Improving intoxicated witness recall with the Enhanced Cognitive Interview

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Abstract

Witnesses and victims typically provide the central leads in police investigations, yet statistics from past research indicates in many instances these individuals are intoxicated. To date, however, no research has looked at how best to interview such witnesses to maximise the amount of accurate information they recall. In the present research, while on a night out, participants watched a videoed theft whilst either sober, moderately (M_{BAC} = .05%) or severely (M_{BAC} = .14%) intoxicated. A week later, in a different location, participants were interviewed using either the Enhanced Cognitive (ECI) or Structured Interview. The ECI was found to improve the recall accuracy and completeness of witness accounts across all three drinking conditions. However, no significant interaction was indicated between alcohol and interview condition. The study findings are discussed in terms of their real-world value in aiding police officers to elicit as complete and as accurate an account as possible from intoxicated witnesses.

Keywords: Eyewitness Recall, Enhanced Cognitive Interview, Structured Interview, Intoxication, Alcohol

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Evidence suggests that as alcohol consumption increases, so does the probability of being targeted by criminals (Touhig, 1998). In fact, a recent survey of English police officers suggested that witness intoxication is a common to very common occurrence, with witness Breath Alcohol Concentrations (BrAC) estimated to be around 50-80 µg/L (.11-.18% Blood Alcohol Concentration (BAC)) (Crossland, Kneller & Wilcock, 2018). A similar pattern has also been seen in North America where, according to police officers, around 41% of interviewed witnesses are most likely over the US drink drive limit at the time of the crime (BAC = .08%; Evans, Schreiber Compo & Russano, 2009). In addition, around a third of the testimonies heard in US courts were found to be from witnesses who had consumed alcohol (or another drug) at the time of the crime (Palmer, Flowe, Takarangi & Humphries, 2013). Ultimately this data suggests that intoxicated witnesses and victims are a widespread issue within the criminal justice system and warrant further study.

Intoxicated Witness Recall

The information provided by witnesses and victims is vital to the investigation of criminal cases and typically provides police officers with the central leads in their enquiries (Kebbell & Milne, 1998; Milne & Bull, 2006). Until relatively recently, research into the effects of alcohol on eyewitness recall (i.e. free or cued description of event details and the ability to identify/recognise the perpetrator) has been limited (Malpass et al., 2008). There is, however, a more comprehensive body of traditional memory research examining alcohol's effect on general recall (e.g., Garfinkel, Dienes, & Duka, 2006; Moulton et al., 2005; Ray, Bates, & Bly, 2004; Söderlund, Parker, Schwartz, & Tulving, 2005). This research indicates that episodic memory (which would include a witness' recollection of a crime) is particularly affected by intoxication using recognition and cued recall tasks (Curran & Hildebrandt, 1999; Nilsson, Bäckman, & Karlsson, 1989). Further to this, memory research, using traditional recall measures such as word lists, have routinely found alcohol to impair effortful but not automatic processing (e.g., Hasher & Chromiak, 1977; Tracy & Bates, 1999). For example, intoxication has been seen to reduce the free recall of words from a word list. In such a situation, as with a witness' recall of a crime, a conscious and intentional effort is required to remember the information. In contrast, when a task does not require a conscious effort to evoke a memory, then research indicates that alcohol does not significantly affect recall. For example, intoxication does not significantly affect an individual's estimation of the frequency at which words are repeated in a word list (Hasher & Chromiak, 1977; Tracy & Bates, 1999).

Regarding the recall of intoxicated witnesses (i.e., event details), a small but increasing body of literature (see Hildebrand Karlén, 2018 for a review) suggests that whether (and to what extent) alcohol affects memory reporting may depend on factors such as the task being completed (negative effect on recall completeness, but no effect on line-up decisions: Bayless, Harvey, Kneller & Frowd, 2018; Flowe, Colloff, Karoğlu, Zelek, Ryder, Humphries & Takarangi, 2017; Harvey, Kneller & Campbell, 2013a; Kneller & Harvey, 2016), the number/timing of the interviews (immediate interviews may lead to an increase in recall completeness at delayed interview: Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag & Söderpalm-Gordh, 2017; La Rooy, Nicol, & Terry, 2013; Schreiber Compo et al., 2017) and the timing of alcohol consumption (alcohol post-encoding protects against misleading post-event information: Gawrylowicz, Ridley, Albery, Barnoth, & Young, 2017). Further, research suggests that whilst alcohol may have little to no effect on recall accuracy, as intoxication levels increase there is a significant reduction in recall completeness (Flowe, Takarangi, Humphries, & Wright, 2016; Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm-Gordh, 2013a; Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag, & Söderpalm-Gordh, 2015; Van Oorsouw & Merckelbach, 2012; Yuille & Tollestrup, 1990). With even small memory errors or omissions potentially having severe consequences (i.e. the conviction of an innocent suspect, or the release of a guilty perpetrator) it is imperative that the accuracy and completeness of a witness's testimony be studied. In these instances, completeness refers to the percentage of total details recalled, and accuracy is determined by the number of correct details recalled out of all details reported by participants. However, it should be noted that recent research by Altman, Schreiber Compo, McQuiston, Hagsand and Cervera (2018), and Altman, McQuiston and Schreiber Compo (2019) have found that alcohol negatively affects both the quality and quantity of a witness's recall with blood alcohol concentrations levels ranging from .00 - .29%. In addition, a recent meta-analysis of the effects of acute alcohol intoxication on witness recall has indicated that whilst alcohol may lead to a significant reduction in correct recall, this effect is not seen with incorrect details (Jores, Colloff, Kloft, Smailes & Flowe, 2019).

When an individual has complete freedom over what they report, as with a witness' free recall, then general memory research suggests that an individual may be strategic in what information they provide (Evans & Fisher, 2011; Koriat & Goldsmith, 1996a; Koriat, Goldsmith, & Pansky, 2000; Luna, Higham, & Martin-Luengo, 2011; Weber & Brewer, 2008). It is theorised that, although they may seek to be both accurate and complete when an individual is uncertain of the information they recall, the two aims of accuracy and completeness (informativeness) may compete (Koriat & Goldsmith, 1996a; Koriat & Goldsmith, 1996b; Koriat et al., 2000; Yaniv & Foster, 1995). Within such a situation, when deciding how to balance accuracy and completeness, an individual is directed by their goals within that particular context (Koriat & Goldsmith, 1996a). To this end, a witness has two main options when providing their account to the police. They may refrain from providing a detail in their testimony if they believe that the likelihood of that detail being correct is less than some accuracy threshold that they have set themselves (Koriat & Goldsmith, 1996b). Alternatively, they may adjust the level of detail (the grain size) of what they report in their testimony (Ackerman & Goldsmith, 2008; Goldsmith, Koriat, & Weinberg-Eliezer, 2002; Yaniv & Foster, 1997).

For sober individuals at least, there is a general aversion to providing a coarse-grained response (Ackerman & Goldsmith, 2008). Such individuals are considered to have set themselves a low accuracy threshold so that when regulating their memory they favour informativeness (completeness) over accuracy. In terms of the memory regulation of intoxicated witnesses, research suggests that individuals expect alcohol consumption to cause cognitive impairments (Adams & McNeil, 1991), with higher intoxication levels anticipated to lead to increasingly more negative effects (George & McAfee, 1987; Southwick, Steele, Marlatt, & Lindell, 1981). Consequently, it may be expected that to compensate for an expected impairment to memory, intoxicated individuals would set themselves a higher accuracy threshold and thereby provide a coarse-grained testimony. Regulating their memory in this way it would be anticipated that an intoxicated witness would provide a testimony that was less complete than a sober witness, but no less accurate. In line with this prediction, the discussed alcohol and eyewitness literature suggests that intoxicated witnesses tend to favour accuracy over completeness when cued or free recall tasks are employed (Flowe et al., 2016; Hagsand et al., 2013a; Hildebrand et al., 2015).

Alcohol Myopia Theory

Until recently, the prevailing theory to account for alcohol's effect on the recall of an eyewitness has been Alcohol Myopia Theory (AMT) (Josephs & Steele, 1990). AMT posits that alcohol reduces an individual's ability to process information, or narrows attention, to those cues that are most salient in a specific situation, such as anxiety (internal cues) or elements of the environment (external cues). The theory states that this restricted perception is due to an increasingly disproportionate amount of attention being given to these immediate salient cues, whilst weaker, less salient cues, subsequently receive less attention. Alternatively, alcohol can affect cognitive functioning by reducing an individual's ability to process and extract meaning from the information or situation they are facing. Ultimately, according to AMT, whether there is a cognitive or recall difference between sober and intoxicated individuals depends on the specific situation and the internal/external cues (e.g. anxiety/elements of the environment) that become most noticeable to the individual in that particular instance (Steele & Josephs, 1990). Whilst research indicates that alcohol myopia could potentially explain an intoxicated person's processing of non-forensic visual stimuli (Clifasefi, Takarangi, & Bergman, 2006; Harvey et al., 2013a; Harvey, Kneller & Campbell, 2013b), forensic recall studies have drawn mixed conclusions regarding this theory, potentially due to differences in study design (Schreiber Compo et al., 2011; Van Oorsouw & Merckelbach, 2012; also see Janssen & Anne, 2019). The findings of initial research by Schreiber Compo et al. (2011) were consistent with AMT, in that alcohol only reduced peripheral (low salience) recall, but participants were still intoxicated at the time of recall. In contrast, when participants were sober at interview, research by Crossland, Kneller and Wilcock, (2016) and Van Oorsouw and Merckelbach (2012) found alcohol to have the most detrimental effect on the recall of central or high salience details.

In light of their research findings, Van Oorsouw and Merckelbach (2012) proposed an alternative explanation to account for alcohol's effect on forensic recall: Fragmentary blackouts. At high blood alcohol concentrations, whilst an intoxicated individual may perceive and encode an event, fragmentary blackouts consider that there may be some failure in the process of consolidating the memory, such that the event or detail is forgotten (White, 2003). An individual may only become aware of those gaps in their memory when they are informed there are details they do not remember, although they still may not recall them first-hand (Goodwin, 1977). Small to moderate fragmentary blackouts, research indicates, can occur with a rapid rate of alcohol consumption and potentially with BACs of .15% (Mintzer & Griffiths, 2002; Ray & Bates, 2006; Ryback, 1971). Crossland et al. (2016), however, proposed a further alternative explanation to account for alcohol's effect on eyewitness recall: the phenomenon of Acute Alcohol Amnesia (Goodwin, Crane, & Guze, 1969a; Hashtroudi & Parker, 1986). As with fragmentary blackouts, acute alcohol amnesia results in an individual recalling some, but not all, of the details they witnessed whilst intoxicated. Like fragmentary blackouts, acute alcohol amnesia is a form of anterograde amnesia, but with recall deficits apparent at BACs as low as .08% (Birnbaum, Parker, Hartley, & Noble, 1978; Carpenter & Ross, 1965; Hashtroudi, Parker, DeLisi & Wyatt, 1983; Jones & Jones, 1980). In contrast to fragmentary blackouts, where the amnesia may be fatal (i.e. the memory may be permanently 'lost'), acute amnesia is more subtle, and the memory may be retrievable to some extent with appropriate cues and prompts (Goodwin et al., 1969a). At present, though, the extent to which alcohol impairs eyewitness recall and how these impairments occur is still unclear. In light of the current theories proposed to explain alcohol's effect on eyewitness recall, however, there may be ways in which intoxicated witnesses could be supported to give best evidence via best practice interviewing techniques. If, as posited by AMT, the salience of internal and external cues has a role in what an individual recalls, and if, as proposed by acute alcohol amnesia, some details can be retrieved with appropriate cues and prompts (Goodwin et al., 1969) then components of the Cognitive Interview, such as mental reinstatement of context, may be able to assist in improving intoxicated witness recall.

