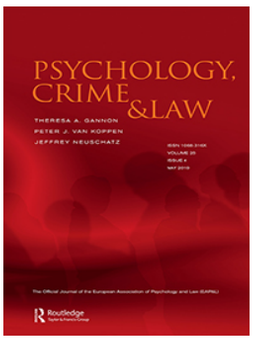

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The devil is not only in the details: gist and detail elaboration in intoxicated witnesses' reports of interpersonal violence

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ABSTRACT

The empirical base relating to alcohol's effects on underlying memory mechanisms among witnesses is sparse. Therefore, the effect of alcohol intoxication on memory mechanisms was investigated, as well as how degree of intoxication and interview delay affected gist and detail elaboration in these witnesses' reports. Participants ($n = 136$) were randomized to an alcohol group (men: 0.8 g/kg, women: 0.75 g/kg) ($n = 70$) or a control group ($n = 66$), given juice. After consumption, they witnessed an intimate partner violence-scenario, and performed tasks assessing memory mechanisms. Half of the intoxicated and sober groups were interviewed immediately. The remaining participants were interviewed one week later. Inter alia, intoxication decreased total gist recall and elaboration capacity. In general, high intoxication (BAC = 0.08–0.15) made witnesses report fewer gist categories, and also to elaborate them less, but there were differences in gist/detail elaboration between levels of intoxication due to emotional context. Less reported information among intoxicated witnesses was caused both by omitting parts of the scenario and to less detailed elaboration. Emotional context influenced reporting among intoxicated witnesses on a gist and detail level. However, intoxication had less impact on gist/detail-elaboration than did a one week delay before interview, suggesting that witnesses should be interviewed immediately, despite intoxication.

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Alcohol intoxication; eye witnesses; gist; level of detail; delayed interview

The devil is not only in the details: gist and detail in intoxicated witnesses' direct and delayed reports of intimate partner violence

The effect of alcohol on the reliability and scope of witnesses' reports is a relatively new area of research. Therefore, many issues are still unclear, among them the underlying mechanisms of alcohol's impact on witnesses' memory for violence. Some previous

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studies have shown that intoxication at encoding (breath alcohol concentration, BAC approx. ≥ 0.07–0.08), leads to a shorter free recall reports by intoxicated witnesses to violent events (see Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm Gordh, 2014; Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag, & Söderpalm, 2014; Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag, & Söderpalm, 2017), which raises the important question of whether these witnesses omit whole parts of the event (gist level) or instead give a less detailed elaboration of each part of the event (detail level). Hence, it is not clear which of alcohol's cognitive effects causes this decrease in reported information. Is it due to a shallower elaboration (see Craik, 1977; Sayette, 1999), resulting in a less detailed description of the entire event while maintaining the same amount of gist reporting? Or to a lack of maintained attention (see Steele & Josephs, 1990), resulting in omitting whole parts of the event on a gist-level but maintaining the same level of detail as sober witnesses in the reported parts? Perhaps both? The present study addresses the impact of alcohol intoxication on gist and detail elaboration of information from different emotional contexts, and puts this in relation to witnesses' performance regarding some aspects of different, and for these questions relevant, cognitive mechanisms.

Effects of alcohol, time and emotionality on elaboration in recall

Alcohol

The amount and quality of the information a person can recall about an event is largely influenced by how comprehensively the information was processed during memory encoding (Craik, 2002; Craik & Tulving, 1975). Alcohol has been suggested to impair free recall and the overall ability to process incoming information in an elaborate way, although it does not necessarily disrupt recognition or the activation of preexisting information (Birnbaum, Johnson, Hartley, & Taylor, 1980; Hashtroudi, Parker, DeLisi, Wyatt, & Mutter, 1984). Hence, alcohol-related memory deficits have mainly been attributed to the disruption of encoding information into long-term memory (Craik, 1977; White, 2003; White, Matthews, & Best, 2000), and to the failure to systematically produce elaborative context to the incoming information (Birnbaum et al., 1980; Sayette, 1993, 1999). As intoxication increases, attention, information processing speed and recall capacity decrease, and these effects are more consistently reported at BAC-levels ≥ 0.07 (see Bjork & Gilman, 2014; Zoethout, Delgado, Ippel, Dahan, & van Gerven, 2011). This has been suggested to result in a quantity-accuracy trade-off in direct free recall reports by intoxicated witnesses, where a tendency to maintain accuracy but reduce report completeness has been found in witnesses to intimate partner violence (IPV) (Hildebrand Karlén et al., 2014; Hildebrand Karlén et al., 2017). However, it is not clear if such a reduced completeness is an effect of reporting the event in a more gist oriented manner, or to omitting whole parts of the event while maintaining the same level of detail.

Factors such as different modes of interview have been found to affect the quantity and accuracy of sober and intoxicated witnesses' reports. For example, Crossland, Kneller, and Wilcock (2016) found that recognizing the to-be-remembered information when given alternatives is easier for intoxicated witnesses than to freely recall it (see also Curran, 2006), and when recall was assessed after a one week delay with a true/false recognition test, more 'I don't know' responses were reported by the participants in the 'high' BAC group. Regarding accuracy, interviews based on specific questions have in some studies

generated more errors than in free recall within this group (Hagsand, Roos af Hjelmsäter, Granhag, Fahlke, & Söderpalm Gordh, 2017; Schreiber Compo et al., 2012; see also Van Oorsouw & Merckelbach, 2012). Also, another study found lower accuracy rates among intoxicated witnesses than among sober/placebo witnesses when they were interviewed with open ended and cued recall formats one week after witnessing the crime (Schreiber Compo et al., 2017). These results are complex, but indicate that alcohol's effect on completeness and accuracy rate in witnesses' reports depend on many factors, among these mode of interview and timing of the interview.

Temporal delay before interview

The issue of temporal delay before interviewing intoxicated witnesses is important to consider since no standard police practice exists regarding use of direct and/or delayed interview (Evans, Schreiber Compo, & Russano, 2009). For sober witnesses, time normally reduces the amount of details a person can remember while the gist of the event is maintained over time (Reyna, Corbin, Weldon, & Brainerd, 2016). Previous research on intoxicated witnesses has shown that a one week delay before interview decreased the completeness of the report for both intoxicated and sober witnesses, meaning that the already shortened immediate reports from intoxicated witnesses were further reduced one week later (Hagsand et al., 2017; Hildebrand Karlén et al., 2017; Yuille & Tollestrup, 1990).

Emotional valence/arousal

Both the levels of arousal (i.e. the level of activation, low to high) and levels of valence (i.e. the level of pleasantness, strongly negative to strongly positive) at encoding seem to affect memory recall (Gomes, Brainerd, & Stein, 2013). However, different levels of emotional arousal and valence have been found to generate different effects on recall output as well as on the type of information processing used. A certain degree of negative emotionality has been shown to have a stimulating effect which enhances focus of attention and facilitates recall (often the level of emotionality in laboratory studies), while a high degree of negative emotionality is detrimental to recall (e.g. life threatening situations) (see Deffenbacher, Bornstein, Penrod, & McGorty, 2004 for a discussion).

According to Gomes et al. (2013), the effect on emotion on episodic memories can be explained from a dual-process perspective through the process of mental reinstatement of contextual features of prior experience (i.e. recollective retrieval: activation of the stimulus' verbatim traces without searching through and comparing traces of other stimuli/items which generates recollective phenomenology) or not (non-recollective retrieval: a two-component process of *reconstruction* using partial target information to construct sets of recall candidates and then choose which item to report based on degree of *familiarity*). The process generating a reconstruction familiarity output are more error prone than the verbatim process since it can generate similar stimuli that was not present at the time of encoding, and because the familiarity judgement can screen out stimuli that was actually present (Gomes et al., 2013). Within this process, arousal has been found to interact with valence of the stimuli, and cognitive processes used when recalling emotionally negative events seem to a larger extent be based on the more error prone cognitive process of gist retrieval (i.e. reconstructing output

from gist familiarity) than when recalling neutral and emotionally positive events (direct access to verbatim traces) (Gomes et al., 2013).

Intoxicated witnesses' recall: relevant theoretical frameworks

The attention-allocation model and cognitive processing

According to the attention-allocation model, alcohol intoxication impairs cognitive processing leading to that the intoxicated person can only perceive and focus on what he/she perceives as the most relevant features of an event (Sayette, 1993; Steele & Josephs, 1990). Based on this theory, (as well as its extension alcohol myopia theory, Steele & Josephs, 1990) intoxicated persons may actually remember certain aspects better than sober persons due to a narrowed attention focus. Alternatively, intoxicated persons may recall less due to a more shallow encoding of the event, and to prevent cognitive overload they refrain from focusing on unnecessary details (see Anand, 2008). That is, intoxicated witnesses may be able to report the overall gist of a witnessed event, but they will report the event in less detail than sober witnesses.

