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Eyewitness memory: The impact of a negative mood during encoding and/or retrieval upon recall of a non-emotive event

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Abstract

The police often appeal for eyewitnesses to events that were unlikely to have been emotive when observed. An eyewitness, however, may be in a negative mood whilst encoding or retrieving such events as mood can be influenced by a range of personal, social, and environmental factors. For example, bad weather can induce a negative mood. This experiment compared the impact of negative and neutral moods during encoding and/or retrieval upon eyewitness recall of a non-emotive event. A negative mood during encoding had no impact upon the number of correct details recalled (provided participants were in a neutral mood at retrieval) but a negative mood during retrieval impaired the number of correct details recalled (provided participants were in a neutral mood at encoding). A negative mood at both time points enhanced the number of correct details recalled, demonstrating a mood-dependent memory enhancement. The forensic implications of these findings are discussed.

Keywords: eyewitness testimony; memory; mood; emotion; mood-dependent

Eyewitness memory: The impact of a negative mood during encoding and/or retrieval upon recall of a non-emotive event

The police often appeal for eyewitnesses to events that were unlikely to have been emotive when observed. For example, a recent appeal on the London Metropolitan Police website (accessed March 21st, 2015) sought eyewitnesses who may have seen an unidentified male suspect stood next to a lamppost in a residential street an hour before a murder took place in a nearby home. It is easy to imagine an eyewitness in this instance, such as a member of a neighbourhood watch scheme who lives on the street and who routinely pays attention to all strangers in the area, intentionally remembering this man/his actions in case it was necessary to recall this information later. Observing such an event is unlikely to induce a negative mood. Subsequently learning that such an event is related to a crime may invoke a negative mood that is then present during a police interview but this will depend upon a range of factors such as the nature of the crime and individual differences in the way moods are experienced (Davidson, 1998). Regardless of whether or not an event induces a negative mood during encoding or retrieval, an eyewitness may already be in a negative mood at either time point as mood is sensitive to a range of personal, social, and environmental factors. For example, negative moods can be induced by bad news (Veitch & Griffitt, 1976) and bad weather (Forgas, Goldenberg, & Unkelbach, 2009).

It is important to establish whether or not a negative mood during encoding and/or retrieval can influence eyewitness recall of a non-emotive event as the completeness and accuracy of eyewitness statements during police interviews can determine an investigation's success (Fisher, McCauley, & Geiselman, 1994). Whilst police interviewers cannot influence an eyewitness's mood during encoding, they can, and are often encouraged to, influence their mood during retrieval. For example, the United Kingdom's Ministry of Justice (2011) recommends police interviewers start with "some neutral questions not related to the event

which can be answered positively and, therefore, create a positive mood" (p. 70) although it is also stated that "interviewers should be aware that it is neither desirable nor essential to discuss neutral topics in every interview" (p. 71). Interviews can therefore commence irrespective of an eyewitness's mood. Mood states are not formally assessed during interviews and the consequences of having an eyewitness freely recall a non-emotive event whilst in a negative mood are unknown. If a negative mood during retrieval can impair recall then it may be best practice to commence all interviews by assessing an eyewitness's mood and trying to establish a neutral mood. If it is not possible to establish a neutral mood then it may be worth conducting a second interview at a later date if the negative mood is likely to have dissipated by then. It is also important to establish whether or not a negative mood during encoding impacts upon eyewitness recall of a non-emotive event. If mood during encoding proves unimportant but mood during retrieval impairs recall, then this would indicate that the aspect of an eyewitness's mood that interviewers can influence is crucial if complete and accurate statements are to be obtained. For similar reasons, it is also important to determine whether or not a negative mood at both time points can interact to influence recall. The present experiment therefore investigates these issues by examining the impact of a negative mood during encoding and/or retrieval upon eyewitness recall of a non-emotive event.

Mood and eyewitness memory

A large number of studies have investigated eyewitness recall of emotive events that induce a negative mood during encoding. When the recall performance of these eyewitnesses is compared to that of eyewitnesses who recall matched non-emotive events, the former typically have enhanced recall of spatially central details that were in the foreground of the events (e.g., a protagonist's clothing or actions) but an impaired recall of spatially peripheral details that were in the background of the events (e.g., the surrounding environment; see

Levine & Edelstein, 2009, for a review). Christianson (1992) suggests that the arousal caused by emotive events leads to attentional narrowing whereby eyewitnesses focus on central details at the expense of peripheral details. Laney, Campbell, Heuer, and Reisberg (2004) later demonstrated that this is most likely to occur when emotive events contain salient arousing central details (e.g., a weapon) as they act as "attention magnets".

More recently, Houston, Clifford, Phillips, and Memon (2013) showed participant eyewitnesses a video of a mugging that was emotive enough to induce a negative mood and then examined their recall of four forensically relevant categories of information. Three of these categories were central details (descriptions of the perpetrator, the victim, and their actions during the event) and one was a peripheral detail (the crime environment). In comparison to controls who watched a matched non-emotive video (where the "perpetrator" and "victim" from the emotive video had a conversation only), participants provided a more complete description of the perpetrator but a less detailed description of his actions. This suggests that emotive events which induce a negative mood may enhance recall of one type of central detail but impair recall of another and that a comparison of different types of central details in future research is important.

Whilst advances have been made towards understanding eyewitness recall of emotive events, it seems unlikely that the effects observed within this literature would also be observed when examining the impact of a negative mood during encoding and/or retrieval upon eyewitness recall of non-emotive events. For example, non-emotive events are unlikely to have "attention magnets" that would enhance recall of central details at the expense of peripheral details. Whilst the impact of a negative mood at each time point upon eyewitness recall of non-emotive events has not previously been examined, the impact of a negative mood during encoding and/or retrieval upon recall of non-emotive materials such as word lists and prose has been investigated in the wider memory literature. Theoretical models have

also been developed that predict how a negative mood at each time point could influence eyewitness recall. An overview of these models is therefore provided next.

