

This is an Author's Original Manuscript of an article published by Taylor & Francis Group in *Psychology, Crime, & Law* on 9 July 2012, available online: <http://dx.doi.org/10.1080/1068316X.2012.700313>

Eye-Closure Improves Memory for a Witnessed Event under Naturalistic Conditions

Annelies Vredeveldt

University of York

Steven D. Penrod

City University of New York

Author Note

Annelies Vredeveldt, Department of Psychology, University of York; Steven D. Penrod, Department of Psychology, John Jay College of Criminal Justice, City University of New York.

Annelies Vredeveldt is now at the Department of Psychology, University of Cape Town.

This research was supported by a Fulbright Visiting Scholarship awarded to Annelies Vredeveldt. We thank Lindsey Rhead for her invaluable assistance in this project; HaeRim Jin, Veronica Cortez, Alexandra Bennett-Roach, Erin Kearns, and Jacqueline Howe for their help with collecting, transcribing, and coding the data; and Graham Hitch, Alan Baddeley, and Dan Wright for their helpful feedback on earlier versions of the manuscript.

Correspondence concerning this article should be addressed to Annelies Vredeveldt, Department of Psychology, University of Cape Town, private bag, Rondebosch, 7701, South Africa. E-mail: anneliesvredeveldt@gmail.com

Abstract

Eye-closure may help people remember live and videotaped mundane events and videotaped violent events. The present study extended this research by examining memory for a forensically relevant live event (a staged verbal altercation) and by interviewing witnesses under naturalistic conditions. Ninety-six mock witnesses were interviewed either inside in a quiet setting or outside on a busy street, with eyes open or closed. In free recall, eye-closure significantly increased the number of correct details reported, without harming testimonial accuracy. These benefits were significant for witnesses interviewed inside but not for witnesses interviewed outside. This finding highlights the potential role of spontaneous mental context reinstatement in the eye-closure effect. In cued recall, eye-closure improved fine-grain recall of visual details for both groups of witnesses. From an applied perspective, the findings suggest that police interviewers should instruct witnesses to close their eyes, both during initial statements taken on the street and during full interviews conducted at the police station.

Keywords: eyewitness memory, eye-closure, investigative interviewing, grain size, mental context reinstatement, environmental distraction

Eye-Closure Improves Memory for a Witnessed Event under Naturalistic Conditions

The completeness and accuracy of memory is important in many contexts. Students want to perform well on exams, patients need to provide full medical histories, and information obtained from eyewitnesses is considered the single most important factor in solving crimes (Fisher, 1995; Kebbell & Milne, 1998). A number of interview procedures have been developed with the goal of helping witnesses remember more, notably the cognitive interview (Geiselman et al., 1984; Geiselman, Fisher, MacKinnon, & Holland, 1985, 1986). The revised cognitive interview (Fisher & Geiselman, 1992) incorporates a combination of cognitive and social techniques to enhance eyewitness memory. Although the cognitive interview has been found to be highly effective (for meta-analyses, see Köhnken, Milne, Memon, & Bull, 1999; Memon, Meissner, & Fraser, 2010), it has proven difficult to implement the complex and time-consuming interview procedure in practice (Clarke & Milne, 2001; Griffiths & Milne, 2006; Kebbell, Milne, & Wagstaff, 1999; Kebbell & Wagstaff, 1999; Memon, Holley, Milne, Köhnken, & Bull, 1994).

Research now suggests that improving memory may be as simple as closing the eyes. Instructing undergraduate students or children to close their eyes improves their performance on mathematical, verbal-reasoning, visuo-spatial, and general knowledge tests (Doherty-Sneddon, Bonner, & Bruce, 2001; Glenberg, Schroeder, & Robertson, 1998; Markson & Paterson, 2009; Phelps, Doherty-Sneddon, & Warnock, 2006). Furthermore, eye-closure may help episodic recall of past public events (Wagstaff et al., 2004), and recall of both live and videotaped mundane events (Perfect et al., 2008). Closing the eyes during the investigative interview may also improve both adults'

(Vredeveldt, Hitch, & Baddeley, 2011) and children's (Mastroberardino, Natali, & Candel, 2010) memory for videotaped emotional events.

The present study extended previous research by examining memory for a forensically relevant live event. The importance of enhancing the ecological validity of eyewitness research has been reiterated many times (e.g., Malpass & Devine, 1981; Mecklenburg, Bailey, & Larson, 2008; Turtle, Read, Lindsay, & Brimacombe, 2008; Yuille & Cutshall, 1986). Nevertheless, due to the ethical difficulties associated with conducting realistic eyewitness research, only relatively few studies have investigated eyewitness memory in a field setting (see e.g., Christianson & Hübner, 1993; Terr, 1983; Thompson, Morton, & Fraser, 1997; Wagenaar & Groeneweg, 1990; Yuille & Cutshall, 1986). In their classic field study, Yuille and Cutshall (1986) found that the testimony provided by real eyewitnesses of a fatal shooting was actually remarkably accurate. Hence, they concluded that their findings "raise some questions about the image of the eyewitness that has emerged from laboratory work" (p. 299). Unfortunately, the typical trade-off associated with conducting more realistic field studies is a loss of experimental control. Therefore, it is important to obtain converging evidence from a combination of laboratory and field studies on any research topic.