The appraisal-disruption model

This model is partially based on the attention allocation model, and therefore predicts similar cognitive effects. Based on this theory, it could be argued that intoxicated witnesses would focus their cognitive capacity on some parts of the event and encode/report these as well as sober witnesses do, while omitting other parts of the event in their reports. Among intoxicated witnesses, this would result in a fragmented recall, in 'islands' of as detailed reporting of certain parts of the event as sober witnesses can maintain throughout their entire report. That is, intoxicated witnesses may focus on some aspects of the witnessed event, and be able to report those aspects with the same level of detail as sober witnesses, while other aspects will not be remembered/reported. According to the appraisal-disruption model, intoxication lower cognitive processing capacity and activation in association networks,[1] but may also during a stressful event alter the stimuli's emotional impact on the person by impairing the cognitive processes associated with the appraisal of incoming information (e.g. making it less salient and hence not necessarily perceived as important). In a sober state, moderate stress can have a strengthening effect on memory and moderately emotional events are typically better remembered than neutral events (see Deffenbacher et al., 2004). In an intoxicated state, even though study results regarding intoxication's effect on stress have varied, alcohol is generally a pharmacological agent that lowers anxiety through its GABAergic properties (Söderpalm, 2011), which would make stressful events seem less stressful when experienced during intoxication (Sayette, 1993; 1999). At least, alcohol lowers the automatic salience of stressful events so that an intoxicated person to a larger extent needs external help to focus (Crossland et al., 2016; Zoethout et al., 1990).

Fuzzy trace theory and quantity-accuracy trade-off

Fuzzy trace theory (FTT) (Brainerd, Wright, Reyna, & Payne, 2002; Reyna et al., 2016; Reyna & Brainerd, 1998) and the quantity-accuracy trade-off (Koriat & Goldsmith, 1996; Pansky & Nemets, 2012) contribute with further understanding of how alcohol affects the amount of information on a gist/detail level in witnesses' reports. According to FTT

(Reyna & Brainerd, 1998), the gist and the details of a to-be-remembered event constitute different representations of the same material, encoded in parallel and maintained separately. This theory is supported by brain imaging studies showing that some structures mainly process gist (primarily frontal structures), while others are implicated in processing detail (primarily left temporal structures) (see Anand, 2008). According to FTT, witnesses can testify accurately about their memory for events either because they retrieve verbatim memories or because they reconstruct them from gist (Reyna et al., 2016). Furthermore, according to FTT, eyewitness reports that occur immediately after a witnessed crime are more likely to be based on verbatim memory than reports given later (e.g. in court, since verbatim recollection dissipates with delay) making these reports more accurate regarding arbitrary detail (Reyna et al., 2016). As alcohol intoxication impacts both frontal and temporal brain structures and their functions (Bjork & Gilman, 2014; White, 2003; Zoethout et al., 2011), it is reasonable to assume that alcohol should have some detrimental effect on both gist and detail elaboration. The quantity-accuracy trade-off framework contributes with further understanding of this process and postulates that during free recall, if a witness focus on being accurate, quantity of information is reduced, and when their focus is quantity, accuracy is reduced (Koriat, Goldsmith, & Pansky, 2000). The decreased amount of reported information but maintained accuracy rate among intoxicated witnesses with BAC-levels approx. ≥ 0.07 found in previous research (e.g. Flowe, Takarangi, Humphries, & Wright, 2016; Hagsand et al., 2017; Hildebrand Karlén et al., 2017), may be due to a reduction in cognitive processing capacity, or put differently, an increase in experienced cognitive load. However, it may also be that witnesses direct their reports towards more confidently remembered aspects of the event, as well as modulate the 'grain-size' along the dimension gist/detail within the report to match the level of abstraction that the person feels is adequate to maintain an acceptable accuracy rate. From a functional perspective, these effects make quantity-accuracy trade-off in combination with appraisal-disruption theory relevant for understanding the effect of intoxication on witnesses' performance, but this has not been investigated in previous studies on intoxicated witnesses.

Theoretical assumptions of gist/detail elaboration and the impact of alcohol

Studies have conceptualized gist and detail somewhat differently, and different levels of gist have been argued to make distinctions within cognitive processing (e.g. local vs. global gist, see Lampinen, Leding, Reed, & Odegard, 2006). However, a common use of the gist concept in the context of a witness report is that a gist-oriented report seems to be that it encompasses the important/main aspects of the stimulus, while a detail-oriented report seems to consist of a thorough description of such main aspects (e.g. verbatim repetition of what was said in such a conversation) (Adolphs, Denburg, & Tranel, 2001; Anand, 2008; Buchanan, Karafin, & Adolphs, 2003). The present study's theoretical base for coding of gist in Part II, emanated from Anand's (2008) description of three forms of gist: categorical gist (i.e. recall of categorically related words in clusters during word-list recall), main-idea gist (i.e. extracting main points of a message) and transformed gist i.e. (abstracting the general meaning of a passage by combining the available information with world knowledge). Within this theoretical context, the concept of main-idea gist (see Figure 1), is most in line with

<table>
<tr><td colspan="8">Entire event (e.g. a quarrel between two persons)</td></tr>
<tr><td rowspan="2">Coarse grained size</td><td colspan="2">Overall gist category 1
(e.g. talk in the kitchen)</td><td colspan="2">Overall gist category 2
(e.g. argued in the living room)</td><td colspan="2">Overall gist category 3
(e.g. fought in the hallway)</td><td>Very large
One sentence characterizing entire event</td></tr>
<tr><td>Minor gist category 1
(e.g. talked about work)</td><td>Minor gist category 2
(e.g. were friendly)</td><td>Minor gist category 3
(e.g. argued about their economy)</td><td>Minor gist category 4
(e.g. man hit a potted plant)</td><td>Minor gist category 5
(e.g. woman screamed at him)</td><td>Minor gist category 6
(e.g. man hit the woman)</td><td>Large
Event is divided into a few sections with sparse details characterizing each section</td></tr>
<tr><td rowspan="2">Fine grained size</td><td>Detail 1
(e.g. computer on the kitchen table)</td><td>Detail 3
(e.g. he tried to touch her hand)</td><td>Detail 5
(e.g. he accused her of spending too much)</td><td>Detail 7
(e.g. the plan was made of plastic)</td><td>Detail 9
(e.g. the man squeezed the woman's wrists)</td><td>Detail 11
(e.g. he hit her with the back of his hand)</td><td>Medium
Moderately detailed elaboration of a few sections of the event</td></tr>
<tr><td>Detail 2
(e.g. she said she was stressed)</td><td>Detail 4
(e.g. she looked at him)</td><td>Detail 6
(e.g. she had bought a bus ticket)</td><td>Detail 8
(e.g. the man was upset)</td><td>Detail 10
(e.g. she tried to break away from him)</td><td>Detail 12
(e.g. she held her had against her cheek for a while)</td><td>Small
Event divided into several subsections and gives detailed elaboration of each</td></tr>
</table>

Figure 1. An overview with examples of gist categories and their respective details.

the gist definition in previously cited research, as including 'salient, general information about the stimulus that could not be changed or excluded without changing the basic story line' (see Buchanan et al., 2003).

Combined effects in practice: alcohol, emotional activation and time of interview

Alcohol and emotional activation

Alcohol affects the amygdala, which, among other things, means that persons who were intoxicated at the time of memory encoding may recall an emotional event differently compared to those who were sober. The amygdala modulates, among other things, declarative memory encoding (Adolphs et al., 2001), experience of emotions such as fear (Adolphs, Tranel, Damasio, & Damasio, 1995) and social judgement (Adolphs, Tranel, & Damasio, 1998). Social judgements are important pieces of information that witnesses to interpersonal violence are asked to report, and research has shown that amygdala's function is impaired by anxiolytic agents such as alcohol and bensodiazepines (Buchanan et al., 2003; Curran, 2006). Even though laboratory studies seldom can recreate a life-like experience in witnessing violence, one laboratory study on intoxicated witnesses to violence has shown that these witnesses perceived the witnessed stimuli (a film) as less

disturbing than sober witnesses (Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag, & Söderpalm, 2015). The memory enhancing effect of moderate stress compared to neutral contexts over time found in previous research is thought to be partly due to a tendency to over time think about emotional information more often than neutral (Christianson, 1992), but also due to an influential role of the amygdala on memory formation (Adolphs et al., 2001). Therefore, while moderately emotional events seem to be remembered better than neutral by sober persons, it is unclear if this is also true for intoxicated witnesses since their emotional experience may be different.

