The Benefits of Eye-Closure on Eyewitness Memory

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Abstract

Eyewitness memory is not perfect. However, recent research suggests that eyewitnesses remember more about a witnessed event if they close their eyes during the interview. The experiments reported in this thesis investigated applied and theoretical aspects of the eye-closure effect. Experiments 1-2 examined whether the effect extended to recall of violent events. Eye-closure was found to be as beneficial for recall of physiologically arousing violent events as it was for non-violent events, extending the generalisibility of the effect. Experiment 3 examined recall after a delay and repeated recall attempts, and found no benefits of eye-closure during immediate free recall, but substantial benefits in both free and cued recall after one week. Experiments 4-5 examined the theoretical underpinnings of the eye-closure effect. No evidence was found for an “ear-closure” effect on a written recall test. Nevertheless, meaningless visual and auditory distractions during an oral interview impaired recall performance, particularly for information presented in the same modality as the distraction. These impairments could be overcome by eye-closure or, to a lesser extent, by looking at a blank screen. The data were fitted to the newly proposed Cognitive Resources framework, to estimate the relative importance of general and modality-specific processes. Experiment 6 enhanced the ecological validity of the research. A forensically relevant event was staged on the street, after which witnesses were interviewed either in a quiet interview room or on a busy street. Eye-closure had substantial benefits in free recall and helped witnesses to provide detailed correct answers about visual aspects of the event. It was most effective for witnesses interviewed inside, suggesting that mental context reinstatement might play a role in the eye-closure effect. Taken together, the findings suggest that the eye-closure instruction could provide a simple alternative to the Cognitive Interview, particularly when police resources are limited.

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Declaration

This thesis comprises the candidate's own original work and has not been submitted previously or simultaneously to this or any other University for a degree. All experiments were designed and conducted by the candidate under supervision of Professor Alan D. Baddeley and Professor Graham J. Hitch. Part of the data from this thesis has been previously presented in the published journal article and conference presentations detailed below.

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Chapter 1

Overview of Thesis

The present chapter is intended to help the reader navigate through the thesis, providing a brief overview of each chapter.

1.1 Introduction

On popular TV programmes, police investigations of crime are typically portrayed as glamorous undertakings, in which state-of-the-art techniques are used to obtain unequivocal proof of the perpetrator's guilt. In the real world, things are unfortunately less clear-cut. The police are often forced to rely on the imperfect memory of eyewitnesses, and the evidence against a perpetrator is rarely unequivocal. To aid the police in their investigations, a number of interview methods have been developed to improve the quality and quantity of information obtained from eyewitnesses. The present thesis investigates the effectiveness of a relatively new interview instruction, namely, asking witnesses to close their eyes during the interview. The eye-closure instruction may have a number of advantages over existing interview methods, as will become clear over the course of this thesis.

1.2 Overview of Chapters

Chapter 2: Helping Witnesses Remember

This chapter comprises the literature review for the thesis, which is organised in three sections. The first section addresses the fallibility of eyewitness memory. The second section outlines a number of interview methods intended to help witnesses remember, with a special focus on mental context reinstatement and the Cognitive Interview. The final section explores recent research into the eye-closure instruction, and speculates about the theoretical underpinnings of the eye-closure effect.

Chapter 3: Memory for Violent Events

This chapter presents two experiments extending the eye-closure effect to memory for violent events. Experiment 1 replicated previous research on eye-closure with a violent event. Experiment 2 generalised the eye-closure effect across a number of different violent events, and included subjective and physiological measures of emotional arousal.

Chapter 4: Memory after a Delay

This chapter presents Experiment 3, which compared the effect of eye-closure in free and cued recall, and examined whether eye-closure was still effective after a one-week delay and repeated recall attempts.

Chapter 5: Environmental Distraction

This chapter presents two experiments assessing the theoretical underpinnings of the eye-closure effect. Experiment 4 examined whether the eye-closure effect has an auditory counterpart. Experiment 5 independently manipulated visual and auditory distractions in the interview environment, to assess the relative impact of general and modality-specific processes in the eye-closure effect.

Chapter 6: Memory for a Live Altercation

This chapter presents the final study, Experiment 6, which enhanced the ecological validity of the research. The experiment assessed the effect of eye-closure on recall of a forensically relevant live event in a racially diverse sample of witnesses, who were interviewed in different locations varying in the degree of realistic environmental distractions.

Chapter 7: Summary and General Discussion

This chapter assesses the theoretical and practical implications of various themes reoccurring throughout the thesis, presents findings from a survey of experienced police interviewers, addresses limitations of the research, and provides directions for future research.

Chapter 2
Helping Witnesses Remember

This chapter will provide a brief introduction into the topic of eyewitness memory, addressing effects of delay, stress, and intervening events. It will then review prominent interview methods, including the Reid Technique, hypnosis, mental context reinstatement, and the Cognitive Interview. Finally, it will explore the effect of eye-closure on eyewitness memory, outlining previous findings and addressing the theoretical underpinnings of the eye-closure effect.

2.1 Eyewitness Memory

The topic of memory has inspired poets, politicians, philosophers, and psychologists alike. Some writers have suggested that memory holds an objective record of our experiences. For instance, Oscar Wilde described memory as “the diary that we all carry about with us”, and Francis Fauvel-Gouraud conceived of memory as “the library of the mind”. Nevertheless, everyday experience suggests that memory is not, in fact, perfect. Schacter (1999) identified seven “sins” of memory: transience, absentmindedness, blocking, misattribution, suggestibility, bias, and persistence. The first three are sins of omission, occurring at different stages of the memory process. One example of a failure at the encoding stage is *absentmindedness* (though this may also occur at the retrieval stage). Thus, if no attention is paid to a certain piece of information, it will not be entered into memory. Or, in the words of English lexicographer Samuel Johnson, “the true art of memory is the art of attention”. Whether a piece of information is encoded depends, amongst other factors, on the level of emotional stress experienced during the event, as will be explained in section 2.1.3. *Transience* reflects a failure at the storage stage of memory: with the passage of time, gradual forgetting occurs. In

Othello, William Shakespeare highlighted the apparent inevitability of this process: "But men are men: the best sometimes forget". This phenomenon will be further discussed in section 2.1.2. Finally, *blocking* occurs at the retrieval stage: even though information may be stored in memory, we are not always able to retrieve it. As once noted by German philosopher Friedrich Nietzsche: "the existence of forgetting has never been proved: we only know that some things don't come to mind when we want them". Some of the methods to help witnesses remember more, described in sections 2.2 and 2.3, probably operate at the retrieval stage of memory.

The next two sins described by Schacter (1999) are sins of commission. *Misattribution* involves attributing an item in memory to an incorrect source. For instance, American humorist Josh Billings noted that people might "mistake their imagination for their memory". This type of mistake will be discussed in section 2.1.2.4. *Suggestibility* means that memory can be affected by external influences. Thus, according to Albert Einstein, "memory is deceptive because it is coloured by today's events". Suggestibility will be further explored in section 2.1.4. The sin of *bias* reflects the fact that memory is shaped by one's knowledge, beliefs, and expectations. For instance, memory may be shaped to fit with one's perception of self: "Memory says, I did that. Pride replies, I could not have done that. Eventually memory yields." (Friedrich Nietzsche). The prevalence of memory bias will be apparent throughout this review of eyewitness memory. Finally, *persistence* is explained best in the words of Michel de Montaigne: "Nothing fixes a thing so intensely in the memory as the wish to forget it." Persistence will not be explicitly addressed in the present thesis; to learn more about intrusive memories, the reader is referred to the literature on Post-Traumatic Stress Disorder (PTSD; e.g., Brewin, Dalgleish, & Joseph, 1996; Bryant & Harvey, 1998; Ehlers & Clark, 2000; Ehlers & Steil, 1995; Hackmann, Ehlers, Speckens, & Clark, 2004). This chapter will begin with a brief history of the research that has been conducted on the topic of eyewitness memory.

2.1.1 A Brief History of Eyewitness Research

Alfred Binet (1900) was one of the first scholars to write about the effects of suggestion on memory. Based on his observations, Binet encouraged the development of a "science of testimony". Several of his contemporaries followed this advice by publishing on the topic of eyewitness testimony (e.g., Arnold, 1906; Stern, 1904; Whipple, 1910, 1911, 1912, 1918). Perhaps the most influential early work on the topic was Münsterberg's (1908) book *On the Witness Stand.* Even though his book was met with fierce criticism (Wigmore, 1909; see also Doyle, 2005), several issues addressed in the book are still relevant today (e.g., the impact of suggestive questioning and the relation between witness confidence and accuracy). After a period of relative inactivity in eyewitness research from the 1920s to the 1960s (but see Burtt, 1931; Snee & Lush, 1941; Stern, 1939), the 1970s witnessed a renaissance in the eyewitness literature with researchers such as Robert Buckhout, Elizabeth Loftus, and Gary Wells picking up where Münsterberg had left off.

Buckhout (1974) pioneered the experimental methodology of mock crimes to study eyewitness memory. Loftus discovered the misinformation effect (Loftus, 1975; Loftus, Miller, & Burns, 1978) and the concept of false memories (Loftus & Pickrell, 1995), which will be discussed in more detail in section 2.1.4. Finally, Wells (1978) coined the distinction between system and estimator variables, fuelling a more systematic approach to eyewitness research (see also Wells et al., 2000). Whereas estimator variables are beyond the control of the justice system (e.g., viewing conditions during the witnessed event); system variables can be influenced by the justice system (e.g., interview instructions). The present thesis is concerned with a system variable that has received relatively little attention to date, namely, eye-closure during the investigative interview.

Because the experiments presented in this thesis did not involve identification of perpetrators from a line-up, the present literature review is primarily concerned with variables affecting recall of events (including person descriptions) rather than face recognition. Issues that are solely relevant to eyewitness identifications (such as line-up fairness, own-race bias, and weapon focus) will not be reviewed here, but reviews are available elsewhere (e.g., Brewer & Palmer, 2010; Brewer, Weber, & Semmler, 2005; Brewer & Wells, 2011; Meissner & Brigham, 2001; Shapiro & Penrod, 1986; Steblay, 1992; Wagenaar & Loftus, 1990; Wells & Quinlivan, 2009). This literature review will explore in detail three phenomena central to eyewitness recall. First, it will explain how memory changes naturally over time. Second, it will address the impact of emotional stress on memory. Third, it will discuss how intervening events may interfere with memory. The section will conclude by highlighting the practical relevance of memory research in legal contexts.

2.1.2 Memory over Time

In court cases, witnesses and victims are often questioned weeks, months, or even years after the witnessed crime (Flin, Boon, Knox, & Bull, 1992; Plotnikoff, 1990; Plotnikoff & Woolfson, 1995; Poole & White, 1993). Unfortunately, with the passage of time, our ability to retrieve information from long-term memory declines. Ebbinghaus's (1885/1964) classic research with lists of nonsense syllables found a steep curve of forgetting within the first hour after learning, after which the rate of forgetting became increasingly gradual. In the present section, I will examine whether Ebbinghaus's simple finding of memory deterioration over time also applies to recall of complex events. The effects of retention interval will be discussed in terms of quantity, specificity, and potential distortions in eyewitness memory.

2.1.2.1 Gist

Reviewing the eyewitness literature, Penrod, Loftus, and Winkler (1982) found that eyewitness memory followed an Ebbinghaus-like pattern, deteriorating rapidly over time. After a delay, witnesses are less likely to make a correct identification of the perpetrator (Shapiro & Penrod, 1986; Sporer, 1992; Wixted & Ebbesen, 1991, 1997), and they remember fewer event details (e.g., Cassel & Bjorklund, 1995; Fivush, Hudson, & Nelson, 1984; Flin et al., 1992; Poole & White, 1993). For instance, Lipton (1977) found that participants remembered 18% less information about a filmed murder after a one-week delay than when tested immediately. Turtle and Yuille (1994) introduced a delay of three weeks and found a 43% decrease in the number of accurate details reported about a simulated armed robbery. Burke, Heuer, and Reisberg (1992) also observed a strong effect of delay, but found no difference between one- and two-week testing, suggesting that "for these materials, forgetting had reached its asymptote by 1 week" (p. 283). Indeed, at first sight, it seems that eyewitness memory follows an Ebbinghaus-like curve of forgetting, with a sharp initial decline and more gradual forgetting over time. Nevertheless, the matter is not as simple as it seems.

It has long been recognised that memory is not an exact reproduction of our experiences—instead, it relies on constructive processes that are prone to simplification, distortion, and error (e.g., Bartlett, 1932; Koffka, 1935; Piaget, 1968; Reyna & Brainerd, 1995). After these constructive processes, what remains is the *gist* of the original experience (potentially accompanied by a few details). As noted by Sanford and Garrod, "gist is a most elusive thing to define" (1981, p. 67), yet people often intuitively agree on what constitutes the gist of a story. In inevitably vague terms, gist can be thought of as a basic semantic representation of the original story or event. Research on memory for sentences, stories, and conversations has established that memory for gist (i.e., the semantic content) is better retained over time than memory for details (i.e., the verbatim form; e.g., Bransford & Franks, 1971; Kintsch, Welsch, Schmalhofer, & Zimny, 1990; Neisser, 1981; Sachs, 1967; Stafford, Burggraf, & Sharkey, 1987).

Thorndyke (1977) proposed a systematic approach for the analysis of story content, which is shown in Figure 2.1. Thus, all stories are thought to have components relating to setting, theme, plot, and resolution. The numbers 1 to 4 in the figure represent different levels of information, ranging from the top-level information or gist (e.g., the main goal of the story) to peripheral details (e.g., attempts to achieve a subgoal in one of the subordinate episodes). In Experiment 3 of the present thesis, memory for a witnessed event was tested in a free recall format. To score the centrality of the reported information, I developed a coding scheme that was inspired by Thorndyke's plot structure approach (see Figure 4.1).

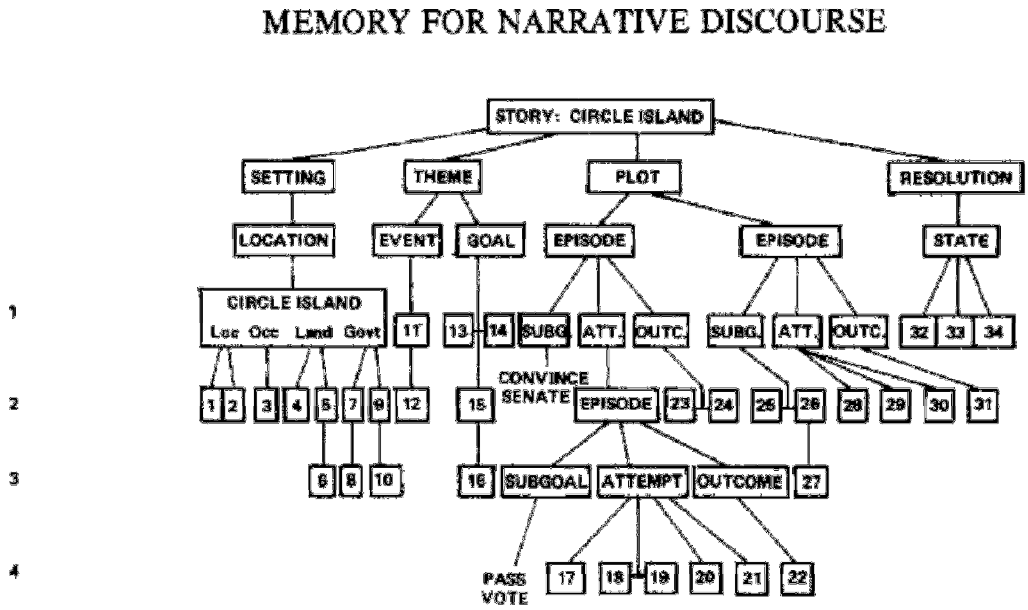


Figure 2.1 Plot structure for "Circle Island" story. A schematic depiction of Thorndyke's plot structure approach (adapted from Thorndyke, 1977, p. 81).

2.1.2.2 Grain Size

Just like memory for stories, memory for events is subject to "gistification" (Heuer & Reisberg, 1990, p. 498). For instance, Fisher (1996) was surprised to find that participants maintained an equivalent level of accuracy, regardless of whether they were tested soon after the event or 40 days later. A closer inspection of his data, however, showed that the degree of accuracy was maintained at the expense of specificity: the information reported after a longer delay was less precise than the information reported soon after the event. Consistent with this observation, Pinto and Baddeley (1991) found that people could still recall with a good degree of accuracy where they had parked their car a month earlier, but only because they responded with significantly larger parking areas. Similarly, even though witnesses of crimes tend to remember the basic facts of the criminal event very well, they tend to forget certain details, such as dates, names (Wagenaar & Groeneweg, 1990), and the colour of clothing (Yuille & Cutshall, 1986). Thus, whereas the basic elements of an event tend to be remembered well, details often get lost.

Koriat and Goldsmith have emphasised the strategic control of the rememberer in choosing what type of information to report (Goldsmith & Koriat, 1999; Goldsmith, Koriat, & Pansky, 2005; Goldsmith, Koriat, &

Weinberg-Eliezer, 2002; Koriat & Goldsmith, 1994, 1996; Koriat, Goldsmith, & Pansky, 2000). As noted by Neisser (1988), people often choose "a level of generality at which they [are] not mistaken" (p. 553). When people are pressured to provide more information than they would have volunteered spontaneously, however, they will shift their response criterion, providing a greater amount of information at the expense of accuracy (i.e., the quantity-accuracy trade-off model; Koriat & Goldsmith, 1996). One way of studying this phenomenon is to examine the *grain size* of responses provided by witnesses (Goldsmith et al., 2002). Grain size or "graininess" (Yaniv & Foster, 1995) refers to the level of specificity at which a person chooses to report information. For instance, when asked how much you paid for the groceries bought yesterday, you could answer "£34.78" (fine-grain response) or "between 30 and 40 pounds" (coarse-grain response). As observed by Fisher (1996), with the passage of time, people choose to provide progressively vaguer responses. This observation was confirmed in a more controlled study by Goldsmith et al. (2005), who found that after a delay, participants boosted the accuracy of their testimony by strategically adjusting the grain size of their reports (e.g., reporting the weight of the victim as "70-80 kg" instead of "73 kg"). To obtain a more detailed picture of the eye-closure effect, I will distinguish between fine- and coarse-grain answers in the experiments presented in this thesis.

2.1.2.3 Schemata and Scripts

What we remember is not a random collection of disparate details. Instead, people organise and remember their knowledge and experiences in line with pre-existing knowledge and beliefs. For instance, Gestalt psychologists noted that memory becomes distorted toward "better form" (Goldmeier, 1982; Koffka, 1935; Riley, 1962; see also Koriat, Goldsmith, & Pansky, 2000). Bartlett (1932) used the term *schema* to refer to a generalised mental representation, or concept, of an object, place, or person. The basic features of such a concept are usually shared amongst members of a particular culture. For example, a common schema of a classroom in Western society would probably include desks, chairs, pencils, pens, notebooks, a black- or white-board, students, and a teacher.

A schema that involves the organisation of events in time rather than objects in space is commonly referred to as a *script* (Schank & Abelson, 1977). Vicki L. Smith (1991, 1993) found that jury decisions are affected by jurors' scripts of how typical crimes occur. For instance, we have scripts for typical robberies (Aizpurua, Garcia-Bajos, & Migueles, 2009; García-Bajos & Migueles, 2003; Greenberg, Westcott, & Bailey, 1998; Holst & Pezdek, 1992), burglaries (V. L. Smith & Studebaker, 1996), and shoplifting (Akehurst, Milne, & Köhnken, 2003; List, 1986). We use these scripts to fill in the gaps in our memory. Although schemata and scripts are a convenient and necessary way of organising our experiences, they also carry the danger of incorporation of schema-consistent errors into memory, which will be discussed in the next section. To sum up, what tends to be retained in memory is the gist of an event, which is shaped by pre-existing knowledge and beliefs.

2.1.2.4 Naturally Occurring Memory Distortions

Painter Anna Mary Robertson Moses once said: "memory is a painter: it paints pictures of the past and of the day". The research reviewed above suggests that over time, the colours of the paint may begin to fade and sharp lines may become blurry. This blurring process is not restricted to the loss of accurate details; it may also involve incorporation of inaccurate details. Borrowing Mazzoni's (2002) helpful distinction, this section will focus on memory distortions that occur naturally, whereas sections 2.1.4.2 and 2.1.4.3 will address suggestion-dependent memory distortions.

A specific type of error that may occur naturally in memory is *source confusion*. According to the source-monitoring framework (M. K. Johnson, Hashtroudi, & Lindsay, 1993), we do not always accurately store the source from which a particular memory stems. Thus, for instance, we may remember that aunt Muriel is now going out with a man half her age, but we might remember hearing this information from our sister, whereas in fact our brother told us (external-external source confusion). Furthermore, we may sometimes confuse something that was imagined for something that was experienced (internal-external source confusion). Studies on *imagination inflation* have found that the simple act of imagining an event increases the perceived likelihood of having experienced that event (Garry, Manning, Loftus, & Sherman, 1996; Garry & Polascheck, 2000; Garry, Sharman, Wade, Hunt, & Smith, 2001; Heaps & Nash, 1999; but see Pezdek & Eddy, 2001). Research using the Deese-Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995) has shown that people naturally develop false memories of having seen lure words that were never presented, provided that the lures were semantically associated to words that were presented (see also Anisfeld & Knapp, 1968; Underwood, 1965).

In eyewitness contexts, source confusion may lead to mistakes, both in recall of events and in eyewitness identifications. For instance, a considerable number of criminal cases have concerned alleged victims who genuinely remembered having been sexually abused as a child, whereas they had in fact only imagined it (for an example, see section 2.1.5). One fascinating real-life example of source confusion resulting in mistaken identification is the case of respected psychologist Donald Thomson, who was accused of rape on the basis of the victim's detailed description of her assailant (Thomson, 1988). The victim had been watching an interview with Thomson on television (ironically, on the topic of memory distortion), and confused her recollection of him with the rapist who attacked her moments after watching the interview. Because Thomson had such a strong alibi (he was giving a live television interview when the crime occurred), the charges were dropped quickly. In sum, eyewitnesses may falsely report criminal actions because they think they experienced them, when they actually only imagined them (Goff & Roediger, 1998; see also D. B. Wright & Schwartz, 2010); and they may make false identifications because they unconsciously "transfer" a person seen in one context to another context (D. R. Ross, Ceci, Dunning, & Toglia, 1994).

Eyewitness testimony may also suffer from more subtle distortions, such as the incorporation of inaccurate details into otherwise accurate memories. As explained in the previous section, we organise our experiences in line with pre-existing knowledge and beliefs. Schemata and scripts perform important structuring functions in memory, but have the unfortunate potential side-effect of introducing schema-consistent errors into our memories for events. For instance, the source-monitoring errors described in the previous paragraph are especially likely to occur when they conform to stereotypes (e.g., Kleider, Pezdek, Goldinger, & Kirk, 2008). In an eyewitness context, Smith and Studebaker (1996) found that spontaneous intrusion errors in memory for a burglary typically involved script-consistent details (e.g., the burglar wore a dark jacket) rather than script-inconsistent details (e.g., the burglar wore a suit jacket). In a similar vein, García-Bajos and Migueles (2003) found that participants were significantly more likely to falsely incorporate script-consistent actions into their testimony about a robbery (e.g., threatening the victim with a weapon), than script-inconsistent actions (e.g., covering the victim's mouth).

2.1.2.5 Conclusion

This section has shown that our memories naturally evolve to align with our existing knowledge and beliefs about certain events. This process may lead to the forgetting of details as well as the incorporation of false information into our memory. An additional factor that may influence our memory for events is emotional arousal, which will be discussed in the next section.

2.1.3 Memory under Stress

Memory for particular events can be influenced by the level of stress experienced during the event (Christianson, 1992; Deffenbacher, Bornstein, Penrod, & McGorty, 2004; Heuer & Reisberg, 1992). However, exactly in what way stress affects memory is still a matter of debate. The type of stress under consideration in the present thesis is *emotional stress*, defined by Christianson (1992, p. 285) as "a consequence of an [*sic*] negative emotional event, in which the person experiences a certain degree of stress or distress with concurrent autonomic–hormonal changes." Some studies have shown that emotional stress during an event impairs memory for that event (e.g., Brigham, Maass, Martinez, & Whittenberger, 1983; Clifford & Hollin, 1981; Clifford & Scott, 1978; Deffenbacher et al., 2004; Valentine & Mesout, 2009). Other studies, however, have shown that emotional stress enhances memory, at least for the central details of the event (e.g., Bornstein, Liebel, & Scarberry, 1998; Burke et al., 1992; Christianson, 1992; Christianson & Loftus, 1991; Heuer & Reisberg, 1990, 1992). A better understanding of the apparent inconsistency in findings requires a brief explanation of the physiology behind emotional stress (for a more elaborate discussion, see Appelhans & Luecken, 2006).

2.1.3.1 Physiology of Emotional Stress

Emotional events have the potential to elicit varying degrees of physiological arousal (Levenson, 2003). Specifically, exposure to emotive and arousing stimuli may cause changes in the activity of the autonomic nervous system. The autonomic nervous system comprises of an excitatory system, which is activated in response to a stressor (the sympathetic nervous system), and an inhibitory system, which is dominant during periods of relaxation (the parasympathetic nervous system). An increase in sympathetic activity is associated with heightened physiological arousal, reflected in accelerated heart rate (Wallin, 1981) and increased electrodermal activity (EDA; i.e., changes in the sweat response; Dawson, Schell, & Filion, 2000; Vetrugno, Liguori, Cortelli, & Montagna, 2003). Parasympathetic activity, on the other hand, is associated with lowered physiological arousal, reflected in reduced EDA (Dawson et al., 2000) and heart rate deceleration (Appelhans & Luecken, 2006).

In the literature on memory and emotion, physiological activity is often discussed in terms of the orienting response versus the defensive response (Lacey & Lacey, 1970, 1974; see also Sokolov, 1963). An orienting response is a reaction of cortical activation to novel, unexpected, or salient stimuli. Physiological correlates of the orienting response are increased EDA (a sign of sympathetic activity) and decreased heart rate (a sign of parasympathetic activity). Thus, it is likely that the orienting response is associated with both sympathetic and parasympathetic influences (cf. Deffenbacher, 1994, Note 4). In contrast, a defensive response (similar to the “fight or flight” response) is a response to threatening or painful stimuli, and is associated with increased EDA and increased heart rate (both indicators of increased sympathetic activity). According to the Lacey and Lacey (1970) model, intense emotional stimulation should trigger a defensive response, whereas milder emotional stimulation should trigger an orienting response. Graham and Clifton (1966) reviewed the literature and found that the physiological data observed across studies confirmed this pattern.

Interestingly, the type of physiological response that is evoked by emotional stimuli seems to depend on individual characteristics. For instance, Klorman, Weissberg, and Wiesenfeld (1977) found that photos of mutilated bodies evoked a defensive response in fearful participants (i.e., those scoring high on the Mutilation Questionnaire), but an orienting response in less fearful participants. Similarly, Lumley and Melamed (1992) found that watching a surgery scene of an incision significantly increased heart rate in blood phobics, but not in non-phobics. The finding that individuals respond in different ways to identical stimulation corresponds with the idea that distinct motivational systems are dominant in different individuals (Carver & White, 1994; Gray, 1981, 1982, 1987, 1990). Gray distinguished between a behavioural activation system (BAS) and a behavioural inhibition system (BIS). The function of the BAS is to initiate goal-directed behaviour, in order to achieve positive outcomes, whereas the function of the BIS is to regulate and inhibit behaviour, in order to avoid negative outcomes. In terms of personality research and the introversion-extraversion distinction (H. J. Eysenck, 1967): the BIS is believed to be stronger in introverts, whereas the BAS is thought to be stronger in extraverts (Deffenbacher, 1994; see also Gray, 1970). In sum, the type of physiological response elicited by an event likely depends on the individual's motivational system.

2.1.3.2 Deffenbacher's Theory

Given that emotional stimuli have the potential to evoke different types of physiological responses in different individuals, the effect of stress on memory is likely to depend on what type of response is elicited. With this in mind, Deffenbacher (1994) developed a theory to explain the apparent discrepancy in findings regarding the effects of emotional stress on memory. Rejecting his earlier notion of a unidimensional continuum of arousal based on the Yerkes-Dodson law[1] (Deffenbacher, 1983, 1991), he proposed a theoretical framework

[1] The Yerkes-Dodson law (1908), also known as the inverted-U curve, holds that increased levels of arousal facilitate performance until an optimal level is attained, after which further increases in arousal will gradually impair performance (see also M. W. Eysenck, 1979; Zajonc, 1965).

incorporating Gray's (1987) distinct arousal systems, Tucker and Williamson's (1984) dual-control model, and Fazey and Hardy's (1988) catastrophe model.

In short, Deffenbacher's (1994) theory highlights the importance of distinguishing between the arousal mode (related to a responsiveness to novel stimulation) and the activation mode (related to a readiness for action), as defined by Tucker and Williamson (1984). Which mode is active depends on what type of stimulus is presented (interesting or aversive), and on which motivational system is dominant in the individual (BIS or BAS). When the arousal mode is dominant, attention to interesting aspects of the stimulus array will be enhanced, and as a result, memory for those aspects will be superior. This is in line with Christianson's (1992) argument that emotional stress causes attentional narrowing (cf. Easterbrook, 1959), resulting in memory enhancement for the central aspects of an event. However, Deffenbacher et al. (2004) argue that the attentional narrowing phenomenon observed by Christianson is irrelevant to the assessment of the impact of stress on eyewitness memory, since the activation mode (rather than the arousal mode) is assumed to be dominant in threatening situations. When the activation mode is dominant, memory performance is said to follow the catastrophe model (Fazey & Hardy, 1988; see also Hardy & Parfitt, 1991). Thus, when cognitive anxiety is high, gradual increases in arousal will improve attention to (and subsequent recall of) the event details, up to a certain point, after which a dramatic drop in performance will occur.

A number of field studies provide evidence for the prediction that memory for an event will be dramatically impaired if physiological arousal during the event is high. First, Peters (1988) found that witnesses who were highly physiologically aroused during an inoculation were significantly worse at identifying the nurse who had just inoculated them (31% accurate) than witnesses who were less physiologically aroused during the inoculation (59% accurate). Second, Morgan et al. (2004) investigated the memory of soldiers who had been confined in a mock prisoner of war camp for 12 hours. They found that soldiers were significantly more likely to identify the person who had interrogated them under low-stress conditions (no physical confrontation) than the person who had interrogated them under high-stress conditions (involving physical confrontation). Furthermore, Bothwell, Brigham and Pigott (1987) provided support for the idea that increases in arousal will impair memory only if cognitive anxiety is high. They found that witnesses scoring low on a neuroticism scale (i.e., low cognitive anxiety) became more accurate in their identifications of a live male target with increasing levels of arousal, whereas witnesses scoring high on neuroticism (i.e., high cognitive anxiety) suffered a catastrophic loss in identification accuracy, from 68% in the low and moderate arousal conditions to 32% in the high arousal condition.

In summary, Deffenbacher (1994) argued that memory will be enhanced if experimental stimuli elicit an orienting response, but impaired if they elicit a defensive response. In 2004, Deffenbacher et al. conducted a meta-analysis on the effects of stress on eyewitness memory. They only included studies that (supposedly—see below) succeeded in eliciting a defensive response rather than an orienting response, since the former is likely more representative of the type of arousal experienced by real witnesses of crime. Across these studies, they found a small to moderate debilitating effect of high stress on the accuracy of eyewitness recall (d = -.31).

2.1.3.3 Problems with Deffenbacher's Theory

Although Deffenbacher presents a convincing account, a number of problems arise. First of all, Deffenbacher et al.'s (2004) classification of studies as eliciting a defensive or an orienting response was not corroborated by physiological manipulation checks. Their selection criteria allowed inclusion of studies with self-ratings of perceived violence level as sole manipulation check (e.g., Clifford & Scott, 1978; Loftus & Burns, 1982), even though they noted themselves that higher ratings of negative emotionality do not necessarily signify a successful manipulation of emotional arousal. At the same time, they excluded other studies which also provided only self-ratings as manipulation check (e.g., Johnson & Scott, 1974; Shepherd, Davies, & Ellis, 1980, both cited in Deffenbacher, 1983), on the basis of a 'belief' that these studies "were generating facilitation of eyewitness memory for central details, because their principal experimental manipulations likely generated an orienting response" (Deffenbacher et al., 2004, p. 690). This selection procedure rendered the argument rather circular: if memory enhancement was found, the experimental stimuli must have failed to produce a defensive response; conversely, if memory impairment was observed, the stimuli must have successfully elicited a defensive response. Thus, even though Deffenbacher's (1994) theory has the potential to explain the apparent inconsistency in findings regarding the effects of emotion on memory, it requires confirmation by physiological manipulation checks before firm conclusions can be drawn.

A second problem with Deffenbacher's (1994; Deffenbacher et al., 2004) position is that it cannot account for various findings showing that real eyewitnesses are in fact quite good at remembering highly emotional events. For instance, Yuille and Cutshall (1986) found that both the amount and accuracy of witness reports about a fatal shooting that had occurred 4-5 months earlier was much higher than would have been expected on the basis of Deffenbacher's theory. Yuille and Cutshall suggest that their findings "raise some questions about the image of the eyewitness that has emerged from laboratory work" (p. 299). Other field studies have reported similarly accurate memories of highly emotional events, ranging from bank robberies (Christianson & Hübinette, 1993), a ferry sinking (Thompson, Morton, & Fraser, 1997), being kidnapped (Terr, 1983), distressing medical procedures (Peterson & Whalen, 2001; Quas et al., 1999), to child sexual abuse (Bidrose & Goodman, 2000; Orbach & Lamb, 1999). Perhaps the most striking finding was that 78 survivors of a concentration camp still remembered many of their camp experiences very well, even after 40 years had passed (Wagenaar & Groeneweg, 1990). According to Deffenbacher's theory, these highly emotional experiences should have caused severe cognitive anxiety and high levels of physiological arousal—yet, memory for the events did not show the corresponding dramatic drop predicted by the theory[2].

The discrepancy between these real-world observations and Deffenbacher et al.'s (2004) meta-analytic findings might be explained by the retention interval between the event and the memory test. Because arousal can enhance memory consolidation (Joëls, Pu, Wiegert, Oitzl, & Krugers, 2006;

[2] It is possible that Deffenbacher's theory only applies to single traumatic events, as opposed to repeated traumatic occurrences such as concentration camp experiences or child sexual abuse (cf. Brubacher, Roberts, & Powell, 2011; Connolly, Price, Lavoie, & Gordon, 2008; Powell, Roberts, & Guadagno, 2007). This possibility warrants further investigation.

McGaugh, 2004; see also Finn & Roediger, 2011), the benefits of arousal on memory could well increase over time, and may thus not be observed when participants are tested after only brief delays (Heuer & Reisberg, 1992). Indeed, studies showing that stress impairs memory typically used retention intervals of an hour or less (e.g., Brigham et al., 1983; Clifford & Hollin, 1981; Clifford & Scott, 1978; Kramer, Buckhout, & Eugenio, 1990; Loftus & Burns, 1982; Maass & Köhnken, 1989; Siegel & Loftus, 1978), whereas many studies showing that stress improves memory (for central details) employed intervals of two weeks or more (e.g., Bradley, Greenwald, Petry, & Lang, 1992; Burke et al., 1992; Christianson, 1984; Christianson & Loftus, 1987; Heuer & Reisberg, 1990). Crucially, most of the studies included in Deffenbacher et al.'s (2004) meta-analysis belonged to the former group. This sheds some doubt on the generalisibility of their findings to real-world settings. It is recommended that future work concerning the effects of stress on eyewitness memory employ delays of more than a few hours or even a few days (cf. Bull, 2010).

2.1.3.4 Conclusion

Although the majority of eyewitness experts agree that high levels of stress impair the accuracy of eyewitness testimony (Kassin, Ellsworth, & Smith, 1989; Kassin, Tubb, Hosch, & Memon, 2001; Yarmey & Jones, 1983), a review of the relevant literature shows that this view is too simplistic. In reality, the effects of emotional stress on memory depend on a number of factors, and "measurements of physiological reactions associated with emotional stress sometimes show a pattern of an orienting response and sometimes a pattern of a defensive or a rejection response" (Christianson, 1992, p. 285). In Chapter 3 of this thesis, the role of emotional stress in the eye-closure effect will be examined in more detail. Hitherto, we have seen that our memories may naturally be affected by factors such as delay and stress. In the next section, we will see that our memories may also be manipulated by intervening events such as repeated questioning and misleading post-event information.

2.1.4 Memory after Intervening Events

Memory researchers post-Ebbinghaus emphasised that forgetting is caused by interference from preceding and intervening stimuli, rather than mere passage of time. For instance, Baddeley and Hitch (1977) found that rugby players' recall of their previous games was impaired as a function of the number of intervening games rather than as a function of elapsed time. In the context of criminal cases, intervening events are also likely to contaminate eyewitness memory. This section will highlight two potential sources of interference in legal settings, namely, repeated retrieval attempts and misleading post-event information.

2.1.4.1 Repeated Retrieval

A particularly striking event, such as witnessing a crime, is likely to be thought about and recounted often (Bohannon, 1988; Christianson & Safer, 1996; Yuille & Cutshall, 1986). Furthermore, in legal contexts, witnesses are often asked to provide testimony on multiple occasions (Gabbert, Hope, & Fisher, 2009; Goodman & Quas, 2008; Henkel, 2004; La Rooy, Lamb, & Pipe, 2009; Odinot, Wolters, & Lavender, 2009). Repeated attempts to retrieve information from memory may have both positive and negative effects.

On the positive side, a considerable number of studies have shown that prior attempts to retrieve information makes the retrieved information more resistant to subsequent forgetting (e.g., Ebbesen & Rienick, 1998; Shaw, Bjork, & Handal, 1995) and suggestive questioning (e.g., Geiselman, Fisher, Cohen, Holland, & Surtes, 1986; Memon, Zaragoza, Clifford, & Kidd, 2010), and may even help witnesses remember new information (Chan, McDermott, & Roediger, 2006; Roediger & Payne, 1982). For instance, Carpenter, Pashler, and Vul (2006) found that a prior recall attempt was even more beneficial to later recall performance than an additional opportunity to study the material; an effect commonly known as the *testing effect* (Dempster, 1996; Karpicke & Roediger, 2008; Zaromb & Roediger, 2010).

Repeated attempts to remember a witnessed crime may also lead to the retrieval of new, previously unreported information (e.g., La Rooy, Pipe, & Murray, 2005; Turtle & Yuille, 1994)—a phenomenon known as *reminiscence*

(Payne, 1987). A number of studies have even found that repeated recall of an event resulted in *hypermnesia* (Payne, 1987), which means that the total amount of information recalled during a subsequent interview was greater than the total amount recalled during the initial interview (e.g., Bornstein et al., 1998; Dunning & Stern, 1992; Scrivner & Safer, 1988). The experimental findings of gains in recall with repeated retrieval attempts are corroborated by diary studies showing that certain autobiographical events are retained well even over extended periods of time, provided that they are retrieved regularly (Baddeley, in press; Linton, 1975, 1978; Wagenaar, 1986).

On the negative side, however, repeated retrieval may cause a number of problems in memory. First, memory for details that are not retrieved during an initial recall attempt may suffer from the earlier attempt to retrieve the information, a phenomenon known as *retrieval-induced forgetting* (M. C. Anderson, Bjork, & Bjork, 1994). A considerable number of studies have shown retrieval-induced forgetting in eyewitness contexts (e.g., MacLeod, 2002; Migueles & García-Bajos, 2007; Saunders & MacLeod, 2002; Shaw et al., 1995). Thus, when witnesses are questioned about some details but not others, retrieval of the unpractised details is impaired. Second, repeated attempts to retrieve information have the potential to introduce errors into the original memory (Bornstein et al., 1998; Turtle & Yuille, 1994). Similarly, repeated recall increases the likelihood of source confusions (Henkel, 2004), and may render memory more vulnerable to misleading suggestions from external sources (Chan, Thomas, & Bulevich, 2009; Saunders & MacLeod, 2002; but see Memon et al., 2010).

Taken together, the evidence suggests that repeated renditions of eyewitness experiences may prevent forgetting of the retold elements and lead to the retrieval of new information, but may at the same time impair memory for non-rehearsed elements of the event and introduce errors into memory for the event. Regardless of whether repeated retrieval is good or bad, it is a reality for the majority of witnesses of violent crime. Hence, we need to develop ways in which we can exploit the advantages of repeated retrieval while reducing its disadvantages. One attempt to do exactly this was proposed recently by Fiona Gabbert and collaborators, who developed the Self-Administered Interview (SAI). The SAI is distributed by the police at the scene of the crime, and is intended to provide eyewitnesses with an initial good-quality recall attempt immediately after witnessing the crime. Gabbert and colleagues theorised that such a good-quality retrieval attempt would preserve memory for the details of the witnessed event, and prevent incorporation of false details. Limited evidence to date suggests that the SAI is indeed effective in improving subsequent recall (Gabbert et al., 2009; Gabbert, Hope, & Fisher, in preparation; Hope, Gabbert, & Fisher, 2011).

2.1.4.2 Misinformation Effect

We now turn to the type of distortions that emerge as a result of suggestions from external sources (Mazzoni, 2002). In keeping with Moses' painting analogy of memory, research suggests that other painters may modify the pictures in our memory. The *misinformation effect* refers to the phenomenon that "misleading postevent information can alter a person's recollection of an event" (Tousignant, Hall, & Loftus, 1986, p. 329). For instance, Loftus (1975) showed participants a video of a car driving along an empty landscape, and questioned them about it immediately after. For half of the participants, one of the questions contained misinformation: they were asked how fast the car was driving when it passed the barn, when in fact no barn had been shown. One week later, 17% of the participants in the misinformation group reported having seen the barn (compared to 3% in the control group). In the same way, researchers have led participants to mistake a stop sign for a yield sign (Loftus et al., 1978), a hammer for a screwdriver (Belli, 1989; Lindsay, 1990; McCloskey & Zaragoza, 1985; Tversky & Tuchin, 1989), and a white for a green teddy bear (Sutherland & Hayne, 2001). Misleading post-event information in the form of doctored photographs has also been shown to influence subsequent recall of famous past public events (Sacchi, Agnoli, & Loftus, 2007) and news reports of death and injury (Garry, Strange, Bernstein, & Kinzett, 2007).

The misinformation effect has proven robust across a number of settings (for reviews, see Ayers & Reder, 1998; Gerrie, Garry, & Loftus, 2005; Loftus, 2005). It should be noted, however, that the original interpretation of the misinformation effect—that the suggested items "overwrite" the original items in memory (Loftus, 1975; Loftus & Loftus, 1980; Loftus et al., 1978)—is probably mistaken. Bekerian and Bowers (1983) showed that the original information was in fact preserved in memory, but that participants in previous studies were unable to retrieve the original items due to a lack of retrieval cues available to them. Taking the argument one step further, McCloskey and Zaragoza (1985) argued that the effect does not reflect memory impairment at all; rather, participants simply assumed that the experimenter who provided the misleading information must have been correct. It is also possible that the effect is due to a combination of memory impairment and misinformation acceptance (Belli, 1989; Loftus & Hoffman, 1989; Tversky & Tuchin, 1989).

From an applied perspective, what matters is the consistent finding that people report inaccurate information as a result of misleading information. Misleading suggestions have also been found to impair recall of forensically relevant information, such as faces (Loftus & Greene, 1980) and criminal actions (Aizpurua et al., 2009; García-Bajos & Migueles, 2003). Such suggestions are especially likely to be incorporated into memory if they are consistent with the witness's pre-existing script of the crime (García-Bajos & Migueles, 2003; Holst & Pezdek, 1992; V. L. Smith & Studebaker, 1996), and if they concern information about which the witness has not been questioned before (Saunders & MacLeod, 2002). In real life, witnesses are frequently exposed to misleading post-event information. For instance, witnesses are often asked suggestive questions (Clarke & Milne, 2001; Holst & Pezdek, 1992; Wheatcroft, Wagstaff, & Kebbell, 2004), which have the potential to alter their memory (Loftus, 1975; Loftus & Palmer, 1974; Sutherland & Hayne, 2001). In addition, they commonly discuss their experiences with other witnesses (Marsh, Tversky, & Hutson, 2005; Paterson & Kemp, 2006; Skagerberg & Wright, 2008), which may also influence their testimony (Gabbert, Memon, & Wright, 2006; Shaw, Garven, & Wood, 1997; see D. B. Wright, London, & Waechter, 2010, for an explanatory model of memory conformity).

2.1.4.3 False Memories

Not only can other painters modify elements of our own pictures in memory, they can even plant whole new pictures into our memory. Loftus and Pickrell (1995) moved from infusing inaccurate elements into accurate memories to implanting complete false autobiographical events in memory. Participants were falsely informed that they had got lost in a mall when they were young (according to a trusted family member), and were encouraged to think about the event and remember as much as they could, on three separate occasions. By the end of the experiment, about a quarter of the participants reported remembering the false childhood event. Subsequent research showed that this effect was not restricted to relatively mundane events like getting lost in a mall. For instance, 26 % of Porter, Yuille, and Lehman's (1999) participants falsely remembered being viciously attacked by an animal in 26% of their participants, and 37% of Heaps and Nash's (2001) participants falsely remembered having nearly drowned as a child.

Although most studies have implanted false events that supposedly occurred in participants' childhood (for other examples, see Braun, Ellis, & Loftus, 2002; Garry & Wade, 2005; Hyman & Billings, 1998; Hyman, Husband, & Billings, 1995; Hyman & Pentland, 1996; Lindsay, Hagen, Read, Wade, & Garry, 2004; Mazzoni & Memon, 2003; Otgaar, Candel, & Merckelbach, 2008; Pezdek, Finger, & Hodge, 1997; Strange, Sutherland, & Garry, 2006), some studies have shown that people can also develop false memories for more recent events. For instance, Crombag, Wagenaar and Van Koppen questioned people about a famous air crash that occurred in the Netherlands ten months earlier, asking whether they had seen the film of the plane crashing into the apartment building. In fact, no such film existed. Nevertheless, the majority of participants asserted that they had indeed seen the film, and often proceeded to provide details about what they had seen in the non-existing film. Similar findings have been obtained when questioning people about non-existing video footage of the 1997 fatal car crash of Princess Diana (Ost, Vrij, Costall, & Bull, 2002), the sinking of a Swedish ferry (Granhag, Strömwall, & Billings, 2003), the bombing of a Bali night club (Ost, Hogbin, & Granhag, 2006; Wilson & French, 2006) and the assassination of a Dutch politician (Jelicic et al., 2006; Smeets et al., 2006).