As explained, a number of laboratory studies have shown that eye-closure can improve eyewitness memory (e.g., Perfect et al., 2008; Vredeveldt et al., 2011; Wagstaff et al., 2004). However, no studies to date have investigated the eye-closure effect in a more naturalistic setting. Although Vredeveldt et al. (2011) extended the eye-closure effect to memory for violent events, their participants watched a video rather than experiencing the event themselves. This is an important limitation, since research using videotaped events may overestimate eyewitness memory (Ihlebaek, Løve,

Eilertsen, & Magnussen, 2003). Because safety concerns prevented the staging of a violent event, the present study examined memory for a live verbal altercation taking place on the street. In real life, violent acts are often preceded by a verbal argument (Murdoch & Ross, 1990), and eyewitness reports of such confrontations may well contain forensically relevant information (e.g., which party initiated the fight). Thus, we examined whether eye-closure helps witnesses to remember an unexpected, forensically relevant, personally experienced event.

Another important issue that has not yet been addressed in previous research is the role of interview location in the eye-closure effect. Although full eyewitness interviews are often conducted at police stations, initial statements are generally taken at the scene of the crime (Gabbert, Hope, & Fisher, 2009). Nevertheless, to our knowledge, all previous studies on the eye-closure effect have taken place in the laboratory (e.g., Mastroberardino et al., 2010; Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008; Vredeveltdt et al., 2011; Wagstaff et al., 2004). Research on the cognitive interview suggests that the type of interview setting (field versus laboratory) may moderate the effectiveness of the interview procedure (cf. Memon et al., 2010). To examine whether interview context also plays a role in the eye-closure effect, the present study assessed the effectiveness of the eye-closure instruction for witnesses interviewed outside on a busy street compared to witnesses interviewed inside on a quiet corridor.

The motivation for the present study was predominantly applied in nature. However, the experimental set-up also allowed for an exploration of the theoretical underpinnings of the eye-closure effect. Specifically, it examined the relative importance of distraction effects and context effects in explaining the eye-closure effect.

First, it is possible that eye-closure improves recall by reducing the interference caused by distractions in the environment (Glenberg, 1997; Glenberg et al., 1998). Vredeveltdt et al. (2011) varied the amount of visual and auditory distraction to which witnesses were exposed during the interview, and found support for both general and modality-specific interference caused by environmental distractions (see also Perfect, Andrade, & Eagan, 2011). If a reduction in environmental distractions is the driving force behind the eye-closure effect, we would expect eye-closure to be more effective for witnesses interviewed outside than for witness interviewed inside, since there are substantially more environmental distractions outside on a busy street than inside on a quiet corridor.

Second, it is possible that eye-closure improves recall by promoting spontaneous mental reinstatement of the context of the witnessed event (cf. Fisher & Geiselman, 1992, p. 133). For instance, Caruso and Gino (2011) found that eye-closure induced participants to mentally simulate events more extensively, even in the absence of instructions to do so. Because information encoded in a particular context is best retrieved in that context (Godden & Baddeley, 1975; Smith, Glenberg, & Bjork, 1978), such spontaneous mental reconstruction of the event context is likely to enhance recall (cf. Hammond, Wagstaff, & Cole, 2006; Smith, 1979; Smith & Vela, 2001). If spontaneous mental context reinstatement is the driving force behind the eye-closure effect, we would expect eye-closure to be more effective for witnesses interviewed inside than for witnesses interviewed outside, since the inside location (i.e., a quiet corridor) was more dissimilar to the context of the staged event (i.e., a busy street) than the outside location (i.e., another busy street).

In sum, the present study was designed to enhance the ecological validity of eye-closure research. First, we examined memory of a forensically relevant live event.

Second, we examined whether eye-closure is as effective for witnesses interviewed outside on the street as for witnesses interviewed inside in a quiet location. The latter manipulation also allowed us to explore the relative contributions of environmental distractions and spontaneous mental context reinstatement in the eye-closure effect.

Method

Participants

Ninety-six undergraduate students from John Jay College of Criminal Justice participated for course credit (40 male and 56 female; mean age = 20.03, $SD = 3.83$). The ethnic composition of the sample was mixed, with 46 Hispanic/Latino participants, 18 African-American, 18 Caucasian, 9 Asian/Pacific Islander, and 5 of another race. The study was approved by the Institutional Review Board of John Jay College of Criminal Justice.

Materials

The staged event took place on a New York street corner and lasted approximately three minutes. Participants were introduced to two confederates, Julia and Sarah, who would tell them where each participant would participate in the experiment. A disagreement about experimental locations escalated into a verbal altercation (with the confederates insulting each other and one pulling the papers out of the other's hands) and ended when one confederate walked away. Based on the performance of 10 pilot participants, we selected eight questions about visual aspects and eight questions about auditory aspects of the event (see Appendix for the list of interview questions).

