study conducted across seven English police forces, 82% of officers claimed intoxicated witnesses were either a common or very common occurrence (Crossland, Kneller & Wilcock, 2018). However, conclusions from applied forensic memory research are mixed as variations in alcohol dose, retention period, encoding-retrieval intoxication state and type of test exert a complex influence on witness performance (for reviews see Altman et al., 2019; Jores et al., 2019).

In an early study by Yuille and Tollestrup (1990) intoxicated participants (M BAC  $\approx$  0.10%) recalled fewer details of a mock-crime than sober controls immediately after the event and significantly less accurate information than controls one week later, under sober response conditions. However, a similar study by Schreiber Compo et al. (2017) showed a reduction in memory accuracy only among participants who had consumed alcohol just prior to encoding, then the same quantity again (M BAC  $\approx$  .08%) just prior to their retrieval attempts a week later. In terms of test format, open response tests such as the free recall task have elicited more complete and accurate memory responses from alcohol participants than cued-questions in some studies (Altman, Schreiber Compo, Hagsand & Evans, 2019; Hagsand et al., 2017; Schreiber Compo et al., 2012) but not all (Crossland et al., 2016). Crossland et al. (2016, Experiment 2) played a video of a mock-crime to inebriated bar patrons, and tested their recall and recognition of the event one-week later when all were sober. Those most intoxicated while viewing the clip (M BAC  $\approx$  .14%) recalled fewer correct

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details of it than viewers with lower breath readings (M BAC  $\approx$  .05%), but recognition memory performance was unaffected by alcohol. Furthermore, following a meta-analysis of the alcohol and scene recall literature, Jores et al. (2019) found only small adverse effects of low to moderate alcohol doses on the completeness of recall, but larger impairments to both recall completeness and accuracy at higher doses (BAC  $\Rightarrow$  .10%). This perhaps explains why null effects of alcohol on scene memory are commonly reported in lab studies which, for ethical reasons, rarely elicit BACs above .10% (e.g., Hagsand et al., 2017; Harvey, Kneller & Campbell, 2013b; Hilderbrand Karlén, Roos-af-Hjelmsäter, Fahlke, Granhag & Söderpalm Gordh, 2017; Schreiber Compo et al., 2012).

Findings from studies of alcohol effects on memory for faces are as inconsistent as those focusing on wider scene features, but there is some evidence the drug can impair the recognition of unfamiliar faces. For example, moderately intoxicated participants in an old-new face recognition experiment were found to make more false identifications of same-race faces than sober controls, a reduction of the own-race face processing bias the study's authors attribute to alcohol disrupting the expert encoding of same-race faces (Hilliar, Kemp & Denson, 2010). Among studies incorporating more forensically relevant face memory tasks (Altman et al. 2018; Bayless, Harvey, Kneller & Frowd, 2018; Colloff & Flowe 2016; Dysart, Lindsay, MacDonald & Wicke, 2002; Flowe et al., 2017; Hagsand et al. 2013a; Harvey et al. 2013a; Kneller & Harvey 2016; Read, Yuille & Tollestrup, 1992; Yuille & Tollestrup, 1990), three reveal an adverse effect of alcohol intoxication on identification accuracy (Bayless et al., 2018; Dysart et al., 2002; Read et al., 1992).

Read et al. (1992, Experiment 2) found an alcohol-linked reduction in face identification accuracy, but from a mock-perpetrator rather than mock-witness perspective. Their sober and alcohol participants committed a simulated robbery before attempting to identify each of two individuals from a 5-person simultaneous line-up – one, a “bystander” seen prior to the mock crime (low arousal condition), the other, an “intruder” encountered during the crime (high arousal condition). Relative to sober controls, alcohol participants showed a 50% reduction in the rate of correct identifications of the “bystander” in the low arousal condition, but not of the “intruder” in the high arousal condition. The authors interpret this effect as an alcohol induced face encoding deficit that is negated when the target’s actions induce witness arousal.

Using a “show-up” procedure in which participants attempted to identify a recently encountered individual from a single photograph, Dysart et al. (2002) found a positive association between breath alcohol concentration and the likelihood of falsely identifying a foil similar in appearance to the target. The authors explain this result in terms of *alcohol myopia theory* (AMT), which states that rising blood alcohol levels deplete cognitive resources, gradually restricting the drinker’s attentional scope to only the most salient or immediate scene details (Steele & Josephs, 1990). As faces are prominent social stimuli and the external face area (esp. hairstyle) plays an important role in the perception of unfamiliar faces (Bruce et al., 1999; Ellis, Shepherd & Davies, 1979; Frowd, Bruce, McIntyre & Hancock, 2007; Johnston & Edmonds, 2009; Young et al., 1985) intoxication at encoding may narrow attention to this salient face region, making it more difficult for witnesses to

discriminate memories of the target's interior face features from those of a similar looking "innocent".

This view is supported by Harvey and Tomlinson (2019), who showed a sequence of 21 full face photos to alcohol drinkers in a local bar then invited them to identify either the full, internal or external region of each target face amongst a series of 21 previously unseen part or whole faces. They found a negative correlation between breath alcohol concentration and recognition accuracy for internal but not external face features, suggesting that acute alcohol restricts the focus of attention on to the more salient hair region of unfamiliar faces when they are viewed for the first time.

Feature-based face encoding deficits were also found by Bayless et al. (2018) who explored the effect of intoxication on the construction of face composites. Participants who viewed the to-be-constructed face following alcohol consumption produced composites (the following day) rated by independent judges as being of a poorer likeness to the target than those of sober controls. Likeness ratings for just the internal (eyes, nose and mouth) and external (hair, contour) region of each composite further suggest that alcohol impaired memory for the external features of shorthaired-male but not longhaired female faces, which is consistent with the notion that alcohol narrows the focus of attention on to distinctive face regions.

Evidence that alcohol restricts attention to the processing of salient visual features is provided by a raft of basic cognitive experiments (e.g., Bayless & Harvey, 2017; Canto-Pereira, David, Machado-Pinheiro & Ranvaud, 2007; Clifasefi, Takarangi & Bergman, 2006; Harvey, 2016; Harvey, Bayless & Hyams, 2017; Hoyer, Semenec & Buchler, 2007;

Moskowitz & Sharma, 1974; Schulte et al. 2001) and a small but growing number of applied studies on alcohol and mock-witness recall (for reviews see Altman et al., 2019; Jores, Colloff, Smailes & Flowe, 2019). For example, Harvey, Kneller and Campbell (2013a) tracked the eye movements of sober and alcohol (M BAC  $\approx$  0.06%) participants as they viewed two successive stimulus photographs each depicting a salient real-world scene as its focus (e.g. riot police apprehending civilians with batons). Participants who viewed the image under the influence of alcohol spent less time gazing at its peripheral features than sober controls and they recalled fewer accurate details about it the following day. Schreiber Compo et al. (2011) and Jaffe, Harris and DeLillo (2019) also report evidence of alcohol myopia in scene memory contexts. Schreiber Compo and colleagues (2011) had an alcohol (M BAC = 0.08%) and placebo control group recall details of a recent drinking session in a university “bar-lab”. Alcohol impaired memory for non-central aspects of the scenario (e.g. objects in the surrounding room) leaving central memories of the participants’ conversations with the bar tender intact. Jaffe et al. (2019) had placebo, low dose (BAC = 0.04%) and high dose (M BAC = 0.11%) alcohol groups watch a film clip depicting a highly traumatic sexual assault and found the highest alcohol dose impaired peripheral recall (memory of the staged screening room and its contents) but had no effect on central recall (memory of the film clip itself). We note that the Jaffe et al. experiment was published after a meta-analysis of acute alcohol and scene memory effects by Jores and colleagues (2019), who report evidence of peripheral but not central alcohol deficits across several studies.

Perpetrators are typically central to the crime scene, which is probably why so few studies have shown negative effects of alcohol on line-up tasks (Altman et al., 2019). But

alcohol has been shown to reduce identification accuracy (Dysart et al., 2002; Read, Yuille & Tollestrup, 1992) and dramatic crimes, such as robbery, assault and affray, present additional cues that may draw witness attention away from the perpetrator's face. In the case of armed crimes, witnesses may be so narrowly fixated on the perpetrator's weapon that their ability to later identify or describe the assailant is significantly impaired.

