# Impact of alcohol on memory: a systematic review

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# Chapter 3

Impact of Alcohol on Memory: A Systematic Review

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**Abstract**

This reviews the literature in psychology on acute alcohol intoxication and memory. Special emphasis is placed on empirical studies that have systematically examined alcohol's effects on memory performance in forensic contexts. Three aspects of memory performance are considered, including memory accuracy (i.e., the ability of the complainant to accurately distinguish between correct and incorrect information about the crime), memory reliability (i.e., the probability that information recalled by the complainant at a given level of certainty is correct), and completeness (i.e., the quantity of information reported by the complainant). The results show that different memory performance measures are differentially important depending on whether we are policy makers formulating interview guidance, versus decision makers evaluating the strength of memory evidence in a given case. Overall, the research to date indicates that acute alcohol intoxication during rape affects the completeness but not the accuracy of what is remembered.

Keywords: alcohol, memory, witness, victim, recall, investigative interviews, false memory, suggestibility

## 3.1 Searching and Reviewing the Literature

*Databases and Search Strategy*

Five online databases including PsychArticles, Pubmed, JStor, Web of Science and Google Scholar were searched to find experimental studies that systematically investigated the effect of acute alcohol intoxication on eyewitness memory and recall, narrowing the focus to studies that investigated memory recall in research participants after they were exposed to a mock criminal event. The experimental studies enabled us to look at the effect of different doses of alcohol on how people remember these events. Although the mock crimes are simulations of criminal events, the advantage of using this approach is that memory accuracy can be evaluated. In real world crimes, it is usually impossible to establish ground truth and thus, memory accuracy is not known and cannot be looked at in relation to alcohol's effects.

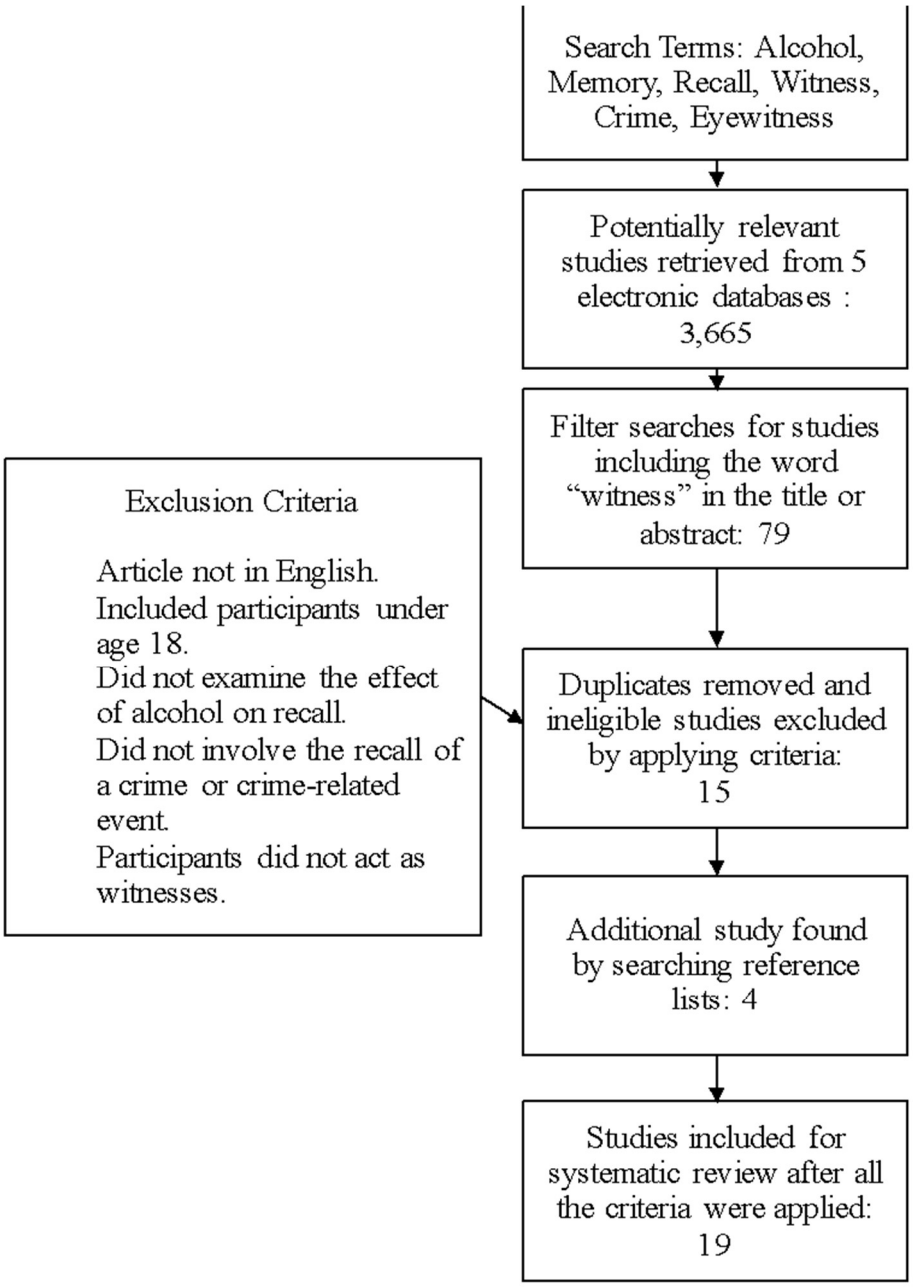
We found studies primarily by using the search terms 'alcohol' and 'recall', and filtering to find articles with the word 'witness' in the title or abstract. Additional searches were conducted using combinations of the search terms alcohol, memory, recall, crime, victim, rape, sexual assault, witness, and eyewitness. All articles published in English in peer-reviewed journals with participants over the age of 18 were considered for review.

*Study Selection*

We had a total of five exclusionary criteria (Table 3.1): First, papers published in other languages besides English were not considered to avoid potential translation errors. Second, papers using participants under the age of 18 were not considered, as their consuming alcohol would not adhere to legal drinking age requirements and this would be problematic from an ethical standpoint. Third, since few forensically relevant studies have studied the effects of other drugs on memory, we included only studies that examined alcohol. Fourth, to maintain generalizability to criminal cases, we excluded studies that were not forensically relevant. For translational purposes, we only analysed studies that portrayed either a mock crime-related event,

or a bar social interaction as the to-be-remembered material, because violent crimes, such as rape, frequently occur near drinking establishments (Block & Block, 1995). We included only those studies where participants took on the perspective of a witness or a victim. Fifth, we included only the studies that conducted research aimed at drawing conclusions about memory performance during police interviews. Some of these studies used free recall, where individuals are able to freely recall all that they can remember about an event without interruption or further instruction by the interviewer during the recall attempt. Other studies used cued-recall techniques, wherein the participants were asked specific questions about the to-be-remembered event, such as prompting the participant for information about the people, actions, and the environment in which the incident took place. Lastly, some of the studies we included used recognition tests during interviewing that required participants to respond to a specific question either in a multiple choice, or a true or false format to capture participants' memory performance.

**Figure 3.1 Study Identification**




*Study Identification and Quality Appraisal*

The search results are detailed in the flowchart shown in Figure 3.1. The initial search using 'alcohol' and 'recall' yielded 3,665 results. Then within each database, the results were filtered for titles and abstracts including the word "witness" or "victim," resulting in a total of 79 studies.

After removing duplicate results and applying the exclusion criteria, a total of 19 studies remained.