The effect of alcohol and emotional activation on gist and detail

Even though alcohol is thought to affect both gist and detail processing negatively (White, 2003), the anxiety-dampening effect of alcohol may affect reporting differently on a gist and detail level. Previous studies on memory for aversive stimuli have shown that in a sober state memory for the overall gist was enhanced and memory for their details was suppressed. However, when affected by an anxiety-dampening pharmacological agent, less information was reported on a gist level and more detailed descriptions given compared to in a sober state (Adolphs et al., 2001; Buchanan et al., 2003).

The present study

The purpose of the present study was to examine the impact of alcohol on relevant aspects of witnesses' cognitive capacities (Part I), and whether the degree of intoxication and time of interview affected the number of reported gist-categories (each representing a meaningful event in the witnessed scenario), and the detailed elaboration of these gist-categories, in different emotional contexts of an IPV-scenario (Part II).

Part I: memory capacity and information processing performance

Based on fuzzy trace theory and an expected increase in cognitive load during intoxication, a reduction in memory capacity and information processing capacity among intoxicated witnesses with BAC > 0.08 was expected (Hypothesis 1). The investigated aspects of memory capacity were: episodic recall capacity after generating distracting information, semantic elaboration capacity, and confabulation. The investigated aspects of information processing capacity were: information processing speed and accuracy.

Part II: gist and detail elaboration in different emotional contexts of the IPV-scenario

Based on the appraisal-disruption model, attention allocation model and the impairing effects of alcohol on memory encoding and frontal and temporal lobe function (see Anand, 2008; White, 2003), the overall recall of the entire witnessed IPV-scenario's gist (here: percent of the total amount of the scenario's investigated gist categories), as well as confidence of their report, was presumed to be diminished among intoxicated witnesses with BAC > 0.8 compared to the performance of sober witnesses (Hypothesis 2). Furthermore, it was hypothesized that intoxicated witnesses (BAC > 0.08) should elaborate these gist categories in less detail (Hypothesis 3) than sober witnesses. Since the emotional level of the material used in the present study would be construed as activating and not paralyzing (Deffenbacher et al., 2004), it was likely that sober witnesses should increase focus of attention during the verbally and physically aggressive

contexts. Hence, sober witnesses would report more gist categories, as well as more details from each category, adhering to these contexts compared to the neutral context. However, due to alcohol's blunting effect on emotional activation (Adolphs et al., 2001; Parrott, Gallagher, & Zeichner, 2012), it was hypothesized that such an enhanced recall for the two aggressive contexts would not occur among intoxicated witnesses (BAC > 0.08) regarding both: amount of reported gist categories, and detailed elaboration of these gist categories (Hypothesis 4). Finally, regarding the impact of temporal delay on report characteristics, it was hypothesized that due to the emotionally blunting effect and loss of detail over time due to temporal delay, a similar decrease as among intoxicated witnesses with BAC > 0.08 was expected for witnesses who were interviewed after a one week delay regarding amount of gist categories as well as the detailed elaboration of these gist categories (Hypothesis 5).

Method

Participant recruitment and screening

The method has previously been described in Hildebrand Karlén et al. (2017) and the data in the present study is derived from the same interviews presented there. Participant recruitment ($n = 137$, mainly university students; 67 men, 70 women) was done by announcing the project on posters at several departments at University of Gothenburg, Sweden. Screening to ascertain eligibility for participation was done in a two-stage procedure.

Screening stage 1

A trained research assistant performed a screening interview by telephone (approx. 20 min). Participants who fulfilled the inclusion criteria: healthy, non-problem social drinkers (AUDIT cut-off scores used: M = men: 3–15; women: 3–13) between the ages of 19–35 with a normal BMI (19–26) and not using medication or drugs ($n = 147$), were subsequently called to screening stage two. In total, 129 persons were excluded in screening stage one, almost exclusively due to too low/too high alcohol consumption and/or to taking antidepressant medication.

Screening stage 2

This stage consisted of a more extensive screening at the Department of Psychology, University of Gothenburg (approx. 1 h). It included a medical examination, a psychiatric screening (SCL-90; Derogatis, 1983) and self-reported alcohol consumption screening with AUDIT (range of included participants: 3–14, $M = 6.49$, $SD = 2.65$) (Barbor, Higgins-Biddle, Saunders, & Monteiro, 2001). Any indication of high-risk responses to AUDIT or SCL-90 was checked directly by a certified clinical psychologist who posed follow-up questions to assess the implications of the answer. Exclusion criteria in the second screening stage were: currently medicating; having a medical condition that could be negatively affected by alcohol (including ulcer, pregnancy); current or history of alcohol/drug abuse or dependence; a body mass index <19–>26; fulfilled criteria of current Axis 1 psychiatric disorder; lack of fluency in Swedish or currently working night shifts. Ten participants completed the second screening stage but did not participate in the experiment. Six of these were excluded due to depressive symptoms on SCL-90 or to too high alcohol consumption. The other four could not find a

suitable time slot for participation. All eligible participants read and signed a written consent, were instructed to eat before arriving to the laboratory. The study was approved by the Regional Ethical Committee in Gothenburg, Sweden.

Design and procedure

An experimental mixed group's design 3 (sober vs. moderate intoxication vs. high intoxication) × 2 (immediate vs. one-week delay interview) was used. The target BAC-level was 0.08 and the alcohol dose used was 0.8g/kg body weight for men, adjusted to 0.75 g/kg for women (see X., 2017). The two alcohol groups were created by assigning the persons who reached BAC < 0.08 to the moderate intoxication group and ≥0.8 to the high intoxication group (see *Analytical strategy and data preparation* for more information). While controlling that the gender dispersion was even over interview- and beverage groups, participants were randomized both to the alcohol ($n = 70$: 34 men, 36 women) or non-alcohol group ($n = 67$, 33 men, 34 women), and to the immediate ($n = 68$: 33 men, 35 women) or the delay interview group ($n = 69$: 34 men, 35 women).

The study was conducted in a laboratory furnished as a living room at the Addiction Biology Unit (Section of Psychiatry and Neurochemistry, Institute of Neuroscience and Physiology), X at University of X. Upon arrival at the laboratory in groups of two to five, the participants' breath alcohol concentration (BAC) was established as zero with a portable breathalyzer (Alert J5, Alcohol Countermeasure Systems Corp., 2006). The participants were also weighed and verbally informed by the experiment leader about the procedure and if their group would consume drinks containing alcohol or not. Thereafter, for 15 min, the participants consumed their drinks. Participants in the alcohol condition were served a solution of 0.8 g/kg alcohol (men) or 0.75 g/kg alcohol (women) consisting of Absolute Vodka 40%, mixed with pulp-free orange juice. Participants in the non-alcohol condition drank pulp-free orange juice and the amount was based on body weight. Afterwards, both groups rinsed their mouths with water to generate a more accurate measure of BAC, and BAC was subsequently measured every 15 min, starting five minutes after concluded consumption. After consumption, the participants viewed an IPV-scenario on a TV from an approx. distance of 3 m, and after viewing the film, they performed memory tasks unrelated to the content of the film during 10 min. After this, 50% of the participants (i.e. those assigned to the immediate interview condition) were interviewed individually about the IPV-scenario, after which the participants in the non-alcohol group left the laboratory. The participants in the alcohol group stayed until their BAC ≤ 0.04, and were then sent by taxi to their home address. For the delay interview condition, sober participants were sent home directly after concluding the memory/information processing tasks, and intoxicated participants were sent home by taxi when BAC ≤ 0.04. These participants returned one week later to the Department of Psychology to be interviewed individually about the event. Compensation for participation was 350 SEK (£35) or three movie tickets.