Cognitive Interview/Enhanced Cognitive Interview Techniques

Since the mid-20th Century, human memory has been modelled upon three successive stages: encoding, storage (retention) and retrieval (Baddeley, Eysenck & Anderson, 2009). Within this memory system, visual, acoustic and semantic information is initially received and processed before a more permanent cognitive record is created for potential later recall. The information that can be retrieved, however, is often only a percentage of the details that were originally encoded. Research, though, indicates that the mnemonics of the Cognitive Interview (CI) can aid in improving recall retrieval (see Memon, Meissner & Fraser, 2010). The CI consists of a set of four interview mnemonics based upon the multiple trace theory (e.g. Bower, 1967; Wickens, 1970) coupled with the encoding specificity principle (Tulving & Thomson, 1973). Multiple trace theory suggests that memory is viewed as a complex network of associations where ultimately information that is not available through one recall method may be available through another. As a result, the CI incorporates the four mnemonics of 'report everything' (e.g., individuals are asked to tell the interviewer 'everything you can remember about the incident', 'change temporal orders' (e.g., recall details of the incident from beginning to end, and also from the end to the beginning), 'change perspective' (e.g., recall event details firstly from one's own viewpoint, and then describe what another witness/perpetrator would have seen) and 'mental reinstatement of context'. The final mnemonic, 'mental reinstatement of context' is based on the encoding specificity principle. This theory emphasises the importance of retrieval cues in aiding recall. For these cues to be effective, however, the theory states they must correspond to some degree with the original memory trace which was established at the encoding stage of memory. Essentially the theory suggests that the effectiveness of a recall method is enhanced when the contextual information at encoding is also present at retrieval (Geiselman, Fisher, MacKinnon & Holland, 1985). In light of this, and to engage all senses in recalling the event, 'mental reinstatement of context' may include statements such as 'Think about that day' …'Think about what had you been doing that morning' … 'Think about what the room looked like'… and 'Did you smell anything as you entered the room'. Each statement is aimed at helping the witness to mentally recreate the day and the context in which the event unfolded.

The CI was further developed into the Enhanced Cognitive Interview (ECI) which contained the same four mnemonics and placed them within a phased structure along with other components (e.g. rapport building and witness compatible questioning), based on principles from memory research and the social psychology of communication (Milne & Bull, 1999). Consequently the (E)CI is based upon three psychological processes; the cognitive processes of the interviewer and the witness, the social dynamics between the interviewer and witness, and finally the communication between the witness and interviewer.

Research indicates the (E)CI can increase the amount of correct information recalled by approximately 35-40% compared to the standard police interviews used by police prior to the (E)CI, and Structured Interviews (SI) which are the same as the ECI, but without the four mnemonics, as well as free recall (Clifford & George, 1996; Fisher, Geiselman & Amador, 1989; Geiselman et al., 1984; Köhnken, Thürer & Zoberbier, 1994; Memon, Meissner, & Fraser, 2010). This effect has been found irrespective of the interviewers' experience (Geiselman, Fisher, MacKinnon, & Holland, 1986; Köhnken et al., 1994; Mantwill, Köhnken, & Aschermann, 1995) or the interviewee's age (Akehurst, Milne, & Köhnken, 2003; Holliday & Albon, 2004; Mantwill et al., 1995; Mello & Fisher, 1996; Milne, Clare, & Bull, 1999; Wright & Holliday, 2007). Research does suggest, however, that the benefit derived from the (E)CI is usually smaller with children than with adults (see Memon et al., 2010). Although some studies have also found a small increase in the amount of incorrect information witnesses recall with the (E)CI, this effect is neither as large or as consistent as the increase in correct information and is not considered sufficient to affect the overall accuracy rate (effect size: $d = 0.24$; Köhnken, Milne, Memon, & Bull, 1999; Memon, et al., 2010). Field tests of the (E)CI have also indicated that police officers who are trained to use the techniques of this interview method obtain more information and greater detail from witnesses (Fisher et al., 1989; Clifford & George, 1996; Kebbell & Milne, 1998; Rivard, Fisher, Robertson, & Dana, 2014; Stein & Memon, 2006).

Such is the reliability of this interview technique that it is tested and used in many countries around the world including Australia (e.g., Davis, McMahon, & Greenwood, 2005), Brazil (e.g. Stein & Memon, 2006), Canada (e.g., Snook, Eastwood, Stinson, Tedeschini, & House, 2010), Germany (e.g., Köhnken et al., 1994), Portugal (e.g., Paulo, Albuquerque, Saraiva, & Bull, 2015) and the USA (e.g., Brock, Fisher, & Cutler, 1999). In England and Wales, all police officers are trained in a number of components of the (E)CI including report everything, mental reinstatement of context, rapport building, transfer control to the witness, focused retrieval, imagery and witness compatible questioning (Boon & Noon, 1994; Mello & Fisher, 1996; Dando, Wilcock, Behnkle, & Milne, 2011). Furthermore, the UK advise that vulnerable witnesses be interviewed using the CI (where beneficial), including those made vulnerable through their use of alcohol and/or drugs (Ministry of Justice, 2011).

Despite this, research suggests that novice (Dando, Wilcock & Milne, 2009) and less experienced police officers (Dando, Wilcock & Milne, 2008) view some aspects of the (E)CI as less effective than others and consequently use them less frequently. For example, change perspective and change temporal order, have been found to be the least applied (Clarke & Milne, 2001; Dando et al., 2009) and least useful components of the (E)CI (Dando et al., 2008; Kebbell, Milne & Wagstaff, 1999), with both components not eliciting any more correct details than a witness merely being told to ‘try again’ (Milne & Bull, 2002). Research also suggests, however, that the combination of ‘report everything’ and ‘mental reinstatement of context’ results in significantly more correct details than any of the individual mnemonics (Milne & Bull, 2002). Consequently, studies have explored the efficacy of an (E)CI procedure that eliminates change perspective and temporal order, as per the procedures administered by police officers in England and Wales. This modified (E)CI procedure has been found to produce comparable amounts of correct and incorrect details, reduce confabulations and increase recall accuracy compared to an (E)CI (Dando et al., 2011).

Intoxicated Witnesses and the Cognitive Interview

To date, whilst the effect of alcohol on eyewitness recall, elicited through an (E)CI, has not been fully examined, previous studies have used elements of this interview technique. For example, Read, Yuille, and Tollestrup (1992), within their interview instructions, recommended that participants use the four primary recommendations of the CI be used. The extent to which participants employed these, if at all, though is not clear. Schreiber Compo et al. (2011) examined the recall of eyewitnesses within the lab whilst they were still intoxicated. Participants were given written instructions on how to complete a written free recall test, which included ‘mentally reinstating’ the original encoding environment and ‘reporting everything’. Compared to placebo and control participants, intoxication (Mean BAC (M_{BAC}) = .09%) was found to have no effect on the number of correct central (i.e., person) or incorrect peripheral (i.e., scenario) details recalled, but did significantly reduce correct peripheral recall (i.e., scenario). However, as there was no comparison recall method, the extent to which the mental reinstatement and report everything instructions aided recall is unknown. Additionally, as with Read et al. (1992) participants were given written instructions, and completed a written free recall task, rather than a more forensically relevant interview. Consequently, ECI components such as rapport building and witness compatible questioning were also not incorporated. Furthermore, alcohol participants were still intoxicated when they completed the recall task. As a result, the findings of Schreiber Compo et al’s (2011) study may have been confounded by the effects of state-dependency, whereby being in the same state (i.e., intoxicated) at encoding and recall may help memory (Goodwin, Powell, Bremer, Hoine, & Stern, 1969; Parker, Birnbaum, & Noble, 1976; Weissenborn & Duka, 2000). Although Schreiber Compo et al. (2017) found that with a written and cued recall task, there was no advantage to state-dependent recall, intoxicated witnesses were seen to be more accurate in their immediate than in their delayed recall. Whilst Schreiber Compo et al.’s (2011) methodology may mimic the witness’ initial and immediate account to the police, the actual testimony presented at court and heard by jurors in the UK will be taken later, when the witness is sober (Crossland, et al., 2018). It is therefore not possible to determine from Schreiber Compo et al.’s (2011) study whether the (E)CI can aid an intoxicated witness’ recall in conditions similar to those experienced in the real-world, i.e., providing a testimony after a sobering delay. It should be noted though that witnesses can, and sometimes do, get interviewed while they are still intoxicated, for example in the US (Evans et al., 2009).

In a more recent eyewitness study, using a balanced placebo design, Flowe et al. (2019) examined the effects of alcohol consumption (M_{BAC} = .06%), expectancy and misleading post-event information on memory. Seven days after completing a hypothetical interactive rape scenario whilst sober or intoxicated, participants were presented with misleading post -event information and interviewed with the Self-Administered Interview © (SAI; Gabbert, Hope & Fisher, 2009; Hope, Gabbert & Fisher, 2011) or Modified Cognitive Interview (Modified CI; Holliday et al., 2012). The SAI is a self-reporting interview technique based upon the CI, and the Modified CI retains the social facilitative and mnemonic techniques of the (E)CI, except ‘change perspective’. Unfortunately, although the Modified CI resulted in significantly more correct and incorrect details than the SAI, due to unequal participant cell sizes (SAI = 47; Modified CI = 22), the researchers collapsed data across interview conditions. Initial analyses, however, found no effect of, or interaction between, intoxication and interview conditions for completeness, accuracy or correct, incorrect or confabulated recall. Within this study, Flowe et al. (2019) overcame a number of Schreiber Compo et al.’s (2011) (E)CI limitations by using a number of the (E)CI social facilitative techniques and mnemonics, conducting the verbal interviews when all participants were sober, and including a comparison interview technique. As indicated by Flowe et al. (2019) there are limitations in relation to the applied implications of these findings. For example, as the study was lab-based the intoxication level of participants (M_{BAC} = .06%) does not reflect the much higher witness BACs that police typically encounter (Evans et al., 2009). Additionally, the study focused on misinformation, and as such the conclusions drawn may not be applicable where witnesses are not exposed to leading questions. Consequently, as indicated by Flowe et al. (2019), further research is needed to investigate the impact of established non-suggestive open-ended interview protocols on memory reporting.

Present study

The aim of the present study was, therefore, to investigate whether the form of the ECI administered by police officers in England and Wales, namely the full ECI minus change perspective and temporal order, had the capacity to improve the recall of an intoxicated witness compared to a SI. Unlike a standard interview, which reflects how officers traditionally interviewed witnesses when not employing a form of the (E)CI (for example, with closed and leading questions; see Köhnken et al., 1994), an SI includes the social facilitative techniques of the ECI but excludes the four mnemonic components. The SI and the ECI within this study will, therefore, be identical other than that the SI will not include the mental reinstatement of context and report everything mnemonics. The SI was chosen for two reasons, firstly, meta-analyses indicate that the SI is more commonly used as the comparison interview when exploring the benefits of the (E)CI than the standard interview (Memon et al., 2010). Secondly, as AMT proposes that alcohols effect on perception and thought arises from an increasingly disproportionate degree of attention being given to immediate salient cues, including external environmental cues, it may be anticipated that at higher levels of intoxication a witness will derive greater benefit from the mental reinstatement component of the (E)CI, where the context/environment is mentally recreated (unlike the SI which does not contain mental reinstatement of context). Within general memory research, alcohols impairment to effortful but not automatic processing is a robust finding. To confirm that any lack of effects of intoxication within the present study were not merely the result of low levels of intoxication a free recall word task (effortful processing) and word frequency estimation task (automatic processing) will be included.

Three groups of participants (sober, moderately intoxicated or severely intoxicated) viewed a video of a mock crime and were interviewed either with an ECI or SI one week later (Akehurst et al., 2003; Evans & Roberts, 2009; Stein & Memon, 2006). In light of the findings of previous research with sober witnesses (Clifford & George, 1996; Fisher et al., 1989; Geiselman et al., 1984; Köhnken et al., 1994), it was firstly hypothesised that the ECI would improve recall accuracy with more correct details being recalled with this interview technique (Flowe et al., 2019) than the SI (hypothesis one). Secondly, it was hypothesised that in line with the findings of earlier intoxicated witness studies (Flowe et al., 2016; Hagsand et al., 2013a; Hildebrand et al., 2015; Yuille & Tollestrup, 1990) and 'basic' memory research (Koriat et al., 2000) intoxication would reduce the completeness but not the accuracy of an individual's testimony (hypothesis two). Thirdly, in light of AMTs prediction of the role internal and external cues play in the recall of an individual, an interaction between drinking condition and interview type was hypothesised with the ECI particularly improving the recall of those individuals who were severely intoxicated (hypothesis three). Finally, it was hypothesised that, due to the narrowing of attention proposed by AMT and in line with the findings of Schreiber Compo et al. (2011), intoxication would result in fewer correct surrounding details being recalled leading to particularly less complete recall of these details (hypothesis four).

