Effects of Eye-Closure & Schematic Information on Memory Accuracy & Confidence in a Witness Testimony Situation

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ABSTRACT

The aim of the current study is to investigate the effects of eye-closure on true and false memory for schematic and non-schematic information. Sixty-four participants were presented with a narrative concerning a bank robbery; within this, information was provided that was highly prototypical (schematic) or non-prototypical (non-schematic) of a robbery. After a delay, memory was assessed with eyes open or eyes closed. The memory test consisted of an item recognition task for events followed by a confidence scale. The items on the test consisted of either studied or non-studied information, which was either schematic or non-schematic. It is hypothesised that (i) eye-closure will reduce false memory and increase true memory accuracy, and (ii) the eye condition will interact with the prototypically of the information. In addition, it is predicted that confidence ratings will mirror the effects of memory accuracy. The findings do not support the hypothesis that predicted that true memory accuracy and confidence would be enhanced and false memory would be reduced following eye-closure. However, the hypothesis that true and false memory would be related to schema relevance was supported. Greater memory recall was reported for studied schema-relevant items (irrespective of eye condition). However, higher false alarms was reported for non-studied schema-relevant items (greater false memory). Therefore, it can be said that schematic information is better remembered when studied and more likely to produce false memories when not studied.

Keywords:	**False memory**	**Eye-closure**	**Schematic information**	**Relevant information**	**Memory accuracy**

Contents:

1. Introduction

1.1. Eye-closure

Eye-closure refers to the phenomenon in which closing eyes whilst recalling information helps improve memory. A large body of research demonstrated that people tend to close their eyes or avert their gaze when engaging in complicated remembering tasks (Glenberg, 1997; Perfect et al., 2011; Vredeveldt et al., 2011; Vredeveldt & Penrod, 2012). Glenberg et al. (1998) found that the spontaneous behaviour of looking away or closing the eyes increases with the complexity of the recall task, and that people who were instructed to close their eyes retrieved information more than people who kept their eyes open. Additionally, Doherty et al. (2002) demonstrated that such behaviour is developed during childhood and can be useful to improve the accuracy of recalling memories. Wagstaff et al. (2004) supported these results and found that free recall (not cued retrieval) of previous public events (e.g. Princess Diana's funeral) can be improved by instructing people to keep their eyes closed during the investigative interviews. Hence, eye-closure is considered to be as a memory aid that plays an effective role in boosting memory. Perfect et al. (2008) expanded these findings by undertaking a series of experiments that aimed to examine the impacts of eye-closure on both free and cued recall of mundane everyday events. The results across all studies found that eye-closure has beneficial impacts on enhancing the accuracy of recalling memories. They concluded that closing the eyes improves both free and cued recollection of visual and auditory information from videotapes and incidentally of everyday events. Similarly, more recent studies found that eye-closure significantly enhances memory recall of visual and auditory information (Vredeveldt, & Sauer, 2015). Thus, cutting out the external interferences by closing the eyes can help improve memory functions. The two main theories that have been proposed to provide meaningful explanations of eye-closure effects will be discussed below.

1.2. Theoretical Basis of Eye-Closure

A potential explanation of eye-closure during recollection can be provided by cognitive load hypothesis. This hypothesis predicts that closing the eyes enhances memory by releasing cognitive resources that might be involved in monitoring the environment. Glenbergs (1997) proposed that a memory is embodied to coordinate the interaction between individuals and their environment. He suggests that recalling information and monitoring the environment are two competitive tasks. Thus, when faced with difficult recollection, external monitoring is suppressed (e.g. closing the eyes) to facilitate internal control of this complicated cognitive process task (recalling task). Recent studies have supported the validity of this assumption in explaining the effect of eye-closure (Perfect et al., 2008; Perfect et al., 2011; Vredeveldt et al., 2011).

The modality-specific interference prediction is another possible explanation of eye-closure effects, which suggests that eye-closure inhibits visual perception from the environment and facilitates mental imagery (Vredeveldt et al., 2011). This was confirmed by the findings that the brain areas activated in the visual perception are the same as those activated in mental visual imagery. Therefore, closing the eyes significantly enhances the mental imagery, which in turn increases retrieval of visual information from long-term memory (Ganis et al., 2004; Caruso & Gino, 2011; Wais et

al., 2010; Vredeveldt et al., 2011). This finding was supported by experimental studies and neurological findings (Ishai et al., 2000; Mechelli et al., 2004; Wais et al., 2010).

Consequently, there are differences between the two assumptions of eye-closure, as each is concerned with a different type of information that is facilitated by such an action. There has been mixed evidence that tests the two assumptions. For instance, Perfect et al. (2008) reports that some evidence was consistent with the modality-specific interferences prediction; however, the vast majority of the evidence supported cognitive load assumption. In addition, Perfect et al. (2011) state that eye-closure decreases false memory, specifically when the subjects are exposed to auditory distraction. This finding strongly supports the hypothesis that eye-closure reduces the combination of general interferences rather than a specific one. To conclude this point, irrespective of the precise theoretical explanations of eye-closure effects, both (cognitive load & modality-specific interference) hypotheses predict that the closure of one's eyes will enhance the retrieval of studied information. Hence, the question remains, does eye-closure help to reduce false memories? The concept of false memory and the techniques of examining this type of memory will be discussed below.