A final thought to consider is that false memories can have a real impact on people's behaviour. Bernstein and colleagues found that people who falsely remembered getting ill from a particular food were significantly less likely to express an intention of eating that food in the future (Bernstein, Laney, Morris, & Loftus, 2005a, 2005b). Moreover, Geraerts et al. (2008) showed that participants were also significantly less likely to actually consume that food when offered a choice of foods four months after the false memory had been implanted. In legal contexts, acting on false memories can have severe consequences, as the next section will illustrate.

2.1.4.4 Conclusion

In real life, eyewitnesses may be exposed to a wide range of potential intervening events, such as repeated attempts to remember, suggestions from other people, and misleading interview questions. These intervening events may have considerable impacts on eyewitness testimony, ranging from misremembering minor details of the witnessed event, to falsely remembering complete events that never happened. The next section will outline potential consequences of the shortcomings of eyewitness memory.

2.1.5 Legal Consequences of the Fallibility of Memory

2.1.5.1 Eyewitness Identifications

Kirk N. Bloodsworth was convicted of sexually assaulting and murdering a 9-year old girl (*Maryland v. Bloodsworth,* 1984). Bloodsworth became a suspect because his appearance closely matched the composite sketch based on the recollections of five eyewitnesses. Probably due to this similarity, one witness identified Bloodsworth from a photo line-up, and at trial, all five witnesses testified that they had seen Bloodworth with the victim. He was sentenced to death. Eight years later, DNA testing proved that Bloodsworth could not have been the source of the semen found in the victim's underwear, and he was released from prison. Even though DNA evidence had excluded him, many people, including one of the original prosecutors, remained convinced of Bloodsworth's guilt. After all, *five* eyewitnesses had identified him as the murderer. Nineteen years after Bloodsworth had been sentenced to death, the real perpetrator was found, and Bloodsworth could finally move on with his life (for more information about this case, see Innocence Project, 2011b; Junkin, 2004; Wells, Memon, & Penrod, 2006).

The Bloodsworth case illustrates that even multiple eyewitnesses can be wrong, especially when the initial reason to arrest a particular suspect (i.e., conformity to the witnesses' descriptions of the perpetrator) subsequently influences identification decisions as well. Furthermore, the case highlights the persuasiveness of eyewitness identification evidence. Indeed, the overwhelming majority of wrongful convictions have involved mistaken eyewitness identifications (Connors, Lundregan, Miller, & McEwen, 1996; Gross, Jacoby, Matheson, Montgomery, & Patil, 2005; Innocence Project, 2011a; Rattner, 1988; Scheck, Neufield, & Dywer, 2003; Wells et al., 1998). Witnesses may make false identifications as a result of naturally occurring memory distortions, for instance due to long delays (Shapiro & Penrod, 1986; Sporer, 1992), own-race bias (Gross et al., 2005; Meissner & Brigham, 2001), or weapon focus (Steblay, 1992). In addition, identification decisions may be influenced by misleading suggestions from external sources, such as biased line-up instructions (S. E. Clark, 2005; Malpass & Devine, 1981a) or co-witness influences (Semmler, Brewer, & Wells, 2004; Skagerberg & Wright, 2008).

2.1.5.2 False Memories of Criminal Events

Even though mistaken identifications are probably the most frequent severe type of memory distortion in legal settings, people sometimes also falsely remember criminal events that never happened. The most harrowing examples of such instances involve the delayed report of "recovered" memories of childhood sexual abuse (see Gudjonsson, 1997; Loftus, 1993; Ofshe & Watters, 1996; Wakefield & Underwager, 1992). The 1980s and 1990s witnessed a surge in allegations from adults claiming to have been sexually abused as a child. The claims of abuse almost always emerged as a result of intensive "memory work" in psychotherapy (see Lindsay & Read, 1995, for more on suggestive memory recovery techniques). One particularly striking example of such a case is the Dutch case of Yolanda van B., or the "Eper incest case". Yolanda accused her parents and various other people in her village of "continual sexual abuse, 23 illegal abortions, the murders of at least six babies, and the sexual abuse of her children" (Wagenaar, 1996, p. 182; see also Chapter 2 in Wagenaar, Van Koppen, & Israëls, 2009). Legal psychologists Wagenaar and Soppe testified that all of the verifiable facts reported by Yolanda were factually inaccurate; yet astonishingly, the suspects were convicted and some of them are still in confinement today. This example illustrates that witnesses and victims do not only make false identifications, but can even come to remember horrific criminal events that never occurred.

2.1.5.3 Errors in Eyewitness Testimony

The present thesis is mostly concerned with somewhat less dramatic cases of distorted eyewitness recall. Witnesses often misremember certain details of the witnessed crime, which may turn out to be crucial in police investigations. For instance, Loftus (2003) highlighted a case of communal memory distortion during the sniper attacks that killed ten people in the Washington DC area. Initially, various witnesses reported seeing a white van fleeing the scene of the crime. After distribution of this information by the media, even more witnesses started remembering a white van (i.e., memory conformity; Gabbert et al., 2006; D. B. Wright et al., 2010; D. B. Wright & Schwartz, 2010). When the snipers were caught, however, they were driving a blue car. This case illustrates that the misremembering of certain details of a criminal event may have significant consequences for police investigations: as a result of the multiple eyewitness reports, the police were looking for a white van. The present thesis examines whether a new interview instruction, eye-closure, can help witnesses remember more event details, and at the same time reduce the number of incorrect details reported. Given that the information obtained from witnesses is often crucial in police investigations (Coupe & Griffiths, 1996; Fisher, 1995; Kebbell & Milne, 1998; Milne & Bull, 2003b), an instruction with the potential to improve eyewitness memory could have a real impact in criminal investigations.

2.1.6 Conclusion

The main message to take away from this section on eyewitness memory is best captured in the words of Wagenaar: “Without falling into the trap of portraying autobiographical memory as a wholly inadequate device, we can safely say that it is not precise.” (1996, p. 180).

2.2 Investigative Interviewing

The previous section highlighted the fallibility of eyewitness memory. Because information obtained from eyewitnesses may provide crucial leads for police investigations, many researchers have attempted to develop methods to help witnesses remember more. The most prominent of these interview methods will be discussed in this section.

2.2.1 The Reid Technique

About a century ago, it was perfectly acceptable in most Western countries to inflict physical pain in order to obtain information from suspects and witnesses. The use of such methods declined gradually in the first half of the twentieth century and was replaced by interview techniques that were more psychological in nature (Kassin, 2006). In 1962, Inbau and Reid published the first edition of the interrogation manual *Criminal interrogation and confessions*, which advocates "non-coercive" but psychologically manipulative interview tactics. On the website promoting the *Reid Technique*, the authors state that "the text has been referenced in U.S. Supreme Court decisions and is considered the 'Bible' of interrogation for the professional investigator" (Reid & Associates Inc., 2011a). Kassin and McNall (1991) identified two main approaches in the Reid Technique: *maximisation*, which includes intimidation, presentation of false evidence, and exaggeration of the seriousness of the crime and the charges; and *minimisation*, which includes downplaying the seriousness of the crime, offering face-saving excuses, and implying leniency.

The Reid Technique is the most frequently used interview technique in the United States (Gudjonsson & Pearse, 2011; Inbau, Reid, Buckley, & Jayne, 2001) and similar techniques have been used elsewhere, such as the United Kingdom (Shawyer, Milne, & Bull, 2009), France, Belgium, The Netherlands (Clément, Van de Plas, Van den Eshof, & Nierop, 2009), Norway, Sweden, and Finland (Fahsing & Rachlew, 2009). Although the Reid technique is mostly used for interviewing suspects, it is also advertised to be appropriate for "the elicitation of information within forensic settings of depositions, jury selection, direct/cross examination, and witness statements" (Reid & Associates Inc., 2011b). Indeed, a number of notorious cases have recently come to light in which witnesses and victims were interrogated with coercive methods similar to the ones advertised by Reid and associates (for instance, the McMartin preschool case, Garven, Wood, & Malpass, 2000; and the Schiedam park murder case, van Koppen, 2008).

Despite its prevalence, most academic scholars consider the Reid Technique highly inappropriate and potentially dangerous. First, the Reid technique increases the risk of false confessions, which may result in the incarceration of innocent persons (Gudjonsson, 2003; Gudjonsson & Pearse, 2011; Kassin, 1997; Wakefield & Underwager, 1998). Second, a larger amount of accurate information can be obtained from suspects and witnesses by using less confrontational interview methods (Gudjonsson & Pearse, 2011; Milne & Bull, 1999; Powell & Bartholomew, 2003; Shepherd, 1988). In *Miranda v. Arizona* (1966), the U.S. Supreme Court found the practices described by Inbau and Reid (1962) to be inherently coercive. Similarly, Pearse and Gudjonsson (1999) found that evidence obtained with Reid-like interview tactics was less likely to be admissible in court. Nevertheless, the Reid technique is still often endorsed among law enforcement agencies and legal professionals (see, e.g., *Missouri v. Seibert,* 2004).

2.2.2 Hypnosis

Another relatively widespread, yet controversial, interview method is hypnosis. The use of hypnosis to help witnesses and victims remember more dates back at least 150 years (Lilienfeld & Landfield, 2008; Webert, 2003), and has been documented in many different countries, including the United States (Ault, 1979), Canada (C. Perry & Laurence, 1983), the United Kingdom (Haward, 1988), Belgium (Clément et al., 2009), and Israel (Clifford & Bull, 1978). Although specific procedures may vary depending on the situation, hypnotic interviewing typically involves an initial phase of establishing rapport, a procedure to induce and deepen the hypnotic state (e.g., looking at a moving visual display), and instructions to facilitate memory retrieval (e.g., "age regression", in which the interviewee travels back in time to re-experience the event; for more information see Kebbell & Wagstaff, 1998). Various studies examining the effectiveness of hypnosis have found that it helps witnesses to remember more (e.g., Geiselman, Fisher, MacKinnon, & Holland, 1985; Hibbard & Worring, 1981; Ready, Bothwell, & Brigham, 1997; Yuille & Kim, 1987). Indeed, in *Beck v. Norris* (1986), hypnosis helped five eyewitnesses to produce a new composite sketch that led to the apprehension of a suspect, who was later independently verified to be the perpetrator of a robbery (Webert, 2003). Nevertheless, the effects of hypnosis on eyewitness memory have not been uniformly positive.

Kebbel and Wagstaff (1998) identified three main problems associated with hypnosis. First, hypnosis may induce false memories (see Erdelyi, 1994, for a review). For instance, consider the case of *State v. Mack* (1980), in which a hypnotised individual remembered "eating pizza in a restaurant that did not serve pizza, seeing tattoos on someone who had none, and having been repeatedly stabbed where there was only evidence of a single cut." (Webert, 2003, p. 1301). In light of the finding that hypnosis encourages the report of both true and false information, it is imperative to establish whether it affects *testimonial accuracy*, that is, the proportion of correct to incorrect details provided by witnesses (cf. Gabbert et al., 2009; Ginet & Verkampt, 2007; Memon, Meissner, & Fraser, 2010; Smeets, Candel, & Merckelbach, 2004). A number of studies have shown that the increase in incorrect recall associated with hypnosis is such that overall testimonial accuracy deteriorates significantly (Dinges et al., 1992; Dywan & Bowers, 1983; Sanders & Simmons, 1983).

Second, hypnosis tends to inflate confidence regardless of accuracy, resulting in false testimony that is reported with a high level of confidence (Dywan & Bowers, 1983; Sheehan, Grigg, & McCann, 1984; Zelig & Beidleman, 1981). Given that jurors often decide whether testimony is reliable on the basis of the witness's expressed confidence (Cutler, Penrod, & Dexter, 1990; Wells, Lindsay, & Ferguson, 1979; Wheatcroft et al., 2004), such misplaced confidence poses potential dangers in courtroom settings. Third, hypnosis may increase an interviewee's susceptibility to leading questions (Dywan & Bowers, 1983; Sheehan et al., 1984; Zelig & Beidleman, 1981).

Taken together, the problems outlined above suggest that the forensic use of hypnosis is inadvisable. In the United Kingdom, the Home Office (1988) has issued guidelines discouraging the use of hypnosis in investigative interviews, and in the United States, many state courts have banned evidence obtained from victims and witnesses who have been interviewed with hypnosis (Webert, 2003). Nevertheless, hypnotic interviewing is still being used in some other countries, such as Belgium (Clément et al., 2009; see also Lilienfeld & Landfield, 2008). Even though the traditional approach to hypnosis may no longer be tenable, Wagstaff and collaborators present a convincing argument that certain components of the technique, related to attention, concentration, and imagination, may still prove valuable in police investigations (Wagstaff, 2008; Wagstaff et al., 2004; Wagstaff, Cole, Wheatcroft, Marshall, & Barsby, 2007; Wagstaff et al., 2010; Wagstaff, Wheatcroft, Caddick, Kirby, & Lamont, 2011).

2.2.3 Context Reinstatement

One procedure originating from the "revivication" technique in hypnotic interviewing is *context reinstatement* (Hibbard & Worring, 1981; Wagstaff et al., 2007). Context reinstatement is based on the idea that recall of a certain event is better if the context of that event is recreated during the interview. In this section, the literature on context-dependent memory will first be reviewed, followed by a discussion of mental context reinstatement in eyewitness settings.

2.2.3.1 Context-Dependent Memory

The famous philosopher John Locke once told a story about a young man who had learnt to dance in a specific room containing an old trunk. He explained that "the idea of this remarkable piece of household stuff had so mixed itself with the turns and steps of all his dances" (Locke, as cited in Dennis, 1948, p.

68), that he could dance excellently well only when the old trunk was there. Locke eloquently illustrated the idea of *context-dependent memory*.

Context-dependent memory refers to the idea that information encoded in a certain context is best retrieved in that context. Although a few studies on context-dependent memory had been conducted previously (e.g., Jensen, Harris, & Anderson, 1971; Rand & Wapner, 1967), the seminal work on this phenomenon is generally considered to be Godden and Baddeley's (1975) diver study. Godden and Baddeley had 18 divers study a list of 36 spoken words, either under water ('wet') or on land ('dry'). After five minutes, they asked the divers to list as many words as they could remember, either under water (on a formica board) or on land. The experimental design was such that the learning and retrieval environment were matched for half of the divers (either wet-wet or dry-dry), and mismatched for the other half of the divers (either wet-dry or dry-wet). Godden and Baddeley found that what was learned under water was significantly better recalled under water, and what was learned on land was significantly better recalled on land.

Subsequent research attempting to replicate the context effect in different settings has not always succeeded (Eich, 1980; Fernandez & Glenberg, 1985). For instance, Godden and Baddeley (1980) did not replicate their earlier findings when using a recognition test, and similar findings were reported by Smith, Glenberg, and Bjork (1978). Smith and Vela (2001) conducted a meta-analysis on context-dependent memory and found that the context effect is reliable, but modest in size (d = .28). Whether context dependency is observed depends on a number of factors. The principle of *encoding specificity* (Thomson & Tulving, 1970; Tulving, 1974, 1983) states that recall may be facilitated by cues that were encoded along with the to-be-remembered material. Therefore, if no context information is encoded during the learning phase (e.g., due to effortful processing of the to-be-learned stimuli; Glenberg, 1997; Glenberg, Schroeder, & Robertson, 1998), then context cues during retrieval will not be helpful (*overshadowing*; cf. S. M. Smith & Vela, 2001). Conversely, if context information was encoded during the learning phase but is not used by the rememberer because stronger cues are available during retrieval, then context cues will not improve recall (*outshining*; cf. S. M. Smith, 1988). In sum, context effects are most pronounced when participants do not have access to more effective cues during either encoding or retrieval.

Recall is not only dependent on one's physical environment, but also on one's internal state. First, the mood experienced during retrieval biases the type of information that is most likely to be retrieved. For instance, if a witness is sad during the interview, she is more likely to retrieve sad memories than happy memories, a phenomenon called *mood congruency* (e.g., Blaney, 1986; Bower, 1981; Madigan & Bollenbach, 1982; Snyder & White, 1982). Second, it has been suggested that neutral information that was encoded in a particular mood is best retrieved in that mood, known as *mood dependency*. Although the evidence for mood dependency is not as robust as that for mood congruency (Baddeley, 2007; Bower, Gilligan, & Monteiro, 1981; Schare, Lisman, & Spear, 1984), several studies have found support for the existence of mood-dependent memory (e.g., Balch, Myers, & Papotto, 1999; Eich, Macaulay, & Ryan, 1994; Eich & Metcalfe, 1989; Ucros, 1989). In addition, there are some indications that materials learned under the influence of marihuana, alcohol, or cigarettes may be best retrieved in the same drug-induced state (Darley, Tinklenberg, Roth, & Atkinson, 1974; Goodwin, Powell, Bremer, Hoine, & Stern, 1969; R. Peters & McGee, 1982; respectively), although the strength of the evidence regarding this issue is modest at best. In line with the findings on mood-dependent and state-dependent memory, Eich (1995) has suggested that the effects of external context on recall may be observed in part because the external context triggers the internal state that was experienced by the rememberer whilst in that environment (see also S. M. Smith, 1995; S. M. Smith & Vela, 2001).

2.2.3.2 Mental Context Reinstatement

The investigative interviewer can use the principle of context-dependent memory to his[3] advantage by helping the witness to mentally reinstate the context of the witnessed event. *Mental context reinstatement* (MCR) involves the use of mental imagery to put oneself back into the context of a previous

[3] Following in Fisher and Geiselman's footsteps (1992; Note 2, p. 3), to avoid ambiguity the present thesis will refer to the eyewitness with feminine pronouns and to the interviewer with masculine pronouns.

experience (see also section 2.3.2.2). Perhaps the most readily apparent form of mental imagery is visual in nature (i.e., picturing a scene in the "mind's eye"). Nevertheless, as sagaciously observed by Clifford and George (1996), MCR is not limited to visual imagery, but rather involves "inviting the witness to think back to all surrounding 'events', including visual, auditory, tactual, kinaesthetic, and emotional" (p. 245).

Smith (1979) was the first to show that the context effects described in the previous section can be brought under cognitive control. His participants learned a number of words in a particular room, and were tested either in the same room or in a different room. Some of the participants who were tested in a different room were instructed to try to remember the input room, whereas others received no such instruction. Smith found that participants instructed to remember the input room performed as well as participants who were tested in the actual input room, and that both of these groups performed better than participants who were tested in a different room and received no MCR instructions.

After Smith's (1979) research on word recall, a number of studies investigated the use of MCR in eyewitness settings. For instance, Malpass and Devine (1981b) found that students who witnessed a staged vandalism were better at identifying the vandal after taking part in a "guided memory" procedure, in which "their feelings, their memory of details of the room, their memory of the vandal, and their immediate reactions to the events were explored" (p. 346). This finding was later replicated in both laboratory (Davies & Milne, 1982) and field settings (Krafka & Penrod, 1985). In follow-up research, Cutler, Penrod, and Martens (1987a) compared two types of context reinstatement procedures on identification of a robber: the "context interview", which included mnemonic instructions, viewing snapshots of the crime scene, and rereading earlier descriptions of the event; and the "lineup context cues" procedure (cf. Cutler, Penrod, O'Rourke, & Martens, 1986), which involved being exposed to a number of cues, such as voice, gait, and posture of the perpetrator. They found that both types of context reinstatement improved identification accuracy, especially when the identification task was difficult (e.g., due to delay or disguise). These findings contrast with the earlier failures to find context effects with recognition tests of words (Godden & Baddeley, 1980; S. M. Smith et al., 1978). This discrepancy might be observed because words tend to be more associable than faces, and the associations formed for words during the learning phase may overshadow the salience of context cues (S. M. Smith & Vela, 2001). However, even for recognition of faces, the benefits of MCR have not always been replicated (e.g., Davies & Milne, 1985; Sanders, 1984).

Although most studies on context reinstatement in eyewitness settings have concerned facial recognition, there is some evidence that it helps recall of witnessed events. For instance, Hammond, Wagstaff, and Cole (2006) found that MCR increased the amount of information reported about a videotaped crime for both adult and child witnesses, in both free and cued recall. Furthermore, witnesses interviewed with context reinstatement outperformed those interviewed with focused meditation. Wagstaff et al. (2011) replicated the procedure with younger children, and found context reinstatement and focused meditation to be equally effective in improving their recall of a videotaped mundane event. Furthermore, Clifford and George (1996) found that the instruction to reinstate context is used consistently by police officers in the field, and that substantially more information is obtained when the instruction is given. They concluded that MCR "is clearly a powerful tool, and is effective in a real life setting" (p. 244).

Krafka and Penrod (1985) report an additional potential benefit of context reinstatement: they found that the procedure increased the correlation between confidence and accuracy of line-up decisions. In contrast, however, Hammond et al. (2006) found that context reinstatement inflated confidence in erroneous recall. As noted by Hammond and colleagues, the impact of context reinstatement on witness confidence has received relatively little attention to date. Given that jurors often judge witness credibility on the basis of their confidence (Cutler et al., 1990; Wells et al., 1979; Wheatcroft et al., 2004), this seems to be a fruitful area for further research.

One might argue that, whenever possible, the investigative interviewer should take the witness back to the scene of the crime (i.e., physical context reinstatement), to maximise the overlap between encoding and retrieval context. Besides the practical concerns with such a procedure, one study suggests that physical context reinstatement is actually slightly *less* effective than its mental counterpart. Hershkowitz et al. (2002) interviewed young alleged victims of sexual abuse, and found that children who were asked to mentally reconstruct the setting in which the incidents occurred reported more information in response to free-recall prompts than children who actually returned to the scene of the incidents. One potential explanation for this finding is that the physical environment may have changed between the time of encoding and the time of retrieval (Hershkowitz et al., 2002; Orbach, Hershkowitz, Lamb, Sternberg, & Horowitz, 2000). For instance, if the crime took place outside, there may be changes in weather, lighting conditions, parked cars, and passersby (Fisher & Geiselman, 1992). Such changes would not only reduce the similarity between encoding and retrieval context, but could also expose the interviewee to additional distractions. With MCR, on the other hand, the witness is in control of her mental copy of the encoding environment.

Several moderators of the effect of MCR on recall have been identified (Emmett, Clifford, & Gwyer, 2003; Memon & Bruce, 1985; Thomson & Davies, 1988). For instance, MCR seems to be effective in free recall, but not cued recall (Emmett et al., 2003; Ready et al., 1997; Wagstaff et al., 2011; but see Hammond et al., 2006). This finding might be explained by the ‘outshining hypothesis’ (S. M. Smith, 1988): the strong cues provided by the questions themselves may ‘outshine’ or overpower the weaker cues provided by MCR. In addition, it has been suggested that certain individuals may benefit more from MCR than others (Emmett et al., 2003; McSpadden, Schooler, & Loftus, 1988; S. M. Smith & Rothkopf, 1984). For instance, Emmett and colleagues found that individuals who have difficulty separating essential information from its context benefit more from MCR than participants who are more selective in their information uptake.

All in all, there is a broad evidence base for the effectiveness of MCR on eyewitness memory. It should be noted, however, that the actual context reinstatement component might not be the sole factor driving the effect. Given that context effects can be relatively weak (Fernandez & Glenberg, 1985; S. M. Smith & Vela, 2001), it is possible that other factors contribute to the effectiveness of MCR. For instance, the MCR procedure may improve recall by helping witnesses to concentrate and relax. Indeed, Wagstaff et al. (2011)

found that focused meditation was just as effective for adult witnesses as MCR. From an applied perspective, *how* MCR works is not as important as the fact *that* it works (although it might be useful to explain the rationale of the method to police interviewers). Thanks to its effectiveness, the MCR instruction has been incorporated in the Cognitive Interview protocol, to which we turn next.

2.2.4 Cognitive Interview

The finding that eyewitness memory can be improved with certain mnemonic techniques has led to the development of comprehensive investigative interview protocols incorporating these techniques. Some of the protocols have been developed with a specific target group in mind. For instance, *conversation management* was designed to help overcome resistance in investigative interviews, for example from suspects or uncooperative witnesses (Shepherd, 1988). Another example is the National Institute of Child Health and Human Development (NICHD) protocol, which was developed for children who may have been victims of abuse (Orbach, Hershkowitz, Lamb, Sternberg, Esplin, et al., 2000). It has been shown that interviewers using the NICHD protocol elicit substantially more forensically relevant information from alleged victims of abuse than interviewers who do not use the protocol (see Lamb, Orbach, Hershkowitz, Esplin, & Horowitz, 2007, for a review of the available evidence), and there are some indications that the additional information elicited is also more likely to be accurate (Lamb, Orbach, Hershkowitz, Horowitz, & Abbott, 2007). Furthermore, the additional information elicited has been found to increase the likelihood of charges being pressed and subsequent conviction of the suspect (Pipe, Orbach, Lamb, Abbott, & Stewart, 2008).

In the present review, I will focus on an interview protocol that was developed for a wider population and has undergone much empirical testing. Based on a number of psychological principles, Geiselman and Fisher developed a set of practical guidelines for investigative interviewers, termed the Cognitive Interview (CI; Geiselman et al., 1984; Geiselman et al., 1985;

Geiselman, Fisher, MacKinnon, & Holland, 1986). The CI is intended to help interviewers obtain more accurate information from victims, witnesses, suspects, and informants alike (cf. Milne & Bull, 2003b). In 1992, Fisher and Geiselman refined the CI, incorporating additional findings from the literature on interviewing, as well as feedback from the police. In this section, I will first explore the instructions used in the enhanced CI, followed by a review of the empirical evidence to support the protocol, concluding with a discussion of its practical implementation.

2.2.4.1 Instructions

The enhanced version of the Cognitive Interview includes a number of general interviewing principles to motivate the witness, as well as several specific techniques to provide mnemonic aids (see Fisher & Geiselman, 1992). In terms of general principles, the CI advocates that: (a) the eyewitness takes an active role, (b) the interviewer establishes a level of trust and rapport with the witness, and (c) the interviewer first obtains an uninterrupted free account, which is followed by (neutrally worded) questions. In terms of specific mnemonic techniques, the interviewer should instruct the witness: (a) to report everything, (b) to mentally reinstate the context of the witnessed event, and (c) to retrieve the event on multiple and varied occasions. For instance, the witness may be asked to recall the event in backward chronological order, from different perspectives, or in different sensory modalities. Furthermore, Fisher and Geiselman suggest that eye-closure on the part of the witness may improve memory retrieval (although this recommendation was not based on empirical research at the time). Many studies have sought to evaluate the effectiveness of the CI techniques, which will be reviewed in the next section.

2.2.4.2 Effectiveness

Since the development of the Cognitive Interview, approximately 65 studies have been published on the topic (Memon, Meissner, et al., 2010). Instead of discussing individual studies, I will report in some detail the findings of two meta-analyses conducted on the CI. About twelve years ago, Köhnken et al. (1999) conducted a highly influential and oft-cited meta-analysis on the effectiveness of the CI. They reviewed 42 experimental studies (29 of which were published) including nearly 2,500 interviewees, containing 55 comparisons between the CI and some form of control interview. Some studies compared the CI to a standard interview similar to procedures often used in practice (to provide an ecologically valid comparison, in line with the 'applied research view'). Other studies compared the CI to a structured interview, which involves an equal amount of interview training as the CI, but does not include the specific mnemonic techniques (to examine whether the CI is purely due to motivational or training effects, in line with the 'theoretical research view').

Köhnken et al.'s (1999) main finding was that the CI (compared to a control interview) significantly increased the amount of correct information (d = .87), as well as the amount of incorrect information (d = .28) obtained from witnesses. Because the increase in errors was substantially smaller than the increase correct information, overall testimonial accuracy for both types of interviews was nearly identical (with 85% of reported details correct for the CI and 82% correct for the control interview). Thus, it seems that the CI does not simply shift participants' response criterion; in that case, a decrease in testimonial accuracy would have been expected (Koriat & Goldsmith, 1996).

In addition, Köhnken and colleagues (1999) identified a number of moderators of the effectiveness of the CI. In terms of the type of to-be-remembered event, the CI is significantly more effective for staged events than for videotaped events, and significantly more effective for recent events than for events that happened longer ago. In terms of the type of witness, the CI seems to elicit slightly more correct details and significantly more incorrect details from adults than from children, and elicits significantly more correct details from active witnesses than from passive witnesses. In terms of the type of interview, the enhanced version of the CI generates significantly more incorrect details than the original version. Finally, in terms of research laboratories, Fisher and Geiselman and colleagues found significantly larger increases in both correct and incorrect details with the CI than researchers in other laboratories. All in all, Köhnken et al. concluded that the benefits of the CI on correct recall are "remarkably stable and consistent" (p. 20), and that "the worst possible effect that may be obtained when a cognitive interview instead of a standard interview is applied is simply no effect at all." (p. 20).

More recently, Memon et al. (2010) published an updated meta-analysis assessing the effectiveness of the CI, which may well become just as influential as its predecessor. Unlike Köhnken et al. (1999), they only included studies published in peer-reviewed outlets, to mirror legal standards for proffered scientific testimony (e.g., *Daubert v. Merrell Dow Pharmaceuticals*, 1993). Their meta-analysis comprised of 46 published studies (including 17 new studies), describing 59 comparisons between the CI and some form of control interview (standard, structured, or free-recall), representing the responses of almost 2,900 participants. They found even greater benefits of the CI overall, with an effect size of d = 1.20 for correct details and d = .24 for incorrect details, and no significant difference between the CI and the control interview in terms of testimonial accuracy. Thus, Memon et al. provided additional support for the effectiveness of the CI.

Like Köhnken et al. (1999), Memon and colleagues (2010) identified a number of moderators in the effectiveness of the CI. They obtained similar findings with regard to the age of the witness and retention interval (see above). In addition, they found that the CI was less effective for events that likely generated emotional arousal than for neutral events, though the effect was still substantial even for emotionally arousing events. The difference between the original and the enhanced versions of the CI obtained by Köhnken et al. was not replicated, but they found that modified (typically shortened) versions of the CI produced significantly more incorrect details than the original and enhanced versions. Finally, they distinguished between the different forms of control interviews, and found that larger effect sizes for the CI were obtained when it was compared to a standard interview as opposed to a structured interview. In other words, structured interviews are more effective than standard interviews.

Type of recall format (free versus cued) was not included as a moderator of the effectiveness of the CI in the meta-analyses, probably because most studies on the CI have collapsed findings across the different interview phases. Nevertheless, a few studies have analysed the phases separately, yielding mixed results. Some studies with adult and child witnesses (Davis, McMahon, & Greenwood, 2005; Holliday, 2003a) have replicated the findings obtained for MCR (Emmett et al., 2003; Ready et al., 1997; Wagstaff et al., 2011); that is, the CI was more beneficial in free recall than in cued recall. Other studies with child witnesses, however (Memon, Wark, Bull, & Köhnken, 1997; Milne & Bull, 2003a), have reported the opposite pattern; that is, the recall advantage of the CI was observed in the cued recall phase, but not the free recall phase. The apparent inconsistency of these findings will be further addressed in section 2.3.1.2.

Besides the increase in the amount of information obtained, several additional benefits of the CI have been reported. For instance, unlike hypnosis, the CI does not inflate confidence in incorrect responses (Allwood, Ask, & Granhag, 2005; Granhag, Jonsson, & Allwood, 2004; Gwyer & Clifford, 1997; McMahon, 2000; Mello & Fisher, 1996; see also Roberts & Higham, 2002). Moreover, the CI has been found to protect against the incorporation of misleading information into eyewitness testimony, provided that the interview is conducted prior to encountering the misinformation (Geiselman, Fisher, Cohen, et al., 1986; Memon, Zaragoza, et al., 2010). This may be because the CI enhances witnesses' ability to notice discrepancies between their original memory and the misleading information (consistent with the discrepancy detection principle; Garry, Loftus, & Brown, 1994; Hall, Loftus, & Tousignant, 1984; Loftus, Levidow, & Duensing, 1992; Tousignant et al., 1986). In conclusion, the CI increases the amount of relevant information obtained from witnesses without inflating confidence or decreasing testimonial accuracy, and may even protect against the incorporation of misleading information encountered after the event.

2.2.4.3 Practical Implementation

Elements of the Cognitive Interview have been included in police interview training in a number of different countries, such as New Zealand, Australia, Canada (Fisher, Milne, & Bull, 2011), Norway, Denmark, Sweden, Iceland (Fahsing & Rachlew, 2009), and The Netherlands (Clément et al., 2009). The CI has perhaps been most widely implemented in the United Kingdom. In response to growing criticism of police interviewing practices (e.g., Baldwin, 1992), the PEACE interview model was developed, and all police officers in England and Wales were trained according to this model (Clarke & Milne, 2001). PEACE is a mnemonic for five interview stages: Planning and preparation, Engage and explain, Account, Closure, and Evaluation. In the Account stage, conversation management and the CI are recommended to facilitate the production of a detailed account of the witnessed event.

Even though research findings suggest that the CI is effective, a number of problems with the practical implementation of the procedure have been reported. In a national evaluation of the PEACE approach, Clarke and Milne (2001) found that police interviewers in England and Wales had failed to use the CI in 83% of interviews. Police officers have provided a number of reasons why the CI is difficult to use in practice. First, there is the issue of training: the CI procedure takes a significant amount of training and even trained interviewers do not always adhere to the procedures (Kebbell & Wagstaff, 1999). In addition, interviewer skills have been found to decline after initial training (Griffiths & Milne, 2006). Furthermore, it takes much longer to conduct a CI than it does to conduct a standard interview, and police officers report that they simply do not have the luxury of time for the bulk of criminal cases (Dando, Wilcock, & Milne, 2008; Kebbell, Milne, & Wagstaff, 1999).

Certain elements of the CI, such as the instructions to report everything and reinstate mental context, are considered to be more useful than other elements, such as the “reverse order” and “change perspective” instructions (Clifford & George, 1996; Dando, Wilcock, & Milne, 2009a; Kebbell et al., 1999; Memon, Holley, Milne, Köhnken, & Bull, 1994; Milne & Bull, 2002). The elements that are judged to be less useful are rarely used in practice, and when they are used, they are often poorly applied. In addition, when interviewers deem certain CI techniques to be inappropriate for a particular witness, they often abandon the CI approach altogether, rather than using it flexibly (Milne & Bull, 2003b). All in all, it seems that the CI is a good idea in theory, but is not feasible to implement in the majority of criminal cases, except perhaps in the most serious cases for which more time and resources are available (Clarke & Milne, 2001; Kebbell et al., 1999; Milne & Bull, 2003b).

To combat some of the practical concerns, a number of researchers have developed modified versions of the CI, which shorten the time necessary to conduct a CI, while preserving its benefits. For instance, Boon and Noon (1994) found that the “change perspective” instruction did not have any additional benefits on top of an initial retrieval attempt (but see Milne & Bull, 2002), and Mello and Fisher (1996) found that a modified CI without the "change perspective" instruction was just as effective for older adults as the enhanced CI. Davis et al. (2005) found that both the "change perspective" and the "reverse order" technique could be omitted from the enhanced CI without any loss in the amount and accuracy of information obtained from witnesses. In another modified procedure developed by Dando and collaborators, the traditional MCR procedure was replaced by the instruction to provide a sketch of the witnessed event (Dando, Wilcock, Behnkle, & Milne, 2011; Dando, Wilcock, & Milne, 2009b; Dando, Wilcock, Milne, & Henry, 2009; see also Gabbert et al., 2009). The researchers found the sketch method to be just as effective as the traditional context reinstatement procedure, and proposed that the technique "may be a viable, less complex and less time consuming alternative" for less serious cases (Dando, Wilcock, et al., 2009b, p. 138).

Although the development of shortened interview procedures seems promising from a practical perspective, Memon et al.'s (2010) meta-analysis showed that the modified CI procedures tend to increase the number of incorrect details reported by the witness. Since eyewitness accuracy is often of paramount importance in criminal proceedings, there still seems to be room for improvement.

2.2.5 Conclusion

A number of interview methods have been proposed to improve eyewitness memory, of which the Cognitive Interview seems to be the most effective. Nevertheless, due to time constraints and limited resources, the Cognitive Interview has turned out to be difficult to implement in practice. For this reason, it would be helpful to have an alternative interview procedure that does not require additional interview time or training. One such procedure could be closing the eyes during the interview, which will be discussed in the next section.

2.3 Eye-Closure

When we are deeply engaged in thought, this may be reflected in our outward behaviour. For instance, we might start walking more slowly (Kundera, 1996), speaking more slowly (Fisher & Geiselman, 1992), look away, or close our eyes (Allport, Antonis, & Reynolds, 1972; Argyle & Cook, 1976; Brooks, 1967; Fisher & Geiselman, 1992). What is perhaps even more interesting is that such bodily manifestations may not only be side effects of cognitive processes; they may also facilitate such processes (Barsalou, 2008; Glenberg, 1997; Niedenthal, 2007). For example, in an interesting line of research, Miles and colleagues found not only that people tend to lean backward when thinking about the past and forward when thinking about the future (L. K. Miles, Nind, & Macrae, 2010), but also that the sensation of backward movement can *cause* people to think about the past, and conversely, the sensation of forward movement can inspire future thought (L. K. Miles, Karpinska, Lumsden, & Macrae, 2010). This line of research illustrates the bidirectional relationship between mental time travel and bodily movement. In a similar vein, Glenberg, Schroeder, and Robertson (1998) conducted pioneering empirical research into the bidirectional relationship between memory performance and the tendency to look away or close the eyes. This section will review the research on the effect of eye-closure on semantic and episodic memory, discuss potential factors involved in the eye-closure effect, and conclude with the proposal of a new framework incorporating some of these factors.

2.3.1 Memory Benefits

2.3.1.1 Semantic Recall

Having observed the human tendency to look away while trying to remember something, Glenberg et al. (1998) decided to study this behaviour in a series of controlled experiments. In their first two experiments, they found that the tendency to avert gaze was greater for difficult than for easy questions about autobiographical and general facts. In their third experiment, they showed that the tendency to avert gaze remained even when social factors were eliminated, indicating that the phenomenon is not solely due to social embarrassment. Of most interest to the present thesis are Glenberg et al.'s (1998) last two experiments, in which they examined the functionality of the behaviour. In Experiment 4, they found that instructing people to close their eyes during the test increased the proportion of correct responses for questions of moderate difficulty by approximately 10%. Their final experiment tested the effects of *not* averting the gaze. Thus, participants were forced to look at a visual display that was either simple (a picture of a sunset) or complex (a silent movie) while trying to recall words. Participants in the simple condition recalled 20% more words than participants in the complex condition. The authors explain their findings in terms of the interplay between environmental and cognitive control over cognition (Glenberg, 1997), which will be explored in more depth in section 2.3.2.3.

Doherty-Sneddon's research group investigated whether the bidirectional relationship between gaze aversion and memory performance reported by Glenberg et al. (1998) would extend to children's performance. First, they found that, like adults, 8-year old children look away more from the experimenter's face when answering difficult as opposed to easy verbal-reasoning and arithmetic questions (Doherty-Sneddon, Bruce, Bonner, Longbotham, & Doyle, 2002; Doherty-Sneddon, Phelps, & Clark, 2007). Second, they found that children's gaze aversion, like adult's gaze aversion, is functional (Doherty-Sneddon, Bonner, & Bruce, 2001; Phelps, Doherty-Sneddon, & Warnock, 2006). Given that children's gaze aversion improves their performance on cognitive tasks, Phelps et al. (2006) investigated whether 5-year old children, who do not spontaneously avert their gaze when faced with a difficult task (Doherty-Sneddon et al., 2002), could be trained to use gaze aversion to their advantage. They found that children who were instructed to look away from the experimenter's face while trying to think of the answer to arithmetic and verbal-reasoning questions spent significantly more time averting their gaze than children simply instructed to try to think of the answer. Crucially, the instructed group also gave significantly more correct answers than the uninstructed group. These findings are in need of replication, however, since Phelps et al. included only ten children in each condition.

In sum, looking away or closing the eyes while trying to remember the answer to a question has the potential to enhance retrieval from semantic memory for both adults and children. The next section will explore the effects of eye-closure on episodic recall.

2.3.1.2 Episodic Recall

Closing the eyes may not only help one to remember the answers to an exam, it may also improve recall of an experienced event. Wagstaff et al. (2004, Experiment 2) examined the effects of focused meditation and eye-closure on recall of Princess Diana's funeral five years earlier. They found that eye-closure was a memory aid in its own right, significantly increasing correct free recall (but not cued recall) of the event. Crucially, the gain in correct recall obtained with eye-closure was not accompanied by an increase in the recall of incorrect details (unlike hypnosis; Erdelyi, 1994). Wagstaff et al. (2004) found that focused meditation was somewhat more effective than eye-closure; however, the efficacy of their eye-closure instruction may have been limited by the fact that participants were required to open their eyes to read and answer the interview questions (cf. Wagstaff et al., 2010). In addition, Wagstaff and colleagues (2004; 2010) found that a focused meditation procedure was most effective when it was combined with eye-closure. In short, the Wagstaff et al. (2004) study shows that closing the eyes during an investigative interview can help witnesses to remember the details of a past public event.

Perfect et al. (2008) extended this finding to recall of mundane events witnessed only once, under various conditions. Their first experiment investigated the effect of eye-closure on cued recall of a videotaped simulated robbery at a car-dealership, and their second experiment examined cued recall of a videotaped local news bulletin. Their third experiment tested free recall of a video clip from a little-known TV series. Their fourth and fifth experiment tested memory for a staged mundane event, in cued and free recall, respectively. Significant and considerable benefits of eye-closure on eyewitness memory were observed across all experiments. They concluded that the 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).

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. Examining the theoretical underpinnings of the eye-closure effect further, Perfect, Andrade and Syrett (2011) manipulated the complexity and predictability of (meaningless) 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 concluded that a reduction in visual distraction as a result of eye-closure improves the quality rather than the quantity of eyewitness testimony. The work by Perfect and colleagues will be considered in further detail in section 2.3.2.3.

Mastroberardino, Natali, and Candel (2010) investigated whether eye-closure also improves event recall for 6- and 11-year old children. They tested free and cued recall of a video extract from the movie Jurassic Park. The selected event was fairly emotional: in the video, a group of people was attacked by a *Tyrannosaurus Rex,* and one man was eaten by the dinosaur. Mastroberardino and colleagues found that, irrespective of age, children who closed their eyes performed better in cued recall. However, eye-closure had no significant effect on free recall performance. This finding adds to the conflicting findings concerning the effects of retrieval techniques on free versus cued recall. One moderator of the inconsistency seems to be the age of the witness. Thus, most studies with children have found that the Cognitive Interview (CI) and the eye-closure instruction are more beneficial in cued recall than in free recall (Mastroberardino et al., 2010; Memon et al., 1997; Milne & Bull, 2003a; but see Holliday, 2003). Most studies with adults, on the other hand, have found that the CI, mental context reinstatement (MCR), and eye-closure are all either equally beneficial in both types of recall (Hammond et al., 2006; Perfect et al., 2008), or more beneficial in free recall than in cued recall (Davis et al., 2005; Emmett et al., 2003; Ready et al., 1997; Wagstaff et al., 2004; Wagstaff et al., 2011).

Perhaps, the retrieval techniques trigger different cognitive processes in children than in adults. It is likely that, in free recall, interview procedures such as the CI, MCR, and eye-closure facilitate accessibility to retrieval cues, for adults and children alike (S. M. Smith, 1988; Thomson & Tulving, 1970). However, it is possible that adults are better at using such cues to their advantage. It has been suggested that adults have richer memory representations than young children (Brainerd & Reyna, 2002; Holliday, 2003a). Hence, for adults, the provided cues may trigger additional related aspects of the memory (J. R. Anderson, 1983; Collins & Loftus, 1975; McKoon & Ratcliff, 1979), whereas it may do so to a lesser extent for children, whose associative connections in memory are perhaps less developed. For children, on the other hand, the greater benefits of interview techniques in cued recall may be observed because they facilitate an understanding of the interview questions; a function which is less relevant for adults, who already tend to have a better understanding of the questions (N. W. Perry et al., 1995). Of course, these explanations are purely speculative and, unfortunately, developmental differences in eyewitness memory are beyond the scope of this thesis. However, for adult witnesses, Experiments 3 and 6 will attempt to provide more insight into the role of recall format in the eye-closure effect.

Wais, Rubens, Boccanfuso, and Gazzaley (2010) examined the neural basis of the eye-closure effect. They conducted a behavioural study and a functional magnetic resonance imaging (fMRI) study. Cued recall of images seen an hour earlier was compared across three within-subjects conditions: participants had their eyes closed, looked at a gray screen, or looked at distraction images of complex scenes. The behavioural results indicated that recollection accuracy was significantly higher in the eyes-closed condition than in the visual-distraction condition, with participants in the gray-screen condition scoring in-between the two other conditions. The fMRI results showed that visual distraction during retrieval disrupted functional connectivity in a network involving the left inferior frontal gyrus, hippocampus, and visual association cortex. In other words, looking at irrelevant images reduced activity in brain regions associated with recollection and visual imagery. The Wais et al. study provides interesting insights into neurocognitive functions involved in the eye-closure effect. Nevertheless, the to-be-remembered stimuli used in their study were quite simple (images of common objects). Neural representations of complex events, on the other hand, likely involve a wider range of brain regions. Future fMRI research could investigate the neural correlates of eye-closure during retrieval of complex events.

To American singer Minnie Riperton, the findings that eye-closure improves episodic memory should come as no surprise. Many years ago, she already advised of the benefits associated with eye-closure in her song entitled “Close your eyes and remember” (Riperton, 1969). The idea is not novel to investigative interviewing either: the Cognitive Interview manual (Fisher & Geiselman, 1992, p. 133), the Self-Administered Interview (Hope et al., 2011), and the Dutch Police Academy manual (van Amelsvoort, Rispens, & Grolman, 2006) all suggest encouraging the witness to close her eyes, and eye-closure is a crucial component of hypnotic interviewing (Barber, 1969; Hibbard & Worring, 1981; Weitzenhoffer & Hilgard, 1962). Nevertheless, until recently, the instruction had received little research attention, and recommendations have solely been based on intuitions about the usefulness of eye-closure. The research discussed in this section provides some empirical support for these intuitions, yet many relevant questions still remain unanswered (see section 2.4). The next section will explore possible explanations for the finding that eye-closure improves memory.

2.3.2 Explaining the Eye-Closure Effect

We have seen that closing the eyes may lead to people retrieving more information from memory. But why does eye-closure facilitate retrieval? Factors such as social demands and mental imagery are likely to play a role in the eye-closure effect. Eye-closure may have a general or modality-specific effect on recall, or a combination of both. At the end of this section, an integrative framework explaining the eye-closure effect will be proposed.