Negative moods during either encoding or retrieval

When investigating the impact of a negative mood during encoding or retrieval upon recall of non-emotive information, researchers typically induce participants into temporary moods at either time point by exposing them to mood-congruent materials such as video clips, music, or prose (see Westermann, Spies, Stahl, & Hesse, 1996, for an overview). Using these techniques, it has been found that a negative mood during encoding or retrieval can create selective recall impairments. Ellis and Ashbrook's (1988) Resource Allocation Model can explain the conditions under which a negative mood at encoding or retrieval can impair recall. Their model suggests we have a limited pool of attentional resources available for memory processing. It also suggests that a negative mood invokes task irrelevant thoughts and the processing of these thoughts utilises these same attentional resources. These irrelevant thoughts therefore reduce the amount of attentional resources available for memory processes and this can impair recall. In support of these assumptions, Ellis, Moore, Varner, Ottaway, and Becker (1997) and Seibert and Ellis (1991) found that participants induced into a negative mood prior to encoding produced more irrelevant thoughts throughout a memory test than neutral mood participants and that the number of irrelevant thoughts generated was negatively correlated with their recall performance. The model also suggests that some memory processes demand more attentional resources than others. If a person is in a negative mood whilst completing a demanding memory process, then the resources required for this process may exceed those that are available and recall will be impaired. What constitutes a demanding memory process differs for encoding and retrieval and is considered next.

An individual can utilise a number of different encoding processes to try and remember new information. The Resource Allocation Model suggests these processes differ

in terms of the amount of attentional resources they require. Ellis, Thomas, and Rodriguez (1984) identified two types of encoding processes that are demanding enough to be disrupted by a negative mood. In their first experiment, Ellis et al. had participants complete a task that promoted elaboration of to-be-remembered target words at encoding. Elaboration is the process of associating to-be-remembered information with pre-existing knowledge. Elaboration enhances recall as it increases the number of retrieval cues that are effective for recalling the to-be-remembered information (e.g., Craik & Tulving, 1975; Stein, Morris, & Bransford, 1978; Stein & Bransford, 1979). In their third experiment, Ellis et al. encouraged effortful decision making about to-be-remembered target words during encoding. When individuals make effortful decisions about to-be-remembered information during encoding then they are more likely to later recall this information as it will have been processed more deeply (Hertel, 1989; Tyler, Hertel, McCallum, & Ellis, 1979). In both experiments, Ellis et al. found that participants in a negative mood during encoding recalled fewer target words than neutral mood controls (see also Ellis, Varner, Becker, & Ottaway, 1995; Seibert & Ellis, 1991). These impairments occurred as the features of the encoding tasks that typically enhance recall, such as creating additional retrieval cues during elaboration, could not be processed due to the reduced attentional resources that arose from being in a negative mood. Importantly, when negative mood participants engaged in non-elaborative encoding or made low-effort decisions then their recall matched that of neutral mood controls (Ellis et al., 1984; see also Ellis, Seibert, & Varner, 1995; Ellis et al., 1997)[1]. Thus, when participants engage in less demanding encoding processes a negative mood has no impact upon recall.

The Resource Allocation Model also suggests that the act of retrieval is demanding enough so that a negative mood will impair recall. To our best knowledge, only two studies have focussed specifically upon the impact of a negative mood during retrieval upon recall of non-emotive stimuli and both support this suggestion. In the first, Ellis, Thomas, McFarland,

and Lane (1985) had participants complete a task that either did or did not promote elaboration of to-be-remembered target words during encoding. When participants were induced into a negative mood during retrieval they recalled fewer target words than neutral mood participants, irrespective of whether they had engaged in elaboration or not. In the second study, Roos and Gow (2007) had participants read a non-emotive story and then freely recall it twice, first whilst in a neutral mood and then a week later whilst in a negative or neutral mood. On the second memory test, those in a negative mood recalled less.

Negative moods during both encoding and retrieval

A matched negative mood state during encoding and retrieval can sometimes produce an effect known as mood-dependent memory (MDM). Eich and Macaulay (2000) describe this as "the observation that events encoded in a certain mood are most retrievable in that mood, irrespective of the events' valence" (p. 244)[2]. Bower developed the Associative Network Theory of Memory and Emotion (henceforth called Associative Network Theory) to explain the cognitive processes responsible for MDM and the conditions under which the effect is most likely to be observed (Bower, 1981, 1992). In explaining why MDM occurs, Associative Network Theory draws on semantic-network models of long-term memory (Anderson & Bower, 1973; Collins & Loftus, 1975). According to these models, memory consists of "nodes" that hold information about distinct concepts. If two concepts are associated (e.g., the concepts of "doctor" and "nurse") connections are conceptualised as existing between them, thus making up a network of associated information. Whenever a person thinks, hears or sees a concept then the appropriate node is activated. Moreover, activation spreads out from that node to associated nodes, with those most closely associated receiving the strongest activation. If the associated nodes receive sufficient activation they become available to conscious retrieval. If a person experiences a novel event that activates concept nodes that have never previously been activated together then new associations are

formed between them. For example, an eyewitness may see a man in a blue jacket rob a woman. In this instance, the concept nodes for “man”, “blue”, “jacket”, “robbed” and “woman” are activated. If the eyewitness had never previously encountered such an event then these concepts would become associated. If the eyewitness is later asked what the man in the blue jacket did, the “man”, “blue” and “jacket” nodes would activate the “robbed” and “woman” nodes and the event would be recalled.