1.3. False Memory

1.3.1. Techniques for Study

False memory is a psychological phenomenon referred to recollection of information and events that never occurred (Brainerd et al., 2008). False memory has been studied through a range of different techniques. For instance, recent research has used the Deese/Roediger-McDermott (DRM) paradigm, which creates memory illusion by providing lists of associated words and asking people to recall as many words as they remember from the lists. The results showed that people are more likely to recall related words that are not presented in the lists. DRM illusion has provided a simple way to understand false memory. However, the main limitation of such a paradigm is that its findings cannot be generalised to autographical memory, which is more complex than associated word lists studied in controlled experiments (Gallo, 2010). Another technique relies on the notion of long-term memory structures referred to as schemas and scripts. This approach is planned for the current experiment and defined below.

1.3.2. False Memory & the Schema & Script Technique:

Cognitive psychologists suggested that studying schema effects is a valuable way to examine the effects of previous knowledge upon encoding, storage and recalling of information (Greenberg, 1998). Schemas are defined as long-term memory structures that represent concepts about various forms of information such as people, places or events (Greenberg, 1998). A significant number of studies have found that people tend to use schemas and scripts to organise, structure, encode and retrieve information (Greenberg, 1998; Lampinen et al., 2000; García-Bajos et al., 2012). A script is a schema of an event that represents the knowledge of typical sequences of events. Hence, when people face familiar situations, they tend to activate a pertinent script, which functions as a guide for expecting what will happen and how they should act. For instance, people have scripts of common occurrences such as visiting a dentist, travelling by plane or going to a restaurant. Moreover, scripts help people to

fill the gaps in memory of certain events when the memory becomes hazy or some details have been forgotten. However, this function of the script might be a source of false memories.

Research on memory that used script-based text found that dependence on scripts often provides incorrect recognition of a script consisting of items that are never mentioned in the event (Bower et al., 1979; Woll et al., 1980; Greenberg et al., 1998). In a typical study, participants were asked to write a script of an event. Thereafter, they were asked to read a text in which some of the scripted actions were not mentioned and some were mentioned. In subsequent memory tests, the participants falsely reported having read scripted actions that had been excluded from the text (Greenberg et al., 1998). However, Nakamura et al. (1985) found that the false recognition, which is produced from using a script, is not only found in text materials. For example, first participants watched actions of the lecturer that were related or non-related to lecture scripts and then were asked to recall them. Results illustrated that the false recognition of script-related actions was considerably greater than the false recognition of script non-related actions.

Additionally, various researches have demonstrated that people have scripts about typical crime events (Migueles & García-Bajos 2006; Smith, 1996; Holst & Pezdek, 1992). For instance, Smith (1996) reports that juries' scripts of typical crimes affect the way they remember trial testimony, which in turn influences their decisions. This result was supported by Holst and Pezdek's (1992) research; they established that people have scripts of several types of thefts, such as robbery of a bank. The participants were asked to listen to a recording of a trial that included selected script-relevant actions that were reported by eyewitnesses and some that were not. After seven days, a considerable number of unreported script items were retrieved and recognised as having been reported (high false memory rate). Similar results were found in a research that examined the effects of using scripts on witnesses. For instance, List (1986) asked the participants to watch a short video of a staged shoplifting that included a combination of high and low probability occurrence activities. After one week, the participants falsely remembered more of the high probability occurrence actions than the low probability occurrence actions. Hence, it appears that scripts were used to fill the gaps in memories. Although scripts and schema are helpful and required to organise everyday experiences and events, they are also a rich source of false memories.

These findings corresponded with more recent study conducted by Kleider et al. (2008). Participants of this study viewed slide shows of males (handyman) and females (homemaker) performing consistent and non-consistent stereotypical activities (e.g. sanding a pipe and mixing cake). After a delay of two days, the participants were exposed to a memory test. The results showed that stereotypical non-consistent activities were falsely remembered as having been carried out by the stereotypical consistent performer. In addition, it has been found that memory errors (false memory) were markedly increased when the wrong performer was suggested during the memory test. Thus, the researcher concluded that when a memory fades, dependence on schematic knowledge increases, leading to increase in the production of false memory. An as yet unanswered question is how to reduce the negative influences of schema on memory.

Therefore, the main aim of this research is to assess the effect of eye-closure on true and false memory accuracy and confidence for schematic and non-schematic information. This aim is based on the premise that eye-closure enhances true recall

(memory accuracy) and reduces false recall for schematic information. Hence, it was hypothesised that recall accuracy and confidence for studied schema information will be greater than the recall and confidence for studied non-schema information. It was also predicted that false recall for non-studied schema information will be higher than the false recall for non-studied non-schema information.

The basis for these predictions stemmed from previous studies, which claimed that people use their prior knowledge (schematic information) to facilitate organising, storing and retrieving information. However, this schematic information also produces false recollections when a memory fades. As eye-closure technique enhances memory performance, it was expected that eye-closure will reduce the effect of schematic information on memory accuracy. Moreover, the reason for focusing on this technique is that the previous experiments have never combined the effect of eye-closure and schematic knowledge on memory accuracy. Such studies examined these factors individually, but not in the combination as chosen in the current study.