Method

Participants

Whilst a total of 142 undergraduates volunteered to take part in this study, only 126 passed the eligibility screening and viewed the stimuli event. Of these 126, only 120 participants (79% female) returned to complete stage two of the study. These participants had a mean age of 19.58 years (*SD* = 2.03). This figure ensured 20 participants in each condition. All student volunteers were recruited through the University's participant pool and received £5 and course credit for their participation. Each student completed a comprehensive screening process as Crossland et al. (2016) to establish their eligibility to participate. As part of this screening process participants were asked to confirm their age, weight and whether they had consumed the equivalent of at least 6-9 units of alcohol in a single drinking occasion, in the past 3 months. A unit of alcohol is equal to 10ml or 8g of pure alcohol, which an average adult can process in an hour. The number of units of alcohol in a drink depends on the strength of the alcohol and the size of the drink. For example, a single shot of vodka (25ml, ABV 40%) is one unit, whilst a can of beer (440ml, ABV 5.5%) is 2 units (National Health Service, 2020). Potential participants were also asked if they had any medical condition, or had received any professional advice to stop or reduce the amount of alcohol they drank. Further to this, participants were asked if they were or could be pregnant and if there was any reason why they should not consume alcohol.

Design

The study utilized a 3 (Drinking condition: sober, moderately intoxicated, severely intoxicated) x 2 (Interview: ECI, SI) independent measures design. Although participants were randomly allocated to an interview condition, random allocation was not possible for the drinking condition without modifying the participants' normal drinking behaviour. This non-random allocation of drinking condition has been used in previous research (Altman et al., 2018; Altman et al., 2019; Van Oorsouw & Merckelbach, 2012; Van Oorsouw et al., 2015). Dependent measures of free recall were obtained using a scoring template technique (Memon, Wark, Holley, Bull, & Köhnken, 1996) and guided by the work of Dando et al. (2011). Details recalled by participants in the verbal free recall task were coded as correct, incorrect or a confabulation. Accuracy scores were also calculated by dividing the number of correct details reported by the total number of details reported (i.e., correct + incorrect + confabulation). A measure of memory completeness was obtained by dividing the number of details recalled correctly by the maximum score possible, for either overall recall or information type, depending on the analysis. The particulars of how the data were coded are presented below under ‘scoring’. In addition, interview duration was recorded. Two further dependent measures were produced to confirm that the intoxication levels achieved were sufficient to produce alcohols well-researched effect of disruption to effortful but not automatic processing: number of words recalled and mean estimated frequency of words presented multiple times (Hasher & Chromiak, 1977; Tracy & Bates, 1999).

Materials and Measures

Automatic and Effortful Recall Task. Within general memory research alcohol is consistently seen to impair effortful but not automatic processing, e.g., fewer words free-recalled, but no effect on frequency estimates. To confirm in the present study that any lack of effects of intoxication were not due to relatively low levels of intoxication a free recall word task (effortful processing) and word frequency estimation task (automatic processing) were employed. Both were based on the work of Tracy and Bates (1999), and the procedure of Hasher and Chromiak (1977). Four lists of 90 words were constructed with 27 unique words within each list. The words were chosen to be high in both mental imagery (> 6.0 on a scale of 1–7, Paivio, Yuille, & Madigan, 1968) and frequency in the English language (>50 occurrences per million; Thorndike & Lorge, 1944) as per Tracy and Bates (1999). The unique words were repeated at different frequencies with four presented once, five presented twice, six presented three times, six presented four times, three presented five times, two presented six times, and one presented seven times. This created a list of 90 words.

As per Tracy and Bates (1999), at the beginning of the effortful and automatic processing task participants were told ‘I will read you a long series of words, one by one. Listen carefully as I will ask you about them later’. After the 90 words had been read aloud participants completed the effortful processing task where they were asked to freely "recall as many words as possible from the list you just heard’. There was a maximum of 27 unique words that could be recalled. The automatic processing task was then completed with participants being asked ‘how many times did I say each of these 27 words’. These tasks had been produced for previous research (Crossland et al., 2016).

Stimuli Event. The event to be remembered consisted of a three-minute video showing a man entering a school and had been used in previous research (Crossland et al., 2016). Initially, the man walked down a corridor where he attempted to break-in to two lockers but failed. He then proceeded to enter a classroom where he stole a laptop and put this in his bag. After leaving the classroom he entered a staffroom area where he attempted to open two doors but when he failed he stole money from a purse on a desk. As he left the room the video ended.

Interview Schedules. A strict interview protocol was adhered to depending on the condition to which participants were randomly allocated: ECI or SI (Fisher & Geiselman, 1992; Milne & Bull, 2001). These protocols were prepared for previous research (Dando et al., 2011) by an experienced CI interviewer and were read verbatim to participants (please contact the first author for additional details of the interview). Each interview had six discrete phases (1) greet and personalise the interview, (2) rapport building, (3) explain the purpose of the interview, (4) free recall, (5) questioning, and (6) closure. The only difference between the ECI and SI schedule was in phase four. Where SI participants merely provided a free recall account of the stimuli event, ECI participants were aided in 'mentally reinstating context' and were instructed to 'report everything' but to never guess, before they began their free recall. All participants were given two recall attempts; phase four (free recall) and phase five (questioning) as per Dando et al. (2011). The SI provided a good control condition as it only differed from the ECI in terms of the two mnemonics and therefore allowed direct comparison between the two interview methodologies as in previous research (Maras & Bowler, 2010; Milne et al., 1999).

As in previous (E)CI research (e.g., Dando et al., 2011; Maras & Bowler, 2010) all participants were interviewed by the first author. Within phase one, participants were welcomed, reminded that they had previously consented to have their interview recorded, and asked to confirm this. Participants were also given the opportunity to ask any questions. During phase two, rapport was built between the interviewer and the participant where neutral topics of mutual interest were discussed. Once the participant had visibly relaxed the purpose of the interview was made explicitly clear in phase three and any questions asked were answered. In phase four, those in the ECI condition were aided in mentally reinstating both the physical and psychological context under which they watched the event. This included instructions such as: "Start by closing your eyes, staring at the floor or looking at a blank wall. Whichever makes you most comfortable. This will help you to think about each of the things I say to you. To begin I would like you to try to think back to the day that you saw the film….like you would do if you had lost something and were trying to remember the last time you saw it. Think about that day" … (*pause*) …What had you been doing that morning … (*pause*) …What was the weather like … (*pause*) ……………Think about what you had been doing immediately before coming up to see the film … (*pause*) … Now I would like you to think about the room in which you saw the film … (*pause*) …Try and get a picture of that room in your mind … (*pause*) ….." Following the mental reinstatement of context, participants were given the instruction "when you have a clear picture in your mind I would like you to tell me everything you can remember about the film", but do not guess. Those in the SI condition were merely asked to recall what they remembered from the film. All participants then provided their initial free recall account. During phase five participants had a second opportunity to recall details of the event when asked open questions about each of the main topics mentioned during the initial free recall. For example; "you mentioned that a laptop was stolen, could you tell me more about that please?" In line with witness compatible questioning, participants were asked questions in the same order that they mentioned each topic during their free recall. Participants were asked between one and six questions depending on the number of main topics that the individual recalled. The closure of the interview happened in phase six where participants were thanked for their help with the study and debriefed as to the purpose of the research.

*Procedur*e

Stage 1: On the day of the study, whilst sober and per University ethical requirements, potential participants were provided with information about the study and invited to take part in the research during their night out. As per ethical guidelines, and in line with Yuille & Tollestrup (1990), the study was advertised to participants as looking at alcohol and memory. Participants were informed that the study would involve them completing a couple of tasks during their night out, and a verbal task which would be recorded by dictaphone the following week. On agreeing to participate, undergraduates were asked to complete a screening form to confirm their eligibility to take part in the study. Those who did not pass the screening phase were thanked for their time but were told they were unable to take part in the research at this time. If a participant was eligible to take part, they were instructed to engage in their normal drinking behaviour during their night out at the Student Union (SU) bar. Participants were also informed that if they did decide to drink alcohol then they should not consume alcohol for the 20 minutes before their allotted appointment time. As per the breathalyser manufacturer instructions, this protocol would ensure the breathalyser produced an accurate Breath Alcohol Concentration (BrAC). At this stage, sober condition participants were identified, as they indicated a ‘typical night out’ would involve them abstaining from alcohol.

Stage 2: During their evening out in the SU bar, at a pre-arranged time participants were met by the researcher and taken to a quiet room to complete stage 2 of the study individually. They were initially asked to confirm that they had not consumed alcohol for the previous 20 minutes and then to detail the quantity and type of all beverages consumed that evening. Those that had not abstained from drinking alcohol in the previous 20 minutes were required to wait 20 minutes before providing a breath sample using a Lion Alcometer 500 breathalyser (Lion Laboratories, Barry, UK). The breathalyser was routinely calibrated by the manufacturer once every 6 months as per the manufacturers’ recommendation. Participants then completed the effortful and automatic processing tasks. Each participant was randomly allocated one of the four word lists. The selected 90 words (incorporating the 27 unique words at varied frequencies) were read aloud in a random order at a presentation rate of one every two seconds. Upon completion, participants were breathalysed again and asked to recall as many of the words as possible (effortful processing task), before estimating the frequency with which the 27 unique words were presented (automatic processing task). Participants proceeded to watch the stimuli event, before and after which they were breathalysed. This 2nd stage lasted between 25 and 45 minutes depending on how long participants abstained from alcohol before they took part. At the end of stage 2 participants returned to the SU bar to continue with their evening.

Stage 3: A week later, during the day, participants arrived at a different venue (to avoid spontaneous context reinstatement) and were breathalysed to confirm a BrAC of 0mg/l, and randomly allocated to either the ECI or SI condition. All interviews were recorded via dictaphone for later transcribing and coding. At the end of the interview participants were debriefed as to the purpose of the study and any questions were answered.

Scoring

The recorded interviews were transcribed and then coded according to a scoring template technique by Memon et al. (1996) and guided by the work of Dando et al. (2011). A comprehensive list of the details in the video was constructed by the first author (and verified by an independent coder) incorporating descriptions of the perpetrator, objects, surroundings, and actions resulting in 312 items of information. Each detail recalled, whether in the free recall or questioning phase of the interview, was coded as correct, incorrect or a confabulation (i.e. recalling a detail or action that did not happen) by the first author. With only a copy of the participants' recall and not the full interview, the author was blind to the drinking condition and interview group of each transcript. To test hypothesis four and the assertions of AMT, these items were also classified according to whether they referred to an action, an object, a person or a surrounding detail. For example, "a man with brown hair was in a classroom. He picked up a laptop and put it in a bag" would be coded as 7 correct points (2 person, 1 surrounding, 2 action, and 2 object). If a detail was repeated within a single interview phase or over two phases then this item was only scored once and the repetition ignored unless additional details were provided. If a participant mentioned a detail but included a qualifying statement such as "I'm not sure if" or "I think that" then the detail itself was coded and the fact that the participant was unsure was ignored. This means of classifying uncertain statements is consistent with previous (E)CI research (e.g. Dando et al., 2011; Davis et al., 2005),

Twenty-four interview transcripts (20%) were randomly selected (4 in each group and condition) and independently scored by the independent coder who was blind to the aims and hypotheses of the study and therefore also the drinking condition and interview condition of the transcript. Pearson correlations of the two coders' scores suggested good inter-rater reliability for the three memory measures; total correct: $r(24) = .92$, $p < .001$, total incorrect: $r(24) = .90$, $p < .001$ and total confabulations: $r(24) = .85$, $p < .001$.

Results

Initially, BrACs and recall from the effortful and automatic tasks were analysed to confirm the distinct nature of the three drinking conditions. In addition, a further analysis was undertaken to look at the effect of drinking condition on interview duration. The effect of interview type and drinking condition on participant memory was also investigated in terms of the number of correct, incorrect and confabulations recalled and also recall accuracy and completeness. Each of these analyses was repeated for detail type (action, object, person and surrounding). Initial explorations of the data highlighted one severely intoxicated SI participant (Mean B_{rAC} (M_{BrAC}) = 0.44mg/l; M_{BAC} = .10%) that did not recall any information from the video. With no recall details to code, this participant was removed from all further analyses. Subsequent statistical tests were run with the remaining 119 participants.