Associative Network Theory suggests that distinct mood states such as joy, fear, and depression have their own nodes. If an individual is experiencing a mood when encoding an event, the concept nodes and the relevant emotion nodes both become activated and the two form a weak association. Thus, if the eyewitness from the above paragraph is in a depressed mood when encoding the robbery then the node for this emotion becomes associated with the concepts nodes. If the eyewitness is later asked what the man in the blue jacket did and is in a depressed mood at the same time, both the appropriate concept nodes and the emotion node would activate the “robbed” and “woman” nodes. The extra source of activation from the emotion node makes the concepts more accessible to conscious retrieval. The theory can also explain why a neutral mood at both encoding and retrieval produces no MDM. There are no hypothesised “emotion nodes” for a neutral mood in the network that can become associated with activated concept nodes during encoding.

MDM effects are not robust and are most likely to occur when experiments include several specific testing conditions (see Bower, 1992, and Eich, 1995, for comprehensive reviews). As not all of these conditions are present in the current experiment, and this will influence the hypotheses generated, a brief overview of each and the reasons why they increase the likelihood of MDM occurring is provided. First, MDM is most likely to occur when to-be-remembered information is self-generated in comparison to when it is generated by a researcher (Eich & Metcalfe, 1989; Beck & McBee, 1995). Associative Network Theory

explains this by suggesting that when an individual is induced into a mood state and the relevant emotion node is activated, concept nodes associated with this emotion node are automatically activated. If asked to generate to-be-remembered information, concepts that are already closely associated with the emotion node (and therefore already activated) are most likely retrieved. If, however, the individual is provided with to-be-remembered information, there is a greater likelihood that there will be no pre-existing association between the emotion node and the concept and only a weak link will be formed. If an individual is later asked to recall both types of to-be-remembered information when in the same mood as during encoding, the self-generated information receives the greatest activation as it is more closely associated with emotion node and is therefore more likely to be retrieved.

Second, MDM is most likely to occur when memory is assessed via free recall tests than cued recall or recognition tests (Eich & Metcalfe, 1989; Kenealy, 1997). Associative Network Theory explains this by suggesting that cued recall and recognition tests contain their own powerful retrieval cues that bypass the emotion nodes and automatically activate relevant concept nodes during retrieval. Thus, when the need for retrieval cues is minimised, the impact of the emotion node as a retrieval cue is diminished and the type of mood participants are in has less influence. Free recall tests do not typically have retrieval cues that can activate concept nodes. The activation provided by emotion nodes during free recall tests is therefore beneficial to retrieval.

Third, MDM is most likely to occur when an induced mood is both strong and stable (Eich Macaulay, & Ryan, 1994; Eich & Metcalfe, 1989; Ucros, 1989). Associative Network Theory suggests stable moods are important as they increase the likelihood that all concept nodes become associated with the relevant emotion node during encoding and that these associations remain active throughout retrieval. If induced moods are strong, then the

emotion nodes send greater activation to the concept nodes at both time points, strengthening the links during encoding and providing a stronger cue during retrieval.

Finally, MDM is most likely to occur when negative moods at both encoding and retrieval are compared to incongruent moods at either time point (e.g., a negative mood during encoding and a positive mood during retrieval) than when compared to an incongruent negative and neutral at either time point (see Ucros, 1989, for a meta-analysis). Associative Network Theory explains this by suggesting incongruent positive and negative moods at each time point interfere with recall and this is more likely to create a statistically significant difference when performance is compared to a congruent negative mood at both time points. Interference occurs as the concepts nodes have become associated with a specific emotion node (e.g., depression) during encoding. When in a different mood state during retrieval (e.g., joy), concept nodes associated with this different mood state are automatically activated. These are unlikely to be the same concepts nodes that were associated with the different mood state during encoding and they interfere with the recall of the concepts nodes from encoding. In contrast, an incongruent neutral mood at one time point only (e.g., a negative mood during encoding and a neutral mood during retrieval) causes no interference as there are no "neutral mood" nodes that activate irrelevant concept nodes.

Aims and hypotheses

The present experiment investigated whether or not eyewitness recall of a non-emotive event is influenced by an induced negative mood during encoding and/or retrieval. A non-emotive video showing an interaction between a man and a woman was used as the to-be-remembered event. As in many eyewitness memory studies (e.g., Memon, Wark, Bull, & Koehnken, 1997; Stein & Memon, 2006, and Houston et al., 2013) correct recall of forensically relevant categories of information was assessed, focussing on two types of central detail (the physical descriptions and actions of the protagonists) and one type of

peripheral detail (the event environment). From a forensic perspective, it is helpful for police interviewers to know whether or not a negative mood at encoding and/or retrieval differentially impacts upon recall of these three types of event detail. For example, if a negative mood at retrieval impairs recall of an event environment, which may not be forensically important during a police investigation, but impairs recall of the physical descriptions of a protagonist and his or her actions, which may be forensically important during a police investigation, then it may be best practice to try and establish a neutral mood at the start of all interviews. It is important to emphasise that there is no a-priori reason to expect a negative mood to differentially effect recall of these three event detail types and these analyses should be considered exploratory. Consequently, the following hypotheses do not discriminate between the three event detail types.

A negative mood during encoding was not expected to impair eyewitness memory. This prediction is consistent with the Resource Allocation Model (Ellis & Ashbrook, 1988) which suggests that impairments are unlikely to occur when encoding is undemanding. Whilst the demands of the encoding task were not assessed here, the encoding is comparable to that of other studies where it was also classed as undemanding and in these same studies a negative mood during encoding had no impact upon the recall of non-emotive materials (Ellis et al., 1984, 1995, 1997). It was also predicted that a negative mood during retrieval would impair eyewitness memory. This prediction is consistent with both the Resource Allocation Model, which suggests a negative mood at retrieval impairs recall of non-emotive information, and past research demonstrating such an effect (Ellis et al., 1985; Roos & Gow, 2007). Finally, it was possible to entertain competing hypotheses with regards to whether or not a negative mood during both encoding and retrieval would produce MDM. Several of the testing conditions identified by the Associative Network Theory (Bower, 1981, 1992) as likely to produce such an effect are present in this experiment but several are also absent.