Film

The intimate partner violence (IPV) scenario used as stimuli (an 11.5 min long film, see Hildebrand Karlén, Roos af Hjelmsäter, Fahlke, Granhag & Söderpalm Gordh, 2014, for a more

detailed description) was set in a home environment and consisted of three stages (3 min and 50 s each) of interaction through which the interpersonal hostility escalated. First, the man and woman involved discussed in an emotionally neutral manner (neutral stage), second, the verbal argument began (verbally aggressive stage) and escalated into third, the physically aggressive stage, which contained multiple expressions of physical violence from both parts. The scenario ended with the man pinning the woman to the floor, sitting on her stomach and threatening her with a raised fist. Though, instead of hitting her face, he hit the floor beside her head, got up and rushed out of the house, after which the woman, apparently hurt, slowly got up, holding a hand to her head. Despite some aspects of mutual aggression, the man's physical aggression was primarily offensive while the woman's physical aggression was primarily defensive.

Memory/information processing capacity tasks: procedure and construction of measures

After seeing the film, two tasks were performed during ten minutes. The tasks were designed to tap both information processing speed/accuracy (measured by task 1, a math task) and aspects of memory (measured by task 2, a semantic elaboration/episodic recall task). Both tasks were performed during three consecutive trials, administered in an interspersed manner, starting with the semantic elaboration/episodic recall task. The participants were asked to listen to, and remember, a list of words (20 words from four semantic categories: colors, furniture, birds, metals) read out loud by the experiment leader. They were then told that the presented words adhered to specific semantic categories and, in addition to recalling the words on the presented list, they should also generate new words from the represented categories. The participants were requested to write down as many answers as they could during one minute trial. The only difference between the three trials was that in the first and second trial of the memory elaboration task, the participants were asked to write down the words from the list presented before and also to add as many additional words adhering to the same semantic categories as possible. The participants' total amount of generated words in these two trials was used as a measure of their capacity to elaborate from implicitly presented semantic categories. In the third trial, only words from the original list were to be noted on the response sheet. In between these three trials, the participants performed the information processing speed/accuracy task. They were given a sheet of paper with math tasks consisting of division and multiplication of three-figure numbers and were instructed to solve as many tasks as possible during three separate trials. All of the above-mentioned instructions were printed on top of an answer sheet given at each trial to minimize risk of the participants misunderstanding the instructions.

Measures obtained from the memory task and the information processing capacity task

Two measures were obtained from the information processing capacity task: *information processing speed*, by summarizing total amount of calculations completed throughout the three trials; *information processing accuracy*, by dividing the amount of correct answers with the total amount of completed calculations (i.e. percentage). The memory capacity task was modeled after Brainerd et al. (2002, with some slight alterations), and three

measures were obtained from this task: *episodic recall*, by counting the amount of words (and calculating the percentage of words) from the original list that were recalled during trial 3; *semantic elaboration capacity*, by counting the total amount of newly generated words during trial 1 and 2; *confabulation*, by calculating number of words reported from the wrong semantic categories (e.g. 'soccer players') that were given throughout all three trials.

Interview: procedure, coding and construction of the measures regarding gist/detail[2]

The interview consisted of free recall of the entire filmed scenario, and when the participants had concluded their free recall account, the following question was posed: can you remember anything else? If the participant denied this, no further questions were posed. If he/she added more information, the reply was registered and the question repeated until the participant answered no. After the interview, the participants rated how confident they were that the reported information was correct (Likert scale 1 = not at all sure, to 6 = very sure). All interviews were audiotaped, transcribed, and coded. The interviewers, transcribers and coders were all blind to the experimental conditions.

Gist elaboration/detail elaboration measures derived from the free recall interview

The main gist measure was the percentage of gist categories represented in the report. This measure captured the ability to maintain attention well enough to report gist throughout the entire scenario. The mean amount of details (converted into percent) reported from each gist category was investigated to capture the ability to elaborate said gist categories in a detailed manner. These measures were based on the coding of the reported information into a list of gist categories ($n = 47$) which were represented in the film (see Figure 1, level 1). The creation of this list was based on the story line of the film (see Buchanan et al., 2003), and the measure *total gist* (i.e. total amount of gist categories represented in the report) was established by calculating how many gist categories from the list that were reported (see Figure 1, level 2). The three measures of *gist in different emotional contexts* were construed by creating three categories based on information adhering to the scenario's neutral, verbally aggressive, and physically aggressive context. The three measures of *level of detail in different emotional contexts* were established by, for each person, dividing his/hers amount of details reported from a certain context with the amount of reported gist categories from the context in question. Since the film was designed with the aspect of emotionality in mind, the three emotional contexts contained a relatively even distribution of gist categories describing the three types of information: actions ($n = 19$, e.g. *information concerning the man's agitated behavior while he was sitting in the living room sofa*), verbal information ($n = 14$; e.g. *information concerning the discussion about the car the woman wanted to buy*) and objects ($n = 14$; e.g. *information concerning the living room sofa and things in it such as blanket etc*). Interrater reliability was assessed by having one person code the entire material and another person code 20% of the material. Based on this overlapping 20%, the interrater reliability was 88.81% in total, and 89.40% for actions, 90.54% for verbal information and 86.48% for objects.

Analytical strategy and data preparation

Due to the results from a previous study on intoxicated witnesses to intimate partner violence (Hildebrand Karlén et al., 2014) where only intoxicated witnesses with BAC ≥ 0.08 reported less information in a free recall interview, BAC = 0.08 was used as a cut-off for analysis. Gender difference in alcohol metabolism was controlled for by using 0.08g/kg for men and 0.075 for women, and a relatively even dispersion around BAC-level = 0.08 was expected. For the analyses, the participants were divided into two groups depending on whether their BAC was <0.08, moderate intoxication, or ≥0.08, high intoxication. It is important to note that the words moderate/high are only used here as labels to separate the BAC-groups. Hence, the word 'high' does not automatically imply a 'highly/severely intoxicated state'.

Effect sizes were reported in eta-squared (η^2), where an effect size of $\eta^2 < 0.01$ was considered small (equivalent to Cohen's $d = 0.2$), $\eta^2 = 0.06$–0.13 (equivalent to Cohen's $d = 0.5$–0.8) was considered moderate, and $\eta^2 > 0.138$ (equivalent to Cohen's $d = 0.8$) was considered large (see Cohen, 1988). All statistical tests were conducted in SPSS for Windows (Version 18; SPSS Inc., Chicago IL), and the general level of significance was set to $p = 0.05$. Non-significant and significant results were not reported if $\eta^2 < 0.06$. Power analyses were conducted using G*power, and calculated with three BAC-groups and two interview condition groups. For BAC, the power to detect a moderate effect with the current sample size was 0.74. For time of interview, the power to detect a moderate effect with the current sample size was 0.83. If no other information is given, the distributions analyzed below did not violate assumptions of normality or sphericity.

Results

Preliminary analyses

Intoxicated witnesses were divided into two groups: moderate (BAC < 0.08, $n = 28$: men = 17, women = 11; range: 0.043–0.079; $M = 0.066$, $sd = 0.011$) and high (BAC ≥ 0.08, $n = 42$: men = 17, women = 25; range: 0.08–0.149; $M = 0.103$, $sd = 0.017$). A chi-square goodness-of-fit test indicated that men and women were evenly distributed between the sober, the moderate intoxication, and the high intoxication group, χ^2 (2, $n = 136$) = 2.76, $p = 0.280$.

Part I: memory capacity and information processing performance

Information processing speed and accuracy

A univariate ANOVA showed that alcohol intoxication did not decrease the amount of mathematical items the witness tried to solve, $F(2, 128) = 0.927$, $p = 0.339$, $\eta^2 = 0.01$. However, a univariate ANOVA showed that alcohol decreased the percentage of mathematical items solved correctly, $F(2, 128) = 7.73$, $p < 0.001$, $\eta^2 = 0.11$. A Tukey HSD post hoc test showed that alcohol had a negative effect on accuracy rate already at a moderate level (BAC = 0.04–0.08), and that sober participants had a higher accuracy rate compared to both the high ($p < 0.001$) and moderate intoxication group ($p < 0.010$).

Episodic recall

A univariate ANOVA showed that intoxicated witnesses recalled fewer words from the list during recall 3 (i.e. after two elaboration trials) compared to sober witnesses, $F(2, 134) =$

10.77, $p < 0.001$, $\eta^2 = 0.14$. A Tukey HSD post hoc test showed that sober witnesses recalled more items from the list compared to witnesses in both moderate ($p < 0.001$) and high ($p < 0.001$) intoxication groups, while moderate and high intoxication groups did not differ ($p = 0.999$). Sober witnesses reported 56% of the original information during recall 3 and the moderate and high intoxication groups 44%, respectively.