Procedure

Participants signed up for a study on “social interactions”. Up to four participants per session arrived in the laboratory and gave informed consent. The experimenter then accompanied them to a street corner next to another university building, where they met the confederates. The staged event was discreetly video-recorded on each occasion by another confederate in a nearby phone booth, to obtain an accurate record of what happened. None of the participants noticed the video camera. After the event, participants were informed that they would be interviewed by one of the researchers. Participants were interviewed either on the sidewalk next to a busy street (with eyes open or closed) or inside on a quiet corridor (with eyes open or closed). Because each session involved a maximum of four participants, all participants could be interviewed at the same time; each by a different interviewer (i.e., the experimenter or one of the research assistants) and in a different interview location (i.e., we used two inside locations and two outside locations). Participants were randomly assigned to one of the four potential interviewers and to one of the four potential interview locations. All interview locations were located at a five-minute walk from the location of the staged event, and each interviewer engaged their interviewee in casual conversation during this walk, to prevent rehearsal.

Upon arrival at the interview location, participants were informed that they would first be asked to provide a free recall (“please tell me everything you can remember”), after which they would be asked specific questions. To increase motivation, participants were also informed that those scoring in the top 25% of the memory test would be enrolled in a lottery to win \$50. Prior to their free report, participants in the eyes-closed condition were asked to keep their eyes closed

throughout, whereas participants in the eyes-open condition received no such instruction. Participants were not informed about the rationale behind the eye-closure instruction; they were simply asked to close their eyes. If participants opened their eyes at any point during the free report, they were reminded to keep their eyes closed.

At the end of the free recall, participants in the eyes-closed condition were asked to open their eyes again. All participants were then told that they would be asked questions about the event, and instructed to try to answer them in as much detail as possible, but not to guess; a “don’t know” response was permissible. After the instructions, participants in the eyes-closed conditions were asked to close their eyes again (and were reminded appropriately if they opened them at any point during the interview). The questions about visual and auditory aspects of the event were asked in chronological order. All interviews were audio-recorded for subsequent analysis. At the end of the interview, participants completed a demographic information sheet, were debriefed, and thanked for their participation.

Data Coding

All recorded interviews were transcribed verbatim. Statements provided in free recall were coded as correct or incorrect, and as visual or auditory. Subjective statements (e.g., “they did not like each other”) were not scored. Prior to the study, the first author listed all details of the staged event together with their corresponding codes in an exhaustive coding scheme. Subsequently, two independent coders scored all transcripts blind to experimental condition, in line with the coding scheme. Any details mentioned by participants that were not in the original coding scheme were added progressively. Ten randomly selected interviews for each coder were scored

independently by the first author. Inter-rater reliability for the 283 double-coded statements (23.0% of the total) was high for both accuracy (Coder 1: $\kappa = .91, p < .001$; Coder 2: $\kappa = .92, p < .001$) and modality (both coders: $\kappa = .98, p < .001$).

Because the eye-closure effect depends on the specificity of responses (Vredeveldt et al., 2011), responses provided in the questioning phase were not only coded for accuracy but also for grain size (cf. Goldsmith, Koriat, & Pansky, 2005; Goldsmith, Koriat, & Weinberg-Eliezer, 2002; Weber & Brewer, 2008). Thus, responses could be coded as fine-grain correct (e.g., “on her left arm just below the shoulder”), coarse-grain correct (e.g., “on her arm”), incorrect (e.g., “on her leg”), or omitted (“don’t know”). Just like responses about visual details, responses about auditory details that were coded as fine-grain correct (e.g., “during breakfast at Starbucks”) were more complete and specific than those coded as coarse-grain correct (e.g., “during breakfast”). Nevertheless, it should be acknowledged that there are potential differences in the way in which grain size is operationalized for visual and auditory responses, respectively. Responses were coded as incorrect if they contained at least one inaccurate element. Due to insufficient data, incorrect responses were not coded for grain size. Ten randomly selected interviews for each coder (i.e., 320 responses; 20.6% of the total) were double-coded by the first author. Inter-rater reliability (for the decision to code a response as coarse-grain correct, fine-grain correct, incorrect, or omitted) was high ($\kappa = .94, p < .001$ for both coders).

Results

Free Report

Total Number of Details

First, we examined the total amount of information reported in free recall. All analyses reported below were conducted on square-root transformed variables, to solve problems with normality. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) analysis of variance (ANOVA) on the square-root transformed number of details revealed no significant main effect of interview location ($F < 1$), but a marginally significant main effect of interview condition, $F(1, 92) = 3.36$, $p = .07$, $d = .45$, and a marginally significant interaction between condition and location, $F(1, 92) = 3.74$, $p = .06$. Participants who closed their eyes tended to report more details ($M = 14.06$, $SD = 7.01$) than participants who kept their eyes open ($M = 11.46$, $SD = 4.27$), and simple effects analyses showed that this difference was significant for participants interviewed inside, $F(1, 92) = 7.10$, $p < .01$, $d = .78$, but not for participants interviewed outside ($F < 1$). To examine whether participants who closed their eyes provided longer testimonies because they reported more *accurate* details or because they reported more *inaccurate* details, the next two sections explore the number and proportion of correct details reported in free recall.