Breath Alcohol Concentration

Participant intoxication was initially assessed through their BrAC. However, to be comparable with previous research, where BAC levels rather than BrACs are reported when a breathalyser has been employed (e.g. Hagsand et al., 2013a; Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm-Gordh, 2017b; Van Oorsouw, Merckelbach & Smeets, 2015), all BrACs were converted to BACs with a blood: breath ratio of 2,300: 1. Participants who drank alcohol during their night out (N = 79) reportedly consumed between 3.30 and 24.20 units of alcohol[1] (*M* = 8.73, *SD* = 4.39), resulting in BACs ranging from .01-.21% (*M* = .09%, *SD* = .05). There was a highly positive correlation between reported units consumed and BAC (r (79) = .56, $p < .001$). Using the mean of the four BACs produced by each intoxicated individual, participants were divided into those above and below the UK drink drive limit of .08%. The 40 participants who were classed as moderately intoxicated generated readings between .01-.08% (*M* = .05%, *SD* = .02), whilst the 39 who were classed as severely intoxicated had BACs ranging from .09-.21% (*M* = .14%, *SD* = .03). Analyses of the BAC reading confirmed a significant difference in the intoxication levels of these two (moderately, severely) intoxicated populations (t (77) = 14.09, $p < .001$).

Word recall and estimation task

A univariate ANOVA confirmed impairment in effortful processing with severely intoxicated (*M* = 6.85, *SD* = 2.61) and moderately intoxicated participants (*M* = 9.75, *SD* = 3.14) both recalling significantly fewer words than sober participants (*M* = 11.90, *SD* = 3.19) (F (2,116) = 28.30, $p < .001$, $\eta\rho^2 = .33$). As anticipated, automatic processing abilities were preserved with the mean difference between the presented frequency of words and the estimates provided by participants not being significantly different for severely intoxicated (*M* = 1.66; *SD* = 0.32), moderately intoxicated (*M* = 1.55, *SD* = 0.30) and sober individuals (*M* = 1.56, *SD* = 0.64) (F (2,116) = .76, $p = .47$, $\eta\rho^2 = .01$). The levels of intoxication achieved were therefore sufficient to replicate previous research, demonstrating a detrimental effect of intoxication on effortful but not automatic processing. Further t-tests confirmed there was no significant difference in the recall of the SI and ECI participants' conditions for the effortful (t (117) = 1.31, $p = .19$) or automatic processing task (t (117) = 0.67, $p = .51$). Thus, confirming that any benefit derived from the ECI was not a consequence of the generally better memory of participants in the ECI condition.

[1] The highest number of units was consumed by a participant claiming to have drunk 750ml of 22% vodka and 568ml of beer.

Interview Duration

The duration of the interview was measured from the beginning of the witnesses' first free recall until they provided their last detail of information, ensuring omission of all instructions given to participants and the context reinstatement and report everything elements of the ECI. A 2 (Interview type) x 3 (Drinking condition) ANOVA indicated a main effect of interview type with ECI recall (*M* = 4 mins 37 secs, *SD* = 2 mins 7 secs) taking significantly longer than the SI (*M* = 3 mins 52 secs, *SD* = 1 min 46secs), (F (1, 113) = 6.44, p = .01, $\eta\rho^2$ = .05). A main effect of drinking condition was also revealed (F (2, 113) = 21.85, p < .001, $\eta\rho^2$ = .28), with post hoc tests indicating the interview duration of sober participants (*M* = 5 mins 34 secs, *SD* = 2 mins 7 secs) was significantly longer than both moderately (*M* = 4 mins, *SD* = 1 min 45 secs) and severely intoxicated (*M* = 3 mins 7 secs, *SD* = 1 min 5 secs) participants (p < .001). No such difference was indicated between the duration of moderately and severely intoxicated participant interviews (p = .06). No interaction between drinking condition and interview type was revealed (F (2, 113) = 1.42, p = .25, $\eta\rho^2$ = .02).

Overall recall performance

To test hypotheses one, two and three, overall recall performance (from the free recall and questioning phase of the interviews) was assessed, with the means and standard deviations for the number of correct, incorrect and confabulated details recalled by participants, as well as accuracy and completeness shown in table 1. An initial 2 (interview) x 3 (intoxication) MANCOVA was conducted with interview duration as a covariate. Using Pillai's trace indicated a significant effect of interview duration (V = .54, F (4, 109) = 31.52, p < .001, $\eta\rho^2$ = .54) and interview style (V = .19, F (4, 109) = 6.42, p < .001, $\eta\rho^2$ = .19) but not BAC condition (V = .12, F (8, 220) = 1.67, p =.11, $\eta\rho^2$ = .06). Follow-up ANOVAs on the outcome variables revealed the covariate, interview duration, was significantly related to the number of correct (F (1, 112) = 88.10, p < .001, $\eta\rho^2$ = .44) and incorrect details recalled (F (1, 112) = 62.05, p < .001, $\eta\rho^2$ = .36) as well as for recall completeness (F (1, 112) = 88.01, p < .001, $\eta\rho^2$ = .44). No effect was found for confabulations (F (1, 112) = 1.47, p =.23, $\eta\rho^2$ = .01), or accuracy (F (1, 112) = .001, p = .971, $\eta\rho^2$ = .001). Consequently, subsequent analyses were performed with interview duration as a covariate for correct and incorrect recall, and for completeness only.

To investigate recall performance a 2 (interview) x 3 (intoxication) ANCOVA was conducted with correct, incorrect and completeness as the dependent variables. A separate 2 (interview) x 3 (intoxication) ANOVA was also conducted with confabulations and recall accuracy as the dependent variables. Although incorrect and confabulated recall was low and indicative of a floor effect, there was a reasonable distribution of scores and no issues with skewness. For both the ANCOVA and ANOVA a reduced α level of 0.01 was employed, applying Bonferroni's correction and significant results were explored by Bonferroni post hoc test. In contrast to the predictions of hypothesis three, across all five measures of recall, no interaction between interview type and drinking condition was highlighted (p = .30 - .82), however, main effects did emerge. As can be seen in table one the completeness of participant recall was rather low irrespective of drinking condition and interview type. In contrast, recall accuracy was high even for severely intoxicated participants.

(Insert Table 1 here)

Correct recall. In line with hypothesis one a significant effect of interview condition was revealed with between 23% and 42% more correct details being recalled with the ECI (M = 44.85; SD = 20.65) than the SI (M = 34.29; SD = 17.23) (F (1, 112) = 6.37, p = .01, $\eta\rho^2$ = .05). Analyses also indicated a significant effect of drinking condition (F (2, 112) = 4.90, p = .009, $\eta\rho^2$ = .08) with sober individuals recalling significantly more correct details (M = 52.40; SD = 16.54) than severely intoxicated participants (M = 27.05; SD = 14.70) (p < .001). No significant differences were revealed between the correct recall of sober and moderately (M = 39.08; SD = 19.00) (p = .02), or between moderately and severely intoxicated participants (p = .04).

Incorrect recall. No significant effect of interview type was revealed in relation to the number of incorrect details recalled (F (1, 112) = 2.06, p =.15, $\eta\rho^2$ = .01). Neither was there a significant effect of drinking condition in the number of incorrect details given by sober, moderately, or severely intoxicated individuals (F (2, 112) = 0.32, p =.73, $\eta\rho^2$ = .01).

Confabulations. No significant effect of interview type was indicated on the number of confabulations participants recalled (F (1, 113) = 3.81, p = .05, $\eta\rho^2$ = .03). In addition, there was no effect of drinking condition indicated in relation to the number of confabulated details recalled by sober, moderately or severely intoxicated individuals (F (2, 113) = 0.94, p = .39, $\eta\rho^2$ = .02).

Accuracy. As predicted in hypothesis one, the ECI significantly improved recall accuracy (M = .89; SD = .07) when compared to the SI (M = .81; SD = .12) (F (1, 113) = 17.32, p < .001, $\eta\rho^2$ = .13). The recall accuracy of sober individuals interviewed with the ECI was 5.77% higher than those interviewed with the SI. For severely intoxicated participants this difference was 7.59% and for moderately intoxicated individuals the difference was 8.37%. In accordance with hypothesis two, no significant effect of drinking condition was indicated (F (2, 113) = 4.00, p = .02, $\eta\rho^2$ = .07) between sober (M = .87, SD = .07), moderately (M = .87, SD = .10) or severely intoxicated (M = .82, SD = .12), participants on the accuracy of their recall.

Completeness. The ECI significantly improved recall completeness (M = .14; SD = .07) compared to the SI (M = .11; SD = .06) (F (1, 112) = 6.37, p = .01, $\eta\rho^2$ = .05). Significant differences between drinking conditions were also apparent (F (2, 112) = 4.90, p = .009, $\eta\rho^2$ = .08). In partial support of hypothesis two, sober individuals were more complete in their recall (*M* = .17; *SD* = .05) than severely intoxicated individuals (*M* = .09; *SD* = .05) (*p* < .001), but moderately intoxicated participants (*M* = .13; *SD* = .06) were not more complete than those who were severely intoxicated (*p* = .04). Sober individuals were also no more complete in their recall than moderately intoxicated participants (*p* = .02).

Type of information

To test hypothesis four and the predictions of AMT, the memory of participants in the three drinking conditions was investigated in relation to the types of information recalled. Means and standard deviations for type of information recalled (action, object, person and surrounding details) across drinking condition and interview type are shown in table 2. To investigate performance by the type of information that was recalled a 2 (interview) x 3 (intoxication) ANCOVA was conducted with correct, incorrect and completeness as the dependent variables. A separate 2 (interview) x 3 (intoxication) ANOVA was also conducted with confabulations and recall accuracy as the dependent variables. In both instances a reduced α level of 0.01 was employed, applying Bonferroni's correction and significant results were explored by Bonferroni post hoc test. Across all five measures of recall, and four types of information no interaction between interview and BAC condition was highlighted (*p* = .10 - .85).

(Insert Table 2 here)

Correct recall. A significant effect of drinking condition was highlighted for the amount of correct surrounding details mentioned (*F* (2, 112) = 6.39, *p* = .002, $\eta\rho^2$ = .10). Sober participants recalled more correct surrounding details (*M* = 18.17; *SD* = 7.35) than those who were severely intoxicated (*M* = 7.90; *SD* = 5.61) (*p* < .001) but not significantly more those who were only moderately intoxicated (*M* = 12.63; *SD* = 6.92) (*p* = .02). No significant difference was indicated between moderately and severely intoxicated participants (*p* = .04). Drinking conditions were also not seen to differ significantly in the amount of correct person (*F* (2, 112) = 0.34, *p* = .71, $\eta\rho^2$ = .01), action (*F* (2, 112) = 4.42, *p* = .014, $\eta\rho^2$ = .07) or object details (*F* (2, 112) = 3.02, *p* = .05, $\eta\rho^2$ = .05) recalled. There was also no significant effect of interview type in relation to correct surrounding (*F* (1, 112) = 1.74, *p* = .19, $\eta\rho^2$ = .02), object (*F* (1, 112) = 3.58, *p* = .06, $\eta\rho^2$ = .03), action (*F* (1, 112) = 3.68, *p* = .06, $\eta\rho^2$ = .03) or person (*F* (1, 112) = 5.01, *p* = .03, $\eta\rho^2$ = .04) information reported.

Incorrect. There was no significant effect of drinking condition for the number of incorrect object (*F* (2, 112) = 0.30, *p* = .75, $\eta\rho^2$ = .01), action (*F* (2, 112) = 2.85, *p* = .06, $\eta\rho^2$ = .05), person (*F* (2, 112) = 1.37, *p* = .26, $\eta\rho^2$ = .02) or surrounding (*F* (2, 112) = 0.23, *p* = .80, $\eta\rho^2$ = .004) details recalled. There was also no significant difference between interview types in the number of incorrect person (*F* (1, 112) = 3.63, *p* = .06, $\eta\rho^2$ = .03), object (*F* (1, 112) = 2.99, *p* = .09, $\eta\rho^2$ = .03) or surrounding (*F* (1, 112) = 0.03, *p* = .87, $\eta\rho^2$ < .001) details recalled. Analyses did reveal, however, that the ECI significantly reduced the number of incorrect action details (*M* = 0.45; *SD* = 0.72) compared with the SI (*M* = 0.97; *SD* = 1.03) (F (1, 112) = 21.33, p < .001, ηρ² = .16).