Semantic elaboration capacity

A univariate ANOVA showed that alcohol decreased the elaboration of the implicitly given categories in the word list, $F(2, 133) = 3.98$, $p < 0.05$, $\eta^2 = 0.06$ (see Table 1). A Tukey HSD post hoc test showed that alcohol's impact was gradual with sober witnesses elaborating the categories the most, compared to moderately intoxicated ($p < 0.05$) who elaborated somewhat less, and the high intoxication group ($p < 0.010$) who elaborated least. Witnesses in the moderate and high intoxication group did not differ in elaboration performance.

Confabulation

Regarding confabulation (i.e. 'false hits' or a failure to accurately identify and use semantic categories), a Pearson correlation showed that the total amount of items reported from *wrong semantic categories* during all three recall trials was positively correlated to BAC, $r(137) = 0.247$, $p = 0.010$.

In sum, the results from Part I showed that regarding information processing speed and accuracy, intoxication (BAC = 0.04–0.15) only reduced some aspects of recall/information processing capacity. While information processing speed was not reduced among intoxicated witnesses, their accuracy was lower, and confabulation was positively correlated with BAC.

Part II: gist and detail elaboration and differences between emotional contexts

Total gist reported and confidence in recall

Sober participants reported 57% of the scenario's gist, the moderate intoxication group 51%, and the high intoxication group 41%. A one week delay before interview also

Table 1. Mean amount of reported gist categories (1) and reported details per gist category (2) as a function of degree of intoxication and different emotional contexts.

		Interview: 10 min after the event		Interview: one week delay	
Neutral	**Sober**	(1) 9.22 (2.57) (2) 3.34 (1.36)	***Interview condition total for neutral context:***	(1) 8.71 (2.07) (2) 2.37 (0.69)	***Interview condition total for neutral context:***
	Moderate	(1) 8.73 (2.10) (2) 2.86 (1.04)	(1) 8.76 (2.53) (2) 3.12 (1.16)	(1) 7.88 (1.92) (2) 2.56 (0.93)	(1) 7.81 (2.32) (2) 2.33 (0.79)
	Severe	(1) 8.17 (2.62) (2) 2.95 (0.88)		(1) 6.06 (2.18) (2) 2.06 (0.78)	
Verbally aggressive	**Sober**	(1) 10.66 (2.06) (2) 3.07 (0.95)	***Interview condition total for verbally aggressive context:***	(1) 8.06 (2.63) (2) 2.47 (0.72)	***Interview condition total for verbally aggressive context:***
	Moderate	(1) 10.18 (2.48) (2) 2.84 (1.08)	(1) 9.58 (2.79) (2) 2.91 (0.93)	(1) 7.69 (1.99) (2) 2.16 (0.76)	(1) 7.16 (2.85) (2) 2.23 (0.79)
	Severe	(1) 7.88 (3.01) (2) 2.73 (0.84)		(1) 5.00 (2.89) (2) 1.84 (0.99)	
Physically aggressive	**Sober**	(1) 8.91 (2.23) (2) 4.75 (1.78)	***Interview condition total for physically aggressive context:***	(1) 7.53 (2.72) (2) 3.59 (1.06)	***Interview condition total for physically aggressive context:***
	Moderate	(1) 7.45 (2.62) (2) 4.43 (1.01)	(1) 7.87 (2.49) (2) 4.43 (1.51)	(1) 5.88 (2.16) (2) 3.03 (0.86)	(1) 6.29 (2.79) (2) 3.40 (1.51)
	Severe	(1) 6.67 (2.24) (2) 4.01 (1.21)		(1) 4.33 (2.20) (2) 3.39 (2.44)	

lowered the total amount of gist-categories included in the scenario, with witnesses interviewed immediately reporting 53% while those interviewed after a one week delay reported 44%. A between-within subjects ANOVA was conducted to assess the impact of degree of intoxication (sober vs. moderate vs. high) and time of interview (immediate vs. delayed) on amount of gist categories reported from the three different emotional contexts (neutral vs. verbally aggressive vs. physically aggressive). Between-subjects analysis showed a significant main effect regarding degree of intoxication, $F(2, 129) = 22.25$, $p < 0.001$; $\eta^2 = 0.26$, where amount of gist categories reported decreased in a dose-dependent manner (see Table 1). A multivariate main effect was found for emotional context, $F(2, 128) = 21.31$, $p < 0.001$; Wilks' Lambda = 0.75; $\eta^2 = 0.25$, showing that all witnesses reported fewer gist categories from the physically violent context (see Figure 1). Multivariate tests also showed an interaction between degree of intoxication and emotional context, although the effect size was small, $F(4, 256) = 2.37$, $p < 0.05$; Wilks' Lambda = 0.93; $\eta^2 = 0.04$ (see Figure 2). The interaction ($p < 0.05$) consisted of sober and moderately intoxicated participants reporting most gist categories from the verbally aggressive context, less from the neutral and least from the physically aggressive context (although moderately intoxicated witnesses reported fewer gist categories from each context than sober witnesses), while the witnesses in the high intoxication group reported most gist categories from the neutral context, less from the verbally aggressive and least from the physically aggressive context ($p < 0.001$) (and reported even fewer gist categories than moderately intoxicated witnesses from each context) (see Figure 2). Regarding the effect of interview delay on amount of reported gist categories, between-subjects analysis resulted in a significant main effect, $F(1, 129) = 28.15$, $p < 0.001$; $\eta^2 = 0.18$, showing that witnesses interviewed after a one week delay reported fewer gist categories overall compared to witnesses interviewed immediately (see Table 1). A multivariate interaction was found between emotional context and time of interview, $F(2, 128) = 5.15$, $p < 0.01$; Wilks' Lambda = 0.93; $\eta^2 = 0.07$. The interaction consisted of witnesses interviewed

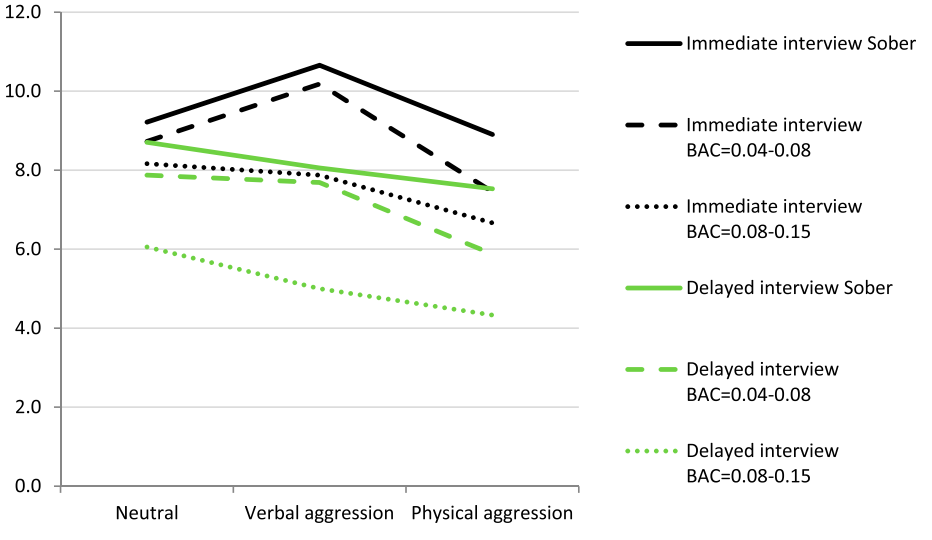

Figure 2. Amount of gist categories reported from the neutral, verbally aggressive and physically aggressive context by beverage condition and interview condition.

immediately showing a pattern consistent with sober witnesses, while witnesses interviewed after a one week delay showed a pattern consistent with that of witnesses in the high intoxication group (see Figure 2). No univariate interaction was found between degree of intoxication and time of interview ($p = 0.439$).

How confident the witnesses were in the accuracy of their recall performance of the IPV-scenario was rated on a Likert scale (1: not at all – 6: very sure). A Pearson correlation showed that, irrespective of interview timing, confidence in report accuracy was moderately negatively correlated with BAC-level, $r_s = -.282$, $n = 70$, $p = 0.018$. However, when interview timing also was considered, a Pearson correlation showed that confidence decreased substantially in witnesses who had been intoxicated during the event but not interviewed until one week later, $r_s = -.491$, $n = 70$, $p < 0.001$, while intoxicated witnesses who were interviewed immediately did not differ significantly from sober witnesses regarding confidence in accuracy of their recall, $r_s = -.182$, $n = 68$, $p = 0.137$.

