Europe's Journal of Psychology
ejop.psychopen.eu | 1841-0413

PsychOpen
publishing psychology

Research Reports

The Effects of Eye-Closure and "Ear-Closure" on Recall of Visual and Auditory Aspects of a Criminal Event

Annelies Vredeveldt[a], Alan D. Baddeley[b], Graham J. Hitch[b]

[a]Department of Psychology, University of Cape Town, Cape Town, South Africa. [b]Department of Psychology, University of York, York, UK.

Abstract

Previous research has shown that closing the eyes can facilitate recall of semantic and episodic information. Here, two experiments are presented which investigate the theoretical underpinnings of the eye-closure effect and its auditory equivalent, the "ear-closure" effect. In Experiment 1, participants viewed a violent videotaped event and were subsequently interviewed about the event with eyes open or eyes closed. Eye-closure was found to have modality-general benefits on coarse-grain correct responses, but modality-specific effects on fine-grain correct recall and incorrect recall (increasing the former and decreasing the latter). In Experiment 2, participants viewed the same event and were subsequently interviewed about it, either in quiet conditions or while hearing irrelevant speech. Contrary to expectations, irrelevant speech did not significantly impair recall performance. This null finding might be explained by the absence of social interaction during the interview in Experiment 2. In conclusion, eye-closure seems to involve both general and modality-specific processes. The practical implications of the findings are discussed.

Keywords: eyewitness memory, eye-closure, ear-closure, cognitive load, modality-specific interference

Europe's Journal of Psychology, 2012, Vol. 8(2), 284–299, doi:10.5964/ejop.v8i2.472

Received: 2012-03-12. Accepted: 2012-04-24. Published: 2012-05-31.

When eyewitnesses close their eyes during an investigative interview, they remember more about a witnessed crime than when they keep their eyes open (Mastroberardino, Natali, & Candel, 2012; Perfect et al., 2008; Wagstaff et al., 2004). Wagstaff et al. (2004) were the first to show that eye-closure during retrieval increased the amount of correct information recalled about a past public event (Princess Diana's funeral), without inflating the report of inaccurate information. Perfect and colleagues (2008) extended this finding to recall of everyday mundane events, and concluded that their experiments "collectively demonstrate that eye-closure can benefit both cued-recall and free-recall, for both visual and auditory materials, for events studied deliberately on video, and for incidentally encoded live interactions" (Perfect et al., 2008, p. 321). Subsequently, Mastroberardino et al. (2012) showed that eye-closure could also help children to answer questions about a witnessed emotional event. Thus, evidence is converging for the benefits of eye-closure on eyewitness recall. However, the question remains *why* eye-closure works. This question is not only interesting from a theoretical point of view, but is also relevant from a practical point of view. That is, if police officers are to implement this interview instruction, they will likely find it useful to know how it works.

Two explanations that have been contrasted in previous work (e.g., Perfect et al., 2008) are the general and the modality-specific explanation of the eye-closure effect. The general explanation, also known as the *cognitive load* hypothesis, originates from Glenberg's (1997) embodied cognition account of memory, which construes environmental monitoring and memory retrieval as two concurrent tasks competing for cognitive resources. Disengaging from the environment (e.g., by closing the eyes) frees up cognitive resources, which can then be re-allocated to the memory retrieval task, resulting in an overall improvement in recall performance (see also Glenberg, Schroeder, & Robertson, 1998). The *modality-specific* explanation, on the other hand, suggests that eye-closure will be more helpful for recall of visual information than for recall of auditory information. This explanation is based on the modality-specific interference effect, studied predominantly in the context of short-term memory (for reviews, see Baddeley, 1986, 2007; Logie, 1986). In one study of particular interest to the current paper, Baddeley and Andrade (2000) examined the role of modality-specific interference on cognitive processes involving long-term memory retrieval (i.e., mental imagery). They found that a concurrent visuospatial task (spatial tapping) interfered more with the vividness of visual imagery (e.g., "imagine the appearance of cows grazing") than with the vividness of auditory imagery (e.g., "imagine the sound of a cat meowing"), whereas a concurrent auditory-verbal task (counting) interfered more with the vividness of auditory than visual imagery. These findings point to the possibility that distractions in the environment may disrupt retrieval from long-term memory in a modality-specific way.

Based on their own findings, Perfect et al. (2008) concluded that there was more evidence in favour of a general explanation (i.e., concentration) than for a modality-specific explanation. They based this conclusion on their assertion that eye-closure in their experiments helped recall of both visual and auditory information—except in Experiment 2, which was "clearly out of line with the subsequent studies" (p. 322). However, a closer look at their data suggests that this assertion may have been somewhat premature. That is, if we take the *accuracy* of the recalled information into account, only Experiment 4 and 5 supported the conclusion that eye-closure improved recall of both visual *and* auditory aspects. Experiment 1 did not bear on the modality issue, and Experiment 2, as acknowledged by the authors, showed that eye-closure impaired both the amount and the accuracy of auditory recall. Crucially, Experiment 3 found that eye-closure increased the *number* of auditory details recalled, but significantly decreased the *accuracy* of the recalled auditory information. Thus, taken together, their findings provided some support for a general effect (Experiments 4 and 5), but also some support for a modality-specific effect (Experiments 2 and 3).

In follow-up research, Perfect, Andrade, and Eagan (2011) combined the eye-closure instruction with the presentation of auditory distraction. Neither eye-closure nor bursts of white noise during the interview had a significant effect on correct recall of visual or auditory information. However, noise significantly increased the number of errors reported by participants, and eye-closure significantly reduced these errors. Perfect and colleagues took these findings as further support for the idea that the eye-closure effect is not modality-specific, since eye-closure helped participants to overcome the cross-modal memory impairment caused by auditory distraction. In another study, Perfect, Andrade, and Syrett (2012) manipulated the complexity and predictability of visual distraction in the interview environment. They found that complex (as opposed to simple) visual distraction significantly impaired the accuracy, but not the number, of responses provided about a news bulletin. They did not find a significant interaction between eye-closure and modality of the recalled information, again bolstering their claim of a general effect. Nevertheless, their data show that the eye-closure effect was somewhat more pronounced for recall of visual information than for recall of auditory information (see Figure 1, Perfect et al., 2012).