2.3.2.1 Social Factors

Witnesses typically experience some social discomfort during police interviews (Fisher & Geiselman, 1992; Memon & Bull, 1991; Milne & Bull, 2003b). Even in an experimental setting, Glenberg et al. (1998) noted that “the participant might become embarrassed by the awkward social situation and this embarrassment would be the cause of averting the gaze” (p.654). This type of social discomfort has been found to impair recall performance. For instance, Wagstaff et al. (2008) found that eyewitness recall was impaired by the mere presence of another person in the interview room. Similarly, Doherty-Sneddon and McAuley (2000) found that children who were interviewed face-to-face provided less accurate testimony than children who were interviewed via a live video link (see also Davies, 1999; Davies & Noon, 1991). Thus, one reason why eye-closure may facilitate retrieval performance is that it reduces social discomfort. However, Doherty-Sneddon et al. (2001) reported that, in their study, closing the eyes actually seemed to *increase* participants’ social discomfort. In Experiment 3, this anecdotal observation will be investigated more systematically by asking all participants how comfortable they felt during the interview.

Even if eye-closure does not reduce social discomfort, it necessarily cuts out visually-based social cues. During an investigative interview, the witness needs to attend to various non-verbal social cues displayed by the interviewer, including visual cues such as facial expressions (Posamentier & Abdi, 2003) and eye gaze (Langton, Watt, & Bruce, 2000); and auditory cues such as pauses in speech (Goldman-Eisler, 1961) and tone of voice (Belin, Zatorre, Lafaille, Ahad, & Pike, 2000). Out of these types of social cues, visual cues tend to be more dominant than auditory cues (de Gelder, Böcker, Tuomainen, Hensen, & Vroomen, 1999; McGurk & MacDonald, 1976; Möttönen, Krause, Tiippana, & Sams, 2002; Saldaña & Rosenblum, 1993; Sams et al., 1991; but see Shams, Kamitani, & Shimojo, 2000). Furthermore, visuospatial imagery is more likely to be disrupted by looking at a face (a social stimulus) than by looking at complex visual patterns (a non-social stimulus; Markson & Paterson, 2009). Thus, eliminating the need to attend to visual social cues is likely to reduce the strain on a witness’s cognitive resources, which facilitates recall (in line with the embodied cognition account proposed by Glenberg, 1997, which will be explained in section 2.3.2.3).

In their research on the mechanisms involved in children's gaze aversion, Doherty-Sneddon and Phelps (2005) independently manipulated both the social demands of the interview environment and the cognitive demands of the questions posed to participants, which involved arithmetic, verbal-reasoning, autobiographical, and episodic tasks. Consistent with previous findings (Doherty-Sneddon & McAuley, 2000), they found that children looked away from the interviewer more often when interviewed face-to-face than when interviewed via a live video link. However, question difficulty had a considerably larger impact on children's tendency to look away than communication mode. Hence, Doherty-Sneddon and Phelps conclude that "although social factors play a role in children's gaze aversion ..., the primary function of averting gaze is to manage the cognitive load involved in the processing of environmental information" (p. 727). In conclusion, social factors probably play a role in the eye-closure effect, although they seem unlikely to provide a full explanation.

2.3.2.2 Mental Imagery

Another potential reason for the finding that eye-closure enhances recall is that it facilitates the use of mental imagery. Mental imagery refers to the idea that people can form mental images of stimuli and events, for instance in their "mind's eye" (i.e., visual imagery; see Finke & Shepard, 1986; Kosslyn, Behrmann, & Jeannerod, 1995) or in their "mind's ear" (i.e., auditory imagery; see Crowder, 1993; Reisberg, 1992). In the Cognitive Interview manual, Fisher and Geiselman (1992) suggest that witnesses should be encouraged to close their eyes, in order to "probe mental images most effectively" (p.133). Supporting this recommendation, Caruso and Gino (2011) found that participants who closed their eyes were significantly more likely to report having mentally simulated a hypothetical scenario while considering its morality than participants who kept their eyes open. In addition, Rode, Revol, Rossetti, Boisson, and Bartolomeo (2007) asked participants to conjure up a mental image of the map of France, and found that participants who were blindfolded reported significantly more cities than participants who kept their eyes open. Finally, Wais et al. (2010) found that, despite the lack of visual input for participants with their eyes closed, visual areas in the brain were activated when they were remembering previously seen visual objects. The authors interpreted this finding as strong evidence that participants who closed their eyes were using visual imagery (see also Ganis, Thompson, & Kosslyn, 2004; Kosslyn & Thompson, 2003; O'Craven & Kanwisher, 2000).

The idea that mental imagery improves memory retrieval is not only supported by ancient wisdom (e.g., the poet Simonides invented the method of loci around 500 B.C.; Yates, 1966), but also by an overwhelming body of empirical research (J. M. Clark & Paivio, 1991; Fletcher et al., 1995; Ishai, Ungerleider, & Haxby, 2000; Jonides, Kahn, & Rozin, 1975; Mechelli, Price, Friston, & Ishai, 2004; Paivio, 1969, 1971; J. Ross & Lawrence, 1968). For instance, Paivio (1969) found that participants who were instructed to use mental imagery recalled more words that could easily be visualised (e.g., “house”), than words that could not readily be visualised (e.g., “truth”). Furthermore, Brooks (1967) found that recall of verbal material was better if the material could be mentally organised in a spatial manner, whereas this advantage was eliminated when visuospatial imagery was disrupted by concurrent reading. In follow-up work, Baddeley and Lieberman (1980) showed that a non-visual spatial tracking task also interfered with the recall of spatially organised verbal material.

In sum, eye-closure seems to facilitate the use of mental imagery, and mental imagery has consistently been found to improve recall. One question to be answered is whether eye-closure only facilitates visual imagery, or whether it also encourages other forms of mental imagery (e.g., auditory imagery). If eye-closure only facilitates visual imagery, it is likely to have a modality-specific effect on recall performance, predominantly improving recall of aspects of the witnessed event that can be visualised. If eye-closure also inspires different forms of mental imagery, however, it is likely to have a general effect on recall performance, improving recall of various aspects of the witnessed event. In previous work, the former possibility has been referred to as the *modality-specific interference hypothesis* of the eye-closure effect, whereas the latter has been referred to as the dual-task or *cognitive load* hypothesis (e.g., Doherty-Sneddon et al., 2001; Mastroberardino et al., 2010; Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008). The next section will explore the background of each of these hypotheses, followed by a discussion of the evidence to date.

2.3.2.3 General and Modality-Specific Processes

It is possible that eye-closure improves recall performance in general, irrespective of the modality of the to-be-remembered information. This hypothesis is based on Glenberg's (1997) embodied cognition account of memory. Glenberg emphasises that cognition has developed in the service of action. Typically, a considerable amount of our cognitive resources is devoted to monitoring the environment, since keeping an eye out for potential dangers in the environment improves our chances of survival. However, we only have a limited pool of cognitive resources, and tasks such as memory retrieval may compete for those resources. Disengaging from the environment, for instance by closing the eyes or looking at the sky (see also Glenberg et al., 1998), helps us to reallocate cognitive resources to the memory retrieval task, thereby improving our performance on that task. In sum, because environmental monitoring and memory retrieval are two competing tasks, the *cognitive load hypothesis* holds that disengaging from the environment through eye-closure will improve overall retrieval performance.

An alternative possibility is that eye-closure improves recall of visual information more than recall of auditory information. This hypothesis 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). Across many studies, it has been found that two concurrent tasks that rely on the same modality interfere more with each other than two concurrent tasks that rely on different modalities. In this context, the word 'modality' can pertain to various types of information, including verbal, acoustic, visual, spatial, and kinaesthetic information. Of particular interest to the present study, Baddeley and Andrade (2000) found that a concurrent verbal task (counting) interfered more with the vividness of auditory imagery (e.g., "imagine the sound of a cat meowing") than with the vividness of visual imagery (e.g., "imagine the appearance of cows grazing"), whereas a concurrent visuospatial task (spatial tapping) interfered more with the vividness of visual imagery than with the vividness of auditory imagery. Applying these findings to the eye-closure effect, the *modality-specific interference hypothesis* holds that eliminating visual distractions through eye-closure will have greater benefits for recall of visual information than for recall of auditory information.

Only a limited number of studies to date have examined the theoretical underpinnings of the eye-closure effect, and they have all concluded that there is more evidence for the cognitive load hypothesis than for the modality-specific interference hypothesis (Perfect, Andrade, & Eagan, 2011; Perfect, Andrade, & Syrett, 2011; Perfect et al., 2008). Perfect et al. (2008) based this conclusion on their assertion that eye-closure improved recall of both visual and auditory information. However, a closer look at their data suggests that their findings provide some support for a general effect, but also some support for a modality-specific effect.[4] In a similar vein, Perfect, Andrade and Syrett (2011) concluded that complex visual distraction impaired the accuracy of responses about both visual and auditory aspects of a news bulletin (but see Chapter 5). Finally, Perfect, Andrade, and Eagan (2011) concluded that the eye-closure effect is not modality-specific because eye-closure helped participants to overcome the cross-modal memory impairment caused by auditory distraction. Perhaps, however, the focus of the work by Perfect and colleagues was somewhat too narrow. Their aim was to find the 'correct' explanation of the eye-closure effect, rather than examining *to what extent* general and modality-specific processes play a role.

To provide a more comprehensive account of the eye-closure effect, it may be useful to adopt an approach similar to the one taken by Baddeley and Hitch (1974) in their development of the Working Memory model (see Figure 2.2a). The model holds that we have two modality-specific subsystems, the

[4] Perfect et al. (2008) concluded that eye-closure 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, 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 mentioned by the authors, showed that eye-closure impaired both the amount and the accuracy of auditory recall. Finally, Experiment 3 found that eye-closure increased the *number* of auditory details recalled, but significantly decreased the *accuracy* of the recalled auditory information. All in all, Perfect et al.'s experiments showed consistent eye-closure benefits for recall of visual details, but inconsistent effects on recall of auditory details.

phonological loop and the *visuospatial sketchpad*, which are governed by a general attentional system, the *central executive*. The phonological loop is thought to be involved in the storage and processing of information held in a verbal or acoustic code, whereas the visuospatial sketchpad is thought to be involved in the storage and processing of information held in a visual or spatial code (and perhaps kinaesthetic, see Baddeley, 2007). The central executive is responsible for the allocation of attentional resources. To account for a number of inconsistent findings after publication of the original model, Baddeley (2000) proposed an additional subsystem capable of integrating and storing information in distinct codes: the *episodic buffer* (see Figure 2.2b). The Working Memory model has been successful in providing an integrated account of research findings from many areas of cognitive science (see Baddeley, 2007, for a review). In a similar vein, the eye-closure effect might be best explained by a combination of general and modality-specific processes.

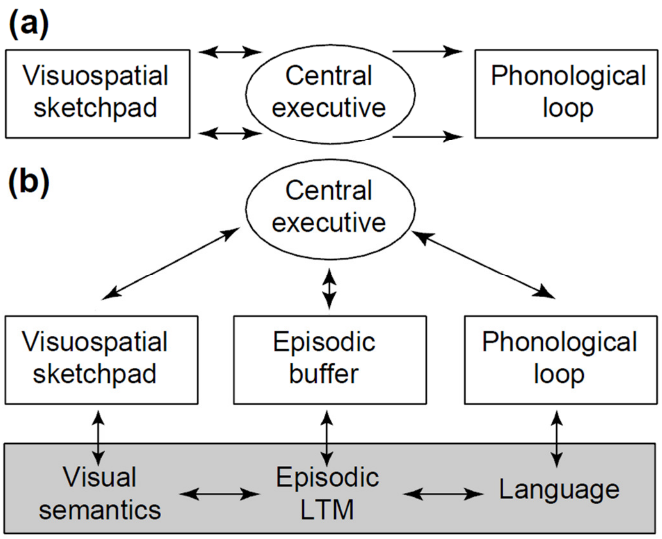


Figure 2.2 Working Memory model. The figure, adapted from Baddeley (2000, p. 418 and p. 421), shows (a) the original version and (b) the current version of the Working Memory model.

2.3.2.4 The Cognitive Resources Framework

In an attempt to integrate the general and modality-specific explanations of the eye-closure effect, I propose the Cognitive Resources framework, depicted in Figure 2.3. In line with Glenberg's (1997) embodied cognition account, environmental distractions and memory retrieval are construed as two concurrent tasks competing for cognitive resources. Moreover, the framework specifies modality-specific sources of distraction. For instance, a witness may be distracted by a flickering clock on the wall (visual), or by a phone ringing in the background (auditory). Of course, a witness may also experience distractions that are based in other sensory domains (e.g., smell; cf. A. J. Johnson & Miles, 2009) or do not reside in a particular sensory domain at all (e.g., nerves), but for the sake of simplicity, the framework focuses on distractions in the visual and auditory domains only.

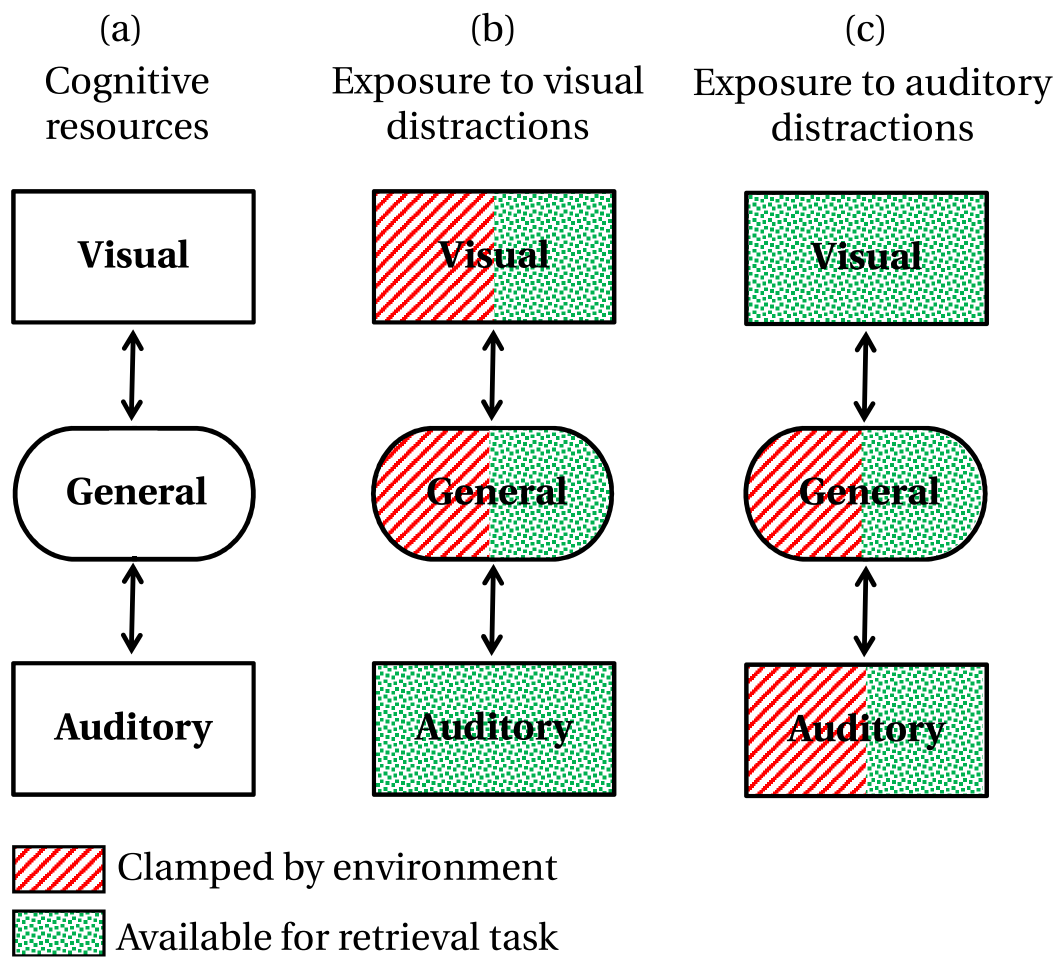


Figure 2.3 Cognitive Resources framework. Schematic representation of (a) the basic framework, (b) the allocation of resources when a witness is exposed to visual distractions in the interview environment, and (c) the allocation of resources when a witness is exposed to auditory distractions.

Following from Baddeley and Hitch's (1974) Working Memory model, the framework specifies three "pools" of cognitive resources involved in both environmental monitoring and memory retrieval. The *visual* pool is thought to be involved in visual and spatial processes, such as visual imagery. The *auditory* pool is thought to be involved in acoustic and verbal processes, such as auditory imagery. Finally, the *general* pool reflects general attentional resources or overall concentration. As shown in Figure 2.3b, visual distractions in the environment may occupy the general pool of resources, leaving fewer resources available for the retrieval task. In addition, visual distractions may occupy the visual pool of resources, leaving fewer resources available for the retrieval of specifically visual information (e.g., what the perpetrator looked like). In a similar vein, as depicted in Figure 2.3c, auditory distractions in the environment may occupy the general pool of resources, but may also engage the auditory pool, thereby impairing recall of auditory aspects of the witnessed event (e.g., what the perpetrator said). In Experiment 5, visual and auditory distractions in the interview environment will be manipulated independently, and the data will be fitted to the Cognitive Resources framework, to provide an estimate of the relative importance of general and modality-specific impairments (see section 5.3.4.1).

2.3.3 Conclusion

Recent research has shown that closing the eyes during the investigative interview may help eyewitnesses to remember more information about witnessed events, without harming the accuracy of their testimony. These findings suggest that the eye-closure instruction may be an effective yet very simple interview procedure that could potentially serve as an alternative to the time-consuming Cognitive Interview procedure in some cases. However, before the instruction can be recommended to police interviewers, it needs to be investigated in more realistic settings. In addition, the theoretical underpinnings of the eye-closure effect are as of yet unclear.

2.4 Research Aims

This section will provide a brief overview of what has been learned from previous research, followed by an outline of research questions that have not yet been answered.

2.4.1 What We Know

An overwhelming body of evidence has shown that eyewitness memory suffers from many limitations. Memory traces may deteriorate over time, and may be influenced by external influences and our own stereotypes. Various interviewing procedures have been developed to overcome these limitations of eyewitness memory. For instance, mental context reinstatement and the Cognitive Interview have proven to be effective in helping witnesses to remember more, without harming the accuracy of their testimony. Nevertheless, these procedures are rather cumbersome, and cannot always be implemented in practice. Relatively recent research suggests that a method as simple as instructing witnesses to close their eyes may substantially improve recall of events. A comprehensive explanation of the eye-closure effect probably involves various factors, such as reductions in social demands and facilitation of mental imagery. The Cognitive Resources framework was proposed to reflect the potential for both general and modality-specific impairments as a result of distractions in the interview environment. The experiments in the present thesis were designed to investigate the robustness of the eye-closure effect in more realistic contexts, and to provide more insight into the cognitive mechanisms underlying the effect.

2.4.2 The Present Research

Based on the literature described in this chapter, a number of research questions were formulated concerning the effects of eye-closure on eyewitness memory. This section will outline these questions, accompanied by a brief rationale relating each question to the relevant portion of the literature review. The first four research questions (pertaining to modality, content, accuracy, and confidence) were assessed across nearly all experiments, whereas the last six were targeted by specific experiments.

2.4.2.1 Modality

The findings on the role of modality in the eye-closure effect have been equivocal (see section 2.3.2.3). For this reason, the research presented in the thesis will examine whether eye-closure facilitates recall of both visual and auditory information, or recall of visual information only.

2.4.2.2 Content

It has been found that witnesses can strategically control the specificity and centrality of the information they choose to report (see section 2.1.2.2). Therefore, the research presented in the thesis will examine whether the eye-closure instruction is equally effective for retrieval of fine-grain and coarse-grain information, and of central and peripheral information.

2.4.2.3 Accuracy

Some interview procedures, notably hypnosis, have been found to impair the accuracy of eyewitness testimony (see section 2.2). In light of this finding, the research presented in the thesis will examine whether the eye-closure instruction affects testimonial accuracy.

2.4.2.4 Confidence

Certain interview instructions, such as hypnosis and mental context reinstatement, have been found to inflate confidence in incorrect responses (see section 2.2). Therefore, the research presented in the thesis will examine whether eye-closure affects eyewitness confidence.

2.4.2.5 Event Violence

Memory for events is affected by the level of emotional arousal experienced during the event (see section 2.1.3). For this reason, Experiments 1 and 2 will examine whether the eye-closure effect extends to recall of emotionally arousing violent events.

2.4.2.6 Recall Format

The benefits of interview procedures may depend on whether memory is tested in free or cued recall (see section 2.3.1.2). Therefore, Experiments 3 and 6 will examine whether eye-closure improves performance in both free and cued recall.

2.4.2.7 Delay and Repeated Recall

Memory for events is influenced by the passage of time and intervening events (see sections 2.1.2 and 2.1.4). In light of this finding, Experiment 3 will examine whether the benefits of eye-closure are still observed when memory is tested after a delay of a week and repeated retrieval attempts.

2.4.2.8 Ear-Closure

Eye-closure might predominantly improve recall of visual information (see section 2.3.2). Following from this observation, Experiment 4 will examine whether “ear-closure” predominantly improves recall of auditory information.

2.4.2.9 General and Modality-Specific Interference

Eye-closure is likely to have both general and modality-specific influences on recall performance (see section 2.3.2). To test the relative impact of each type of process, Experiment 5 will examine the extent to which sensory distractions have general or modality-specific effects on recall.

2.4.2.10 Ecological Validity

Eye-closure improves recall of mundane live events, when witnesses are interviewed in quiet interview rooms (see section 2.3.1). To enhance the ecological validity of the research, Experiment 6 will examine whether eye-closure improves recall of a forensically relevant live event on the street, with the interview taking place either in a quiet interview room or on the street.

2.4.3 Conclusion

In conclusion, we know that closing the eyes may help us remember, but we do not know whether the effect extends to realistic settings, nor do we have a complete understanding of *why* closing the eyes helps memory. The present thesis was designed to shed more light on applied and theoretical questions concerning the effects of eye-closure on eyewitness memory.

2.5 Chapter Summary

- Eyewitness memory is affected by factors such as the passage of time, the emotional response elicited by the witnessed event, and intervening events such as repeated retrieval and misleading suggestions.
- Various methods have been proposed to help witnesses remember more, most notably the Cognitive Interview. The CI significantly increases the amount of information obtained from witnesses, but police interviewers struggle to implement the procedure in practice.
- A feasible alternative to complex interview procedures could be instructing witnesses to close their eyes. Eye-closure has been found to improve semantic recall, as well as episodic recall of mundane events. The experiments presented in the thesis investigate the eye-closure effect under more realistic conditions.
- The Cognitive Resources framework is proposed to provide a comprehensive explanation of the eye-closure effect, incorporating general and modality-specific impairments in recall performance caused by environmental distractions.

Chapter 3
Memory for Violent Events

3.1 Introduction

This chapter presents two experiments examining the effect of eye-closure on recall of violent events. Experiment 1 investigated whether the eye-closure effect extends to recall of a violent event. Experiment 2 directly compared the eye-closure effect for violent and non-violent events, and incorporated subjective and physiological measures of emotional arousal, and self-report measures of confidence and retrieval strategies.

3.2 Experiment 1: Violent Event

3.2.1 Introduction

The first experiment intended to replicate and extend the findings reported by Perfect et al. (2008). The eye-closure effect was explored in the context of a violent event, and the modality and grain size of the recalled information was examined in more detail.

3.2.1.1 Extension of the Eye-Closure Effect

Perfect et al. (2008) provided evidence that closing the eyes during an investigative interview improves recall of "mundane events about which the police may interview witnesses" (p. 315), such as a commonplace social interaction. However, the police may also interview witnesses about less mundane events, and obtaining information about such events (e.g., violent crime) is often even more important than obtaining information about relatively mundane events. Although Mastroberardino et al. (2010) examined the effect of eye-closure on children's recall of a fairly emotional event, this event was highly unrealistic (a person was eaten by a dinosaur). Hence, the video was probably more entertaining than upsetting, which was reflected in the enthusiastic reactions from the children (S. Mastroberardino, personal communication, September 5, 2009) and in the fact that the clip was rated as suitable for all ages. Thus, research to date has not yet examined the effect of eye-closure on adults' recall of a violent event. Given that recall of violent versus non-violent events seem to involve distinct memorial processes (e.g., Christianson, 1992; Deffenbacher et al., 2004), it is possible that eye-closure has a different impact on recall of violent events than on recall of mundane events. To examine this possibility, the present experiment assessed the effect of eye-closure on recall of a violent event.

3.2.1.2 Modality and Grain Size

An additional aim of the present experiment was to provide more insight into the type of information that is most affected by eye-closure. First, as explained in detail in section 2.3.2.3, the findings obtained by Perfect et al. (2008) were ambivalent concerning the role of information modality in the eye-closure effect. Even though two of their experiments showed eye-closure benefits for recall of visual as well as auditory details (Experiment 4 in terms of both amount and accuracy, and Experiment 5 in terms of amount only); two other experiments showed that eye-closure improved recall of visual details but impaired recall of auditory details (Experiment 2 in terms of both amount and accuracy, and Experiment 3 in terms of accuracy only). Therefore, the interview questions in the present experiment distinguished between uniquely visual and uniquely auditory aspects of the event, to investigate to what extent the benefits of eye-closure are general or modality-specific in nature.

To obtain additional insight into the type of information affected by eye-closure, participants' responses were scored in terms of grain size (e.g., Goldsmith et al., 2002). As explained in section 2.1.2.2, participants strategically control the level of generality at which they choose to answer a question (Goldsmith & Koriat, 1999; Koriat & Goldsmith, 1996; Neisser, 1988). Previous research has shown that eye-closure helps participants to provide more correct responses, but it is unclear whether these responses were correct but vague (*coarse-grain*; e.g., "between 30 and 40 pounds") or correct and specific (*fine-grain*; e.g., "£34.78"). Intuitively, it seems likely that the retrieval of fine-grain information requires some form of mental imagery, for instance, mentally picturing the amount displayed on the bottom of the receipt. Retrieval of coarse-grain information, on the other hand, might be less dependent on mental imagery, for instance, remembering roughly how much one paid for the groceries. Previous research has shown that eye-closure facilitates the use of mental imagery (Caruso & Gino, 2011; Rode et al., 2007; Wais et al., 2010). Therefore, if one assumes that recall of fine-grain information involves a greater degree of mental imagery than recall of coarse-grain information does, then one might expect eye-closure to be more effective for fine-grain recall than for coarse-grain recall.

3.2.1.3 Aims and Hypotheses

The primary goal of the present experiment was to test the effect of eye-closure on recall of a violent event. In addition, it was hypothesised that eye-closure would have the greatest impact on recall of visual (as opposed to auditory) details, and on retrieval of fine-grain (as opposed to coarse-grain) information.

3.2.2 Method

3.2.2.1 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. All experiments presented in this thesis were approved by the Ethics Committee of the Department of Psychology at the University of York, and participants provided informed consent in line with Committee guidelines.

3.2.2.2 Materials

A two-and-a-half-minute video clip was extracted from an episode of the commercial TV series “Six Feet Under” (season 1, episode 12, aired August 2001). The British Board of Film Classification rated this episode as ‘15’ (suitable only for 15 years and over). 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. The interview about the event consisted of 16 questions; half addressing uniquely visual aspects and half addressing uniquely auditory aspects of the event (see Appendix A.1). 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.

3.2.2.3 Pilot

Eight pilot participants watched the video and attempted to answer the original set of 22 questions; 11 about visual details and 11 about auditory details. Based on their performance, 8 questions per category of roughly equivalent difficulty were selected for the main experiment. None of the pilot participants took part in the main experiment.

3.2.2.4 Design

The experiment manipulated two independent variables. The first, interview condition, was a between-subjects variable with two levels: eyes open and eyes closed. The second, question modality, was a within-subjects variable with two levels: visual and auditory. Thus, the study employed a 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed design with repeated measures on the second factor. There were four dependent variables: the total number of correct responses, the number of fine-grain correct responses, the number of coarse-grain correct responses, and the proportion of responses that were correct (i.e., testimonial accuracy).

3.2.2.5 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. Participants were randomly assigned to interview condition. 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.[5] 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.

3.2.2.6 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. 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 Appendix A.1. 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, κ = .92, $p < .001$. The scores of the first coder were retained for the main analysis.

[5] Participants tended to provide more “do not remember” responses for questions about auditory details (M = 1.86, SD = .96) than for questions about visual details (M = .14, SD = .35).

3.2.3 Results

The aim of this experiment was to assess the effects of eye-closure on recall of visual and auditory aspects of a violent event. This section will first outline the results in terms of the total number of correct responses, followed by a separate analysis of the number of fine- and coarse-grain correct responses. Finally, it will assess the proportion of provided responses that were correct.

3.2.3.1 Total Number Correct

The total number of correct responses provided by participants (fine- plus coarse-grain) is displayed in Figure 3.1. Exploratory analyses showed that all assumptions of parametric tests (normality, homogeneity of variance, interval data, and independence) were met[6].

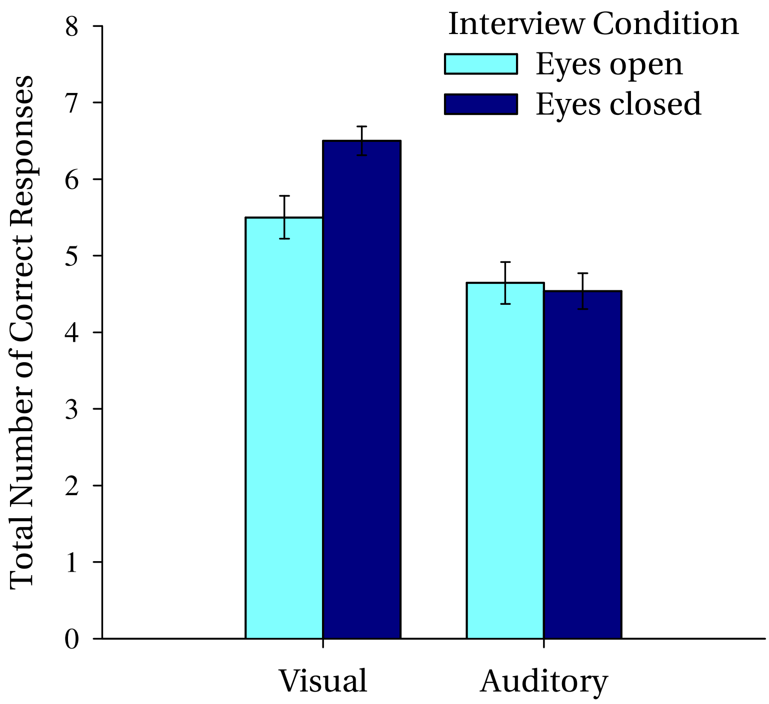


Figure 3.1 Experiment 1: Total number correct. Mean total number of correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed analysis of variance (ANOVA) was conducted on the total number of correct responses. There was a significant main effect

[6] From this point forward, the reader may assume that parametric assumptions were met, unless mentioned otherwise.

of modality, F (1, 54) = 45.46, $p < .001$, $\eta^2 = .43$; despite efforts to match questions about visual and auditory aspects for difficulty, participants gave significantly more correct responses to questions about visual aspects than to questions about auditory aspects (see section 3.4.4 for a discussion of this finding). There was no main effect of eye-closure, F (1, 54) = 2.57, $p = .12$, but there was a significant interaction between eye-closure and modality, F (1, 54) = 7.00, $p < .05$, $\eta^2 = .07$. Simple effects analyses showed that participants who closed their eyes remembered significantly more correct visual aspects than participants who kept their eyes open, F (1, 54) = 8.79, $p < .01$, $\eta^2 = .14$, $d = .79$, whereas the difference was not significant for auditory aspects ($F < 1$).[7]

3.2.3.2 Fine-Grain Correct

Next, the number of correct responses was separated into fine-grain and coarse-grain correct responses. Figure 3.2 shows the number of fine-grain correct responses provided by participants.

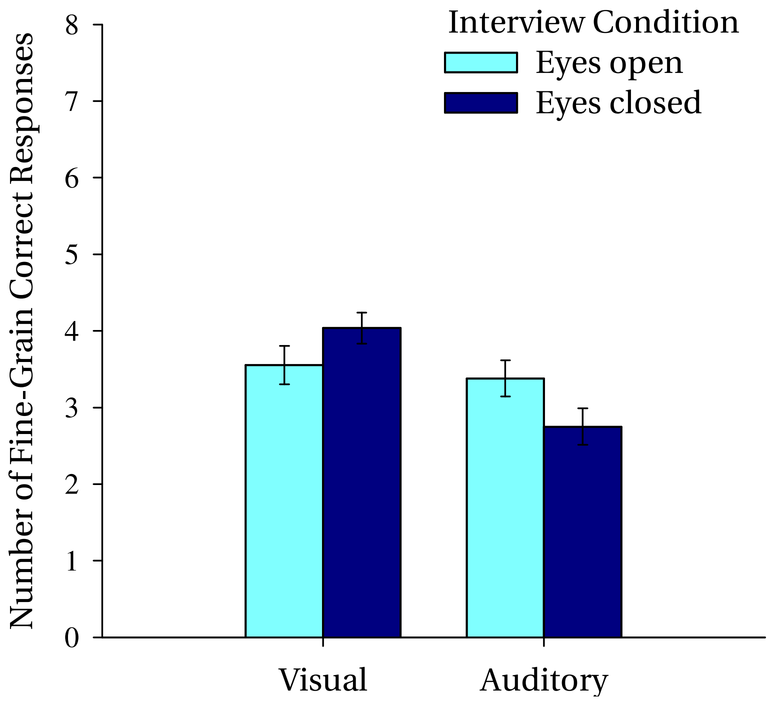


Figure 3.2 Experiment 1: Fine-grain correct. Mean number of fine-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

[7] Although η^2 will be the preferred estimate of effect size for significant effects throughout this thesis (cf. Levine & Hullett, 2002), I will also provide Cohen's *d* for the eye-closure effects only, to allow for comparisons with previous research reporting this statistic.

The fine-grain correct recall data violated the assumption of homogeneity of variance (Levene, 1960), and data transformations did not solve the problem. Therefore, non-parametric tests were also performed, with results confirming the findings reported below (see Appendix B.2). A 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed ANOVA on fine-grain correct responses revealed a significant main effect of question modality, $F(1, 54) = 12.65$, $p < .001$, $\eta^2 = .17$, in the same direction as described for the total number of correct responses. There was again no significant main effect of eye-closure ($F < 1$), but a significant interaction between eye-closure and modality, $F(1, 54) = 6.46$, $p < .05$, $\eta^2 = .09$. Figure 3.2 suggests that eye-closure tended to increase the number of fine-grain correct responses to questions about visual aspects and decrease the number of fine-grain correct responses to questions about auditory aspects, but simple effects analyses showed that neither of these contrasts was significant (both *p*s > .08).

3.2.3.3 Coarse-Grain Correct

The number of coarse-grain correct responses is shown in Figure 3.3.

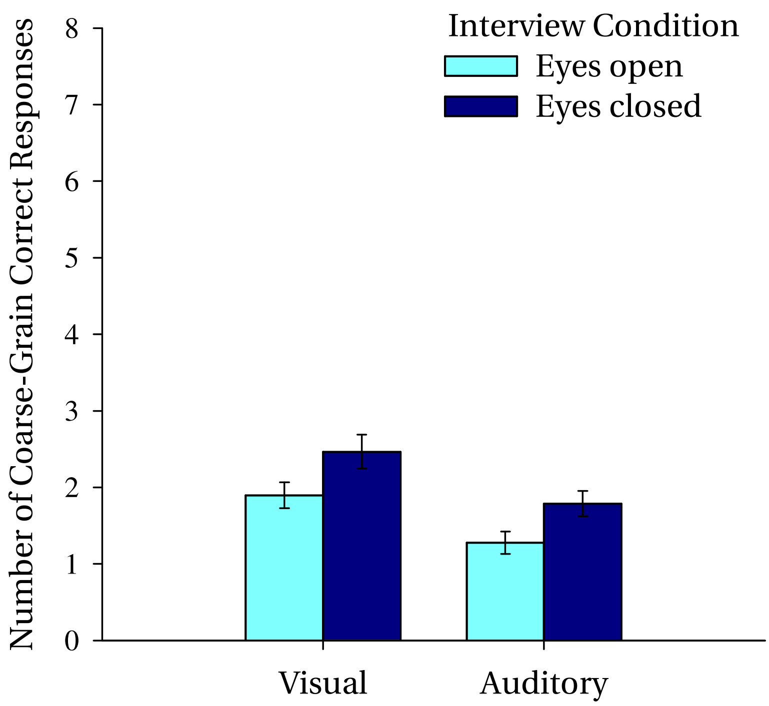


Figure 3.3 Experiment 1: Coarse-grain correct. Mean number of coarse-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed ANOVA on coarse-grain correct responses showed a main effect of modality in the same direction as described above, F (1, 54) = 13.68, $p < .001$, $\eta^2 = .20$. Furthermore, there was a significant main effect of eye-closure, F (1, 54) = 8.28, $p < .01$, $\eta^2 = .15$, $d = .77$, and no significant interaction between eye-closure and modality ($F < 1$). Thus, participants who closed their eyes volunteered significantly more correct coarse-grain responses than participants with their eyes open, pertaining to both visual and auditory aspects of the witnessed event.

3.2.3.4 Proportion Correct

On average, participants answered 3.41 out of 16 questions incorrectly (*SD* = 1.87). Examples of inaccurate responses are provided in Appendix A.1, and the nature of these errors will be addressed in the Discussion. Testimonial accuracy was calculated by dividing the total number of correct responses (fine-grain plus coarse-grain) by the total number of answered questions (correct plus incorrect responses). Proportion correct in all conditions is shown in Figure 3.4.

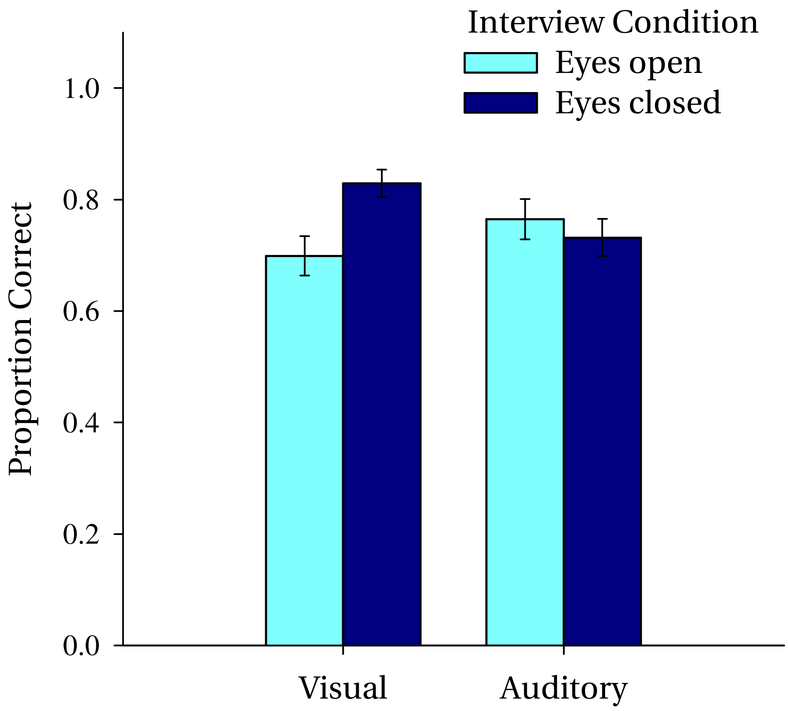


Figure 3.4 Experiment 1: Proportion correct. Mean proportion of responses that were correct for questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed ANOVA on the proportion of correct answers revealed no main effects of modality ($F < 1$) or eye-closure, $F(1, 54) = 1.74$, $p = .19$. There was, however, a significant interaction between eye-closure and modality, $F(1, 54) = 8.54$, $p < .01$, $\eta^2 = .14$. Simple effects analyses showed that eye-closure significantly increased proportion correct for questions about visual aspects, $F(1, 54) = 9.15$, $p < .01$, $\eta^2 = .14$, $d = .81$, but did not significantly affect proportion correct for questions about auditory aspects ($F < 1$).

3.2.4 Discussion

The primary goal of the present experiment was to extend the eye-closure effect to recall of a violent event. This goal was partially achieved. In terms of the total number of correct responses, eye-closure had no significant effect overall, but significantly increased correct recall of the visual aspects of the violent event. In terms of grain size, eye-closure increased fine-grain correct recall only for visual details, but increased coarse-grain correct recall for both visual and auditory details. Finally, in terms of testimonial accuracy, eye-closure had no significant main effect, but significantly increased proportion correct for questions about visual details only. This section will first address the role of grain size and modality, after which limitations of the experiment will be discussed.

3.2.4.1 Modality and Grain Size

The finding that eye-closure increased fine-grain correct recall of visual, but not auditory, aspects of the event is consistent with the idea that eye-closure facilitates visual imagery (Rode et al., 2007; Wais et al., 2010). Thus, it seems that eye-closure helped participants in the present study to retrieve a mental image of detailed aspects of the event (e.g., the exact appearance of the perpetrator's shirt), thereby enhancing retrieval of correct fine-grain visual information. This speculative interpretation of the findings will be examined with self-report measures in the next experiment.

Unexpectedly, eye-closure also increased the number of correct coarse-grain responses reported by participants, and this effect was observed 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, Andrade, & Eagan, 2011; Perfect et al., 2008). Thus, the present findings seem to suggest that both modality-specific and general processes play a role in the eye-closure effect, as described in the Cognitive Resources framework in section 2.3.2.4. This topic will be addressed in more detail in Chapter 5. In addition, the present findings suggest that it is useful to distinguish between fine-grain and coarse-grain responses (cf. Goldsmith et al., 2002), since eye-closure had a different impact on each type of recall.

3.2.4.2 Nature of False Memories

Although participants generally did not volunteer many incorrect responses, the nature of some of these responses was surprisingly consistent across participants. For instance, a substantial number of participants reported that the man cut the woman's dress with his knife (whereas he actually ripped it with his hands), and that he told her that he was going to kill her (whereas he actually said that it would hurt; see Appendix A.1). Thus, certain false memories were shared among many participants, potentially pointing to the existence of common event scripts (see section 2.1.2.3), and this tendency was predominantly observed for violent actions. This issue will be addressed in more detail in section 3.4.2.

3.2.4.3 Limitations

As explained in section 2.1.3, the quality of one's memory for an event likely depends on the emotional response elicited by that event. Although the to-be-remembered event used in the present experiment was selected to be more violent than the events used by Perfect et al., (2008) it is not clear whether the video elicited an orienting response or a defensive response in the participants. To be more confident that the present findings will generalise to real-world eyewitness contexts, it is imperative to establish whether the violent event succeeded in eliciting an emotional response that approximates the emotional response experienced by real eyewitnesses of violent crime (although laboratory studies are unlikely to elicit an emotional response as strong as the response elicited by violent events in real life). To provide more insight into the emotional response generated by violent videos, the next experiment included subjective and physiological measures of emotional arousal. In addition, given that the effect of arousal on memory may depend on the centrality of the to-be-remembered information (cf. Christianson, 1992), the next experiment distinguished between questions addressing central aspects of the event and questions addressing peripheral aspects.

3.2.4.4 Conclusion

The present findings suggest that instructed eye-closure may be a useful tool for interviewing witnesses about a violent event. Eye-closure increased the number of correct coarse-grain responses about both visual and auditory aspects of the event, and increased the number of correct fine-grain responses and testimonial accuracy for visual aspects of the event. The broader implications of these findings will be discussed in the General Discussion of this chapter. We now turn to the second experiment, in which the effect of eye-closure on recall of violent and non-violent events was compared.

3.3 Experiment 2: Emotional Arousal

3.3.1 Introduction

In the first experiment, the eye-closure effect was successfully extended to recall of a violent event. However, Experiment 1 did not confirm whether the violent event elicited emotional arousal in the participants. Furthermore, it was unclear whether the eye-closure effect would generalise to different violent and non-violent events. The present experiment investigated these questions, and included additional measures of interest, such as confidence and self-reported retrieval strategies. Each of these issues will be discussed in turn below.

3.3.1.1 Emotional Arousal

As explained in section 2.1.3, real-world events have the potential to elicit two different physiological responses in the viewer. If the viewer's reaction is predominantly one of interest, this will likely be reflected in an orienting response, which is associated with increased electrodermal activity (EDA) and decreased heart rate. If the event is perceived to be threatening, however, this will likely be reflected in a defensive response, which is associated with increased EDA and increased heart rate. In previous research, some studies have found that videos or slides depicting violence or injuries evoked an orienting response (e.g., Burke et al., 1992; Christianson, 1984; Heuer & Reisberg, 1992; Palomba, Angrilli, & Mini, 1997; van Stegeren, Everaerd, Cahill, McGaugh, & Gooren, 1998), whereas other studies have found that similar stimuli elicited a defensive response (e.g., Christianson, 1987; Christianson & Nilsson, 1984; Mordkoff, 1964; Steptoe & Vögele, 1986).

To assess what type of emotional response was elicited by the violent and non-violent events in the present study, a number of subjective and physiological measures were included. First, a self-report measure of emotional arousal was included, asking participants to indicate how violent, upsetting, emotional, and interesting they had found each video (cf. Clifford & Scott, 1978; Heuer & Reisberg, 1990; Loftus & Burns, 1982; Read, Yuille, & Tollestrup, 1992). Second, skin conductance response (SCR; also known as galvanic skin response), was recorded to measure participants' EDA before and during the videos (cf. Dawson et al., 2000). EDA has been described as a method that "may unambiguously reflect primary arousal" (Hubert & De Jong-Meyer, 1990, p. 88). It was hypothesised that EDA would be higher while watching the videos than during the baseline period, and that it would be higher while watching the violent videos compared to the non-violent videos. Although EDA provides an indication of the level of physiological arousal experienced by participants, it does not distinguish between the defensive and the orienting response, since both are associated with increased EDA (Christianson, 1992; Deffenbacher et al., 2004; Lacey & Lacey, 1970, 1974).

Therefore, heart rate variability (HRV) measures were taken to assess participants' cardiovascular response to the videos. HRV assesses the interplay between sympathetic and parasympathetic influences described in section

2.1.3, which "yields information about autonomic flexibility and thereby represents the capacity for regulated emotional responding" (Appelhans & Luecken, 2006, p. 230). In the current study, HRV analysis was conducted on blood volume measurement obtained with photoplethysmography (PPG), which measures changes in blood volume in the blood vessels close to the surface of the skin (Murthy, Ramamoorthy, Srinivasan, Rajagopal, & Rao, 2001). Selvaraj, Jaryal, Santhish, Deepak and Anand (2008) have shown that the peak-to-peak intervals derived from PPG can be used to reliably estimate heart rate. It was expected that participants would exhibit an increase in heart rate while watching the videos compared to the baseline period before watching the videos. However, in light of the inconsistent findings in previous research, it was unclear whether the violent videos in the present study would increase or decrease heart rate compared to the non-violent videos.