**Table 3.1 Study Methods Quality Assessment**

| | Criterion | Score Range | Mean Score |
|---|---|---|---|
| 1 | Were study participants blinded to treatment group assignment? | 0-1 | 0.31 |
| 2 | Were study providers blinded to treatment group assignment? | 0-1 | 0.71 |
| 3 | Were the people assessing the outcomes blinded to the participants' group assignments? | 0-1 | 0.67 |
| 4 | Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)? | 0-1 | 0.86 |
| 5 | Was the sample size sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power? | 0-1 | 1.00 |
| 6 | Did the researchers state that the participants randomly allocated to experimental conditions? | 0-1 | 0.81 |
| 7 | Were there no confounds that may have affected the results? | 0-1 | 0.76 |
| 8 | Were the participants intoxication levels assessed using breathealysers after alcohol consumption? | 0-1 | 0.98 |
| 9 | Were the number of alcoholic beverages given adjusted by participant weight/sex? | 0-1 | 0.86 |
| 10 | Was the sample recruited relevant to the population of interest? | 0-1 | 0.33 |
| 11 | Were the methods of recall relevant to applied situations (free/cued recall)? | 0-1.5 | 1.00 |
| 12 | Did the participants recall immediately or after a delay period? Or both? | 0-1.5 | 1.02 |
| 13 | Did the event to be recalled resemble a violent crime? | 0-1 | 0.62 |
| 14 | Were there multiple groups with different mean levels of intoxication? | 0-1 | 0.48 |
| 15 | Were there non-alcohol control and placebo groups? | 0-1 | 0.76 |
| 16 | Did participants recall details whilst in the same state as they were in during encoding? | 0-1 | 0.55 |
| 17 | Did the researchers reinstate intoxication during recall (state dependent controls)? | 0-1 | 0.10 |

Two of the authors (T.J. and H.F.), both of whom have methodological and content expertise in this research area, independently evaluated the quality of the studies. The studies were evaluated based on a total of 17 criteria (see Table 3.1). Currently, there are no quality assessment criteria

specifically designed for memory research. Therefore, we adopted quality assessment criteria from medical research. Criteria one to seven were adapted from the guidelines of the National Heart, Lung and Blood Institute (NHLBI, 2018) for assessing the quality of controlled intervention studies. These criteria resemble many other quality assessment tools for randomised control trials. However, several criteria were excluded because they were not applicable either because none of the selected studies met the criteria or because they were not relevant to memory research. Criteria 8 to 17 were added after considering the factors that can influence the internal and external validity of a memory experiment. If a study met a given criterion, it would receive one point, whereas if it partially met the criterion it was given a half a point, and if it did not meet the criteria at all, it received no points. However, there are exceptions for criteria 13 and 14, where, if a study met both conditions within each criterion, they would receive one and a half points. The criteria will be discussed below.

Criteria 1 to 7 assess whether the outcomes obtained may have been influenced by bias on the part of the participants, researchers or assessors due to knowledge of the participant's group allocation, or whether experimental outcomes may have been influenced by unforeseen or ignored variables.

Criterion 8 assesses whether researchers determined alcohol dose taking account the sex and weight of the participant, since Blood Alcohol Concentration (BAC) level can vary in relation to these factors (Mumenthaler, Taylor, O'Hara, & Yesavage, 1999), and criterion 9 assesses whether the researchers used a breathalyzer to estimate participants' BAC level.

Criteria 10 to 14 assess whether the results of the experiment are applicable to real life crime scenarios. We coded the degree to which the sample was representative of witnesses and victims

in actual cases (criterion 10). Many studies recruit student samples that may be less representative of the populations to which generalizations are intended. For example, an all-female, student sample recalling the details of a rape scenario would likely provide results that generalize to rape cases since sexual victimization is relatively more prevalent in female undergraduate samples compared to other segments of the population (Fisher, Cullen, & Turner, 2000). Moreover, field research allows researchers to gain a fuller understanding of the effects of alcohol on memory performance. Multiple studies, which will be reviewed in this chapter, have recruited participants from bars. Compared to general student samples, samples from drinking establishments may not only be comprised of individuals who are relatively more likely to witness crimes, but also who are more representative with respect to key variables associated with memory performance (e.g., age, drinking habits, general memory ability) that are likely to characterise witnesses in criminal cases. Another key consideration is that the upper limit of intoxication in the field research is considerably higher when compared to lab settings, which allows researchers to investigate whether patterns found in the laboratory hold at higher intoxication levels. Thus, whilst laboratory research is needed to determine causality (owing to experimental control over study and testing conditions, and the random assignment of participants to conditions), field research remains an important corollary to laboratory research for purposes of generalizing theory to the legal system.

The quality coding also considered the types of questioning used during interviews, as this can affect how applicable a study is to real world scenarios (criterion 11). UK police interviewers are encouraged to use open-ended rather than closed questions (College of Policing, 2018). Open-ended prompts invite the interviewee to elaborate their answer (e.g., “Tell me what happened.”), whereas closed questions prompt the interviewee to provide an answer using a limited set of options, such as yes or no (e.g. “ did he have any facial hair?”). Additionally, the timing of

participant interviews may influence the applicability of a study's results to real life scenarios (criterion 12). The timing of interviews varies in police practice. Equally, complainants are interviewed at several time points over the course of an investigation. They may answer questions and recall information to emergency phone operators, first responders, and to police officers who initially respond to the call. Thereafter, there might be subsequent interviews, a formal interview(s), and questioning at trial. Therefore, research that has considered the effects of immediate and delayed interviews, as well as repeated interviews on memory performance, and these types of studies may yield findings that are most relevant to the cases in the legal system (see Flowe, Carline, & Karoğolu, 2018). Lastly, the type of material that participants encode is particularly relevant when considering how acute alcohol intoxication may impact the performance of witnesses and victims in actual cases. Witnesses and victims are most likely to be under the influence of alcohol during crimes that are violent when compared to other types of crime categories (UK Crimestats, 2018). Thus, we coded the degree to which the to-be-remembered event context corresponded to the context of violent crime (criterion 13).

Criteria 14-17 consider whether the results of the study could be explained by other factors that were not controlled in the study. For example, the use of multiple alcohol intoxication levels, and multiple control groups, such as alcohol placebo and no beverage control groups, in which no beverage is consumed, can allow for a greater understanding of the physiological effects of alcohol and alcohol expectancies on encoding and memory (criteria 14 and 15). As will be discussed in this chapter, memory performance is affected not only by the dose of alcohol consumed, but also by alcohol expectancies, which are the effects of alcohol on memory that people anticipate (e.g., Schreiber Compo et al., 2016; Gawrylowicz, Scoboria, Teodorini, & Albery 2018). Two further criteria (16 and 17) looked at whether the study took into account state-dependent memory effects. Memory performance can be affected by intoxication state

during encoding (i.e., when the memory is acquired), as well as by intoxication state during recall (i.e., when the memory is retrieved). This is important to consider because a rape complainants' intoxication state may vary from the time of the attack to the time of the police interview. Further, as will be discussed below, memory performance can be aided by being in the same state during memory retrieval as when the memory was encoded, a phenomenon known as state dependent learning. Therefore, studies that controlled for state at learning and at test were rated as higher in quality (criterion 16). Some research has found that recalling in a different state leads to poorer recall performance (Crow & Ball, 1975; Weingartner, Adefris, Eich, & Murphy, 1976; Weingartner & Faillace, 1971; see Schreiber Compo et al., 2016 for a discussion). Therefore, we also looked at whether the studies used state-dependent controls (criterion 17). Here, participants are tested in the same state or in a different state (sober or intoxicated) as when they encoded the crime. This is important because it enables one to study the effects of natural forgetting on memory performance as a function of alcohol intoxication at encoding, while controlling for differences in state at learning and test. Studies that were able to do so were rated higher in quality.

Table 3.1 presents the results of the quality assessment for each criterion. The criterion on which studies scored the highest was 13 (testing delay). This reveals that, with respect to delay, researchers as a whole were striving to reflect the conditions that real world witnesses experience (see Flowe et al.,2018). The criterion on which participants scored the lowest was 17 (state dependency). This reveals that most researchers do not manipulate state at test, perhaps owing to resource constraints or the research having been conducted in the field with self-intoxicating participants. The overall quality score ranged across studies from 8 to 13.5, with the mean being 11.69 (*SD* =2.11) out of a possible 18 points, which yields an average mark of 65% (11.69/18), indicating the quality of the studies as a group was good overall.

## 3.2 Results: Findings and Theoretical Perspectives

*Study Characteristics*

The methodological characteristics for each study were extracted and are presented in **Table 3.2**. Characteristics, including the research design, sample size, interview type, and participant intoxication level were recorded.