In sum, although Perfect and colleagues dismissed modality-specific interference as an explanation of the eye-closure effect, some of their findings suggest that there may be modality-specific processes at play. Indeed, Vredeveldt, Hitch, and Baddeley (2011) found evidence for a combination of general and modality-specific interference caused by visual and auditory distractions in the interview environment. Specifically, they found that meaningless visual or auditory distractions during recall (i.e., Hebrew words popping up on a computer screen or being spoken via headphones, respectively) disrupted recall of both visual and auditory information compared to conditions in which participants looked at a blank computer screen or had their eyes closed. However, visual distractions had a greater impact on recall of visual information, whereas auditory distractions had a greater impact on recall of auditory information.

Experiment 1: Eye-Closure

Because the findings reported by Perfect et al. (2008) were mixed with regards to the modality issue, Experiment 1 was designed to shed more light on this issue. To enhance the ecological validity of the research, we examined the effect of eye-closure on recall of a violent event, instead of the mundane events used by Perfect et al. (2008). Following from Baddeley and Andrade's (2000) findings, we predicted that looking at visual stimuli in the interview environment while trying to retrieve *visual* information would be more problematic than looking at visual stimuli while trying to retrieve *auditory* information. In other words, we hypothesized that eye-closure would have greater benefits for recall of visual information than for recall of auditory information.

Method

Participants — Fifty-seven undergraduate psychology students from the University of York participated for course credit or a small monetary reward. One participant who had seen the video before was excluded from the analysis, leaving 56 participants. The sample consisted of 10 males and 46 females, with ages ranging from 18 to 26 (M = 19.75 years, SD = 1.60). All participants were native English speakers and had normal or corrected-to-normal vision and hearing.

Materials — Participants watched a two-and-a-half-minute video clip taken from a TV drama. A crime scene containing moderate violence, blood, and injuries was selected, depicting a man who breaks into a woman's house and tries to cut her with a knife. Sixteen interview questions were drawn up about the event; half addressing uniquely visual aspects and half addressing uniquely auditory aspects of the event (see Appendix). The questions were asked in the order in which the corresponding information appeared in the video clip; hence the different types of questions were mixed, and in a fixed order throughout.

Procedure — All participants were tested individually in a small laboratory. After providing informed consent, participants watched the video and engaged in a two-minute distracter task involving the backwards spelling of animal names (cf. Perfect et al., 2008). Subsequently, they were interviewed about the video. Twenty-eight participants were assigned to the eyes-open condition and 28 to the eyes-closed condition, using a random sequence generator. Those in the eyes-closed condition were instructed to keep their eyes closed throughout the interview, whereas those in the eyes-open condition received no instructions. If participants in the eyes-closed condition inadvertently opened their eyes (which happened infrequently), they were reminded to keep them closed. None of the participants in the eyes-open condition spontaneously closed their eyes; all of them were facing the interviewer throughout the interview. Participants were encouraged to ask the interviewer to repeat the question if they did not hear it properly (which happened occasionally in both interview conditions). They were asked to remember as much as possible, but not to guess; a "do not remember" response was allowed. All interviews were audio-taped for subsequent analysis. After completing a demographic information sheet, participants were asked whether they had seen the TV series before, debriefed, and thanked for their participation.

Data Coding — The audio-taped interviews were coded blind to interview condition. Responses were coded as correct, incorrect, or omitted (“don’t know”), and all correct responses were coded for grain size (cf. Goldsmith, Koriat, & Pansky, 2005; Goldsmith, Koriat, & Weinberg-Eliezer, 2002; Yaniv & Foster, 1995). Thus, a correct response could be classified as coarse-grain (e.g., “the shirt was grey”) or fine-grain (e.g., “the shirt had a grey body with dark-blue sleeves”). Examples of each type of response can be found in the Appendix. Incorrect responses were not coded for grain size, due to insufficient data. Ten interviews (160 responses; 18% of the total sample) were randomly selected and coded independently by a second blind coder. Inter-rater reliability (for the decision to score a response as fine-grain correct, coarse-grain correct, incorrect, or omitted) was high, $\kappa = .92$, $p < .001$. The scores of the first coder were retained for the main analysis.

Results and Discussion

Figure 1 shows the number of fine-grain correct, coarse-grain correct, incorrect, and omitted responses about visual and auditory aspects of the witnessed event. It should be noted that any main effects of modality cannot reasonably be attributed to modality effects per se, because the interview questions differed in terms of content, and some were likely more difficult to answer than others (despite attempts to select questions of equivalent difficulty about visual and auditory aspects of the event). Hence, the main focus of the present analyses is on potential main effects of eye-closure, and on potential interactions between eye-closure and modality.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed ANOVA on fine-grain correct recall[i] revealed that participants provided significantly more fine-grain correct responses to questions about visual details than to questions about auditory details, $F\,(1, 54) = 12.65$, $p < .001$, $\eta^2 = .17$. There was no significant main effect of eye-closure ($F < 1$), but there was a significant interaction between eye-closure and modality, $F\,(1, 54) = 6.46$, $p < .05$, $\eta^2 = .09$. Figure 1 shows that, in line with our predictions, eye-closure tended to increase the number of fine-grain correct responses to questions about visual aspects. At the same time, it tended to decrease the number of fine-grain correct responses to questions about auditory aspects. However, neither of these simple contrasts was significant (both *p*s > .08).

A corresponding two-way ANOVA on coarse-grain correct recall revealed that participants also provided significantly more coarse-grain correct responses to questions about visual details than to questions about auditory details, $F\,(1, 54) = 13.68$, $p < .001$, $\eta^2 = .20$. Furthermore, participants who closed their eyes provided significantly more coarse-grain correct responses than participants who kept their eyes open, $F\,(1, 54) = 8.28$, $p < .01$, $\eta^2 = .15$, $d = .77$. There was no significant interaction between eye-closure and modality ($F < 1$). Thus, in terms of coarse-grain recall, eye-closure had a general rather than a modality-specific effect.