3.3.1.2 Comparison of Violent and Non-Violent Events

If the violent videos in the present study elicit a defensive response, overall recall is expected to be impaired for violent events compared to non-violent events (Deffenbacher et al., 2004). If, on the other hand, the violent videos elicit an orienting response, recall of peripheral details is expected to be impaired, whereas recall of central details is expected to be improved compared to the non-violent videos (Christianson, 1992). To distinguish between these potential effects, interview questions in the present study addressed either central or peripheral aspects of the event. Centrality was determined based on plot relevance, defined by Heuer and Reisberg (1990) as "any fact or element pertaining to the basic story that could not be changed or excluded without changing the basic story line" (p. 499; see also Rosch, 1978). Appendix A.2 provides an overview of all questions used in the present experiment, categorised based on centrality and modality.

Although eye-closure has been found to be effective for recall of mundane events (Perfect et al., 2008) as well as for recall of a violent event (Experiment 1), it is unclear whether it is more effective for recall of non-violent or violent events. The mundane events used by Perfect et al. could not be directly compared to the violent event used in Experiment 1, because the nature of the events was not comparable. The present study was designed to compare violent and non-violent events that were similar in nearly all respects (e.g., plot, setting, characters), except the level of violence. Knowing which type of event benefits most from the eye-closure instruction will allow us to provide more specific recommendations to investigative interviewers regarding the use of the eye-closure instruction in interviews about violent and non-violent crime.

Based on the literature on mood congruency (see section 2.2.3.1), it might be hypothesised that eye-closure will be more effective for recall of violent events than for recall of non-violent events. First, it has consistently been shown that memories about negative emotional events, such as violent crime, are most likely to be retrieved if the rememberer is in a negative emotional mood during retrieval (e.g., Blaney, 1986; Bower, 1981; Madigan & Bollenbach, 1982; Snyder & White, 1982). Second, there are some indications that eye-closure intensifies negative emotional mood.[8] Caruso and Gino (2011) found that unethical scenarios were judged as more unethical when participants had their eyes closed. They showed that eye-closure facilitated vivid mental simulation of the scenarios, resulting in more intense negative emotions (measured by self-report). In a similar vein, Lerner, Papo, Zhdanov, Belozersky, and Hendler (2009) found that eye-closure increased the intensity of emotions experienced while listening to negative emotional music. These findings provide an interesting parallel to previous research showing that eye movements and visually-based tasks can potentially reduce the vividness of emotionally-laden mental images, for instance in PTSD patients (Andrade, Kavanagh, & Baddeley, 1997; van den Hout, Muris, Salemink, & Kindt, 2001) or during cravings of cigarettes and food (Kemps, Tiggemann, Woods, & Soekov, 2004; Panabokke, May, Eade, Andrade, & Kavanagh, 2004). In sum, closing the eyes has the potential to intensify (negative) emotional moods experienced during the interview, and this enhanced emotionality is likely to benefit recall of emotionally-laden events (e.g., violent events), as opposed to emotionally-neutral events (e.g., non-violent events; see Ginet & Verkampt, 2007, for a similar argument pertaining to the Cognitive Interview).

[8] Eye-closure might also intensify positive emotions, but research to date has primarily focussed on negative emotions.

3.3.1.3 Modality and Grain Size

The interview questions used in the present study again addressed either uniquely visual or uniquely auditory aspects of the event, and all correct responses were scored for grain size. In line with the findings from Experiment 1, it was expected that eye-closure would enhance fine-grain recall of visual but not auditory details, and that it would increase coarse-grain recall irrespective of question modality.

3.3.1.4 Confidence

In Experiment 1, participants' confidence in their responses was not assessed. However, eyewitness confidence may play an important role in legal cases, because jurors and judges tend to rely heavily on expressed levels of confidence to determine whether a witness's testimony is accurate (Cutler et al., 1990; Wells et al., 1979; Wheatcroft et al., 2004). For instance, Cutler et al. found that jurors were considerably more likely to judge an identification decision as reliable and the suspect as guilty if the witness said she was 100% (as opposed to 80%) confident that she had correctly identified the robber. In reality, however, correlations between eyewitness confidence and identification accuracy tend to be weak (Bothwell, Deffenbacher, & Brigham, 1987; Cutler, Penrod, & Martens, 1987b; Sporer, Penrod, Read, & Cutler, 1995). To assess the correlation between confidence and accuracy of responses about the witnessed event in the present experiment, participants were asked to rate the level of confidence in each of their responses on a scale from 1 (not confident at all) to 5 (extremely confident).

Given that the witness's expressed level of confidence may influence how jurors perceive the reliability of her testimony, it is important that investigative interview techniques do not impair the correlation between confidence and accuracy. As we have seen in section 2.2.2, hypnosis tends to inflate witness confidence in incorrect responses (Dywan & Bowers, 1983; Sheehan et al., 1984; Zelig & Beidleman, 1981). Research to date on the effect of mental context reinstatement on the confidence-accuracy (CA) correlation has been inconclusive (Hammond et al., 2006; Krafka & Penrod, 1985). Finally, evidence suggests that the Cognitive Interview does not inflate confidence

(Allwood et al., 2005; Granhag et al., 2004; Gwyer & Clifford, 1997; McMahon, 2000; Mello & Fisher, 1996).

With respect to the eye-closure instruction, the only previous studies that included a measure of witness confidence were those conducted by Wagstaff and colleagues. Wagstaff et al. (2004) analysed three sets of CA correlations, one per type of question (free-recall, names, and closed questions). They examined the correlation between the average confidence rating per question category provided by each participant, and his or her total correct score for that question category. The CA correlation was only significant for the closed-question category, and eye-closure tended to increase the correlation (the CA correlation was .57 for the eyes-open group and .74 for the eyes-closed group)[9]. This finding suggests that participants who generally gave high confidence ratings in the closed-question category were generally accurate in that category. Wagstaff et al. (2010) opted for a different approach to analysing the effect of eye-closure on eyewitness confidence: instead of assessing CA correlations, they computed the mean confidence rating in correct responses and incorrect responses, respectively. They found that mean confidence was significantly higher for correct responses than for incorrect responses, and that eye-closure did not affect either type of confidence rating.

The relationship between confidence and accuracy in the present study will be examined in four different ways. First, like Wagstaff et al. (2010), I will examine average confidence in correct and incorrect responses. Second, like Wagstaff et al. (2004), I will examine whether a generally confident rememberer is also a generally accurate rememberer. Third, I will examine whether a *particular* response given with high confidence is also likely to be accurate. Fourth, to assess potential effects that may not be revealed in CA correlations, a calibration technique will be used (cf. Brewer & Day, 2005; Juslin, Olsson, & Winman, 1996; Olsson, 2000). This technique involves plotting the subjective probability that a response is correct (i.e., the confidence rating) against the objective probability that the response is

[9] Wagstaff et al. (2004) do not report whether the difference between these correlation coefficients is significant, although in stating that "C-A relationships were more or less unaffected by the FM and eye-closure manipulations" (p. 444), they imply that the difference was non-significant.

correct (i.e., the accuracy of the response). In light of Wagstaff et al.'s findings, eye-closure was not expected to significantly affect any of the confidence measures.

3.3.1.5 Retrieval Strategies

In Experiment 1, eye-closure increased fine-grain correct recall of visual details. To explain this finding, it was speculated that eye-closure may have facilitated visual imagery, allowing for the retrieval of detailed visual information. To test this interpretation of the findings more directly, self-report measures of retrieval strategies were included in the present experiment (see Appendix C).[10] In line with previous findings (Rode et al., 2007; Wais et al., 2010), it was hypothesised that participants in the eyes-closed condition would be more likely to report using visual imagery than participants in the eyes-open condition. Furthermore, it was expected that participants who reported using visual or auditory imagery would exhibit superior recall performance compared to participants who did not report using mental imagery (cf. Carlson, Kincaid, Lance, & Hodgson, 1976; Wang & Thomas, 2000).

3.3.1.6 Aims and Hypotheses

The primary aims of the present study were to assess the emotional response generated by the violent events, and to examine whether eye-closure was more or less effective for violent compared to non-violent events. In line with previous research, the violent videos were expected to increase electrodermal activity in the participants, but it was not clear how they would affect heart rate. In light of the findings that eye-closure has the potential to induce negative emotional mood (e.g., Lerner et al., 2009), it was hypothesised that eye-closure would be more effective for recall of violent events than for recall of non-violent events. Secondary aims were to assess eyewitness confidence and self-reported retrieval strategies. It was hypothesised that eye-closure would not affect confidence ratings, but that it would increase the self-reported use of visual imagery.

[10] I am grateful to Graham Davies for this idea.

3.3.2 Method

3.3.2.1 Participants

Fifty-six students from the University of York participated in the study for course credit or a small monetary reward. The sample consisted of 11 males and 45 females, with ages ranging from 18 to 29 (M = 19.91, SD = 2.47). All participants were native English speakers and had normal or corrected-to-normal vision and hearing.

3.3.2.2 Materials

One violent and one non-violent version were created for two episodes of different TV series ("Lost", season 3, episode 11; and "Survivors", season 1, episode 4). The British Board of Film Classification rated the "Lost" episode as suitable for 12 years and over and the "Survivors" episode as suitable for 15 years and over. Each of the video clips was eight minutes in duration. Figure 3.5 illustrates the video editing process for the "Lost" episode.

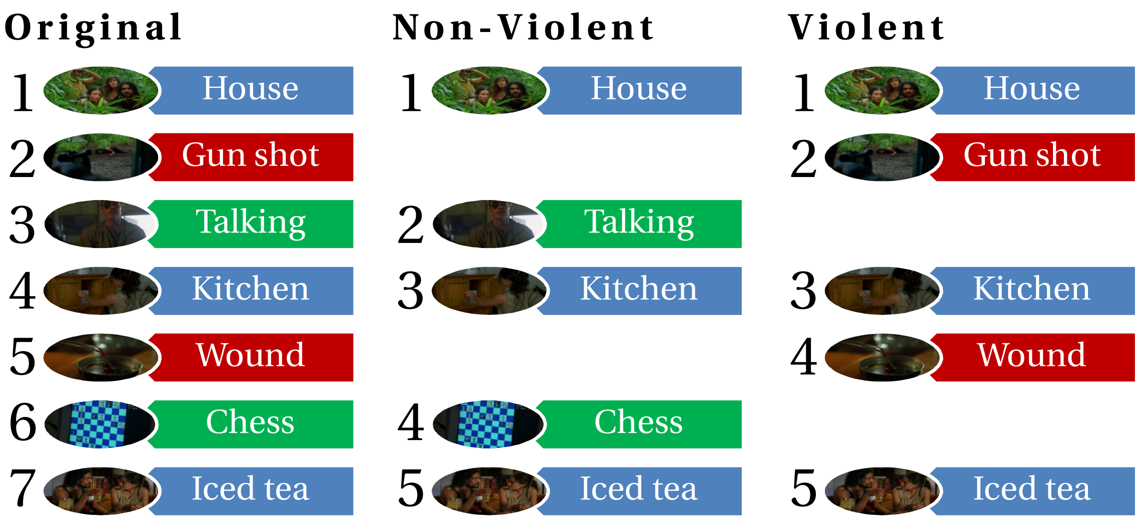


Figure 3.5 Video editing process. Schematic representation of the transformation from the original version of the "Lost" episode to the non-violent and violent versions. The scenes depicted in blue and green were non-violent, whereas the scenes depicted in red involved violence or injury.

The "Lost" video involved four survivors of a plane crash on a deserted island, who discover a house. In both versions of the video, they go into the house, explore the rooms and interact with the resident. In the violent version, one man gets shot by a rifle, the wound is stitched up, and a physical fight breaks out. In the non-violent version, the scenes containing violence and injury were replaced with other scenes of the survivors exploring the house and interacting with the resident. The "Survivors" video involved a woman who is looking for her missing son and thinks he might be among a group of boys living in a house in the forest. Both versions of the video contained scenes in the forest and in the house, and showed interactions between the woman, the boys, and a man who is helping the woman. In the violent version, the man gets shot by an arrow, the wound is stitched up, and a physical fight breaks out. In the non-violent version, the scenes containing violence and injury were replaced with other scenes of the woman and the man exploring the forest, and interactions with the boys. In editing the video clips, every effort was made to maintain the story line of the event.

There were four question categories: visual-central, visual-peripheral, auditory-central, and auditory-peripheral (see Appendix A.2 for all questions listed per category for each video). Centrality was established based on plot relevance (Heuer & Reisberg, 1990)[11]. 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.

3.3.2.3 Pilot

A pilot study was conducted to select interview questions of equivalent difficulty within each question category for the violent and non-violent versions of the videos. Eight pilot participants watched the videos and attempted to answer the original set of 24 questions. In addition, they were asked to tell the experimenter about the strategies they had used to retrieve the information. Based on their performance, five questions were selected for

[11] An alternative distinction was also assessed, in which central details for the violent videos were defined as those central to the violence itself (i.e., the likely source of the emotional arousal; cf. Christianson & Safer, 1996; Safer, Christianson, Autry, & Österlund, 1998). However, this alternative distinction revealed the same data pattern as the plot relevance distinction. Therefore, only the latter findings are reported here.

each of the four question categories, and a list of potential retrieval strategies was constructed for the main experiment (see Appendix C). None of the pilot participants took part in the main experiment.

3.3.2.4 Physiological Measures

Electrodermal activity (EDA) and photoplethysmography (PPG) measurements were used as physiological correlates of the level of emotional arousal experienced by participants. The physiological responses were monitored using a MP36 system (BIOPAC Systems, Inc., Goleta, CA) and analysed with BIOPAC software Acq*Knowledge* 3.9.2 for Mac OS X. EDA was sampled at 1000 Hz using disposable electrodermal gel electrodes (BIOPAC model EL507) attached to the distal phalanx of the index and middle fingers of the participant's non-dominant hand. Participants were asked to wash their hands with water and dry them gently before the electrodes were attached. A constant voltage (.5 V) was used to measure skin conductance (cf. Fowles et al., 1981). EDA was digitized at the electrodes and a 1 Hz filter applied (Gain 2 μmho/V). Skin conductance responses were located using a threshold level of .15 μmho (with the exception of two recordings that contained a lot of noise, for which threshold levels of .20 μmho and .25 μmho were applied). The PPG was sampled at 1000 Hz using a BIOPAC SS4L PPG finger transducer attached to the distal phalanx of the thumb of the participant's non-dominant hand. PPG signals were high-pass filtered at .5 Hz to obtain a stable baseline with level peaks and no drift. Peaks were detected automatically using a threshold level fixed at zero. The automatic detections were verified visually and corrected in case of misdetection.

3.3.2.5 Design

The experiment manipulated one between-subjects independent variable (eye-closure) and three within-subjects independent variables (the type of video, question modality, and question centrality). The experiment comprised a 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Question Modality: visual, auditory) x 2 (Question Centrality: central, peripheral) mixed design with repeated measures on the last three factors. The dependent variables were identical to Experiment 1.

3.3.2.6 Procedure

In the announcement calling for participants, it was stated that the aim of the experiment was "to investigate people's physiological patterns while they are watching violent TV". Participants were informed that physiological measurements would be taken throughout the session. All participants were tested individually in a dimly lit room. A curtain separated them from the experimenter during the experimental stages in which no interaction was required. Participants signed an informed consent form and were asked to wash their hands, after which the EDA electrodes and the PPG transducer were attached. Participants were first asked to engage in a word finder filler task for five minutes in order to allow stabilisation of hydration under the electrodes. After the task, participants were instructed to just sit and relax for two minutes while a baseline measure was taken.

During the session, participants watched two videos, one violent and one non-violent version. Videos were counterbalanced as shown in Figure 3.6. After the first baseline, participants were informed that they would watch a video about which they would be asked questions afterwards.[12] After watching the video, they engaged in another word finder task for two minutes. Subsequently, the interviewer asked them 20 questions about the first video. Participants were randomly assigned to receive either an instruction to keep their eyes closed throughout the interview, or no instruction. They were asked to remember as much as possible, but not to guess: a "don't know" response was allowed. They responded orally to the questions, and indicated their level of confidence in their responses on a five-point scale, ranging from 1 (not confident at all) to 5 (extremely confident). After the interview questions, participants were asked to rate on a five-point scale how emotional, interesting, violent, and upsetting they had found the first video.

[12]The reason for informing participants that they would be asked questions about the video was to prevent any differences between the first and the second video relating to expectations of being tested (i.e., incidental versus intentional learning, see McLaughlin, 1965; Neill, Beck, Bottalico, & Molloy, 1990; but also see Postman, 1964).

Figure 3.6 Video counter-balancing. Violence level of videos was a within-subjects variable. Participants were randomly assigned to one of the four counterbalancing conditions.

The procedure was then repeated for the second video (i.e., a second baseline was taken, participants watched the second video, engaged in another two-minute filler task, and were interviewed about the second video). All interviews were audio-taped for subsequent analysis. At the end of the interview about the second video, participants completed a demographic information sheet and a retrieval strategies form (see Appendix C). The form provided a list of possible strategies that had been mentioned by the eight pilot participants. It also included the option to list other strategies that were not on the list. Finally, it asked the participant's opinion on whether eye-closure had helped (eyes-closed condition) or would have helped (eyes-open condition) in remembering the visual and auditory information, respectively. At the end of the experiment, participants were asked whether they had seen either of the TV episodes before (none of them indicated that they had), and were debriefed and thanked for their participation.

3.3.2.7 Data Coding

The audio-taped interviews were coded blind to interview condition. Responses could be coded as correct, incorrect, or omitted, and all correct responses were coded for grain size as in Experiment 1 (see section 3.2.2.6). Examples of each type of response for the violent version of the "Lost" episode are provided in Appendix A.2. For each of the four video clips, the responses of 5 randomly selected participants were double-coded by an independent coder (i.e., 100 responses per video; 400 responses in total; 18% of the total sample). Inter-rater reliability (for the decision to score a response as fine-grain correct, coarse-grain correct, incorrect, or omitted) was high, $\kappa = .95$, $p < .001$. The scores of the first coder were retained for the main analysis.

3.3.3 Results

This section will first report the findings of the subjective and physiological measures of emotional arousal. It will then outline the findings with respect to number correct, fine-grain correct, coarse-grain correct, and proportion correct. Subsequently, it will examine correlations between the measures of emotional arousal and recall performance. Finally, it will discuss the findings pertaining to confidence ratings and self-reported retrieval strategies.

3.3.3.1 Subjective Ratings of Arousal

The average self-report ratings of emotional arousal for the violent and non-violent videos are displayed in Table 3.1.

Table 3.1 Experiment 2: Self-reported emotional arousal. Mean ratings of the videos on a scale from 1 (not at all) to 5 (very much).

	Type of Video	
Rating	Non-violent (N = 56)	Violent (N = 56)
How violent?	1.77 (.10)	3.63 (.11)
How upsetting?	1.61 (.11)	2.14 (.11)
How emotional?	3.00 (.13)	3.29 (.11)
How interesting?	3.61 (.12)	4.09 (.09)

Note. Standard errors in parentheses.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Type of Rating: violent, upsetting, emotional, interesting) mixed ANOVA revealed significant main effects of type of video, F

(1, 54) = 88.05, $p < .001$, $\eta^2 = .13$, and type of rating, F (3, 162) = 133.37, $p < .001$, $\eta^2 = .42$, but no significant effect of eye-closure ($F < 1$). There was a significant interaction between type of video and type of rating[13], F (2.67, 144.33) = 33.92, $p < .001$, $\eta^2 = .08$, but no other significant interactions (all *p*s > .27). Simple effects analyses showed that the violent videos were rated as significantly more violent, F (1, 54) = 214.73, $p < .001$, $\eta^2 = .80$, more upsetting, F (1, 54) = 16.11, $p < .001$, $\eta^2 = .23$, and more interesting, F (1, 54) = 13.27, $p < .001$, $\eta^2 = .20$, and as marginally more emotional, F (1, 54) = 3.59, $p = .06$, $\eta^2 = .06$, than the non-violent videos. Taken together, the self-report ratings suggest that the violence manipulation was successful: participants rated the violent videos as more violent and more upsetting than the non-violent videos.

3.3.3.2 Skin Conductance Responses

Due to difficulties with initially defective equipment, physiological responses were recorded for only 29 of the 56 participants. In line with Prokasy and Kumpfer's (1973) recommendations, frequency and amplitude of skin conductance responses (SCRs) were assessed separately. A preliminary 2 (Presentation Order: first, second) x 2 (Phase Type: baseline, video) x 2 (Video Condition: neutral-violent, violent-neutral) mixed ANOVA revealed no significant order effects for SCR frequency. The same analysis for SCR amplitude revealed that mean amplitude was significantly higher during the first half of the experiment than during the second half, F (1, 21) = 18.67, $p < .001$, $\eta^2 = .47$, but presentation order did not interact with phase type or video condition. Therefore, the data were collapsed over video condition to increase statistical power. Thus, skin conductance responses were compared in four experimental phases: the baseline preceding the non-violent video (NV base), the non-violent video (NV video), the baseline preceding the violent video (V base), and the violent video (V video). Figure 3.7 shows the average frequency and amplitude of evoked SCRs during each of the experimental phases.

[13] Because Mauchly's test indicated that the assumption of sphericity had been violated for the interaction between type of video and type of rating ($\chi^2(5) = 12.35$, $p = .03$), degrees of freedom were corrected using the Greenhouse-Geisser estimate of sphericity ($\varepsilon = .79$).

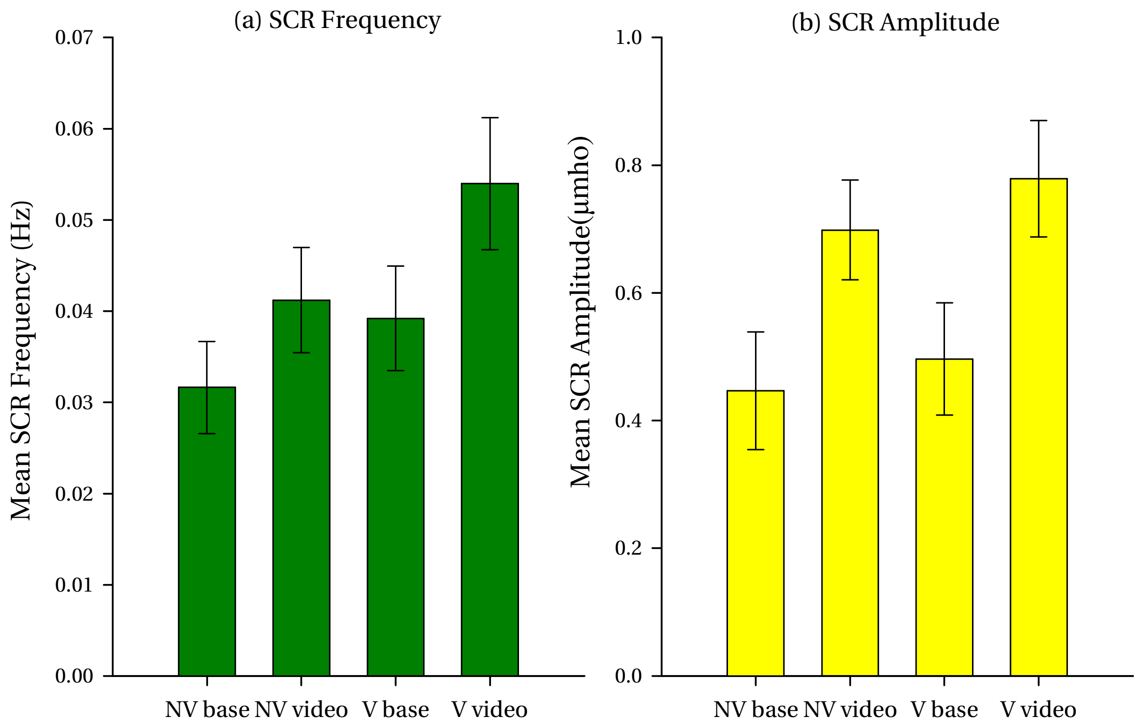


Figure 3.7 Experiment 2: Skin conductance responses. The average a) frequency (in Hz) and b) amplitude (in µmho) of SCRs, during the four different experimental phases: baseline preceding non-violent video (NV base), non-violent video (NV video), baseline preceding violent video (V base), and violent video (V video). Error bars represent standard errors.

A 4 (Experimental Phase: NV base, NV video, V base, V video) repeated measures ANOVA on the frequency of SCRs revealed a significant main effect of experimental phase, F (3, 84) = 6.15, $p < .001$, $\eta^2 = .07$. Planned contrasts showed that SCRs were marginally more frequent during the non-violent video than during the baseline preceding the non-violent video, F (1, 28) = 3.79, $p = .06$, $\eta^2 = .13$, and significantly more frequent during the violent video than during the baseline preceding the violent video, F (1, 28) = 7.60, $p < .05$, $\eta^2 = .21$. The two baseline periods did not differ significantly, F (1, 28) = 3.19, $p = .09$, but SCRs were significantly more frequent during the violent video than during the non-violent video, F (1, 28) = 5.31, $p < .05$, $\eta^2 = .17$.

The same ANOVA on the square-root transformed amplitude of SCRs also revealed a significant main effect of experimental phase[14], F (1.82, 40.06) =

[14] A square root transformation was used to normalise the distribution of the amplitude data (Dawson et al., 2000). After transformation, there was still one significant outlier on all of the amplitude measures, therefore the original values of this participant were replaced by the mean plus two standard deviations (cf. Field, 2004). For the ANOVA, Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(5) = 23.87$, $p < .001$), therefore degrees of freedom were corrected using the Greenhouse-Geisser estimate of sphericity ($\varepsilon = .61$).

8.14, p = .001, η^2 = .27. Planned contrasts showed that the average amplitude was significantly higher during the non-violent video than during the baseline period preceding the non-violent video, F (1, 22) = 18.14, p < .001, η^2 = .45, and also significantly higher during the violent video than during the baseline period preceding the violent video, F (1, 22) = 30.29, p < .001, η^2 = .58. There were no significant differences between the two baseline periods (F < 1) or between the two videos (F < 1).

In sum, both types of video increased electrodermal activity compared to the baseline periods. Furthermore, skin conductance responses were significantly more frequent (but not higher in amplitude) during the violent video than during the non-violent video. It was also examined whether the electrodermal measures of emotional arousal correlated with subjective ratings of emotional arousal and interest. To increase power, the three ratings assessing emotional arousal (violent, upsetting, and emotional) were collapsed into one emotional-arousal score (ranging from 3 to 15). Bonferroni corrections were applied to control for Type I error for the two comparisons (i.e., emotional-arousal and interest ratings; α = .025). However, neither frequency nor amplitude of SCRs was significantly correlated with the emotional-arousal score or with interest rating (all *p*s > .22). Thus, subjective ratings of emotional arousal did not reflect electrodermal-activity indicators of physiological arousal.

3.3.3.3 Heart Rate Variability

Peak-to-peak intervals obtained with HRV analysis were converted into heart rate in beats per minute (BPM) to allow for comparisons with previous research on emotion and memory (e.g., Burke et al., 1992; Christianson, 1984, 1987; Read et al., 1992). Heart rate was 58 BPM on average during the baseline preceding the non-violent video, 61 BPM during the non-violent video, 60 BPM during the baseline preceding the violent video, and 61 BPM during the violent video. A 4 (Experimental Phase: NV base, NV video, V base, V video) repeated measures ANOVA on heart rate did not reveal a significant effect of experimental phase (F < 1). In addition, heart rate during the videos did not correlate significantly with self-report ratings of emotional arousal or interest (all *p*s > .29).

The HRV analysis also provided estimates of sympathetic activity, parasympathetic (vagal) activity, "sympathovagal balance" (Eckberg, 1997; Pagani et al., 1986), and power in the very low frequency (VLF; .00 Hz to .04 Hz), low frequency (LF; .04 Hz to .15 Hz), high frequency (HF; .15 Hz to .4 Hz), and very high frequency (VHF; .40 Hz to 3.00 Hz) domains. Briefly, power in the high frequency bands reflects parasympathetic activity, whereas power in the low frequency bands is thought to correspond mainly to sympathetic activity (Murthy et al., 2001; Selvaraj et al., 2008); although the latter may reflect both sympathetic and parasympathetic influences (Appelhans & Luecken, 2006; Pumprla, Howorka, Groves, Chester, & Nolan, 2002; Task Force, 1996). Out of these measures, only VLF band power revealed significant effects; this measure will therefore be explored in further detail below.

A 4 (Experimental Phase: NV base, NV video, V base, V video) repeated measures ANOVA on the square-root transformed power in the VLF band revealed a significant main effect[15], F (2.37, 66.55) = 399.15, $p < .001$, $\eta^2 = .93$. Planned contrasts showed that average VLF band power during the non-violent video (M = 8.57, SD = 2.23) was substantially higher than during the baseline preceding the non-violent video (M = 1.08, SD = .71), F (1, 28) = 484.25, $p < .001$, $\eta^2 = .95$. Similarly, average VLF band power during the violent video (M = 8.94, SD = 2.47) was substantially higher than during the baseline preceding the violent video (M = .82, SD = .42), F (1, 28) = 752.93, $p < .001$, η^2 = .96. However, there were no significant differences in VLF band power between the two baseline periods ($F < 1$) or between the violent and non-violent video ($F < 1$). Power in the VLF domain did not correlate significantly with self-report ratings of emotional arousal or interest (all ps > .50). The implications of the HRV findings will be addressed in the discussion.

In sum, electrodermal and cardiovascular measures showed that participants were more aroused during the videos than during the baseline periods, and self-report and electrodermal measures showed that participants were more aroused during the violent video than during the non-violent video.

[15] Prior to analysis, three significant outliers in VLF band power were replaced by the mean plus two standard deviations (Field, 2004) and the distribution was normalised by square-root transformation. Because the assumption of sphericity was violated ($\chi^2(5) = 16.29$, $p = .006$), degrees of freedom were corrected using the Greenhouse-Geisser estimate ($\varepsilon = .79$).

3.3.3.4 Total Number Correct

Figure 3.8 depicts the total number of correct responses per type of video.

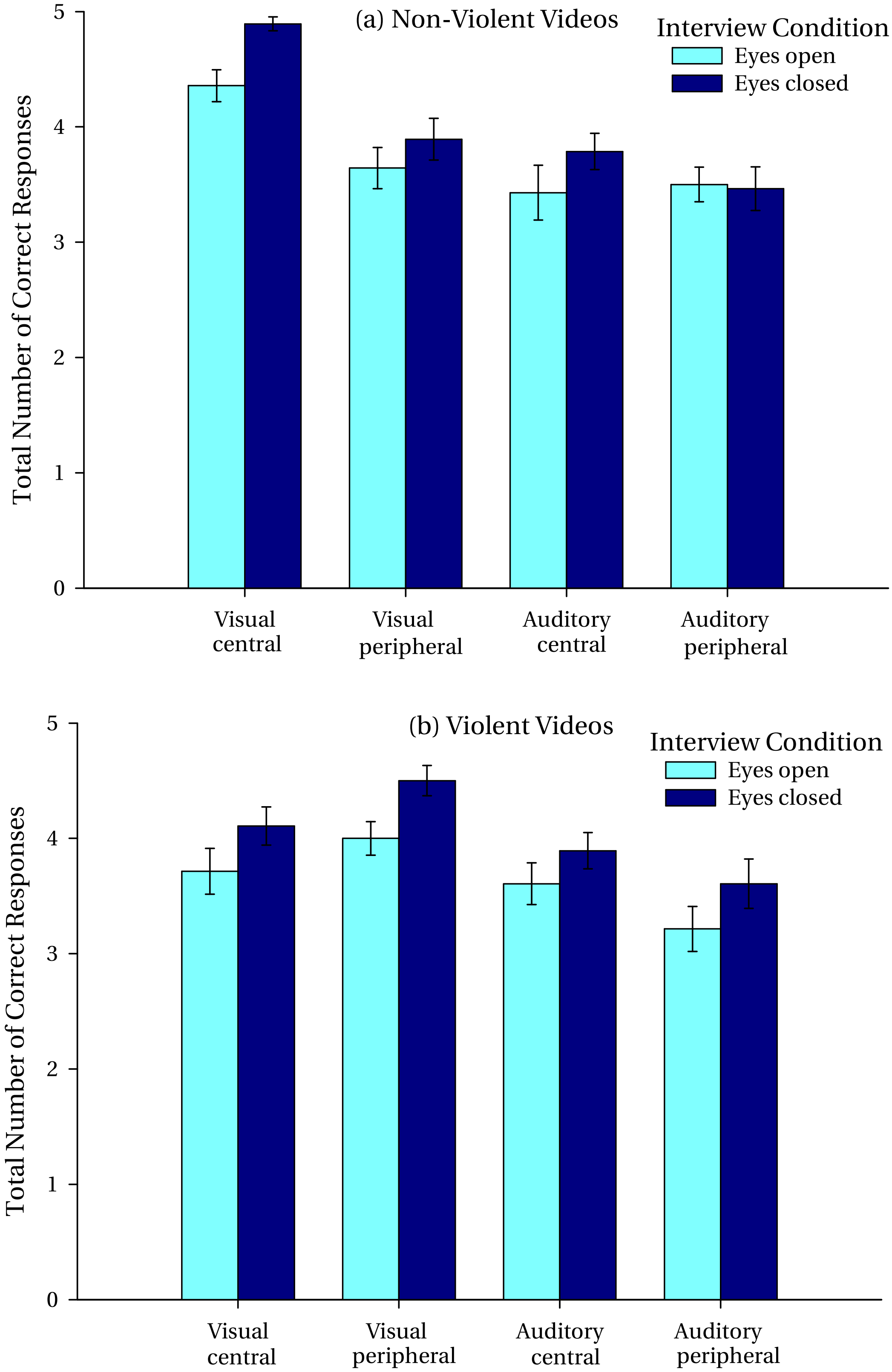


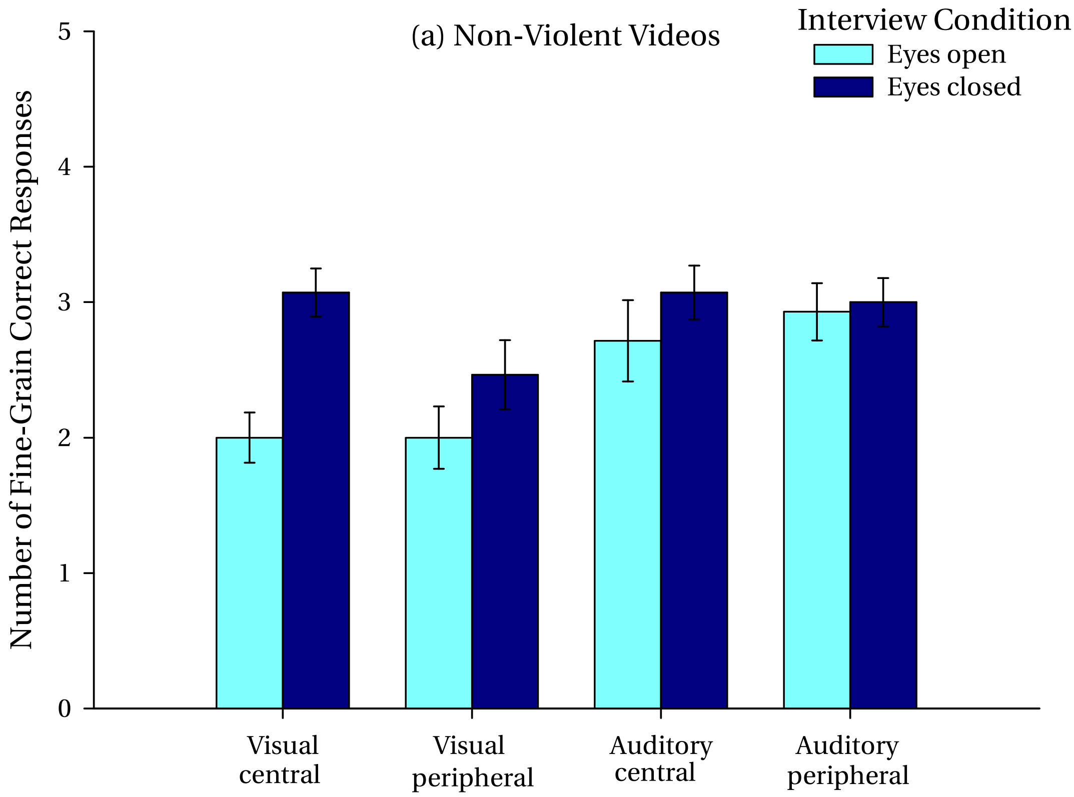
Figure 3.8 Experiment 2: Total number correct. Mean total number of correct responses to different types of questions about (a) non-violent and (b) violent videos. Error bars represent standard errors.

Because the distribution for visual-central responses about the non-violent videos could not be normalised, non-parametric tests were also performed, with results confirming the findings reported below (see Appendix B.3). A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Question Modality: visual, auditory) x 2 (Question Centrality: central, peripheral) mixed ANOVA was conducted on the total number of correct responses. Overall, participants who closed their eyes gave significantly more correct responses than participants who kept their eyes open, F (1, 54) = 7.12, $p < .05$, $\eta^2 = .12$, $d = .71$. There was no significant main effect of type of video ($F < 1$). Participants gave significantly more correct responses about visual than about auditory aspects, F (1, 54) = 68.17, $p < .001$, $\eta^2 = .11$, and significantly more correct responses about central than about peripheral details, F (1, 54) = 7.56, $p < .01$, $\eta^2 = .02$.

Unlike in Experiment 1, there was no significant interaction between eye-closure and question modality, F (1, 54) = 1.48, $p = .23$, and there were also no other significant interactions involving eye-closure (all ps > .14). However, there was a significant interaction between type of video and question centrality, F (1, 54) = 10.50, $p < .01$, $\eta^2 = .02$. Simple effects analyses showed that central details from the non-violent videos were significantly better remembered than peripheral details, F (1, 54) = 18.63, $p < .001$, $\eta^2 = .26$, whereas there was no significant difference between central and peripheral details for the violent videos ($F < 1$). Finally, there was a significant three-way interaction between type of video, question modality, and question centrality, F (1, 54) = 14.08, $p < .001$, $\eta^2 = .04$. As shown in Figure 3.8, the interaction between type of video and question centrality was observed for recall of visual, but not auditory, aspects of the videos. There were no other significant interactions (all ps > .14).

3.3.3.5 Fine-Grain Correct

Figure 3.9 depicts the number of fine-grain correct responses per video.



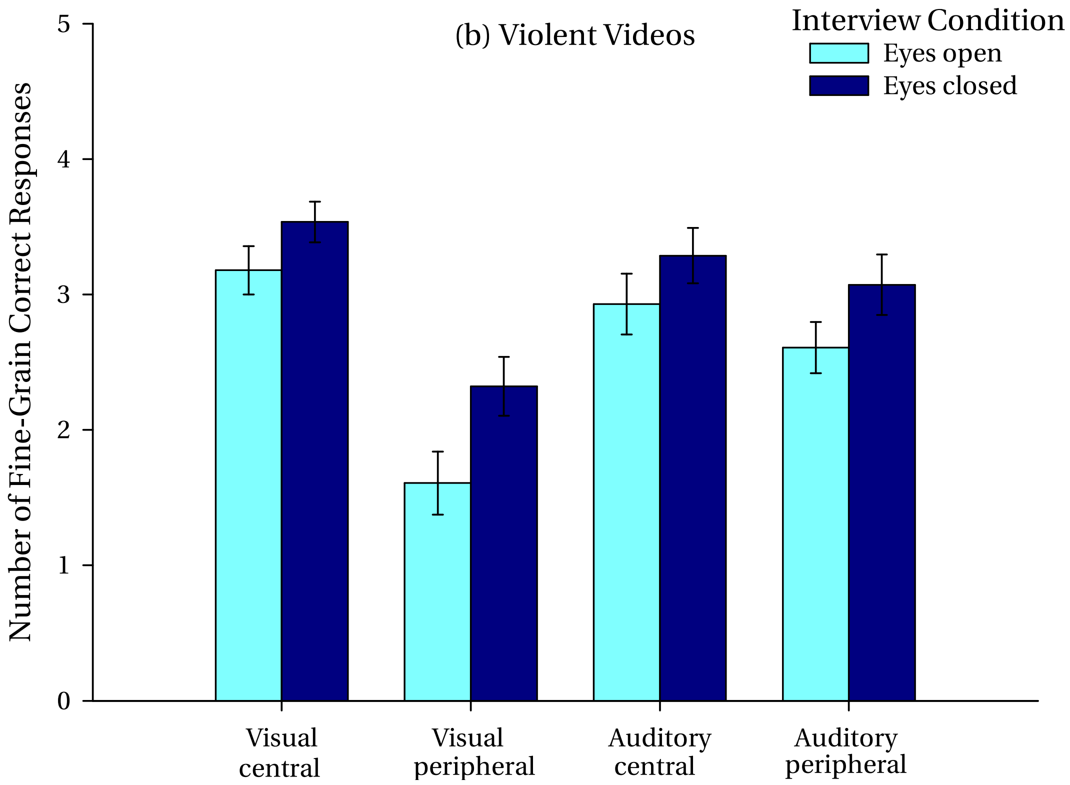


Figure 3.9 Experiment 2: Fine-grain correct. Mean number of fine-grain correct responses to different types of questions about (a) non-violent and (b) violent videos. Error bars represent standard errors.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Question Modality: visual, auditory) x 2 (Question Centrality: central, peripheral) mixed ANOVA was conducted on the number of fine-grain correct responses. Participants who closed their eyes provided significantly more fine-grain correct responses than participants who kept their eyes open, F (1, 54) = 8.85, p < .01, η^2 = .14, d = .80, but there was no significant main effect of type of video, F (1, 54) = 2.92, p = .09, η^2 = .01. Participants gave significantly more fine-grain correct responses about central details than about peripheral details, F (1, 54) = 22.72, p < .001, η^2 = .05, but unlike the pattern observed for total correct, they gave significantly more fine-grain correct responses about auditory aspects than about visual aspects, F (1, 54) = 24.04, p < .001, η^2 = .04.

There was a marginally significant interaction between eye-closure and question modality, F (1, 54) = 3.77, p = .06, η^2 = .01, indicating a significant eye-closure effect for visual aspects, F (1, 54) = 12.02, p < .01, η^2 = .18, d = .93, but not for auditory aspects, F (1, 54) = 3.01, p = .09, η^2 = .05. There were no other significant interactions involving eye-closure (all ps > .09). There was a significant interaction between type of video and question centrality, F (1, 54) = 13.08, p < .001, η^2 = .03, but the pattern was opposite from that observed for the total number of correct responses. Thus, central details from the violent videos were reported in significantly more fine-grain detail than peripheral details, F (1, 54) = 30.05, p < .001, η^2 = .36, whereas there was no significant difference between central and peripheral details for the non-violent videos (F < 1). Finally, there was a significant interaction between question modality and question centrality, F (1, 54) = 12.84, p < .001, η^2 = .03, suggesting that participants were more likely to provide a fine-grain correct answer for visual-central questions than for visual-peripheral questions, F (1, 54) = 32.36, p < .001, η^2 = .37, whereas there was no difference between auditory-central and auditory-peripheral questions (F < 1). There were no other significant interactions (all ps > .06).

3.3.3.6 Coarse-Grain Correct

Figure 3.10 depicts the number of coarse-grain correct responses per video.

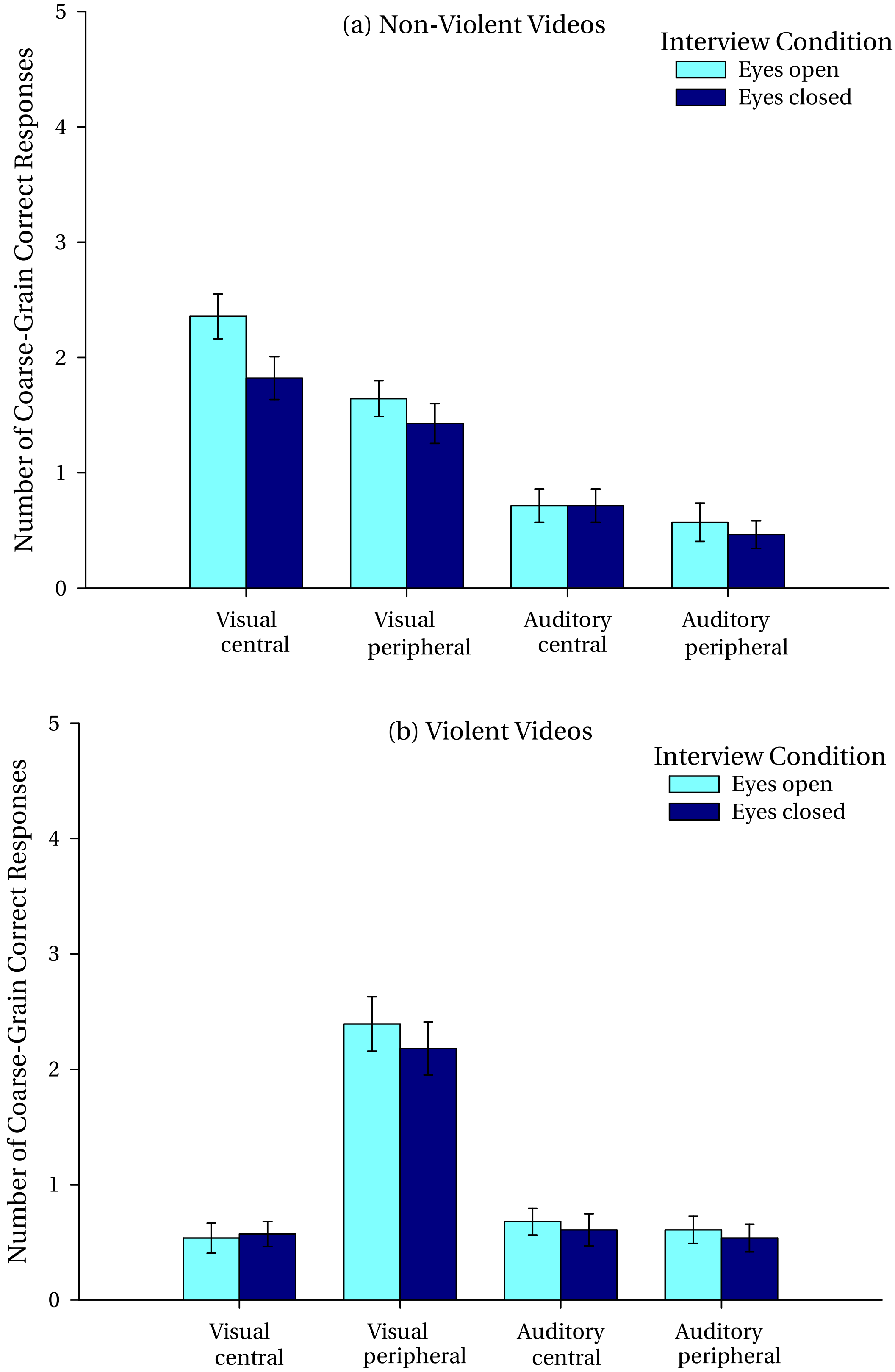


Figure 3.10 Experiment 2: Coarse-grain correct. Mean number of coarse-grain correct responses to different types of questions about (a) non-violent and (b) violent videos. Error bars represent standard errors.