Level of detail reported for each of the gist-categories in each emotional context

A between-within subjects ANOVA was conducted to assess the impact of degree of intoxication (sober vs. moderate vs. high) and time of interview (immediate vs. delayed) on the level of detail for each gist category reported from the three different emotional contexts (neutral vs. verbally aggressive vs. physically aggressive). A multivariate effect was found for emotional context, $F(2, 127) = 44.74$, $p < 0.001$; Wilks' Lambda = 0.59; $\eta^2 = 0.41$, showing that all witnesses reported most details from the physically violent context, and less details from the neutral and verbally aggressive contexts (see Figure 3). A between-subjects analysis showed a significant main effect of degree of intoxication, $F(1, 128) = 3.62$, $p < 0.05$; $\eta^2 = 0.05$, where the level of detail from all emotional contexts was lowered for intoxicated witnesses in a dose-dependent manner compared to sober witnesses (see Table 1). No multivariate interactions were found between degree of intoxication and the types of emotional context (p's > 0.266 in all interactions).

A between-subjects analysis also showed a significant main effect of time of interview $F(1, 128) = 30.50$, $p < 0.001$; $\eta^2 = 0.19$, where witnesses interviewed after a delay reported less details from all emotional contexts compared to witnesses interviewed immediately (see Table 1). No univariate interaction was found between degree of intoxication and time of interview ($p = 0.939$).

In summary, alcohol intoxication lowered the amount of reported gist categories, as well as the level of detailed elaboration of these, in a dose dependent manner. All witnesses reported less gist categories from the physically aggressive context, but all witnesses also elaborated the gist categories from the physically aggressive context the most. An interview delay resulted in all witnesses reporting fewer gist categories overall, as well as elaborated them in less detail, compared to witnesses interviewed immediately. However, a multivariate interaction with a small effect size suggested that in direct interview, most gist categories were reported from the verbally aggressive context, but in delayed interview, most categories came from the neutral context. Finally, alcohol intoxicated witnesses interviewed after one week were less confident in their reports compared to directly after the event, as well as compared to sober witnesses directly or after a delay.

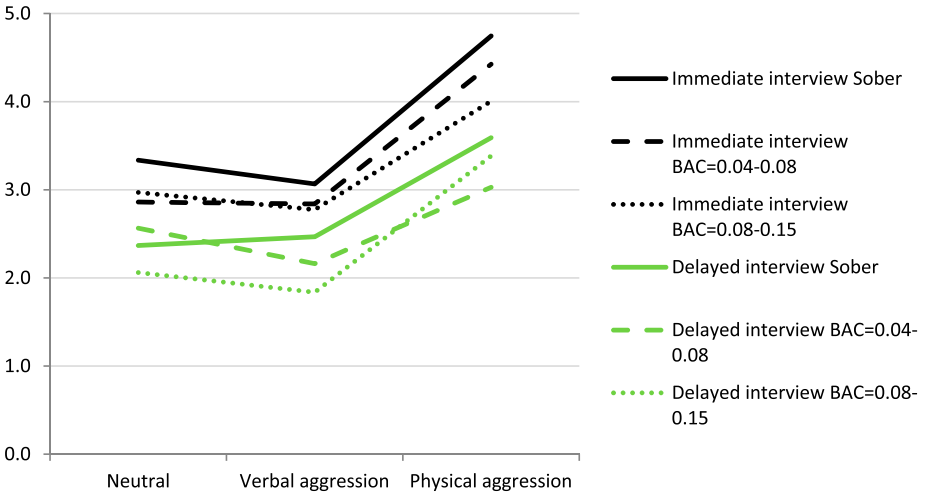

Figure 3. Detailed elaboration of gist categories reported from the neutral, verbally aggressive and physically aggressive context by beverage condition and interview condition.

Discussion

The purpose of the present study was to examine if the degree of intoxication and time of interview affected the amount of reported gist-categories, and the detailed elaboration of these gist categories, from a neutral, verbally aggressive and a physically aggressive interaction within an IPV-scenario. To weigh the contribution of previous research and different theoretical explanations put forward in such previous research on intoxicated witnesses, this performance was put in relation to the impact of the entire BAC-range investigated in this study (BAC = 0.04–0.15) on some aspects of witnesses' cognitive capacities relevant to memory performance. Overall, both sober and intoxicated witnesses reported approximately only half of the IPV-scenario on a gist level, which is in line with their reporting approximately half of the words in the memory task. Combined, the gist/detail results indicated that all witnesses were more gist-oriented when they reported about the neutral/verbally aggressive interaction, *but* that they chose/only remembered certain aspects and reported these in more detail when reporting about the physically aggressive interaction. Despite this similar pattern between sober and intoxicated witnesses, both the amount of gist categories and the detailed elaboration of these gist categories decreased with rising BAC.

Part I: memory capacity and information processing performance

Information processing speed and accuracy

The present study showed that intoxication (BAC = 0.04–0.15) only reduced some aspects of information processing capacity. While information processing speed was not reduced among intoxicated witnesses, their accuracy was lower. This was in part anticipated (see Hypothesis 1), since it indicates a quantity-accuracy trade-off between speed and accuracy among intoxicated witnesses. However, that this trade-off was apparent already at moderate level (BAC 0.04–0.08), and that the trade-off occurred in the opposite direction,

since intoxicated witnesses lowered their accuracy while maintaining their speed of processing, was not anticipated. These results lend support to the well documented fact that during higher BAC-levels, intoxication increases cognitive load and reduces efficacy of cognitive processing ability (see Ryback, 1971; White, 2003), which decreases the scope of the witnesses' cognitive abilities to perceive, associate and encode incoming information. The results showed that the impact of alcohol was dose dependent, and that intoxication already at BAC-0.04–0.08 had a negative impact on accuracy in witnesses' information processing when they maintained the same processing speed as sober witnesses.

Episodic recall and semantic elaboration

Intoxication decreased episodic memory capacity in several ways. Intoxicated persons reported fewer words from the list in total, indicating a lower episodic recall capacity. They also displayed a decreased performance regarding semantic elaboration from the implicitly presented categories and reduced specificity in identifying these categories. These results may indicate that intoxicated witnesses had a lower capacity for meaningful association and specificity, in line with the appraisal-disruption model (Sayette, 1993). However, intoxicated witnesses were less accurate during the last recall trial, and confabulated slightly more, which is in line with a considerable amount of basic research showing an impairment of alcohol on episodic memory capacity when word-list stimulus is used (Birnbaum & Parker, 1977; Maylor, Rabbitt, & Kingstone, 1987; Zoethout et al., 2011). This could indicate that somewhat more errors occur during encoding and storage of semantic information, as well as less effective monitoring judgements during its retrieval, which in turn could be related to lower capacity for extraction of meaning based gist that was found due to alcohol intoxication in the present study. That BAC was positively correlated to confabulation is interesting, and could be related to a reduced capacity for encoding and organization of incoming semantic material resulting in less precise memories in line with fuzzy-trace theory. Furthermore, in the present study, the participants were informed that the to-be-remembered words adhered to different categories. Lampinen et al. (2006) showed that adults memory performance did not benefit from getting such information (i.e. of a common and meaningful semantic denominator) since they already use this global gist mechanism automatically. However, children in 3rd grade were aided by this instruction, resulting in reduced reporting of confabulated words, but 1st graders were not aided by such information, presumably because they habitually use local gist instead of global gist to extract meaning. This is interesting since the present results would indicate that the higher the level of intoxication, the less prone (and perhaps also less able) the witness would be to use global gist to make sense of the witnessed event. This could be interpreted as supporting the idea of intoxicated witnesses basing their recall output on 'islands of memory', that they are making sense of the witnessed information using local gist instead of global gist to a larger extent than sober witnesses. In other words, it is possible that they base their decision of reporting a piece of information based on its familiarity with a specific other piece of information (i.e. using local gist) instead of a shared sense of familiarity with many other items (i.e. using global gist), which would create problems with binding different pieces of information together into a cohesive and meaningful description of the event.