Another two-way ANOVA on incorrect recall revealed no significant main effects of modality, $F\,(1, 54) = 2.09$, $p = .15$, or eye-closure, $F\,(1, 54) = 1.88$, $p = .18$. However, there was a significant interaction between modality and eye-closure, $F\,(1, 54) = 9.90$, $p < .01$, $\eta^2 = .15$. Simple effects analyses showed that eye-closure significantly decreased incorrect recall of visual details, $F\,(1, 54) = 8.91$, $p < .01$, $\eta^2 = .14$, whereas it did not significantly affect incorrect recall of auditory details, $F\,(1, 54) = 1.05$, $p = .31$. This finding is consistent with our prediction that eye-closure would be most beneficial for recall of visual information.

PsychOpen publishing psychology

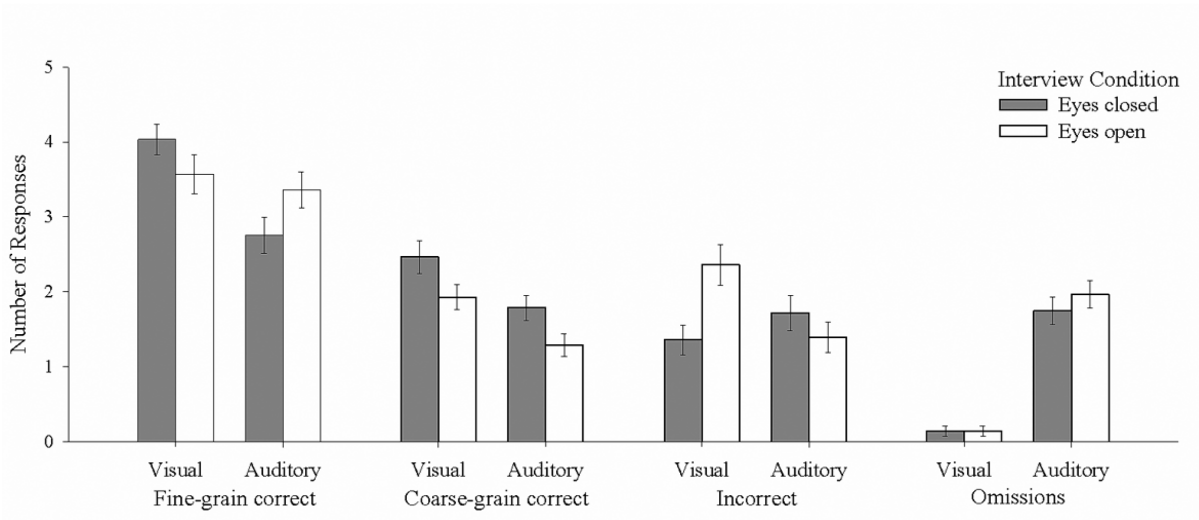

Figure 1.

Mean number of fine-grain correct, coarse-grain correct, incorrect, and omitted responses about visual and auditory aspects of the witnessed event in Experiment 1. Error bars indicate standard error.

Finally, a two-way ANOVA on the number of omissions[ii] showed that participants responded "don't know" significantly more often to questions about auditory details than to questions about visual details, F (1, 54) = 174.99, p < .001, η^2 = .76. There was no significant effect of eye-closure (F < 1) and no significant interaction between eye-closure and modality (F < 1).

Experiment 2: "Ear-Closure"

Experiment 1 investigated one part of the modality-specific interference hypothesis, namely, whether eye-closure would improve recall of visual information more than recall of auditory information. Experiment 2 was designed to investigate the auditory counterpart of this hypothesis, namely, whether "ear-closure" would improve recall of auditory information more than recall of visual information. As an auditory equivalent of eye-closure, participants in Experiment 2 were provided with noise-cancelling headphones. This "ear-closure" condition was compared to a condition high in auditory distractions, in which participants were exposed to irrelevant speech in the participants' native language. Due to the absence of an "ears-open" control condition, the experimental design in Experiment 2 was not an exact auditory parallel of the experimental design in Experiment 1. For this reason, the findings will be discussed in terms of the impairment caused by irrelevant speech, rather than in terms of the benefits associated with "ear-closure".

Most previous studies on irrelevant sound have focussed on its impact on short-term recall of simple stimuli. Although irrelevant speech does not seem to disrupt tasks that rely on phonological *processing*, such as judgments of rhyme and homophony (Baddeley & Salamé, 1986), it has consistently been found to disrupt tasks that rely on phonological *storage*, such as recall of visually presented digits (e.g., Colle & Welsh, 1976; Jones, 1993; Jones & Macken, 1995; Salamé & Baddeley, 1982, 1987). However, given that short-term storage relies primarily on a phonological form of coding, whereas long-term storage relies primarily on a semantic form of coding (Baddeley, 1966), we cannot conclude from these findings that irrelevant speech will also disrupt long-term storage.

More recent studies have investigated the impact of irrelevant speech and other types of noise on long-term recall of prose passages. Some of these studies have examined the impact of chronic noise exposure (e.g., Banbury & Berry, 2005; Hygge, Evans, & Bullinger, 2002; Matsui, Stansfeld, Haines, & Head, 2004); others have examined the impact of noise during encoding (Enmarker, 2004; Knez & Hygge, 2002); and yet others have examined the impact of noise during both encoding and retrieval (e.g., Banbury & Berry, 1998, Experiment 2; Hygge, Boman, & Enmarker, 2003). Across these different conditions, noise has been found to disrupt long-term memory for prose passages. Although these studies examined long-term recall, they concerned memory for text passages, not memory for events as in the present experiment. Furthermore, none of the studies investigated the impact of noise presented solely during retrieval. Miles, Jones, and Madden (1991) found that short-term recall of digits was not disrupted when irrelevant speech was presented only during retrieval, but as explained above, this type of recall is not comparable to long-term recall of events.