Confabulations. No effect of drinking condition was indicated for the number of confabulated object (F (2, 106) = 1. 13, p = .33, ηρ² = .02), action (F (2, 106) = 0.04, p = .96, ηρ² = .001), person (F (2, 106) = 1.22, p = .30, ηρ² = .02) or surrounding (F (2, 106) = 2.07, p = .13, ηρ² = .04) details recalled. There was also no significant effect of interview type on the amount of confabulated object (F (1, 106) = 2.00, p = .16, ηρ² = .02), action (F (1, 106) = 0.39, p = .53, ηρ² = .004), person (F (1, 106) = 0.22, p = .64, ηρ² = .002) or surrounding (F (1, 106) = 1.85, p = .18, ηρ² = .02) details reported.

Accuracy. Analyses indicated no significant effect of drinking condition on the accuracy of recalled object (F (2, 106) = 0.83, p = .44, ηρ² = .02), person (F (2, 106) = 1.02, p = .37, ηρ² = .02), action (F (2, 106) = 3.88, p = .02, ηρ² = .07) or surrounding (F (2, 106) = 2.83, p = .06, ηρ² = .05) details. The ECI significantly improved recall accuracy for object (ECI: *M* = .83; *SD* = .15; SI: *M* = .73; *SD* = .22) (F (1, 106) = 10.28, p = .002, ηρ² = .09) and action details (ECI: *M* = .94; *SD* = .09; SI: *M* = .87; *SD* = .12) (F (1, 106) = 14.29, p < .001, ηρ² = .12) However, the ECI did not significantly improve recall accuracy for person (F (1, 106) = 6.75, p = .011, ηρ² = .06) or surrounding (F (1, 106) = 1.01, p = .32, ηρ² = .01) details.

Completeness. In partial support of hypothesis four, a significant effect of drinking condition was indicated for the overall completeness of recall for surrounding details (F (2, 112) = 6.39, p = .002, ηρ² = .10), with sober individuals providing a significantly more complete account (*M* = .12; *SD* = .05) than severely intoxicated participants (*M* = .05; *SD* = .04) (p < .001). There was however no significant difference in recall completeness between sober and moderately (*M* = .08, *SD* = .05) (p = .02) or moderately and severely intoxicated participants (p = .04). No significant effect of drinking condition was indicated for action (F (2, 112) = 4.42, p = .014, ηρ² = .07), object (F (2, 112) = 3.02, p = .05, ηρ² = .05) or person details (F (2, 112) = 0.34, p = .71, ηρ² = .01). In terms of interview type, no significant effect was indicated for surrounding (F (1, 112) = 1.74, p = .19, ηρ² = .02), object (F (1, 112) = 3.58, p = .06, ηρ² = .03), action details (F (1, 112) = 3.68, p = .06, ηρ² = .03) or person details (F (1, 112) = 5.01, p = .03, ηρ² = .04).

In summary, the ECI significantly improved the correct recall of participants irrespective of drinking condition, resulting in a significantly more accurate and complete account. Analyses by information type indicated that the ECI (irrespective of drinking condition) improved recall accuracy predominately for object and action details but also reduced the number of inaccurate actions details reported. Irrespective of interview type, those individuals who were severely intoxicated recalled significantly fewer correct details than sober participants and were consequently less complete in their recall although no less accurate. Moderately intoxicated individuals, however, were no less complete or less accurate than sober participants. Statistical analyses in relation to information type indicated that it was in relation to surrounding details that the correct recall of severely intoxicated individuals was particularly impaired, resulting in a significantly less complete recall of surrounding details by severely intoxicated participants.

Discussion

This is the first study to look at the ECI as a possible means of improving the recall of intoxicated witnesses. As was initially hypothesised, the ECI was found to improve recall accuracy, with 23-42% more correct details being recalled with this interview technique than the SI. This is in line with previous research where the (E)CI has been seen to increase the recall of correct information by approximately 35-40% (Clifford & George, 1996; Fisher et al., 1989; Flowe et al., 2019; Geiselman et al., 1984; Köhnken et al., 1994). Further to the initial prediction, analyses by information type indicated that the improvement in recall from the ECI was derived primarily from an increase in the accuracy of participants' recall of object and action details. It was also hypothesised that in light of the findings of previous intoxicated witness studies (Flowe et al., 2016; Hagsand et al., 2013a; Hildebrand et al., 2015; Yuille & Tollestrup, 1990), and memory regulation research (Koriat et al., 2000), that intoxication would reduce the completeness but not the accuracy of an individual's recall. There was partial support for this hypothesis: whilst the recall of moderately and severely intoxicated participants was, as predicted, just as accurate as that provided by sober participants; the recall of severely but not moderately intoxicated individuals was significantly less complete than sober participants.

Whilst an interaction between drinking condition and interview type was initially hypothesised, with the ECI particularly improving the recall of severely intoxicated individuals, no such effect was indicated in the analyses. In choosing to compare participant recall using the ECI, with recall obtained through the SI, the only difference between the two recall methods was the 'mental reinstatement of context' and 'report everything' mnemonics. This decision was made in accordance with Memon et al.'s (2010) meta-analysis of (E)CI research, where the SI was the most common comparison interview technique adopted by researchers. The lack of interaction between drinking condition and interview technique within the present study, however, may be a consequence of the relatively small differences between the two interview methods. As already stated, though, the (E)CI was seen to improve the recall of both sober and intoxicated witnesses and from a forensic perspective, this is the key factor for judicial authorities. From a theoretical perspective, the lack of interaction between interview and drinking condition suggests that an increase in intoxication level does not affect the benefit an individual derives from the internal and external cues provided by mentally reinstating the context.

Finally, it was hypothesised that, due to the narrowing of attention proposed by AMT and in line with the findings of Schreiber Compo et al. (2011), intoxication would result in fewer correct surrounding details being recalled leading to a particularly less complete recall for these details. Once again there was partial support for this hypothesis.

As predicted severely intoxicated participants recalled significantly less correct surrounding details and subsequently provided a less complete account of these details than sober individuals. However, compared with sober participants, moderately intoxicated individuals did not recall significantly fewer correct details; neither were they significantly less complete in their account of the stimuli event.

Ultimately, in terms of alcohol's effect on witness recall, the findings of this study suggest that with mild intoxication (M_{BAC} = .05%), at BACs below the UK drink drive limit (.08%), alcohol is not particularly problematic for recall; these individuals were just as accurate and complete in their recollections as sober participants. However, with moderate intoxication (M_{BAC} = .14%), at BACs above the UK drink drive limit, alcohol was seen to reduce the completeness but not the accuracy of recall. Whilst these findings, for moderate intoxication, are in line with predictions of memory regulation (Koriat et al., 2000) in that, in providing as accurate an account as possible, fewer details were recalled; this is not the case for more mild BACs. So why were severely intoxicated participants recalling fewer correct details?

As previously mentioned one possible suggestion posited by Van Oorsouw and Merckelbach (2012) is that of fragmentary blackouts. Through this explanation an intoxicated individual recalls some, but not all, of the details they experienced whilst intoxicated (Goodwin, 1977). Such individuals only become aware they have gaps in their memory when they are told by others. The present study, however, suggests that the 'report everything' and 'mental reinstatement of context' mnemonics of the (E)CI have the capacity to increase correct recall and to improve the recall accuracy and completeness of moderately and severely intoxicated individuals. If fragmentary blackouts could fully account for the effects of alcohol on eyewitness recall, then the method of interview should not affect the accuracy or completeness of an intoxicated individual's recall, as, through a fragmentary blackout explanation, an intoxicated individual is expected to only become aware that they have gaps in their memory when they are told about details they do not remember. The individuals, though, would still not be expected to be able to recall these details first-hand; the information is 'lost'. Yet, within the present study, interview method affected the number of correct details recalled. Essentially some of the memories that could be considered 'lost' by the fragmentary blackouts explanation were retrieved, potentially due to the additional support provided by the mnemonics of the (E)CI. An acute alcohol amnesia (Birnbaum et al., 1978; Jones & Jones, 1980) explanation, however, results in an individual recalling some, but not all, details that they witnessed whilst intoxicated. This amnesia is not permanent, and details that were not initially recalled can be retrieved to some extent with appropriate cues and prompts (Goodwin et al., 1969a). The effect could explain why the ECI (with the report everything and mental reinstatement of context instructions) improved recall, as the 'mental reinstatement of context' mnemonic provided the cues necessary to access the memories that fragmentary blackouts considered 'lost'. Essentially, this suggests that the effect of alcohol concerns the accessibility of memories rather than their availability (Tulving, 1983; Tulving & Pearlstone, 1966) and that the ECI can be used to help witnesses access these memories without negatively affecting the accuracy of what is recalled.

Limitations and future research

This study furthers our understanding of the effects of alcohol on eyewitness recall with real-world levels of intoxication and provides an important first step towards improving the recall of intoxicated witnesses. However, there are a number of areas where improvements could be made including addressing potential concerns regarding floor effects with incorrect and confabulated recall. First, although participants were randomly allocated to either the ECI or SI condition, this was not the case with the three drinking conditions. Random allocation to BAC group was not possible as the purpose of the study was to ensure that the levels of intoxication achieved were comparable to those participants typically experienced while out drinking, and from a health and safety perspective to ensure that participants were not encouraged to consume more alcohol than they were used to. However, no measure of a participant's tolerance to alcohol was included in the study. It might be that those who drank more alcohol during their evening out had built up a higher tolerance to alcohol, which could subsequently affect how alcohol impacts their memory. Whilst in the case of a real crime the police would not have a measure to establish a witness' alcohol tolerance, from a theoretical perspective this information would be beneficial. Future field research exploring the effects of alcohol on eyewitness memory should, therefore, seek to include a measure to determine a participant's tolerance to alcohol.

Second, aside from intoxication level there is a further distinction between the alcohol and sober participants. In the recall phase of the study all participants were sober. Consequently, moderately and severely intoxicated participants experienced a change of state (i.e., intoxicated at encoding but sober at retrieval). In contrast, sober participants were sober at both encoding and retrieval. It is therefore necessary to acknowledge that the effects of state-dependency may have been a factor in the findings of this study. Schreiber Compo et al. (2017), however, indicated that there was no advantage to state-dependent recall for intoxicated participants. Further to this, previous research indicates that in the field, police officers have to sometimes interview intoxicated witnesses whilst they are still under the influence of alcohol (Evans et al., 2009). The actual testimony presented to the court, and jurors, though, is the testimony the police obtain once the witness is no longer intoxicated. So, while it is important to highlight the fact that state-dependency may have a role in the conclusions that have been drawn in this study, to be of forensic relevance intoxicated participants would need to be sober at recall.

Third, the stimuli event used in this study was forensically relevant and purposely complex to include a range of object, person, action, and surrounding details. However, with a real crime, a witness is unlikely to have a clear view of a perpetrator entering several rooms, as occurred in this study. Possibly, a witness would have also had direct involvement with the event which is also not possible with video stimuli. Although, as with previous research (Crossland et al., 2016), health and safety concerns and legal restrictions within the SU bar prevented a live event being staged, and as such the effects of anxiety could not be assessed. Future research, where possible, should therefore seek to include a live event to further increase the forensic relevance of the study and the validity of the conclusions drawn.

Fourth, as in previous research, the first author conducted the participant interviews. There are disadvantages to this approach which should be highlighted. To alleviate concerns regarding the efficacy of the interviews and also interview consistency, the ECI and SI scripts were prepared by an experienced CI interviewer. These transcripts were developed for previous research (Dando et al., 2011), and enabled the ECI and SI interview components (including mental reinstatement of context) to be read verbatim to participants. Potentially, though, non-verbal behaviours such as eye contact, body position, and hand signals may not have been as consistent as with a fully trained ECI police officer. Consequently, such deficits could mean that the SI and ECI procedures within the present study were not as effective as those applied by fully trained police officers and that the present study in turn may be underestimating the benefit that participants derive from the ECI. Yet it is also worth noting that the percentage increase in correct recall evident in this study is in line with previous (E)CI research, using a range of different interviewers (Clifford & George, 1996; Fisher et al., 1989; Geiselman et al., 1984; Köhnken et al., 1994).

Fifth, as per Yuille and Tollestrup's (1990) research, the study was advertised to participants as studying alcohol and memory. In addition, the automatic and effortful processing tasks were completed by participants before watching the stimuli event. As a consequence, participants were not totally blind to the aim of the study and this may have had an impact on the encoding of the stimuli event. Further to this, some of the psychological effects of alcohol might have occurred precisely because participants knew that the effects of alcohol were being studied (e.g., Rosenthal effect, Rosenthal, 1976). Future research should therefore present the stimuli event before the effortful/automatic processing tasks and also obscure, as far as possible, the fact that the effects of alcohol are being studied. Sixth, when scoring participant recall, if an individual included a qualifying statement such as "I'm not sure if" or "I think that" then the detail itself was coded and the participants uncertainty was ignored. It may be of potential interest to code this information in future research, as intoxicated individuals may use this type of response more often than a sober witness, in an attempt to monitor their memory recall.