The predominant theoretical accounts of this so-called *weapon focus effect* (WFE) are the *unusual item hypothesis*, the idea that the weapon's contextual unusualness or unexpectedness captures attention (e.g. Pickel, 1998, 1999, 2009), and the *arousal hypothesis*, according to which a defensive stress response channels witness attention on to the threatening object (e.g. Loftus, Loftus & Messo, 1987). The arousal hypothesis is derived from Easterbrook's *cue-utilisation theory*. According to this view, a stress response that does not overwhelm the organism should focus attention by restricting the range of available cues only to those most relevant to the threatening stimulus, such as the location and orientation of a gun, which a witness must track to evade its line of fire (see Deffenbacher et al., 2004, for a review of the stress and eyewitness memory literature). However, the strongest evidence of weapon focus is confined to laboratory studies in which participants are shown a mock-crime (either live or via video or slideshow) that they are later questioned about. Participants who witness a scene featuring an armed perpetrator tend to remember this person less accurately than those shown a matched scene in which he was unarmed (e.g., Carlson, Dias, Weatherford & Carlson, 2017; Cutler et al., 1986, 1987a, 1987b; Erickson, Lampinen & Leding, 2014; Loftus et al., 1987, Experiment 2; Pickel, 1999; Tooley et al., 1987). While there is evidence that arousing stimulus scenes restrict the attentional focus of participants on



to the most central features impairing memory for peripheral scene features (Christianson, 1992; Davies, Smith & Blincoe, 2008) it is unlikely that the levels of participant-arousal elicited by mock-crimes shown in lab studies are anywhere near as high as those experienced by witnesses of real armed crimes (Kocab & Sporer, 2016). The unusualness hypothesis therefore offers a convincing account of WFEs elicited by relatively neutral stimuli. It also explains why attention is similarly narrowed on to surprising but non-threatening objects, such as a feather duster (Hope & Wright, 2007; Pickel, 1998), and vanishes entirely in stimulus contexts where weapons are expected (Pickel, 1999; Pickel & Sneyd, 2018).

To date, three meta-analyses of the weapon focus literature have been conducted and all report larger effects for scene and person description measures than for identification accuracy (Fawcett, Russell, Peace & Christie, 2013; Kocab & Sporer, 2016; Steblay, 1992). In fact, Kocab and Sporer (2016) found no significant evidence of weapon focus on identification performance. These may be conservative estimates though, as few studies have incorporated target-absent line-ups in their design. Recent evidence suggests the presence of a weapon in mock crimes increases the risk of mistaking a foil for the perpetrator (Fawcett, Peace & Greve, 2016), which is obviously more likely to occur when the target is absent from the line-up. Reviews also reveal that direct evidence of weapon focus impairing real witnesses, gleaned from archive and field studies, is quite rare (Fawcett et al., 2013; Fawcett et al., 2016; Kocab & Sporer, 2016). For example, Tollestrup, Turtle and Yuille (1994) found the presence of a weapon in true crimes to be associated with more complete eyewitness accounts that are no less accurate than those recorded for non-weapon crimes. Other studies have revealed non-significant effects of weapon presence on identification accuracy

(Behrman & Davey, 2001; Mecklenburg, 2006; Pike et al., 2001) and Valentine, Pickering and Darling (2003) found weapon-presence reduced the number of false identifications by around 8%. Nevertheless, the phenomenon is widely acknowledged among law enforcement agencies and deemed worthy of judicial consideration (Fawcett, Peace & Greve, 2016).

Given the extent of alcohol-related violent crime, the abundance of drunken witnesses and the possibility that a restricted attentional focus under alcohol might intensify weapon focus, we are surprised that the combined effects of these two important estimator variables on witness memory have not been examined. To address this gap, we had sober and alcohol-intoxicated participants view a slideshow of a young man either borrowing a laptop or stealing it at gunpoint from a university help desk. Participants then answered multiple-choice questions about the scene and attempted to identify the male from a simultaneous target-present or target-absent lineup.

The hypotheses we tested with this procedure, which closely replicated that of Loftus et al. (1987), are as follows. In line with previous alcohol and eyewitness memory studies, participants were (1) expected to show greater memory accuracy for questions related to central scene features concerning the target male and his exchange with the assistant, relative to peripheral scene features (Harvey et al., 2013b; Schreiber Compo et al., 2011; Crossland, Kneller & Wilcock, 2016; Harvey et al., 2013a, 2013b). (2) Those shown the weapon scene were expected to respond less accurately to the memory questionnaire than no-weapon controls (Loftus, Loftus & Messo, 1987). (3) Despite mixed findings in the alcohol and witness memory literature and a prevalence of null effects at lower intoxication levels, we anticipated that the higher BAC levels obtained in the present field study would, in

accordance with AMT, reduce questionnaire accuracy for items related to peripheral rather than central scene features (Jaffe et al., 2019; Harvey et al., 2013a; Schreiber Compo et al., 2011). (4) On the basis of Bayless et al. (2018) who found alcohol impaired memory for the external features of shorthaired-male but not longhaired-female faces; and Dysart et al. (2002) and Harvey and Tomlinson (2019) who suggest alcohol may narrow the focus of attention to the external region of unfamiliar faces, we thought higher BACs might be associated with differential responses to questions concerning the target's internal (facial hair) and external (colour and length of head hair) face features though, in the absence of a facial distinctiveness manipulation, this was an exploratory two-tailed prediction. (5) We expected more weapon-scene participants to make incorrect identification decisions than no weapon controls, particularly under target-absent line-up conditions (Fawcett, Peace & Greve, 2016). (6) We thought participants with high BACs were more likely to make identification errors than low-BAC and no alcohol counterparts, particularly under more challenging target-absent conditions (Dysart et al., 2002). And, (7) we expected the combined attentional narrowing effects of alcohol and weapon-presence to produce the poorest scene memory and face identification performance overall.

A secondary aim of the study was to explore the influence of weapon-presence and alcohol intoxication on the relationship between identification accuracy and the confidence participants expressed in their identification decisions. Following a review of the eyewitness confidence and identification accuracy literature, Wixted and Wells (2017) conclude that confidence is a reliable predictor of identification performance under "pristine" line-up conditions, such as when visual exposure to the perpetrator is of sufficient duration, the

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retention interval is not too long, the line-up is fair, the witness is cautioned that the perpetrator may not be present and when witness confidence is taken immediately after the identification decision. But, as far as we are aware, there is just one published study on the effect of weapon-presence on the confidence-accuracy (CA) relationship (Carlson, Dias, Weatherford & Carlson, 2017). Carlson and colleagues found that witnesses of an armed mock-crime showed closer alignment between identification confidence and accuracy than no-weapon controls, which may reflect a metacognitive awareness that weapons are a distraction, with confidence downgraded accordingly. The effect of alcohol on eyewitness confidence and identification accuracy has also received little attention beyond the observation that alcohol tends generally to lower memory confidence (e.g. Harvey et al., 2013b). One exception is a study by Flowe et al. (2017), who looked specifically at the effect of alcohol on the CA relationship in an eyewitness context but found it had no influence. They suggest this is because participants suspect alcohol impairs memory and thus lower their confidence to more realistic levels than sober counterparts. Carlson et al. and Flowe et al. thus offer similar interpretations concerning the respective influence of weapon presence and alcohol on metacognitive memory judgements, which Palmer et al. (2013) would categorise as ‘theory-based’ approaches to identification confidence. This is the idea that participants make downward corrections to their confidence judgements in response to factors they feel may have compromised their memory. On this basis we made one final prediction, that (8) weapon presence and alcohol consumption would have no effect on the CA relationship.

## Method

### Participants

Five-hundred and fifteen participants aged 18-71 years ( $M = 21.77$ ,  $SD = 5.51$ ) were recruited for the study (251 male, 264 female) all reporting normal or corrected-to-normal vision. Of these individuals 466 were volunteers recruited in the host university's Student Union bar, based in the UK, where the legal age for the purchase of alcohol is 18 years. Overall, 274 participants had consumed alcohol prior to testing and 241 had not. To more closely balance the size of our sober and alcohol groups following a shortage of non-alcohol drinkers in the bar venue, we recruited 49 sober participants from the host institution's Department of Psychology participant-pool. These participants received course credit for their participation but were tested under the same quiet lab-like conditions as counterparts recruited in the bar. Sample size was determined by an *a priori* power analysis ( $\beta = .8$ ) using G\*Power 3.1.9.2 (Faul, Erdfelder, Buchner & Lang, 2009). This is based on use of a three-way mixed analysis of variance with four independent groups and one within-subjects variable, with two repeated measures (central vs. peripheral memory recognition). To detect a small effect of acute alcohol on scene recognition memory ( $f = 0.1$ ) using this test, assuming a correlation of 0.1 between repeated measures and an alpha of 0.05, a total sample size of at least 496 participants was required.