The studies included were published from 1990 to 2019. As can be seen in **Table 3.2**, most studies recruited student samples for experimentation in lab conditions. Across studies, the mean age of participants ranged from 19.50 to 28.58 and the sample size ranged from 54 to 249 people. Most of the studies employed mock-crime videos as the to-be-remembered material. The studies were diverse with respect to whether they employed placebo or non-alcohol beverage groups as control conditions, and testing procedures (written versus verbal; types of questions asked, whether participants were tested after a delay and repeatedly).

Table 3.2

| Study | Year | N | Participants | Mean Age (SD) | Setting | Non-alcohol Group | Alcohol Groups | Mean BAC |
|---|---|---|---|---|---|---|---|---|
| Yuille & Tollestrup | 1990 | 120 | Students | 21.20 (N/A) | Lab | Control | 1 | 0.08 |
| Schreiber Compo et al. | 2011 | 94 | Students | 24.00 (N/A) | Lab | Control & Placebo | 1 | 0.08 |
| Schreiber Compo et al. | 2012 | 93 | Students | 24.00 (4.60) | Lab | Control & Placebo | 1 | 0.07 |
| Van Oorsouw & Merckelbach | 2012 | 76 | Bar patrons | 21.00 (2.25) | Field | Control | 2 | 0.06, 0.16 |
| Hagsand et al. | 2013 | 126 | Staff/Students | 26.00 (3.26) | Lab | Control | 2 | 0.04, 0.06 |
| Harvey et al. Study 1 | 2013 | 106 | Students | 20.17 (4.40) | Lab | Control | 1 | 0.06 |
| Harvey et al. Study 2 | 2013 | 120 | Students | 19.70 (2.74) | Lab | Control | 1 | 0.11 |
| La Rooy, Nicol, & Terry | 2013 | 58 | Students | 21.50 (2.20) | Lab | Placebo | 2 | 0.02, .07 |
| Flowe et al. | 2015 | 88 | Students | 20.42 (2.27) | Lab | Placebo | 2 | 0.05, 0.08 |
| Hildebrand Karlén et al. | 2015 | 87 | Students | 19-32 | Lab | Control | 1 | 0.07/0.08 |
| Crossland, Kneller & Wilcock Study 1 | 2016 | 88 | Students | 20.92 (6.22) | Lab | Control & Placebo | 2 | .06, 0.09 |
| Crossland, Kneller & Wilcock Study 2 | 2016 | 54 | Students | 19.50 (1.27) | Field | None | 2 | 0.05, 0.14 |
| Schreiber Compo et al. | 2016 | 249 | Students | 24.36 (4.53) | Lab | Control & Placebo | 1 | 0.08 |
| Gawrylowicz et al. | 2017 | 83 | Staff/Students | 27.38 (9.45) | Lab | Control & Reverse Placebo | 1 | 0.065 |
| Hagsand et al. | 2017 | 99 | Staff/Students | 24.76 (4.19) | Lab | Control | 1 | 0.05 |
| Hildebrand Karlén et al. | 2017 | 136 | Students | 24.76 (4.19) | Lab | Control | 2 | 0.07, 0.10 |
| Altman et al. | 2018 | 138 | Bar patrons | 27.67 (7.91) | Field | Control | 1 | 0.08 |
| Evans et al. | 2019 | 210 | Students | 24.00 (5.00) | Lab | Control & Placebo | 1 | 0.08 |
| Flowe et al. | 2019 | 80 | Students | 20.36 (2.41) | Lab | Control & Placebo | 1 | 0.06 |
| Gawrylowicz et al. | 2019 | 129 | Students | 28.58 (10.09) | Lab | Control & Placebo | 1 | 0.06 |
| Van Oorsouw et al. Study 1 | 2019 | 86 | Bar patrons | 22.90 (5.11) | Bar | None | continous measure | 0.06 |
| Van Oorsouw et al. Study 2 | 2019 | 191 | Bar patrons | 26.46 (6.84) | Bar | None | continous measure | 0.05 |

Table 3.2

| Study | Year | BAC Range | Stimulus Type | Event Type | Interview | Question Type |
|---|---|---|---|---|---|---|
| Yuille & Tollestrup | 1990 | .06-0.12 | Live-staged crime | Theft | Verbal | Free & cued |
| Schreiber Compo et al. | 2011 | N/A | Interaction | Bar interaction | Written | Free |
| Schreiber Compo et al. | 2012 | .04-0.13 | Live-staged crime | Theft | Verbal | Free, cued or mixed |
| Van Oorsouw & Merckelbach | 2012 | .00-.24 | Mock-crime video | House robbery | Written | Free & cued |
| Hagsand et al. | 2013 | N/A | Mock-crime video | Kidnapping | Verbal | Free |
| Harvey et al. Study 1 | 2013 | .00-0.10 | Photos | Riot | Verbal | Free |
| Harvey et al. Study 2 | 2013 | .05-.16 | Photo Slideshow | Theft | Written | Recognition |
| La Rooy, Nicol, & Terry | 2013 | .00-.07 | Mock-crime video | Armed robbery | Written | Free |
| Flowe et al. | 2015 | N/A | Interactive narrative | Rape | Written | Recognition |
| Hildebrand Karlén et al. | 2015 | .04-0.10 | Mock-crime video | Inter partner violence | Verbal | Free |
| Crossland, Kneller & Wilcock Study 1 | 2016 | .03-0.11 | Mock-crime video | Burglary | Written | Free & recognition |
| Crossland, Kneller & Wilcock Study 2 | 2016 | .00-.23 | Mock-crime video | Burglary | Written and verbal | Free & recognition |
| Schreiber Compo et al. | 2016 | .00-.12 | Mock-crime video | Theft | Written | Free & cued |
| Gawrylowicz et al. | 2017 | .03-.11 | Mock-crime video | Burglary | Written | Cued |
| Hagsand et al. | 2017 | .00-.07 | Mock-crime video | Kidnapping | Verbal | Free & cued |
| Hildebrand Karlén et al. | 2017 | .04-0.15 | Mock-crime video | Inter partner violence | Verbal | Free |
| Altman et al. | 2018 | .00-0.29 | Mock-crime video | Armed robbery | Verbal | Free & cued |
| Evans et al. | 2019 | .06-.08 | Mock-crime video | Theft | Written | Free & cued |
| Flowe et al. | 2019 | .04-.09 | Interactive narrative | Rape | Written and verbal | Free & recognition |
| Gawrylowicz et al. | 2019 | CI .95: .05-.07 | Mock-crime video | Drink spiking, suggested sexual assault | Written | Free & cued |
| Van Oorsouw et al. Study 1 | 2019 | .00-.14 | Social interaction | Noncriminal | Written | Free & cued |
| Van Oorsouw et al. Study 2 | 2019 | .00-.20 | Social interaction | Noncriminal | Written | Free & cued |

Table 3.2

| Study | Year | Immediate Testing | Delayed Testing | Immediate and Delayed Tesing |
|---|---|---|---|---|
| Yuille & Tollestrup | 1990 | 30 mins | 1 week | Yes |
| Schreiber Compo et al. | 2011 | 1-2 mins | N/A | N/A |
| Schreiber Compo et al. | 2012 | 20 mins | N/A | N/A |
| Van Oorsouw & Merckelbach | 2012 | N/A | 3-5 days | N/A |
| Hagsand et al. | 2013 | N/A | 1 week | N/A |
| Harvey et al. Study 1 | 2013 | N/A | 1 day | N/A |
| Harvey et al. Study 2 | 2013 | N/A | 1 day | N/A |
| La Rooy, Nicol, & Terry | 2013 | 30 mins | 1 day | Yes |
| Flowe et al. | 2015 | N/A | 1 day and 4 months | N/A |
| Hildebrand Karlén et al. | 2015 | Yes | N/A | N/A |
| Crossland, Kneller & Wilcock Study 1 | 2016 | N/A | 1 week | N/A |
| Crossland, Kneller & Wilcock Study 2 | 2016 | N/A | 2 weeks | N/A |
| Schreiber Compo et al. | 2016 | 10 mins | 1 week | N/A |
| Gawrylowicz et al. | 2017 | N/A | 1 day | N/A |
| Hagsand et al. | 2017 | 15 mins | 1 week | Yes |
| Hildebrand Karlén et al. | 2017 | 10 mins | 1 week | Yes |
| Altman et al. | 2018 | Yes | N/A | N/A |
| Evans et al. | 2019 | Yes | 1 week | No |
| Flowe et al. | 2019 | N/A | 1 week | N/A |
| Gawrylowicz et al. | 2019 | 30 mins | N/A | N/A |
| Van Oorsouw et al. Study 1 | 2019 | Yes | 2-14 days | Yes |
| Van Oorsouw et al. Study 2 | 2019 | Yes | 4-23 days | Yes |