Number Correct

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVA on the square-root transformed number of correct details showed that witnesses who closed their eyes reported significantly more correct details than witnesses who kept their eyes open, $F(1, 92) = 4.43$, $p < .05$, $d = .51$ (see Figure 1). There was no significant main effect of interview location ($F < 1$), but there was a marginally significant interaction between interview condition and location, $F(1, 92) = 3.59$, $p = .06$. Simple effects analyses showed that the eye-closure effect was significant

for participants interviewed inside, $F(1, 92) = 8.00, p < .01, d = .88$ but not for participants interviewed outside ($F < 1$).

[FIGURE 1 NEAR HERE]

Modality of reported details could not be included in the main ANOVA, because we could not control how many visual and auditory details participants chose to report in free recall. Separate 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVAs were conducted on the square-root transformed number of correct visual and auditory details, respectively. Although Figure 1 shows that eye-closure increased the number of both visual and auditory details, the increase was significant for visual details, $F(1, 92) = 6.61, p < .05, d = .56$, but not for auditory details, $F(1, 92) = 1.26, p = .26, d = .34$. Specifically, eye-closure increased the number of visual details by 37.6% (compared to a non-significant 18.8% increase in auditory details). Participants interviewed inside reported significantly more visual details than participants interviewed outside, $F(1, 92) = 5.57, p < .05, d = .41$, but interview location did not affect the number of auditory details reported ($F < 1$). There were no significant interactions between interview condition and location (visual: $F < 1$; auditory: $F(1, 92) = 3.06, p = .08$).

Proportion Correct

Finally, the accuracy of the free reports was examined. An index of testimonial accuracy was calculated by dividing the number of correct details by the total number of details reported (cf. Smeets, Candel, & Merckelbach, 2004). It is worth noting that this

index favours short but accurate accounts over more comprehensive accounts that contain some errors, and should therefore be considered in conjunction with the measure of quantity reported above. The proportion of reported details that were correct was high in all conditions, ranging from .90 to .93. Since the proportions could not be transformed into normal distributions, we conducted non-parametric tests. Eye-closure did not significantly affect overall proportion correct, $U = 1058.50$, $p = .86$, and separate analyses for visual and auditory details showed no significant effects either (both $ps > .05$). Similarly, proportion correct was not affected by interview location, $U = 1137.00$, $p = .65$, with no significant effects for either visual or auditory details (both $ps > .05$). In sum, eye-closure increased the amount of information reported in free recall without harming testimonial accuracy.

Questioning

Number Correct

Next, we assessed the number of correct responses provided during the specific questioning phase of the interview. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) ANOVA on the total number of correct responses (i.e., coarse- plus fine-grain) revealed no significant main effects or interactions (all $ps > .20$). To examine whether the eye-closure effect depended on the specificity of the responses, coarse- and fine-grain answers were analyzed independently. A three-way ANOVA on coarse-grain recall revealed no significant main effects or interactions involving interview condition or location (all $ps > .05$). However, there were significantly more coarse-grain correct

responses to questions about visual details than to questions about auditory details, $F(1, 92) = 6.85, p < .05, d = .43$.

A corresponding ANOVA on fine-grain correct recall also revealed no significant main effects of interview condition ($F < 1$) or location ($F < 1$). However, there were significantly more fine-grain correct responses to questions about auditory details than to questions about visual details, $F(1, 92) = 9.21, p < .01, d = .34$ (see Figure 2). Moreover, there was a significant interaction between interview condition and question modality, $F(1, 92) = 6.85, p < .05$. Simple effects analyses showed that eye-closure significantly increased fine-grain recall of visual details (by 23.8%), $F(1, 92) = 4.40, p < .05, d = .43$, but did not significantly affect fine-grain recall of auditory details, $F(1, 92) = 1.51, p = .22, d = -.25$. It is worth noting that eye-closure increased the number of fine-grain responses to questions about visual details regardless of interview location (see Figure 2a).

[FIGURE 2 NEAR HERE]

Proportion Correct

A list of interview questions with the corresponding percentage of participants per interview condition who answered that question correctly is provided in the Appendix. Due to the relatively small number of participants, we did not conduct a statistical item analysis, but visual inspection of the percentages in the Appendix suggests that the pattern of findings was not drastically different depending on the interview question. To calculate testimonial accuracy, the total number of correct responses per participant was divided by the total number of answered questions. The

average proportions correct in different experimental conditions ranged from .66 to .72. A three-way mixed ANOVA on proportion correct showed no main effects of interview condition, interview location, or question modality, and no interactions (all $ps > .14$).

A corresponding three-way mixed ANOVA on the log-transformed number of omitted responses also revealed no significant effects of interview condition or location and no interactions (all $ps > .31$). However, participants responded “don’t know” significantly more often in response to questions about auditory details ($M = 1.46$, $SD = 1.28$) than in response to questions about visual details ($M = .98$, $SD = .93$), $F(1, 92) = 7.00$, $p < .01$, $d = .43$. In sum, eye-closure increased the number of fine-grain correct responses to questions about visual details without affecting testimonial accuracy or the number of “don’t know” responses.