To the authors' knowledge, the only previous study in which participants were exposed to auditory distractions during recall of an event was conducted by Perfect and colleagues (2011). In their study, participants were interviewed face-to-face about a staged event; some in quiet conditions, while others were exposed to bursts of white noise in-between the interview questions. They found that bursts of white noise significantly increased the number of erroneous responses about the event, thus impairing recall accuracy. Given that irrelevant speech typically disrupts performance even more than white noise does (e.g., Salamé & Baddeley, 1987), we expected that irrelevant speech in the current study would also impair recall of the witnessed event. Perfect et al. did not find evidence for a modality-specific impairment caused by bursts of white noise, suggesting that the noise disrupted general concentration rather than the specific retrieval of *auditory* information. However, when Baddeley and Andrade (2000) exposed their participants to a more cognitively demanding auditory-verbal task (i.e., the instruction to count from 1 to 10, instead of exposure to bursts of white noise), the retrieval of auditory images from long-term memory was disrupted more than the retrieval of visual images. Therefore, it is possible that exposure to irrelevant speech will also impair the retrieval of auditory information more than the retrieval of visual information.

In sum, Experiment 2 was designed to examine whether auditory distractions in the interview environment impair recall performance. Following from Perfect et al.'s (2012) findings that white noise impaired event recall, we hypothesized that irrelevant speech would also impair event recall (perhaps even more so than white noise; cf. Salamé & Baddeley, 1987). Furthermore, in line with Baddeley and Andrade's (2000) findings, we predicted that being exposed to irrelevant speech while trying to retrieve *auditory* information would be more problematic than being exposed to irrelevant speech while trying to retrieve *visual* information. Put differently, we hypothesized that "ear-closure" would have greater benefits for recall of auditory information than for recall of visual information.

Method

Participants — Fifty-six undergraduate psychology students from the University of York participated for course credit or a small monetary reward. The sample consisted of 16 males and 40 females, with ages ranging from 18 to 30 (M = 19.87 years, SD = 2.41). All participants were native English speakers and had normal or corrected-to-normal vision and hearing.

Materials — The videotaped event was identical to the video used in Experiment 1. The headphones used were Beyerdynamic DT 770 professional monitoring headphones (250 Ohms), which exclude ambient sounds. The irrelevant-speech stimulus was a fragment of the English-language audio book "The power of now", written and narrated by Eckhart Tolle. The irrelevant speech was presented at approximately 70 dB SPL(A) on average, with a range of approximately 14 dB.

Procedure — The first part of the procedure was identical to Experiment 1. After completing the distracter task, participants were asked to put on the headphones. Participants were randomly assigned to either hear no sound via the headphones (quiet condition) or hear irrelevant speech, which they were instructed to ignore (irrelevant-speech condition). They then wrote their answers on a paper sheet with questions about the video (see Appendix). Participants were instructed to remember as much as possible, but not to guess; a “do not remember” response was permissible. Upon completion of the question sheet, participants removed the headphones and completed a demographic information sheet. At the end of the session, they were asked whether they had seen the TV series before (none of them had), and were thanked and debriefed. The completed answer sheets were coded blind to experimental condition, using a coding procedure identical to Experiment 1 (see Appendix for examples).

Results and Discussion

Figure 2 shows the number of fine-grain correct, coarse-grain correct, incorrect, and omitted responses about visual and auditory aspects of the witnessed event. A 2 (Interview Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) mixed ANOVA on fine-grain correct recall revealed no significant effects of modality ($F < 1$) or interview condition, $F(1, 54) = 1.61$, $p = .21$, and no interaction between the two ($F < 1$). Thus, the tendency for irrelevant speech to decrease fine-grain correct recall, shown in Figure 2, was not statistically significant.

A corresponding two-way ANOVA on coarse-grain correct recall revealed that participants provided significantly more coarse-grain correct responses to questions about visual details than to questions about auditory details, $F(1, 54) = 7.97$, $p < .01$, $\eta^2 = .12$. There was no significant main effect of interview condition ($F < 1$), but there was a significant interaction between condition and modality, $F(1, 54) = 4.16$, $p < .05$, $\eta^2 = .06$. Figure 2 shows that irrelevant speech tended to decrease the number of coarse-grain correct responses to questions about auditory aspects; whereas it tended to increase coarse-grain correct answers about visual aspects. However, simple effects analyses showed that neither of these contrasts was significant (both *p*s > .09).

Another two-way ANOVA on incorrect recall revealed that participants provided significantly more incorrect responses to questions about visual details than to questions about auditory details, $F(1, 54) = 4.61$, $p < .05$, $\eta^2 = .08$. There was no significant main effect of interview condition ($F < 1$) and no interaction between interview condition and question modality ($F < 1$).

Finally, a two-way ANOVA on the number of omissions[iii] showed that participants responded “don’t know” significantly more often to questions about auditory details than to questions about visual details, $F(1, 54) = 42.91$, $p < .001$, $\eta^2 = .43$. There was no significant main effect of interview condition, $F(1, 54) = 1.53$, $p = .22$, and no significant interaction between condition and modality, $F(1, 54) = 3.13$, $p = .08$. Thus, the observed tendency for irrelevant speech to increase the number of omissions in response to questions about auditory details (see Figure 2) was not significant.