*Alcohol Dose*

Most studies were conducted in the lab with students and the researchers employed alcohol-dosing procedures that considered the participant's weight and sex, leading to a BAC that ranged from .05%-.10% for the group of participants receiving the highest dose of alcohol in the study (see Table 3.2). To put these levels into perspective, the legal blood alcohol limit is .05% or lower in most countries, although, in the UK and the US, the legal limit is .08%. A handful of field studies (Altman, Schreiber Compo, McQuiston, Hagsand, & Cervera, 2018; Crossland, Kneller, & Wilcock, 2016 (Study 2); van Oorsouw & Merckelbach, 2012), recruited members of the public who were self-intoxicating from pubs and bars who had mean BAC levels ranging from 0.20% to 0.29% (see Table 3.2). As discussed below, the studies conducted in the laboratory and the field report similar findings despite their differences in methodology and BAC levels.

## 3.3 Theoretical Perspectives

Across the papers included in the systematic review, four broad theoretical perspectives were adopted by researchers regarding the effects of alcohol on memory performance, including: alcohol myopia theory, alcohol expectancy effects, memory consolidation disruption, and the quantity-accuracy tradeoff. We will now discuss each of these in turn.

*Alcohol myopia theory*. Alcohol myopia theory (AMT) is an attention allocation model positing that alcohol impairs perception and thought processes by restricting an inebriated person's focus of attention to aspects of events that are the most salient to them (Steele & Josephs, 1990). The model was first applied to understand why people sometimes engage in risky behaviors, such as unprotected sex (MacDonald, Zanna, & Fong, 1996), gambling (Steele & Southwick, 1985), and sexual aggression (e.g., Flowe, Stewart, Sleath, & Palmer,

2011; Marx, Gross, & Juergens, 1997). The AMT framework has also been applied to make predictions about the effects of acute alcohol intoxication on cognition and memory. Results are mixed across these studies, as we will describe next.

Schreiber Compo and colleagues (2011) tested participants' memory recall for an interactive event that took place in a bar lab. They found that intoxicated (BAC = .08%) compared to sober participants accurately recalled a similar number of central details, but fewer correct peripheral details. In contrast, Crossland et al. (2016) had participants watch a video of a staged theft and found that while participants recalled fewer peripheral details compared to central details, alcohol consumption (average BAC = 0.06-0.09%) did not moderate this effect. In another study, Harvey, Kneller, and Campbell (2013) recorded participants' eye movements while they processed emotional scenes and found that participants who were intoxicated (BAC = 0.08%) as opposed to sober during the task were more likely to fixate on the central aspects of the visual scene. Participants returned to the lab 24 hours later and recalled the visual scene when they were sober. Contrary to predictions based on AMT, participants who had viewed the scene while intoxicated were no more likely to recall central information than sober controls.

The AMT framework has also been applied to investigate how victims remember rape. AMT predicts that a victim will focus more on central aspects of a rape scenario, such as the perpetrator, compared to peripheral aspects (e.g., bystanders, features of the surrounding environment). Consequently, rape victims who were acutely intoxicated during the attack will have primarily focused their attention on the perpetrator, and therefore, will better remember information about him than other aspects of the crime. Flowe and colleagues (2016) tested this prediction in sober and intoxicated participants (BAC = .04% and .08%), presenting them

with an interactive hypothetical rape scenario (Flowe, Takarangi, Humphries, & Wright, 2016). They found that participants better remembered information about the perpetrator compared to more peripheral scenario details 24 hours and 4 months later. Contrary to predictions derived from AMT, however, these results held regardless of whether participants were sober or intoxicated during encoding. One possible explanation for these results is that sober and alcohol-intoxicated participants alike mainly focus their attention on the perpetrator because he is emotionally salient (Takarangi, Flowe, & Humphries, 2014). Further, when remembering the scenario, participants may have thought about the perpetrator and his actions compared to peripheral details, which may have reinforced their memory for him (see Christianson & Loftus, 1987).

*Expectancy effects*. People naturally expect alcohol to have adverse effects on memory and they may engage in compensatory behavior to compensate for these anticipated effects. For instance, in scenarios associated with a heightened risk for sexual assault (e.g., drinking establishments, dating scenarios), women appear to be especially hypervigilant when they have consumed alcohol (Testa et al., 2006). According to the *hypervigilance hypothesis*, when women have been drinking alcohol, they increase their attention to risk factors in the environment. The idea is that increased attention serves to offset women's heightened vulnerability to rape induced by alcohol intoxication. In line with this, women more accurately remembered details about a rape scenario if they merely thought that they were under the influence of alcohol (Flowe et al., 2016; c.f. Gawrylowicz et al., 2019). It appeared that women who were led to think they had consumed alcohol paid greater attention to the scenario than their counterparts, thus remembering it better. Further, a study employing a drink spiking scenario that implied sexual assault, found cue-recall (but not free recall accuracy) was lower for participants who consumed alcohol but did not expect to do so,

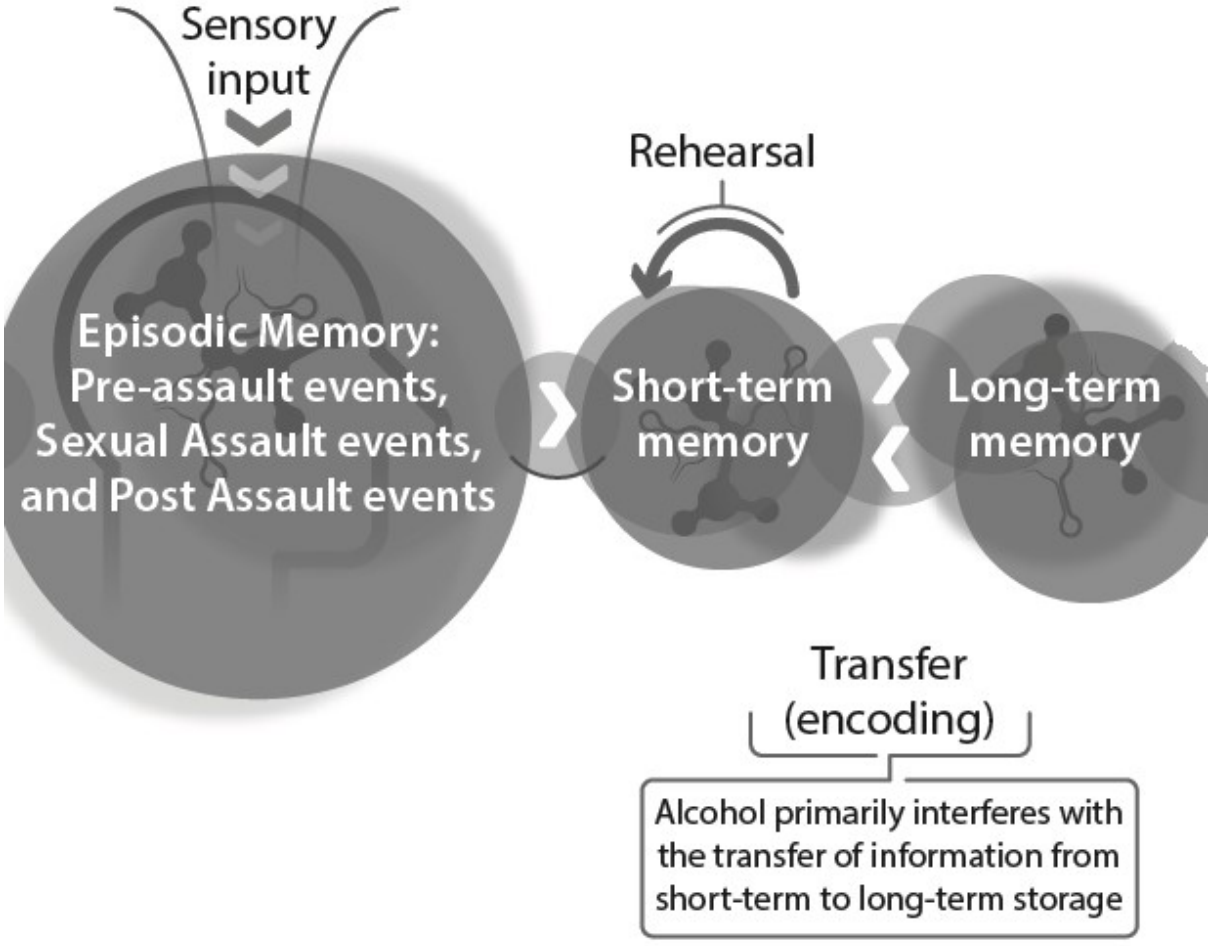
whereas performance for participants who consumed alcohol and had expected to do so did not differ compared to control and placebo participants (Gawrylowicz et al., 2019).