As this is the first study to look at the ECI as a means of improving the recall of an intoxicated witness future research should initially seek to replicate this study taking into account the limitations detailed above. A range of stimuli events and participant demographics should also be employed to determine whether the results found within this study are supported. Further to this, future studies should also consider examining the effectiveness of the ECI when used both at immediate and delayed recall, when the witness is intoxicated at both recall attempts. Whilst research indicates such a scenario is not common in England (Crossland et al., 2018), studies do suggest that such a situation may be more common practice in the US (Evans et al., 2009). In addition, with the present research indicating that the recall of a moderately intoxicated witness is just as accurate and complete as the testimony provided by a sober witness, future studies should also look at how jurors perceive the testimony of these individuals. If, as previous research suggests with intoxicated victims/witnesses of sexual assault (Evans & Schreiber Compo, 2010; Schuller & Wall, 1998; Wall & Schuller, 2000) jurors view the testimony of an intoxicated eyewitness as less credible than that provided by a sober witness then jurors may be led to disregard the testimony of a potentially accurate and credible moderately intoxicated witness.

Policy implications and final remarks

From a criminal justice perspective, this study indicates that severely intoxicated witnesses (those with BAC's above the UK drink drive limit) are likely to recall fewer correct details of a witnessed crime and thereby provide a less complete testimony than a sober witness. Such individuals, however, are likely to be just as accurate in the details they do recall as a sober witness. In contrast, moderately intoxicated witnesses (those with BACs below the UK drink drive limit) are likely to be just as complete and accurate in their recall as a witness who had not consumed alcohol. Such findings have potentially important policy implications for how intoxicated witnesses are interviewed by police. For if, as this study suggests, the ECI is an effective tool in improving the accuracy and completeness of an intoxicated witness' testimony, then police officers should be encouraged to use this technique (minus reverse order and change perspective) with any witness who is intoxicated when encoding the crime, and where the completeness of the account is essential.

Table 1: Means (standard deviations) of overall recall performance and interview duration across drinking condition and interview type.

	Drinking condition			
	Sober (n = 40)	Moderately Intoxicated	Severely Intoxicated	Total

		(n = 40)	(n = 39)	
SI				
Correct	47.00 (13.02)	33.00 (16.70)	22.26 (12.22)	34.29 (17.23)
Incorrect	7.45 (4.06)	5.05 (3.66)	4.37 (2.89)	5.64 (3.76)
Confabulations	1.65 (1.93)	1.10 (1.21)	1.26 (1.41)	1.34 (1.54)
Accuracy	.84 (.08)	.83 (.12)	.78 (.15)	.81 (.12)
Completeness	.15 (.04)	.11 (.05)	.07 (.04)	.11 (.06)
Interview duration	4 mins 49 secs (1 min 38 secs)	3 mins 49 secs (1 min 57 secs)	2 mins 54 secs (1 min 4 secs)	3 mins 52 secs (1 min 45 secs)
ECI				
Correct	57.80 (18.19)	45.15 (19.62)	31.60 (15.69)	44.85 (20.64)
Incorrect	6.40 (3.99)	4.25 (2.83)	3.60 (1.96)	4.75 (3.22)
Confabulations	0.90 (1.21)	0.60 (1.19)	1.00 (1.38)	.83 (1.25)
Accuracy	.89 (0.05)	.91 (0.05)	.85 (0.08)	.89 (.07)
Completeness	.19 (0.06)	.14 (0.06)	.10 (0.05)	.14 (.07)
Interview duration	6 mins 19 secs (2 mins 20 secs)	4 mins 13 secs (1 min 34 secs)	3 mins 20 secs (1 min 4 secs)	4 mins 37 secs (2 mins 7 secs)
Total				
Correct	52.40 (16.54)	39.08 (19.00)	27.05 (14.70)	
Incorrect	6.93 (4.01)	4.65 (3.26)	3.97 (2.46)	
Confabulations	1.28 (1.63)	.85 (1.21)	1.13 (1.38)	
Accuracy	.87 (.07)	.87 (.10)	.82 (.12)	
Completeness	.17 (.05)	.13 (.06)	.09 (.05)	
Interview duration	5 mins 34 secs (2 mins 8 secs)	4 mins 0 secs (1 min 45 secs)	3 mins 7 secs (1 min 5 secs)	

Table 2: Means (standard deviations) for recalled information type across drinking condition and interview type.

	Surrounding	Object	Action	Person
Sober				
SI				

Correct	17.50 (7.08)	8.45 (3.83)	13.05 (4.54)	8.00 (3.63)
Incorrect	1.60 (1.64)	2.10 (1.77)	1.05 (1.10)	2.70 (2.41)
Confabulations	0.60 (0.94)	0.50 (0.83)	0.45 (0.69)	0.10 (0.31)
Accuracy	.88 (.10)	.77 (.21)	.89 (.09)	.76 (.17)
Completeness	.12 (.05)	.16 (.07)	.19 (.06)	.20 (.09)
ECI				
Correct	18.85 (7.72)	10.00 (5.10)	16.50 (5.62)	12.45 (5.13)
Incorrect	1.70 (2.15)	2.05 (1.54)	0.45 (0.76)	2.20 (2.26)
Confabulations	0.45 (0.51)	0.20 (0.41)	0.20 (0.52)	0.05 (0.22)
Accuracy	.91 (0.07)	.83 (0.12)	.96 (0.07)	.85 (0.12)
Completeness	.13 (0.05)	.19 (0.10)	.24 (0.08)	.31 (0.13)
Moderately **Intoxicated**				
SI				
Correct	10.75 (6.84)	5.35 (3.90)	9.65 (5.43)	7.25 (4.24)
Incorrect	0.95 (1.00)	1.80 (1.64)	1.05 (1.23)	1.25 (1.41)
Confabulations	0.40 (0.68)	0.20 (0.52)	0.45 (0.76)	0.05 (0.22)
Accuracy	.85 (.24)	.70 (.25)	.85 (.17)	.84 (.15)
Completeness	.07 (.05)	.10 (.07)	.14 (.08)	.18 (.11)
ECI				
Correct	14.50 (6.65)	8.40 (4.75)	12.95 (6.34)	9.30 (4.77)
Incorrect	0.95 (1.10)	1.45 (1.32)	0.40 (0.60)	1.45 (1.54)
Confabulations	0.10 (.31)	0.10 (0.31)	0.35 (0.75)	0.05 (0.22)
Accuracy	.94 (.06)	.87 (.10)	.95 (.07)	.86 (.12)
Completeness	.10 (.04)	.16 (.09)	.19 (.10)	.23 (.12)
Severely Intoxicated				
SI				
Correct	5.89 (4.67)	2.84 (2.41)	6.68 (4.47)	6.84 (3.48)
Incorrect	0.53 (0.96)	1.11 (0.94)	0.79 (0.71)	1.95 (1.78)
Confabulations	0.58 (1.22)	0.26 (0.56)	0.42 (0.61)	0.00 (0.00)
Accuracy	.86 (.18)	.64 (.34)	.77 (.25)	.77 (.21)
Completeness	.04 (.03)	.05 (.05)	.10 (.06)	.17 (.09)
ECI				
Correct	9.80 (5.87)	5.05 (3.66)	8.45 (4.45)	8.30 (4.70)
Incorrect	1.05 (1.19)	1.05 (1.15)	0.50 (0.83)	1.00 (0.92)
Confabulations	0.40 (0.82)	0.20 (0.52)	0.35 (0.59)	0.05 (0.22)
Accuracy	.85 (.11)	.79 (.22)	.90 (.13)	.86 (.14)
Completeness	.07 (.04)	.10 (.07)	.12 (.06)	.21 (.12)

References

Ackerman, R., & Goldsmith, M. (2008). Control over grain size in memory reporting - With and without satisficing knowledge. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(5), 1224-1245. doi: 10.1037/a0012938

Adams, S. L., & McNeil, D. W. (1991). Negative alcohol expectancies reconsidered. *Psychology of Addictive Behaviors*, *5*(1), 9-14. doi: 10.1037/h0080576

Akehurst, L., Milne, R., & Köhnken, G. (2003). The effects of children's age and delay on recall in a cognitive or structured interview. *Psychology, Crime and Law, 9*(1), 97-107. doi: 10.1080/10683160308140.

Altman, C.M., McQuiston, D, & Schreiber Compo, N. (2019). How Elevated BAC level and Identification Format Affect Eyewitness Memory: A Field Study. *Applied Cognitive Psychology*, *33*(3), 426-438. doi: 10.1002/acp.3535.

Altman, C.M., Schreiber Compo, N., McQuiston, D., Hagsand, A, & Cervera, J. (2018). Witnesses' memory for events and faces under elevated levels of intoxication, *Memory, 26*(7), 946-959. doi:10.1080/09658211.2018.1445758

Baddeley, A., Eysenck, M., & Anderson, M. C. (2009). *Memory*. Hove, UK: Taylor & Francis

Bayless, S. J., Harvey, A. J., Kneller, W., & Frowd, C. D. (2018). Do intoxicated witnesses produce poor facial composite images? *Psychopharmacology*, *235*(10), 2991-3003. doi: 10.1007/s00213-018-4989-2

Birnbaum, I. M., Parker, E. S., Hartley, J. T., & Noble, E. P. (1978). Alcohol and memory: Retrieval processes. *Journal of Verbal Learning and Verbal Behavior*, *17*(3), 325-335. doi: 10.1016/S0022-5371(78)90210-4.

Boon, J., & Noon, E. (1994). Changing perspectives in cognitive interviewing. *Psychology, Crime and Law*, *1*(1), 59-69. doi: 10.1080/10683169408411936.

Bower, G. (1967). A multicomponent theory of the memory trace. In K. Spence & J. Spence (Eds.), *The Psychology of Learning and Motivation: Advances in Research and Theory Vol 1. (*pp.229-327). New York: Academic Press.

Brock, P., Fisher, R., & Cutler, B. (1999). Examining the cognitive interview in a double-test paradigm. *Psychology, Crime and Law, 5*, 29–45. doi: 10.1080/10683169908414992.

Carpenter, J. A., & Ross, B. M. (1965). Effect of alcohol on short-term memory. *Quarterly Journal of Studies on Alcohol*, *26*(4), 561-579.

Clarke, C., & Milne, R. (2001). *National evaluation of the PEACE investigative interviewing course*. London: Home Office.

Clifasefi, S. L., Takarangi, M. K., & Bergman, J. S. (2006). Blind drunk: The effects of alcohol on inattentional blindness. *Applied Cognitive Psychology*, *20*(5), 697-704. doi: 10.1002/ acp.1222

Clifford, B. R., & George, R. (1996). A field evaluation of training in three methods of witness/victim investigative interviewing. *Psychology, Crime and Law*, *2*(3), 231-248. doi: 10.1080/10683169608409780.

Crossland, D., Kneller, W., & Wilcock, R. (2016). Intoxicated witnesses: Testing the validity of the Alcohol Myopia Theory. *Applied Cognitive Psychology, 30* (2), 270-281. doi:10.1002/acp.3209.

Crossland, D., Kneller, W., & Wilcock, R. (2018). Intoxicated Eyewitnesses: Prevalence and Procedures according to England's Police Officers. *Psychology, Crime & Law, 24*, 979-997. doi.org/10.1080/1068316X.2018.1474216

Curran, H. V., & Hildebrandt, M. (1999). Dissociative effects of alcohol on recollective experience. *Consciousness and Cognition: An International Journal, 8*(4), 497-509. doi: 10.1006/ccog.1999.0417.

Dando, C. J., Wilcock, R., Behnkle, C., & Milne, R. (2011). Modifying the cognitive interview: Countenancing forensic application by enhancing practicability. *Psychology, Crime and Law, 17*(6), 491-511. doi: 10.1080/10683160903334212

Dando, C., Wilcock, R., & Milne, R. (2008). The cognitive interview: Inexperienced police officers' perceptions of their witness/victim interviewing practices. *Legal and Criminological Psychology*, *13*(1), 59-70. doi: 10.1348/135532506X162498.