Based on the previous studies on the effect of eye-closure on memory, 64 participants were randomly assigned to one of the two eye conditions (open vs closed). The participants were required to recall information from an auditory narrative. The memory test was employed to assess recall accuracy, followed by a confidence scale. Confidence ratings are utilized in this experiment for three reasons; firstly, to evaluate the quality of the true and false memory; secondly, to ascertain the impact of eye-closure technique on familiarity and recollection processes. Thirdly, there is a widespread belief that memory accuracy and confidence are positively correlated; people who accurately recall information are generally more confident than people who are less accurate (Dixon and Memon 2005; Tenney et al. 2007).

2. Method and Analysis

2.1. Design

The study used a 2X2X2 mixed ANOVA design, with each of the three independent variables possessing two levels. The first IV is eye-condition (eye open vs eye closed) and was manipulated between-subjects. The second IV was the relevance of items to the robbery script. This had two levels (relevance vs irrelevance) and was manipulated within-subjects. The third IV was the study status of the items (studied vs unstudied) and was manipulated within-subjects. The experiment had two dependent variables. The first was the participants' responses to each of the recognition items (number of 'yes' responses). The second dependent variable was the confidence scale response to recognition items, which presents an additional measure of the false memory rate. The data of this study was analysed using SPSS statistic program in order to compare mean differences between the independent factors and examine whether there was a significant interaction between these factors on the dependent variables.

2.2. Participants

A total of 64 participants, both males and females, aged between 20 to 45 years took part in this experimental research. The mean ages of the participants in the eye-open condition were 27.63 and 27.94 for participants in the eye-closure condition. A total of 32 participants were allocated randomly into each of the between-subject

conditions (eyes open vs eyes closed). The ethnic composition of the participants was mixed, and they were selected from inside and outside the university campuses.

2.3. Materials

The materials consisted of a narrative and a recognition test booklet; each of these will be described below.

2.3.1. The narrative

The narrative was based on the analysis of typical script-based actions pertaining to a robbery and was validated by Holst and Pezdek (1992). The list of these can be found in Appendix 2. The 475 word-long scenario described a bank robbery crime carried out by three characters: John, Michael and Tom. John was the main character who robbed the bank. The narrative provided many details about the crime scene and robbery actions. A total of 12 script statements were selected and divided into two sets (A and B) for counterbalancing; participants were exposed to only one set with the relevant items on the recognition test. Further, 12 non-script-relevant items and events were generated to form the basis for unrelated recognition memory. These were divided into two sets of six each; one set was paired with set A and the other was paired with set B to form sets A1 and B1, respectively. Those that did not appear in a particular set and were to be presented to the participants were used as unrelated distracters on the recognition test. Counterbalancing was achieved by reversing this pairing to form sets A2 and B2. The scenario itself was then created by using the selected set of items (e.g. A1) and creating a story from those items. Alternative scenarios were created for each of the other sets, whilst maintaining as much similarities as possible, with the exception that only the selected sets were used as studied items.

For example, the scenario where the robber went to the cashier and demanded money (script-relevant) did not state that the robber used a gun or took the money. This was reserved for an alternative scenario. The scenario was described by a male and recorded into a computer. The four scripts and the recognition test can be found in (Appendix 1).

2.3.2. The recognition test

The recognition test was auditory and delivered by the experimenter. The test contained a total of 24 items comprising six studied script-relevant items, six unstudied script-relevant items, six studied script unrelated items and six unstudied unrelated items. The items were randomly placed into the test with the constraint that no three items from the same item type will appear in succession. Accompanying the test was a test booklet in which the experimenter recorded the responses of the participant. Each word was scored as old or new (recognised vs not recognised) and a seven point confidence scale with the scale anchors, 1 = very confident to 7 = not confident at all.

2. 4. Procedure

A pilot study was undertaken upon a small sample of participants in order to ensure that the protocols of the study are understandable and easy to follow. In addition, the pilot study enabled the researcher to identify any potential obstacles that

might arise during the main experiment and also to examine the effectiveness of research materials (van Teijlingen et al. 2001). After conducting the pilot study, the researcher extended the delay between listening to the scenario and the recognition test from 10 minutes (the initial delay time) to 20 minutes to ensure that the false memories are produced. Kleider et al. (2008) suggested that false memories are created as a result of longer retention interval; the longer the retention interval, the more likely people are to produce false memories. Additionally, Vredeveldt et al. (2011) suggested that eye-closure technique might be especially effective after a long delay.

In both the pilot study and the main study, participants were informed that the experiment consists of different phases. Each participant was tested individually, and they were told that the study is about the perception of everyday events. Once inside the experimental room, participants were asked to put on headphones to listen to a story. The experimenter then operated the auditory record.

Once the story ended, the participants took a 20-minute break, and during this time, they were given a blank sheet to write as many street names as possible. This was used as a means to distract the participants and impose the time between the narrative and the recognition test (Parker et al., 2009).