Discussion

The first way in which the present study extended previous research on the eye-closure effect was by testing memory for a forensically relevant live event (see Murdoch & Ross, 1990). Overall, mock witnesses who closed their eyes reported significantly more correct information and gave significantly more fine-grain correct answers to questions about visual aspects of the verbal altercation than witnesses who kept their eyes open. Furthermore, the increases in correct recall as a result of eye-closure were not accompanied by a decrease in testimonial accuracy. The second way in which the present study extended previous research was by comparing witnesses interviewed inside in a quiet location (as is common for full police interviews) to witnesses interviewed outside on a busy street (as is relatively common for initial statements taken by the police; Gabbert et al., 2009). We found no overall differences in

recall performance between the two groups of witnesses, although witnesses interviewed inside reported significantly more visual details in free recall than witnesses interviewed outside. In free recall (but not cued recall), the eye-closure instruction was significantly more effective for witnesses interviewed inside than for witnesses interviewed outside. Each of these findings will be considered in turn below.

Despite the severe distractions to which witnesses interviewed outside were exposed, their overall recall performance was not significantly impaired compared to witnesses interviewed inside. This is surprising given that recall performance is typically impaired even by minimal environmental distractions such as simple visual displays (Perfect, Andrade, & Syrett, 2011; Vredeveltdt et al., 2011) and bursts of white noise (Perfect, Andrade, & Eagan, 2011). However, given that similarity between the context of the witnessed event and the context of the interview is likely to promote recall (e.g., Godden & Baddeley, 1975), it is possible that any decreases in recall performance caused by environmental distractions for witnesses interviewed outside were compensated by increases in recall performance as a result of context similarity. To examine this possibility more thoroughly, future studies should manipulate environmental distraction and context similarity in a full factorial design (i.e., compare quiet-similar, quiet-dissimilar, noisy-similar, and noisy-dissimilar interview conditions).

The importance of the role of context in recall was further supported by the finding that eye-closure tended to be more effective for witnesses interviewed inside than for witnesses interviewed outside, at least in free recall. Thus, if eye-closure works by encouraging spontaneous mental context reinstatement (Caruso & Gino, 2011; Fisher & Geiselman, 1992), it is likely to be more helpful for witnesses interviewed in a context that is dissimilar from the context of the event (i.e., a quiet corridor) than for

witnesses interviewed in a context that is similar (i.e., on a busy street). In sum, the current findings suggest that the benefits associated with spontaneous mental context reinstatement as a result of eye-closure are more prominent than the benefits associated with a reduction in environmental distractions, since eye-closure was more helpful for witnesses interviewed in a quiet but dissimilar environment than for witnesses interviewed in a noisy but similar environment.

An alternative explanation for the marginally significant interaction between eye-closure and interview location found in free recall could be that witnesses interviewed outside were less comfortable closing their eyes than witnesses interviewed inside. That is, monitoring the current environment serves an evolutionary purpose (Glenberg, 1997), and witnesses may experience discomfort when closing the eyes in a potentially dangerous environment. This discomfort may in turn reduce the benefits of eye-closure. To explore this possibility, future research could examine correlations between self-report or behavioural measures of witness discomfort and memory performance.

We investigated the eye-closure effect using a research design intended to combine the strengths of field and laboratory research. Thus, we increased the realism of the witnessed event (by exposing unsuspecting mock witnesses to a live verbal altercation), while maintaining experimental control (by obtaining a video-recording of each instance of the staged event). From an applied perspective, the findings were promising. In free recall, the effect size of the eye-closure effect for witnesses interviewed inside ($d = .88$) approached the effect size obtained with the cognitive interview ($d = .87$ as reported by Köhnken et al., 1999; and $d = 1.20$ as reported by Memon et al., 2010). For witnesses interviewed outside, the benefit of eye-closure

during free recall was small and not significant ($d = .16$). Nevertheless, both groups of witnesses benefited significantly from eye-closure when answering questions about visual aspects of the witnessed event. Therefore, eye-closure may still be recommended when taking witness statements on the street, especially when asking specific questions about visual aspects of the witnessed event.

In sum, the recall benefits associated with eye-closure were replicated under naturalistic conditions. Although we do not suggest that the eye-closure instruction should replace the cognitive interview altogether, the cognitive interview can often not be used in practice due to lack of training or time constraints (for instance, Clarke & Milne, 2001, found that the cognitive interview had not been used in 83% of investigative interviews in the United Kingdom). Given that the eye-closure instruction requires no training or additional interview time, it could prove to be a useful alternative when interviewer training or interview time is limited.

References

- Caruso, E. M., & Gino, F. (2011). Blind ethics: Closing one's eyes polarizes moral judgments and discourages dishonest behavior. *Cognition*, 118(2), 280–285. doi: 10.1016/j.cognition.2010.11.008
- Christianson, S. A., & Hübner, B. (1993). Hands up! A study of witnesses' emotional reactions and memories associated with bank robberies. *Applied Cognitive Psychology*, 7(5), 365–379. doi: 10.1002/acp.2350070502
- Clarke, C., & Milne, R. (2001). *National evaluation of the PEACE investigative interviewing course*. Police Research Award Scheme. London: Home Office.