Memory of the overall IPV-scenario and confidence in such recall

In line with hypothesis 2, intoxication reduced witnesses' episodic recall of the original information on a gist level, as well as their confidence in the accuracy of their report about the witnessed IPV-scenario. This reduced confidence seemed to a certain extent be correlated with BAC, but more so with alcohol in combination with a delay before interview. Intoxicated witnesses who were not interviewed until after one week reported lower confidence in accuracy of recall compared to sober witnesses, while no significant correlation between BAC and confidence in recall was found among intoxicated witnesses interviewed immediately. Hence, these results only lend support to the assumption of a less deep and/or distinct memory traces during intoxication at this BAC level, since the reduction in confidence among witnesses who were intoxicated while witnessing the event was even more substantial when there was a temporal delay before interview. It should be noted that according to previous research, such a reduction in confidence in recall among intoxicated witnesses does not seem to be indicative of the reported information's accuracy. Previous research on intoxicated witnesses' free recall in comparable BAC-levels has found no reduction in accuracy rate among intoxicated witnesses one week after having witnessed the event that was due to alcohol, but instead found a minor reduction in accuracy rate for all witnesses (i.e. both intoxicated and sober) due to temporal delay before interview (Hagsand et al., 2017; Hildebrand Karlén et al., 2017; see Hildebrand Karlén, 2018 for a summary). This could indicate a more cautious approach among intoxicated witnesses and the results are in line with Wixted and Wells' (2017) conclusion in their analysis of witnesses' confidence in identification accuracy from lineups. Wixted and Wells (2017) concluded that the confidence level obtained directly after the first interview is most indicative of a witness' actual accuracy, and applied to the current results, this may indicate that the knowledge of having been intoxicated at the time of the witnessed event (i.e. knowing that the information was perceived under less than 'pristine' conditions, see Wixted & Wells, 2017) incline witnesses to feel comparatively even less confident in their memory of said event compared to sober witnesses when interviewed after a delay. Taken together, the combination of time and intoxication and temporal delay would lend support to the fuzzy-trace theory according to the following *hypothetical* chain of events. Memory traces become less precise during encoding as BAC-level rises, making them harder to follow back and associate to/rehearse during the retention phase and subsequently harder to recall during the interview. According to Craik and Lockhart (1972), distinctiveness of encoding and spread of activation in association networks are key concepts associated with good memory retention. Alcohol may disrupt this process by impairing maintained attention and hippocampal function (i.e. organizing elements for encoding) as well as emotional activation in relation to elements within the event (Sayette, 1999; Steele & Josephs, 1990; White, 2003; Zoethout et al., 2011), resulting in 'islands' of memory images and not in the coherent chain of events as sober witnesses with maintained cognitive abilities could create. This may also make it harder for intoxicated witnesses to hold onto their memories over time and may explain why intoxicated witnesses after a delay were less confident of their memory.

Considerations of generalizations between the tasks and the witnesses' performance

It is important to note that the memory capacity task and list of gist categories entailed a finite number of to-be-remembered words. Such a study design, previously utilized on

social drinkers' recall in a crime context (although including perpetrators instead of witnesses), has showed that intoxicated persons tend to report more erroneous information (e.g. Van Oorsouw & Merckelbach, 2012). This suggests that when asked to recall a minor amount of information using specific questions, intoxicated witnesses may be liable to report more erroneous information (even at BAC-levels 0.04–0.08; see Zoethout et al., 2011), but when allowed to freely recall an event with an abundancy of details and direct their reporting as they wish, they can maintain as high an accuracy rate in their report as sober witnesses do (see Hildebrand Karlén et al., 2014; Hildebrand Karlén et al., 2017). This is in line with previous research on intoxicated witnesses indicating that intoxicated witnesses perform differently in more structured and/or suggestive modes of interview compared to in free recall (e.g. Crossland et al., 2016; Flowe et al., 2016; Hagsand et al., 2017; Schreiber Compo et al., 2012). Hence, the present results do not negate the relevance of quantity-accuracy trade-off for understanding free recall performance by intoxicated witnesses, but based on the present results the relevance of this theory for intoxicated witnesses may be limited to a free recall interview structure of an event which entail a lot of information. The present results also illustrate a potential contribution of fuzzy-trace theory to this issue: due to increased cognitive load by intoxication, an intoxicated person cannot process information as fast *and* as accurately as a person who is not under cognitive strain (e.g. sober) when reporting about a certain event. During free recall of an event which entails a lot of information, this is less problematic since he/she can direct the report and talk less about the aspects he/she is more unsure of. However, when he/she is asked to recall a more limited amount of specific information, the impairing effects of alcohol may become evident already at a moderate BAC-level.

Part II: gist and detail elaboration in different emotional contexts

In line with hypothesis 3, intoxicated witnesses reported information from fewer gist categories, as well as elaborated them less, in all three contexts compared to sober witnesses. This indicates that intoxication lowered the general ability to recall information on both a gist and detail-level, regardless of the stimulus material's emotional context. However, it should be noted that the recall ability was considerably more impaired when reporting gist categories ($\eta^2 = 0.25$) compared to their detailed elaboration ($\eta^2 = 0.05$). Since this effect of alcohol seems to be relatively linear, larger effects might be expected on both a gist and a detail-level when BAC increases further (Curran, 2006; Mintzer, 2007; White, 2003).

Research has shown that intoxication creates cognitive load which, according to quantity-accuracy trade-off, should cause intoxicated witnesses to either sacrifice accuracy for quantity or quantity for accuracy in their reports (Koriat et al., 2000; Koriat & Goldsmith, 1996). In previous studies on intoxicated witnesses to violence during free recall conditions, the last pattern has been indicated (see Hildebrand Karlén et al., 2014; Hildebrand Karlén et al., 2017; Pansky & Nemets, 2012). According to basic alcohol research and fuzzy-trace theory, intoxication should make witnesses prone to 'losing' information in the encoded chains of events, due to decreased maintained attention *and* to a reduced ability to associate/elaborate (Sayette, 1993; Steele & Josephs, 1990; White, 2003). Both these assumptions were supported by the present results.

Impact of intoxication and emotional context and of their interaction

The effect of *level of emotionality* on level of detail was strong. All witnesses elaborated the reported gist categories in more detail when it originated from the physically aggressive context compared to from the neutral and verbally aggressive context. This indicates that all witnesses (even with BAC 0.08–0.15), while witnessing physically aggressive behavior focused their attention and/or reported more on these gist aspects as well as elaborated them in more detail. Seen in the light of the results showing that all witnesses reported more gist categories (but elaborated in less detail) from the neutral/verbally aggressive context, while they reported less gist categories (but in more detail) from the physically aggressive context, there seems to be a selective focus on some gist categories and their details while witnessing physical aggression. Hence, it could be argued that a more 'coarse grained' level of reporting was used by both sober witnesses and intoxicated witnesses at these BAC-levels when reporting about the neutral/verbally aggressive interaction, but a more 'fine grained' level was used when reporting about the physically aggressive interaction. Considered from a dual process perspective, Gomes et al. (2013) found that recall for negative stimuli, compared to neutral, were chiefly supported by non-recollective processes which are more reliant on gist processing and especially so when arousal was high. They claimed that emotional valence is a conceptual gist that people often rely on to reconstruct past events and that to have experienced an negative emotional state while witnessing a stimuli then could provide a base for reconstruction of missing elements from that episode. This process could make reconstruction more efficient through limiting the potential output (i.e. only things that evoke negative emotions are considered) and/or increase the strength of familiarity signals). These results are interesting when considering the effect of intoxication on reporting of gist from different emotional levels in the present study. The results were partly in line with hypothesis 4, showing that intoxication had a strong effect on amount of reported gist categories and the profile was similar in nature to the above mentioned effect of level of emotionality. Hence, high intoxication decreased the reporting of gist primarily in the verbally and physically aggressive contexts compared to sober witnesses, but these witnesses still elaborated information from the physically aggressive context in most detail. This combination of results indicates that for intoxicated witnesses, a stronger focus on detailed elaboration of some gist parts comes at the cost of omitting other gist parts of the physically aggressive context. Hence, this pattern (i.e. less reported gist categories, but a more detailed elaboration of the ones reported) is in line with quantity-accuracy trade-off for intoxicated witnesses, but contrary to the results by Gomes et al. (2013). In the present study, a trade-off between gist reporting/detail elaboration seems to have occurred in reporting of the physically aggressive stage, which indicate that intoxicated witnesses during these free recall interview conditions seemed to monitor the reliability of their recalled information before reporting. This would result in a selective reporting of the bits of information that they remember well in highly detailed manner, omit those of which memory is poor or lacking, and for the rest, adjust the reported information's grain-size to match the perceived current ability for source memory specificity. Presumably, this effect is due to a combination of less ability to maintain attention and associative/elaborative abilities discussed previously. This combination of results also nuances the picture of intoxicated witnesses' ability to report further, and suggest that intoxicated

witnesses are most at a disadvantage on a gist-level, especially when they are recalling the verbally and physically aggressive aspects of events, they miss or do not report as many parts of the 'overall picture' as sober witnesses do.