When the 20 minutes elapsed, the experimenter described the instructions of the recognition test. The participants were randomly assigned to one of the conditions. In the eyes closed condition, the participants were asked to close their eyes during the test. Whilst in the eyes open condition, the participants were asked to keep their eyes open. The participants were informed that they were going to listen to 24 items delivered by the researcher, some of which were stated in the narrative and some were not. Their task was to indicate which items they heard in the narrative by answering ‘yes’. They were given about 10 seconds to provide their answers. They responded with a ‘yes’ for the item that was stated in the narrative and with a ‘no’ for the item that was not stated. When the response was made, the participants were asked to rate their confidence for each response from 1 = very confident to 7 = not confident at all. These instructions were developed by Holst and Pezdek (1992). The ‘yes’ response, associated with the rate of 1 point in the confidence scale, was described as a strong recognition of the items, while the ‘yes’ response that was combined with 7 point in the scale was described as a weak recognition of items. Before starting the actual test, the experimenter ensured that the participants understood the instructions of the test and the way of providing their responses.

2.5. Ethics

The researcher follows the guidelines stated by the British Psychology Society. The (AEAF) have been processed (Appendix 2)

3. Results

3.1. Overview of Results

Analyses for the recall accuracy and confidence were carried out separately. Separate univariate analyses were applied to overall recall scores and the confidence ratings. Unless otherwise stated, analyses were all 2 (Eye condition; open vs closed) between-subjects by 2 (Schema relevance; relevant vs irrelevant) within-subject by 2 (Study status; studied vs unstudied) within-subject ANOVA.

3.2. Recall Accuracy

Overall recall scores revealed a main effect of study status, $F(1, 62) = 35.18$, $p < 0.001$, showing more 'yes' responses for studied items. The main effect of schema relevance was $F(1, 62) = 51.77$, $p < 0.001$, indicating more 'yes' responses for schema-relevant items. The interaction between study status and schema relevance was also significant, $F(1, 62) = 5.77$, $p = 0.02$. No other effects were significant; $F(1, 62) = 1.49$, $p = 0.23$ for eye condition, $F(1, 62) = 0.01$, $p = 0.92$ for the interaction between eye condition and schema relevance, $F(1, 62) = 2.77$, $p = 0.10$ for the interaction between eye condition and study status and $F(1, 62) = 0.02$, $p = 0.88$ for the three way interaction. The means and SDs can be seen in Table 1 below.

Table 1. Means (SDs) of Recall Accuracy as a Function of Eye Condition, Schema Relevance and Study Status.

	Eye Condition	
	Open	Closed
Studied		
Schema Relevant	4.28 (1.35)	4.34 (1.54)
Schema Irrelevant	3.62 (1.45)	3.71 (1.46)
Unstudied		
Schema Relevant	3.87 (1.70)	3.34 (1.92)
Schema Irrelevant	2.28 (1.53)	1.65 (1.31)

The interaction between study status and schema relevance was assessed by t-test for each level of study condition. For studied information, there was a significant difference in memory between schema-relevant vs not-relevant items, $t(63) = 2.44$, $p = 0.02$, showing better recall (true memory) of schema-relevant items. For unstudied items, there was also a significant difference, $t(63) = 6.40$, $p < 0.001$, showing a larger difference between the two item types and indicating greater *false memory* for schema-relevant information.

3.3. Recall Confidence

Overall confidence scores for the interaction between schema relevance and eye condition was significant, $F(1, 62) = 4.75$, $p < 0.03$. No other main effects or interactions were significant; $F(1, 62) = 2.23$, $p = 0.14$ for the main effect of eye condition, $F(1, 62) = 0.28$, $p = 0.60$ for the main effect of study status and $F(1, 62) = 0.11$, $p = 0.74$ for the main effect of schema relevance. For the interactions, the findings were $F(1, 62) = 2.48$, $p = 0.12$ for the interaction between schema relevance and study status, $F(1, 62) = 1.32$, $p = 0.26$ for interaction between study status and

eye condition and $F(1, 62) = 0.001$, $p = 0.97$ for the three way interaction between eye condition, study status and schema relevance. The means and SDs can be seen in Table 2 below.

Table 2. Means (SDs) of Recall Confidence as a Function of Eye Condition, Schema Relevance and Study Status.

	Eye Condition	
	Open	Closed
Studied		
Schema Relevant	2.18 (0.86)	2.37 (1.03)
Schema Irrelevant	2.30 (1.38)	1.91 (0.79)
Unstudied		
Schema Relevant	2.19 (0.94)	2.06 (1.23)
Schema Irrelevant	2.75 (1.38)	2.03 (1.55)

The interaction between schema relevance and eye condition was assessed by t-test for each level of eye condition. Neither comparison revealed significant overall differences; $t(31) = -1.60$, $p = 0.12$ for eyes open and $t(31) = 1.50$, $p = 0.15$ for eyes closed. For descriptive purposes, the level of confidence was reversed between the relevant (vs non-relevant) items across the conditions. In particular, in eyes open condition, more confidence was expressed for schema non-relevant items and in eyes closed condition, more confidence was indicated for schema-relevant items.