Contrary to our predictions, irrelevant speech caused neither an overall impairment in recall performance, nor a modality-specific impairment. Unexpectedly, the effects of irrelevant speech on recall of visual aspects varied as a function of grain size: irrelevant speech tended to decrease fine-grain correct recall while increasing coarse-grain correct recall, leaving the total number of correct responses about visual details unaffected. It is difficult to interpret

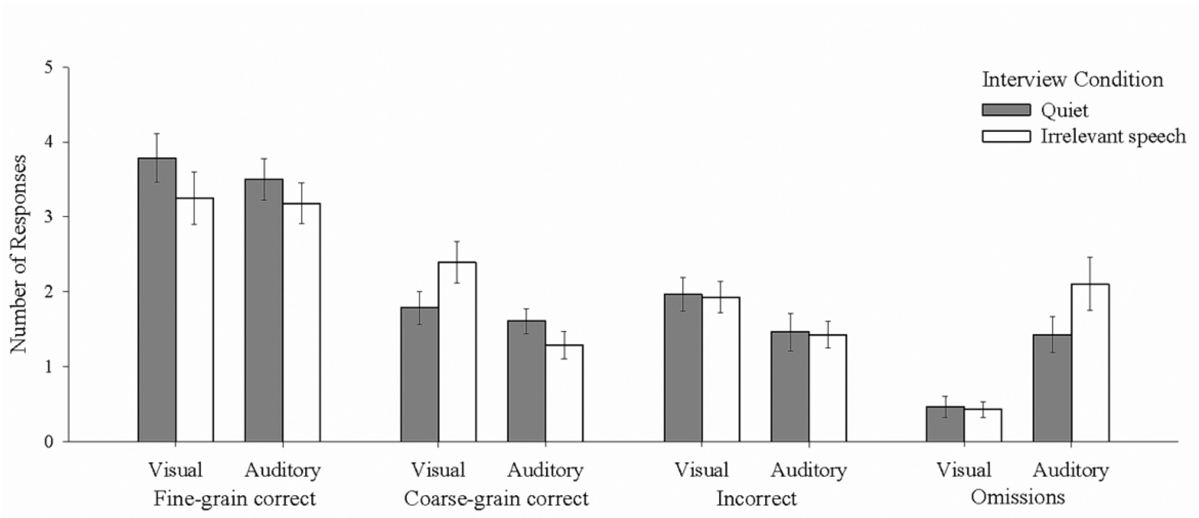

Figure 2.

Mean number of fine-grain correct, coarse-grain correct, incorrect, and omitted responses about visual and auditory aspects of the witnessed event in Experiment 2. Error bars indicate standard error.

this pattern of findings, because the number of fine-grain correct responses was not fully independent from the number of coarse-grain correct responses. For instance, it is possible that the significant interaction between condition and modality for coarse-grain recall was observed because participants in the irrelevant-speech condition replaced their (more informative) fine-grain correct visual responses with (less informative) coarse-grain alternatives.

General Discussion

We found evidence for an asymmetrical modality-specific interference effect of distractions in the interview environment. Thus, eye-closure had greater benefits for recall of visual information than for recall of auditory information. However, "ear-closure" had no significant effect on overall recall performance, nor specifically on recall of auditory information. In this section, we will first explore potential explanations for the non-significant "ear-closure" findings in Experiment 2. Subsequently, we will consider the implications of the significant eye-closure effect observed in Experiment 1.

Given that the pattern observed in Experiment 2 was in the expected direction, the non-significant findings may simply have been due to a lack of power. However, it is also possible that a more fundamental theoretical issue underlies the non-significant effect of irrelevant speech in the present study. In Baddeley and Andrade's (2000) Experiment 4 and 5, the vividness of auditory images retrieved from long-term memory was significantly disrupted by concurrent counting from 1 to 10. In the present experiment, the retrieval of auditory images from long-term memory (which was supposedly required to answer the interview questions about auditory aspects of the event) was not significantly disrupted by exposure to irrelevant speech. Perhaps, the discrepancy is due to the nature of the auditory-distraction task. It is likely that counting involves different functional components of the phonological loop (e.g., subvocal rehearsal) than hearing irrelevant speech does (cf. Baddeley & Salamé, 1986). The components that are disrupted by counting, but not by irrelevant speech, may be involved in the retrieval of auditory images from long-term memory (see also Baddeley & Logie, 1992). To test this idea, future research could compare the impact of concurrent counting with the impact of irrelevant speech on the retrieval of visual and auditory images from long-term memory.

.From an applied perspective, one significant limitation of Experiment 2 was the elimination of important social aspects of an eyewitness interview. Because the written answer sheet required no social interaction between the experimenter and the participant, the retrieval environment lacked socially-based environmental distractions. It has consistently been found that attending to another person's social cues demands a substantial amount of cognitive resources (Doherty-Sneddon & McAuley, 2000; Doherty-Sneddon, & Phelps, 2005; Glenberg et al., 1998; Markson & Paterson, 2009). Indeed, Wagstaff et al. (2008) found that recall performance in response to complex interview questions about a witnessed criminal event deteriorated as the number of observers in the interview room increased. Thus, it is possible that the irrelevant, non-social auditory distractions in Experiment 2 simply were not severe enough to disrupt recall performance to a significant extent. Perhaps, if the interview in Experiment 2 had involved social interaction, the added auditory distractions would have disrupted recall performance to a significant extent. Support for this idea is provided by previous findings. In Vredeveldt et al.'s (2011) experiment, participants who took part in a face-to-face interview (i.e., including social interaction) *while* being exposed to irrelevant speech in a foreign language indeed provided significantly fewer fine-grain correct responses about a witnessed event than participants who were not exposed to environmental distractions. Similarly, in Perfect et al.'s (2012) study, bursts of white noise interposed between the interview questions in a face-to-face interview significantly impaired the accuracy of event recall.

Social psychological research has also shown that looking at another person's face is a cognitively demanding task (Beattie, 1981; Ehrlichman, 1981; Kendon, 1967; Markson & Paterson, 2009). Interpreted in this light, the eye-closure benefits observed in Experiment 1 are consistent with Baddeley and Andrade's (2000) finding that visual tasks (in this case, looking at the interviewer's face) disrupt the vividness of visual images retrieved from long-term memory. That is, it seems likely that fine-grain correct recall requires a degree of visualization. For instance, by visualizing the witnessed scene, witnesses would have been able to report that the man was kneeling on the floor by the coffee table (fine-grain correct answer), rather than simply concluding from a gist-based memory that the man was on the floor (coarse-grain correct answer). This interpretation of the present findings is also consistent with previous findings showing that eye-closure facilitates visualization (Caruso & Gino, 2011; Rode, Revol, Rossetti, Boisson, & Bartolomeo, 2007; Wais, Rubens, Boccanfuso, & Gazzaley, 2010). Furthermore, the decrease in incorrect visual responses associated with eye-closure suggests that the increase in correct recall observed as a result of eye-closure was not merely the result of a criterion shift (Koriat & Goldsmith, 1996; see also Perfect et al., 2012).