The distribution of coarse-grain correct recall was normalised by log-transformation. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Question Modality: visual, auditory) x 2 (Question Centrality: central, peripheral) mixed ANOVA was conducted on the log-transformed number of coarse-grain correct responses. However, it was difficult to interpret the findings of this ANOVA, due to serious floor effects in the number of coarse-grain correct responses provided (particularly pertaining to auditory details; see Figure 3.10). For the present purposes, however, the most relevant finding was that eye-closure did not significantly affect the number of coarse-grain responses provided, and did not interact with any of the other variables (all *p*s > .14).

3.3.3.7 Proportion Correct

Figure 3.11 depicts the proportion of responses that were correct. On average, participants gave 2.04 incorrect responses for the non-violent videos (*SD* = 1.35), and 2.96 for the violent videos (*SD* = 1.76; for examples, see Appendix A.2). Proportion correct was calculated by dividing the number of correct responses by the total number of correct and incorrect responses. Because the distributions of proportion correct for several question categories about the non-violent video were skewed, all variables were inverted and square-root transformed, which solved all problems with normality.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Question Modality: visual, auditory) x 2 (Question Centrality: central, peripheral) mixed ANOVA on the transformed proportions showed that participants who closed their eyes were significantly more accurate than participants who kept their eyes open, $F\,(1, 54) = 11.26$, $p < .01$, $\eta^2 = .17$, $d = .93$. Proportion correct was significantly higher for non-violent videos than for violent videos, $F\,(1, 54) = 12.75$, $p < .001$, $\eta^2 = .03$. Finally, proportion correct was significantly higher for visual questions than for auditory questions, $F\,(1, 54) = 12.44$, $p < .001$, $\eta^2 = .02$, and significantly higher for central questions than for peripheral questions, $F\,(1, 54) = 8.75$, $p < .01$, $\eta^2 = .03$. Interactions will be explored in the next paragraph.

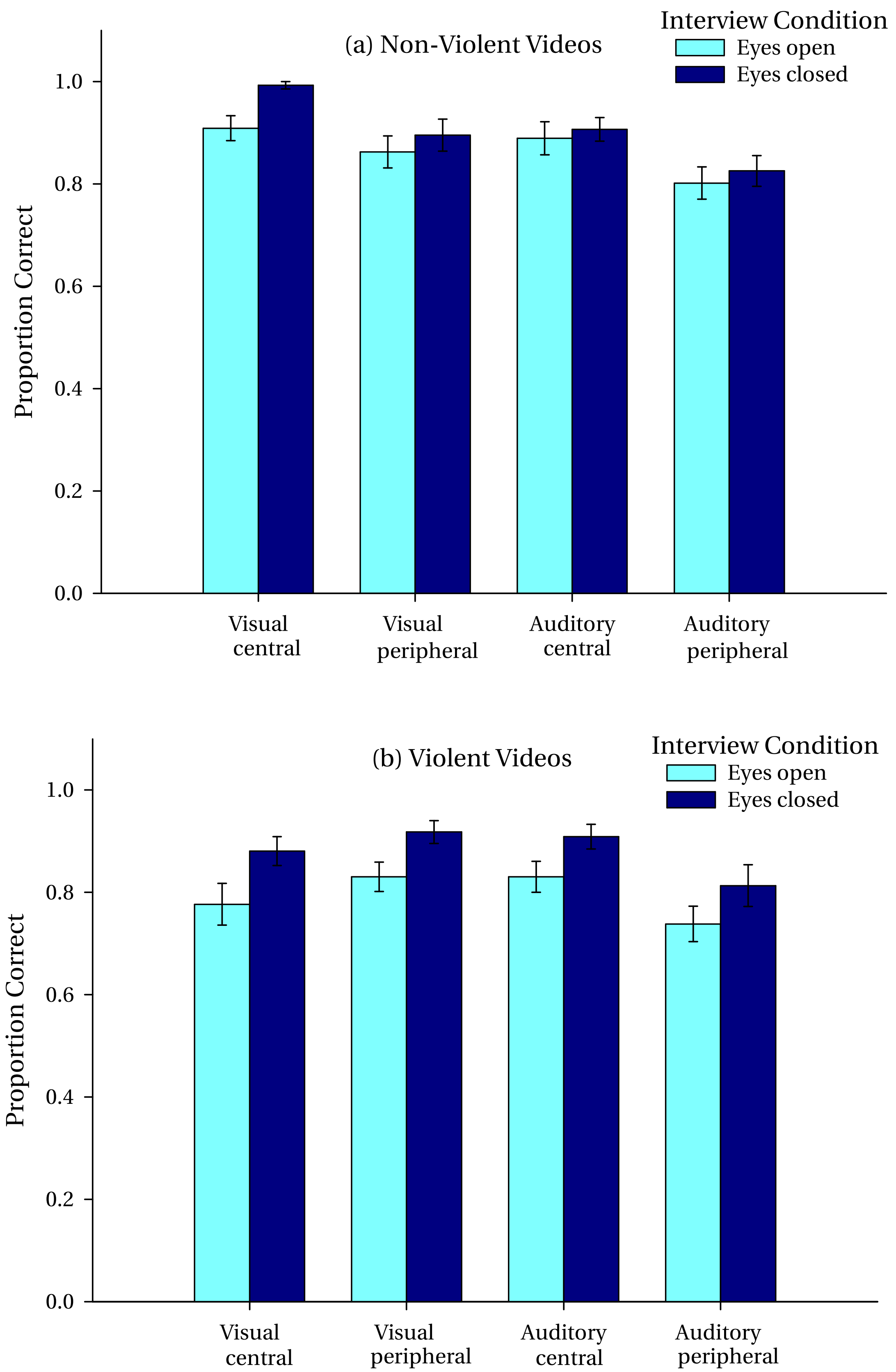


Figure 3.11 Experiment 2: Proportion correct. Mean proportion of responses that were correct for different types of questions about (a) non-violent and (b) violent videos. Error bars represent standard errors.

In terms of proportion correct, there was no significant interaction between eye-closure and question modality, $F\ (1, 54) = 1.39$, $p = .24$, and there were no other significant interactions involving eye-closure (all ps > .09). There was a marginally significant interaction between type of video and question centrality, $F\ (1, 54) = 3.90$, $p = .05$, $\eta^2 = .01$, suggesting that participants were more accurate about central than about peripheral details for the non-violent videos, $F\ (1, 54) = 20.84$, $p < .05$, $\eta^2 = .28$, but not for the violent videos ($F < 1$). A significant three-way interaction between type of video, question modality, and centrality, $F\ (1, 54) = 5.18$, $p < .05$, $\eta^2 = .01$, indicated that the interaction between type of video and centrality was observed only for visual aspects. There was again a significant interaction between question modality and centrality, $F\ (1, 54) = 9.69$, $p < .01$, $\eta^2 = .02$, suggesting that participants were more accurate for auditory-central than for auditory-peripheral questions, $F\ (1, 54) = 14.20$, $p < .001$, $\eta^2 = .21$, whereas there was no difference between visual-central and visual-peripheral questions ($F < 1$). There were no other significant interactions (all ps > .09).

In sum, eye-closure significantly increased the total number of correct responses provided about both types of videos, which was driven by an increase in fine-grain, but not coarse-grain, correct responses. In addition, eye-closure significantly increased testimonial accuracy.

3.3.3.8 Correlations between Arousal and Recall

It was assessed whether the level of emotional arousal elicited by the violent video affected recall of the violent video. Table 3.2 shows the correlations between each measure of emotional arousal and number and proportion correct for the violent video. Because two correlations were assessed for each arousal measure (i.e., number and proportion correct), significance levels were adjusted with a Bonferroni correction ($\alpha = .025$).

Recall performance did not correlate significantly with the emotional-arousal score (i.e., collapsed ratings of how violent, emotional, and upsetting the video was), but proportion correct marginally correlated with interest rating. Participants who found the violent video more interesting tended to recall it with a higher level of accuracy. Recall performance did not correlate with the square-root transformed amplitude of skin conductance responses (SCRs), but proportion correct marginally correlated with SCR frequency. Participants who reacted to the violent video with more frequent SCRs tended to remember it less well.

Table 3.2 Experiment 2: Correlations between arousal and recall. Correlations between measures of emotional arousal during the violent video and the number and proportion correct for the violent video.

	Pearson's *r*	
Measure of emotional arousal	Number correct	Proportion correct
Self-report ratings: emotional-arousal score	.02	.10
Self-report ratings: interest rating	.22	.28*
Skin conductance responses: frequency	-.40*	-.38*
Skin conductance responses: transformed amplitude	-.28	-.19
Heart rate variability: heart rate	.12	.24
Heart rate variability: transformed VLF power	-.44**	-.42*

Note. *denotes significance at $\alpha < .05$
**denotes significance at Bonferroni-corrected level of $\alpha < .025$

There were no significant correlations between heart rate during the violent video and recall performance. However, there was a significant negative correlation between square-root transformed power in the VLF domain during the violent video and number correct, and a marginally significant negative correlation with proportion correct. Thus, participants who reacted to the violent video with increased sympathetic activity tended to remember it less well than participants who were less physiologically aroused. Implications of these findings will be considered in the Discussion.

3.3.3.9 Confidence

Confidence ratings were only obtained if participants provided a response; hence "don't know" responses were not taken into account in the analyses presented in this section. Preliminary analyses were conducted separately for fine-grain and coarse-grain responses. Although the confidence-accuracy (CA) relation was somewhat different for each type of response (for more information on the relation between grain size and confidence, see Goldsmith et al., 2005; Weber & Brewer, 2008), the effects of eye-closure were similar for both types of responses. Therefore, for the sake of simplicity, fine-grain and coarse-grain correct responses were combined into one 'correct' category for the analyses presented in this thesis.

First, it was examined how eye-closure and type of video[16] affected average confidence ratings for correct and incorrect responses (see Figure 3.12). A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Video: non-violent, violent) x 2 (Type of Response: correct, incorrect) mixed ANOVA with repeated measures on the last two factors revealed three significant main effects (see below), but no significant interactions (all *p*s > .12). As expected, mean confidence ratings were significantly higher for correct responses than for incorrect responses, $F\ (1, 46) = 161.66$, $p < .001$, $\eta^2 = .58$. Furthermore, participants who had their eyes open gave significantly higher confidence ratings overall than participants who had their eyes closed, $F\ (1, 46) = 4.80$, $p < .05$, $\eta^2 = .09$. Finally, participants were significantly more confident in their responses about the violent videos than in their responses about the non-violent videos, $F\ (1, 46) = 4.52$, $p < .05$, $\eta^2 = .01$.

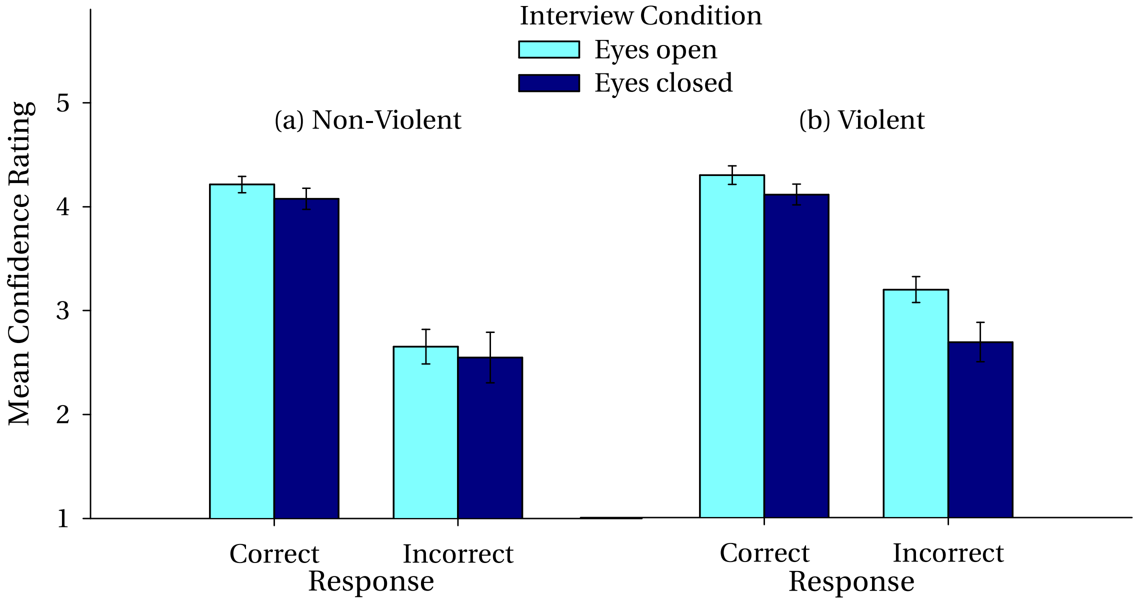


Figure 3.12 Experiment 2: Mean confidence ratings. Average confidence ratings (1 = not confident at all; 5 = extremely confident) for correct and incorrect responses about (a) non-violent and (b) violent videos, provided by participants with eyes open or closed. Errors bars represent standard errors.

[16] Question modality and question centrality could not be included as variables in this analysis, because there were not enough incorrect responses in each question category.

Second, it was examined whether a generally confident rememberer is also likely to be generally accurate. The average confidence rating per video was calculated for each participant, resulting in 112 ratings (each participant watched two videos). The distribution of proportion correct was normalised by inverting and square-root transforming the data. The average confidence rating expressed by a particular participant for a particular video was significantly negatively correlated with the transformed proportion correct for that video, r = -.29, p < .01. Because proportion correct was inverted, this meant that participants who were generally confident in their responses about a particular video were also generally accurate in their responses about that video. Separate general CA correlations for each interview condition (N = 56 per correlation) did not differ significantly from each other, Fisher's z = .10, p = .92 (eyes-open: r = -.35, p < .01; eyes-closed: r = -.34, p < .05).

Third, it was examined whether responses that were expressed with high confidence were also likely to be accurate. To calculate this specific CA correlation, each individual confidence rating for all answered questions was taken into account (ignoring which participant provided the answer), resulting in 2005 ratings in total. Point-biserial CA correlations were calculated between the confidence rating for a particular response and the accuracy of that response (correct or incorrect). Overall, the specific CA correlation was significant and medium to large in size, r_{pb} = .43, p < .001. In other words, a particular response expressed with high confidence was relatively likely to be accurate. Analysis of separate specific CA correlations for each interview condition (eyes-open group: N = 997; eyes-closed group: N = 1008) showed that the correlation was slightly higher for participants who kept their eyes open, r_{pb} = .45, p < .001, than for participants who closed their eyes, r_{pb} = .41, p < .001, but this difference was not significant, Fisher's z = 1.21, p = .23.

Fourth, a calibration technique was used to plot the proportion of correct responses against participants' confidence ratings (see Figure 3.13). Calibration assesses the level of correspondence between subjective and objective probabilities of accuracy. Due to the five-point rating scale used for confidence assessments in the present study, it was not technically possible to assess calibration.[17] For the present purposes, however, perfect calibration was defined as following: responses rated as 5 should be 100% accurate, responses rated as 4 should be 75% accurate, responses rated as 3 should be 50% accurate, responses rated as 2 should be 25% accurate, and responses rated as 1 should be 0% accurate (cf. Brewer & Day, 2005).

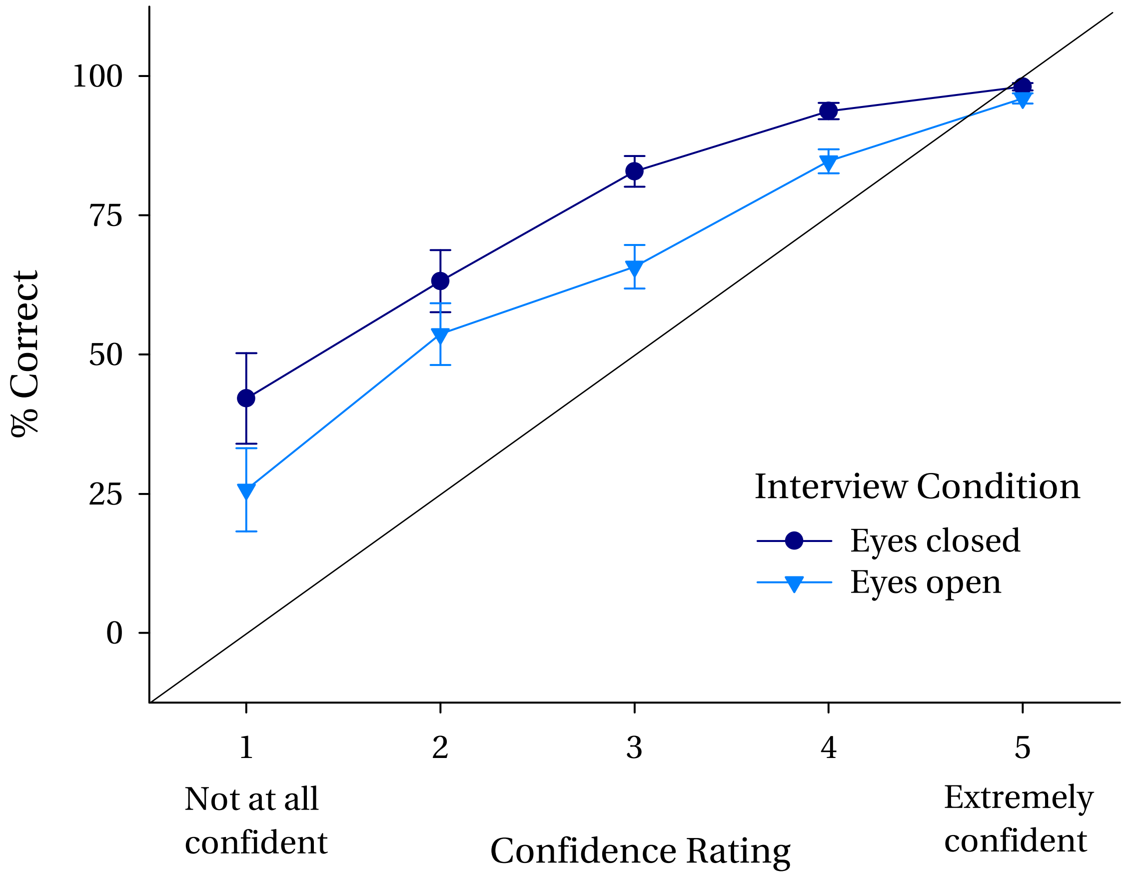


Figure 3.13 Experiment 2: Confidence-accuracy calibration. Mean percentage of correct responses by confidence rating for the eyes-open and eyes-closed conditions. The black line denotes perfect calibration. Errors bars represent standard errors.

As shown in Figure 3.13, participants in both interview conditions were *under*confident, achieving a higher proportion correct than would be expected on the basis of their confidence ratings. Furthermore, visual inspection[18] of the calibration graph suggests that the eyes-closed group was more likely to be

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[17] To assess correspondence between subjective and objective probabilities, each should be measured on the same scale (i.e., 0-100%). I was unaware of this requirement while conducting the present experiment, but the findings obtained with a 1-5 scale reported here were broadly replicated with a 0-100% confidence scale in Experiment 5.

[18] Note that the standard error bars permit an estimation of the stability of group differences. Overlapping standard error bars (as observed for confidence ratings of 2 and 5) suggest non-reliable differences (see also Sauer, Brewer, Zweck, & Weber, 2010).

underconfident than the eyes-open group, at nearly every level of confidence. For instance, for confidence ratings at the mid-point of the scale, perfect calibration would have predicted 50% accuracy for the corresponding answers. In reality, participants who provided this rating were 65.8% accurate in the eyes-open condition, and 82.9% accurate in the eyes-closed condition. In sum, participants in the eyes-closed condition were more often correct, but did not adjust their confidence ratings in accordance with their accuracy, which will be discussed in more detail in the Discussion.

3.3.3.10 Retrieval Strategies

At the end of the experiment, participants were asked to select which retrieval strategies they had used from a list of options provided (see Appendix C). Table 3.3 shows the number of participants in each interview condition who selected each retrieval strategy. Participants reported using between 1 and 5 strategies, with 2.89 strategies used on average (SD = 1.15).

Table 3.3 Experiment 2: Self-reported retrieval strategies. Number of participants who selected each retrieval strategy, by interview condition.

	Interview Condition	
Retrieval Strategy	Eyes open (N = 28)	Eyes closed (N = 28)
Remembered main story line, reconstructed details	16	15
Concentrated hard on remembering the video	14	19
Visualised/pictured the video in my mind's eye	21	26
Replayed the voices and sounds in my head	13	21
Pure guessing	6	6
Other	4	1
Did not use any memory retrieval strategies	0	0

To examine whether eye-closure during the interview influenced self-reported retrieval strategies, Pearson's chi-square (χ^2) tests were conducted. Although more participants in the eyes-closed condition than in the eyes-open condition reported having used visual imagery, the difference between conditions was not significant, $\chi^2(1) = 3.31$, $p = .14$. Unexpectedly, participants who closed their eyes were more likely to report having used auditory imagery than participants who kept their eyes open, and this difference approached significance, $\chi^2(1) = 4.79$, $p = .05$. Eye-closure did not significantly affect any of the other self-reported retrieval strategies (all *p*s > .27).

Next, the relation between self-reported use of mental imagery and recall performance was examined. First, Bonferroni-corrected point-biserial correlations between self-reported visual imagery (yes/no) and number correct, fine-grain correct, coarse-grain correct, and proportion correct for visual and auditory questions were assessed (i.e., eight comparisons in total; $\alpha = .006$). None of the correlations reached significance (all *p*s > .03). Second, Bonferroni-corrected point-biserial correlations between self-reported auditory imagery (yes/no) and the same eight recall variables were assessed. None of the correlations between auditory imagery and recall of auditory details were significant (all *p*s > .09). However, there was a significant positive correlation between self-reported use of auditory imagery and fine-grain correct recall of visual aspects, $r_{pb} = .51$, $p < .001$, and a significant negative correlation between auditory imagery and coarse-grain correct recall of visual aspects, $r_{pb} = -.43$, $p = .001$. Thus, participants who reported replaying the voices and sounds in their head were more likely to give specific instead of vague responses to questions about visual details. This unexpected finding will be addressed in the Discussion.

3.3.4 Discussion

The primary aim of the present study was to examine whether eye-closure was more or less effective for recall of violent compared to non-violent events, while providing manipulation checks to assess emotional arousal. First, the benefits of eye-closure observed in Experiment 1 were partially replicated for different violent and non-violent events in the present study. Second, violent videos were rated as significantly more violent and upsetting than non-violent videos, and generated significantly more frequent skin conductance responses. Third, eye-closure was found to be equally beneficial for recall of violent and non-violent events. Finally, eye-closure significantly reduced witness confidence, and seemed to facilitate the use of mental imagery.

3.3.4.1 Emotional Arousal

In Deffenbacher et al.'s (2004) influential meta-analysis on the effects of emotional arousal on memory, no physiological measurements of arousal were included, which limited potential interpretations of their findings (see section 2.1.3.3). In the present study, both subjective and physiological measures of emotional arousal were included. Compared to baseline periods, both violent and non-violent videos significantly increased electrodermal activity (in terms of frequency and amplitude of skin conductance responses) and cardiovascular activity (in terms of power in the very low frequency domain). Although the physiological correlates of the very low frequency domain are still relatively unknown (Task Force, 1996), Matthews, Paulus, Simmons, Nelesen, and Dimsdale (2004) argue that activity in this domain reflects influences of the sympathetic nervous system on heart rate. Thus, it seems that both violent and non-violent videos in the present study heightened sympathetic activity.

Violent videos were rated as significantly more violent and upsetting than non-violent videos, and as marginally more emotional. The subjective ratings were consistent with the finding that violent videos elicited significantly more frequent skin conductance responses than non-violent videos. Thus, it seems that violent videos were indeed more arousing than non-violent videos. However, due to the lack of differences in heart rate variability between the violent and non-violent videos, there was no evidence for either an orienting response (decelerated heart rate) or a defensive response (accelerated heart rate). Because two quite different patterns of physiological responding might cancel each other out (Deffenbacher et al., 2004; see also section 2.1.3.1), the distribution of the heart rate data was inspected. However, the bimodal pattern that would be expected if individual differences caused the non-significant findings (i.e., some participants would show heart rate deceleration, whereas others would show heart rate acceleration in response to the violent video) was not observed.

It should be noted that potential differences between the violent and non-violent videos in terms of cardiovascular response may not have been apparent because physiological data were obtained for only 29 participants in the present study. In light of the current non-significant findings and previous inconsistent findings with regards to heart rate (e.g., Burke et al., 1992; Christianson, 1987), future physiological assessments are needed to provide more insight into the type of physiological response elicited by violent videos in the laboratory. In addition, because the self-report ratings of emotional arousal did not correlate with the physiological measures of arousal, it might be useful to include more extensive subjective measures of emotional arousal. For instance, Valentine and Mesout (2009) used Spielberger's (1983) 20-item State Anxiety Inventory, which correlated significantly with heart rate, unlike the three ratings of emotional arousal used in the present study.

3.3.4.2 Comparison of Violent and Non-Violent Events

In terms of the *number* of correct responses, there was no evidence of either impairment (Deffenbacher, 1994) or improvement (Christianson, 1992) as a result of event violence. In terms of the *proportion* of correct responses, however, there was a difference between violent and non-violent videos. In line with Deffenbacher et al.'s (2004) meta-analytic findings, testimonial accuracy was significantly lower for violent events than for non-violent events, due to a higher number of incorrect responses. Furthermore, physiological arousal during the violent video (in terms of frequency of skin conductance responses and power in the very low frequency domain) tended to correlate negatively with recall performance for that video. This finding provides support for Deffenbacher's (1994) argument that memory impairment will be observed only if the violent event elicits sympathetic activity in the viewer.

Perhaps, participants provided more incorrect responses for the violent videos because their scripts for the violent events are more elaborate and vivid than their scripts for the non-violent events. An informal observation while scoring participants' responses was that the incorrect responses provided about violent acts were more consistent across participants than those provided about non-violent acts. For instance, many participants who saw the violent "Lost" episode falsely reported that the woman hit the man with the back of the rifle and that the man bandaged the shot wound; and many participants who saw the violent “Survivors” episode reported that the boys tried to strangle the man and that the man said that the older boy had killed the younger boy. Such shared false memories were much less frequent for the non-violent videos. Indeed, previous research has found that people tend to have well-defined scripts of criminal acts (e.g., Aizpurua et al., 2009; Holst & Pezdek, 1992), and that script-consistent errors are often incorporated into eyewitness testimony (e.g., García-Bajos & Migueles, 2003; V. L. Smith & Studebaker, 1996). In sum, the reduced testimonial accuracy for violent events may have been due to incorporation of script-consistent errors into memory for the violent event. The notion of violent event scripts will be considered in more detail in the General Discussion of this chapter (section 3.4.3).

In terms of centrality of the to-be-remembered information, the attentional narrowing hypothesis (Christianson, 1992; Easterbrook, 1959) was partly confirmed. Although the number-correct data did not provide support for the hypothesis, the fine-grain correct data did. The hypothesis holds that emotional arousal enhances attention to (and subsequent recall of) central aspects of the event, at the expense of peripheral aspects. In line with this idea, central aspects for the violent events in the present study were more likely to be reported in fine-grain detail than peripheral aspects, whereas there was no difference in fine-grain recall between central and peripheral aspects for the non-violent events. This finding again highlights the usefulness of Goldsmith et al.’s (2002) distinction between fine-grain and coarse-grain correct responses, which allowed for a more sensitive analysis of the data.

A final note of caution is warranted regarding the interpretation of the observed differences between violent and non-violent events. Although two violent events and two non-violent events were used in the present study, it is difficult to generalise from this small sample of stimulus materials (cf. Wells & Windschitl, 1999). Despite attempts to match the violent and non-violent versions of each episode in terms of plot, characters, and setting, the violent videos were rated as significantly more interesting than the non-violent videos. Due to this confound, it is impossible to know whether the reduced testimonial accuracy for violent videos was due to increased arousal or due to increased interest. However, it seems unlikely that *more* interesting events are remembered with *less* accuracy; indeed, the correlational data showed that participants who rated the video as more interesting actually remembered it with a higher level of accuracy. Nevertheless, the difference in testimonial accuracy could have been due to the fact that different questions were asked for the violent and non-violent events (see Appendix A.2). For instance, some of the information classed as visual-peripheral for the violent videos (e.g., "Where on his body does the curly-haired man get shot?") may have been more salient than some of the information classed as visual-peripheral for the non-violent videos (e.g., "What was in the fridge?"). To address these confounds, future research should use a wider range of violent and non-violent events, preferably while keeping the questions consistent across violent and non-violent events (cf. Loftus & Burns, 1982).

3.3.4.3 The Eye-Closure Effect

Despite the difference in testimonial accuracy between violent and non-violent videos, eye-closure was equally effective for both types of event. Although this finding is perhaps not as theoretically interesting as I had hoped, it is highly encouraging from an applied point of view. That is, eye-closure may be useful in a broad range of eyewitness interviews, concerning both violent and non-violent crimes. Unlike in Experiment 1, no eye-closure effects were observed for coarse-grain recall in the present study (perhaps due to floor effects). In line with Experiment 1, however, eye-closure was particularly effective for the retrieval of fine-grain visual information (although the interaction between eye-closure and question modality was only marginally significant in the present study). These findings will be considered in the General Discussion of this chapter (section 3.4.4).

3.3.4.4 Confidence

Unsurprisingly, participants were more confident in their correct responses than in their incorrect responses. Furthermore, participants were more confident in their responses about the violent videos than in their responses about the non-violent videos, even though testimonial accuracy was significantly lower for violent videos. This seems to suggest that false memories of violence are held with relatively high levels of confidence.

Unexpectedly, eye-closure significantly reduced overall levels of confidence. Although there was no significant interaction between eye-closure and type of response, Figure 3.12 seems to indicate that eye-closure reduced confidence particularly for incorrect responses about the violent videos. This points to the possibility that eye-closure may not only improve recall, but may also improve meta-cognitive assessments of the accuracy of one's own recall. However, in light of the non-significant findings of eye-closure on confidence observed by Wagstaff et al. (2004; 2010), this finding needs to be replicated before firm conclusions can be drawn.

The average confidence rating provided by a particular witness was a moderately accurate predictor of her accuracy (r = .29), and the confidence rating provided for a particular response was an even better predictor of its accuracy (r = .43). However, the calibration graph showed that participants were correct more often than would have been predicted based on their confidence ratings. Furthermore, the tendency towards underconfidence was especially pronounced in witnesses who had their eyes closed. This highlights the importance of using multiple approaches to assess the relation between confidence and accuracy, since no significant group differences were detected in the analysis of general and specific CA correlations (cf. Brewer & Day, 2005; Juslin et al., 1996; Olsson, 2000). The implications of this finding will be addressed in the final Chapter (section 7.2.5).

3.3.4.5 Retrieval Strategies

In the present study, participants were asked to report on their retrieval strategies, to examine whether eye-closure increased the self-reported use of mental imagery (cf. Caruso & Gino, 2011). Eye-closure tended to increase the self-reported use of visual imagery, but this tendency was not significant, possibly because almost all participants reported using this strategy. Interestingly, there was a marginally significant difference between groups in terms of auditory imagery: participants who closed their eyes during the interview were more likely to report having replayed the voices and sounds in their head than participants who kept their eyes open. This finding suggests that eye-closure not only has the potential to facilitate visual imagery (cf. Wais et al., 2010), but may also facilitate other forms of mental imagery, such as auditory imagery. It should be noted, however, that participants might lack insight into their own cognitive processes (e.g., Holmes, Waters, & Rajaram, 1998; Loftus & Loftus, 1980; Lundeberg, Fox, & Punćochaŕ, 1994; Merckelbach & Wessel, 1998). Therefore, this finding needs to be replicated with more objective measures (e.g., image-evoking qualities; Paivio, 1969).

In line with previous research on the use of mnemonic techniques (Carlson et al., 1976; Wang & Thomas, 2000), it was expected that the self-reported use of mental imagery would be associated with higher recall performance. Unexpectedly, the only significant association observed was cross-modal in nature: participants who reported using auditory imagery were more likely to provide a fine-grain (as opposed to coarse-grain) correct response to questions about visual details. This finding provides an interesting parallel to previously reported cross-modal effects in the opposite direction (i.e., that visual imagery facilitates recall of auditory-verbal stimuli; cf. Brooks, 1967, 1968; J. M. Clark & Paivio, 1991; Paivio, 1969). Cross-modal and modality-specific processes in the eye-closure effect will be examined in more detail in Chapter 5.

3.3.4.6 Conclusion

The present findings suggest that witnesses are less accurate in their testimony about violent events than in their testimony about non-violent events, perhaps due to the incorporation of script-consistent false details. Crucially, however, benefits of eye-closure were observed for both violent and non-violent events, highlighting the broad potential applicability of the eye-closure instruction. In addition, the confidence data seemed to suggest that, in addition to improving recall, eye-closure might improve meta-cognitive judgments, although this finding is in need of replication. Finally, the role of mental imagery in the eye-closure effect does not seem to be modality-specific in nature (at least not when measured by self-report). In the next section, the broader implications of the findings obtained in Experiments 1 and 2 will be discussed.

3.4 General Discussion

Taken together, the experiments presented in this chapter confirm that the eye-closure instruction can benefit recall of violent as well as non-violent events. In Experiment 1, eye-closure increased the number of coarse-grain correct responses overall, and increased the number of fine-grain correct responses for visual, but not auditory, aspects of the violent event. In Experiment 2, eye-closure did not affect coarse-grain responses, but significantly increased fine-grain responses, again predominantly for visual aspects of the violent and non-violent events. In this general discussion of the findings, I will consider effect sizes, testimonial accuracy, the nature of false memories, and the modality and grain size of the to-be-remembered information.

3.4.1 Effect Size

In previous research on the eye-closure effect, Perfect et al. (2008) compared the overall effect size of the eye-closure effect (d = .98) to the overall effect size of the Cognitive Interview (CI; d = .87; Köhnken et al., 1999). To present a complete picture, I also calculated Cohen's d for the eye-closure effects observed in the present experiments. In Experiment 1, no significant effect of eye-closure was observed overall, but according to Cohen's (1988, 1992) admittedly arbitrary classification, eye-closure had a large effect on recall of visual details (d = .79). In Experiment 2, eye-closure had a moderate to large effect on the total number of correct responses (d = .71), which was most pronounced for fine-grain recall of visual aspects (d = .93). Due to the considerable differences between studies on the CI and the present experiments, it is difficult to compare effect sizes across studies. Nevertheless, as noted by Perfect et al., "the magnitude of the eye-closure effect does not seem to suffer in comparison" (p. 321). The size of the eye-closure effect will be examined in more detail in the final chapter (see section 7.2.2), when all the relevant findings have been presented.

3.4.2 Testimonial Accuracy

In both experiments, eye-closure boosted not only the number of correct responses, but also significantly increased the proportion of correct responses, particularly for visual aspects of the events. In Experiment 1, eye-closure increased testimonial accuracy of participants' reports about visual information by 18.6%. In Experiment 2, eye-closure increased testimonial accuracy of participants' reports about visual information by 9.1%. Although these effects are relatively modest, even a small increase in testimonial accuracy is somewhat unique amongst investigative interview procedures. For instance, the Cognitive Interview does not improve (or impair) testimonial accuracy (Köhnken et al., 1999; Memon, Meissner, et al., 2010; Memon & Stevenage, 1996), and hypnosis significantly *decreases* testimonial accuracy (Dinges et al., 1992; Erdelyi, 1994; Kebbell & Wagstaff, 1998).

However, the current finding that eye-closure increased testimonial accuracy may have been due to the nature of the recall test. Because witnesses were provided with the option to omit their response, correct and incorrect answers were not strictly reciprocal. Nevertheless, because a response could only be scored as either fine-grain correct, coarse-grain correct, incorrect, or omitted, the different types of responses were not wholly independent either; hypothetically speaking, if participants produced 20 fine-grain correct responses, they would no longer be able to provide any other type of response. When recall is tested in free recall, on the other hand, the number of incorrect details reported is not dependent on the number of correct details reported. Therefore, it is possible that eye-closure will no longer increase testimonial accuracy when recall is tested in free recall (cf. Perfect et al., 2008; Experiments 3 and 5). To examine this possibility, Experiments 3 and 6 in the present thesis will assess the effect of eye-closure in free recall.

3.4.3 Violent Event Scripts

Although participants gave relatively few incorrect responses overall, some of these errors were remarkably consistent across participants. For instance, many participants in Experiment 1 falsely remembered the man cutting the woman's dress open with the knife, and many participants in Experiment 2 falsely remembered the woman hitting the man with the back of the rifle. While comparing violent events with non-violent events in Experiment 2, it was found that incorrect responses were not only more numerous for violent events, but also more consistent across participants. This finding might be explained by the existence of shared event scripts for violent acts (Schank & Abelson, 1977). As outlined in section 2.1.2.3, people's memories for events seem to be influenced by their pre-existing knowledge and beliefs, a large part of which is shared with other people who belong to the same cultural group.

People in Western societies have been found to have relatively well-defined and vivid scripts of certain crimes (e.g., García-Bajos & Migueles, 2003; Greenberg et al., 1998; Holst & Pezdek, 1992; List, 1986). The present findings suggest that university students in the United Kingdom also have relatively well-defined shared scripts of violent acts. It is suspected that the popularity of violent movies and TV series is in large part responsible for these shared scripts. Because witnesses are more likely to report false information when they are prompted by specific questions than when they provide a free account of what they witnessed (Aizpurua et al., 2009; Lipton, 1977; Loftus, 1979; Migueles & García-Bajos, 1999), it is unclear whether participants will still report script-consistent errors when their memory is tested in free recall. This issue will be examined in the next chapter.

3.4.4 Modality and Grain Size

The interactions observed between eye-closure and question modality in Experiments 1 and 2 suggest that eye-closure is most beneficial for fine-grain recall of visual, as opposed to auditory, information. However, there is a potential alternative explanation for the interaction. Because participants generally performed better on questions about visual details than on questions about auditory details, it might be that eye-closure is particularly beneficial for recall of easy-to-remember, as opposed to difficult-to-remember, information. That is, question modality was confounded with question difficulty. One finding inconsistent with this interpretation of the data, however, is that participants in Experiment 2 provided significantly more fine-grain responses about auditory aspects than about visual aspects; yet the benefits of eye-closure on fine-grain recall were primarily observed for visual, not auditory, information. Thus, even when visual items were harder to remember than auditory items (at least to a level of fine-grained detail), eye-closure was still most effective for recall of visual items. This suggests that the interaction was driven by the modality, rather than the difficulty, of the information (see also section 7.2.4.2).

Both experiments reported thus far show that the pattern of findings differs markedly depending on the specificity of the responses provided. In Experiment 1, eye-closure had general benefits on coarse-grain recall, but modality-specific benefits on fine-grain recall. In Experiment 2, eye-closure did not have a significant effect on correct coarse-grain recall, but had significant benefits for fine-grain recall, especially for visual aspects of the witnessed event. These findings highlight the importance of distinguishing between vague and precise answers, which has not been done in previous research on the eye-closure effect (e.g., Mastroberardino et al., 2010; Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008; Wagstaff et al., 2004). Thus, the concept of grain size (Goldsmith et al., 2002) has proven useful in assessing the effects of eye-closure on recall. Potential explanations for the role of grain size in the eye-closure effect will be explored in section 7.2.4.

3.4.5 Conclusion

The findings suggest that the eye-closure instruction may be used in police interviews regarding both violent and non-violent crime. Eye-closure seems to be particularly helpful for the retrieval of fine-grain visual information, which may provide important leads in criminal investigations (e.g., detailed descriptions of the offender's appearance, clothing, or vehicle). Indeed, information reported by eyewitnesses is often considered the most important determinant of whether criminal cases are solved (e.g., Kebbell & Milne, 1998). Thus, the eye-closure instruction has the potential to improve the quality and quantity of evidence obtained in criminal cases.

3.5 Chapter Summary

- The eye-closure effect was extended to recall of a violent event.
- Eye-closure seemed to be particularly beneficial for recall of fine-grain visual information.
- Eye-closure was equally effective for non-violent and physiologically arousing violent versions of similar videotaped events.
- Eyewitness reports about violent events were less accurate than reports about non-violent events, possibly due to the incorporation of script-consistent false memories.
- Witnesses who were more physiologically aroused while witnessing the violent event performed less well on the recall test.
- Eye-closure reduced the overall level of confidence in responses, and increased underconfidence in terms of confidence-accuracy calibration.
- According to self-report measures, eye-closure tended to facilitate mental imagery, particularly auditory imagery.

Chapter 4
Memory after a Delay

4.1 Experiment 3: Delay

4.1.1 Introduction

The previous chapter provided useful new insights into the effect of eye-closure on recall of violent events, but a number of questions remain. The present experiment enhanced the realism of the experimental conditions by introducing a delay of a week between observation of the event and the interview, by incorporating repeated retrieval attempts, and by assessing the effects of eye-closure in free and cued recall.

4.1.1.1 Delay

In previous eye-closure research, participants were interviewed only a few minutes after watching the video (see Experiments 1 and 2; Mastroberardino et al., 2010; Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008). In real life, however, eyewitnesses often experience substantial delays between witnessing a crime and being interviewed about it (Fisher & Geiselman, 1992; Flin et al., 1992; Gabbert et al., 2009). Given that Burke et al. (1992) found that the largest extent of forgetting takes place in the first week after witnessing the event, the present study introduced a delay of a week between the event and the interview. When people are trying to remember events that occurred longer ago, they are more likely to look away or close their eyes than when they are retrieving memories of recent events (Glenberg et al., 1998). This suggests that eye-closure might be especially helpful after a delay. Furthermore, Smith's (1988) outshining hypothesis suggests that retrieval aids (such as mental context reinstatement) are more effective when there are relatively few retrieval cues available to the rememberer. Because accessibility to retrieval cues deteriorates over time (Lipton, 1977; Turtle & Yuille, 1994), it is expected that eye-closure will be more effective during a delayed interview.

4.1.1.2 Repeated Retrieval

Eyewitnesses are typically asked to recount a witnessed crime on multiple occasions, both in informal settings (such as retelling the story to family, friends, and colleagues) and in formal settings (such as the initial statement to the police, the follow-up interview at the police station, and testimony provided in court). As explained in section 2.1.4.1, repeated attempts to remember can help witnesses retrieve previously unreported information (*reminiscence*; e.g., Turtle & Yuille, 1994), which is desirable in a police investigation. However, repeated recall attempts can also result in an increase in the number of errors reported (Bornstein et al., 1998; Turtle & Yuille, 1994). The present study examined the effect of eye-closure on the amount and accuracy of new information reported during the second interview.

In addition, the present experiment assessed whether recall after a week would be influenced by eye-closure during the *initial* interview. If eye-closure during the initial interview results in the report of more information about the event, the witness may be able to draw upon this relatively elaborate previous testimony during a subsequent interview. In addition, it is possible that eye-closure during an initial retrieval attempt strengthens the memory representation of the event itself, potentially facilitating subsequent retrieval of memories about the event. In other words, the benefits of eye-closure during the first interview might ‘carry over’ to the second interview. Consistent with this idea, Gabbert and colleagues have shown that a good-quality initial recall attempt prevents forgetting and protects against the incorporation of misinformation in subsequent testimony (Gabbert et al., 2009; Gabbert et al., in preparation; Hope et al., 2011; see also Bjork, 1975). However, the few studies addressing the role of repeated recall in the effectiveness of the Cognitive Interview have found no evidence of any carry-over effects from the first to the second interview (Brock, Fisher, & Cutler, 1999; McCauley & Fisher, 1995; Memon et al., 1997). Therefore, it was hypothesised that eye-closure during the first session would not affect recall performance during the second session.

4.1.1.3 Free and Cued Recall

In the experiments reported in Chapter 3, participants were asked to answer questions about the witnessed events, but they were not asked to provide a free report of their experiences. Eyewitnesses in real life, on the other hand, are typically asked to provide a free report of the event first, which is followed by questioning (Fisher & Geiselman, 1992; Ministry of Justice, 2011; Perfect et al., 2008; Yuille & Cutshall, 1986). To enhance the ecological validity of the research, witnesses in the present experiment were first asked to provide a full free report of the event, and were asked questions only after they had completely finished their free report. In free recall, witnesses have full control over what they choose to report, and are able to withhold information about which they are not certain (Goldsmith & Koriat, 1999; Koriat & Goldsmith, 1996; Koriat et al., 2000). Indeed, many studies have found that witnesses are generally more accurate when providing a free report than when prompted with questions (Aizpurua et al., 2009; Fisher, 1995; Lipton, 1977; Memon, Holley, Wark, Bull, & Köhnken, 1996; Roediger & Payne, 1985; Scoboria, Mazzoni, & Kirsch, 2008). Therefore, testimonial accuracy was expected to be higher in free recall than in cued recall. The proportion of statements that were correct in free recall was compared with the proportion of responses that were correct in cued recall to examine this hypothesis.

It is possible that eye-closure affects free and cued recall in different ways. In previous studies with adult witnesses (see section 2.3.1.2), when free recall was followed by cued recall, interview techniques such as MCR, the CI, and eye-closure tended to be more beneficial in the free recall phase than in the cued recall phase (e.g., Davis et al., 2005; Emmett et al., 2003; Wagstaff et al., 2004; Wagstaff et al., 2011). It is possible that the techniques provide accessibility to retrieval cues, which are lacking in free recall (Thomson & Tulving, 1970). In cued recall, on the other hand, provision of cues may not be as necessary because strong cues are already provided by the questions themselves (S. M. Smith, 1988). Thus, in terms of the amount of information obtained, eye-closure may be more effective in free recall than in cued recall (although Perfect et al., 2008, found it to have equivalent benefits for free and cued recall of mundane events).