### Study Design

In their seminal study, Loftus, Loftus and Messo (1987) observed WFEs using a photographic stimulus slide sequence. To optimise our chances of obtaining the effect and to

keep study administration as simple as possible, we therefore chose to replicate Loftus et al as closely as possible, although we had to move the context of the scene from a restaurant line to a queue at a university helpdesk. When the target male in our scene arrives at the counter he either points a gun at the assistant or merely proffers his student ID card. In both weapon and no-weapon scenarios, the same female assistant responds by handing the male a laptop computer with which he exits the scene. As in Loftus et al. (1987), following a brief filled retention interval, participants completed a 20-item multiple-choice questionnaire testing their memory of the target male and the objects he handled (gun, ID card, laptop), hereafter referred to as “central” details, and other scene features, including the helpdesk assistant, bystanders in the queue and objects around the room, which we refer to as “peripheral” details. They then attempted to identify the target male from a 12-person (target-present or target-absent) photospread line-up and record a confidence rating for this decision.

A 2(Alcohol vs. No Alcohol)  $\times$  2(Weapon vs. No Weapon)  $\times$  2(Central Stimulus vs. Peripheral Stimulus) mixed quasi-experimental design was used to test the effects of alcohol consumption and weapon presence on scene feature memory, with stimulus type being the only within-subjects variable. The dependent variable was recognition performance on the memory questionnaire.

To assess the influence of alcohol on identification accuracy we used a 2(Alcohol vs. No Alcohol)  $\times$  2(Weapon vs. No Weapon)  $\times$  2(Response: Correct Rejection vs. Incorrect Identification) contingency table design for target-absent (TA) line-ups, and a 2(Alcohol vs. No Alcohol)  $\times$  2(Weapon vs. No Weapon)  $\times$  3(Response: Correct Identification vs. Incorrect Identification vs. Incorrect Rejection) design for target-present (TP) line-ups.

To complement the contingency table analysis, we used logistic regression models with breath alcohol concentration serving as a continuous predictor and weapon presence/absence as a categorical predictor to examine the extent to which these variables predict either a correct or incorrect identification response.

The host university's ethics committee approved the study, which was administered with full adherence to the British Psychological Society Code of Ethics and Conduct.

### **Apparatus and materials**

Participant alcohol levels were recorded using an Alcosense DA5000 Pro Digital Breathalyser and breath measures (mg/100ml) were converted to blood alcohol concentration estimates (BAC% by volume) based on a 2300:1 blood-breath partition ratio.

We matched our stimuli as closely as possible to those of Loftus, Loftus and Messo (1987), who observed a WFE using an 18 slide series showing a target male move through the order line of a fast food restaurant. We used the same number of slides to depict a male in a line of three students awaiting service by a female assistant at the helpdesk of a university administration office. In the no-weapon scene the male shows his student identification card to the assistant as he reaches the counter and she responds by handing him a laptop computer, the implication being that the device is on-loan. The weapon scene differs only in that the same male points a gun at the assistant as he reaches the counter. She again responds by handing him a laptop, but the event is now clearly an armed robbery. Two matched pairs of weapon/no-weapon slide series were created with each pair showing a different target male, producing a total of four 18-slide sequences (Target-A with no weapon, Target-A with

weapon, Target-B with no weapon, Target-B with weapon). We shot the images in colour using a Canon EOS 1300D DSLR digital camera. Greyscale examples are shown in Figure 1.

FIGURE 1 ABOUT HERE

During the memory retention interval participants completed a “*Where’s Wally?*” visual search task. This comprised a series of six illustrations depicting scenes of characters engaged in a variety of novel and amusing activities in some themed location, such as a beach or fun fair. Hidden amidst each densely detailed scene was a character wearing a red and white striped hat and sweater called “Wally”, whom participants were asked to find.

Four multiple-choice memory questionnaires were constructed, one for each of two target males (Target A and Target B, see below for further details) acting in each of two weapon scenes (weapon vs. no-weapon). These only differed with regard to two questions, one concerning the target’s hair colour (blonde vs. brown) and the other concerning the item he revealed to the receptionist (gun vs. student card). Every question had four answer options, three false and one correct. As in Loftus et al. (1987) seven items related to details about the target male, which we refer to as “central” questions, and thirteen to wider scene features, described as “peripheral” questions. As an example, we have appended the questionnaire for Target A in the weapon scene. While participants received the questions in a randomised order, for convenience we organise the appendix such that central questions are listed as the first seven items.



For the identification task, participants were presented with a photospread of twelve 10cm × 7cm head-and-shoulder colour portrait shots of young men (early 20s) in frontal-view, simultaneously displayed in a 3(rows) × 4(columns) array. Each image was shot against the same white background under similar lighting conditions using the high-resolution camera described above. In TP arrays the target occupied position 10 (bottom row, second column) and in TA line-ups his image was replaced with a foil similar in appearance to the other foils. Stimuli were presented in colour on a 15" laptop screen.

**Line-up construction.** TA and TP line-up fillers were selected by matching to the appearance of each target male. We observed hundreds of people passing through the lobby of a large university library in search of males resembling either of our two targets. We identified 22 males with a good likeness, all of whom agreed to have their image captured for use in the study. The faces of half of these men resembled Target-A, and the rest Target-B. We used a mock witness procedure to validate our similarity judgements and to compute line-up fairness statistics. This involved asking individuals unfamiliar with the targets to identify each from his respective photospread on the basis of only a (modal) physical description derived from the accounts of 7 participant-witnesses who had viewed the respective stimulus scene. We invited 94 participants to imagine this was an eyewitness description of the perpetrator that they should use to identify him (without having viewed his face). They were presented with a TP photospread and asked: "Which person in this line-up best fits the description?" We calculated Tredoux's (1998) effect size (E) to measure each line-up's functional size, which reflects the number of array members considered a good match to the mock-witness description ranging from 1 to the line-up's nominal size of 12. For the Target

A line-up  $E = 4.88$  and for the Target B line-up  $E = 6.37$ . The line-ups therefore had a broadly similar functional size that falls within the nominal size range of police line-ups used around the world, which have a mean of 5.4 ( $SD = 2.51$ ) and a mode, surprisingly, of just 3 (Fitzgerald, Rubinova & Juncu, 2019).

## Procedure

Alcohol drinkers were recruited in the host university's Student Union and freely volunteered their time to participate in a study exploring the effect of alcohol on visual attention. To reduce the risk of candidates consenting when they did not fully understand the requirements of the study, those showing signs of extreme intoxication, including slurred speech, anger, boisterousness, confusion, nausea or stupor were not recruited. Each volunteer was individually escorted to a quiet pre-booked test room situated one floor above the Union bar where they were seated and had the study explained to them. After consenting to proceed, the participant was given tap water, to rinse residual alcohol from the mouth, followed by a breath alcohol test, the results of which were not disclosed. The experimenter then opened a laptop placed in front of the participant and commenced with the task.

Participants were randomly assigned to view one of the four stimulus scenes described in the Materials section. They were told a sequence of 18 slides would be presented to them at a rate of 1.5 seconds per slide, and that they should just view this sequence normally. Participants gave a second closed breath alcohol reading immediately after stimulus presentation then began the "*Where's Wally?*" filler task. They were shown a picture of Wally, told that he was hidden somewhere in the complex scene presented on the laptop

and that they should tell the experimenter and point to Wally if they spot him. Each participant was given 5-minutes to look for Wally and those who found him were given a new scene to search, and so on, until the full time had elapsed.

After this delayed distraction period participants were shown the 20-item multiple choice memory questionnaire displayed on the laptop in an interactive format using Qualtrics survey software. They were told the questions were about the 18-slide scene shown before the “Where’s Wally?” task and that they should read each one carefully before indicating, with a mouse-click, the option they think is correct. Questions were self-paced and presented to each participant in a different randomised order.

Having answered the final question participants were shown the 12-person photospread possibly showing the target male among similar looking foils. They were told that the male who took the laptop may or may not be present in this array and that they should either point to him or say “not present” if they believed he was absent. Next, participants were asked to rate how confident they were with this identification decision on a scale of 1 (“guess”) to 6 (“very sure”). After a final breath measure that was shared with participants, they were debriefed and given the opportunity to ask questions about the study. We then thanked them for participating, escorted them back to the bar area and asked them not to discuss details of the study with other bar dwellers. Testing time from recruitment to debrief was approximately 20 minutes per participant.

As with the SU bar recruits, sober volunteers recruited from the Department of Psychology participant pool were invited to take part in a study of the effects of alcohol on visual attention and were tested under the same quiet conditions. However, whereas the bar

dwellers were largely tested in the late afternoon and evening, participants from the pool were tested during office hours (between 9am and 5pm). Pool participants were also breathalysed only once, just prior to testing, to ensure sobriety upon arrival at the test venue and received course credit for their time.

## Results

### Intoxication levels

Figure 2 shows the distribution of mean breath alcohol measures (taken across three breathalyser tests) for participants with a BAC greater than 0.00% ( $n = 274$ ). BACs among these participants ranged from 0.04% to 0.23% with a mean of 0.08% ( $SD = .05$ ). For comparison, the legal BAC limit for driving in the UK and US is 0.08%.