Dando, C., Wilcock, R., & Milne, R. (2009). The cognitive interview: Novice police officers' witness/victim interviewing practices. *Psychology, Crime and Law*, *15*(8), 679-696. doi: 10.1080/10683160802203963.

Davis, M. R., McMahon, M., & Greenwood, K. M. (2005). The efficacy of mnemonic components of the cognitive interview: towards a shortened variant for time-critical investigations. *Applied Cognitive Psychology*, *19*(1), 75-93. doi: 10.1002/acp.1048

Evans, J. R., & Fisher, R. P. (2011). Eyewitness memory: Balancing the accuracy, precision and quantity of information through metacognitive monitoring and control. *Applied Cognitive Psychology, 25*(3), 501-508. doi: 10.1002/acp.1722

Evans, A. D., & Roberts, K. (2009). The effects of different paraphrasing styles on the quality of reports from young child witnesses. *Psychology, Crime and Law*, *15*(6), 531-546. doi: 10.1080/10683160802385398.

Evans, J. R., & Schreiber Compo, N. (2010). Mock jurors' perceptions of identifications made by intoxicated eyewitnesses. *Psychology, Crime & Law, 16*(3), 191-210. doi: 10.1080/ 10683160802612890

Evans, J.R., Schreiber Compo, N., & Russano, M.B. (2009). Intoxicated witnesses and suspects: Procedures and prevalence according to law enforcement. *Psychology, Public Policy, and Law*, *15*(3), 194-221. doi: 10.1037/a0016837.

Fisher, R. P., & Geiselman, R. E. (1992). *Memory-enhancing techniques for investigative interviewing: The cognitive interview*. Springfield, IL: Charles C. Thomas Publishing.

Fisher, R.P., Geiselman, R.E., & Amador, M. (1989). Field test of the cognitive interview: Enhancing the recollection of actual victims and witnesses of crime. *Journal of Applied Psychology*, *74*(5), 722-727. doi: 10/1037/0021-9010.74.5.722.

Flowe, H. D., Takarangi, M. K., Humphries, J. E., & Wright, D. S. (2016). Alcohol and remembering a hypothetical sexual assault: Can people who were under the influence of alcohol during the event provide accurate testimony? *Memory*, *24*(8), 1042-1061. doi: 10.1080/09658211.2015.1064536.

Flowe, H. D., Colloff, M. F., Karoğlu, N., Zelek, K., Ryder, H., Humphries, J. E., & Takarangi, M. K. (2017). The effects of alcohol intoxication on accuracy and the confidence–accuracy relationship in photographic simultaneous line-ups. *Applied Cognitive Psychology*, *31*(4), 379-391. doi: 10.1002/acp.3332

Flowe, H. D., Humphries, J. E., Takarangi, M. K., Zelek, K., Karoğlu, N., Gabbert, F., & Hope, L. (2019). An experimental examination of the effects of alcohol consumption and exposure to misleading postevent information on remembering a hypothetical rape scenario. *Applied Cognitive Psychology*. *33*(3), 393-413. doi: 10.1002/ACP.3531

Gabbert, F., Hope, L., & Fisher, R. P. (2009). Protecting eyewitness evidence: Examining the efficacy of a self-administered interview tool. *Law and Human Behavior*, *33*, 298-307. doi: 10.1007/s10979-008-9146-8

Garfinkel, S. N., Dienes, Z., & Duka, T. (2006). The effect of alcohol and repetition at encoding on implicit and explicit false memories. *Psychopharmacology, 188*(4), 498-508. doi: 10.1007/s00213-006-0480-6

Gawrylowicz, J., Ridley, A. M., Albery, I. P., Barnoth, E., & Young, J. (2017). Alcohol-induced retrograde facilitation renders witnesses of crime less suggestible to misinformation. *Psychopharmacology*, *234*(8), 1267-1275. doi: 10.1007/s00213-017-4564-2

Geiselman, R. E., Fisher, R. P., Firstenberg, I., Hutton, L. A., Sullivan, S. J., Avetissian, I. V., & Prosk. A. (1984). Enhancement of eyewitness memory: An empirical evaluation of the cognitive interview. *Journal of Police Science and Administration*, *12*(1), 74-80.

Geiselman, R. E., Fisher, R. P., MacKinnon, D. P., & Holland, H. L. (1985). Eyewitness memory enhancement in the police interview: cognitive retrieval mnemonics versus hypnosis. *Journal of Applied Psychology*, *70*(2), 401-12. doi: 10.1037/0021-9010.70.2.401.

Geiselman, R. E., Fisher, R. P., MacKinnon, D. P., & Holland, H. L. (1986). Enhancement of eyewitness memory with the cognitive interview. *The American Journal of Psychology*, *99*(3), 385-401. doi: 10.2307/1422492.

George, W. H., & McAfee, M. P. (1987). The effects of gender and drinking experience on alcohol expectancies about self and male versus female other. *Social Behavior and Personality*, *15*(2), 133-144. doi: 10.2224/sbp.1987.15.2.133

Goldsmith, M., Koriat, A., & Weinberg-Eliezer, A. (2002). Strategic regulation of grain size in memory reporting. *Journal of Experimental Psychology: General*, *131*(1), 73-95. doi: 10.1037/0096-3445.131.1.73

Goodwin, D. W. (1977). The alcoholic blackout and how to prevent it. In I. M. Birnbaum & E. S. Parker (Eds.) *Alcohol and Human Memory* (pp. 177-183), Hillsdale, NJ: Lawrence Erlbaum Associates.

Goodwin, D.W., Crane, J.B., & Guze, S.B. (1969a). Phenomenological Aspects of the Alcoholic "Blackout", *British Journal of Psychiatry*, *115(*526), 1033-1038. doi: 10.1192/bjp.115.526.1033.

Goodwin, D. W., Powell, B., Bremer, D., Hoine, H., & Stern, J. (1969b). Alcohol and recall: State-dependent effects in man. *Science*, *163*(3873), 1358-1360. doi: 10.1126/science. 163.3873.1358.

Hagsand, A., Roos af Hjelmsäter, E., Granhag, P. A., Fahlke, C., & Söderpalm-Gordh, A. (2013a). Bottled memories: On how alcohol affects eyewitness recall. *Scandinavian Journal of Psychology, 54*(3), 188-195. doi: 10.1111/sjop.12035.

Hagsand, A., Roos af Hjelmsäter, E., Granhag, P., Fahlke, C., & Söderpalm-Gordh, A. (2013b). Do sober eyewitnesses outperform alcohol intoxicated eyewitnesses in a line-up? *The European Journal of Psychology Applied to Legal Context*, *5*(1), 23-47.

Hagsand, A., Roos af Hjelmsäter, E., Granhag, P. A., Fahlke, C., & Söderpalm-Gordh, A. (2017). Witnesses stumbling down memory lane: The effects of alcohol intoxication, retention interval, and repeated interviewing. *Memory*, *25*(4), 531-543. doi: 10.1080/09658211.2016.1191652

Harvey, A. J., Kneller, W., & Campbell, A. C. (2013a). The effects of alcohol intoxication on attention and memory for visual scenes. *Memory*, *21*(8), 969-980. doi: 10.1080/09658211.2013.770033

Harvey, A. J., Kneller, W., & Campbell, A. C. (2013b). The elusive effects of alcohol intoxication on visual attention and eyewitness memory. *Applied Cognitive Psychology, 27*(5), 617-624. doi: 10.1002/acp.2940

Hasher, L., & Chromiak, W. (1977). The processing of frequency information: an automatic mechanism?. *Journal of Verbal Learning and Verbal Behavior*, *16*(2), 173-184. doi: 10.1016/S0022-5371(77)80045-5.

Hashtroudi, S., & Parker, E. S. (1986). Acute Alcohol Amnesia: What is remembered and what is forgotten. In H. Cappell, F. Glaser, Y. Israel, H. Kalant, W. Schmidt, E. Sellers, & R. Smart (Eds.). *Research Advances in Alcohol and Drug Problems* (Vol. 9, pp. 179-209). New York, NY: Plenum.

Hashtroudi, S., Parker, E. S., DeLisi, L. E., & Wyatt, R. J. (1983). On elaboration and alcohol. *Journal of Verbal Learning and Verbal Behavior*, *22*(2), 164-173. doi: 10.1016/S0022-5371(83)90123-8

Hildebrand Karlén, M, (2018). Interviewing intoxicated witnesses: Memory performance in theory and practice. *Scandinavian Journal of Psychology, 59*(2), 113-126. doi: 10.1111/sjop.12404

Hildebrand Karlén, M., Roos af Hjelmsäter, E., Fahlke, C., Granhag, P. A., & Söderpalm-Gordh, A. (2015). Alcohol intoxicated eyewitnesses' memory of intimate partner violence. *Psychology, Crime & Law*, *21*(2), 156-171. doi: 10.1080/1068316X.2014.951644

Hildebrand Karlén, M., Roos af Hjelmsäter, E., Fahlke, C., Granhag, P. A., & Söderpalm-Gordh, A. (2017). To wait or not to wait? Improving results when interviewing intoxicated witnesses to violence. *Scandinavian Journal of Psychology*, *58*(1), 15-22. doi: 10.1111sjop.12345

Holliday, R. E., & Albon, A. J. (2004). Minimising misinformation effects in young children with cognitive interview mnemonics. *Applied Cognitive Psychology*, *18*(3), 263-281. doi: 10.1002/acp.973.

Holliday, R. E., Humphries, J. E., Milne, R., Memon, A., Houlder, L., Lyons, A., & Bull, R. (2012). Reducing misinformation effects in older adults with cognitive interview mnemonics. *Psychology and Aging, 27*, 1191-1203. doi: 10.1037/a0022031

Hope, L., Gabbert, F., & Fisher, R. P. (2011). From laboratory to the street: Capturing witness memory using the self-administered interview: The self-administered interview. *Legal and Criminological Psychology, 16*, 211-226. doi:10.1111/j.2044-8333.2011.02015.x

Janssen, S. M., & Anne, M. (2019). And one more for the road: Commentary on the Special Issue on alcohol and eyewitness memory. *Applied Cognitive Psychology*, *33*(3), 456-462. doi: 10.1002/acp.3562

Jones, M. K., & Jones, B. M. (1980). The relationship of age and drinking habits to the effects of alcohol on memory in women. *Journal of Studies on Alcohol and Drugs*, *41*(1), 179-186. doi: 10.15288/jsa.1980.41.179

Jores, T., Colloff, M. F., Kloft, L., Smailes, H., & Flowe, H. D. (2019). A meta-analysis of the effects of acute alcohol intoxication on witness recall. *Applied Cognitive Psychology*. 33(3), 334-343. doi: 10.1002/acp.3533

Josephs, R. A., & Steele, C. M. (1990). The two faces of alcohol myopia: Attentional mediation of psychological stress. *Journal of Abnormal Psychology*, *99*(2), 115-126. doi: 10.1037/0021-843X.99.2.115

Kebbell, M. R., & Milne, R. (1998). Police officers' perceptions of eyewitness performance in forensic investigations. *The Journal of Social Psychology*, *138*(3), 323-330. doi: 10.1080/00224549809600384.

Kebbell, M., Milne, R., & Wagstaff, G. (1999). The Cognitive interview: A survey of its forensic effectiveness. *Psychology, Crime and Law*, 5(1-2), 101-115. doi: 10.1080/10683169908414996.

Kneller, W., & Harvey, A. J. (2016). Lineup identification accuracy: The effects of alcohol, target presence, confidence ratings, and response time. *The European Journal of Psychology Applied to Legal Context*, *8*(1), 11-18. doi:10.1016/j.ejpal.2015.09.001.

Köhnken, G., Milne, R., Memon, A., & Bull, R. (1999). The cognitive interview: A meta-analysis. *Psychology, Crime and Law*, *5*(1-2), 3-27. doi: 10.1080/10683169908414991

Köhnken, G., Thürer, C., & Zoberbier, D. (1994). The cognitive interview: Are the interviewers' memories enhanced, too? *Applied Cognitive Psychology*, *8*(1), 13-24. doi: 10.1002/acp.2350080103

Koriat, A., & Goldsmith, M. (1996a). Memory metaphors and the real-life/laboratory controversy: Correspondence versus storehouse conceptions of memory. *Behavioral and Brain Sciences*, *19*(2), 167-188. doi: 10.1017/S0140525X00042114

Koriat, A., & Goldsmith, M. (1996b). Monitoring and control processes in the strategic regulation of memory accuracy. *Psychological Review*, *103*(3), 490-517. doi: 10.1037/0033-295X.103.3.490

Koriat, A., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology*, *51*(1), 481-537. doi: 10.1146/annurev.psych.51.1.481.