In terms of testimonial accuracy, on the other hand, eye-closure may have greater benefits in cued recall than in free recall. As explained in section 3.4.2, correct and incorrect responses in cued recall are not fully independent. Therefore, if eye-closure increases the number of correct responses, it will at the same time decrease the number of incorrect and omitted responses. In free recall, on the other hand, an increase in correct details reported does not inevitably decrease the report of incorrect details, and eye-closure may in fact increase the report of both correct *and* incorrect details, as hypnosis does (e.g., Dinges et al., 1992; see also Perfect et al., 2008; Experiments 3 and 5). The present experiment was designed to investigate how eye-closure affects the quantity and accuracy of information reported in free recall.

4.1.1.4 Type of Information

Another benefit of free recall measures is that they allow us to investigate which type of spontaneously reported information is most likely to be facilitated by the eye-closure instruction. In line with the findings reported in the previous chapter, it was hypothesised that eye-closure would benefit recall of visual details more than recall of auditory details. Furthermore, whereas previous research on the Cognitive Interview has shown that the CI facilitates the recall of both central and peripheral details (Ginet & Verkampt, 2007), previous studies on the eye-closure effect have not distinguished on the basis of centrality. In the present study, a comprehensive coding scheme was established by combining the distinction between gist and detail (e.g., Bransford & Franks, 1971; Kintsch et al., 1990; Neisser, 1981; Sanford & Garrod, 1981) with the distinction between central and peripheral detail (e.g., Burke et al., 1992; Christianson, 1992; Heuer & Reisberg, 1990). Thus, statements could be coded as gist, central detail, or peripheral detail. The coding structure used was inspired by Thorndyke's (1977) plot structure approach (illustrated in Figure 2.1). More details on the coding procedure can be found in the Methods section. It was hypothesised that eye-closure would increase recall of both central and peripheral details (cf. Ginet & Verkampt, 2007), but it was unclear whether it would also facilitate recall of the gist of the event.

4.1.1.5 Auxiliary Variables

A number of variables reported in previous experiments were not the main focus of the present experiment, but were included for the sake of replication. In line with previous findings, eye-closure was expected to have the greatest impact on fine-grain correct responses in cued recall. As in Experiment 2, participants rated their confidence in responses provided in cued recall. It was hypothesised that eye-closure would again reduce overall confidence in (correct and incorrect) responses. Furthermore, one additional variable of interest was added in the present experiment. One of the potential reasons why eye-closure may improve recall performance is because it reduces the need to attend to visual social cues (cf. Markson & Paterson, 2009). On the other hand, closing the eyes during an investigative interview creates an unusual and potentially uncomfortable social situation (Doherty-Sneddon et al., 2001). To investigate whether eye-closure increased or reduced feelings of comfort, participants in the present study were asked to indicate how comfortable they had felt during the session.

4.1.1.6 Aims and Hypotheses

The primary aim of the present study was to investigate whether eye-closure is still effective after a week and repeated recall attempts. Three central hypotheses were formulated with respect to this aim. First, based on findings that individuals are more likely to spontaneously block out the environment when recalling events that happened longer ago (Glenberg et al., 1998), it was hypothesised that eye-closure would have greater benefits during delayed free recall than during immediate free recall. Second, consistent with research on the Cognitive Interview (e.g., Memon et al., 1997), eye-closure during the first free recall test was not expected to have carry-over effects on recall performance during the second session. Finally, it was hypothesised that eye-closure would enhance both free and cued recall (cf. Perfect et al., 2008), but would have the greatest impact on free recall (cf. Wagstaff et al., 2011).

4.1.2 Method

4.1.2.1 Participants

Fifty-five students from the University of York signed up to participate in the study for course credit or a small monetary reward. Six participants failed to appear for the second experimental session and one participant had seen the TV series before; their data were removed from the analysis. Among the remaining 48 participants (18 males and 30 females), ages ranged from 18 to 38 (M = 21.00, SD = 3.30). All participants were native English speakers and had normal or corrected-to-normal vision and hearing.

4.1.2.2 Materials

The stimulus materials were identical to those used in Experiment 1 (see section 3.2.2.2).

4.1.2.3 Design

Prior to the experiment, participants were randomly assigned to one of four interview conditions (N = 12 in each condition): eyes open during both sessions (open-open); eyes closed during both sessions (closed-closed); eyes open in the first session but closed in the second session (open-closed); or eyes closed in the first session but open in the second session (closed-open).

For the free recall phase, the experiment manipulated two between-subjects variables (eye-closure in each session) and one within-subjects variable (timing of the interview). It employed a 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Time of Test: immediate, delayed) mixed design with repeated measures on the last factor. The dependent variables were the number of correct statements reported and the proportion of statements reported that were correct.

For the cued recall phase, the experiment manipulated two between-subjects independent variables (eye-closure in each session) and one within-subjects independent variable (question modality). The study used a 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Question Modality: visual, auditory) mixed design with repeated measures on the last factor. The dependent variables were identical to Experiment 1.

4.1.2.4 Procedure

All participants arrived individually at a small laboratory and provided informed consent. Participants watched the videotaped event, and engaged in a two-minute distracter task (backwards spelling of animal names). Upon completion, participants provided their first free recall of the event. Participants were instructed to describe the event in as much detail as possible, and were informed that the interviewer would not interrupt their story. Participants in the closed-closed and closed-open conditions were instructed to keep their eyes closed throughout the interview, whereas those in the open-open and open-closed condition received no instructions. If participants in one of the instructed eye-closure conditions inadvertently opened their eyes, they were reminded to keep them closed. None of the participants in the uninstructed conditions spontaneously closed their eyes; all of them were facing the interviewer throughout the interview. All interviews were audio-taped for subsequent analysis. After providing their testimony, participants were dismissed and asked to come back to the laboratory exactly one week later.

Upon arrival at the laboratory one week later, participants were told that they would first provide another free recall of the event, after which they would be asked questions. Participants in the closed-closed and open-closed conditions were instructed to keep their eyes closed throughout the session (with a brief break in-between the free and cued recall phases), whereas participants in the open-open and closed-open conditions received no instructions. However, some of the participants in the latter condition asked if they should close their eyes again, and they were asked to keep their eyes open. Upon completion of the free recall phase, participants answered 16 questions about the video (see Appendix A.1). They were asked to remember as much as possible, but not to guess: a “don’t know” response was allowed. In addition, they were asked to rate their level of confidence in each response on a scale from 1 (not confident at all) to 5 (extremely confident). At the end of the interview, participants were asked whether they had ever seen the TV series before, and were asked to rate how comfortable they had felt during that session on a scale from 1 (not comfortable at all) to 5 (extremely comfortable). Finally, they completed a demographic information sheet, were debriefed, and thanked for their participation.

4.1.2.5 Data Coding

All the audio-taped interviews were transcribed verbatim, and coded blind to interview condition. Prior to the experiment, a list was drawn up including potential statements that could be made about the event, accompanied by their corresponding codes. Any additional statements made by participants were added progressively while coding the free reports. To maximise scoring consistency, all transcripts were coded in line with the codes on the predetermined list. First, the statements provided during free recall were coded as correct, incorrect, or subjective. Because the accuracy of subjective statements could not be determined (e.g., "he was ugly"), these statements were excluded from further coding. Next, the 135 correct and 19 incorrect statements on the list were coded as gist, central detail, or peripheral detail. Figure 4.1 depicts the coding scheme with some example statements, modelled after Thorndyke's (1977) plot structure approach (see Figure 2.1).

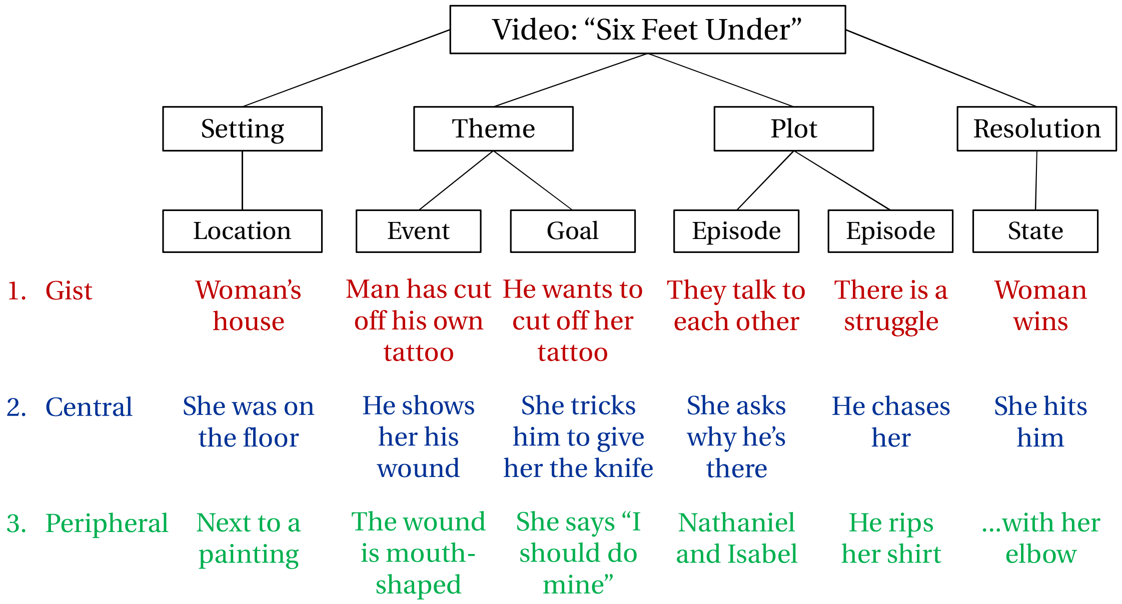

Figure 4.1 Plot structure for "Six Feet Under" video. Example statements from the plot structure used to code statements provided in free recall.

Thus, statements were classified as gist if they referred to the essence of the story and did not reside in a particular sensory domain. Examples of gist in terms of setting, theme, plot, and resolution are provided in Figure 4.1. Only 8 out of the 154 statements on the list were classified as gist. All remaining details were scored as either central or peripheral. Details were coded as central if they pertained to the most important or goal-relevant elements of the video in terms of setting, theme, plot, or resolution. There were 26 possible central details on the list. Details were coded as peripheral if they pertained to less important or goal-irrelevant elements of the video. There were 120 peripheral details on the list. Finally, all central and peripheral details were coded as visual (information that was seen) or auditory (information that was heard; i.e., mostly verbal utterances, but also a few non-verbal sounds). Out of the 146 details, 102 were coded as visual and 44 were coded as auditory. [19]

The immediate and delayed free reports of ten randomly selected participants were scored independently by a second blind coder (401 statements; 19% of the total sample). Inter-rater reliability was deemed to be acceptable for both accuracy (correct, incorrect), $\kappa = .89$, $p < .001$, and centrality of statements (gist, central, peripheral), $\kappa = .96$, $p < .001$. For the 342 statements that were coded as either central or peripheral detail by both coders, inter-rater reliability was very high for modality of details (visual, auditory), $\kappa = .99$, $p < .001$. The codes of the first coder were retained for the main analysis.

For the cued recall phase, responses could be coded as correct, incorrect, or omitted, and all correct responses were coded for grain size as in Experiment 1 (see section 3.2.2.6). Examples of each type of response are provided in Appendix A.1. Because the coding scheme for the questioning phase was identical to the coding scheme used in Experiment 1, no additional attempts were made to assess inter-rater reliability for the cued recall phase.

[19] The statements provided in free report were not coded for grain size. Whereas it is relatively straightforward to determine whether an answer provided in response to a question is a full (fine-grain) or partial (coarse-grain) correct answer to that question, it is relatively difficult to make the same distinction in free recall. For instance, where a description of the door as having "a white frame and glass panes" would be coded as a fine-grain correct response to question 11 in cued recall, it would be scored as two separate correct details in free recall ("white frame" and "glass panes").

4.1.3 Results

This section will first examine number and proportion correct in free recall, with separate analyses based on modality and centrality. In addition, it will assess the number of *new* details reported during the second free recall (reminiscence). Next, it will examine number and proportion correct in delayed cued recall, with separate analyses based on grain size. Finally, it will discuss self-report ratings of confidence and feelings of comfort.

4.1.3.1 Number Correct in Free Recall

Figure 4.2 shows the number of correct visual and auditory statements provided during immediate and delayed free recall. Prior to analysis, the data were inspected for violations of parametric assumptions. Two participants performed exceptionally well, one remembering many correct auditory peripheral details (19 in the first session and 13 in the second session), and the other many correct visual peripheral details (46 in the first session and 31 in the second session). Because these significant outliers skewed the data, each of the values was replaced with the mean plus two standard deviations (Field, 2004), which solved all problems with normality.

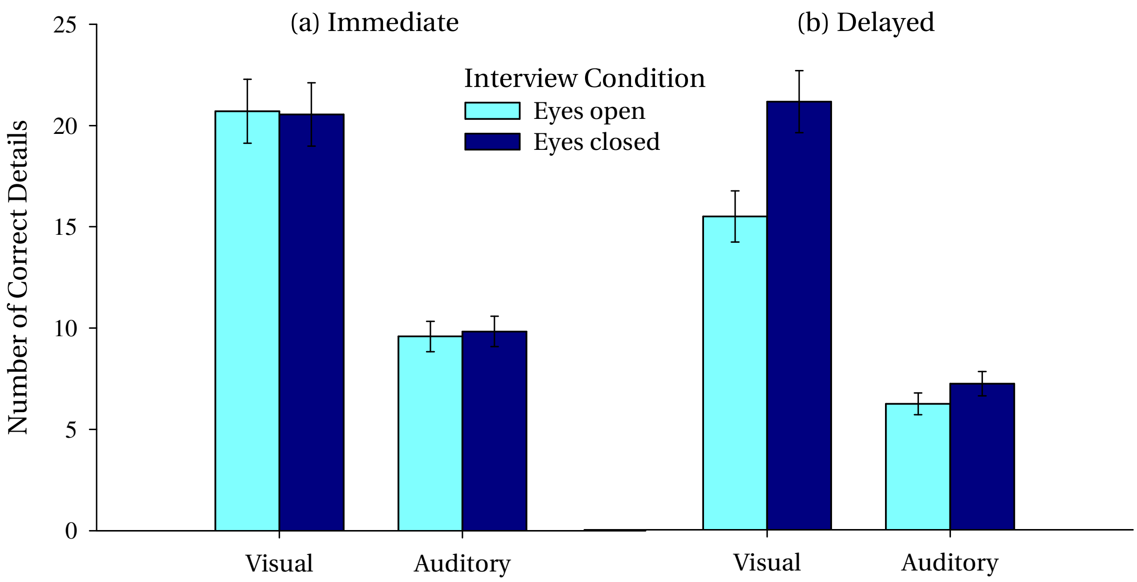

Figure 4.2 Experiment 3: Number correct in free recall. Mean number of correct visual and auditory details, reported during (a) immediate and (b) one-week delayed free recall. Experimental conditions were collapsed over session (e.g., in the immediate session, the eyes-open group is comprised of the open-open and open-closed conditions). Error bars represent standard errors.

First, it was assessed whether eye-closure during the first and second session affected the total number of correct details reported during the first and second free recall phase, respectively. A 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Time of Test: immediate, delayed) mixed ANOVA was conducted on the total number of correct details reported. Participants reported 14.8% fewer details during delayed free recall than during immediate free recall, $F(1, 44) = 62.06$, $p < .001$, $\eta^2 = .55$. There was no significant main effect of eye-closure during the immediate test ($F < 1$) and no significant interaction between immediate eye-closure and time of test ($F < 1$). Thus, as expected, eye-closure during the first session did not affect performance during the second session (i.e., there was no carry-over effect). Surprisingly, it also failed to affect recall performance during the session itself, suggesting that eye-closure during immediate free recall is not an effective retrieval aid (see Figure 4.2).

There was a marginally non-significant main effect of eye-closure during the delayed test, $F(1, 44) = 3.16$, $p = .08$, $\eta^2 = .07$, which was qualified by a significant interaction between delayed eye-closure and time of test, $F(1, 44) = 6.25$, $p < .05$, $\eta^2 = .06$. Simple effects analyses showed that eye-closure during delayed free recall did not affect recall performance during the previous session (which would have been impossible), $F(1, 44) = 1.14$, $p = .29$. However, eye-closure during the delayed session significantly increased the number of correct details reported in that session, $F(1, 44) = 6.12$, $p < .05$, $\eta^2 = .12$, $d = .72$ (see Figure 4.2). There were no other significant interactions (all *F*s < 1).

Because it could not be controlled how many visual and auditory details participants chose to report, modality of details could not be included as an independent variable in the previous analysis. As illustrated in Figure 4.2, on average, participants reported significantly more visual than auditory correct details, $t(47) = 14.10$, $p < .001$, $\eta^2 = .81$. A separate 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Time of Test: immediate, delayed) ANOVA on the number of correct visual details again revealed a significant main effect of delay, $F(1, 44) = 16.93$, $p < .001$, $\eta^2 = .24$, and no significant effects or interactions involving eye-closure during the first session (all *F*s < 1). There was a marginally significant main effect of eye-closure during the second session, $F(1, 44) =$

3.72, $p = .06$, $\eta^2 = .08$, which was qualified by a significant interaction with time of test, $F(1, 44) = 9.08$, $p < .01$, $\eta^2 = .13$. Participants who closed their eyes during the second session reported 36.7% more visual details during that session than participants who kept their eyes open, $F(1, 44) = 7.95$, $p < .01$, $\eta^2 = .15$, $d = .83$. The same three-way ANOVA on the number of correct auditory details revealed a significant main effect of delay, $F(1, 44) = 86.99$, $p < .001$, $\eta^2 = .66$, but no other significant main effects or interactions (all *p*s > .29). In sum, the benefits of eye-closure after a delay were most pronounced for visual details.

To assess whether the effects of eye-closure depend on the centrality of the to-be-remembered information, the data were categorised as gist statements, central details, and peripheral details (see Table 4.1).

Table 4.1 Experiment 3: Number correct by centrality. For each type of statement, the table shows the potential number of statements that could have been recalled, and the average number that was recalled per session. Experimental conditions were collapsed over session.

			Interview Condition	
Statement	**Potential**	**Session**	Eyes open	Eyes closed
Gist	8	First	4.92 (.21)	5.46 (.21)
		Second	5.38 (.26)	5.17 (.24)
Central	26	First	12.83 (.53)	12.33 (.60)
		Second	10.5 (.53)	12.58 (.61)
Peripheral	120	First	17.46 (1.83)	18.04 (1.64)
		Second	11.17 (1.33)	15.75 (1.67)

Note. Standard errors in parentheses.

A separate 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Time of Test: immediate, delayed) ANOVA on gist statements revealed no significant main effects or interactions (all *p*s > .11). For central details, the ANOVA revealed a significant decrease as a result of delay, $F(1, 44) = 11.28$, $p < .01$, $\eta^2 = .17$. Furthermore, there was a significant interaction between eye-closure during the second session and time of test, F (1, 44) = 9.55, $p < .01$, $\eta^2 = .15$. Participants who closed their eyes during the second session recalled 19.8% more central details during that session than participants who kept their eyes open (see Table 4.1), and simple effects analyses showed that this difference was significant, F (1, 44) = 6.60, $p < .05$, $\eta^2 = .13$, $d = .74$. No other significant main effects or interactions were found for central details (all ps > .14). For peripheral details, the ANOVA again revealed a significant decrease as a result of delay, F (1, 44) = 54.47, $p < .001$, $\eta^2 = .54$, but no other significant effects or interactions (all ps > .09). Nevertheless, simple effects analyses[20] showed that the 41.0% increase in peripheral details associated with eye-closure in the second session was significant, F (1, 44) = 4.47, $p < .05$, $\eta^2 = .09$, $d = .62$. In sum, the benefits of eye-closure after a delay were observed for recall of central and peripheral details, but not for recall of gist.

4.1.3.2 Proportion Correct in Free Recall

Participants generally volunteered few incorrect details in free recall ($M = 1.85$, $SD = .89$). To calculate testimonial accuracy, the number of correct statements was divided by the total number of statements provided in free recall. Testimonial accuracy in free recall was close to ceiling in all interview conditions (see Figure 4.3). Prior to analysis, problems with normality were solved by inverting and square root transforming all proportions.

A 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) x 2 (Time of Test: immediate, delayed) ANOVA on the transformed proportions revealed a significant decrease in accuracy as a result of delay, F (1, 44) = 12.35, $p < .01$, $\eta^2 = .22$, but no other significant effects or interactions (all Fs < 1). Separate ANOVAs for visual and auditory statements revealed no significant effects or interactions (all ps > .08). Thus, eye-closure during the second session increased the amount of information provided in that session without decreasing the accuracy of that information.

[20] The interaction between eye-closure during the second session and time of test failed to reach significance because participants who closed their eyes during the second session also tended to have reported more peripheral details in the first session. Of course, it is impossible for eye-closure to have an effect backwards in time, and simple effects analyses confirmed that this tendency was not significant, F (1, 44) = 1.48, $p = .23$.

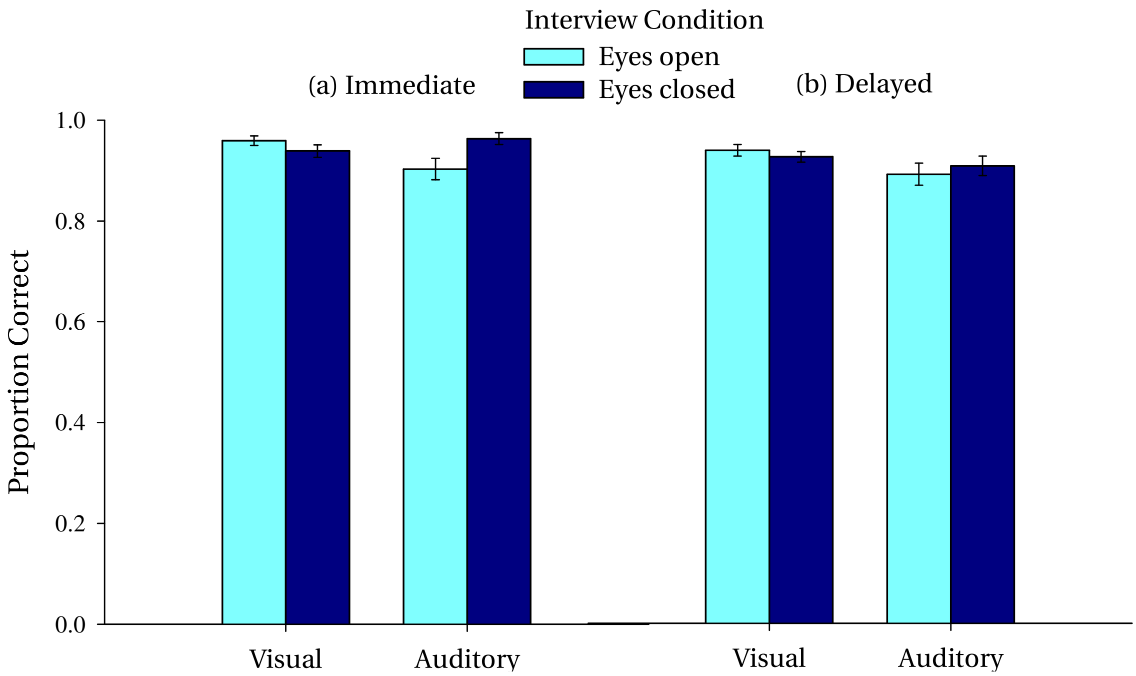

Figure 4.3 Experiment 3: Proportion correct in free recall. Mean proportion of visual and auditory details that were correct, reported during (a) immediate and (b) one-week delayed free recall. Experimental conditions were collapsed over session. Error bars represent standard errors.

4.1.3.3 Reminiscence

One of the most important goals of conducting multiple interviews is to elicit new information that was not reported during an earlier interview. For this reason, it was examined whether eye-closure affected the number and accuracy of *new* details obtained during the second free recall (i.e., reminiscence). Out of the 48 participants, 47 reported at least one new detail during the second free recall, and 45 reported at least one new detail that were correct. On average, participants recalled 4.54 (SD = 3.01) new correct details and 1.40 (SD = 1.05) new incorrect details.

First, a 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) ANOVA was conducted on the *number* of correct new details added during delayed free recall. Participants who closed their eyes during the second session recalled significantly more correct new details than participants who kept their eyes open, F (1, 44) = 5.43, $p < .05$, η^2 = .10, d = .67. There were no other significant effects (both ps > .11). Separate ANOVAs for visual and auditory details showed that eye-closure during the second session nearly doubled the number of correct new visual details recalled (from 2.54 on average in the eyes-open condition to 4.83 in the eyes-closed condition), F (1, 44) = 9.56, $p < .01$, $\eta^2 = .17$, $d = .88$, whereas it had no significant effect on correct new auditory details, F (1, 44) = 2.23, $p = .14$.

Second, a 2 (Immediate Condition: eyes open, eyes closed) x 2 (Delayed Condition: eyes open, eyes closed) ANOVA on the *proportion* of new details that were correct revealed no significant effects of eye-closure during either session (all Fs < 1). Similarly, separate ANOVAs on proportion correct for visual and auditory new details, respectively, revealed no significant effects (all Fs < 1). In sum, eye-closure during delayed free recall did not simply help witnesses to repeat previously reported information, but actually increased the amount of *new* visual information obtained, without affecting the testimonial accuracy of that information.

4.1.3.4 Number Correct in Cued Recall

Figure 4.4 shows the total number of correct responses (i.e., fine-grain plus coarse-grain) as a function of eye-closure during questioning.[21]

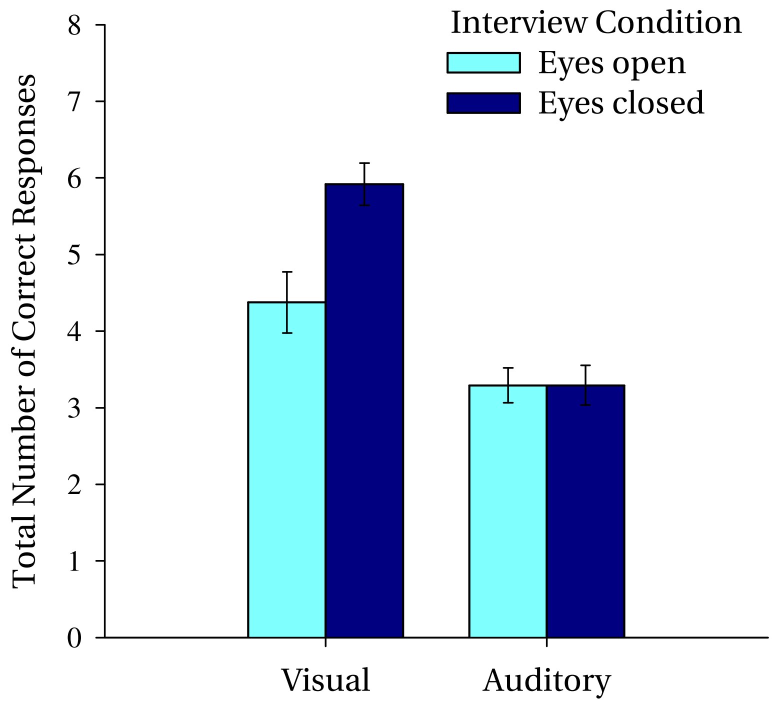

Figure 4.4 Experiment 3: Total correct in cued recall. Mean total number of correct responses to questions about visual and auditory aspects of the event, provided by participants with eyes open or closed during questioning. Error bars represent standard errors.

[21] Because none of the analyses revealed any effects of eye-closure during the first session on cued recall performance during the second session, this variable is not included in the Figures presented in this section.

A 2 (Immediate Condition: eyes closed, eyes open) x 2 (Delayed Condition: eyes closed, eyes open) x 2 (Question Modality: visual, auditory) mixed ANOVA on the total number of correct responses revealed a significant main effect of question modality, F (1, 44) = 41.91, p < .001, η^2 = .43. Participants gave significantly more correct responses to questions about visual details than about auditory details. Eye-closure during the first interview had no significant effect on cued recall performance a week later, F (1, 44) = 2.62, p = .11. Participants who closed their eyes during questioning, however, provided significantly more correct responses, F (1, 44) = 6.77, p < .05, η^2 = .13, d = .74. This main effect was qualified by a significant interaction between delayed eye-closure and question modality, F (1, 44) = 7.24, p < .05, η^2 = .07. Simple effects analyses showed that eye-closure during questioning significantly increased correct recall of visual aspects, F (1, 44) = 10.06, p < .01, η^2 = .19, d = .92, whereas it did not affect recall of auditory aspects (F < 1). All other interactions were non-significant (all ps > .10).

4.1.3.5 Fine-Grain Correct in Cued Recall

Figure 4.5 shows the number of fine-grain correct responses provided.

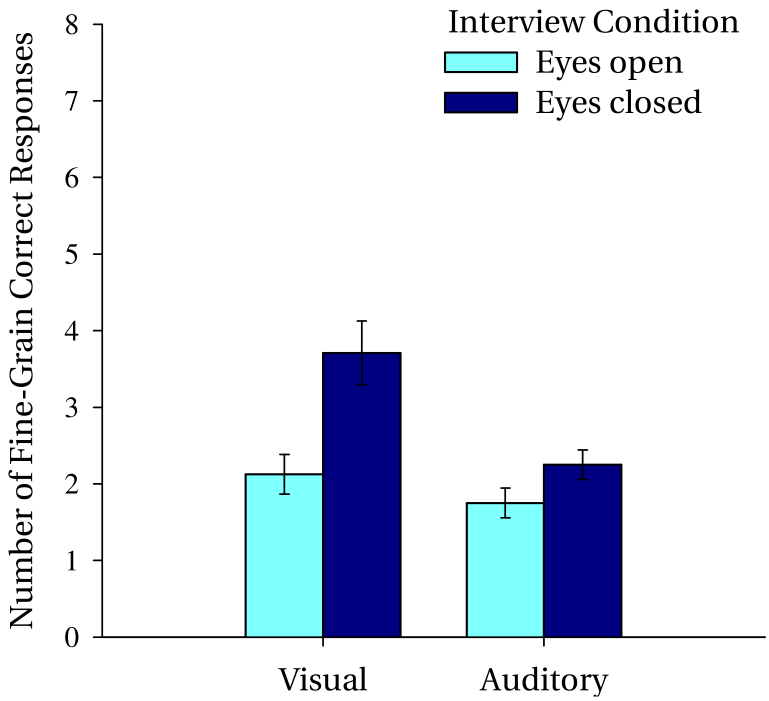

Figure 4.5 Experiment 3: Fine-grain correct in cued recall. Mean number of fine-grain correct responses to questions about visual and auditory aspects of the event, provided by participants with eyes open or closed during questioning. Error bars represent standard errors.

A 2 (Immediate Condition: eyes closed, eyes open) x 2 (Delayed Condition: eyes closed, eyes open) x 2 (Question Modality: visual, auditory) ANOVA on fine-grain correct recall showed a main effect of modality, F (1, 54) = 10.68, $p < .01$, $\eta^2 = .18$, with more fine-grain answers pertaining to visual details than to auditory details. Eye-closure during the first session had no significant effect on delayed fine-grain recall, F (1, 44) = 2.22, $p = .14$, but there was a significant main effect of eye-closure during questioning, F (1, 54) = 13.88, $p < .001$, $\eta^2 = .22$, $d = 1.07$. Participants who closed their eyes during questioning gave substantially more fine-grain correct responses than participants with eyes open. There was a marginally significant interaction between delayed eye-closure and modality, F (1, 44) = 3.73, $p = .06$, $\eta^2 = .06$, suggesting that eye-closure during questioning was more effective for fine-grain correct recall of visual information, F (1, 44) = 10.22, $p < .01$, $\eta^2 = .19$, $d = .94$, than for fine-grain correct recall of auditory information, F (1, 44) = 3.65, $p = .06$, $\eta^2 = .08$, $d = .53$. All other interactions were non-significant (all ps > .30).

4.1.3.6 Coarse-Grain Correct in Cued Recall

Figure 4.6 shows the number of coarse-grain correct responses provided.

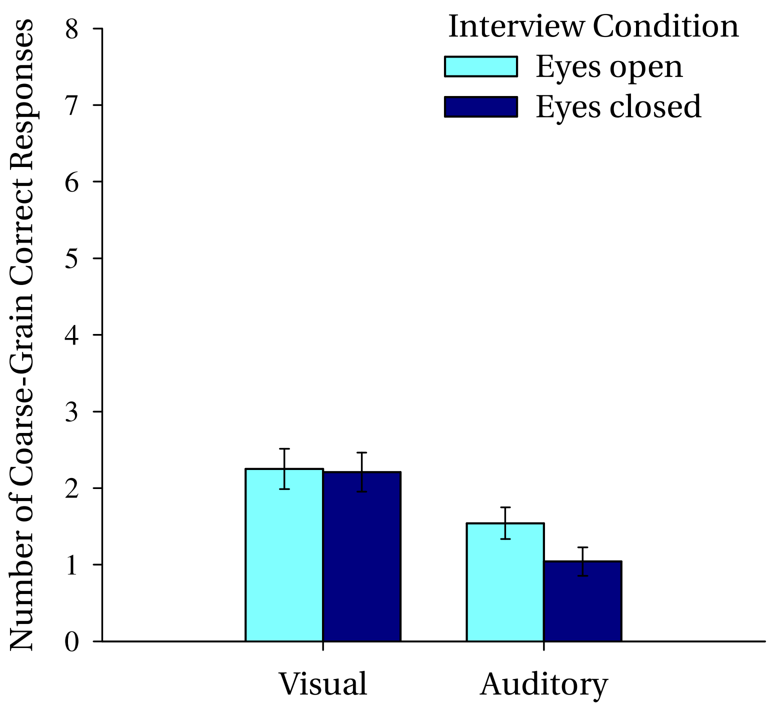

Figure 4.6 Experiment 3: Coarse-grain correct in cued recall. Mean number of coarse-grain correct responses to questions about visual and auditory aspects of the event, provided by participants with eyes open or closed during questioning. Error bars represent standard errors.

A 2 (Immediate Condition: eyes closed, eyes open) x 2 (Delayed Condition: eyes closed, eyes open) x 2 (Question Modality: visual, auditory) ANOVA on coarse-grain correct recall revealed only a significant main effect of modality, $F(1, 54) = 13.88$, $p < .001$, $\eta^2 = .22$, with more coarse-grain responses to questions about visual details than to questions about auditory details. All other effects were non-significant (all *p*s > .23), which might have been due to floor effects. In sum, closing the eyes during questioning helped participants to provide more fine-grain correct responses (particularly about visual aspects of the event), but did not significantly affect the number of coarse-grain correct responses provided.

4.1.3.7 Proportion Correct in Cued Recall

On average, participants gave 3.27 incorrect responses (*SD* = 1.51; see Appendix A.1). Figure 4.7 shows the proportion of responses that were correct.

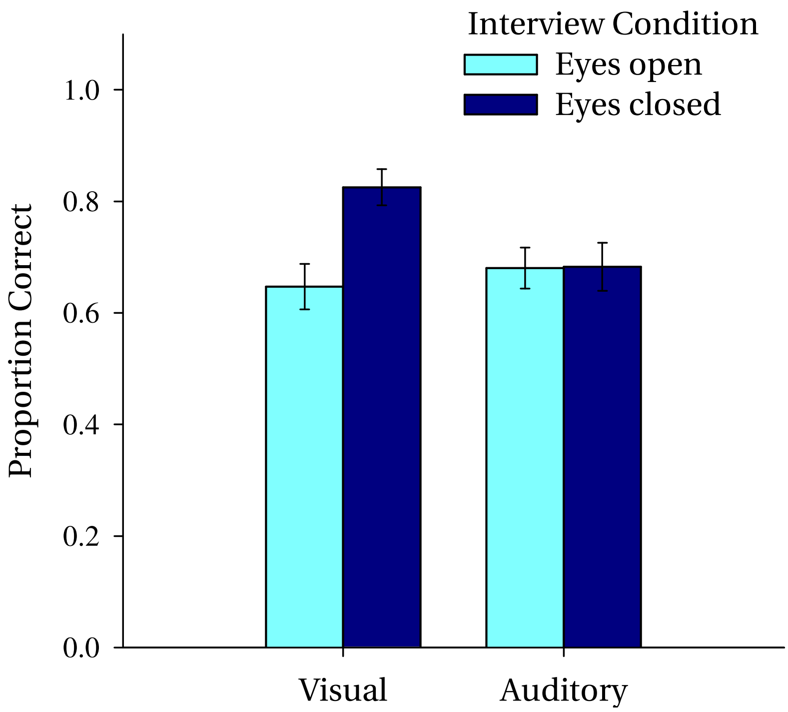

Figure 4.7 Experiment 3: Proportion correct in cued recall. Mean proportion of answers that were correct, in response to questions about visual and auditory aspects of the event, provided by participants with eyes open or closed during questioning. Error bars represent standard errors.

A 2 (Immediate Condition: eyes closed, eyes open) x 2 (Delayed Condition: eyes closed, eyes open) x 2 (Question Modality: visual, auditory) ANOVA on proportion correct revealed no main effects of modality, $F(1, 44) = 1.78$, $p = .19$, or of eye-closure during the first session, $F(1, 44) = 1.07$, $p = .31$, but there was a significant main effect of eye-closure during the second session, $F(1, 44) = 6.37$, $p < .05$, $\eta^2 = .12$, $d = .77$. As illustrated in Figure 4.7, participants who closed their eyes during questioning were significantly more accurate than participants who kept their eyes open. Furthermore, there was a significant interaction between eye-closure during questioning and question modality, $F(1, 44) = 4.60$, $p < .05$, $\eta^2 = .09$. Simple effects analyses showed that the increase in testimonial accuracy associated with eye-closure during questioning was significant for questions about visual details, $F(1, 44) = 11.39$, $p < .01$, $\eta^2 = .21$, $d = .99$, but not for questions about auditory details ($F < 1$). All other interactions were non-significant (all *p*s > .19).

4.1.3.8 Confidence

Confidence ratings were obtained for all answered questions. For the sake of simplicity, fine-grain and coarse-grain correct responses were combined into one ‘correct’ category. Preliminary analyses revealed that eye-closure during the first session did not affect confidence ratings provided during questioning in the second session; therefore, the analyses reported here only concern the effect of eye-closure during the second session. First, average confidence ratings for correct and incorrect responses were examined. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Type of Response: correct, incorrect) mixed ANOVA with repeated measures on the last factor was conducted on mean confidence ratings. There was a significant main effect of type of response, $F(1, 46) = 48.20$, $p < .001$, $\eta^2 = .51$, with higher confidence ratings for correct responses ($M = 3.35$, $SD = .63$) than for incorrect responses ($M = 2.56$, $SD = .71$). There was no significant effect of eye-closure ($F < 1$) and no interaction between eye-closure and type of response ($F < 1$). Thus, unlike Experiment 2, eye-closure in the present study did not affect mean confidence ratings.

Second, it was investigated whether a generally confident rememberer in the present study was also likely to be generally accurate. The average confidence rating per participant was significantly correlated with proportion correct for that participant, r = .40, p < .01. Separate analyses for each interview condition revealed that the general confidence-accuracy (CA) correlation was significant and large for the eyes-closed group, r = .60, p < .001, whereas it was not significant for the eyes-open group, r = .26, p = .22. However, these correlation coefficients did not differ significantly, Fisher's z = 1.37, p = .17.

Third, point-biserial correlations between the confidence rating for a particular response and accuracy of that response (correct or incorrect) were calculated. All participants together provided 562 responses in total, which were used to calculate the specific CA correlation. Overall, there was a significant medium-sized specific CA correlation, r_{pb} = .33, p < .001. In other words, a particular response expressed with high confidence was relatively likely to be accurate. Separate analyses for the eyes-open condition (N = 273) and the eyes-closed condition (N = 289) showed that eye-closure did not significantly affect the specific CA correlation, Fisher's z = .37, p = .75 (eyes-open: r_{pb} = .34, p < .001; eyes-closed: r_{pb} = .32, p < .001). In sum, across interview conditions, responses that were expressed with high confidence were also moderately likely to be accurate.

Fourth, the calibration graph shown in Figure 4.8 reveals that participants were again generally underconfident in their responses, achieving a higher percentage correct than would have been expected on the basis of their confidence ratings. As in Experiment 2, this underconfidence was somewhat more pronounced for the eyes-closed group than for the eyes-open group, although the group differences in the present study were smaller.

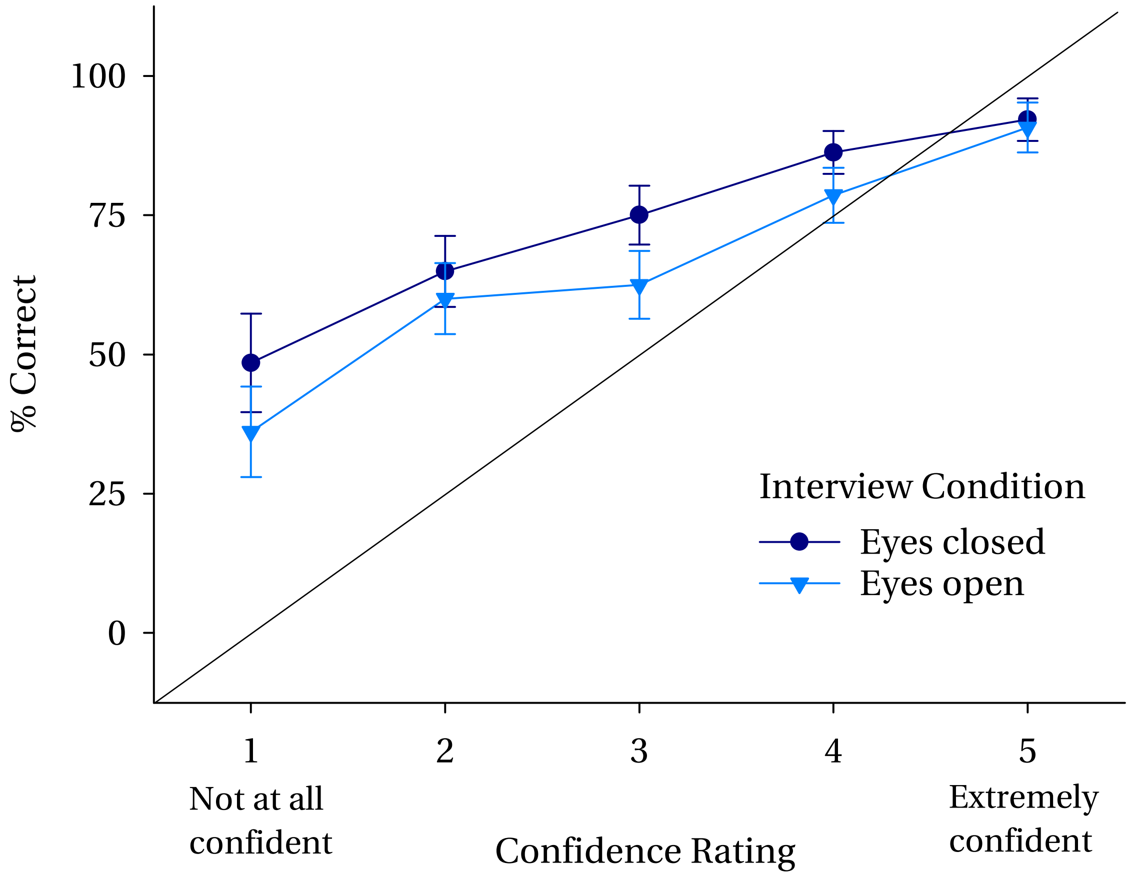

Figure 4.8 Experiment 3: Confidence-accuracy calibration. Mean percentage correct by confidence rating for the eyes-open and eyes-closed conditions. The black line denotes perfect calibration. Errors bars represent standard errors.

4.1.3.9 Feelings of Comfort

At the end of the second session, participants were asked to rate on a five-point scale how comfortable they had felt during that session. As shown in Table 4.2, the lower end of the scale was used infrequently. Therefore, prior to analysis, self-report ratings were collapsed into a dichotomous variable, comparing participants who reported being extremely comfortable (i.e., ratings of 5; N = 17) with participants who were less than extremely comfortable (ratings of below 5; N = 31). In terms of this dichotomous variable, closing the eyes or keeping the eyes open during the second session did not significantly affect how comfortable participants felt during that session, χ^2 (1) = .82, p = .55.

Table 4.2 Experiment 3: Ratings of comfort. Frequency of comfort ratings on a five-point scale, by participants with their eyes open or closed during the second session.

	not comfortable at all		**Comfort** ⟵⟶		*extremely comfortable*
Interview Condition	*1*	*2*	*3*	*4*	*5*
Eyes open	0	0	1	13	10
Eyes closed	0	2	4	11	7
Total	*0*	*2*	*5*	*24*	*17*

Next, it was examined whether ratings of comfort during the second session correlated with recall performance in that session. First, point-biserial correlations[22] were inspected between the dichotomous comfort variable and the number and proportion correct in free recall. Neither of the correlations reached Bonferroni-corrected levels of significance ($\alpha = .025$; number correct: $r_{pb} = .26$, $p = .08$; transformed proportion correct: $r_{pb} = .11$, $p = .46$). However, in terms of cued recall performance, dichotomous comfort ratings were significantly correlated with the number of correct responses, $r_{pb} = .37$, $p < .01$, and marginally correlated with the proportion of responses that were correct, $r_{pb} = .31$, $p = .03$. In other words, participants who reported feeling extremely comfortable were more likely to have performed well during questioning than participants who reported feeling less than extremely comfortable.

4.1.4 Discussion

The present data show that, whereas eye-closure during immediate free recall had no direct or carry-over effects on recall performance, eye-closure during the one-week delayed interview substantially increased the amount of visual information obtained from witnesses in both free and cued recall. In delayed free recall, eye-closure increased the number of correct visual details reported by 36.7%. In delayed cued recall, eye-closure increased correct recall of visual aspects by 35.3%, and fine-grain correct recall of visual aspects by 42.7%. This

[22] I calculated the more conservative point-biserial correlations instead of biserial correlations, because it was not clear that the continuous dichotomy underlying the comfort variable was normally distributed (see e.g., Howell, 1997, p. 288).

section will first discuss the role of delay and repeated retrieval, followed by a consideration of the type of information enhanced by eye-closure. The section will conclude with a brief discussion of the findings concerning confidence ratings and feelings of comfort. A comparison between free and cued recall will be reported in section 7.2.2.