3.4. Summary

The findings do not support the hypotheses that predicted true memory would be enhanced and false memory would be reduced following eye-closure. However, the hypothesis that true and false memory would be related to schema relevance was supported. Principally, the main finding of interest related to recall *accuracy*; this demonstrated greater memory for schema-relevant items (irrespective of eye condition), when those items had been studied. However, when the items had not been studied, the number of false alarms was higher for schema-relevant items (greater false memory). Consequently, schematic information is better remembered when studied and more likely to produce false memories when not studied. In addition, the results showed non-significant correlation between memory accuracy and overall confidence scores. However, more confidence was reported for non-schema–relevant items in eye open condition, while more schema-relevant items was expressed in eye-closure condition.

4. Discussion

The findings of the current study confirm, but also contradict the outcomes of previous research. However, the findings fail to support the assumption regarding the effect of eye-closure on reducing the false memory that is created from schematic information.

With regard to schematic information, the current study found a significant effect of schematic information on the recall of studied and non-studied information. With regard to true memory (memory for studied items), schematic (vs non-schematic) information was more likely to be recalled. With respect to false memory, the memory of non-studied items was higher for schematic information. Thus, schema relevance increased both true and false memory. Therefore, these findings support the principle of schema theory that was established by Bartlett (1932) and advanced by others (e.g. Tuckey & Brewer, 2003; Konopka & Benjamin, 2009; Sakamoto & Love, 2004). Essentially, schema theory proposes that information that can be 'slotted' into a schema framework is more likely to be recalled if studied and falsely recalled if not studied. In the context of false memory, it is proposed that schemas shape individual's expectations, influence how people interpret new information and how they recall that information over time.

The current results appear to be similar to the previous findings of Holst and Pezdek (1992) and of Migueles and García-Bajos (2006), which highlighted that when memory of a specific event fades, individuals rely on schematic information to fill the gap in their memories, which in turn leads to recalling information that never happened (false memory). The current results also support the findings of Lampinen et al. (2001), where more false memories were reported for typical items and actions than for atypical items and actions. Similarly, Neuschatz et al. (2002) demonstrated that delayed recall of presented information that consists of schema-relevant and schema-irrelevant actions resulted in more false alarms being reported for schema-relevant actions than schema-irrelevant actions.

Although the results of this study did not find significant effects of eye-closure on memory, this is not the only experiment to find a null outcome. For example, Wagstaff et al. (2011) found that using the eye-closure technique alone has no significant effect on enhancing memory recall. However, when eye-closure was combined with the Focus Mediation technique, a few minutes of deep breathing, results showed a significant increase in memory accuracy and a reduction in recall errors (false memory).

With respect to recall confidence, confidence ratings did not mirror the accuracy of memory performance in both the conditions (eye-closure conditions). These findings supported the results reported by Wagstaff et al. (2004), Wagstaff et al. (2011) and Vredeveldt and Sauer (2015). They found a non-significant correlation between recall accuracy and confidence level. Hence, these results suggest that there is no correlation between confidence and memory accuracy. On the other hand, some researchers (e.g. Bradfield et al. 2002; Odinot and Wolters 2006; Dunlosky and Metcalfe 2009) found a significant positive correlation between memory accuracy and confidence. Hence, DeSoto and Roediger (2014) argued that these puzzling outcomes are due to differences in the nature of the memory tests, materials (e.g. word lists, face recognition, other materials) as well as the methods of analysis that were used in each experiment. Consequently, the association between memory accuracy and confidence

is a complex one that remains a puzzle and one that is clearly in need of further research, both in general terms and in relation to eye-closure.

4.1. Limitations

Before concluding that eye-closure has no effects, one needs to take into account the range and breadth of research in which significant effects were found (e.g. Vredeveldt & Penrod, 2013) and some potential methodological limitations of the current experiment. For example, (i) auditory stimuli vs visual stimuli, (ii) disengagement/motivation, (iii) discomfort and (iv) nature of the memory test (free recall vs cued recall). Each of these limitations will be addressed below.

(i) Auditory vs Visual Stimuli: The current experiment made use of an auditory recording to present the details of the narrative events, which may be less affected by eye-closure than visual presentation. Researchers such as Vredeveldt et al. (2012) and Mastroberardino et al. (2015) found that eye-closure has selective benefits for the recall of visual information rather than auditory information. These findings favour modality-specific effect prediction; closing one's eyes improves the recalling performance of visual details of the witnessed events, while it is less likely to enhance recall of auditory information. However, Prefect et al. (2008) found that the eye-closure effect appears to involve general as well as modality-specific processes and facilitates memory recall for visual and auditory information with no increase in the recall of false memories. Future research could compare the effects of modality combined with schema-relevant information on memory; this point is dealt with below.

(ii) Disengagement/Motivation: Participants' lack of motivation and disengagement may affect encoding of the narrative events, which may in turn reduce the beneficial effect of eye-closure in enhancing memory recall of such events. Participants' attention and engagement is required while listening to the scenarios. Thus, disengagement while receiving the information may affect participants' responses and result in more dependence on schematic knowledge. According to Lozito and Mulligan (2006), lack of attention while encoding new information resulted in reduced recall accuracy in a later memory test. In addition, Nadkarni and Narayanan (2007) stated that schema can affect the attention and the absorption of new information; when people pay less attention to new information, they are more likely to recognise only the details that correspond with their schema. Thus, when people recall such memories, they tend to alert them and add more details from their schema to produce more coherent information of an event.