FIGURE 2 ABOUT HERE

### Questionnaire accuracy

Scene memory data were subjected to a  $2(\text{Alcohol Group}) \times 2(\text{Weapon Group}) \times 2(\text{Stimulus Region})$  mixed factorial analysis of variance (ANOVA), with Stimulus Region serving as a within-subjects variable. As expected, and in support of Hypothesis 1, participants were substantially better at remembering central ( $M = 70.16\%$ ,  $SD = 19.16$ ) than peripheral scene details ( $M = 49.37\%$ ,  $SD = 18.51$ ),  $F(1, 511) = 321.80$ ,  $p < .001$ ,  $\eta_p^2 = .386$ . However, all other main and interaction effects were non-significant ( $ps > .20$ ), so our prediction that weapon presence would impair scene memory (Hypothesis 2) and that alcohol

intoxication would impair peripheral but not central scene memory (Hypothesis 3) were not supported.

To address Hypothesis 4, which predicts differential performance by higher BAC alcohol participants for questions concerning the target's internal and external face features, we examined relationships between BAC and accuracy of responses to items related to these facial regions. One question referred to the target's facial hair (presence, style or absence) and two to his scalp hair (length and colour). Binary logistic regression analyses, with BAC (%) as the sole predictor and response accuracy (0 = incorrect, 1 = correct) as the outcome variable, confirmed that BAC was not a significant predictor of hair colour memory accuracy,  $\beta = -0.17$ ,  $SE = 0.11$ ,  $p = .878$ . However, increases in BAC were associated with poorer memories for target hair length (an external face feature),  $\beta = -0.27$ ,  $SE = 0.12$ ,  $p = .024$ , but also facial hair (an internal face feature),  $\beta = -0.56$ ,  $SE = 0.18$ ,  $p = .002$ . We therefore found no unequivocal evidence in support of Hypothesis 4.

### **Comparing identification responses between alcohol and weapon groups**

Table 1 shows counts of line-up decisions made across all experimental groups. To explore the effect of alcohol intoxication and weapon exposure on identification accuracy we performed separate loglinear analyses for the TP and TA data as these two line-up conditions produce different response categories. (For consideration of TA and TP line-up accuracy within the same analytical framework please see the ROC and confidence accuracy analyses below.)

## TABLE 1 ABOUT HERE

The 2(Alcohol Group)  $\times$  2(Weapon Group)  $\times$  3(ID Response) interaction for the TP group was non-significant,  $\chi^2(2, N = 260) = 0.32, p = .852$ , as was the 2(Alcohol Group)  $\times$  3(ID Response) interaction,  $\chi^2(2, N = 260) = 5.14, p = .077$ . The 2(Weapon Group)  $\times$  3(ID Response) interaction was significant but, contrary to Hypothesis 5, reflected a reverse *weapon focus* effect,  $\chi^2(2, N = 260) = 9.19, p = .01$ . More members of the weapon-present group made correct (35.5%) than incorrect identifications (30%), more of the weapon-absent group made incorrect (46%) than correct identifications (21.5%), and the rate of lineup rejections was unaffected by the weapon manipulation (see Figure 3).

## FIGURE 3 ABOUT HERE

The TA data analysis revealed the 2(Alcohol Group)  $\times$  2(Weapon Group)  $\times$  2(ID Response),  $\chi^2(1, N = 255) = 1.70, p = .192$ , and 2(Weapon Group)  $\times$  2(ID Response) interactions to be non-significant,  $\chi^2(1, N = 255) = .17, p = .68$ , again indicating no support for the person-identification weapon focus prediction (Hypothesis 5) or the expected interaction between weapon presence and alcohol group on identification performance (Hypothesis 7). However, the 2(Alcohol Group)  $\times$  2(ID Response) interaction was highly significant,  $\chi^2(1, N = 255) = 11.57, p = .001$  (see Figure 4). Consistent with Hypothesis 6, substantially more alcohol participants identified a foil from the lineup (55.5%) than no

alcohol participants (34%), while more sober participants (66%) correctly rejected the target absent line-up than alcohol participants (44.5%).

Note, we repeated the above loglinear analyses with target male included as an additional variable. Despite the poorer bias outcome for the Target B line-up (see Method for details) we found no significant variations in lineup response between participants shown the Target A and Target B scenes.

FIGURE 4 ABOUT HERE

### **Weapon presence and BAC (%) as predictors of identification performance**

We conducted logistic regressions on the TP and TA line-up data to examine the extent to which breath alcohol variations predict identification accuracy. In these analyses weapon group served as a categorical predictor, BAC a continuous predictor and line-up response accuracy the binary outcome variable (correct vs. incorrect). For TP line-ups BAC was not a significant predictor of identification accuracy,  $\beta = -5.73$ ,  $SE = 3.78$ ,  $p = .16$ , nor was the presence of a weapon,  $\beta = -0.63$ ,  $SE = 0.34$ ;  $p = .07$ . The BAC  $\times$  weapon group interaction was also non-significant,  $\beta = -2.10$ ,  $SE = 6.19$ ,  $p = .74$ . But BAC was a significant predictor of identification accuracy from TA line-ups,  $\beta = -9.28$ ,  $SE = 3.42$ ,  $p = .007$ , the BAC  $\times$  weapon group interaction was not significant,  $\beta = 8.10$ ,  $SE = 4.58$ ,  $p = .08$ , and the presence/absence of a weapon alone did not significantly predict TA line-up accuracy,  $\beta = -0.29$ ,  $SE = 0.34$ ,  $p = .39$ . Thus, targets wielding a weapon in the scene were identified more accurately from TP line-ups than targets with no weapon, which contradicts Hypothesis 5;

and higher BAC participants were more likely to falsely identify a foil from TA line-ups than lower BAC counterparts, which supports Hypothesis 6. Furthermore, the lack of a significant interaction between weapon presence and BAC level on identification accuracy contradicts Hypothesis 7.

### **Confidence-based ROC analysis of identification accuracy**

In order to examine the effects of alcohol on identification confidence (response bias) and accuracy, and to combine the effects of TA and TP lineups within the same analysis, we constructed receiver operating characteristic (ROC) curves (see Figure 5). These show correct identification rates (from TP line-ups) and incorrect identification rates (from TA line-ups) for alcohol and non-alcohol drinkers in each weapon group, plotted as a function of identification confidence (see Gronlund, Wixted & Mickes, 2014). For each drinking group, the rightmost coordinate includes identifications made at all confidence levels, ranging from 1 (“guess”) to 6 (“very sure”). Moving left, the next coordinate represents identifications made at confidence levels 2 to 6, then those made at levels 3 to 6, and so on to the leftmost coordinate, which only includes accuracy rates from participants who felt “very sure” they were correct (confidence level 6). Each point reflects how the face identification *diagnosticity ratio* (i.e., correct ID rate / false ID rate) changes at each level of response bias. The most liberal identification decisions (those made regardless of confidence level) are reflected in the rightmost point and the most conservative decisions (only those made with the highest confidence) are represented by the leftmost point. The broken line in Figure 5 indicates equality between rates of correct and incorrect decisions and thus represents chance



performance. Hence, the further up and away ROC points are from the chance line the better the respective group was at discriminating the target face (or its absence) from a line-up. Contrary to Hypothesis 5 and 7, the presence of a weapon improved target face discriminability by a similar degree for both sober and alcohol participants. However, consistent with Hypothesis 6, it is clear from Figure 5 that participants under the influence of alcohol performed above chance but were nevertheless poorer at discriminating the target face than sober counterparts.

### **The Identification Confidence-Accuracy Relationship**

To explore the influence of alcohol intoxication and weapon presence on the relationship between identification confidence and accuracy we present calibration curves in Figure 6. These show the mean proportion of correct identifications made with low (1-2), medium (3-4) and high (5-6) levels of confidence. For TP lineups, the proportion of correct identifications is simply  $\# \text{correct IDs} / (\# \text{correct IDs} + \# \text{false IDs})$ . For TA lineups, where correct identifications are not possible, an estimate for  $\# \text{correct IDs}$  is computed using the formula:  $\# \text{false identifications} / \text{lineup size}$  (Mickes, 2015). In an ideal world, measurements of witness confidence in identification decisions would align precisely with the corresponding measure of identification accuracy.