Researchers have also assessed the effect of alcohol expectancies on people's willingness to report their memories. People who had consumed an alcohol placebo can be more likely than control participants to say 'I don't know' when they recall details about an event, as reported in an experiment conducted by Schreiber Compo and colleagues (2012). These results provide evidence that witnesses to events who believe they have consumed alcohol are more cautious when they are later asked what they remember about the criminal event (c.f., Altman et al., 2018). However, findings from similar studies have been mixed. Gawrylowicz et al. (2018) found no expectancy related effects under free recall conditions. Basic memory studies, which were not included in the systematic review because they did not employ crime scenarios as the to-be-remembered material, have also found that participants are more cautious when providing answers on a memory test if they had consumed alcohol before learning (Curran & Hildebrandt, 1999; Maylor, Rabbitt, & Kingstone, 1987; Mintzer & Griffiths, 2001, 2002; Söderlund, Parker, Schwartz, & Tulving, 2005). However, more research is needed to better understand the conditions in which alcohol expectancies are likely to affect remembering, especially given that alcohol expectancy effects may vary depending on test format (see Eich, 1980).

*Memory consolidation disruption*. The effects of alcohol on memory are most pronounced for the transfer of information from short-term to long-term memory (see Figure 3.2). The modal memory model (Atkinson & Shiffrin, 1968) is a structural model of memory. Information is detected by a person's sense organs (e.g., eyes, ears, touch sensors), and if the person allocates attention to the information, it will enter short term memory (also called working memory). If the person consolidates (i.e., repeats, elaborates) the information, then it

will be stored as a long-term memory. The information can then be retrieved and brought back to short term memory and told (i.e., recalled) to other people. A sexual assault, and the events surrounding it, may become an episodic memory or event memory, which is consolidated into a long-term memory.

**Figure 3.2 Modal Model of Memory**




In the basic memory literature, which was not included in the review because the researchers in these studies do not use forensically relevant materials, alcohol has been found to disrupt processing in regions of the brain (e.g., the hippocampus and amygdala) that consolidate newly learned information into long-term memory (Goodwin, Othmer, Halikas, & Freemon, 1970; White, 2003; White & Best, 2002). Here, two different types of blackout,

en bloc blackout and fragmentary blackout, can emerge (Goodwin, Crane, & Guze, 1969a). With an en bloc blackout, a person will have no memory and not be able to recall anything about the events that took place during a stretch of time. Sensory and short-term memory are preserved during an en bloc blackout. Fragmentary blackouts are more common than en bloc blackouts (e.g., White, Signer, Kraus, & Swartzwelder, 2004). Memory loss in a fragmentary blackout is less complete and information from memory can be cued at test and successfully recalled in part (Goodwin, Crane, & Gaze,1996b). Blackouts are more likely when BAC levels increase sharply, although not everyone will experience a blackout following a rapid rise in BAC level (Ryback, 1970). In basic memory studies, BACs range from .14 -.28 on average during a blackout, and blackouts can last from several hours to as long as three days (Goodwin et al., 1970; Ryback, 1970). Women are more likely to experience a blackout and alcohol-related memory impairments than men, owing to sex differences in physiology (Mumenthaler, et al., 1999; Rose & Grant, 2010). While alcohol blackout was thought initially to be an indication of progressive alcoholism, this is no longer the case (White, et al., 2004).

In keeping with the consolidation theoretical account, the studies included in the current systematic review, though methodologically varied, found that people remember less information about an event if they witnessed it while under the influence of alcohol. Most studies found that participants who were alcohol intoxicated reported fewer correct details if they were still intoxicated when tested (Altman, et al., 2018; Gawrylowicz et al., 2018; Gawrylowicz et al., 2019; Hildebrand Karlén, Roos Af Hjelmsäter, Fahlke, Granhag, & Söderpalm-Gordh, 2017; Yuille & Tollestrup, 1990) or if they were tested after they became sober (Flowe et al., 2016; Flowe et al., 2019; Hagsand, Roosaf-Hjelmsäter, Granhag, Fahlke, & Söderpalm Gordh, 2013; Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm

Gordh, 2017; Hildebrand Karlén et al.,2017; Schreiber Compo et al., 2016; van Oorsouw & Merckelbach, 2012; Yuille & Tollestrup, 1990). However, with two exceptions, every study in the literature, that did not try to deliberately mislead participants about what they saw (see below for a review of alcohol and suggestibility research), has found that the number of incorrectly remembered details does not significantly vary in relation to alcohol intoxication during the crime. The two exceptions are papers by Yuille and Tollestrup (1990), who found in their laboratory study that participants who had consumed alcohol were 91% accurate whereas those who did not were 93% accurate with regard to their recall accuracy. Altman and colleagues (2018) found in their field study with self-intoxicating participants that, while the number of free recall errors did not differ depending on alcohol intoxication level, participants who were the most intoxicated made a larger number of cued recall errors compared to participants who had lower levels alcohol in their system.

A recent meta-analysis of the literature on eyewitness memory recall and alcohol is consistent with the overarching observations noted above. The analysis found that across studies, increasing levels of acute alcohol intoxication is associated with a significant decrease in the number of correct details recalled about a crime. However, increasing the level of intoxication does not affect the number of incorrect details recalled, and individuals who were intoxicated compared to sober during encoding do not report more incorrect details (Jores, Colloff, Kloft, Smailes, & Flowe, 2019). Thus, looking across the body of literature as a whole, while participants who were intoxicated during encoding recall less information compared to their sober counterparts, the majority of studies find that alcohol intoxication during a crime does not lead to participants to report a higher number of incorrect details.

Why does alcohol tend to not affect the accuracy of information remembered about a crime? One explanation has to do with the type of information participants are being asked to remember. Staged crime studies are concerned with episodic memory (i.e., memory for a crime), whereas basic memory studies test verbal learning (e.g., memory for lists of words). Memory for an episodic event may be particularly strong compared to other types of information due to increased attention and rehearsal, which may help to compensate for the adverse effects of alcohol on memory (Schreiber Compo et al., 2012). A second reason accuracy may be higher for episodic memory studies compared to other types of memory studies is that participants employ different cognitive strategies, such as reducing the quantity of information that they report in order to maintain accuracy, a theoretical explanation we will consider next.

*Quantity-Accuracy Tradeoff*. Participants in staged crime experiments are tested in a manner that allows them to use strategic processes. Participants are asked open-ended questions, allowing them to decide whether to withhold or report information that they hold in memory about the event. These testing procedures are used to mirror the way in which complainants and witnesses typically recall events when they are questioned by criminal investigators. In basic memory experiments, which tend to report a negative effect of alcohol on memory, participants are tested systematically about all of the information that was presented during the learning phase. They are not typically given the option to indicate that they do not know an answer (i.e., report "I don't remember") to a given question or allowed to omit answering questions. Instead, participants in basic memory studies are required to provide an answer to every test question that they are asked.

Why does allowing people the option to volunteer or withhold information result in a higher accuracy rate? One idea is that people strategically engage in a *quantity-accuracy tradeoff* when they recall events (Koriat & Goldsmith, 1996). When people report their memories, such as during a police interview, they evaluate the subjective likelihood that the information they hold in memory is accurate using confidence as the criterion. Confidence is thought to be an indicator of memory strength, and is a widely used measure in memory research. When memory for a given detail is weak, people withhold reporting the information because their level of confidence indicates that there is a low probability of the information being accurate. There is research showing that people trade-off the amount of information that they report in order to maintain the accuracy of recall, as will be discussed next.