In addition to the modality-specific benefit for fine-grain correct recall, eye-closure was associated with a modality-general benefit for coarse-grain correct recall. Thus, eye-closure increased the number of correct coarse-grain responses irrespective of the modality of the to-be-remembered information. This finding is compatible with the idea that eye-closure reduces general cognitive load, thereby improving overall concentration (e.g., Glenberg et al., 1998; Perfect et al., 2011; Perfect et al., 2008). Thus, the present findings suggest that both modality-specific and general processes play a role in the eye-closure effect, in line with our previous findings (Vredeveldt et al., 2011). Which type of process is dominant will likely depend on a multitude of factors, including the nature of the recalled event. For instance, it is possible that eye-closure during the interview will be more beneficial for the recall of auditory information when the witnessed event does not contain any visual information.

To investigate this possibility, future research could study the eye-closure effect in an "earwitness" setting (cf. Campos & Alonso-Quecuty, 2006; Pezdek & Prull, 1993; Yarmey, 1992).

An investigation of the cognitive mechanisms behind the eye-closure effect is not only interesting from a theoretical point of view, but also relevant from an applied point of view. First of all, it is useful for police interviewers to know what kind of recalled information can be enhanced by instructing witnesses to close their eyes, and what kind of information does not seem to benefit. Moreover, police officers are unlikely to use an interview tool if they are not convinced of its benefits, as exemplified by the fact that certain interview instructions that are perceived to be ineffective (e.g., the reverse-order and change-perspective instructions) are rarely used in practice (e.g., Dando, Wilcock, & Milne, 2009; Kebbell, Milne, & Wagstaff, 1999; Milne & Bull, 2002). Thus, an examination of the underpinnings of the eye-closure effect is important from both a theoretical and a practical perspective. The present findings add to the converging evidence (e.g., Mastroberardino et al., 2012; Perfect et al., 2008; Vredeveldt et al., 2011; Wagstaff et al., 2004) that eye-closure has the potential to become a valuable tool in eyewitness interviewing, particularly to facilitate recall of detailed visual information about the witnessed criminal event.

Funding

This research was supported by a University of York departmental studentship and a VSB foundation scholarship awarded to Annelies Vredeveldt.

Acknowledgements

We thank Jodie Davies-Thompson for her help with double coding the interviews, and Julian Oldmeadow for his valuable feedback on earlier versions of this work.

Notes

i) Because the fine-grain correct recall data violated the assumption of homogeneity of variance (Levene, 1960), non-parametric tests were also performed. These tests confirmed the reported findings.
ii) Because the visual omission data violated assumptions of normality, non-parametric tests were also performed. These tests confirmed the reported findings.
iii) Because the omission data violated assumptions of normality, non-parametric tests were also performed. These tests confirmed the reported findings.

References

Baddeley, A. D. (1966). The influence of acoustic and semantic similarity on long-term memory for word sequences. *The Quarterly Journal of Experimental Psychology, 18(4),* 302-309. doi:10.1080/14640746608400047

Baddeley, A. D. (1986). *Working memory*. Oxford, UK: Oxford University Press.

Baddeley, A. D. (2007). *Working memory, thought, and action*. New York: Oxford University Press.

Baddeley, A. D., & Andrade, J. (2000). Working memory and the vividness of imagery. *Journal of Experimental Psychology. General, 129(1),* 126-145. doi:10.1037/0096-3445.129.1.126

Baddeley, A. D., & Logie, R. H. (1992). Auditory imagery and working memory. In D. Reisberg (Ed.), *Auditory imagery* (pp. 179–197). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Baddeley, A. D., & Salamé, P. (1986). The unattended speech effect: Perception or memory? *Journal of Experimental Psychology. Learning, Memory, and Cognition, 12(4),* 525-529. doi:10.1037/0278-7393.12.4.525

Banbury, S. P., & Berry, D. C. (1998). Disruption of office-related tasks by speech and office noise. *The British Journal of Psychology, 89(3),* 499-517. doi:10.1111/j.2044-8295.1998.tb02699.x

Banbury, S. P., & Berry, D. C. (2005). Office noise and employee concentration: Identifying causes of disruption and potential improvements. *Ergonomics, 48(1),* 25-37. doi:10.1080/00140130412331311390

Beattie, G. W. (1981). A further investigation of the cognitive interference hypothesis of gaze patterns during conversation. *The British Journal of Social Psychology, 20,* 243-248. doi:10.1111/j.2044-8309.1981.tb00493.x

Campos, L., & Alonso-Quecuty, M. L. (2006). Remembering a criminal conversation: Beyond eyewitness testimony. *Memory (Hove, England), 14(1),* 27-36. doi:10.1080/09658210444000476

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

Colle, H. A., & Welsh, A. (1976). Acoustic masking in primary memory. *Journal of Verbal Learning and Verbal Behavior, 15(1),* 17-31. doi:10.1016/S0022-5371(76)90003-7

Dando, C. J., Wilcock, R., & Milne, R. (2009). The cognitive interview: Novice police officers' witness/victim interviewing practices. *Psychology, Crime & Law, 15(8),* 679-696. doi:10.1080/10683160802203963

Doherty-Sneddon, G., & McAuley, S. (2000). Influence of video-mediation on adult–child interviews: Implications for the use of the live link with child witnesses. *Applied Cognitive Psychology, 14(4),* 379-392. doi:10.1002/1099-0720(200007/08)14:4<379::AID-ACP664>3.0.CO;2-T