With regards to the former, the present experiment assessed memory via free recall and this can increase the likelihood of MDM (see Eich & Metcalfe, 1989; Kenealy, 1997). To foreshadow our results, the present experiment also had strong and stable moods and these can increase the likelihood of MDM (Eich Macaulay, & Ryan, 1994; Eich & Metcalfe; Ucros, 1989). With regards to the latter, the to-be-remembered material was experimenter generated and this can reduce the likelihood of MDM (Eich & Metcalfe; Beck & McBee, 1995). The impact of a negative mood at both time points was also being compared to a neutral mood at both time points and this can also reduce the likelihood of MDM (Ucros).

Method

Participants

There were 144 participants (109 females, 35 males) aged 18 - 45 (M = 21.54, SD = 5.92). They were randomly allocated to four equal-sized groups that differed according to whether neutral or negative mood states were induced prior to encoding and retrieval. All reported good or very good health on an author generated five-point Likert scale (1 = very bad health; 2 = bad health; 3 = okay health; 4 = good health; 5 = very good health) and none reported taking medication that can influence mood. They were screened for symptoms of anxiety or depression using The Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) as pre-existing depressive mood states could interfere with the moods we were trying to induce. The HADS is a brief self-report questionnaire designed to measure generalised symptoms of anxiety and depression in non-psychiatric hospital clinics. It consists of two subscales, anxiety and depression, each containing seven items scored on a four-point Likert scale (0–3). Scores of eleven and above on either subscale are considered abnormal. The HADS has good reliability and validity (see Mykletun, Stordal, & Dahl, 2001; Bjelland, Dahl, Haug, & Neckelmann, 2002). No participants HADS scores fell within the

abnormal range and the four groups did not differ in self-rated anxiety, $F(3, 140) = 1.04$, $MSe = 3.96$, $p = .38$, $\eta_p^2 = .02$, or depression, $F(3, 140) = 0.49$, $MSe = 3.37$, $p = .69$, $\eta_p^2 = .01$.

Stimuli

Mood Induction Materials. Moods were induced using four video clips (two negative, two neutral) that lasted 6 - 8 min. The negative videos were the execution scene from the movie Dancer in the Dark and the death scene from the movie The Champ. The neutral videos were from nature documentaries with the first being a scene about deserts from the programme Planet Earth, and the second being a scene about the Galapagos Islands from the programme Life on Earth. These videos were selected as the content does not in any way overlap with that from the to-be-remembered non-emotive critical event video (discussed below), meaning they should not provide any information that could inadvertently contaminate participants' memory of the non-emotive event.

Mood Assessment Materials. The effectiveness of the videos at inducing moods was assessed using the valence subscale of the Self-Assessment Manikin (SAM; Lang, 1980; Bradley & Lang, 1994). This is a validated non-verbal nine-point pictorial assessment scale that directly measures a person's affective reaction to stimuli. Each of the nine points on the scale is accompanied by a humanoid figure whose expression changes from frowning and unhappy at the lower end of the scale to smiling and happy at the high end of the scale. Participants circle the point of the scale which best represents their current mood. The SAM has good reliability and validity (see Bradley & Lang; Greenwald, Cook, & Lang, 1989; McManis, Bradley, Berg, Cuthbert, & Lang, 2001). For comparative purposes, it should be noted that neutral moods are slightly higher than the midpoint of the scale (e.g., 6.20) as healthy non-depressive people have a slight positive mood bias (Bless, Schwarz, Clore, Golisano, & Rabe, 1996). We have previously used these same videos and the SAM scale to

successfully induce and assess negative and neutral moods (Knott & Thorley, 2014; Schnitzspahn et al., 2014).

The Non-Emotive Critical Event Video. The neutral valence critical event video from Houston et al. (2013) was used as the to-be-remembered stimuli. The video shows a woman withdrawing money from an ATM outside a supermarket, leaving the supermarket on foot via the car park, walking down a quiet road, and entering a wooded area. In the wooded area she encounters a man who asks her the time. As the woman looks at her watch, she drops her handbag to the floor. The man picks up the handbag, the woman tells him the time, and he returns her handbag. The man then runs off to catch a bus. Finally, the woman phones a friend and arranges to meet. The video lasts 2 min 44 s. The neutral valence of the video was confirmed in a pilot study where 12 adults (aged 18 - 23) showed no significant difference in their SAM scale valence scores prior to watching the video (M = 5.83, SD = 0.72) and after watching it (M = 6.00, SD = 0.74), $t(11) = 0.48$, $p = .64$, $d = 0.22$. As these scores fall close to the SAM scale mid-point they indicate the video is non-emotive.

Procedure

Participants were tested in individual cubicles. Participants first read an information sheet about the experiment. It informed them that the experiment was investigating their perceptual ability, that they would be required to watch three short videos across two testing sessions, that their mood would be assessed in both sessions as this can potentially impact upon perceptual ability, and that they would be asked questions about the three short videos. No specific information with regards to the nature of the questions was provided. Participants then completed a consent form, socio-demographic questionnaire, health questionnaire, and the HADS. The first mood induction video was then shown[3], followed by a mood assessment with the SAM. The participants then watched the non-emotive critical event video before having their mood assessed with a second SAM. A one-week interval was then introduced to

increase the likelihood that moods induced prior to encoding would have dissipated prior to retrieval. Such a delay is forensically relevant as there can then be a potentially indefinite time period between a witness observing an event and recalling it for legal testimony (Thorley & Rushton-Woods, 2013). After the one week interval, participants returned to the same laboratory and watched the second mood induction video. Their mood was then assessed with a third SAM. Participants were then given a lined sheet of paper and told "In the second video you saw a woman leaving a supermarket. Please write down all the details that you remember from this video". There was no time limit for the recall task. Finally, participants' mood was assessed with a fourth SAM. They were then debriefed and the experiment ended.