(iii) Participants' Discomfort: It has been noticed that participants in the eye closed condition were less comfortable – because of being instructed to close their eyes during the memory test – than those in the eyes open condition. Thus, experience of discomfort may influence the participants' responses, which may in turn decrease the effectiveness of eye-closure in recalling performance. Hence, to assess such a possibility, further experiments could assess the correlation between memory performances and self-report of the participants' discomfort. In addition, instructing participants to look at a blank screen can be used as an alternative technique to eye-closure. This technique was recommended by Fisher and Geiselman (1992) and supported by Vredeveld and Sauer (2015). They found non-significant differences in recall performance between participants who closed their eyes and those who looked at a blank wall. They explained that the impact of eye-closure was because of minimising the distractions from the external environment, rather than the action itself.

(iv) Nature of the memory test: In the current experiment, the participants were required to answer whether they recognised specific statements (cued recall) from the narrative events, but were not required to provide a free recall of their experiences. Thus, cued recall may remove any differences in the eye-closure condition. In other words, if participants work best in the eye-closure condition, cued recall would negate such effects. Consistent with this assumption, Vredeveld and Penrod (2012) found that eye-closure has a significant positive impact on improving memory accuracy during free recall tasks, while it has less effect during cued recall tasks. Vredeveldt et al. (2011) explained that the eye-closure technique may work differently in cued and free recall tasks; cued recall tasks provided information that led the participants of both the eye conditions (open vs closed) to rely on such cues and ignore their own memories, while in free recall on the other hand, the participants of both the conditions had full control of what they wanted to report without being prompted by questions. Thus, Vredeveldt et al. (2011) found that the amount and accuracy of information provided by participants in the eye-closure condition during the free recall task were higher than those provided by the participants in the eye open condition during the same task. Conversely, Perfect et al. (2008) stated that eye-closure has equivalent benefits in terms of memory accuracy to cued recall and free recall of mundane events.

4.2. Summary of Limitations and Importance of Further Research

The current study did not find a significant effect of eye-closure on memory accuracy and confidence for schematic information. This result may be due to (i) using auditory record to present narrative events, (ii) participants' disengagement and lack of motivation, (iii) uncomfortable situation because of instructing the participants to close their eyes and (iv) using cued recall method to assess memory. However, much work remains to be done to confirm the effect of eye-closure on memory accuracy in order to discover a useful technique to improve memory accuracy. Such technique might be interesting to people in the education field when providing students with an effective way to remember information in exam settings. It might also help police officers in investigation interviews to obtain more details from eyewitnesses. In addition, this technique may also assist juries to accurately remember trial testimony, rather than depending on their prior knowledge in making decisions. Therefore, more research is needed that will take into account the limitations of the current research.

4.3. Further research

To assess the effect of eye-closure on memory accuracy, further research should overcome the limitations of the current experiment as outlined above. Thus, by (i) making use of both visual and auditory information. In particular, both visual and auditory information that varies in terms of schema relevance could be used. For visual information, story scenarios could be employed in which the typicality (schema relevance) of visual objects or events varies across conditions. Under such circumstances, it would be possible to assess the precise effect of eye-closure on the recall of schema-relevant (vs irrelevant) visual information. (ii) By varying motivation (Rewards/Payoffs) for instance, the participants could be told that their scores will be compared with the scores of other participants. (iii) To avoid discomforting experiences, researchers could instruct the participants to look at a blank screen instead of closing their eyes, which may be more comfortable than closing the eyes. (iv) Subsequent research could employ two memory tests that require both free and

cued recall provided in different phases; this would allow the researcher to assess whether cued recall influenced the subjects' ability to accurately remember information.

5. Summary of overall findings & conclusion

To sum up, the current findings appear partially parallel to those of previous studies by illustrating that schematic knowledge has a significant impact on the overall recall scores that included true and false memories. The eye-closure technique was intended to reduce such an impact on recalling false memories. Unfortunately, the results indicate that eye-closure fails to minimise the production of false memory from prior knowledge. However, much remains to be done to ascertain the effectiveness of eye-closure in enhancing memory accuracy and eliminating the effect of schema in creating false memory.

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References:

Allport, D. A., Antonis, B., & Reynolds, P. (1972) 'On the division of attention: A disproof of the single channel hypothesis'. *Quarterly Journal of Experimental Psychology,* 24 (2), pp. 225–235.

Bartlett, F.C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge, England: Cambridge University Press.

Bower, G. H., Black, J. B., & Turner, T. J. (1979) 'Scripts in memory for text'. *Cognitive psychology*, 11 (2), pp. 177-220.

Bradfield, A. L.,Wells, G. L.,&Olson, E. A. (2002) 'The damaging effect of confirming feedback on the relation between eyewitness certainty and identification accuracy'. *Journal of Applied Psychology*, 87, pp. 112–120.