Individuals who were sober while they encoded a mock crime have been shown to monitor and control their subsequent memory reports about the event in this manner, trading off the quantity of information reported for increased accuracy (e.g., Weber & Brewer, 2008). Concerning events that are encoded under the influence of alcohol, the pattern of findings suggests that intoxicated participants are similarly able to regulate the accuracy of their memory reports, unless memory for non-occurrence is tested.

To date, two mock crime studies e have tested the quantity-accuracy trade-off in highly inebriated participants. Van Oorsouw and colleagues (2015) recruited self-intoxicating participants from a drinking establishment and asked them to engage in a mock theft of an office located at the premises. Participants in the high dose group had an average BAC of 0.17%, whereas those in the moderate dose group had a BAC of 0.06% on average (van Oorsouw, Merckelbach, & Smeets, 2015). Control participants who had not consumed any alcohol were also included in the study. Immediately after the ‘crime,' and thus, while still

inebriated, participants were asked to recall the theft. About two-thirds of these participants returned for another interview 3-5 days later. Results indicated that, while intoxicated participants recalled fewer correct details about the theft, the number of recall errors they made did not differ compared to sober participants, regardless of whether they were interviewed immediately or 3-5 days later. These results suggest that intoxicated compared to sober participants had adopted a more conservative report criterion, and therefore reported less information overall than their sober counterparts. Applying signal detection theory to memory, assuming that participants are not biased to guess answers, when the report criterion shifts to a more conservative level this affects correct recall (i.e., the hit rate) more so than incorrect recall (i.e., the false alarm rate) (see Macmillan & Creelman, 1991). Consequently, we would expect the pattern of results found by van Oorsouw and colleagues (2015), with a reduction in the reporting of correct, but not incorrect, details if intoxicated participants adopt a more conservative criterion than sober participants to avoid making memory report errors.

In another study, Altman and colleagues (2018) recruited research participants who were self-intoxicating at a drinking establishment. Participants who were highly intoxicated (BAC = 0.131% and over), moderately intoxicated (BAC = 0.08-.13%) and under the legal limit (BAC < 0.08%) watched a video of a robbery and then were immediately tested using open-ended and cued recall questions. Results from the study indicate that, in line with other research, highly intoxicated participants had an increased tendency to report 'I don't know' compared to the other groups, resulting in their reporting a reduced amount of information about the crime. Further, the average accuracy of the information recalled was found to significantly differ by intoxication group. Highly intoxicated participants averaged 70% accuracy, whereas those in the moderate and sober conditions averaged 83% and 85% accuracy, respectively. Further, on average, 22% of the information recalled was inaccurate

for highly intoxicated participants compared to 13% and 12% for moderately intoxicated and sober participants, respectively. Therefore, while those in the highly-intoxicated group were attempting to monitor the accuracy of their memory recall by withholding information, preliminary results suggest they made more memory errors compared to the other groups. However, inebriated participants were intoxicated during learning and testing. Hence, it is unknown whether recall accuracy would have differed across alcohol groups had participants been tested sober. Participants in the highly-intoxicated group may have been better able to strategically regulate their memory reporting and withhold inaccurate responses if they had been tested sober.

Compared to the above studies which suggest intoxicated participants adopt a more conservative memory report criterion, Gawrylowicz et al. (2018) *directly* tested how alcohol impacts the quantity-accuracy tradeoff. They asked participants to answer a series of answerable and unanswerable cued-recall questions twice. During the first set of questions, participants were not allowed to opt out of responding. This allowed the researchers to measure what information participants held and could access in memory. During the second set of questions, participants were permitted to answer 'I don't know', thereby allowing participants' metacognitive control processes to influence their output. For answerable questions, accuracy increased when 'I don't know' responses were allowed, regardless of intoxication level. However, for unanswerable questions (questions about non-occurrences) alcohol reduced the number of 'I don't know' replies, resulting in more erroneous responses. It could be argued that people who are still intoxicated at test, exhibit difficulties with metacognitive regulation when responding to unanswerable cued-recall questions. Intoxicated participants may adopt a more liberal response criterion at test when answering questions relating to non-occurrences, or be less able to accurately evaluate the lack of a retrieved

mental image. This is in line with research by Mazzoni and Kirsch (2002), who argue memory for occurrence and nonoccurrence involve different metacognitive strategies. According to their metacognitive model, individuals use different strategies to determine whether an event occurred or did not occur. That is, people first search for a memory of the event. If they recollect a memory then they may conclude that the event happened. This conclusion is based on metacognitive beliefs about characteristics that real memories should hold, for example, memories are richer, more vivid, and more detailed than fantasies or dreams. If the retrieved mental image fulfills these autobiographical beliefs it will be evaluated as a real memory, if it does not it might be evaluated as a false memory. When it comes to remembering non-occurrences, different metacognitive strategies are utilized to determine whether not retrieving a mental image is actually diagnostic for the event not having occurred at all. Rather than evaluating the qualities of the retrieved mental image, the likelihood of the non-occurrence is judged according to a set of inferential beliefs – how common is the event in question, how plausible is it that the event has happened, are there any other signs or traces that the event has actually occurred? Thus, a different set of metacognitive strategies is employed when answering unanswerable questions, because they relate to non-occurrences. Could it be that the consumption of alcohol affects those two sets of metacognitive strategies in different ways? Research examining the effects of alcohol intoxication on metacognition is still in its infancy and more studies are required to disentangle the physical as well as the expectancy effects of alcohol on autobiographical memory and metacognition.

### 3.4 Alcohol and Memory Retrieval

A key question for criminal investigators is whether intoxicated complainants should be interviewed whilst they are under the influence of alcohol. Investigators may delay the

interview until the witness is sober due to concerns about the accuracy and reliability of the testimony. As will be discussed in the next chapter, in England, Wales, and Australia, as examples, a complainant may provide an initial (brief) account to the officer who first responds to the report. Subsequently, after a delay, the police will conduct a video recorded formal interview with the complainant. Therefore, studies comparing the form of forgetting in individuals who were alcohol intoxicated compared to sober during encoding is of considerable interest in legal contexts.

Compared to a sober witness, an intoxicated witness could be less likely to say when they do not know information or they may be less willing to correct an interviewer who is mistaken about case facts. Further, strategic memory processes may be impaired when a person is intoxicated, with intoxicated witnesses being less likely to withhold incorrect responses, or perhaps accurately evaluate the likely accuracy of their memory. On the other hand, concerns about delayed interviewing and forgetting may prompt an investigator to interview a witness as soon as possible following a crime, even if the witness is still intoxicated. Increasing the delay, or the retention interval, between learning and test results in less accurate recall, and interviewing people right after an event can help to reduce forgetting (e.g., Brainerd & Ornstein, 1991) and, potentially, the contaminating influences of misinformation encountered after the event (e.g.,, Gabbert, Hope, Carter, Boon, & Fisher, 2015). Investigators may also be concerned that witnesses who are interviewed following a relatively long delay may provide less information and detail that lack specificity. Perhaps most important, public safety concerns, including whether the witnesses or others need safeguarding, may motivate investigators to interview witnesses to gather information about the perpetrator as soon as possible, even if the witnesses are intoxicated.

A small but growing number of studies in recent years have examined the effects of repeated interviewing and alcohol intoxication on recall accuracy. Hildebrand Karlén and colleagues (2017) randomly assigned participants to either consume alcohol (average BAC = .06 or .10%) or juice, and then had them watch a video depicting interpersonal violence. Half of the participants were interviewed immediately and then a week later, whereas the other half were interviewed only once, a week later. The interview consisted of asking participants to freely recall the event until they could no longer remember any further information. People who were intoxicated during encoding provided fewer details about the event than their sober counterparts. However, the information that participants in the highest intoxication group gave was not less accurate compared to participants in the other groups. Importantly, on the initial interview, participants who were interviewed immediately after the crime gave more complete and more accurate reports than those who had their initial interview delayed for a week. Further, those who were interviewed immediately and again a week later gave more complete and more accurate accounts compared to those who were interviewed for the first time a week later, regardless of whether and how much alcohol participants had consumed. These results support the contention that an initial account could be obtained from a complainant as soon as possible, even if the complainant is still intoxicated.