Data scoring

A coding scheme was developed by having three experiment-blind assistants create independent transcripts capturing all of the critical event video details. These details were then classified by the three assistants and the lead author as belonging to a person (the two protagonists in the video), an action (the behaviours of the two protagonists), or the event environment. This information was then pooled to create a coding scheme. Each eyewitness statement was then blind scored against the coding scheme by the lead author, with one point awarded for each correct person, action, or environment detail recalled. For example, a statement saying "the woman in a purple jacket was using an ATM at the supermarket" contains only correct details and was coded as "the woman (person detail) in a purple (person detail) jacket (person detail) was using (action detail) an ATM (environment detail) at the supermarket (environment detail)". Recall errors were scored as either incorrect details or confabulations. Incorrect details are those that appear in the video but are described inaccurately (e.g., saying the woman's jacket was orange). These were also scored according to whether they related to people details, action details, or environment details.

Confabulations were classed as details that were not part of the video (e.g., a baby). All scored details therefore fell into one of seven categories. Digressions, subjective remarks, or excessively vague details were not scored. 25% of the eyewitness statements were then blind double-scored by an assistant. The inter-coder agreement between the first and second scorer was high (κ = .83), with disagreements resolved by accepting the first scorer's initial coding decision as correct.

Results

Mood-manipulation check

The mean valence scores, standard deviations, and 95% confidence intervals for the four mood groups are in Table 1. Valence scores after watching the neutral videos were slightly above the SAM scale mid-point and valence scores after watching the negative mood videos were below the scale mid-point, indicative of neutral and negative moods respectively. One-way between-subjects ANOVA's confirmed that the four groups' valence scores differed immediately prior to encoding, $F(3, 140) = 101.98$, $MSe = 1.30$, $p<.01$, $\eta_p^2 = .69$, and immediately after encoding, $F(3, 140) = 20.95$, $MSe = 1.27$, $p<.01$, $\eta_p^2 = .31$, with separate planned comparisons for each analysis demonstrating that the two groups who watched a negative video had lower valence scores than the two groups who watched a neutral video (both *p's* <.05). Similarly, there was a difference between the four mood groups valence scores immediately prior to retrieval, $F(3, 140) = 131.33$, $MSe = 1.16$, $p<.01$, $\eta_p^2 = .74$, and immediately after retrieval, $F(3, 140) = 17.70$, $MSe = 1.69$, $p<.01$, $\eta_p^2 = .27$, with separate planned comparisons for each analysis showing that the two groups who watched a negative video had lower valence scores than those who watched a neutral video (both *p's* <.05). Mood induction was therefore successful with medium-to-large effects observed immediately prior to encoding and retrieval. Moreover, the moods were maintained throughout encoding and retrieval although the effects diminished slightly and were small-to-medium sized at the

end of each. This is not unexpected as induced moods are typically experienced for less than 10 min (e.g., Fiedler, Nickel, Muehlfriedel, & Unkelbach, 2001; Gilboa, Roberts, & Gotlib, 1997; Varner & Ellis, 1998).

INSERT TABLE 1 HERE

Eyewitness recall analyses overview

There were seven eyewitness recall measures. These were the number of correct and incorrect people details, action details, and environment details recalled and the total number of confabulations. As discussed in the introduction, it is forensically important to examine people details, action details, and environment details separately although there is no a-priori reason to expect them to be differentially effected by a negative mood at encoding and/or retrieval and these analyses are exploratory. Each of the seven recall measures were therefore analysed separately using 2 x 2 between-subjects ANOVA's with mood during encoding (neutral, negative) and mood during retrieval (neutral, negative) as the independent variables. Significant interactions were decomposed with simple effects analyses, with a Bonferroni adjustment used to lower alpha to .0125. Table 2 contains the mean scores, standard deviations, and 95% confidence intervals for the number of correct details recalled. Across each of the four conditions, participants recalled few incorrect people details (M = 0.53, SD = 0.87, *95% CI* = 0.35 – 1.03), action details (M = 0.95, SD = 1.13, *95% CI* = 0.76 – 1.14), and environment details (M = 0.22, SD = 0.46, *95% CI* = 0.14 – 0.29) and there were only a small number of confabulations (M = 0.82, SD = 0.82, *95% CI* = 0.68 – 0.95). To save journal space, and avoid presenting readers with a long series of null effects, we simply report that none of these analyses reached statistical significance at the 0.05 level. The lead author (CT) can supply full details of these analyses upon request.