#### **FIGURE 6 ABOUT HERE**

In Figure 6, a perfect confidence-accuracy (CA) calibration is denoted by the unbroken line, which allows us to gauge the extent to which weapon presence and alcohol

intoxication influence the CA relationship. Calibration was excellent for highly confident participants, and no-weapon group members with low confidence are similarly well calibrated. Contrary to Hypothesis 8, however, for which we predicted no effect of weapon-presence or alcohol on the CA relationship, weapon group members who expressed low confidence performed substantially better at the identification task than they had anticipated. Furthermore, alcohol consumption enhanced calibrations in both weapon and no-weapon groups.

### Discussion

We used a photographic mock-crime stimulus to examine the combined influence of viewer intoxication and weapon presence on scene memory, person-identification and witness confidence. As predicted in Hypothesis 1, participants were substantially better at remembering “central” (the target male and his transaction with the victim) than “peripheral” (bystanders, room contents, etc.) scene details. Contrary to expectation, scene memory was not affected by the presence of a weapon (Hypothesis 2) or alcohol state (Hypothesis 3). We thought accuracy for questions concerning the internal and external region of the target face may vary as a function of acute alcohol (Hypothesis 4) but no clear evidence of this emerged either. Rising BAC levels were negatively associated with the ability to remember the target’s facial hair status (an internal feature) but they were also negatively associated with memory accuracy for scalp hair length (an external feature). In a surprising reversal of Hypothesis 5, following attempts to recognise the target from a line-up, weapon presence *increased* the rate of correct identifications and *reduced* the rate of foil identifications from TP line-ups.

Consistent with Hypothesis 6, however, alcohol-participants made fewer correct identifications and more false identifications than no-alcohol counterparts with a larger increase in false identifications from TA than TP line-ups. Though, when line-up data were analysed using logistic regression models with BAC serving as a continuous rather than categorical predictor of identification performance, BAC increases were significantly predictive of a reduction in identification accuracy from TA but not TP line-ups; and we found no significant interaction between weapon presence and alcohol consumption for any memory measure (Hypothesis 7). Our final prediction that weapon presence and alcohol consumption would not influence the identification confidence-accuracy relationship (Hypothesis 8) was also unsupported.

The absence of a standard WFE in the scene memory and face identification data may have been caused by the visibility of the gun-wielding target prior to him drawing the weapon. As shown in Figure 1, his face/head are visible in 10 of the 18 stimulus images (slide number 8-17, exposure time = 15s) but the gun was visible only in slide numbers 5-9 (weapon exposure time = 7.5s). Weapon scene participants therefore had an opportunity to encode the target face for 6s prior to emergence of the potentially distracting weapon. Furthermore, in slide-15 the target holds the gun quite close to his face, possibly allowing viewers to encode both salient features at the same time. We also note that the receptionist looms large in the centre of the display, which may also have been a distraction. It is difficult to explain the reverse-WFE (rWFE) revealed in our TP identification data, but similar effects are reported elsewhere. Shaw and Skolnick (1994) had participants watch a slide scene in which a male or female target walked out of a telephone booth then along a university

corridor before disappearing through an exit door. The study revealed rWFEs for target description and target identification measures – though only for female participants in the former and the latter effect was not statistically significant. In a follow-up experiment, Shaw and Skolnick (1999) presented a video recording of a dramatic scene in which a male or female, carrying a book, a gun or some salient non-threatening object, bursts into a university classroom, confronts the professor and demands to know the whereabouts of a student. An analysis of intruder feature descriptions revealed significant WFEs when intruder sex matched that of participants, significant rWFEs for opposite sex pairings, and the same pattern of effects when a salient object (a child's toy or stethoscope) was substituted for the gun. The authors suggest the source of their rWFE was heightened interest in the opposite versus same sex intruder.

Shaw and Skolnick's (1999) weapon focus reversal was unanticipated but Carlson and Carlson (2012) deliberately manipulated the effect by applying a sports sticker to the face of a male perpetrator in a mock crime scenario. This obviously made the target's face more distinctive, but weapon scene participants may have been particularly curious as to the motivations and mental state of this odd-looking assailant, causing them to pay closer attention to his face than no weapon counterparts. Curiosity has been described as an exploratory drive to resolve incongruities between knowledge and experience (Stare, Gruber, Nadel, Ranganath, & Gómez, 2018) and the drawing of a deadly weapon by an unassuming actor in an otherwise mundane scenario may, for some viewers at least, be an example of this incongruence. As high curiosity encoding states are known to enhance memory (Gruber, Gelman, & Ranganath, 2014; Kang et al., 2009; Marvin & Shohamy, 2016) it is conceivable

that distinctive or otherwise intriguing perpetrators may sometimes neutralise or even reverse WFEs among curious witnesses. As we did not manipulate target distinctiveness in the present study, we have no basis to claim that curiosity drove our rWFE. Nevertheless, *curiosity* is an under-explored estimator variable in eyewitness memory research worthy of scientific attention, particularly from an individual difference perspective. Though we note the risks that extended scrutiny of a perpetrator pose for witnesses, which may limit the extent of rWFEs in real crimes (but see Hsee & Ruan, 2016, for examples of the so-called “Pandora Effect” – the satiation of curiosity despite potentially perilous consequences).

It is difficult to evaluate the present alcohol and scene memory data in the context of the contrasting methods and findings of earlier work (for reviews see Altman, Schreiber Compo, Hagsand & Evans, 2019; Jores, Colloff, Kloft, Smailes & Flowe, 2019) but our results are at least consistent with several studies reporting null alcohol effects (e.g., Crossland et al., Exp. 1, 2016; Hagsand et al., 2017; Harvey et al., 2013b; Hilderbrand Karlén et al., 2017; Schreiber Compo et al., 2012). We note, however, that the absence of a “don’t know” response option on our questionnaire likely inflated guessing rates, which may vary as a function of alcohol level. This was shown by Crossland, Kneller and Wilcock (2016) whose intoxicated participants made significantly more “don’t know” responses to cued recall questions than sober responders. The sensitivity of our questionnaire to alcohol effects would therefore be strengthened by inclusion of a “don’t know” option plus a confidence rating for each item response.

The finding that alcohol consumption was associated with reductions in identification accuracy is consistent with the work of Read, Yuille and Tollestrup (1992), whose alcohol

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participants made significantly fewer correct identifications from a 5-person TP line-up than sober controls, although they encoded the stimulus scene as mock-perpetrators rather than witnesses, and this alcohol effect did not extend to conditions of high participant arousal. Read et al. suspected that alcohol had induced a face encoding deficit, but one negated by the arousing presence of a threatening stimulus. A similar encoding account was offered by Dysart et al. (2002) who found a positive association between rising BACs and the rate of false showup identifications. They suggest alcohol myopia may narrow the scope of witness attention to the external region of unfamiliar faces with distinctive scalp hair, making it harder for participants to discriminate the target's internal face features from those of foils sporting a similar hairstyle. This view is supported by Harvey and Tomlinson (2019) but receives only partial support from our findings. In the current study, BAC levels were negatively associated with an increase in false identifications and the ability to remember details of the target's facial hair (an internal feature) with alcohol having no effect on memory for the target's scalp hair colour (an external feature). However, BACs were also negatively associated with memory accuracy for scalp hair length (another external face feature). Given this inconsistency we are unable to draw firm conclusions regarding the "myopic" narrowing of attention to specific face features under acute alcohol. To address this question, further studies on alcohol and face processing are needed, which measure attention and memory for individual face features across a range of forensically relevant identification tasks.

Our descriptive exploration of the relationship between participant identification confidence and the accuracy of these decisions revealed two interesting findings. Contrary to

the suggestion that it would have little influence on this relationship, acute alcohol improved confidence-accuracy calibrations. Sober participants who expressed medium ID confidence (a rating of 3 or 4) were more accurate at the line-up task than alcohol counterparts expressing the same level of confidence. Weapon presence also influenced confidence-accuracy calibrations as weapon group participants who expressed low ID confidence (a rating of 1 or 2) were considerably more accurate than low-confidence no-weapon counterparts, who were perfectly calibrated. We are not sure what caused these confidence-accuracy variations, but they may reflect meta-cognitive changes in the witness (e.g. Palmer et al., 2013). It is possible, for example, that knowledge of alcohol's potential impact on memory or a belief that the gun was a distraction may have contributed to less optimistic ratings of self-confidence for the ID task, but it is unclear why sober participants expressing medium rates of identification confidence perform almost as well as sobers reporting high confidence. We note that, during debrief, no participants reported awareness of the WFE prior to taking part in the study when asked, but we did not quiz them on their prior beliefs regarding the effects of alcohol on memory. Also, while studies on the effects of alcohol intoxication and meta-memory are rare, those available show little evidence of adverse effects (e.g. Nelson, McSpadden, Fromme & Marlatt, 1986; Evans et al., 2017).