- Doherty-Sneddon, G., Bonner, L., & Bruce, V. (2001). Cognitive demands of face monitoring: Evidence for visuospatial overload. *Memory & Cognition*, 29(7), 909–919. doi: 10.3758/BF03195753
- Fisher, R. P. (1995). Interviewing victims and witnesses of crime. *Psychology, Public Policy, & Law*, 1(4), 732–764.
- Fisher, R. P., & Geiselman, R. E. (1992). *Memory-enhancing techniques for investigative interviewing: The cognitive interview*. Springfield: Charles Thomas.
- Gabbert, F., Hope, L., & Fisher, R. (2009). Protecting eyewitness evidence: Examining the efficacy of a self-administered interview tool. *Law and Human Behavior*, 33(4), 298–307. doi: 10.1007/s10979-008-9146-8
- Geiselman, R. E., Fisher, R. P., Firstenberg, I., Hutton, L. A., Sullivan, S., Avetissian, I., & Prosk, A. (1984). Enhancement of eyewitness memory: An empirical evaluation of the cognitive interview. *Journal of Police Science and Administration*, 12(1), 74–80.
- Geiselman, R. E., Fisher, R. P., MacKinnon, D. P., & Holland, H. L. (1985). Eyewitness memory enhancement in the police interview: Cognitive retrieval mnemonics versus hypnosis. *Journal of Applied Psychology*, 70(2), 401–412. doi: 10.1037/0021-9010.70.2.401
- Geiselman, R. E., Fisher, R. P., MacKinnon, D. P., & Holland, H. L. (1986). Enhancement of eyewitness memory with the cognitive interview. *The American Journal of Psychology*, 99(3), 385–401.
- Glenberg, A. M. (1997). What memory is for: Creating meaning in the service of action. *Behavioral and Brain Sciences*, 20(1), 1–55. doi: 10.1017/S0140525X97470012

- Glenberg, A. M., Schroeder, J. L., & Robertson, D. A. (1998). Averting the gaze disengages the environment and facilitates remembering. *Memory & Cognition*, 26(4), 651–658. doi: 10.3758/BF03211385
- Godden, D. R., & Baddeley, A. D. (1975). Context-dependent memory in two natural environments: On land and underwater. *British Journal of Psychology*, 66(3), 325–331.
- Goldsmith, M., Koriat, A., & Pansky, A. (2005). Strategic regulation of grain size in memory reporting over time. *Journal of Memory and Language*, 52(4), 505–525. doi: 10.1016/j.jml.2005.01.010
- Goldsmith, M., Koriat, A., & Weinberg-Eliezer, A. (2002). Strategic regulation of grain size in memory reporting. *Journal of Experimental Psychology: General*, 131(1), 73–95. doi: 10.1037//0096-3445.131.1.73
- Griffiths, A., & Milne, R. (2006). Will it all end in tiers? Police interviews with suspects in Britain. In T. Williamson (Ed.), *Investigative interviewing: Rights, research, regulation* (pp. 167–189). Cullompton: Willan.
- Hammond, L., Wagstaff, G. F., & Cole, J. (2006). Facilitating eyewitness memory in adults and children with context reinstatement and focused meditation. *Journal of Investigative Psychology and Offender Profiling*, 3(2), 117–130. doi: 10.1002/jip.47
- Ihlebak, C., Løve, T., Eilertsen, D. E., & Magnussen, S. (2003). Memory for a staged criminal event witnessed live and on video. *Memory*, 11(3), 319–327. doi: 10.1080/09658210244000018

- Kebbell, M. R., & Milne, R. (1998). Police officers' perceptions of eyewitness performance in forensic investigations. *Journal of Social Psychology, 138*(3), 323–330. doi: 10.1080/00224549809600384
- Kebbell, M. R., Milne, R., & Wagstaff, G. F. (1999). The cognitive interview: A survey of its forensic effectiveness. *Psychology, Crime & Law, 5*(1), 101–115. doi: 10.1080/10683169908414996
- Kebbell, M. R., & Wagstaff, G. F. (1999). The effectiveness of the cognitive interview. In D. Canter & L. Allison (Eds.), *Interviewing and deception* (pp. 25–39). Aldershot: Ashgate Publishing.
- Köhnken, G., Milne, R., Memon, A., & Bull, R. (1999). The cognitive interview: A meta-analysis. *Psychology, Crime & Law, 5*(1), 3–27. doi: 10.1080/10683169908414991
- Malpass, R. S., & Devine, P. G. (1981). Eyewitness identification: Lineup instructions and the absence of the offender. *Journal of Applied Psychology, 66*(4), 482–489. doi: 10.1037/0021-9010.66.4.482
- Markson, L., & Paterson, K. B. (2009). Effects of gaze-aversion on visual-spatial imagination. *British Journal of Psychology, 100*(3), 553–563. doi: 10.1348/000712608X371762
- Mastroberardino, S., Natali, V., & Candel, I. (2010). The effect of eye closure on children's eyewitness testimonies. *Psychology, Crime & Law, Advance online publication*, 1-13. doi: 10.1080/10683161003801100
- Mecklenburg, S. H., Bailey, P. J., & Larson, M. R. (2008). The Illinois field study: A significant contribution to understanding real world eyewitness identification