In another study, Hagsand and colleagues (2017) randomly assigned participants to consume alcohol (average BAC = 0.05%) or juice and then asked them to watch a video of a kidnapping. After a delay of 15 minutes, half of the participants were given a live interview consisting of a free recall followed by cued recall, and then returned a week later for another interview. The other participants were interviewed only once, a week later. Results indicated that sober participants recalled more information, but the accuracy of the information recalled did not differ depending on whether participants had consumed alcohol or not. Importantly,

two recalls a week apart resulted in 30% more information being recalled compared to participants who were interviewed only once. These results held regardless of whether participants had consumed alcohol (also see Schreiber Compo et al., 2016). Further, participants were more accurate when they were tested immediately after the event as opposed to a week later. These latter results are also in keeping with van Oorsauw et al.'s (2015) work on repeated interviewing with highly intoxicated participants, which we reviewed earlier. Thus, taken together, the research conducted to date indicates that an initial account should be taken even if the complainant is still intoxicated.

In a more recent study, Schreiber Compo et al. (2016) investigated the effect of intoxication and state-dependent recall on memory for a theft mock-crime video. Student participants were recruited and allocated to a control, placebo or intoxication group (mean BAC= .08), then they witnessed a live staged theft. Some participants were then interviewed immediately, in the same state they had been during encoding. Some participants, however, were interviewed one week later. The researchers ensured that half of the delayed recall sample would be interviewed in the same state they were in during encoding and the other half would be interviewed in a different state. The participants wrote their answers to a free recall question asking them to report all that they could remember and several cued recall questions. The researchers discovered that, during immediate recall, alcohol had no significant effect on the completeness of free recall or the accuracy of free and cued recall. Intoxication did not significantly reduce the accuracy or completeness of free or cued recall after a delay period. Moreover, when examining state-dependent recall, intoxication during encoding did not significantly reduce the accuracy of cued recall or the completeness of free recall. Additionally, intoxication during retrieval did not significantly reduce the accuracy of free recall.

Some further considerations arise in considering the advantages and disadvantages of interviewing a complainant who was intoxicated during the attack. One issue arising with witnesses and complainants who are repeatedly interviewed, is whether new information reported during a subsequent interview will be inaccurate, particularly if the complainant was intoxicated during the crime. Studies using crime scenarios have been conducted to investigate this issue. These studies found that the accuracy of the new information recalled did not differ compared to the information that was recalled during the initial interview (Flowe et al., 2017; Hagsand et al., 2017; La Rooy, Nicol, & Terry, 2013). The consistency of information reported by the complainant is another concern often raised by sexual assault investigators (Cole & Logan, 2010). The crime studies that conducted to date, however, have not found evidence that intoxicated compared to sober participants provide more inconsistent responses when tested repeatedly (Flowe et al., 2016; Hagsand et al., 2017; La Rooy et al., 2013; van Oorsouw et al., 2015).

Considering the research as a whole, non-suggestive repeated interviews that ask open-ended questions have clear advantages, including hypermnesia (i.e., increases in recall across interviews) and reminiscence (i.e., the recovery of new information). However, care must be taken to ensure that the interviewee is not exposed to misleding information during the interview (e.g., La Rooy, Katz, Malloy, & Lamb, 2010), a topic to which we will now turn.

### 3.5 Alcohol and Memory Suggestibility

A topic often raised in legal investigations is whether alcohol intoxication increases the susceptibility of people's memory to suggestible influences, thereby decreasing the accuracy and reliability of their testimony. By suggestibility, we are referring to the reporting of

erroneous information due to exposure to misleading questions (immediate suggestibility) or incorrect information that is later recalled (delayed suggestibility; Ridley & Gudjonsson, 2013). A growing number of studies have examined the impact of alcohol on suggestibility (Evans, Schreiber Compo, & Russano,, 2019; Gawrylowicz, Ridley, Albery, Barnoth, & Young, 2017; Schreiber Compo et al., 2012; van Oorsouw et al., 2015; van Oorsouw, Broers, & Sauerland, 2019), and while the findings have been mixed:, most research finds that intoxicated individuals are more prone to reporting incorrect information when they have been misled about what happened during the crime.

One way in which rape complainants may encounter misleading information about the crime is via incorrect testimony given by another witness in the case. Sober and intoxicated (BAC = .08%) participants in Schreiber Compo and colleagues' (2012) study witnessed a live staged theft and then overheard the experimenter give an account of the theft, ostensibly to campus security. Misinformation about the theft was included in the experimenter's account. In a subsequent interview given 15 minutes later, participants were more likely to include the misinformation they overheard in their testimony. However, intoxicated participants were no more likely than sober participants to report misinformation. In contrast, Evans and colleagues (2019) found that participants who were intoxicated (mean BAC = .08%) as opposed to sober at encoding, and who received incorrect answers (by seeing incorrect answers given ostensibly by another research participant), reported answers that were less accurate (as measured by proportion correct) on a cued and free recall written test after a one-week delay.

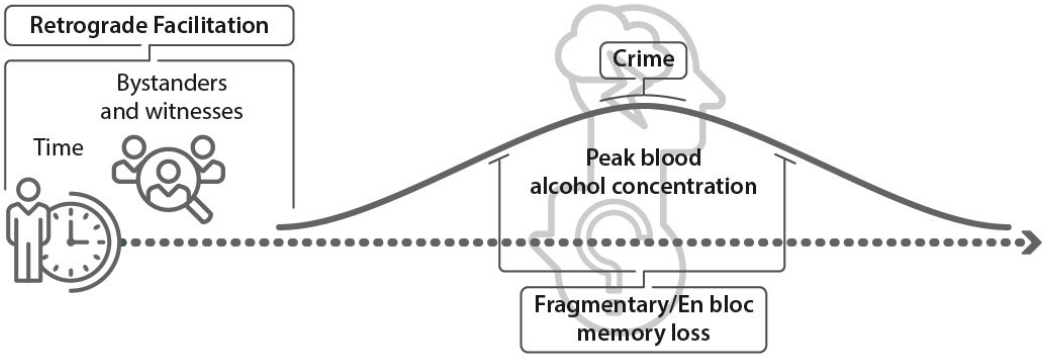
Another way in which a complainant may encounter misinformation is through misleading questions. Van Oorsauw and colleagues (2015) asked sober (average BAC = .01%) and

intoxicated (average BAC ranged from .06 -.16%) participants to commit a mock theft and then tested their memory for the crime using a written cued recall task, which included misleading questions. The test was given immediately after the crime and again 3-5 days later. Some questions provided two false alternatives about details that did not occur in the mock crime (e.g., 'Did the wallet contain 50 or 100 euros?', when in fact the wallet contained 70 euros). The researchers examined whether intoxicated compared to sober participants were more likely to recall one of the false alternatives and thereby *yield* to the misinformation. Participants were told after the test that they had made quite a few mistakes and should check their answers. This instruction was included to investigate whether the feedback would differentially encourage intoxicated compared to sober participants to *shift* their answers to misinformation. Results indicated that intoxicated compared to sober participants were more likely to yield to misinformation, both when tested sober and while still inebriated. Alcohol did not influence the degree to which participants shifted their answers, but participants overall were more likely to shift their answers when they were questioned 3 to 5 days later instead of immediately after the event. The authors argue that high intoxication levels may lead to an increased tendency to go along with misleading questions due to poor memory encoding and an inability to differentiate between what has actually happened and what is suggested. They further argue that alcohol might not affect an individual's tendency to shift answers after negative feedback due to its anxiety-relieving properties. Thus, it seems as if alcohol does not *per se* make an individual more suggestible; rather, it depends on the level of intoxication and how suggestibility is measured (i.e., endorsement of misinformation vs. shifting answers due to negative feedback). In a more recent study conducted in a bar with self-intoxicating participants, as BAC level increased participants reported a greater number of misleading details about a (noncriminal) social interaction they had with a research

confederate, and overall accuracy (as measured by proportion of correct) decreased (van Oorsouw et al., 2019).