Brainerd, C. J., Reyna, V. F., & Ceci, S. J. (2008) 'Developmental reversals in false memory: a review of data and theory'. *Psychological bulletin*, 134 (3), p.343.

Caruso, E. M., & Gino, F. (2011) 'Blind ethics: Closing one's eyes polarizes moral judgments and discourages dishonest behaviour'. *Cognition*, 118, pp. 280–285.

DeSoto, K. A., & Roediger, H. L. (2014) 'Positive and negative correlations between confidence and accuracy for the same events in recognition of categorized lists'. *Psychological Science, 25*(3), pp. 781-788.

Dixon, S., & Memon, A. (2005) 'The effect of post-identification feedback on the recall of crime and perpetrator details'. *Applied Cognitive Psychology*, 19, pp. 935–961.

Doherty-Sneddon, G., Bruce, V., Bonner, L., Longbotham, S., & Doyle, C. (2002) 'Development of gaze aversion as disengagement from visual information'. *Developmental Psychology,* 38 (3), pp.438–445.

Dunlosky, J., & Metcalfe, J. (2009).*Metacognition*. New York, NY: Sage.

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

Gallo, D. A., McDonough, I. M., & Scimeca, J. (2010) 'Dissociating source memory decisions in the prefrontal cortex: fMRI of diagnostic and disqualifying monitoring'. *Journal of Cognitive Neuroscience*, 22, pp. 955-969.

Ganis, G., Thompson, W. L., & Kosslyn, S. M. (2004) 'Brain areas underlying visual mental imagery and visual perception: An fMRI study'. *Cognitive Brain Research*, 20, pp. 226–241.

García-Bajos, E., Migueles, M., & Aizpurua, A. (2012) 'Bias of Script-Driven Processing on Eyewitness Memory in Young and Older Adults'. *Applied Cognitive Psychology*, *26* (5), pp.737-745.

Glenberg, A. M. (1997) 'What memory is for: Creating meaning in the service of action'. *Behavioral and brain sciences*, 20 (01), pp.41-50.

Glenberg, A. M., Schroeder, J. L., & Robertson, D. A. (1998) 'Averting the gaze disengages the environment and facilitates remembering'. *Memory & Cognition, 26,* pp. 651–658.

Gouraud, F. (1845) 'Phreno-Mnemotechny; Or, The Art of Memory'. *The North American Review*, 61 (1), p. 260.

Greenberg, M. S., Westcott, D. R., & Bailey, S. E. (1998) 'When believing is seeing: The effect of scripts on eyewitness memory'. *Law and Human Behavior*, *22*(6), pp. 685-694.

Holst, V. F., & Pezdek, K. (1992) 'Scripts for typical crimes and their effects on memory for eyewitness testimony'. *Applied Cognitive Psychology*, *6* (7), pp. 573-587.

Ishai, A., Ungerleider, L. G., & Haxby, J. V. (2000) 'Distributed neural systems for the generation of visual images'. *Neuron*, 28, pp. 979–990.

Kleider, H. M., Pezdek, K., Goldinger, S. D., & Kirk, A. (2008) 'Schema-driven source misattribution errors: remembering the expected from a witnessed event'. *Applied Cognitive Psychology*, *22*(1), pp. 1-20.

Kleider, H. M., Goldinger, S. D., & Knuycky, L. (2008). Stereotypes influence false memories for imagined events. *Memory*, *16*(2), 97-114.

Konopka, A. E., & Benjamin, A. S. (2009) 'Schematic knowledge changes what judgments of learning predict in a source memory task'. *Memory & Cognition, 37*(1), pp. 42-51.

Kundera, M. (1996) *Slowness*. New York: HarperCollins.

Lampinen, J. M., Faries, J. M., Neuschatz, J. S., & Toglia, M. P. (2000) 'Recollections of things schematic: The influence of scripts on recollective experience'. *Applied Cognitive Psychology*, 14 (6), pp. 543-554.

Lampinen, J. M., Copeland, S. M., & Neuschatz, J. S. (2001) 'Recollections of things schematic: room schemas revisited'. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(5), p.1211.

List, J. A. (1986) 'Age and schematic differences in the reliability of eyewitness testimony'. *Developmental Psychology,* 22 (1), pp. 50–57.

Lozito, J. P., & Mulligan, N. W. (2006) 'Exploring the role of attention during memory retrieval: Effects of semantic encoding and divided attention'. *Memory & Cognition*, 34(5), pp. 986-998.

Mastroberardino, S., & Vredeveldt, A. (2015). Eye-closure increases children's memory accuracy for visual material. *Reduction of Environmental Distraction to Facilitate Cognitive Performance*, p. 76.

Mechelli, A., Price, C. J., Friston, K. J., & Ishai, A. (2004) 'Where bottom-up meets top-down: Neuronal interactions during perception and imagery'. *Cerebral Cortex*, 14, pp. 1256–1265.

Migueles, M., & Garcia-Bajos, E. (2006) 'Influence of the typicality of the actions in a mugging script on retrieval-induced forgetting'. *Psicologica, 27*(1), 119-135.