Our study is limited by its quasi-experimental design, which precluded the administration of randomised placebo-controlled alcohol treatments, and we have no knowledge of participants' alcohol drinking history or wider drug use at or prior to the time of test. The effects of alcohol on identification performance we report may therefore be confounded by pre-existing factors, such as concomitant drug use, differences in the time

alcohol participants took to reach equivalent states of intoxication, time of day effects or, perhaps, the use of a different recruitment context for forty-nine members of our sober sample. But, on the latter point, it is important to emphasise that a similar quiet lab-like setting was used for the testing of both bar and participant pool volunteers. Use of a brief 5-minute retention interval meant that our alcohol participants both encoded and retrieved stimulus material while under the influence of the drug. It is therefore unclear if our findings would occur following a longer, sobering delay, nor if the present alcohol deficits stem from disruption to processes of encoding or retrieval. Furthermore, in each of our TP line-up arrays, the target always occupied the same position, which may have exerted an influence on participant choosing behaviour. However, we believe that variations in target position are likely to have a much larger influence on sequential than simultaneous line-ups (Carlson, Gronlund & Clark, 2008).

A further problem with our study, and one that affects numerous similar studies (e.g. Harvey et al., 2013a, 2013b; Hagsand et al., 2013a, 2013b; Schreiber Compo et al., 2011) is that our central stimulus classification was not objectively defined. While few would argue that the armed assailant is not the “central” feature of our weapon scene, his semantic salience is confounded by his spatial positioning near the centre of the display. One might also argue that some aspects of the target himself are more “central” than others, yet we made no a priori distinctions between the salience of his various features. Similar problems affect our no-weapon control scene for which the “salience” of the control object (the ID card) did not match that of the gun in the weapon scene, thus, its status as a “central” feature may vary depending on each viewer’s interpretation of the event depicted.



We nevertheless show that the consumption of alcohol can significantly impair eyewitness identification performance from a simultaneous line-up within a context in which the presence of a gun did not. If this face memory deficit was caused by alcohol myopia then it is surprising that the presence of the weapon did not intensify it, as guns are highly distinctive objects known to capture witness attention. But this is only the first examination of alcohol and weapon focus and, while we tested real-world drinkers, we did not employ an ecologically valid stimulus scenario. A video recorded or live mock-crime enactment should be used in future studies, as these capture the visual dynamism and arresting sounds of an armed crime that our participants were not exposed to. These more dramatic situations are also likely to elicit far more witness arousal, which is another factor known to focus attention on to central stimuli (Christianson, 1992; Easterbrook, 1959; Öhman, Flykt, & Esteves, 2001). An important question for future research, therefore, is whether alcohol intensifies this attentional “tunnelling” or if its anxiolytic properties dampen witness arousal leading to improved peripheral awareness under threat. An alternative possibility, as the findings of Read et al. (1992) suggest, is that elevated witness arousal provides resistance to alcohol’s depressant effects leading to enhanced memory performance under its influence.

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Figure 1. Slides numbers 8-17 featuring Target 1 in the weapon scene.

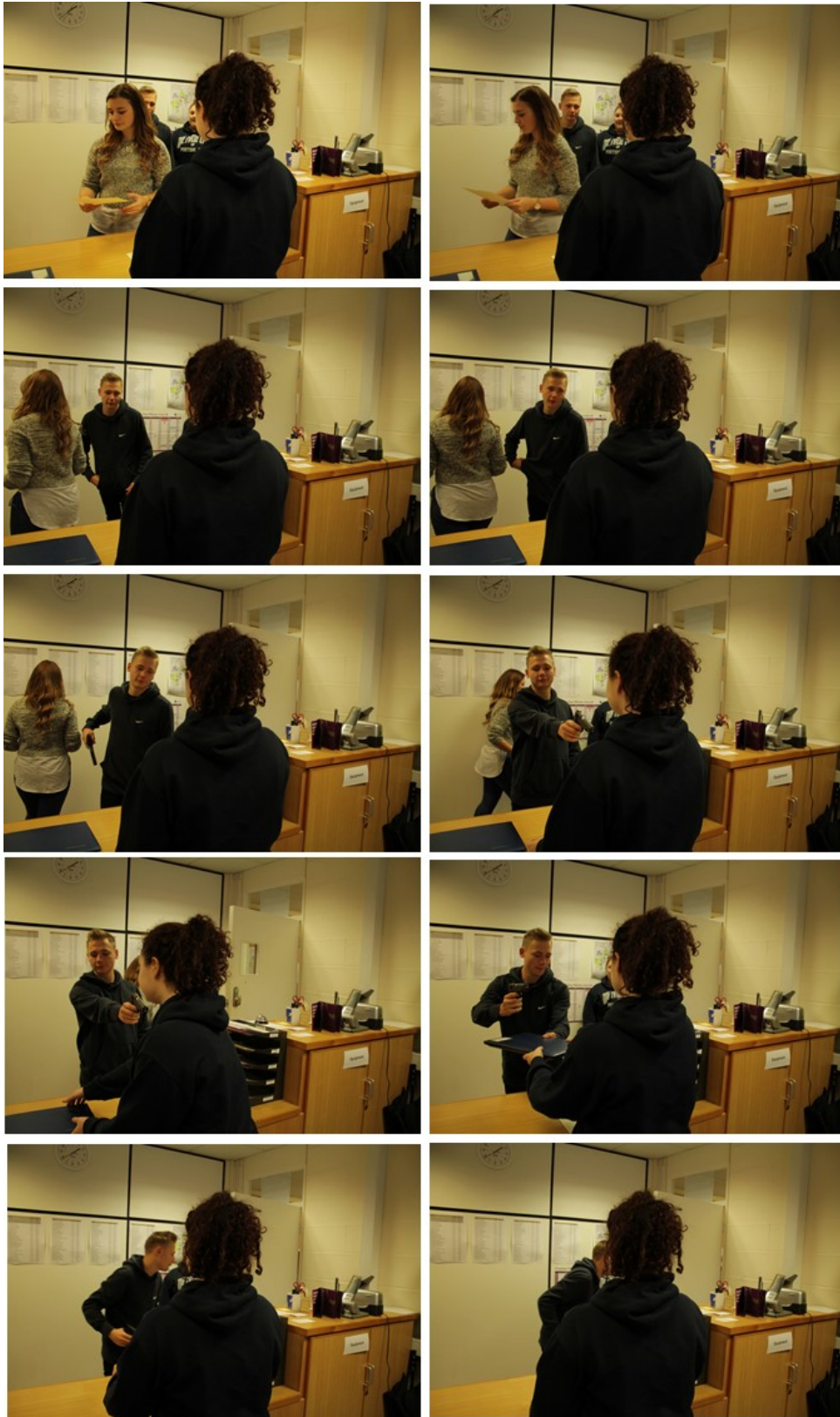


Figure 2. Distribution of breath measures for alcohol participants with normal curve superimposed (n = 274).

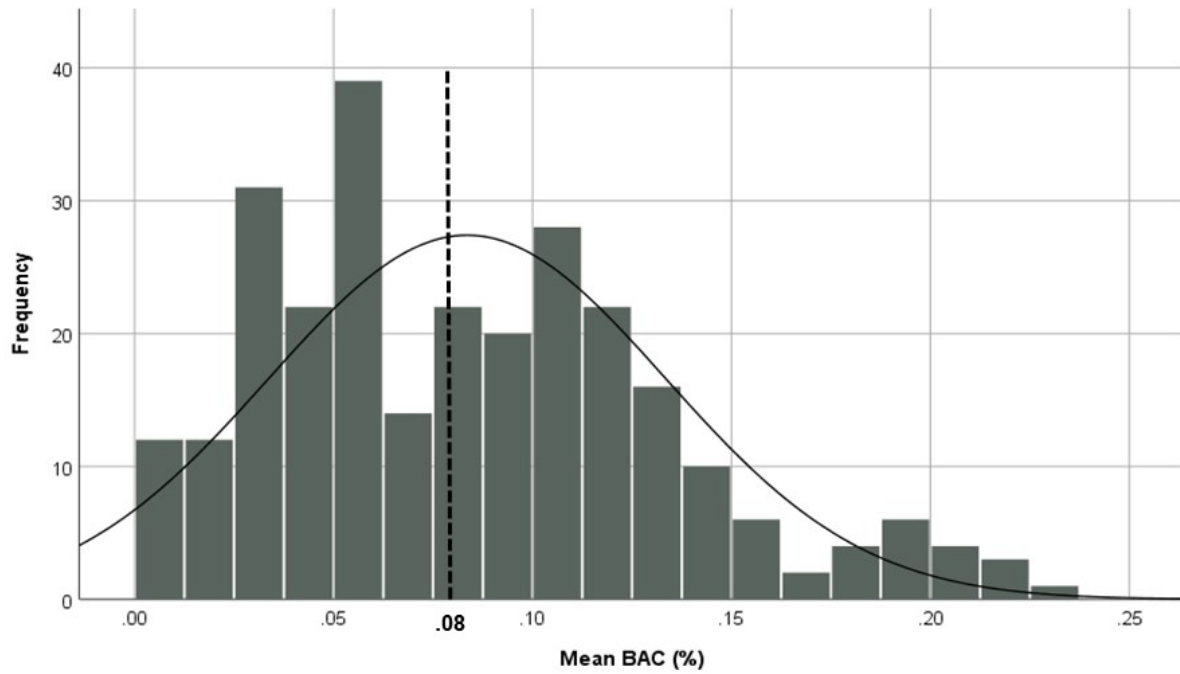


Figure 3. Percentage of target-present line-up decisions per weapon group for alcohol and no-alcohol participants.