Doherty-Sneddon, G., & Phelps, F. G. (2005). Gaze aversion: A response to cognitive or social difficulty? *Memory & Cognition, 33(4),* 727-733. doi:10.3758/BF03195338

Ehrlichman, H. (1981). From gaze aversion to eye-movement suppression: An investigation of the cognitive interference explanation of gaze patterns during conversation. *The British Journal of Social Psychology, 20(4),* 233-241. doi:10.1111/j.2044-8309.1981.tb00492.x

Enmarker, I. (2004). The effects of meaningful irrelevant speech and road traffic noise on teachers' attention, episodic and semantic memory. *Scandinavian Journal of Psychology, 45(5),* 393-405. doi:10.1111/j.1467-9450.2004.00421.x

Glenberg, A. M. (1997). What memory is for: Creating meaning in the service of action. *The Behavioral and Brain Sciences, 20(1),* 41-50. 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

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

Hygge, S., Boman, E., & Enmarker, I. (2003). The effects of road traffic noise and meaningful irrelevant speech on different memory systems. *Scandinavian Journal of Psychology, 44(1),* 13-21. doi:10.1111/1467-9450.00316

Hygge, S., Evans, G. W., & Bullinger, M. (2002). A prospective study of some effects of aircraft noise on cognitive performance in schoolchildren. *Psychological Science, 13(5),* 469-474. doi:10.1111/1467-9280.00483

Jones, D. M. (1993). Objects, streams and threads of auditory attention. In A. D. Baddeley & L. Weiscrantz (Eds.), *Attention: Selection, awareness and control* (pp. 87–104). Oxford: Clarendon Press.

Jones, D. M., & Macken, W. J. (1995). Phonological similarity in the irrelevant speech effect: Within- or between-stream similarity? *Journal of Experimental Psychology. Learning, Memory, and Cognition, 21(1),* 103-115. doi:10.1037/0278-7393.21.1.103

Kebbell, M. R., Milne, R., & Wagstaff, G. F. (1999). The cognitive interview: A survey of its forensic effectiveness. *Psychology, Crime & Law, 5(1-2),* 101-115. doi:10.1080/10683169908414996

Kendon, A. (1967). Some functions of gaze direction in social interaction. *Acta Psychologica, 26,* 22-63. doi:10.1016/0001-6918(67)90005-4

Knez, I., & Hygge, S. (2002). Irrelevant speech and indoor lighting: Effects on cognitive performance and self-reported affect. *Applied Cognitive Psychology, 16(6),* 709-718. doi:10.1002/acp.829

Koriat, A., & Goldsmith, M. (1996). Monitoring and control processes in the strategic regulation of memory accuracy. *Psychological Review, 103(3),* 490-517. doi:10.1037/0033-295X.103.3.490

Levene, H. (1960). Robust tests for equality of variances. In I. Olkin, S. G. Ghurye, W. Hoeffding, W. G. Madow & H. B. Mann (Eds.), *Contributions to probability and statistics: Essays in honor of Harold Hotelling* (pp. 278–292). Stanford, CA: Stanford University Press.

Logie, R. H. (1986). Visuo-spatial processing in working memory. *The Quarterly Journal of Experimental Psychology, 38A(2),* 229-247. doi:10.1080/14640748608401596

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. (2012). The effect of eye closure on children's eyewitness testimonies. *Psychology, Crime & Law, 18(3),* 245-257. doi:10.1080/10683161003801100

Matsui, T., Stansfeld, S. A., Haines, M. M., & Head, J. (2004). Children's cognition and aircraft noise exposure at home — The West London Schools Study. *Noise & Health, 7(25),* 49-57.

Miles, C., Jones, D. M., & Madden, C. A. (1991). Locus of the irrelevant speech effect in short-term memory. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 17(3),* 578-584. doi:10.1037/0278-7393.17.3.578

Milne, R., & Bull, R. (2002). Back to basics: A componential analysis of the original cognitive interview mnemonics with three age groups. *Applied Cognitive Psychology, 16(7),* 743-753. doi:10.1002/acp.825

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. (2012). Environmental visual distraction during retrieval affects the quality, not the quantity, of eyewitness recall. *Applied Cognitive Psychology, 26(2),* 296-300. 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

Pezdek, K., & Prull, M. (1993). Fallacies in memory for conversations: Reflections on Clarence Thomas, Anita Hill, and the Like. *Applied Cognitive Psychology, 7(4),* 299-310. doi:10.1002/acp.2350070404

Rode, G., Revol, P., Rossetti, Y., Boisson, D., & Bartolomeo, P. (2007). Looking while imagining: The influence of visual input on representational neglect. *Neurology, 68(6),* 432-437. doi:10.1212/01.wnl.0000252936.54063.b0

Salamé, P., & Baddeley, A. D. (1982). Disruption of short-term memory by unattended speech: Implications for the structure of working memory. *Journal of Verbal Learning and Verbal Behavior, 21(2),* 150-164. doi:10.1016/S0022-5371(82)90521-7

Salamé, P., & Baddeley, A. D. (1987). Noise, unattended speech and short-term memory. *Ergonomics, 30(8),* 1185-1194. doi:10.1080/00140138708966007

Vredeveldt, 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

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. *The International Journal of Clinical and Experimental Hypnosis, 52(4),* 434-455. doi:10.1080/00207140490889062

Wagstaff, G. F., Wheatcroft, J., Cole, J. C., Brunas-Wagstaff, J., Blackmore, V., & Pilkington, A. (2008). Some cognitive and neuropsychological aspects of social inhibition and facilitation. *The European Journal of Cognitive Psychology, 20(4),* 828-846. doi:10.1080/09541440701469749

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. *The Journal of Neuroscience, 30(25),* 8541-8550. doi:10.1523/JNEUROSCI.1478-10.2010

Yaniv, I., & Foster, D. P. (1995). Graininess of judgment under uncertainty: An accuracy-informativeness trade-off. *Journal of Experimental Psychology. General, 124(4),* 424-432. doi:10.1037/0096-3445.124.4.424

Yarmey, A. D. (1992). The effects of dyadic discussion on earwitness recall. *Basic and Applied Social Psychology, 13(2),* 251-263. doi:10.1207/s15324834basp1302_8

Appendix: Interview Questions with Example Responses

Questions Addressing Visual Aspects

Note: Question numbers refer to the order in which the questions were asked.