Nadkarni, S., & Narayanan, V. K. (2007) 'Strategic schemas, strategic flexibility, and firm performance: The moderating role of industry clockspeed'. *Strategic management journal*, 28(3), pp. 243-270.

Nakamura, G. V., Graesser, A. C., Zimmerman, J. A., & Riha, J. (1985) 'Script processing in a natural situation'. *Memory & Cognition*, 13 (2), pp. 140-144.

Neuschatz, J. S., Lampinen, J. M., Preston, E. L., Hawkins, E. R., & Toglia, M. P. (2002) 'The effect of memory schemata on memory and the phenomenological experience of naturalistic situations'. *Applied Cognitive Psychology*, *16*(6), pp. 687-708.

Odinot, G., & Wolters, G. (2006) 'Repeated recall, retentions interval and the accuracy-confidence relation in eyewitness memory'. *Applied Cognitive Psychology*, 20, pp. 973–985.

Parker, A., Buckley, S., & Dagnall, N. (2009) 'Reduced misinformation effects following saccadic bilateral eye movements'. *Brain and Cognition*, 69 (1), pp. 89-97.

Perfect, T. J., Wagstaff, G. F., Moore, D., Andrews, B., Cleveland, V., Newcombe, S., & Brown, L. (2008) 'How can we help witnesses to remember more? It's an (eyes) open and shut case'. *Law and Human Behavior*, 32 (4), p. 314.

Perfect, T. J., Andrade, J., & Eagan, I. (2011) 'Eye closure reduces the cross-modal memory impairment caused by auditory distraction'. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *37* (4), p.1008.

Phelps, F. G., Doherty-Sneddon, G., & Warnock, H. (2006) 'Helping children think: Gaze aversion and teaching'. *British Journal of Developmental Psychology*, 24 (3), pp. 577-588.

Roediger, H. L., III, & DeSoto, K. A. (2014) 'Confidence and memory: assessing positive and negative correlations'. *Memory,* 22, pp. 76–91.

Sakamoto Y, Love BC (2004) 'Schematic influences on category learning and recognition memory'. *Journal of Experimental Psychology-General,* 133, pp. 534–553.

Salmaso, P., Baroni, M. R., Job, R., & Peron, E. M. (1983) 'Schematic information, attention, and memory for places'. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9*(2), pp. 263-268.

Schacter, D. L. (1999) 'The seven sins of memory: Insights from psychology and cognitive neuroscience'. *American Psychologist,* 54 (3), pp. 182–203.

Smith, V. L., & Studebaker, C. A. (1996) 'What do you expect? The influence of people's prior knowledge of crime categories on fact-finding'. *Law and Human Behaviour,* 20 (5), pp. 517–532.

Smith, V. L. (1993) 'When prior knowledge and law collide'. *Law and Human Behaviour,* 17 (5), pp. 507–536.

Tenney, E. R.,MacCoun, R. J., Spellman, B. A., & Hastie, R. (2007) 'Calibration trumps confidence as a basis for witness credibility'. *Psychological Science*, 18, pp. 46–50.

Tuckey, M., & Brewer, N. (2003) 'The influence of schemas, stimulus ambiguity, and interview schedule on eyewitness memory over time'. *Journal Of Experimental Psychology*: *Applied*, 9(2), pp. 101-118.

Van Teijlingen, E. R., Rennie, A. M., Hundley, V., & Graham, W. (2001) 'The importance of conducting and reporting pilot studies: the example of the Scottish Births Survey'. *Journal of advanced nursing*, 34(3), pp. 289-295.

Vredeveldt, A., Hitch, G. J., & Baddeley, A. D. (2011) 'Eye closure helps memory by reducing cognitive load and enhancing visualisation'. *Memory & cognition*, 39 (7), pp. 1253-1263.

Vredeveldt, A., & Penrod, S. D. (2012) 'Eye-closure improves memory for a witnessed event under naturalistic conditions'. *Psychology, Crime & Law*, 19 (10), pp. 893-905.

Vredeveldt, A., & Sauer, J. D. (2015) 'Effects of eye-closure on confidence-accuracy relations in eyewitness testimony'. *Journal of Applied Research in Memory and Cognition*,*4* (1), pp.51-58.

Wagstaff, G. F., Brunas-Wagstaff, J., Cole, J., Knapton, L., Winterbottom, J., Crean, V., & Wheatcroft, J. (2004) 'Facilitating memory with hypnosis, focused meditation, and eye closure'. *International journal of clinical and experimental hypnosis*, 52 (4), pp. 434-455.

Wagstaff, G. F., Wheatcroft, J. M., Caddick, A. M., Kirby, L. J., & Lamont, E. (2011). Enhancing witness memory with techniques derived from hypnotic investigative interviewing: Focused meditation, eye-closure, and context reinstatement. *International Journal of Clinical and Experimental Hypnosis*,*59*(2), 146-164.

Wais, P. E., Rubens, M. T., Boccanfuso, J., & Gazzaley, A. (2010) 'Neural mechanisms underlying the impact of visual distraction on retrieval of long-term memory'. *Journal of Neuroscience*, 30, pp.8541-550.