Correct recall: people details

There was a main effect of mood during encoding, $F(1, 140) = 28.16$, $MSe = 7.04$, $p<.001$, $\eta_p^2 = .17$, $1 - \beta = 1.00$, but no main effect of mood during retrieval, $F(1, 140) = 0.52$, $MSe = 7.04$, $p = .47$, $\eta_p^2 = .01$, $1 - \beta = .11$. There was a mood during encoding x mood during retrieval interaction, $F(1, 140) = 25.56$, $MSe = 7.04$, $p<.001$, $\eta_p^2 = .15$, $1 - \beta = .11$. Simple effects analyses revealed that participants recalled a comparable number of people details when in a neutral mood during both encoding and retrieval and when in a negative mood during encoding and a neutral mood during retrieval, $F(1, 140) = 0.32$, $MSe = 7.04$, $p = .86$, $d = 0.05$, $1 - \beta = .05$. Participants, however, recalled more people details when in a neutral mood during both encoding and retrieval compared to when in a neutral mood during encoding and a negative mood during retrieval, $F(1, 140) = 9.39$, $MSe = 7.04$, $p< .01$, $d = 0.91$, $1 - \beta = .86$. These first two results therefore demonstrate that a negative mood during encoding has no impact upon recall (provided participants are in a neutral mood during retrieval) but a negative mood during retrieval impairs it (provided participants are in a neutral mood during encoding). Participants also recalled more people details when in a negative mood during both time points compared to when in a negative mood during encoding and a neutral mood during retrieval, $F(1, 140) = 16.69$, $MSe = 7.04$, $p<.001$, $d = 0.82$, $1 - \beta = .98$, and compared to when in a neutral mood during encoding and a negative mood during retrieval, $F(1, 140) = 53.69$, $MSe = 7.04$, $p<.001$, $d = 1.52$, $1 - \beta = 1.00$. A matched negative mood during both time points therefore enhanced recall, demonstrating MDM.

Correct recall: action details

The findings for the number of action details correctly recalled mirror those for the number of people details correctly recalled. Once again, there was a main effect of mood during encoding, $F(1, 140) = 25.49$, $MSe = 15.82$, $p< .001$, $\eta_p^2 = .15$, $1 - \beta = 1.00$, but no

main effect of mood during retrieval, $F(1, 140) = 0.53$, $MSe = 15.82$, $p = .82$, $\eta_p^2 = .01$, $1 - \beta = .06$. There was a mood during encoding x mood during retrieval interaction, $F(1, 140) = 23.42$, $MSe = 15.82$, $p < .001$, $\eta_p^2 = .14$, $1 - \beta = 1.00$. Simple effects analysis revealed no difference in the number of action details recalled when participants were in a neutral mood during both time points compared to when in a negative mood during encoding and a neutral mood during retrieval, $F(1, 140) = 0.22$, $MSe = 15.82$, $p = .88$, $d = 0.03$, $1 - \beta = .05$. In contrast to this, participants recalled more action details when in a neutral mood during both time points in comparison to when in a neutral mood during encoding but a negative mood during retrieval, $F(1, 140) = 10.62$, $MSe = 15.82$, $p < .01$, $d = 0.90$, $1 - \beta = .90$. These two results again suggest that a negative mood during encoding has no impact upon recall (provided participants are in a neutral mood during retrieval) but a negative mood during retrieval impairs it (provided participants are in a neutral mood during encoding). Participants did also recalled more action details when in a negative mood during both time points in comparison to when in a negative mood during encoding and neutral mood during retrieval, $F(1, 140) = 12.85$, $MSe = 15.82$, $p < .001$, $d = 0.75$, $1 - \beta = .94$, and in comparison when in a neutral mood during encoding and a negative mood during retrieval, $F(1, 140) = 48.89$, $MSe = 15.82$, $p < .001$, $d = 1.67$, $1 - \beta = 1.00$. Combined, these two results show a matched negative mood at both time points produced MDM.

Correct recall: environment details

The findings for the number of environment details correctly recalled follow the same pattern as those for the number of people and action details correctly recalled. There was a main effect of mood during encoding, $F(1, 140) = 30.28$, $MSe = 4.24$, $p < .001$, $\eta_p^2 = .18$, $1 - \beta = 1.00$, but no main effect of mood during retrieval, $F(1, 140) = 0.53$, $MSe = 4.24$, $p = .47$, $\eta_p^2 = .01$, $1 - \beta = .11$. There was also a mood during encoding x mood during retrieval interaction, $F(1, 140) = 25.99$, $MSe = 4.24$, $p < .001$, $\eta_p^2 = .16$, $1 - \beta = 1.00$. Simple effects

analyses revealed that participants recalled an equivalent number of environment details when in a neutral mood at both time points compared to when in a negative mood during encoding and a neutral mood during retrieval, $F(1, 140) = 0.08$, $MSe = 4.24$, $p = .78$, $d = 0.07$, $1 - \beta = .06$. Participants, however, recalled more environment details when in a neutral mood during both time points compared to when in a neutral mood during encoding and a negative mood during retrieval, $F(1, 140) = 9.54$, $MSe = 4.24$, $p < .01$, $d = 0.93$, $1 - \beta = .87$. Combined, these effects show a negative mood during encoding has no impact upon recall (provided participants are in a neutral mood during retrieval) but a negative mood during retrieval impairs recall (provided participants are in a neutral mood during encoding). In contrast, participants recalled more environment details when in a negative mood during both time points compared to when in a negative mood during encoding and a neutral mood during retrieval, $F(1, 140) = 16.97$, $MSe = 4.24$, $p < .001$, $d = 0.82$, $1 - \beta = .98$, and compared to when in a neutral mood during encoding and a negative mood during retrieval, $F(1, 140) = 56.18$, $MSe = 4.24$, $p < .001$, $d = 1.66$, $1 - \beta = 1.00$. Again, these latter two simple effects show a matched negative mood during encoding and retrieval invoked MDM.

INSERT TABLE 2 HERE

Discussion

The present experiment compared the impact of induced negative and neutral moods during encoding and/or retrieval upon eyewitness recall of a non-emotive event. There were four principal findings. First, it was found that a negative mood during encoding had no impact upon the number of correct event details recalled (but only when participants were in a neutral mood at retrieval). Second, a negative mood during retrieval impaired the number of correct event details recalled (but only when participants were in a neutral mood at encoding). Third, a negative mood during both time points enhanced the number of correct

event details recalled. Fourth, there were few incorrect details recalled or confabulations produced and a negative mood during encoding and/or retrieval had no impact upon these.