4.1.4.1 Delay and Repeated Retrieval

Let us first consider the effect of eye-closure in the first session. Unexpectedly, eye-closure during immediate free recall did not increase the amount of information reported during that session. Given that Perfect et al. (2008) showed that eye-closure was effective in immediate free recall, it is unclear why this effect was not observed in the present experiment. However, rather than dwell on these findings here, I will address this issue in section 7.2.2, after further relevant evidence from Experiment 6 has been presented. Another possibility under examination in the present study was that eye-closure during the first session would 'protect' the memory against forgetting (Gabbert et al., 2009; Hope et al., 2011), thereby enhancing subsequent recall performance. However, as in previous research with the Cognitive Interview (Brock et al., 1999; McCauley & Fisher, 1995; Memon et al., 1997), no such carry-over effects were observed; neither in free recall nor in cued recall after a week.

Let us now consider recall performance in the second session. First of all, in line with previous research (e.g., Lipton, 1977; Turtle & Yuille, 1994), witnesses in the present study reported significantly less information and were significantly less accurate in free recall after a week had passed. However, witnesses who closed their eyes during delayed free recall remembered significantly more visual information than witnesses who kept their eyes open. Inspection of the number of *new* details reported during the second free recall phase revealed that eye-closure did not just help witnesses to retain the information that they had already reported during the first interview, but also helped them to recall *new* accurate visual details that had not been reported previously. Obtaining new information is one of the main purposes of conducting multiple eyewitness interviews (Turtle & Yuille, 1994). The present data suggest that instructing witnesses to close their eyes during a repeated interview can help the police to achieve this goal.

Eye-closure during questioning substantially increased both the number and the proportion of correct responses, particularly for questions about visual aspects of the event. Because there was no immediate questioning phase in the present study, the effects of eye-closure during delayed cued recall cannot be compared directly to an immediate cued recall phase. However, it is noteworthy that eye-closure during immediate cued recall about the same event in Experiment 1 increased the total number of correct responses about visual aspects by 'only' 18.2%, whereas eye-closure during delayed cued recall in the present experiment increased correct recall of visual aspects by 35.5%. Because this observation is based on a comparison across two experiments that involved different conditions (most notably, the presence of two free recall attempts prior to questioning in the present experiment), it should be interpreted with the appropriate caution. Nevertheless, it seems that the eye-closure instruction is at least no *less* effective after a delay.

Like mental context reinstatement and the Cognitive Interview (cf. Cutler et al., 1987a; Larsson, Granhag, & Spjut, 2003; Memon, Meissner, et al., 2010), eye-closure might be particularly successful at enhancing retrieval performance after a delay. Glenberg et al. (1998) found that people tend to avert gaze more for retrieval of memories from the distant past than for retrieval of recent memories. Smith (1988) argued that providing retrieval cues (for instance via mental context reinstatement or eye-closure) will be most beneficial in a situation in which relatively few retrieval cues are available. Because accessibility to retrieval cues deteriorates with the passage of time, retrieval aids such as eye-closure should thus be most effective after a delay. Indeed, the eye-closure effect observed in delayed recall in the present experiment seemed to be somewhat more substantial than the eye-closure effects observed in immediate recall in the previous experiments (see also section 7.2.2). However, it should be noted that the role of delay in the present study was confounded with the number of retrieval attempts. To tease apart the effects, future research should manipulate the role of delay and repeated recall attempts independently. For the present purposes of enhancing ecological validity, however, the most important finding was that eye-closure was still highly effective after a one-week delay and repeated recall attempts.

4.1.4.2 Type of Information

It is clear from the present findings that eye-closure has the greatest benefits for the recall of visual information. Witnesses who closed their eyes during the delayed interview recalled 36.7% more visual information in free recall and 35.5% more visual information in cued recall, whereas eye-closure had no significant benefits for the recall of auditory information. In addition, as in Experiment 2, the benefits of eye-closure in cued recall were observed for fine-grain correct responses but not for coarse-grain correct responses about visual aspects. The role of modality and grain size in the eye-closure effect will be examined in more detail in Chapter 6, which is concerned with the theoretical underpinnings of eye-closure.

In addition, the coding scheme in free recall allowed for a distinction between gist, central details, and peripheral details. Whereas eye-closure during the second session did not affect the reporting of gist, it significantly increased the reporting of both central and peripheral information. From an applied perspective, this is a promising finding, since it shows that the eye-closure instruction may enhance recall of information that is potentially important in a criminal investigation. In Experiment 6, the type of information reported in free recall will be examined in even more detail. Therefore, further discussion of the type of information reported in free recall that may be enhanced by eye-closure will be deferred to the final chapter (section 7.2.4).

4.1.4.3 Testimonial Accuracy

As predicted, the testimonial accuracy of witnesses' testimony tended to be higher in free recall (mean proportion correct: .94) than in cued recall (mean proportion correct: .72), in line with Koriat and Goldsmith's (1996) strategic control model. Furthermore, whereas eye-closure during the second session significantly increased the proportion correct in cued recall, it did not affect the proportion correct in free recall. Thus, when the number of incorrect details is completely independent from the number of correct details reported, eye-closure does not seem to improve testimonial accuracy. Nevertheless, unlike hypnosis, it also does not *decrease* testimonial accuracy, which is an important finding from an applied point of view. Testimonial accuracy will be discussed in more detail in the final chapter (section 7.2.3).

Although reporting of incorrect details was relatively rare in free recall, the false information that was reported was again remarkably consistent across participants. Across all 48 participants, only 19 incorrect statements were reported in total. Among these statements, the ones that seemed to be most consistently reported were again violent in nature, for instance that the man pushed the woman up against the wall, that he said he was going to kill her, and that he cut open her shirt with the knife. As mentioned in section 3.2.4.2, some of these statements were also reported in response to specific questions. The present findings show that these violent false memories tend to be reported even in the absence of specific questions, suggesting that shared event scripts of violent acts may have a quite powerful influence on memory for violent events (see also section 3.4.3).

4.1.4.4 Confidence

Eye-closure during questioning in the present study did not reduce witnesses' overall confidence in their responses. This finding is in line with Wagstaff et al.'s (2010) findings, but at odds with the findings reported in Experiment 2. However, as in Experiment 2, witnesses who closed their eyes in the current study failed to adjust their confidence levels upward to reflect their superior accuracy, which resulted in an increased level of underconfidence compared to witnesses who kept their eyes open. Nevertheless, an increase in underconfidence is probably preferable to the increase in overconfidence associated with hypnosis (e.g., Wagstaff et al., 2004), because the practical consequences of underconfidence tend to be less severe than those of overconfidence. The influence of eye-closure on confidence ratings will be addressed in more detail in the final chapter (section 7.2.5), once all the relevant findings have been presented.

4.1.4.5 Feelings of Comfort

Most participants in the present study reported feeling very or extremely comfortable during the interview. Interestingly, participants who reported feeling extremely comfortable during the second session (5 out of 5) were more likely to have performed well during questioning than participants who reported feeling somewhat less comfortable (2, 3, or 4 out of 5). However, it is unclear whether increased feelings of comfort improved recall performance, or conversely, whether higher recall performance increased participants' subsequent ratings of comfort.

There was no evidence that eye-closure affected participants' self-reported feelings of comfort. Thus, the data supported neither the idea that eye-closure reduces social pressure (cf. Markson & Paterson, 2009), nor the idea that it makes people feel uncomfortable (cf. Doherty-Sneddon et al., 2001). It should be noted, however, that the self-report ratings obtained in the present study may not have accurately reflected the level of comfort actually experienced by participants (cf. Blackhart, Brown, Clark, Pierce, & Shell, 2011). First, retrospective introspection may not have offered adequate insight into their feelings during the interview. Second, ironically, participants may not have felt comfortable enough to indicate that they were uncomfortable during the interview. Therefore, the self-report findings in the present study do not exclude the possibility that eye-closure affects how comfortable witnesses feel.

4.1.4.6 Conclusion

The finding that eye-closure was still highly effective after a week is promising from an applied perspective, since eyewitnesses in real life typically experience substantial delays. Furthermore, eye-closure facilitated recall of previously unreported visual information, thereby increasing the overall amount of relevant information obtained from witnesses across interviews. However, the finding that eye-closure did not affect immediate free recall is surprising. Experiment 6 will also include an immediate free recall phase, to assess the consistency of this finding. Before turning to this experiment, however, the next chapter will examine the theoretical underpinnings of the eye-closure effect.

4.2 Chapter Summary

- Eye-closure improved free and cued recall after a one-week delay, but did not affect free recall after a few minutes.
- Eye-closure increased the amount of information reported in delayed free recall without harming testimonial accuracy of that information.
- Eye-closure was particularly beneficial for recall of visual information, and increased the report of both central and peripheral details.
- Eye-closure increased fine-grain correct but not coarse-grain correct responses about visual aspects of the witnessed event.
- Unlike hypnosis, eye-closure tended to reduce rather than inflate confidence in incorrect responses.

Chapter 5

Environmental Distractions

5.1 Introduction

This chapter presents two experiments looking into the nature of the impairment in eyewitness memory caused by visual and auditory distractions in the interview environment. In light of the finding that eye-closure improves recall of visual information, Experiment 4 investigated whether “ear-closure” improves recall of auditory information. To increase the realism of the interview and to compare visual and auditory distractions in the environment directly, Experiment 5 manipulated each independently in a face-to-face interview.

5.2 Experiment 4: Irrelevant Speech

5.2.1 Introduction

In all of the experiments presented thus far, eye-closure had the greatest benefits for recall of visual information. From a theoretical point of view, the next question was: if eye-closure predominantly improves recall of visual information, does “ear-closure” predominantly improve recall of auditory information? The present experiment compared an “ear-closure” condition, in which participants wore noise-reducing headphones, with an auditory-distraction condition, in which participants were exposed to irrelevant speech. Due to the absence of an “ears-open” control condition, the experimental design in the present study was not an exact auditory parallel of the experimental design used to study eye-closure in the previous experiments. For this reason, the findings will be discussed in terms of the impairment caused by irrelevant speech, rather than in terms of the benefits caused by "ear-closure".

5.2.1.1 Irrelevant Speech

Most 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 research. 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. In sum, the current study was the first to present irrelevant speech during retrieval of memories about a witnessed event.

5.2.1.2 Modality-Specific Interference

The studies discussed above were concerned with the impact of irrelevant speech on the short-term retention of simple stimuli or the long-term retention of text passages. The irrelevant speech effect has not been studied in relation to retrieval of visual and auditory images from long-term memory. However, Baddeley and Andrade (2000) have investigated the impact of concurrent counting on the *vividness* of visual and auditory imagery. Counting, a task which involves the phonological loop (Baddeley, 2007), was found to interfere more with the vividness of auditory images retrieved from long-term memory than with the vividness of visual images. Tasks involving the visuospatial sketchpad, on the other hand (e.g., spatial tapping), were found to interfere more with the vividness of visual images than with the vividness of auditory images. In light of these findings, it is hypothesised that irrelevant speech (which also involves the phonological loop; Baddeley & Logie, 1992) will also interfere more with the vividness of auditory images than with the vividness of visual images. Because mental imagery tends to facilitate memory retrieval (see section 2.3.2.2), it is expected that this decline in vividness will be reflected in recall performance for questions about auditory aspects of the witnessed event.

5.2.1.3 Aims and Hypotheses

The aim of the present experiment was to examine whether auditory distractions in the interview environment impair recall performance. In line with findings on the irrelevant speech effect (e.g., Banbury & Berry, 1998), irrelevant speech was expected to impair overall recall performance. Furthermore, consistent with findings of modality-specific interference on vividness of imagery (Baddeley & Andrade, 2000), it was hypothesised that irrelevant speech would impair recall of auditory information more than recall of visual information.

5.2.2 Method

5.2.2.1 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.

5.2.2.2 Materials

The videotaped event was identical to the video used in Experiment 1 (see section 3.2.2.2). 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.

5.2.2.3 Design

The experiment manipulated one between-subjects independent variable (irrelevant speech) and one within-subjects independent variable (question modality). It used a 2 (Experimental Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) mixed design with repeated measures on the last factor. The dependent variables were identical to Experiment 1.

5.2.2.4 Procedure

All participants were tested individually in a small laboratory. After signing an informed consent form, participants watched the video and engaged in a two-minute distracter task involving the backwards spelling of animal names. After completing the 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 A.1).

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 session, they were asked whether they had seen the TV series before (none of them had), and were thanked and debriefed.

5.2.2.5 Data Coding

The completed answer sheets were coded blind to experimental condition. Responses could be coded as correct, incorrect, or omitted, and all correct responses were coded for grain size as in Experiment 1 (see section 3.2.2.6). Examples of each type of response are provided in Appendix A.1. Because the coding scheme was identical to the coding scheme used in Experiment 1, no additional attempts were made to assess inter-rater reliability.

5.2.3 Results

In this section, the effects of experimental condition will be presented in terms of the total number of correct responses, the number of fine-grain correct responses, the number of coarse-grain correct responses, and the proportion of responses that were correct.[23]

[23] Unlike in the previous experiments, confidence ratings were not obtained in the present experiment because it took place before I became aware of the importance of confidence.

5.2.3.1 Total Number Correct

Figure 5.1 displays the total number of correct responses (fine- plus coarse-grain) provided by participants.

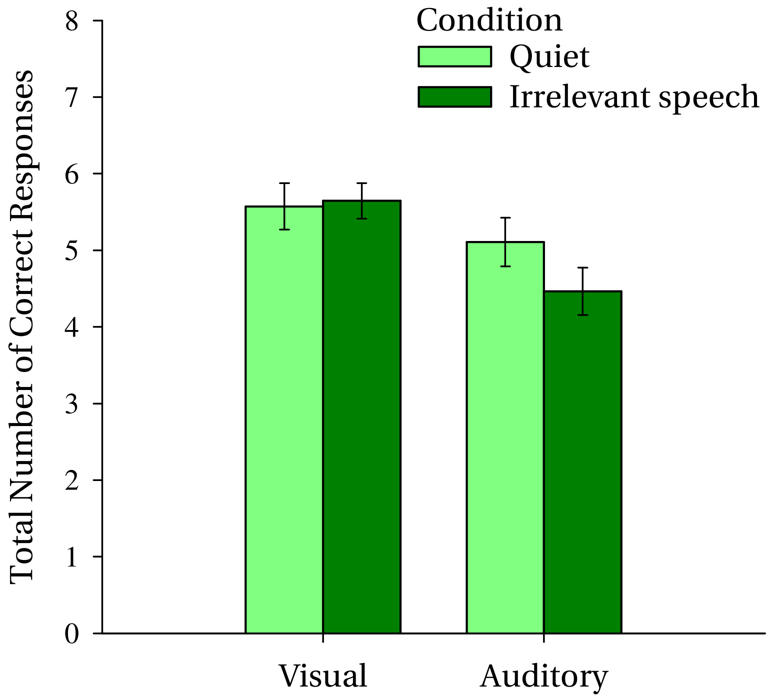

Figure 5.1 Experiment 4: Total number correct. Mean total number of correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Experimental Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) mixed ANOVA on the total number of correct responses revealed a significant main effect of question modality, F (1, 54) = 10.35, $p < .01$, $\eta^2 = .16$: participants gave significantly more correct responses to questions about visual details than to questions about auditory details. Although the data pattern displayed in Figure 5.1 was in the expected direction, there was no significant effect of experimental condition ($F < 1$), and no significant interaction between condition and modality, F (1, 54) = 3.57, p = .17.

5.2.3.2 Fine-Grain Correct

The number of fine-grain correct responses is displayed in Figure 5.2.

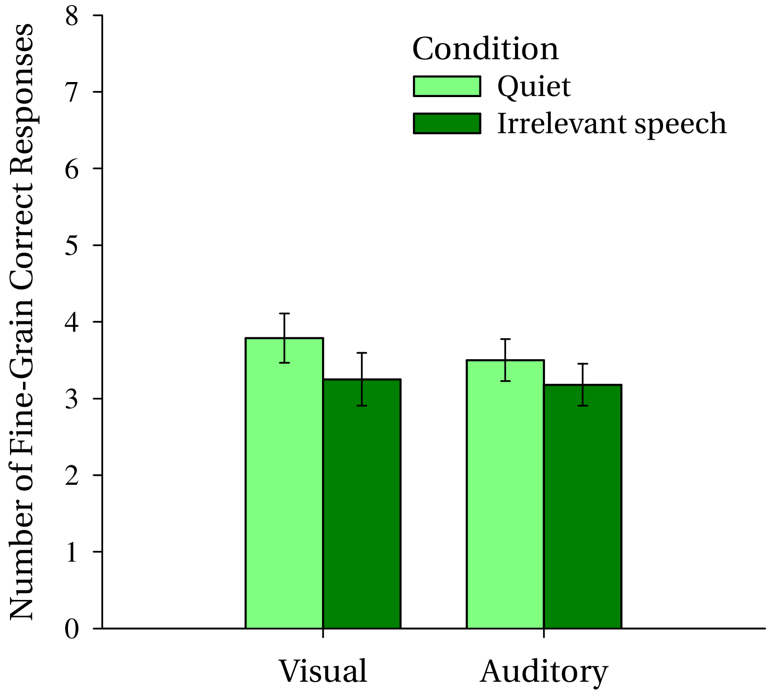

Figure 5.2 Experiment 4: Fine-grain correct. Mean number of fine-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Experimental Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) ANOVA on fine-grain correct responses revealed no significant effects of modality ($F < 1$), experimental condition, $F(1, 54) = 1.61$, $p = .21$, and no interaction between the two ($F < 1$). Thus, unlike participants in Experiments 1 and 3, participants in the present study did not provide significantly more fine-grain correct responses about visual aspects of the video than about auditory aspects. Furthermore, although there was a non-significant tendency for irrelevant speech to decrease fine-grain correct recall, there was no hint of an interaction with question modality.

5.2.3.3 Coarse-Grain Correct

Figure 5.3 shows the number of coarse-grain correct responses.

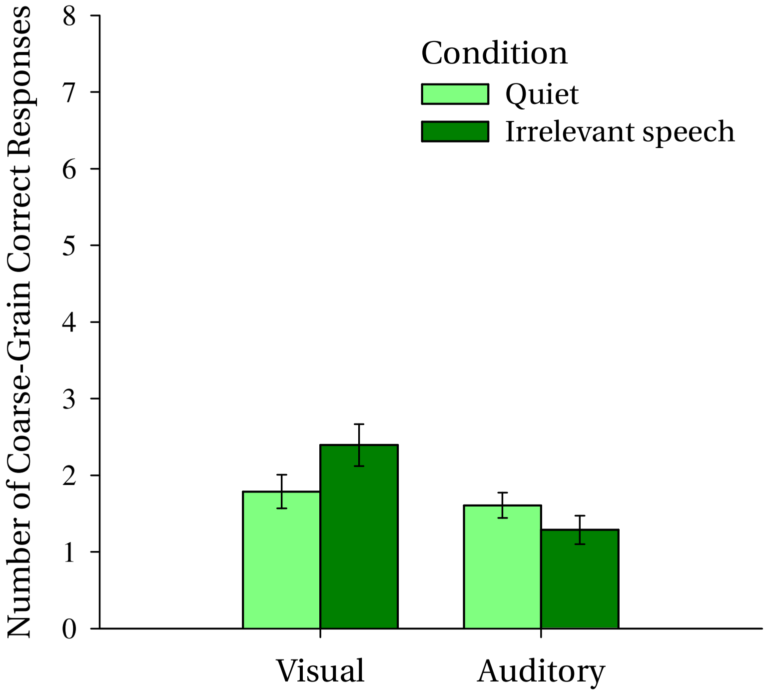

Figure 5.3 Experiment 4: Coarse-grain correct. Mean number of coarse-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 2 (Experimental Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) ANOVA on coarse-grain correct responses revealed no significant main effect of experimental condition ($F < 1$), but a significant main effect of question modality, F (1, 54) = 7.97, $p < .01$, $\eta^2 = .12$: participants provided more coarse-grain correct responses to questions about visual details than to questions about auditory details. Interestingly, there was also a significant interaction between condition and modality, F (1, 54) = 4.16, $p < .05$, $\eta^2 = .06$. Figure 5.3 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).

5.2.3.4 Proportion Correct

On average, participants answered 3.39 out of 16 questions incorrectly (*SD* = 1.46). Examples of inaccurate responses are provided in Appendix A.1. The proportion of responses that were correct is depicted in Figure 5.4. A 2 (Experimental Condition: quiet, irrelevant speech) x 2 (Question Modality: visual, auditory) ANOVA on proportion correct revealed no significant main effects and no interaction (all Fs < 1).

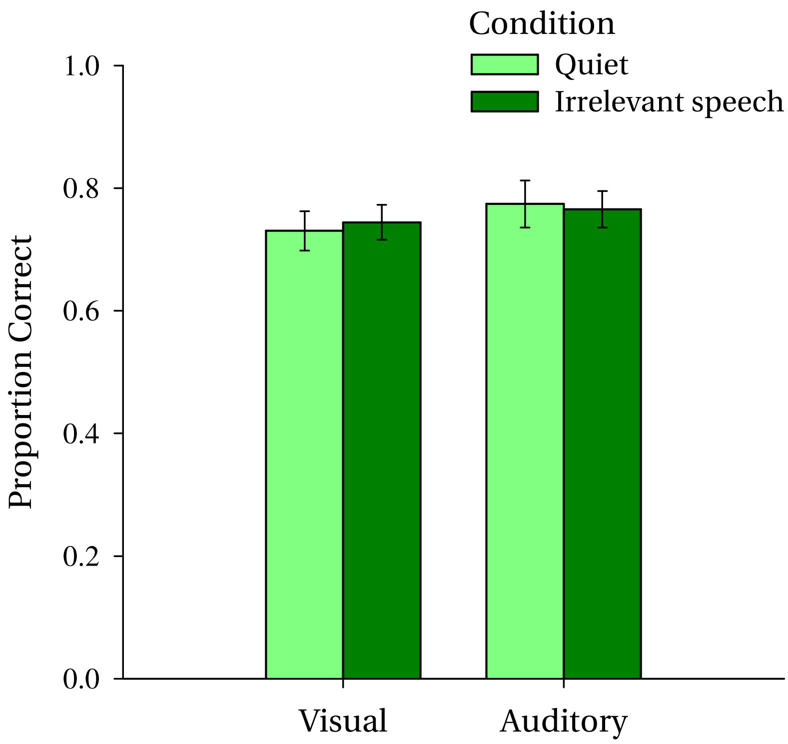

Figure 5.4 Experiment 4: Proportion correct. Mean proportion of responses that were correct for questions about visual and auditory aspects of the video. Error bars represent standard errors.

5.2.4 Discussion

Prior to the experiment, it was predicted that irrelevant speech would decrease the number of correct responses provided, particularly for questions about auditory aspects of the event. In line with the predictions, irrelevant speech tended to decrease both fine- and coarse-grain correct responses to questions about auditory aspects of the event, but this tendency was not significant. The effects on recall of visual aspects varied as a function of grain size: irrelevant speech tended to decrease fine-grain correct recall but increase coarse-grain correct recall of visual aspects, leaving the total number of correct responses unaffected. Because the number of fine-grain correct responses was not independent from the number of coarse-grain correct responses (see section 3.4.2), it is difficult to interpret this pattern of findings.

5.2.4.1 Nature of Distraction

Given that the pattern observed in the present study 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 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.

5.2.4.2 Social Factors

From an applied perspective, one significant limitation of the present experiment was the elimination of important social aspects of an investigative interview. Because the written answer sheet required no social interaction between the experimenter and the participant, the retrieval environment lacked socially-based environmental distractions. This absence offers an alternative (though not contradictory) potential explanation for the non-significant findings. In line with Glenberg's (1997) embodied cognition account, environmental distractions that are relevant to survival, such as social cues, should take up more cognitive resources than distractions that are not relevant to survival. In the present experiment, the nature of the auditory distraction was not relevant to survival (after all, participants were instructed to ignore the irrelevant speech), and participants in neither the irrelevant-speech condition nor the quiet condition were exposed to social cues during the retrieval task. The next experiment investigated this issue further by independently manipulating visual and auditory distractions during a face-to-face interview.

5.2.4.3 Conclusion

In sum, the present study found no evidence for an irrelevant speech effect. The non-significant findings may signify the genuine absence of an effect, but they may also reflect theoretical or practical limitations of the research. For the next experiment, I decided to focus on the practical limitations rather than the theoretical limitations. Although the role of the phonological loop is theoretically interesting, it is less relevant to investigative interviewing practices. After all, eyewitnesses will not be asked to count out loud while completing a form with questions about a witnessed event. However, it is not unlikely that eyewitnesses will be exposed to visual and auditory distractions during a face-to-face interview with a police interviewer, for instance when they are interviewed at the scene of the crime (see next chapter). Therefore, the next experiment examined whether such distractions affect witnesses' recall of an event, and if so, to what extent they do so in a general or modality-specific manner.

5.3 Experiment 5: Visual and Auditory Distractions

5.3.1 Introduction

In Experiment 4, auditory distraction did not cause significant general or modality-specific impairments in recall performance. The present study investigated whether auditory distractions would impair recall in a more realistic interview setting. Furthermore, it provided a direct comparison of visual and auditory distractions, and examined potential differences between closing the eyes and looking at a blank screen.

5.3.1.1 General and Modality-Specific Interference

The primary aim of the present experiment was to examine to what extent the recall impairments caused by visual and auditory distractions in the interview environment are general in nature, and to what extent they are modality-specific. As explained in section 2.3.2.3, the *cognitive load hypothesis* predicts that the eye-closure effect is due to a general improvement in concentration. The hypothesis is based on Glenberg's (1997) embodied cognition account, which construes environmental monitoring and memory retrieval as two tasks competing for cognitive resources. Thus, closing the eyes helps witnesses to block out environmental distractions, thereby leaving more cognitive resources available for the retrieval task. The *modality-specific interference hypothesis*, on the other hand, predicts that the eye-closure effect is due to the elimination of specifically visual distractions. It is based on the modality-specific interference effect found in Working Memory (Baddeley, 1986, 2007; Baddeley & Hitch, 1974). Because visual distractions have been found to disrupt the vividness of visual imagery more than the vividness of auditory imagery (Baddeley & Andrade, 2000), eye-closure is expected to be particularly beneficial for recall of information that can readily be visualised. The Cognitive Resources framework proposed in Chapter 2 incorporates both of these hypotheses, suggesting that sensory distractions in the environment have the potential to disrupt both general and modality-specific pools of cognitive resources.

The findings obtained in the experiments presented hitherto provide some insight into general and modality-specific processes in the eye-closure effect. Eye-closure improved recall of both visual and auditory aspects in Experiment 2, but only improved recall of visual information in Experiments 1 and 3. This suggests that eye-closure may have both general and modality-specific benefits on recall performance. However, there are alternative explanations for the findings that eye-closure was most beneficial for the recall of visual information. For instance, eye-closure might be most effective for information that is relatively easy to remember, given that participants generally remembered visual details better than auditory details (but see section 3.4.4). To provide a more direct test of the hypotheses, visual and auditory distractions in the interview environment were manipulated independently.

In two separate studies, Perfect and colleagues manipulated visual and auditory distractions during the interview. Perfect, Andrade, and Eagan (2011) found that bursts of white noise (compared to quiet) impaired the accuracy, but not the quantity, of responses about a witnessed scene, and Perfect, Andrade and Syrett (2011) found that a visual display of two moving boxes (compared to one moving box) during the interview impaired the accuracy, but not the quantity of responses about a news bulletin. These impairments were observed for recall of both visual and auditory aspects of the to-be-remembered stimuli. However, it is difficult to compare the effects of visual and auditory distractions across these two studies, because the to-be-remembered stimuli and the content of the distractions differed across experiments.

The present study compared visual and auditory distraction in one study, keeping the nature of the to-be-remembered stimuli and the distractions consistent. Participants were exposed to either visual or auditory presentations of the same Hebrew words during the interview (presented on a computer screen or via speakers, respectively). The stimuli were presented in a foreign language to eliminate any semantic effects, focussing on the sensory aspects of the distractions. Previous studies have shown that both short-term and long-term recall performance can be significantly disrupted by irrelevant speech in a foreign language (Banbury & Berry, 1998; Colle & Welsh, 1976; LeCompte & Shaibe, 1997; Salamé & Baddeley, 1987), as well as dynamic irrelevant visual displays (Glenberg et al., 1998; Logie, 1986; McConnell & Quinn, 2000; Parker & Dagnall, 2009; Quinn & McConnell, 1996; but see Andrade, Kemps, Werniers, May, & Szmalec, 2002). Therefore, the distraction manipulations in the present study were expected to impair recall of the witnessed event. The data will be fitted to the Cognitive Resources framework, to assess the relative impact of general and modality-specific impairment.

5.3.1.2 Looking at a Blank Visual Field

In the Cognitive Interview manual, Fisher and Geiselman (1992) mention that eyewitnesses may be reluctant to close their eyes (see also section 7.3). They propose that focussing "on a solid visual field, like a blank wall" (p. 133) may serve as an effective alternative to eye-closure. An additional aim of the present study was to investigate whether looking at a blank computer screen would be just as effective as closing the eyes. If eye-closure helps memory by reducing distraction from the environment, memory benefits should also be observed when participants look at a blank screen. However, if the effect is unique to the act of closing the eyes (perhaps because eye-closure increases alpha activity; Wagstaff et al., 2004), memory benefits should not be observed when participants look at a blank screen.

In a study examining cued recall of visual images, Wais et al. (2010) also included a condition in which participants looked at a blank screen. They found that participants in the blank-screen condition performed roughly in-between participants in the eyes-closed condition and participants in the visual-distraction condition. In a study assessing performance on a visual-imagination matrix task, on the other hand, Markson and Paterson (2009) found no significant difference in performance between the eyes-closed and blank-screen conditions, whereas both were superior to looking at a face. Consistent with these findings, it is predicted that participants who look at a blank screen will perform better than participants who are exposed to sensory distractions. However, because closing the eyes more effectively blocks out the environment than looking at a blank computer screen does, it is expected that eye-closure will be somewhat more effective in improving recall.

5.3.1.3 Auxiliary Variables

In light of previous findings, it was expected that visual and auditory distractions during the interview would have the greatest impact on recall of fine-grain information. In addition, participants in the present study were asked to express their confidence in the form of a percentage (0-100%) rather than on a five-point scale. This scale allows for a clearer analysis of confidence-accuracy calibration (N. Brewer, personal communication, March 19, 2010), since it measures the subjective probability of accuracy (i.e., confidence rating) on the same scale as the objective probability of accuracy (i.e., the likelihood that an answer is correct lies between 0 and 100%). It was unclear whether eye-closure would reduce participants' confidence in their responses (as in Experiment 2), or have no significant effect on average confidence (as in Experiment 3), but it was expected that eye-closure would again increase underconfidence in terms of confidence-accuracy calibration.

5.3.1.4 Aims and Hypotheses

The primary aim of the present study was to contrast general and modality-specific influences of visual and auditory distractions in the interview environment. It was predicted that any type of distraction would lead to a general impairment in recall performance. In addition, it was hypothesised that visual distraction would be most disruptive to recall of visual information, whereas auditory distraction would be most disruptive to recall of auditory information. The secondary aim was to investigate whether looking at a blank screen can serve as a useful alternative to eye-closure. It was predicted that participants in the eyes-closed and blank-screen conditions would perform better than participants in the visual-distraction and auditory-distraction conditions.

5.3.2 Method

5.3.2.1 Participants

Eighty-seven undergraduate psychology students from the University of York participated for course credit or a small monetary reward. Seven participants who had seen the video before were excluded from the analysis, leaving 80 participants. The sample consisted of 19 males and 61 females, with ages ranging from 18 to 47 (M = 20.82 years, SD = 3.92). All participants had normal or corrected-to-normal vision and hearing, were native English speakers, and did not understand Hebrew.

5.3.2.2 Materials

The "Lost" violent video from Experiment 2 was used again for the present experiment (see section 3.3.2.2). Participants who did not close their eyes looked at a 17-inch monitor placed in front of them at approximately 15 inches from their face. Around the screen, all that was visible was a blank wall and a desk that was empty save for a keyboard and speakers. The screen was switched off in the blank-screen and auditory-distraction conditions. In the visual-distraction condition, participants looked at 12 Hebrew words (in Hebrew script) gradually appearing and disappearing in random locations on the screen at a rate of 1 per second, looped throughout the interview. In the auditory-distraction condition, participants listened to the same Hebrew words being spoken via speakers, at 55 to 60 dB SPL(A). Pilot work confirmed that the spoken words did not interfere with the ability to hear the questions.

5.3.2.3 Design

The experiment manipulated one between-subjects independent variable (interview condition) and one within-subjects independent variable (modality of questions). The study comprised a 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Question Modality: visual, auditory) mixed design with repeated measures on the last factor. The dependent variables were identical to Experiment 1.

5.3.2.4 Procedure

All participants were tested individually in a small laboratory. After signing an informed consent form, participants watched the event. They then engaged in a five-minute word finder distracter task, before taking part in the interview. Participants were randomly assigned to one of four interview conditions, with 20 participants in each condition. Participants in the *blank-screen* condition were instructed to keep looking at the blank screen of the monitor throughout the interview. Participants in the *eyes-closed* condition were instructed to keep their eyes closed throughout the interview. Participants in the *visual-distraction* condition were instructed to keep looking at the screen throughout the interview, and to ignore the Hebrew words popping up on the screen. Participants in the *auditory-distraction* condition were instructed to keep looking at the blank screen throughout the interview, and to ignore the spoken Hebrew words in the background. Participants who failed to comply with the instructions at any point during the interview were reminded appropriately. All participants were specifically instructed to ask the interviewer to repeat a question if they could not hear it properly. They were asked to remember as much as they could, but not to guess: a “do not remember” response was allowed. Participants were asked to indicate how confident they were in their answer on a scale from 0% (not confident at all) to 100% (extremely confident). After answering the interview questions, participants completed a demographic information sheet. At the end of the session, they were asked whether they had seen the TV series before, and were thanked and debriefed.

5.3.2.5 Data Coding

All interviews were audio-taped and transcribed for subsequent analysis. The transcripts were coded blind to interview condition. Responses could be coded as correct, incorrect, or omitted, and all correct responses were coded for grain size as in Experiment 2 (see section 3.3.2.7). Sixteen interviews (320 responses; 20% of the total sample) were randomly selected and scored 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, $\kappa = .96$, $p < .001$. The codes of the first coder were retained for the main analysis.

5.3.3 Results

For each dependent variable presented in the Results section, three research questions will be assessed. First, was there a general difference in recall performance between the low-distraction (blank-screen, eyes-closed) and high-distraction (visual-distraction, auditory-distraction) conditions? Second, were visual and auditory distractions associated with modality-specific impairments in recall? And third, was there a difference in performance between the blank-screen and eyes-closed condition? At the end of the Results section, confidence ratings will be assessed.

5.3.3.1 Total Number Correct

The total number of (fine- plus coarse-grain) correct responses is shown in Figure 5.5. The distribution for the total number of responses about visual aspects was significantly skewed and could not be transformed into a normal distribution. Therefore, non-parametric tests were also performed, with results confirming the findings reported below (see Appendix B.4).

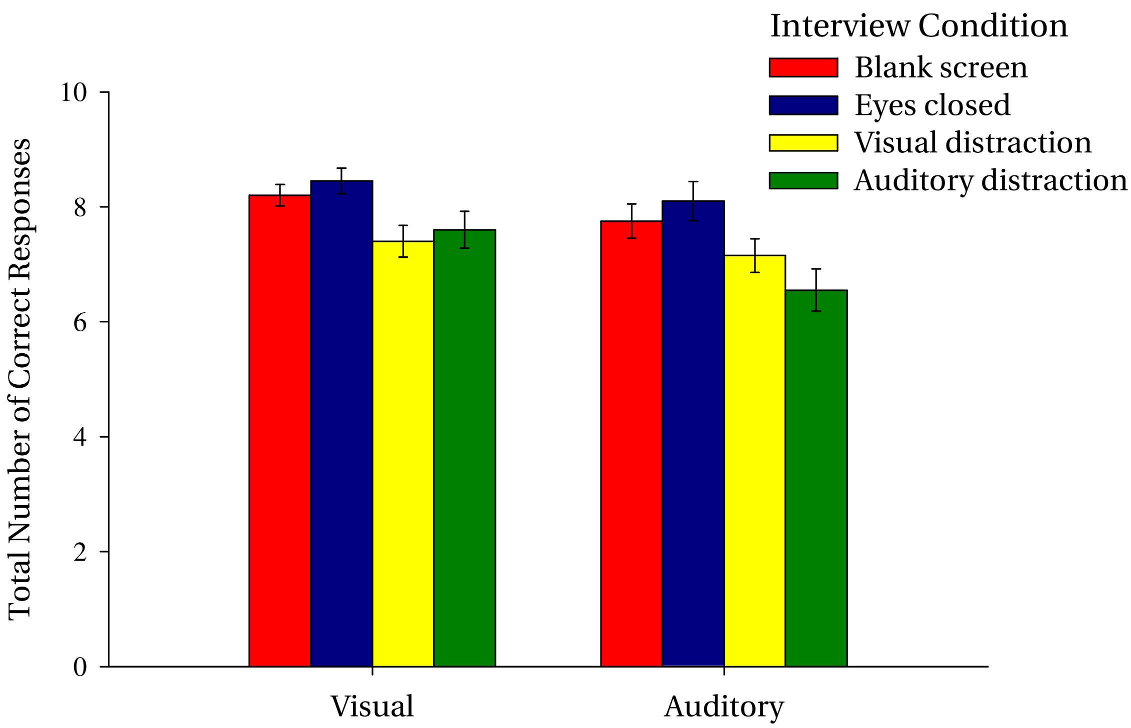

Figure 5.5 Experiment 5: Total number correct. Mean total number of correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

First, to assess general disruptive effects of distraction, a 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Question Modality: visual, auditory) mixed ANOVA was conducted on the total number of correct responses. There was a significant main effect of question modality, F (1, 76) = 7.41, p < .01, η^2 = .09. Overall, more correct responses were provided for questions about visual aspects of the event than for questions about auditory aspects. Moreover, there was a significant main effect of interview condition, F (3, 76) = 6.64, p < .001, η^2 = .21. Planned contrasts showed that participants in the low-distraction conditions gave significantly more correct responses than participants in the high-distraction conditions, t (76) = 4.31, p < .001, η^2 = .20.

Second, because I had the *a priori* prediction that visual and auditory distraction would selectively impair memory for aspects presented in the same modality, it was examined whether there was an interaction between type of distraction and question modality in the two high-distraction conditions. A 2 (Type of Distraction: visual, auditory) x 2 (Question Modality: visual, auditory) mixed ANOVA was conducted on the total number of correct responses. Figure 5.5 shows that the pattern was in the expected direction, but the interaction between type of distraction and question modality was not significant, $F(1, 38) = 1.89$, $p = .18$.

Third, to assess potential differences between looking at a blank screen and closing the eyes, a 2 (Type of Instruction: blank screen, eyes closed) x 2 (Question Modality: visual, auditory) mixed ANOVA was conducted on the total number of correct responses. There was no significant effect of type of instruction, $F(1, 38) = 1.12$, $p = .30$, and no interaction between type of instruction and question modality ($F < 1$).

5.3.3.2 Fine-Grain Correct

Figure 5.6 shows the number of fine-grain correct responses provided.

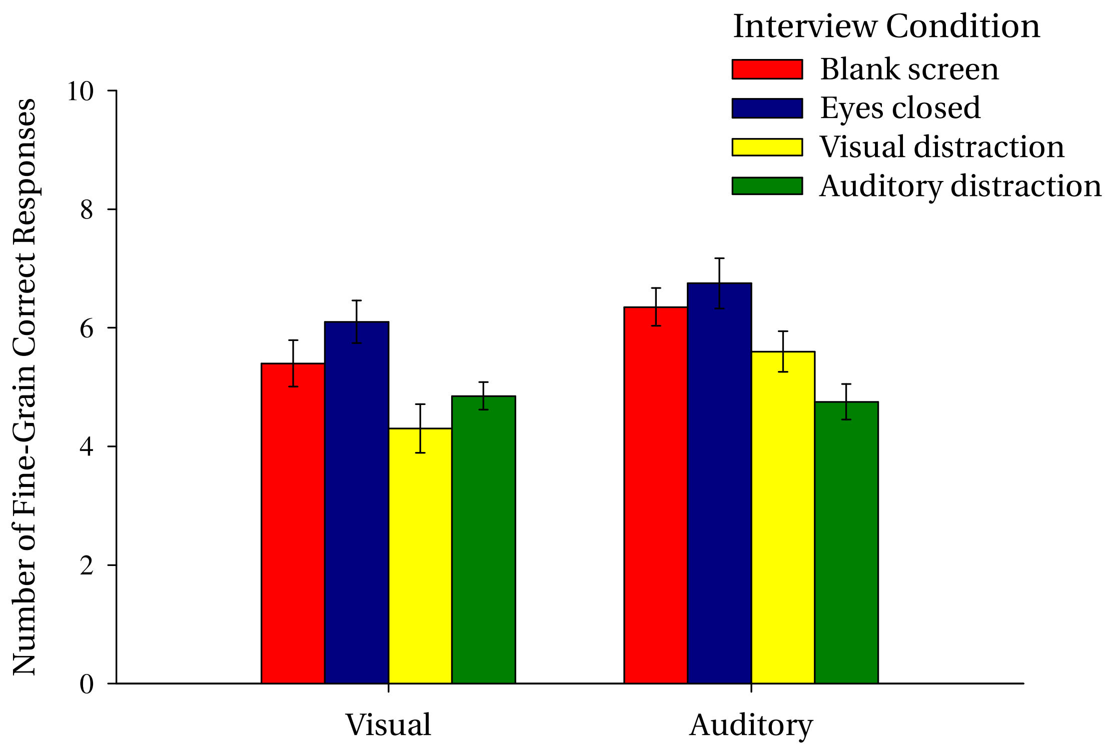

Figure 5.6 Experiment 5: Fine-grain correct. Mean number of fine-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Question Modality: visual, auditory) ANOVA on fine-grain correct responses again revealed a significant main effect of question modality, $F(1, 76) = 13.21$, $p < .001$, $\eta^2 = .14$, but in the opposite direction from one reported above: participants provided more fine-grain correct responses to questions about auditory information than to questions about visual information. Furthermore, there was again a significant main effect of interview condition, $F(3, 76) = 6.83$, $p < .001$, $\eta^2 = .21$. Planned contrasts showed that participants who were not exposed to sensory distraction gave significantly more correct fine-grain responses than participants who were exposed to sensory distraction, $t(76) = 4.31$, $p < .001$, $\eta^2 = .20$.

To test whether visual and auditory distractions had modality-specific effects on fine-grain correct recall, a 2 (Type of Distraction: visual, auditory) x 2 (Question Modality: visual, auditory) ANOVA was conducted. For fine-grain correct recall, there was a significant interaction between type of distraction and question modality, $F(1, 38) = 8.66$, $p < .01$, $\eta^2 = .16$. Figure 5.6 shows that visual distraction impaired fine-grain recall of visual details significantly more than fine-grain recall of auditory details, $F(1, 38) = 14.94$, $p < .001$, $\eta^2 = .28$, whereas auditory distraction disrupted fine-grain recall of visual and auditory details to a similar extent ($F < 1$).

To test for differences between the low-distraction conditions, a 2 (Type of Instruction: blank screen, eyes closed) x 2 (Question Modality: visual, auditory) ANOVA was conducted on fine-grain correct responses. There was no significant effect of type of instruction, $F(1, 38) = 1.58$, $p = .22$, and no interaction between type of instruction and question modality ($F < 1$).

5.3.3.3 Coarse-Grain Correct

Figure 5.7 shows the number of coarse-grain correct responses. For coarse-grain responses about auditory aspects, the variances across conditions were significantly heterogeneous, $F(3, 76) = 3.56$, $p < .05$, and data transformations did not solve this problem. Therefore, non-parametric tests were also performed, which confirmed the findings reported below (see Appendix B.4).

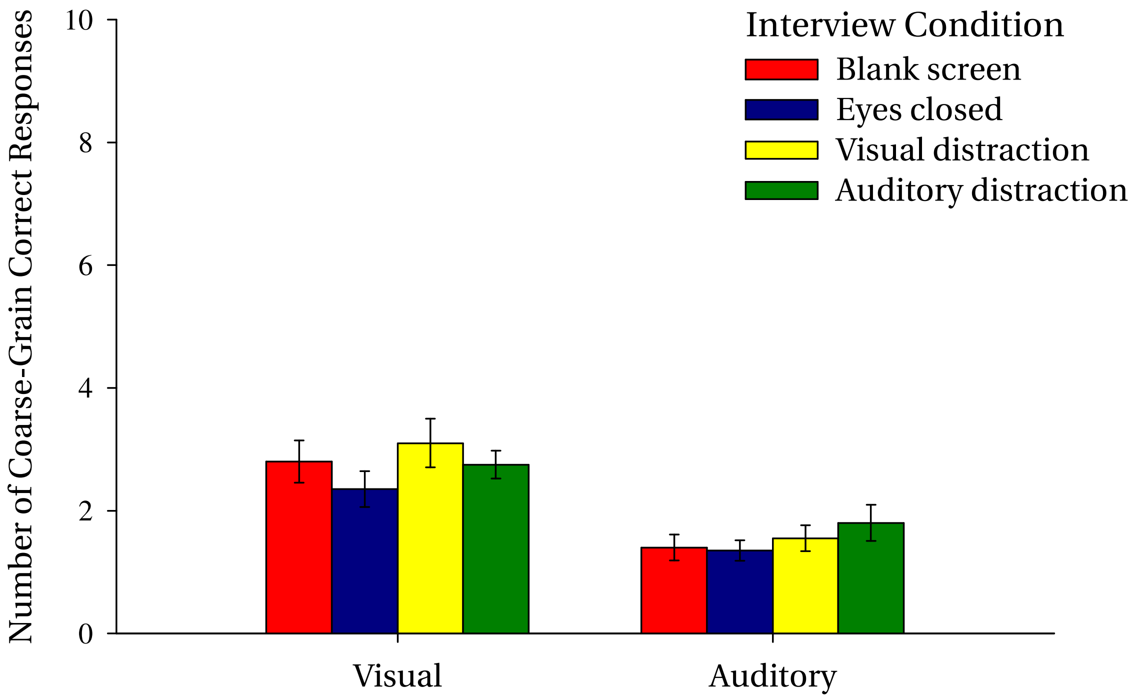

Figure 5.7 Experiment 5: Coarse-grain correct. Mean number of coarse-grain correct responses to questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Question Modality: visual, auditory) ANOVA on coarse-grain correct responses revealed a significant effect of question modality, F (1, 76) = 38.55, p < .001, η^2 = .33, with significantly more coarse-grain answers provided about visual aspects than about auditory aspects. However, there was no significant main effect of interview condition, F (3, 76) = 1.20, p = .32, perhaps due to floor effects.