La Rooy, D., Nicol, A., & Terry, P. (2013). Intoxicated eyewitnesses: the effects of alcohol on eyewitness recall across repeated interviews. *Open Journal of Medical Psychology*, *2*(3), 107-114. doi: 10.4236/ojmp.2013.23017.

Luna, K., Higham, P. A., & Martín-Luengo, B. (2011). Regulation of memory accuracy with multiple answers: The plurality option. *Journal of Experimental Psychology: Applied*, *17*(2), 148-158. doi: 10.1037/a0023276

Malpass, R. S., Tredoux, C. G., Schreiber Compo, N., McQuiston-Surrett, D., MacLin, O. H., Zimmerman, L. A., & Topp, L. D. (2008). Study space analysis for policy development. *Applied Cognitive Psychology*, *22*(6), 789-801. doi: 10.1002/acp.1483

Mantwill, M., Köhnken, G., & Aschermann, E. (1995). Effects of the cognitive interview on the recall of familiar and unfamiliar events. *Journal of Applied Psychology*, *80*(1), 68-78. doi: 10.1037/0021-9010.80.1.68.

Maras, K. L., & Bowler, D. M. (2010). The cognitive interview for eyewitnesses with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *40*(11), 1350-1360. doi: 10.1007/s10803-010-0997-8.

Mello, E. W., & Fisher, R. P. (1996). Enhancing older adult eyewitness memory with the cognitive interview. *Applied Cognitive Psychology*, *10*(5), 403-417. doi: 10.1002/ (SICI)1099-0720(199610)10:5<403::AID-ACP395>3.0.CO;2-X.

Memon, A., Meissner, C. A., & Fraser, J. (2010). The Cognitive Interview: A meta-analytic review and study space analysis of the past 25 years. *Psychology, Public Policy, and Law*, *16*(4), 340-372. doi: 10.1037/a0020518.

Memon, A., Wark, L., Holley, A., Bull, R., & Köhnken, G. (1996). Interviewer behaviour in investigative interviews. *Psychology, Crime and Law*, *3*(2), 135-155. doi: 10.1080/ 10683169608409800.

Milne, R., & Bull R. (1999). *Investigative Interviewing: Psychology and practice*. Chichester, UK: Wiley.

Milne, R., & Bull, R. (2001). Interviewing witnesses with learning disabilities for legal purposes. *British Journal of Learning Disabilities*, *29*(3), 93-97. doi: 10.1046/j.1468-3156.2001.00139.x.

Milne, R. & Bull, R. (2002). Back to basics: a componential analysis of the original cognitive interview mnemonics with three age groups. *Applied Cognitive Psychology, 16*(7), 743–753. doi: 10.1002/acp.825

Milne, R., & Bull, R. (2006). Interviewing victims of crime, including children and people with intellectual difficulties. In M.R. Kebbell & G.M. Davies (Eds.), *Practical psychology for forensic investigations and prosecutions* (pp. 7–24). Chichester, UK: John Wiley & Sons.

Milne, R., Clare, I. C., & Bull, R. (1999). Using the cognitive interview with adults with mild learning disabilities. *Psychology, Crime and Law*, *5*(1-2), 81-99. doi: 10.1080/10683169908414995.

Ministry of Justice. (2011). *Achieving best evidence in criminal proceedings: Guidance on interviewing victims and witnesses, and guidance on using special measures.* (1st ed.). London, UK: Ministry of Justice.

Mintzer, M. Z., & Griffiths, R. R. (2002). Alcohol and triazolam: Differential effects on memory, psychomotor performance and subjective ratings of effects. *Behavioural Pharmacology, 13(8)*, 653-658. doi: 10.1097/00008877-200212000-00007

Moulton, P. L., Petros, T. V., Apostal, K. J., Park, R. I., Ronning, E. A., King, B. M., & Penland, J. G. (2005). Alcohol-induced impairment and enhancement of memory: A test of the interference theory. *Physiology and Behavior, 85*(3), 240–245. doi: 10.1016/j.physbeh.2005.03.011

National Health Service. (2020). *Alcohol Units and Alcohol Support*. https://www.nhs.uk/live-well/alcohol-support/calculating-alcohol-units/

Nilsson, L. G., Bäckman, L., & Karlsson, T. (1989). Priming and cued recall in elderly, alcohol intoxicated and sleep deprived subjects: A case of functionally similar memory deficits. *Psychological Medicine*, *19*(2), 423-433. doi: 10.1017/S0033291700012460

Paivio, A., Yuille, J. C., & Madigan, S. A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology*, *76*(1), 1-25. doi: 10.1037/h0025327.

Palmer, F. T., Flowe, H. D., Takarangi, M. K., & Humphries, J. E. (2013). Intoxicated witnesses and suspects: An archival analysis of their involvement in criminal case processing. *Law and Human Behavior*, *37*(1), 54-59. doi: 10.1037/lhb0000010.

Parker, E. S., Birnbaum, I. M., & Noble, E. P. (1976). Alcohol and memory: Storage and state dependency. *Journal of Verbal Learning and Verbal Behavior, 15*(6), 691-702. doi: 10.1016/0022-5371(76)90061-X.

Paulo, R. M., Albuquerque, P. B., Saraiva, M., & Bull, R. (2015). The enhanced cognitive interview: Testing appropriateness perception, memory capacity and error estimate relation with report quality. *Applied Cognitive Psychology*, *29*(4), 536-543. doi: 10.1002/acp.3132.

Ray, S., & Bates, M. E. (2006). Acute alcohol effects on repetition priming and word recognition memory with equivalent memory cues. *Brain and Cognition, 60*(2), 118-127. doi: 10.1016/j.bandc.2005.07.009

Ray, S., Bates, M. E., & Bly, B. M. (2004). Alcohol's dissociation of implicit and explicit memory processes: Implications of a parallel distributed processing model of semantic priming. *Experimental and Clinical Psychopharmacology, 12*(2), 118-125. doi: 10.1037/1064-1297.12.2.118

Read, J. D., Yuille, J. C., & Tollestrup, P. (1992). Recollections of a robbery: Effects of arousal and alcohol upon recall and person identification. *Law and Human Behavior*, *16* (4), 425-446. doi: 10.1007/BF02352268.

Rivard, J. R., Fisher, R. P., Robertson, B., & Dana, H. M. (2014). Testing the Cognitive Interview with professional interviewers: Enhancing recall of specific details of recurring events. *Applied Cognitive Psychology, 28,* 917-925. doi: 10.1002/acp.3026

Rosenthal, R. (1976). *Experimenter Effects in Behavioural Research.* New York, NY: Appleton-Century Crofts.

Ryback, R. S. (1971). The continuum and specificity of the effects of alcohol on memory: A review. *Quarterly Journal of Studies on Alcohol, 32*(4), 991-1016.

Schreiber Compo, N., Carol, R. N., Evans, J. R., Pimentel, P., Holness, H., Nichols-Lopez, K., . . . Furton, K. G. (2017). Witness Memory and Alcohol: The Effects of State Dependent Recall. *Law and Human Behavior*, *41*(2), 202-215. doi: 10.1037/lhb0000224

Schreiber Compo, N., Evans, J. R., Carol, R. N., Kemp, D., Villalba, D., Ham, L. S., & Rose, S. (2011). Alcohol intoxication and memory for events: A snapshot of alcohol myopia in a real-world drinking scenario. *Memory*, *19* (2), 202-210. doi: 10.1080/09658211. 2010.546802.

Schuller, R.A., & Wall, A.M. (1998). The effects of defendant and complainant intoxication on mock jurors' judgements of sexual assault. *Psychology of Women Quarterly*, 22(4), 555-573.

Snook, B., Eastwood, J., Stinson, M., Tedeschini, J., & House, J. C. (2010). Reforming investigative interviewing in Canada. *Canadian Journal of Criminology and Criminal Justice*, *52*(2), 215-229. doi: 10.3138/cjccj.52.2.215.

Söderlund, H., Parker, E. S., Schwartz, B. L., & Tulving, E. (2005). Memory encoding and retrieval on the ascending and descending limbs of the blood alcohol concentration curve. *Psychopharmacology*, *182*(2), 305-317. doi: 10.1007/s00213-005-0096-2

Southwick, L. L., Steele, C. M., Marlatt, G. A., & Lindell, M. K. (1981). Alcohol-related expectancies: Defined by phase of intoxication and drinking experience. *Journal of Consulting and Clinical Psychology*, *49*(5), 713-721. doi: 10.1037/0022-006X.49.5.713

Steele, C. M., & Josephs, R. A. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist*, *45*(8), 921-933. doi: 10.1037/0003-066X.45.8.921.

Stein, L. M., & Memon, A. (2006). Testing the efficacy of the Cognitive Interview in a developing country. *Applied Cognitive Psychology*, *20* (5), 597–605. doi: 10.1002/ acp.1211.

Thorndike, E. L., & Lorge, I. (1944). *The teacher's book of 30,000 words.* New York: Teacher's College Press.

Touhig, D. A. (1998). British All-Party Committee view on alcohol and violence. *Alcohol and Alcoholism*, *33*(1), 89-91.

Tracy, J. I., & Bates, M. E. (1999). The selective effects of alcohol on automatic and effortful memory processes. *Neuropsychology*, *13*(2), 282-290. doi: 10.1037/0894-4105.13.2. 282.

Tulving, E. (1983). *Elements of Episodic Memory*, New York: Oxford University Press.

Tulving, E., & Pearlstone, Z. (1966). Availability versus accessibility of information in memory for words. *Journal of Verbal Learning and Verbal Behavior*, *5*(4), 381-391. doi: 10.1016/S0022-5371(66)80048-8.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*(5), 352-373. doi: 10.1037/h0020071.

Van Oorsouw, K., & Merckelbach, H. (2012). The effects of alcohol on crime-related memories: A field study. *Applied Cognitive Psychology*, *26(1),* 82-90. doi: 10.1002/ acp.1799.

Van Oorsouw, K., Merckelbach, H., & Smeets, T. (2015). Alcohol intoxication impairs memory and increases suggestibility for a mock crime: a field study. *Applied Cognitive Psychology*, *29*(4), 493-501. doi: 10.1002/acp.3129.

Wall, A., & Schuller, R. A. (2000). Sexual Assault and Defendant/Victim Intoxication: Jurors' Perceptions of Guilt. *Journal of Applied Social Psychology*, *30*(2), 253-274.

Weber, N., & Brewer, N. (2008). Eyewitness recall: Regulation of grain size and the role of confidence. *Journal of Experimental Psychology: Applied, 14*(1), 50-60. doi: 10.1037/1076-898X.14.1.50

Weissenborn, R., & Duka, T. (2000). State-dependent effects of alcohol on explicit memory: the role of semantic associations. *Psychopharmacology*, *149*(1), 98-106. doi: 10.1007/ s002139900349.

White, A. M. (2003). What happened? Alcohol, memory blackouts, and the brain. *Alcohol Research & Health*, *27*(2), 186-196. Retrieved from http://pubs.niaaa.nih.gov/ publications/arh27-2/186-196.pdf

Wickens, D. D. (1970). Encoding categories of words: An empirical approach to meaning. *Psychological Review*, 77(1), 1–15. doi: 10.1037/h0028569.

Wright, A. M., & Holliday, R. E. (2007). Enhancing the recall of young, young–old and old–old adults with cognitive interviews. *Applied Cognitive Psychology*, *21*(1), 19-43. doi: 10.1002/acp.1260.

Yaniv, I., & Foster, D. P. (1995). Graininess of judgment under uncertainty: An accuracy informativeness trade-off. *Journal of Experimental Psychology: General*, *124*(4), 424-432. doi: 10.1037/0096-3445.124.4.424

Yaniv, I., & Foster, D. P. (1997). Precision and accuracy of judgmental estimation. *Journal of Behavioral Decision Making*, *10*(1), 21-32. doi: 10.1002/(SICI)10990771(199703) 10:1<21:AID-BDM243>3.0.CO;2-G

Yuille, J. C., & Tollestrup, P. A. (1990). Some effects of alcohol on eyewitness memory. *Journal of Applied Psychology*, *75*(3), 268 – 273. doi: 10.1037/0021-9010.75.3.268.