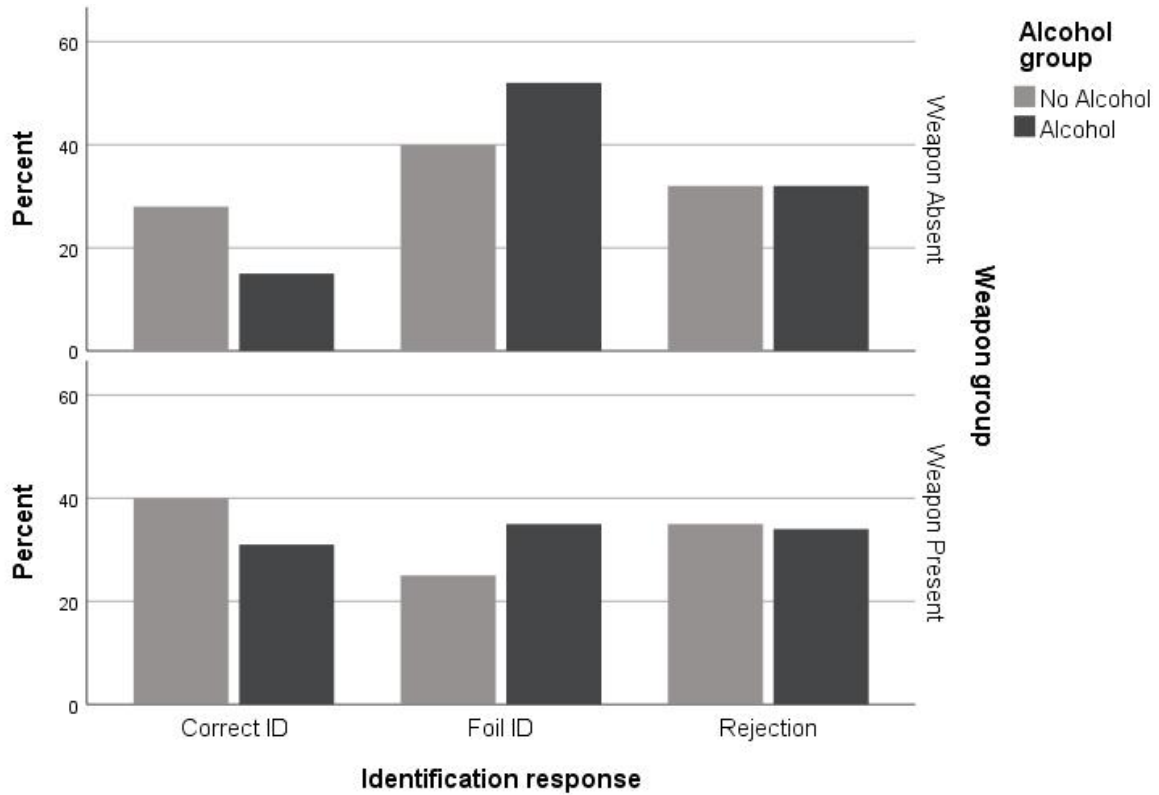


Figure 4. Percentage of target-absent line-up decisions per weapon group for alcohol and no-alcohol participants.

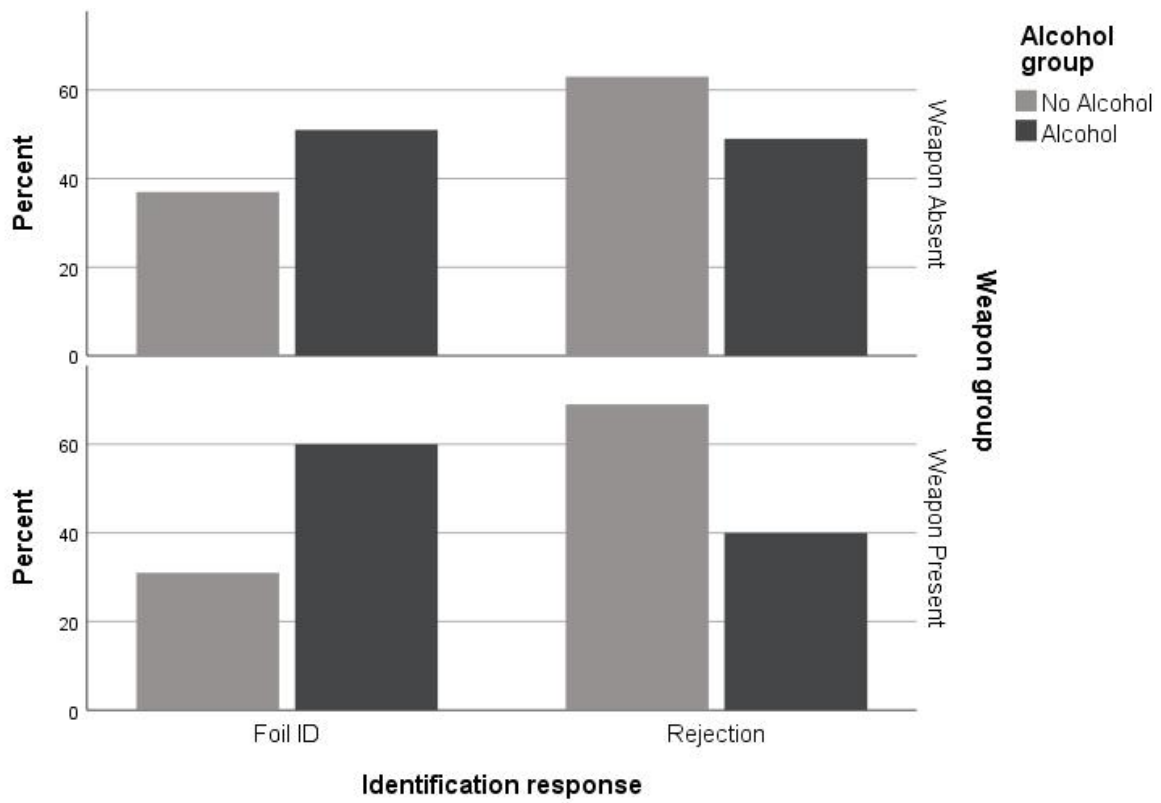
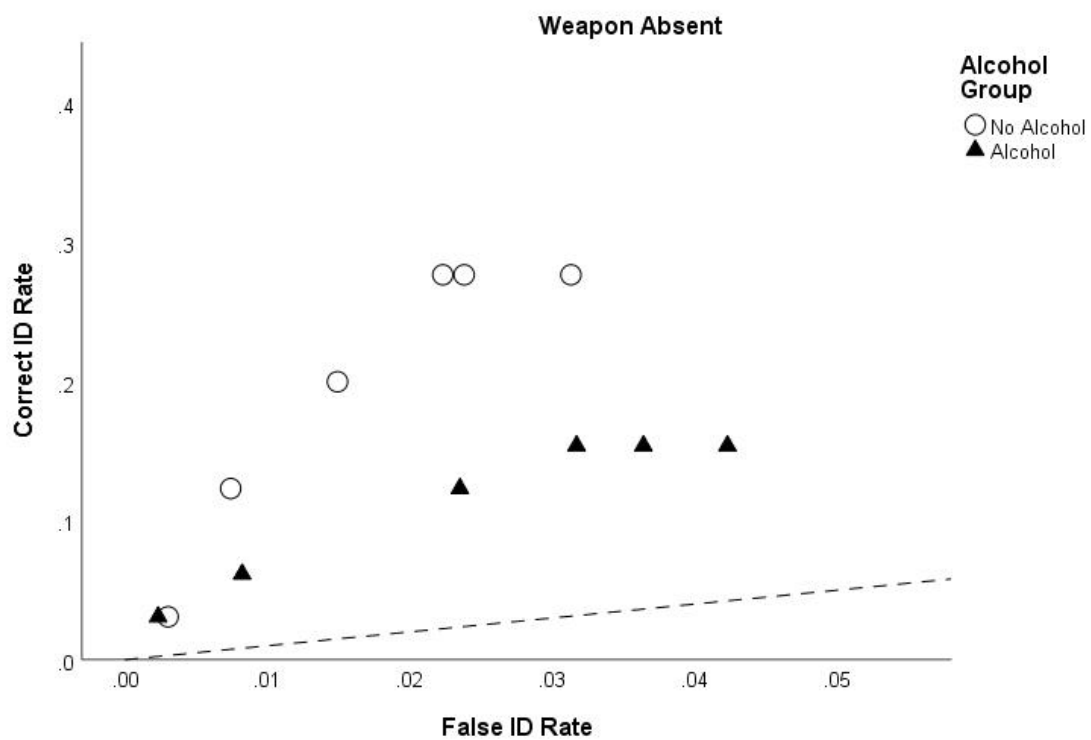




Figure 5. Confidence-based receiver operating characteristic (ROC) data for each alcohol group as a function of weapon absence and weapon presence.