Regarding the effect of *intoxication* on level of detail of information with different levels of emotionality, intoxication only had a minor effect. However, the results showed that that emotional activation still guided these witnesses' evaluation of the event to some extent – that the physically aggressive stage was the most important to focus on during the event to elaborate upon during the interview. Based on the obtained effect sizes, intoxicated witnesses' ability to do this is only somewhat impaired at these BAC-levels. This pattern of results is supported by research on reduced hippocampal- and frontal lobe function during intoxication. Reduced glutamate activity in these areas reduces the ability to organize the various details in order and comprehend the bigger picture in an event. This may create the obtained pattern of encoded 'islands' of memory fragments, or 'gist-categories', that intoxicated witnesses encode at a reasonably detailed level compared to sober witnesses, even though some gist categories/details seem to be lost due to intoxication. Such a disjointed encoding process among intoxicated witnesses is in line with results obtained from witnesses under stress, and the resulting string of 'snapshot images' with low degree of internal coherence would also reduce these witnesses' ability to activate previously stored memories of similar events and understand the event better based on these.

The detrimental effect of time

Last, but perhaps with most important implications for legal practitioners, the present study indicated similar, but more severely negative, effects of time on both a gist and detail level compared to alcohol intoxication (which was in line with hypothesis 5). Previous research has been suggested that the effect of intoxication on memory recall is similar to the effect of temporal delay (Craik, 1977; Hildebrand Karlén et al., 2017), and effect sizes have indicated that the negative effect on report completeness due to interview delay is more comprehensive than the corresponding negative impact of alcohol at these BAC-levels in an immediate interview (Hagsand et al., 2017; Hildebrand Karlén et al., 2017; Yuille & Tollestrup, 1990). The results from the present study showed that witnesses interviewed after one week delay reported fewer gist categories and to a certain extent lowered their reported level of detail for each gist category. According Reyna et al. (2016), time normally reduces the amount of details a person can remember while the gist of the event is maintained over time, which makes these results important to note since they indicate that time affected both sober and intoxicated witnesses' elaboration negatively on *both* a gist and a detail level. For sober witnesses in the present study, interview delay primarily affected reporting of gist from observed verbal and physically aggressive behavior, but the combination of intoxication and interview delay decreased the amount of information reported on both gist and detail-level from the entire scenario. Furthermore, these results have implications for the way that eyewitness memory is handled in the legal system, since police interviews often occur a long time after the event. Notably, after only 10 min of delay before a free recall interview, even sober witnesses only reported information from 57% of the event's total amount of gist-categories. It is possible that this result is an effect of free recall and that open/closed specific questions may have exerted more information, but research has shown that being able to

control the focus of the report (Pansky & Nemets, 2012) as well as 'grain-size' of their answers (Goldsmith, Koriat, & Pansky, 2005) within a free recall setting used made report accuracy decline at a more modest rate when investigated again after one week. That only minor effects on accuracy rates have been found in studies on intoxicated witnesses using free recall format after one week delay supports this assumption (e.g. Hagsand et al., 2014; Hildebrand Karlén et al., 2017; Yuille & Tollestrup, 1990). Based on the results in the present study, such a rise in error rates among both sober and intoxicated witnesses after one week as found in such previous studies, is likely related to the increased use of gist processing over time (Reyna et al., 2016) that is more error prone due to use of the two-component process of reconstruction and familiarity judgement (Goldsmith et al., 2005). Nevertheless, these results are still important to consider for legal practitioners who interview or evaluate witness statements, since they indicate that even after such a short delay as ten minutes, witnesses may not spontaneously (or in fact be able to) fully report the meaningful gist aspects of an interpersonal violent event.

Limitations and future directions

Memory performance is moderated by, for example, age, level of education, drinking habits and psychiatric problems, which makes generalization to other demographic groups than the one outlined in the 'Participant'-section problematic, and would require further replication. Due to that no differentiation was made in the design between perpetrator/man and victim/woman, it is not clear from the present study if the differences in reporting of social behavior was due to that the gender of the victim or the role of the victim in such a situation in general. This is important to investigate further to investigate if generalization of the present results also can be made to situations of interpersonal violence in general or IPV between same sex parties. Furthermore, it should be noted that a substantial number of persons who expressed interest to participate did not meet the inclusion criteria in screening stage 1, particularly due to too low alcohol consumption. To be able to drink the present dose during the allotted 15 min, it was considered important that the participants were experienced social drinkers to minimize aversive consequences. This emphasizes that generalization of the present results is limited to social drinkers who drink alcohol regularly (AUDIT = 3–14).Since no placebo group was used in the present study, the present results cannot separate expectancy effects from the pharmacological effects of alcohol alone. Hence, generalization of the results is limited to persons who knowingly have been drinking alcohol.

Regarding the memory tasks included in the present study, it could be argued that they are not specific in testing mutually exclusive cognitive abilities. However, these tasks have been modeled after Reyna and Brainerd (1998) and their overall design is therefore previously tested within the theoretical framework used in the present study. Another limitation with the present study is that differentiating a gist category from a detail in a general manner is always difficult. Therefore, it is important that future studies on the subject describe their definition of gist 'in detail' to be able to interpret the results in light of the definitions used. In future studies, persons with substance abuse problems should also be investigated since they often are represented in IPV reported to the police and since long-term effects of alcohol exposure often creates qualitative differences in

cognition compared to acute intoxication in social drinkers. Finally, the effects of other interview conditions (e.g. open questions, varieties of cued recall formats), less/more emotional as well as more limited stimulus material on gist/detail elaboration should also be investigated since the present study indicates that intoxication might affect recall of specific information from a limited and neutral source in another manner. For example, other study designs where intoxicated witnesses' performance is checked against a pre-set list of required information to be reported from the event may incline these witnesses to report more erroneous information. In such designs, quantity-accuracy trade-off is questionable as a theoretical construct, while the present study indicates that in a free recall format, it seems to have explanatory value when BAC = approx. 0.08–0.15.

Conclusions

Within an applied witness context, intoxication (BAC = 0.04–0.15) seems to impair cognitive capacities relevant to witnesses' information processing and episodic recall regarding: a) diminished ability to process the same amount of information; b) diminished ability to process the incoming information; and c) altered performance regarding gist/detail-reporting in a free recall interview due to the emotional character of the stimulus. However, even though intoxicated witnesses reported less information from all emotional contexts on both a gist and detail level, they seemed to 'prioritize' in the same manner as sober witnesses, to report more detailed information from the physically aggressive context. The results indicated that intoxicated witnesses focus their reporting toward aspects of the event that they remember well and that their performance was negatively affected by alcohol on both gist and detail level. However, reporting at a gist-level was more impaired, which might indicate that the effect of alcohol on maintained attention is more severe than alcohol's effect on ability to associate within the present design. Furthermore, intoxicated witnesses were affected by level of emotionality in the stimulus in roughly the same manner as sober witnesses, with a more detailed elaboration of gist categories regarding the physical aggression. Nonetheless, intoxication lowered the amount of gist categories elaborated during the physically aggressive and verbally aggressive context in a pattern consistent with assumptions within quantity-accuracy trade-off. Despite these impairing effects of intoxication, time proved to have an even more detrimental effect on all witnesses' recall on both a gist and detail level. The present study showed that it is more detrimental for a witness' memory performance, on both a gist and detail level, to delay the interview one week than for that witnesses to have been intoxicated while witnessing the event. This calls into question both that intoxicated witnesses are considered less credible within the legal system, as well as the idea of delaying interviews with intoxicated witnesses at these BAC-levels. It is important to note that since a temporal delay had a larger effect on memory on both a gist and detail level than intoxication at the present levels, the results suggest that even if a witness is intoxicated, s/he should be interviewed as soon as possible after the event. Taken together, the present results indicate that the reduced memory capacity of intoxicated witnesses is due to a recall reduction on both the gist and the detail level, but while watching interpersonal physical aggression, intoxicated witnesses seem to focus on some aspects of the event in detail, while neglecting other aspects entirely.

Notes

1. To clarify, the use of the term association within this theory denotes meaningful association, not meaningless, and is therefore compatible with fuzzy-trace theory (see Reyna et al., 2016).
2. It should be noted that data derived from the interviews that is the basis of this part of this study has been presented previously (see Hildebrand Karlén et al., 2017), but the data in the present sample stems from a coding of gist/detail of these interviews which has not been presented in any previous publication.

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