Negative mood during either encoding or retrieval: correct recall

It was predicted that a negative mood during encoding, when participants were in a neutral mood at retrieval, would have no impact upon recall. This prediction was supported and is consistent with the Resource Allocation Model (Ellis & Ashbrook, 1988). To recap, this model assumes we have a limited pool of attentional resources available for memory processing. A negative mood invokes task irrelevant thoughts and the processing of these thoughts utilises these same attentional resources (Ellis et al., 1997; Seibert & Ellis, 1991). Negative moods therefore reduce the amount of attentional resources available for encoding and can prevent people from utilising demanding encoding processes, such as creating additional retrieval cues as a result of elaboration, that typically enhance recall (e.g., Ellis et al., 1984, Experiments 1). The model also suggests that when encoding does not require demanding processes such as elaboration, as was the case in this experiment, then the reduction in attentional resources available as a result of being in a negative mood has no impact upon recall. This suggestion is supported by several experiments whose encoding was comparable to ours (Ellis et al., 1984, Experiments 1 & 3; Ellis et al., 1995, 1997). It is possible that the null effects observed here resulted from a Type 2 error as there was a small level of achieved Power in this analysis but this seems unlikely given that the findings are consistent with existing theory and past research in the area.

It was also predicted that a negative mood during retrieval, when participants were in a neutral mood at encoding, would impair eyewitness recall. This prediction was supported and is consistent with the Resource Allocation Model which suggests that the act of retrieval is cognitively demanding enough so that the reduction in attentional resources that arises from irrelevant thought processing will disrupt performance. In support of this, and consistent

with the present findings, past studies examining the impact of a negative mood during retrieval on recall of non-emotive information have observed recall impairments (Ellis et al., 1985; Roos & Gow, 2007).

Whilst the present experiment replicates previous findings with regards to whether or not a negative mood during encoding or retrieval impacts upon recall of non-emotive information, it also offers an important methodological advancement. With the exception of Roos and Gow (2007), none of the earlier studies in the literature assessed participants' moods during both encoding and retrieval. Instead, mood was assessed prior to encoding only (Ellis et al., 1984, 1995, 1997, Seibert & Ellis, 1991) or prior to retrieval only (Ellis et al., 1985). Mood at the unassessed time-point was therefore free to vary and was not necessarily neutral. This is a shortcoming given that the MDM literature shows that mood at both encoding and retrieval can combine to have a unique influence upon recall. The present experiment controlled and assessed mood at both time points. Using this more controlled procedure it was demonstrated that the effects observed in these earlier studies are robust.

Negative mood during both encoding and retrieval: correct recall

Competing hypotheses were proposed with regards to whether or not a negative mood during encoding and retrieval would produce MDM so it was not entirely unexpected that an effect was observed. Associative Network Theory (Bower, 1981, 1992) suggests MDM is most likely to be observed when to-be-remembered information is generated by participants themselves, when retrieval is assessed via free recall, when induced moods are strong and stable, and when a congruent negative mood at both encoding and retrieval is compared to an incongruent positive and negative mood at either time point. The present experiment examined free recall, the induced negative moods were fairly strong prior to encoding and retrieval, and the negative moods were fairly stable as they remained significantly different to the neutral moods after encoding and retrieval. These conditions therefore seem to have been

sufficient to invoke MDM. Associative Network Theory can explain the MDM observed in this experiment. This theory suggests that memory contains discrete emotion nodes that are part of the same associative network as concepts nodes. When a person studies new information the relevant concept nodes become activated. If they are experiencing a mood during encoding, the relevant emotion node also becomes activated and linked to concept nodes. When later recalling the studied information in the same mood, the emotion node provides additional activation of the relevant concept nodes and this enhances recall.

Incorrect recall and confabulations

Recall accuracy and the number of confabulations produced were uninfluenced by mood in the present experiment. Across each of the four mood conditions, participants recalled few incorrect people details, action details, and environment details, and only a small number of confabulations were produced. Such a finding is typical in eyewitness memory studies where free recall is used. As demonstrated by Koriat and colleagues (see Koriat & Goldsmith, 1996), free recall produces accurate recollection as it requires self-guided retrieval, meaning that eyewitnesses typically only report information they are confident about. In contrast, cued recall and recognition require externally-guided retrieval, where the experimenter/interviewer dictates what information is important and thus what information the participant reports. This leads individuals to report information which they may not necessarily choose to report because they are unsure of it, resulting in increased errors and confabulations.

Applied implications

Knowing whether or not a negative mood can influence eyewitness recall of a non-emotive event is important as it can inform best practice during police interviews. Whilst interviewers have no control over an eyewitness's mood during encoding, they can influence mood during retrieval. Some judicial systems (such as the United Kingdom's) recommend

trying to place eyewitnesses in a neutral or positive mood at the start of an interview. These are, however, just recommendations and interviews can proceed when an eyewitness is in a negative mood (see Ministry of Justice, 2011).

In terms of statistical significance, the present experiment suggests that an eyewitness who is in a negative mood when being interviewed about a non-emotive event should, where possible, be induced into a neutral mood. Doing so can reduce the likelihood of recall impairments if the eyewitness happened to be in a neutral mood when observing the to-be-remembered event. This does mean missing out on a potential recall enhancement if the eyewitness also happened to be in negative mood when observing the event. From a practical point of view the effect sizes in this experiment for all observed enhancements and impairments were small. Thus, it is helpful to know that having no control over an eyewitness's mood during encoding or that commencing an interview whilst an eyewitness is in a negative mood (especially if an interview is time-sensitive or it is simply not possible to induce a neutral mood) would not be overly detrimental to recall. The authors do, however, wish to emphasise that this is the first demonstration of these effects, moods induced in a laboratory can be milder than those experienced outside the laboratory, and that recalling in a laboratory is inherently different to recalling during a police interview. No policy statements or recommendations are therefore being made at this juncture and further research is essential before any are made.