- issues. *Law and Human Behavior*, 32(1), 22-27. doi: 10.1007/s10979-007-9108-6
- Memon, A., Holley, A., Milne, R., Köhnken, G., & Bull, R. (1994). Towards understanding the effects of interviewer training in evaluating the cognitive interview. *Applied Cognitive Psychology*, 8(7), 641–659. doi: 10.1002/acp.2350080704
- Memon, A., Meissner, C. A., & Fraser, J. (2010). The cognitive interview: A meta-analytic review and study space analysis of the past 25 years. *Psychology, Public Policy, and Law*, 16(4), 340–372. doi: 10.1037/a0020518
- Murdoch, D., & Ross, D. (1990). Alcohol and crimes of violence: Present issues. *Substance Use & Misuse*, 25(9), 1065–1081. doi: 10.3109/10826089009058873
- 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), 1008–1013. doi: 10.1037/a0022930
- Perfect, T. J., Andrade, J., & Syrett, L. (2011). Environmental visual distraction during retrieval affects the quality, not the quantity, of eyewitness recall. *Applied Cognitive Psychology, Advance online publication*. doi: 10.1002/acp.1823
- 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), 314–324. doi: 10.1007/s10979-007-9109-5

- Phelps, F. G., Doherty-Sneddon, G., & Warnock, H. (2006). Helping children think: Gaze aversion and teaching. *British Journal of Developmental Psychology*, 24(3), 577–588. doi: 10.1348/026151005X49872
- Smeets, T., Candel, I., & Merckelbach, H. L. G. J. (2004). Accuracy, completeness, and consistency of emotional memories. *American Journal of Psychology*, 117(4), 595–609.
- Smith, S. M. (1979). Remembering in and out of context. *Journal of Experimental Psychology: Human Learning and Memory*, 5(5), 460–471. doi: 10.1037/0278-7393.5.5.460
- Smith, S. M., Glenberg, A. M., & Bjork, R. (1978). Environmental context and human memory. *Memory & Cognition*, 6(4), 342–353. doi: 10.3758/bf03197465
- Smith, S. M., & Vela, E. (2001). Environmental context-dependent memory: A review and meta-analysis. *Psychonomic Bulletin & Review*, 8(2), 203–220. doi: 10.3758/bf03196157
- Terr, L. C. (1983). Chowchilla revisited: The effects of psychic trauma four years after a school-bus kidnapping. *American Journal of Psychiatry*, 140(12), 1543–1550.
- Thompson, J., Morton, J., & Fraser, L. (1997). Memories for the Marchioness. *Memory*, 5(5), 615–638.
- Turtle, J., Read, J. D., Lindsay, D. S., & Brimacombe, C. A. E. (2008). Toward a more informative psychological science of eyewitness evidence. *Applied Cognitive Psychology*, 22(6), 769–778.
- Vredeveltdt, A., Hitch, G. J., & Baddeley, A. D. (2011). Eyeclosure helps memory by reducing cognitive load and enhancing visualisation. *Memory & Cognition*, 39(7), 1253–1263. doi: 10.3758/s13421-011-0098-8

- Wagenaar, W. A., & Groeneweg, J. (1990). The memory of concentration camp survivors. *Applied Cognitive Psychology*, 4(1), 77–87. doi: 10.1002/acp.2350040202
- 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 & Experimental Hypnosis*, 52(4), 434–455. doi: 10.1080/00207140490889062
- Weber, N., & Brewer, N. (2008). Eyewitness recall: Regulation of grain size and the role of confidence. *Journal of Experimental Psychology: Applied*, 14(1), 50–60. doi: 10.1037/1076-898X.14.1.50
- Yuille, J. C., & Cutshall, J. L. (1986). A case study of eyewitness memory of a crime. *Journal of Applied Psychology*, 71(2), 291–301.

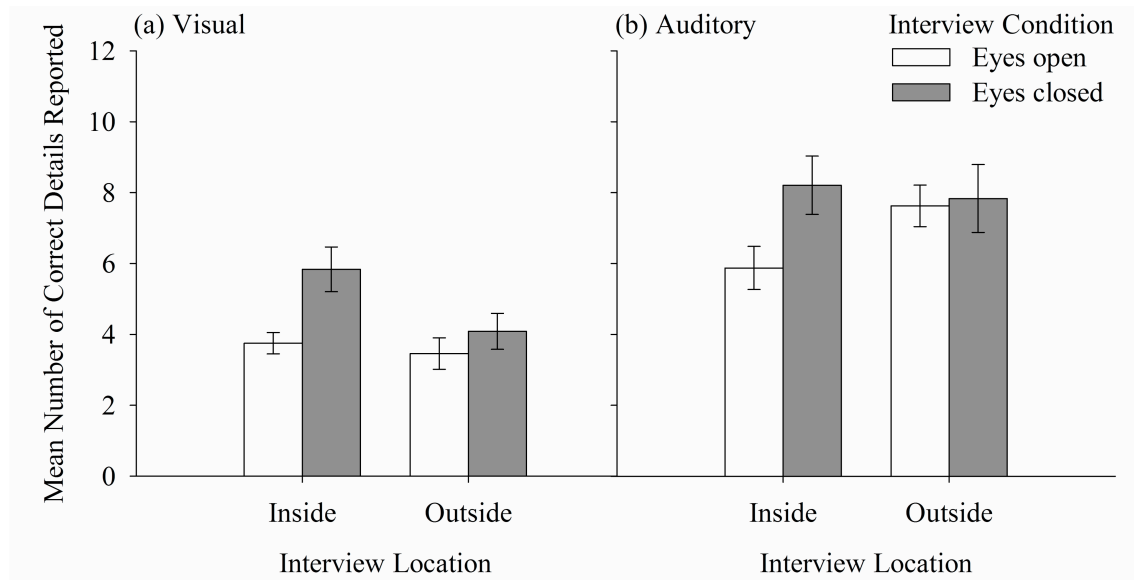


Figure 1. Mean number of (a) visual and (b) auditory correct details reported during the free recall phase, in interviews conducted either inside or outside, with eyes open or closed. Error bars indicate standard error.