1. The woman in the video was watching TV at the start of the clip. On TV, there was a lady talking to children. How many children were there?

- **a.** *Fine-grain correct:* “four”.
- **b.** *Coarse-grain correct:* “between three and five”.
- **c.** *Incorrect:* “one”.

3. When the woman walked into the room, where was the man sitting?

- **a.** *Fine-grain correct:* “he was kneeling on the floor by the coffee table”.
- **b.** *Coarse-grain correct:* “on the floor”.
- **c.** *Incorrect:* “in a chair”.

4. What did the man’s shirt look like?

- **a.** *Fine-grain correct:* “grey body with dark blue sleeves”.
- **b.** *Coarse-grain correct:* “grey”.
- **c.** *Incorrect:* “red”.

7. From where did the man pull his knife?

- **a.** *Fine-grain correct:* “from his right jeans pocket”.
- **b.** *Coarse-grain correct:* “from his jeans”.
- **c.** *Incorrect:* “from his jacket pocket”.

8. What type of knife did the man have?

- **a.** *Fine-grain correct:* “a Stanley knife”.
- **b.** *Coarse-grain correct:* “a knife you use for DIY”.
- **c.** *Incorrect:* “a pen knife”.

11. When the man said “I need to do it”, the woman ran to the door. What did the door look like?

- **a.** *Fine-grain correct:* “a white frame with glass panes”.
- **b.** *Coarse-grain correct:* “white”.
- **c.** *Incorrect:* “brown”.

13. When the man held the woman to the floor, what did he do?

- **a.** *Fine-grain correct:* “he ripped her dress, exposing the tattoo”.
- **b.** *Coarse-grain correct:* “he exposed the tattoo”.
- **c.** *Incorrect:* “he cut the dress open with the knife”.

15. How did the woman get the man off her?

- **a.** *Fine-grain correct:* “she elbowed him in the face”.
- **b.** *Coarse-grain correct:* “she hit him”.
- **c.** *Incorrect:* “she kicked him”.

Questions Addressing Auditory Aspects

Note: Question numbers refer to the order in which the questions were asked.

2. What sound prompted the woman to walk to the living room?

- **a.** *Fine-grain correct:* “breaking glass”.
- **b.** *Coarse-grain correct:* “something breaking”.
- **c.** *Incorrect:* “door slamming”.

5. When the woman asked what the man was doing in her house, what did he say?

a. *Fine-grain correct:* “I know how to fix it”.

b. *Coarse-grain correct:* “I am going to sort it out”.

c. *Incorrect:* “I don’t know”.

6. For whom did the man say that he hurt himself?

a. *Fine-grain correct:* “for his sister”.

b. *Coarse-grain correct:* “for a woman”.

c. *Incorrect:* “for their father”.

9. What did the woman say when the man said that she had to cut her tattoo as well?

a. *Fine-grain correct:* “okay, give me the knife”.

b. *Coarse-grain correct:* “okay”.

c. *Incorrect:* “that she did not want to”.

10. The man and the woman talked about fictional characters: Nathaniel and ...?

a. *Fine-grain correct:* “Isabel”.

b. *Coarse-grain correct:* “something starting with an ‘I’ ”.

c. *Incorrect:* “Janet”.

12. When the man held the woman to the floor, she shouted his name. What was his name?

a. *Fine-grain correct:* “Billy”.

b. *Coarse-grain correct:* “the name started with a B”.

c. *Incorrect:* “John”.

14. When the man held the woman to the floor, he warned her. What did he say?

a. *Fine-grain correct:* “I’m warning you, this is going to hurt”.

b. *Coarse-grain correct:* “I’m warning you”.

c. *Incorrect:* “I will kill you”.

16. What did the woman say on the phone?

a. *Fine-grain correct:* “yes, hello, I need an ambulance”.

b. *Coarse-grain correct:* “something about an ambulance”.

c. *Incorrect:* “please help me”.

About the Authors

Annelies Vredeveldt graduated from University College Utrecht in 2007, after which she went on to do a Masters in Psychology and Law at Maastricht University. Upon receiving her M.Sc. degree, she moved to the University of York, where she conducted her Ph.D. research with Professors Alan Baddeley and Graham Hitch. She completed her Ph.D. thesis, entitled "The benefits of eye-closure on eyewitness memory", in 2011. Annelies is now a postdoctoral research fellow at the University of Cape Town, working with Professor Colin Tredoux.

Alan D. Baddeley graduated from University College London in 1956, after which he went on to do a Masters at Princeton University. He then joined the MRC Applied Psychology Unit (APU) in Cambridge, where he completed his Ph.D. After several years on the scientific staff of the APU he moved to the University of Sussex in Experimental Psychology, then to a chair at Stirling University, before returning to the APU as Director, where he and Graham Hitch developed the multi-component model of working memory [Baddeley, A. D. & Hitch, G. J. (1974): Working memory. In: G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 8, pp. 47–89). New York: Academic Press.]. Some 21 years later, Alan moved to Bristol University for 8 years before joining the University of York as a Professor in 2003.

Graham J. Hitch completed his first degree in Physics at the University of Cambridge. He then completed a Masters in Experimental Psychology at the University of Sussex before he returned to Cambridge to study short-term memory for his Ph.D. Since then, he has held posts at Sussex, Stirling, Cambridge, Manchester, and Lancaster Universities. During his postdoc with Alan Baddeley at the University of Cambridge, they developed the multi-component model of working memory [Baddeley, A. D. & Hitch, G. J. (1974): Working memory. In: G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 8, pp. 47–89). New York: Academic Press.], and both have continued to be concerned with the model and its evolution ever since. In 2000, Graham moved to the University of York to take up a Professorship.