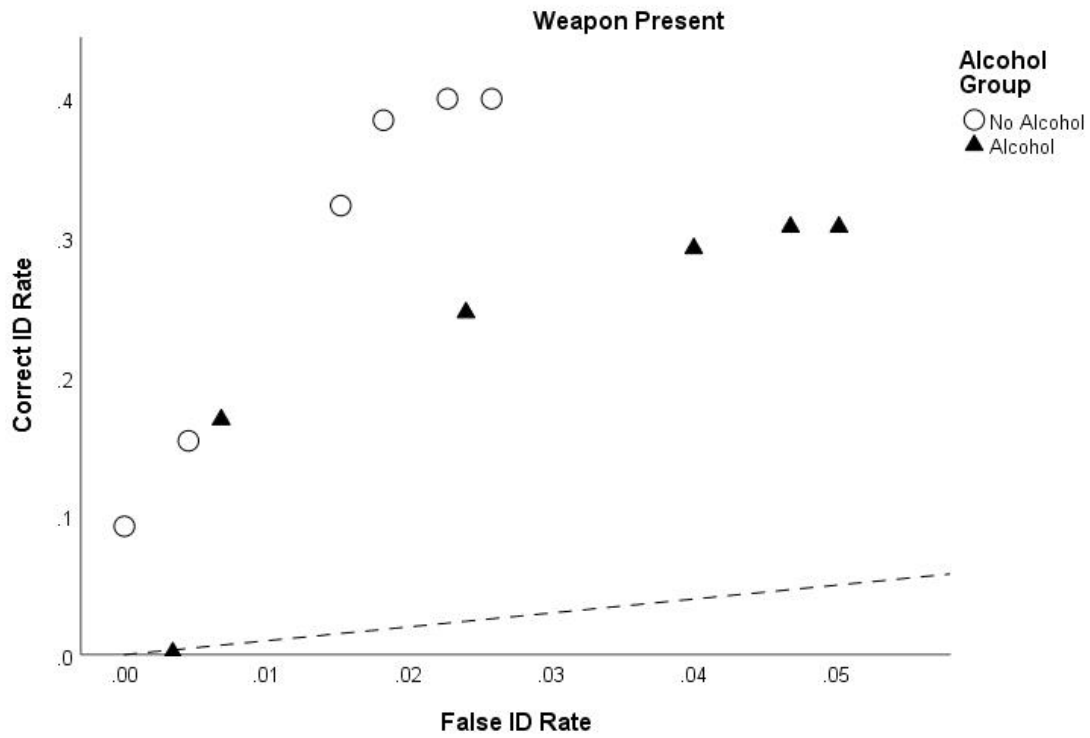
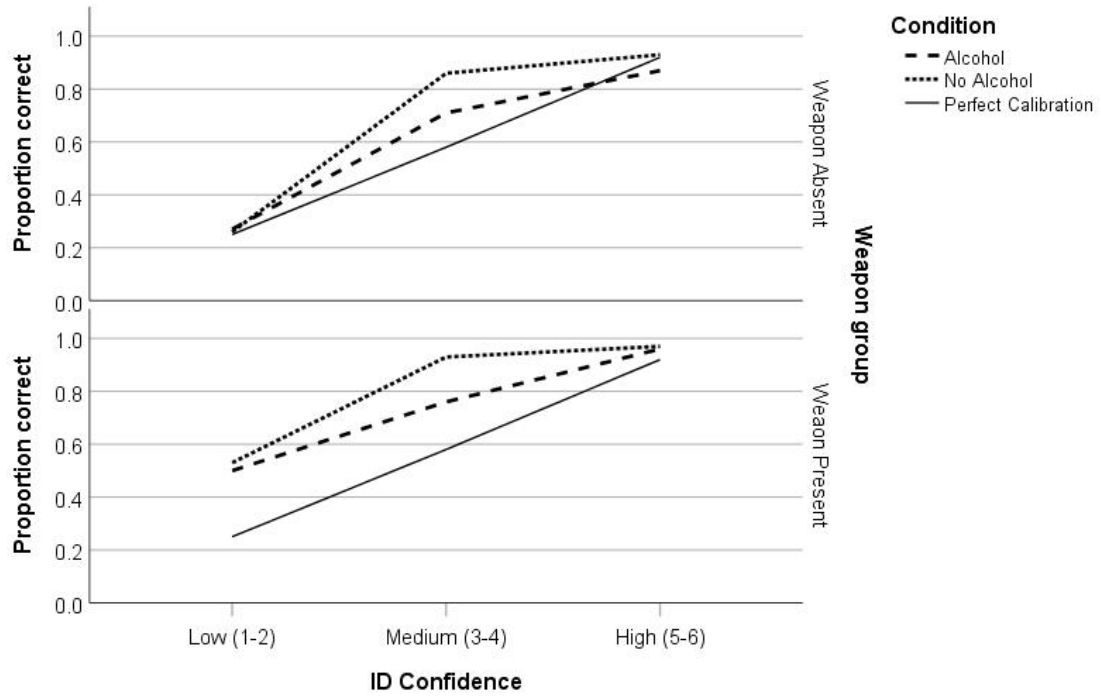


Figure 6. Calibration curves for each alcohol group as a function of weapon absence and weapon presence.



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Table 1. Proportion of responses to TP and TA line-ups across weapon and alcohol groups (number of participants per group shown in parentheses).

Condition	Target-present line-up			Target-absent line-up	
	Correct ID	Foil ID	Rejection	Foil ID	Rejection
Weapon, no alcohol	.40 (26/65)	.25 (16/65)	.35 (23/65)	.31 (17/55)	.69 (38/55)
Weapon, alcohol	.31 (20/65)	.35 (23/65)	.34 (22/65)	.60 (44/73)	.40 (29/73)
No weapon, no alcohol	.28 (18/65)	.40 (26/65)	.32 (21/65)	.37 (21/56)	.63 (35/56)
No weapon, alcohol	.15 (10/65)	.52 (34/65)	.32 (21/65)	.51 (36/71)	.49 (35/71)

Appendix

Memory Questionnaire (Weapon Scene, Target A)

- 1) What item did the male take from the receptionist?  
Book Laptop Tablet Folder
- 2) What item did the male show to the receptionist?  
Gun Knife Book Pen
- 3) What colour hair did the male have?  
Brown Blonde Black Red
- 4) What colour hoodie was the male wearing?  
Blue Grey Red Black
- 5) What colour was the logo on the male's hoodie?  
White Grey Pink Yellow
- 6) How would you describe the male's hair length?  
Balding Short (ears visible) Medium (ears just covered) Long (shoulder length)
- 7) What style of facial hair did the male have (if any)?  
Clean shaven Goatee Moustache Beard
- 8) What word was written on the cupboard door?  
"Stationary" "Recycling" "Equipment" "Ethics"
- 9) What colour was the booklet on top of the cupboard?  
Black Purple Blue Pink
- 10) What colour were the scissor handles on top of the cupboard?  
Purple Black Silver Red/Black
- 11) What item was resting on the cupboard door?  
Umbrella Walking stick Rucksack Coat
- 12) What colour hoodie was the girl at the back of the queue wearing?  
Grey Brown Black Blue
- 13) Was there a clock on the wall?  
No Yes – it was white Yes – it was black Yes – it was grey
- 14) What colour was the door?

Grey White Black Beige

15) How many posters were on the back wall?

Three Five Six Eight

16) What hair style did the receptionist have?

Straight Plaited Bun Curly

17) What was the maximum number of people in the queue?

Two Three Four Five

18) What was above the door?

Window Clock Monitor "Fire Exit" sign

19) How many doors did the cupboard under the counter have?

One Two Three Four

20) What was the receptionist wearing?

Hoodie T-Shirt Shirt Dress

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