Another factor that might impact the relationship between alcohol and suggestibility is the timing of alcohol consumption with regard to the target event. Alcohol may reduce suggestibility if consumed after the to-be-remembered event is encoded (e.g., Wixted, 2005). Gawrylowicz et al. (2017) had participants watch a mock crime, and thereafter, randomly assigned some participants to consume alcohol (average BAC = .065%). After a 24-hour delay, all participants were interviewed about the crime when sober again. Participants who consumed alcohol after witnessing the crime were less likely to report the misinformation when sober. Thus, in line with past research and theory, if consumed after encoding, alcohol seems to protect memory from the harmful effects of misinformation. A potential explanation for reduced suggestibility is that alcohol decreases retrograde interference (see Mueller, Lisman, & Spear, 1983). That is, alcohol seems to protect already existing memories by preventing new information from entering memory, a process known as *retrograde facilitation* (see Wixted, 2005). The implication is that acute alcohol intoxication strengthens memory for information acquired prior to the blackout, such as the complainant's memories of her interactions with the perpetrator and bystanders prior to the blackout (see Figure 2.3).

**Figure 3.3 Retrograde Facilitation**




All things considered, although the link between alcohol and suggestibility is complex and not yet well understood, there is evidence that alcohol can render an individual more vulnerable to suggestive influences, but this depends on the level of intoxication, the timing of alcohol consumption, and how suggestibility and memory are tested. Nevertheless, to achieve the best evidence possible in cases with rape complainants who were intoxicated during the attack, we will argue in the next chapter that it is imperative that interviewers are well trained in light of the research evidence, and then act consistently in accordance with best-practice guidelines to avoid any potential effects of suggestibility on the accuracy of testimony.

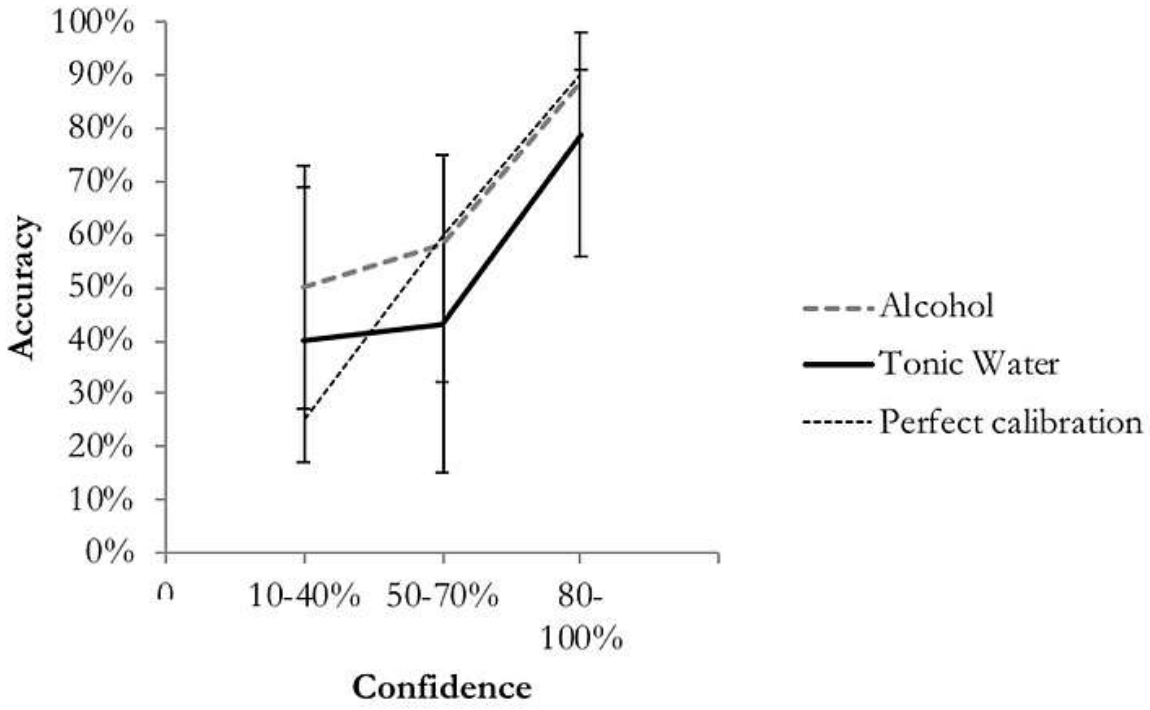
### 3.6 Alcohol and Memory Reliability

Another memory performance indicator of interest to criminal investigators and others making decisions about cases is memory reliability. Memory reliability refers to people's ability to monitor the likely accuracy of their memory. People monitor their memory

processes according to trace access theories of memory (Burke, MacKay, Worthley, & Wade, 1991; also see Green & Swets, 1966; Macmillan & Creelman, 1991). As discussed earlier, people evaluate the contents of their memory and evaluate how certain they are that the information they hold in memory is accurate. People assign higher confidence to items in memory as the strength of memory increases. For instance, we would expect under these models that witnesses view the culprit for a longer period of time that memory strength would increase. Thus, people who view the culprit for longer will report higher confidence when recalling information about the culprit's appearance. If confidence and accuracy are underpinned by memory strength, they should be positively correlated, which they are (see Wixted & Wells, 2017). Researchers have noted that the magnitude of the confidence-accuracy relationship is stronger than many other predictors of accuracy studied by eyewitness researchers, including weapon focus and own race bias (Sporer et al., 2005).

An important question is whether acute alcohol intoxication during memory encoding attenuates the confidence-accuracy relationship. For witnesses who were alcohol intoxicated during the crime, are they less able to gauge the reliability of their memory? This is important because investigators may wish to estimate the probability that the information being recalled by a witness is accurate.

**Figure 3.4 Confidence Accuracy Relationship and Alcohol**




Research on this topic in the domain of rape has been conducted. This work finds that both for criminal identification lineups (Flowe et al., 2018) and when people have their memory tested for a rape event using a recognition test (Flowe et al., 2019), the confidence-accuracy relationship does not vary for sober compared to intoxicated participants. There is also research to suggest that alcohol intoxication during the encoding of a to-be-remembered event may reduce overconfidence (Flowe et al., 2018), which is when people assign a higher degree of confidence in the accuracy of their memory than is warranted. Figure 3.4 portrays the confidence accuracy relationship for people who made a positive identification from a lineup in Flowe et al. (2018). As can be seen, confidence increases along with average identification accuracy for those who consumed alcohol and those who consumed tonic water prior to event encoding. Confidence more closely tracks perfect calibration, where there is a 1:1 correspondence between confidence and accuracy, for those who had consumed alcohol compared to tonic water. Participants who were randomly assigned to consume tonic water demonstrated overconfidence, whereby they were more confident than warranted given their

lineup identification accuracy. One explanation for why alcohol reduces overconfidence is that when people know their memory has been weakened by the conditions in which they encoded information (i.e., short period of study, long delay between learning and test, alcohol intoxication), they discount the likely accuracy of their memory and overconfidence is thus reduced (see Palmer, Brewer, Weber, & Nagesh, 2013).

### 3.7 Conclusion

This chapter presented a systematic review of forensically relevant research on the effects of acute alcohol intoxication and memory performance. This included consideration of key theories and translational issues that arise in applying the findings to the context of police interviews with rape complainants. Our main conclusion from the review is that acute alcohol intoxication decreases the completeness, or quantity of information recalled about forensic events, but not the accuracy of the information recalled, a result that is important for policy makers. We further found that this conclusion does not differ depending on whether people are interviewed immediately after the crime, whilst still intoxicated, or after a delay. Acute alcohol intoxication also does not affect the reliability of memory evidence. People who were intoxicated (as well as sober) during encoding and who report low confidence in their memory accuracy are less accurate than those who report high confidence in their memory accuracy. Importantly, the positive relationship between confidence and accuracy does not differ for those who were sober as opposed to intoxicated. Further, acute alcohol intoxication may serve to strengthen memories for events that took place before the blackout, a phenomenon known as retrograde facilitation. We will discuss in the next chapters how investigators may capitalize on our findings to aid memory performance during police interviews.

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