Future directions

Future research should be directed towards examining the impact of different types of discrete moods upon the encoding and/or retrieval of non-emotive information. It is an oversimplification within the mood and memory literature as a whole to consider both negative and positive moods as a single constructs. Whilst there is disagreement as to how many discrete negative and positive mood states exist (see Watson & Clark, 1997), mood

induction materials have been created that can reliability differentiate between several (e.g., Schaefer, Nils, Sanchez, & Philipott, 2009, created a database of mood induction videos that invoke sadness, anger, fear, disgust, amusement, and tenderness). The impact of these discrete moods upon the encoding and/or retrieval of non-emotive information has received little attention. In the present experiment, the type of negative mood induced was not formally assessed but, given the nature of the scenes depicted in the mood induction videos, it was likely to be sadness. There is also evidence that MDM can occur when participants are induced into a fearful state or a relaxed state at encoding and retrieval and asked to recall non-emotive stimuli (Lang, Craske, Brown, & Ghaneian, 2001). It would benefit the memory literature as a whole to establish whether or not each type of discrete mood impacts upon encoding and/or retrieval equally or whether differences exist between them that need to be accounted for by existing theories.

Conclusion

This experiment provides an important first step in understanding how a negative mood can impact upon eyewitness recall of non-emotive events. A negative mood during encoding has no harmful consequences (provided eyewitnesses are in a neutral mood at retrieval), a negative mood during retrieval impairs correct recall (but only when eyewitnesses are in a neutral mood at encoding), whereas a negative mood during both time points can enhance correct recall. All observed effects, however, were small. As mood is a complex construct it is hoped that this experiment will provide a platform for future studies to examine its impact upon eyewitness memory of non-emotive events.

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Footnote

[1] Several studies have induced participants into negative or neutral moods prior to encoding, had them engage in non-elaborative or non-effortful encoding of non-emotive word lists, and found the negative mood had no impact upon recall of these word lists (e.g., Chepenik, Cornew & Farah, 2007; Storbeck & Clore, 2005). In these studies each word list was studied and immediately recalled in turn. It is therefore possible that participants were in a negative mood at both encoding and retrieval. These studies are therefore excluded from this discussion.

[2]As the valence of to-be-remembered information has no impact upon mood-dependent memory, the coverage of this literature includes studies that examined recall of emotive materials.

[3] The mood induction video presentation order was not counterbalanced, with the same neutral video (the desert documentary) and same negative video (the execution video) always used during encoding. The two neutral videos are matched in terms of their effectiveness in inducing moods, as are the two negative mood videos. This has been confirmed in previous studies by the authors and also in the analysis here. The lack of counterbalancing is unlikely to have an effect on recall performance.

Appendices

Table 1: *Mean valence scores, standard deviations, and 95% confidence intervals immediately prior to encoding and retrieval and immediately after encoding and retrieval across the four mood groups as assessed by the nine-point Self-Assessment Manikin (Bradley & Lang, 1994). Low scores denote negative valence.*

	Valence Score							
Mood During Encoding/ Retrieval	Pre-Encoding		Post-Encoding		Pre-Retrieval		Post Retrieval	
	M, SD	95% CI	*M, SD*	95% CI	*M, SD*	95% CI	*M, SD*	95% CI
Neutral/ Neutral	6.17, 1.08	[5.80, 6.53]	5.97, 1.23	[5.55, 6.39]	6.11, 1.06	[5.75, 6.47]	6.08, 1.29	[5.65, 6.52]
Neutral/ Negative	6.38, 1.05	[6.03, 6.74]	5.86, 1.00	[5.53, 6.19]	2.53 [a], 1.21	[2.12, 2.94]	4.31 [a], 1.35	[3.85, 4.76]
Negative/ Neutral	2.89 [a], 1.09	[2.52, 3.26]	4.25 [a], 1.10	[3.88, 4.62]	6.42, 0.91	[6.11, 6.72]	6.03, 1.46	[5.53, 6.52]
Negative/ Negative	3.03 [a], 1.32	[2.58, 3.47]	4.67 [a], 1.17	[4.27, 5.06]	2.92 [a], 1.11	[2.54, 3.29]	4.69 [a], 1.06	[4.33, 5.05]

Note: Mean scores with a superscript ‘a’ are significantly lower than those means without a superscript ‘a’ at the same mood assessment stage (all p’s $<.05$)

Table 2: *Means, standard deviations, and 95% confidence intervals for the number of correct people, action, and environment details freely recalled across four different mood groups*

	People Details		Actions Details		Environment Details	
Mood During Encoding/ Retrieval	M, SD	95% CI	M, SD	95% CI	M, SD	95% CI
Neutral/ Neutral	7.17, 2.38	[6.36, 7.97]	13.94, 3.59	[12.73, 15.16]	5.53, 1.57	[4.99, 6.06]
Neutral/ Negative	5.25[a], 1.78	[4.65, 5.85]	10.89[a], 3.16	[9.82, 11.96]	4.03[a], 1.65	[3.47, 4.59]
Negative/ Neutral	7.28, 2.11	[6.56, 7.99]	14.08, 4.42	[12.59, 15.58]	5.67, 2.20	[4.92, 6.41]
Negative/ Negative	9.83[b], 3.86	[8.53, 11.14]	17.44[b], 4.57	[15.89, 18.99]	7.67[b], 2.63	[6.78, 8.55]

Note: For each detail type, those mean scores with a superscript ‘a’ are significantly lower than all other means whereas those mean scores with a superscript ‘b’ are significantly higher than all other means (all p’s $<.0125$).