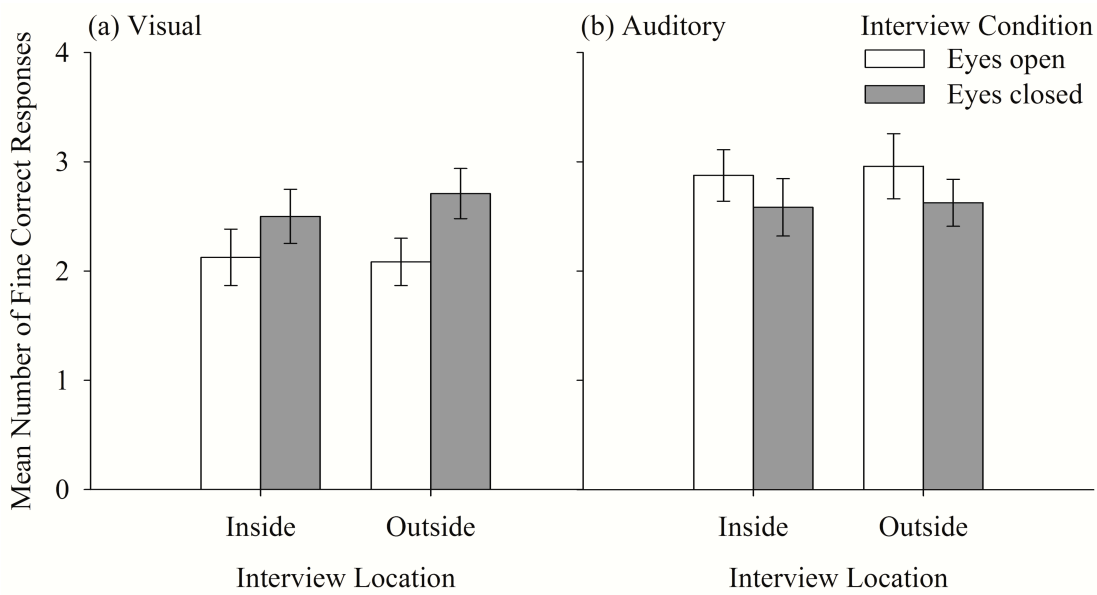


Figure 2. Mean number of correct fine-grain responses to questions about (a) visual and (b) auditory aspects of the event, in interviews conducted either inside or outside, with eyes open or closed. Error bars indicate standard error.

Appendix

Percentage of Participants per Interview Condition who Provided a (Fine- or Coarse-Grain) Correct Response, Broken Down by Interview Question.

No.	Interview Question	Interview Condition			
		inside open	inside closed	outside open	outside closed
	<i>Visual</i>				
1	Where did you meet with Sarah and Julia?	100%	91.7%	75.0%	95.8%
2	What clothes was Sarah/Julia wearing? ^a	45.8%	37.5%	45.8%	45.8%
4	Which animals did you see on the papers that Sarah was holding?	75.0%	83.3%	62.5%	75.0%
8	When Julia and Sarah did not agree on the animal assignment, what did Julia do?	62.5%	66.6%	70.8%	62.5%
9	What colours were the papers that dropped on the floor?	75.0%	70.8%	83.3%	79.2%
10	What happened to the papers after they had dropped on the floor?	50.0%	50.0%	54.2%	75.0%
12	Where did the experimenter touch Sarah?	8.3%	33.3%	20.8%	0%
16	What did Sarah do right before she left?	29.2%	54.2%	50.0%	45.8%
	<i>Auditory</i>				
3	Once you met with the colleagues, who started to speak to you first and what did they say?	33.3%	29.2%	37.5%	33.3%
5	Why did they need to know your participant numbers?	91.7%	83.3%	83.3%	79.2%
6	When the first participant gave Sarah his/her number, which animal did she assign to him/her?	83.3%	70.8%	83.3%	95.8%
7	And what animal did Julia think he/she should have been assigned?	41.7%	37.5%	50.0%	70.8%
11	After the papers were picked up, what did the experimenter say to the participants?	8.3%	29.2%	12.5%	25.0%
13	When and where did Sarah say that Julia had been rude to her before?	87.5%	79.2%	83.3%	54.2%
14	What did Julia call Sarah at the end?	54.2%	33.3%	50.0%	20.8%
15	What did Sarah say to the participants right before she left?	66.6%	87.5%	70.8%	70.8%

Note. Question numbers refer to the order in which the questions were asked. ^a Half of the participants were asked about Julia and half about Sarah; interviewers never asked about the clothes that they were wearing themselves.