To assess modality-specific effects, a 2 (Type of Distraction: visual, auditory) x 2 (Question Modality: visual, auditory) ANOVA was conducted on coarse-grain correct responses. There was no significant interaction between type of distraction and question modality, F (1, 38) = 1.18, p = .28. Finally, to assess differences between the low-distraction conditions, a 2 (Type of Instruction: blank screen, eyes closed) x 2 (Question Modality: visual, auditory) ANOVA was conducted. There was no significant effect of type of instruction, F (1, 38) = 1.06, p = .31, and no interaction between type of instruction and question modality (F < 1).

5.3.3.4 Proportion Correct

On average, participants answered 3.31 out of 20 questions incorrectly (SD = 1.89). The proportion of responses that were correct is depicted in Figure 5.8. The distributions for proportion correct relating to visual and auditory aspects were significantly skewed and could not be normalised. Non-parametric tests (see Appendix B.4) confirmed all but one of the parametric test results, which will be discussed in more detail below.

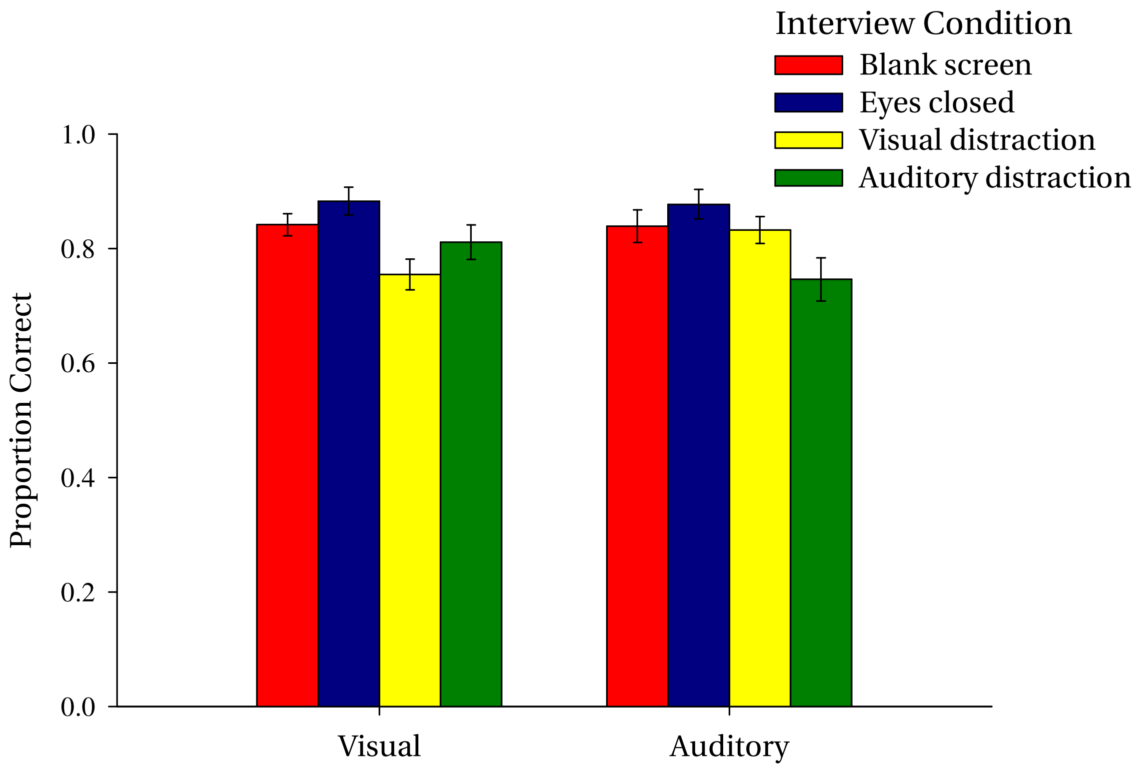

Figure 5.8 Experiment 5: Proportion correct. Mean proportion of responses that were correct for questions about visual and auditory aspects of the video. Error bars represent standard errors.

A 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Question Modality: visual, auditory) ANOVA on proportion correct revealed no significant effect of question modality ($F < 1$), but a significant main effect of interview condition, $F(3, 76) = 5.04$, $p < .01$, $\eta^2 = .17$. Planned contrasts showed that participants in the low-distraction conditions were significantly more accurate than participants in the high-distraction conditions, $t(76) = 3.61$, $p < .001$, $\eta^2 = .15$.

To test for modality-specific effects, a 2 (Type of Distraction: visual, auditory) x 2 (Question Modality: visual, auditory) ANOVA was conducted on proportion correct. There was a significant interaction between type of distraction and question modality, $F(1, 38) = 6.60$, $p < .05$, $\eta^2 = .15$. As illustrated in Figure 5.8, there was a marginally significant tendency for visual distraction to decrease testimonial accuracy more for visual than for auditory aspects, $F(1, 38) = 3.93$, $p = .05$, $\eta^2 = .09$, and a non-significant tendency for auditory distraction to decrease testimonial accuracy more for auditory than for visual aspects, $F(1, 38) = 2.73$, $p = .11$, $\eta^2 = .07$.

To compare the low-distraction conditions, a 2 (Type of Instruction: blank screen, eyes closed) x 2 (Question Modality: visual, auditory) ANOVA was conducted on proportion correct. There was no significant main effect of type of instruction, $F(1, 38) = 2.33$, $p = .14$, and no interaction between type of instruction and question modality ($F < 1$). However, the non-parametric test conducted on proportion correct (see Table B.6 in Appendix B.4) did reveal a significant difference between the two conditions, $U = 274.00$, $p < .05$, $\eta^2 = .10$. As illustrated in Figure 5.8, participants in the eyes-closed condition (*Mdn* = .89) were somewhat more accurate than participants in the blank-screen condition (*Mdn* = .85).

5.3.3.5 Confidence

Participants provided confidence ratings on a scale from 0% (not confident at all) to 100% (extremely confident). For the confidence analysis, fine-grain and coarse-grain correct responses were again combined for simplicity. First, the effect of interview condition on average confidence ratings for correct and incorrect responses was examined. The confidence distributions were normalised by inverting and square-root transforming the data. A 4 (Interview Condition: blank screen, eyes closed, visual distraction, auditory distraction) x 2 (Type of Response: correct, incorrect) mixed ANOVA was conducted on the transformed mean confidence ratings. There was a significant main effect of type of response, $F(1, 74) = 44.08$, $p < .001$, $\eta^2 = .32$, reflecting that participants gave higher confidence ratings for correct responses ($M = 84.26\%$, $SD = 8.02\%$) than for incorrect responses ($M = 58.76\%$, $SD = 21.92\%$). There was no significant effect of interview condition, $F(3, 74) = 1.63$, $p = .19$, and no significant interaction between interview condition and type of response, F (3, 74) = 1.01, p = .39.

Second, the correlation between the average confidence rating per participant and the proportion correct for that participant was calculated. There was a significant general confidence-accuracy (CA) correlation, $r = .27$, $p < .05$. Separate analyses for each interview condition showed that the correlation was somewhat lower for the low-distraction conditions (blank screen: $r = .20$, $p = .41$; eyes closed: $r = .24$, $p = .31$) than for the high-distraction conditions (visual distraction: $r = .40$, $p = .08$; auditory distraction: $r = .46$, $p < .05$), but the difference between the low- and high-distraction conditions was not significant, Fisher's $z = .74$, $p = .46$.

Third, the specific CA correlation between the confidence rating provided for a particular response and the accuracy of that response was examined. All participants together provided 1489 responses in total, and there was a significant point-biserial correlation between confidence and accuracy for a specific response, $r_{pb} = .38$, $p < .001$. Separate analyses showed that the correlation was similar across interview conditions (blank screen: $r = .40$, $p < .001$; eyes closed: $r = .33$, $p < .001$; visual distraction: $r = .35$, $p < .001$; auditory distraction: $r = .45$, $p < .001$).

Fourth, a calibration technique was used to plot the proportion of correct responses against participants' confidence ratings. Because certain parts of the confidence scale were used relatively infrequently, confidence ratings were collapsed into six categories (0-20%, 21–40%, 41–60%, 61–80%, 81–99%, 100%) to provide more stable estimates of percentage correct. Accuracy in each category was compared with the weighted mean confidence rating in that category. Furthermore, since the patterns looked highly similar for the two conditions with relatively few distractions (blank-screen and eyes-closed) and for the two conditions with relatively many distractions (visual-distraction and auditory-distraction), the four conditions were collapsed into two, to present a clearer picture of the data (see Figure 5.9).

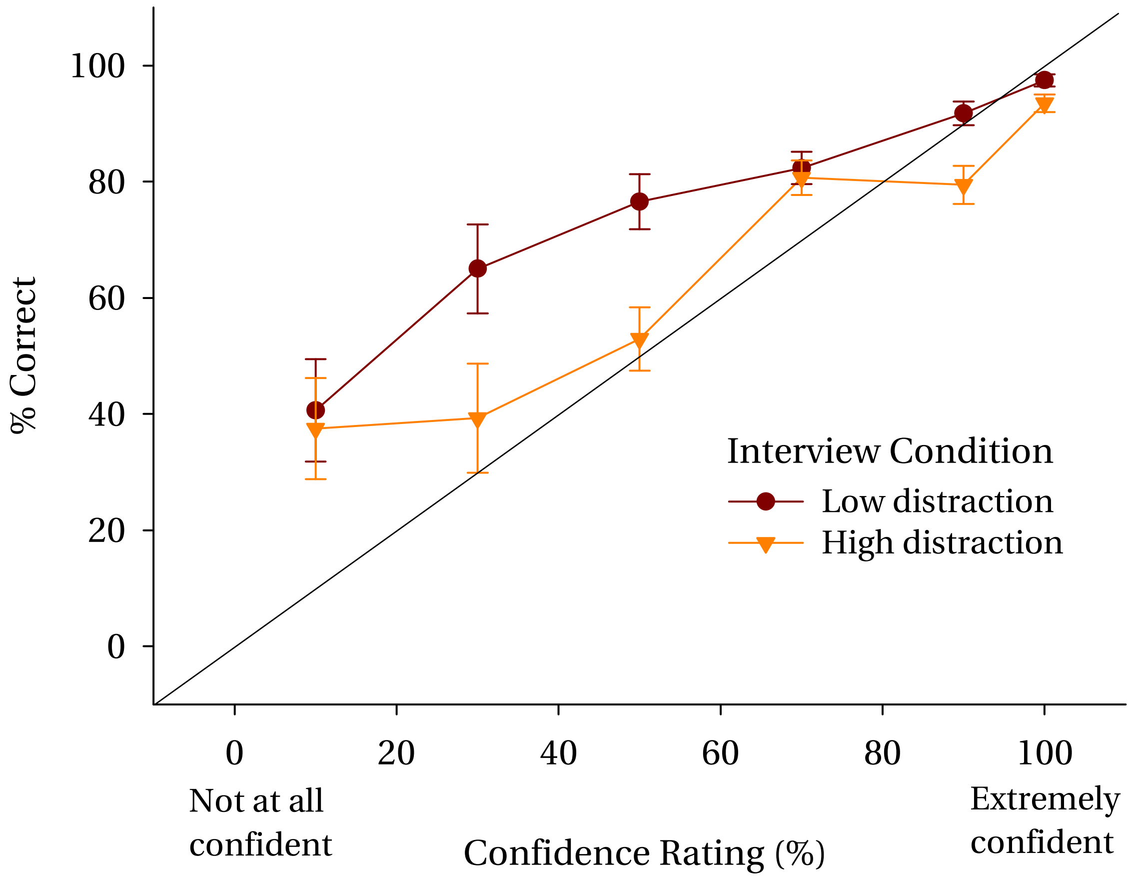

Figure 5.9 Experiment 5: Confidence-accuracy calibration. Mean percentage correct by confidence rating in the low-distraction conditions (blank-screen and eyes-closed) and high-distraction conditions (visual-distraction and auditory-distraction). The black line denotes perfect calibration. Errors bars represent standard errors.

Figure 5.9 reveals that participants in the low-distraction conditions tended to be more underconfident in their responses than participants in the high-distraction conditions. Participants in the high-distraction conditions were closer to perfect calibration at lower levels of confidence (particularly between 21% and 60%), but participants in the low-distraction conditions were closer to perfect calibration at higher levels of confidence (between 81% and 100%). Visual inspection of separate calibration graphs for recall of visual and auditory details revealed no clear differences based on question modality, therefore these data are not presented here.

5.3.4 Discussion

It was found that participants in the low-distraction conditions performed significantly better than participants in the high-distraction conditions, both in terms of number and proportion correct. Furthermore, visual distraction tended to impair fine-grain correct recall and testimonial accuracy more for questions about visual aspects than for questions about auditory aspects, whereas auditory distraction impaired fine-grain correct recall and testimonial accuracy more for auditory details than for visual details. Finally, eye-closure was somewhat more effective than looking at a blank screen, but most differences between these two conditions were non-significant. In sum, the findings provide evidence for general as well as modality-specific disruptive effects of sensory distractions in the interview environment, which can be overcome by closing the eyes or looking at a blank screen.

5.3.4.1 General and Modality-Specific Interference

In line with the Cognitive Resources framework explained in section 2.3.2.4 (see Figure 5.10), environmental distractions in the present study caused both general and modality-specific impairments in memory retrieval. Contingent upon a few assumptions, the framework allows for a quantitative analysis of the relative importance of general and modality-specific impairments caused by visual and auditory distractions, respectively. To demonstrate how such a qualitative analysis could be conducted, the data for fine-grain correct responses in the present study were fitted to the Cognitive Resources framework. This dependent variable was selected because modality-specific effects were most pronounced in fine-grain correct recall (see section 5.3.3.2).

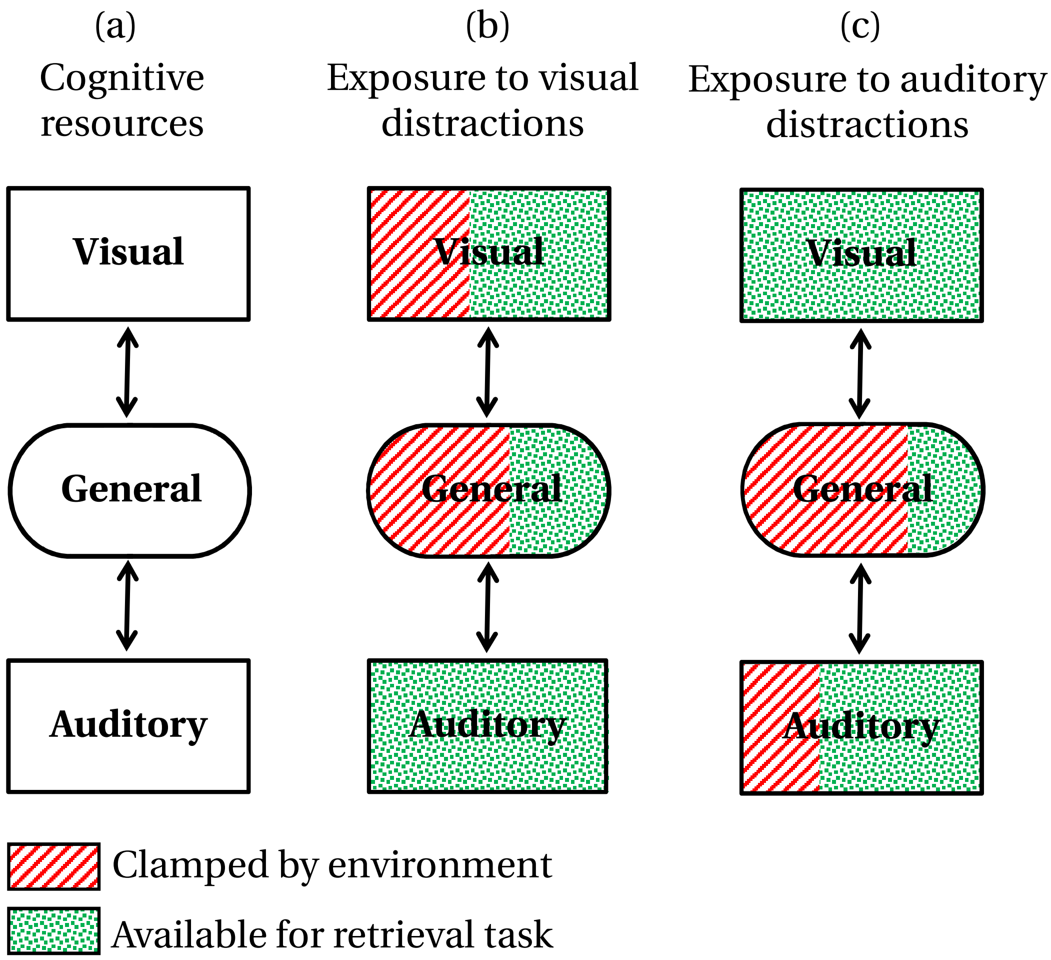

Figure 5.10 Application of the Cognitive Resources framework. Schematic representation of (a) the basic framework, (b) the allocation of resources for witnesses who were exposed to visual distraction in Experiment 5, and (c) the allocation of resources for witnesses who were exposed to auditory distraction in Experiment 5.

Let us first consider the impact of visual distraction (see Figure 5.10b). The impairment in recall of auditory details as a result of exposure to visual distraction can be explained by a reduction in general resources available for the retrieval task. Compared to the eyes-closed condition, visual distraction impaired auditory recall by 17% (from 6.75 to 5.60 fine-grain responses). If we assume that a reduction in general resources has an equal impact on visual and auditory recall, then visual distraction would have impaired recall of visual details through a reduction in general resources by 17% as well (17% of 6.10 = 1.04 fine-grain responses). The remainder of the impairment in visual recall caused by visual distraction (1.80 – 1.04 = .76 fine-grain responses) can then be explained by a reduction in the “visual pool” of cognitive resources. In other words, approximately 58% of the impairment caused by visual distraction in fine-grain correct recall in the present study was general in nature (1.04 out of 1.80), whereas approximately 42% was modality-specific (.76 out of 1.80). This distribution is illustrated in Figure 5.10b.

Next, let us consider the impact of auditory distraction (see Figure 5.10c). The impairment in recall of visual details as a result of exposure to auditory distraction can be explained by a reduction in general resources. Compared to the eyes-closed condition, auditory distraction impaired visual recall by 20% (from 6.10 to 4.85 fine-grain responses). If we assume that a reduction in general resources has an equal impact on visual and auditory recall, then auditory distraction would have impaired recall of auditory details through a reduction in general resources by 20% as well (20% of 6.75 = 1.35 fine-grain responses). The remainder of the impairment in auditory recall caused by auditory distraction (2.00 – 1.35 = .65 fine-grain responses) can then be explained by a reduction in the “auditory pool” of cognitive resources. In other words, approximately 68% of the impairment in fine-grain correct recall caused by auditory distraction in the present study was general in nature (1.35 out of 2.00), whereas approximately 32% was modality-specific (.65 out of 2.00). This distribution is depicted in Figure 5.10c.

Because these percentages are specific to the particular manipulations used in the present study, and because they rely on a number of theoretical assumptions, they should be interpreted with caution. Nevertheless, the framework permits an assessment of the data that goes beyond the conclusion that “both processes played a role”. Thus, it seems that auditory distraction in the present study caused a recall impairment that was predominantly general in nature (68%), whereas visual distraction resulted in a somewhat more equal division of general (58%) and modality-specific (42%) impairment.

Interestingly, these findings are compatible with the results obtained by Perfect and colleagues. In terms of auditory distraction, Perfect, Andrade, and Eagan (2011) found that bursts of white noise affected recall accuracy for visual and auditory details to the same extent, suggesting a general effect. In terms of visual distraction, Perfect, Andrade and Syrett’s (2011) findings seem to provide some evidence for a combination of general and modality-specific effects. Thus, even though visual distraction impaired recall accuracy for both visual and auditory details, it had a greater effect on recall of visual details (see Figure 1 in their article). In conclusion, both general and modality-specific processes seem to be involved in the eye-closure effect, and the Cognitive Resources framework allows for a more detailed analysis of the relative impact of each type of process.

5.3.4.2 Looking at a Blank Visual Field

An additional variable of interest in the present study was whether looking at a blank screen would be just as effective as closing the eyes. As observed in previous research (Wais et al., 2010), performance in the blank-screen condition fell in-between the eyes-closed condition and the high-distraction conditions. Compared with the high-distraction conditions, eye-closure increased the number of correct fine-grain responses by 32%, whereas looking at a blank screen resulted in a 21% increase. The difference between the eyes-closed and blank-screen conditions was not significant. In addition, eye-closure increased testimonial accuracy rates by 12%, whereas looking at a blank screen increased accuracy by 7%. According to non-parametric tests, this difference was significant. In sum, although looking at a blank screen is better than being exposed to visual or auditory distractions, it is not quite as effective as closing the eyes.

The slight difference between closing the eyes and looking at a blank visual field is probably due to the fact that there were still a few visual distractions in the blank-screen condition. For instance, the edges of the computer screen, the desk, and the wall behind the screen were all visible. Nevertheless, the data do not suggest that the eye-closure effect is unique to the physical act of closing the eyes (e.g., due to an increase in alpha activity; Wagstaff et al., 2004). From an applied perspective, this is an encouraging finding. Apparently, when a witness is reluctant to close her eyes, looking at a blank visual field can be a useful, albeit slightly less effective, alternative to eye-closure (cf. Fisher & Geiselman, 1992). It should be noted, however, that the blank screen at which participants were looking during the interview was also the screen on which the video had been presented earlier. Future research should investigate whether focussing on *any* blank space improves memory retrieval, to rule out context-specific effects (cf. Godden & Baddeley, 1975).

5.3.4.3 Confidence

The confidence data revealed that distractions in the interview environment did not significantly affect average confidence ratings or confidence-accuracy correlations. However, participants in the low-distraction conditions were more underconfident than participants in the high-distraction conditions. Perhaps, the absence of distractions allowed participants to pay more attention to meta-cognitive aspects of the retrieval task (cf. Brewer, Keast, & Rishworth, 2002). In other words, when cognitive resources were available to reflect on the retrieval task, participants realised that it was rather difficult, and that they should adjust their confidence levels accordingly. This issue will be addressed in more detail in section 7.2.5.

5.3.4.4 Conclusion

The present findings show that visual and auditory distractions in the interview environment can cause both general and modality-specific impairments in recall performance, and that the general impairments seem to be most dominant. Thus, in line with Glenberg's (1997) embodied cognition account, environmental distractions demand cognitive resources, and these demands detract from resources allocated to the retrieval task. Moreover, environmental distractions take both visual and auditory forms, and each form interferes predominantly with recall of information in the same modality (cf. Baddeley & Andrade, 2000). The good news is that retrieval impairments may be prevented by closing the eyes or, to a lesser extent, by looking at a blank visual field during the interview.

5.4 General Discussion

The two experiments presented in this chapter were intended to shed more light on the theoretical underpinnings of the eye-closure effect. In Experiment 4, the auditory counterpart of the eye-closure effect was not found to be significant. In Experiment 5, it was found that sensory distractions in the interview environment can cause both general and modality-specific impairments in retrieval performance, and that these can be overcome by eye-closure or looking at a blank screen.

5.4.1 Auditory Distractions

In section 5.2.4, two potential explanations were proposed for the non-significance of the irrelevant speech effect in Experiment 4. In light of the findings of Experiment 5, the explanation based on the nature of the auditory-distraction task does not seem to provide a convincing account of the data. After all, irrelevant speech (in a foreign language) in Experiment 5 did disrupt the retrieval of auditory images from long-term memory. The explanation based on the presence or absence of social interaction, however, does seem to provide a possible reason for the divergent findings. Thus, when social interaction is required, as in Experiment 5, the addition of irrelevant sensory distractions in the interview environment may result in an overload on cognitive resources, which is reflected in impaired recall performance. When social interaction is not required, on the other hand, as in Experiment 4, simple sensory distractions on their own may not be sufficient to overload the system, and therefore do not cause a significant impairment in recall performance.

In an interesting recent study, Perfect et al. (2011) found that the overload caused by auditory distractions during a face-to-face interview can be overcome by eye-closure during the interview. Auditory distraction was presented in the form of bursts of white noise, which were played directly after each question had been posed. The bursts significantly increased the number of errors made by witnesses. More importantly, the increase in errors was completely eliminated when witnesses closed their eyes during the interview. Thus, it seems that eye-closure can overcome the retrieval impairments caused by auditory distractions. Extrapolating these findings to an applied context, it seems likely that the eye-closure instruction will be particularly beneficial when witnesses are interviewed in a noisy environment. This prediction will be examined in a more realistic context in Experiment 6.

5.4.2 Modality and Grain Size

Unlike most previous experiments reported in this thesis, the modality-specific interaction in Experiment 4 was observed for coarse-grain, not fine-grain, correct recall. However, this interaction was mostly driven by an *increase* in coarse-grain recall of visual aspects as a result of irrelevant speech (see Figure 5.3), which was probably due to the fact that irrelevant speech tended to decrease fine-grain correct recall of visual (and auditory) aspects. Because the number of fine-grain responses and the number of coarse-grain responses provided in cued recall were not independent, it is difficult to draw conclusions from this finding.

In Experiment 5, however, fine-grain recall was more affected by environmental distractions than coarse-grain recall. If we assume that fine-grain recall involves a greater degree of mental imagery than coarse-grain recall, then this result is compatible with the finding that concurrent visual and auditory tasks disrupt the vividness of images retrieved from long-term memory (Baddeley & Andrade, 2000). It seems that witnesses who were not exposed to visual distraction were better at conjuring up and inspecting a mental image of what they saw in the event. For instance, by inspecting a mental image of how the fight started, they would have been able to report that the man with the eye-patch threw the jug of iced tea at the other man (fine-grain answer), rather than simply concluding from a gist-based memory that the man with the eye-patch started it (coarse-grain answer). In a similar vein, witnesses who were not exposed to auditory distraction seemed to be better at conjuring up and inspecting a mental image of what they heard in the event. For instance, by replaying the voices in their “mind’s ear”, witnesses could have retrieved a verbatim memory of what the older woman said ("I will wait for you by the *stream*"; fine-grain answer), instead of reporting the gist of what she said (e.g., "I will wait by the *water*"; coarse-grain answer). Thus, although speculative, it seems that the recall impairment caused by environmental distractions may be due to a disruption of visual and auditory imagery.

5.4.3 Conclusion

The experiments presented in this chapter showed that neither the cognitive load hypothesis nor the modality-specific interference hypothesis is likely to provide a complete explanation of the eye-closure effect. Instead, the effect might be best understood in terms of a combination of general and modality-specific processes, which is reflected in the Cognitive Resources framework. Thus, the visual and auditory distractions in the present study caused both general and modality-specific impairments in retrieval performance. Closing the eyes during the interview blocks out visual distractions in the environment, and has also been found to reduce interference from auditory distractions (Perfect, Andrade, & Eagan, 2011). Therefore, eye-closure (or looking at a blank space) has the potential to help witnesses remember more, particularly when they are interviewed in a distracting environment. However, the environmental distractions in the present experiments were highly unrealistic. After all, it is unlikely that a witness will be exposed to a recording of an audio book, or of Hebrew words. The experiment reported in the next chapter investigated realistic potential distractions in the interview environment, by interviewing witnesses outside on a busy street.

5.5 Chapter Summary

- Irrelevant speech did not significantly impair performance on a written cued-recall test.
- Witnesses who were exposed to visual or auditory distractions during the interview remembered less accurate information than witnesses who closed their eyes or looked at a blank screen.
- Auditory distractions in the interview environment interfered most with fine-grain correct recall and testimonial accuracy of auditory details, whereas visual distractions interfered most with fine-grain correct recall and testimonial accuracy of visual details.
- Closing the eyes was only slightly more effective in improving recall performance than looking at a blank computer screen.
- Fitting the data to the Cognitive Resources framework revealed that visual distractions caused both general and modality-specific impairments in recall, whereas auditory distractions caused predominantly general impairments.
- When witnesses were distracted by sensory stimuli in the environment, they were less likely to be underconfident in their responses.

Chapter 6

Memory for a Live Altercation

6.1 Experiment 6: Staged Argument

6.1.1 Introduction

In Experiment 5, the visual and auditory distractions in the interview environment were meaningless to the participants, and rather artificial. Although this allowed for a closer inspection of the theoretical underpinnings of the eye-closure effect, it did not reflect a realistic interview situation. The present experiment examined the role of real-life distractions during the interview, by conducting interviews in a distracting environment (on a busy street) versus in a quiet environment (on a quiet corridor). Furthermore, the study assessed recall of a forensically relevant live event, and involved witnesses from a racially diverse, gender-balanced sample from the United States.

6.1.1.1 Type of Event

Perfect et al. (2008) found that eye-closure was effective for mundane live and videotaped events. This finding is potentially relevant for police interviewing about non-violent crime. The previous experiments showed that eye-closure is also effective for violent videotaped events. However, a question left to be answered is whether eye-closure also improves recall of violent *live* events. This question is relevant in legal settings, since eyewitness evidence may provide important leads in the investigation of violent crimes (Kebbell & Milne, 1998). Despite the relevance of this question, exposing participants to a violent live event is ethically unjustifiable. Therefore, the present study examined the effect of eye-closure on recall for a forensically relevant live event instead. Violent crimes such as assault and homicide are usually preceded by a verbal argument, especially if alcohol is involved (Murdoch &

Ross, 1990; Pihl & Peterson, 1995; Pittman & Handy, 1964). Thus, what happens during a verbal argument is potentially relevant to a criminal investigation. For this reason, in the present experiment, a verbal altercation was staged for unsuspecting witnesses, to test whether eye-closure improves recall for the type of live event that real eyewitnesses might be asked about.

Ihlebæk, Løve, Eilertsen, and Magnussen (2003) compared eyewitness memory for videotaped and live presentations of a staged robbery. In their study, participants who viewed the robbery on video provided almost twice as much information about the robbers' clothing as participants who witnessed the robbery live, and the information they provided was also significantly more likely to be accurate (83.3% correct for video witnesses; 72.7% correct for live witnesses). Thus, it seems that laboratory studies using videotaped events may overestimate the performance of eyewitnesses in real life. In light of the qualitative differences in memory for videotaped versus live events, it is important to investigate whether the benefits of certain interview procedures replicate when witnesses are interviewed about a forensically relevant live event. In meta-analyses of the Cognitive Interview, Köhnken et al. (1999) found that the CI was even more beneficial for recall of live events than for recall of videotaped events, and Memon and colleagues (2010) found that the CI was equally effective for videotaped and live events.[24] In a similar vein, the eye-closure instruction has been found to be equally effective for recall of videotaped and live mundane events (Perfect et al., 2008). Therefore, it was hypothesised that eye-closure would also aid recall of a forensically relevant live event.

6.1.1.2 Interview Location

In previous research on the eye-closure effect, witnesses were always interviewed in a designated interview room. In real life, however, initial eyewitness statements are sometimes taken at another location (Fisher & Geiselman, 1992). Indeed, on a survey of experienced European police interviewers (see section 7.3 for more information), the majority of police interviewers indicated that they had interviewed eyewitnesses at locations

[24] The types of events used in these studies was a mixture of "arousing" events (i.e., crime or accident scenarios) and mundane events.

other than a designated interview room, both inside and outside. Examples of alternative locations inside were the home or work of the witness, hotels, and restaurants. Examples of alternative locations outside were prisons or detention centres, on the street, and at or near the scene of the crime. In most of these alternative locations, elaborate interview procedures such as the Cognitive Interview are unlikely to be feasible. However, it would probably be feasible to ask witnesses to close their eyes. Therefore, the present study investigated whether eye-closure enhanced recall for witnesses interviewed outside on the street, near the "scene of the crime" (in this case, the location of the verbal altercation), compared to witnesses interviewed on a quiet corridor inside a university building. Based on previous literature, at least two competing hypotheses exist concerning the role of interview location in the eye-closure effect.

First, in line with Glenberg's (1997) embodied cognition account, it could be hypothesised that eye-closure will be more beneficial for witnesses interviewed outside than for witnesses interviewed inside. According to Glenberg, keeping the eyes open interferes with recall performance because monitoring the environment takes up cognitive resources. Furthermore, Glenberg et al. (1998) found that looking at a complex stimulus is more disruptive to retrieval performance than looking at a simple stimulus. Therefore, monitoring an environment full of distractions and possible dangers, such as a busy sidewalk in New York, should be more disruptive than monitoring an environment with relatively few distractions and potential dangers, such as a quiet corridor. By closing the eyes, the interviewee necessarily blocks out the visual distractions in the environment. Moreover, Perfect et al. (2011) found that eye-closure also helps witnesses to overcome auditory distractions in the environment. Therefore, eye-closure should be more helpful in an environment with many distractions (outside on the street) than in an environment with few distractions (inside on a quiet corridor). From now on, I will refer to this prediction as the *distraction hypothesis.*

Second, in line with the literature on context-dependent memory (see S. M. Smith & Vela, 2001), it could be hypothesised that eye-closure will be more helpful for witnesses interviewed inside than for witnessed interviewed outside. According to context-dependent memory, information is best retrieved in the context in which it was encoded. In the present experiment, for witnesses interviewed outside, the retrieval context was highly similar to the context of the witnessed event. For witnesses interviewed inside, on the other hand, the context was markedly different. Therefore, witnesses interviewed inside would likely benefit from mental context reinstatement (e.g., Hammond et al., 2006; S. M. Smith, 1979). Closing the eyes is recommended to facilitate mental context reinstatement (e.g., Fisher & Geiselman, 1992). Moreover, Caruso and Gino (2011) found that eye-closure induced people to mentally simulate events more extensively, even in the absence of instructions to do so. Therefore, even though witnesses in the present study were not instructed to mentally reinstate context, it is possible that eye-closure inspired them to do so spontaneously. This should be most helpful for witnesses interviewed inside, for whom the recall context was considerably different from the context of the witnessed event. From now on, I will refer to this prediction as the *context hypothesis.*

6.1.1.3 Witness Characteristics

Previous research on the effect of eye-closure on episodic memory has typically involved undergraduate students from the United Kingdom (Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008; Wagstaff et al., 2004; Wagstaff et al., 2010). Similarly, the experiments presented thus far in this thesis have involved homogeneous samples of predominantly Caucasian participants from the United Kingdom. The present study, on the other hand, involved a racially diverse sample from the United States. It was hypothesised that the eye-closure effect would replicate in this sample.

Unlike previous experiments, the present sample included a substantial number of male participants. This allowed for an investigation of gender differences in the eye-closure effect. Male and female individuals have been found to differ in the type of information they remember best (e.g., Chipman & Kimura, 1998; Clifford & Scott, 1978; Herlitz, Airaksinen, & Nordström, 1999; Herlitz, Nilsson, & Backman, 1997; Loftus, Banaji, Schooler, & Foster, 1987). Furthermore, females have been found to be more field-dependent than males (i.e., they have more difficulty separating central information from its context; Messick & Damarin, 1964), and the effectiveness of mental context reinstatement has been found to rely on field dependency (Emmett et al., 2003). In light of these findings, it is possible that there are gender differences in the effectiveness of eye-closure.

6.1.1.4 Type of Information

As in the previous experiment, all statements provided in free recall were scored for accuracy, modality, and centrality. In the present experiment, an additional categorisation was added based on the content of the reported information. Analyses of real eyewitness statements have shown that witnesses predominantly report information about actions, and that their descriptions of actions are more likely to be accurate than their descriptions of persons (Woolnough & MacLeod, 2001; Yuille & Cutshall, 1986). From an applied perspective, it is useful to know what kind of information is most affected by eye-closure. If the eye-closure instruction improves recall of information that is crucial to police investigations, such as the perpetrator’s appearance and actions, it would be of higher practical significance than if it improves recall of relatively unimportant information, such as the surroundings of the criminal event. The previous experiments showed that eye-closure was equally effective for central and peripheral information, but the present study provided a more in-depth analysis by coding the reported information in terms of specific content as well.

Previous research on the effectiveness of the Cognitive Interview has distinguished between statements pertaining to persons, actions, objects, and surroundings (e.g., A. M. Wright & Holliday, 2007). Due to the verbal nature of the witnessed event in the present study, an additional coding category was added for descriptions of verbal aspects (following from Woolnough & MacLeod, 2001). The type of information found to benefit most from the Cognitive Interview varies between studies, possibly due to the variability in stimulus materials used. The CI seems to have the most consistent impact on recall of actions (e.g., Akehurst et al., 2003; Holliday & Albon, 2004; A. M. Wright & Holliday, 2007), but benefits have also been observed for person descriptions (e.g., Milne & Bull, 2003a; Milne, Bull, Koehnken, & Memon, 1995), object descriptions (e.g., Holliday, 2003a; Memon et al., 1997), and surrounding descriptions (e.g., Holliday, 2003b; A. M. Wright & Holliday, 2007). In light of these findings, it was hypothesised that eye-closure would improve recall for all types of descriptions, but would have the greatest impact on action descriptions.

6.1.1.5 Auxiliary Variables

In light of previous findings, it was again expected that eye-closure would have a greater impact on recall of visual details than on recall of auditory details. Furthermore, in cued recall, eye-closure was expected to increase fine-grain correct recall but not coarse-grain correct recall. Consistent with the findings from Experiment 3 and Perfect et al. (2008), eye-closure was expected to have benefits in both free and cued recall. Finally, as in Experiment 5, participants in the present study were asked to express their confidence on a scale from to 0 to 100%. It was expected that eye-closure would again result in greater underconfidence in terms of confidence-accuracy calibration.

6.1.1.6 Aims and Hypotheses

The overall aim of the present study was to investigate whether eye-closure is effective for recall of a personally experienced verbal altercation, and whether the eye-closure effect is affected by interview location. The main hypothesis was that the eye-closure effect would replicate for recall of the live altercation in a racially diverse sample. In addition, two competing hypotheses were formulated with regard to interview location: the *distraction hypothesis* predicted that eye-closure would be most effective for witnesses interviewed in a distracting (but similar) environment (cf. Glenberg, 1997; Glenberg et al., 1998), whereas the *context hypothesis* predicted that eye-closure would be most effective for witnesses interviewed in a dissimilar (but quiet) environment (cf. Caruso & Gino, 2011; S. M. Smith & Vela, 2001).

6.1.2 Method

6.1.2.1 Participants

Ninety-seven undergraduate students from John Jay College of Criminal Justice (City University of New York) participated in the study for course credit. Due to a technical failure with the audio-recording equipment, one participant was excluded from the analysis, leaving 96 participants. The sample consisted of 40 males and 56 females, with ages ranging from 18 to 48 (*M* = 20.03, *SD* = 3.83). All participants were fluent English speakers and had normal or corrected-to-normal vision and hearing. The ethnic composition of the sample was mixed, with 46 Hispanic/Latino participants, 18 African-American, 18 Caucasian, 9 Asian/Pacific Islander, and 5 participants of another race. The experiment was approved by the John Jay Institutional Review Board, and participants signed an informed consent form in line with the guidelines of the Board.

6.1.2.2 Design

For the free recall phase, the experiment manipulated two between-subjects independent variables (eye-closure and location). It employed a 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) between-subjects design. For the cued recall phase, the experiment manipulated two between-subjects independent variables (eye-closure and location) and one within-subject independent variable (modality of questions). The study used a 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) mixed design with repeated measures on third factor. The dependent variables were identical to Experiment 3.

6.1.2.3 Procedure and Materials

The event was staged 38 times, following the same script each time. Four research assistants were involved in each session: one playing the role of experimenter, two staging the live altercation, and one videotaping the event. The experimenter received up to four participants per session in a designated experimental room. Participants were informed that they would be participating in an experiment on social interactions, and that they would be assigned to different experimental locations. Once all participants had signed the informed consent form, they walked with the experimenter in the direction of another university building. After five minutes, they arrived at a busy street corner in New York, where the research assistants were positioned.

The staged event lasted approximately four minutes, and started when the experimenter introduced the participants to the two research assistants, Sarah and Julia, who would be assigning them to experimental rooms. First, the research assistants explained the room assignment, which was a rather complex process. Sarah showed the participants several pictures of animals, each of which corresponded to a specific experimental room. She then asked one participant for his or her participation number, and assigned him or her to a room. At this point, however, Julia disagreed with the room assignment, and asked another participant for his or her participation number. The two research assistants started arguing about the room assignment, and Julia tried to pull the assignment papers out of Sarah's hands, which scattered on the floor. The disagreement then escalated into an argument about things that had occurred earlier that day. The argument became progressively more heated, to a point where Sarah got so upset that she walked away from the scene. This marked the end of the staged event. The entire event was filmed from a nearby phone booth by another research assistant, to obtain an objective record of each session against which participants' responses could be scored. The research assistant was pretending to make a phone call in the phone booth, and the video camera was hidden in her clothes. None of the participants noticed the camera.

At the end of the staged event, the experimenter informed the participants that the argument they had just witnessed was not real. She told participants that each of them would be interviewed about the event, and explained why the use of deception had been necessary to simulate a real-life, unexpected event. The four research assistants then each took one participant on another five-minute walk to a different location where they would be interviewed about the event. During the walk, the investigator engaged the participant in casual conversation, to prevent rehearsal of the event he or she had just witnessed. Participants were randomly assigned to be interviewed either inside or outside, either with eyes open or with eyes closed. There were 24 participants in each of the four interview conditions (inside-open, inside-closed, outside-open, outside-closed). The inside location was a quiet corridor in the John Jay building, which had white walls and floors and was empty save for a filing cabinet. The outside interviews took place on the same street as the staged event (i.e., Tenth Avenue in New York), but four blocks northwards. Therefore, although the event location and the outside interview location differed in terms of specific features (e.g., specific stores located on that part of the street), they were highly similar in overall appearance.

Upon arrival at the interview location, participants were informed that those scoring in the top 25% on the memory test would be enrolled in a lottery to win $50, to increase their motivation to perform well. The investigator explained that participants would first provide a free report of the witnessed event, after which they would be asked specific questions. Participants in the eyes-closed condition were asked to keep their eyes closed throughout the interview. Once participants had told the interviewer everything they could remember about the staged event, they answered eight questions about visual aspects of the event, and eight about auditory aspects (see Appendix A.3). The questions were asked in the order in which the corresponding information appeared in the event; hence the different types of questions were mixed, and in a fixed order throughout. Participants were asked to indicate their level of confidence in their answer on a scale from 0% (not confident at all) to 100% (extremely confident). All interviews were audio-taped for subsequent analysis. At the end of the interview, participants completed a demographic information sheet (consisting of questions about gender, age, and race). Finally, each interviewer thanked and debriefed their interviewee.

6.1.2.4 Pilot

Prior to the main experiment, three pilot sessions were conducted, involving ten pilot participants in total. The goals of the pilot sessions were to provide an opportunity for the research assistants to practise their acting performance, to check whether the event was believable, to ensure that the participants did not notice the camera, and to check whether the interview questions were appropriate. The pilot participants indicated that the event was believable; none of them reported suspicions that the argument had been fake, and some of them reacted with genuine surprise when they were told that the argument was not real. None of the pilot participants noticed the research assistant who was filming the event. Finally, the pilot participants performed approximately equally well on the eight questions about visual aspects and eight questions about auditory aspects; therefore, the original set of questions was retained for the main experiment. None of the pilot participants took part in the main experiment.

6.1.2.5 Data Coding

Three research assistants transcribed all the audio-taped interviews verbatim. Two different research assistants coded all transcripts, blind to interview condition. An exhaustive coding scheme was generated, listing all possible statements about the event with their corresponding scores. The two independent coders scored the transcripts on the basis of this scheme, progressively adding any details mentioned by participants that were not in the original list. First, the statements provided during free recall were coded as correct, incorrect, or subjective. The present study did not include a coding category for gist statements, because gist proved difficult to define, and could often be considered to be subjective (e.g., "they didn't like each other"). Thus, all statements that could not be scored for accuracy (e.g., "she was pretty") or modality (e.g., "she was rude") were classified as subjective and excluded from further analysis. All participants together reported 83 correct and 10 incorrect statements, which were coded as visual or auditory, and as central or peripheral (based on plot relevance; cf. Burke et al., 1992). Of all reported details, 38 were scored as visual and 55 as auditory. In addition, there were 20 central details on the list (e.g., "they started arguing") and 73 peripheral details (e.g., "one called the other a big baby"). Finally, all statements were scored in terms of content, resulting in 51 verbal descriptions (e.g., "they told us about the different rooms"), 14 action descriptions (e.g., "she walked away"), 10 person descriptions (e.g., "she had brown hair"), 10 surrounding descriptions (e.g., "it was raining"), and 8 object descriptions (e.g., "the papers were wet").

Inter-rater reliability was established for each of the two coders. Thus, a third coder randomly selected ten interviews for each coder and double-coded all statements provided in free recall and all responses provided in cued recall. In total, 283 statements in free recall were double-coded (23.0% of the total sample). Inter-rater reliability was high for both coders in terms of accuracy (Coder 1: $\kappa = .91$, $p < .001$; Coder 2: $\kappa = .92$, $p < .001$) and modality of details

(Coder 1: κ = .98, p < .001; Coder 2: κ = .98, p < .001), and acceptable for centrality (Coder 1: κ = .95, p < .001; Coder 2: κ = .85, p < .001), and content of the information (Coder 1: κ = .92, p < .001; Coder 2: κ = .85, p < .001). The scores of the original two coders were retained for the main analysis.

In the cued recall phase, answers were scored as correct, incorrect, or omitted, and all correct responses were coded for grain size as in previous experiments. Examples of each type of response are provided in Appendix A.3. For this phase, 320 responses were double-coded (20.8% of the total sample). Inter-rater reliability (for the decision to score a response as fine-grain correct, coarse-grain correct, incorrect, or omitted) for both coders was κ = .94, p < .001. Again, the scores of the original coders were retained for the main analysis.

6.1.3 Results

The aim of this experiment was to assess the effects of eye-closure and interview location on recall of a forensically relevant live event in a racially diverse sample. First, the results from the free recall phase will be presented, in terms of both the number of correct statements and the proportion of statements that were correct. Separate analyses will be conducted based on modality, centrality, and type of description. Second, the findings from the cued recall phase will be discussed, again in terms of both number and proportion correct, with separate analyses based on grain size. Finally, confidence ratings and witness characteristics will be examined.

6.1.3.1 Number Correct in Free Recall

Figure 6.1 shows the number of correct visual and auditory statements provided during free recall, by interview condition and location. Prior to analysis, the distributions of the dependent variables were normalised by square-root transformation. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVA on the square-root transformed total number of correct statements revealed a significant main effect of interview condition, F (1, 92) = 4.43, p < .05, η^2 = .04, d = .51, but no significant effect of interview location ($F < 1$). Participants who closed their eyes during the interview provided 25.4% more correct statements in free recall than participants who kept their eyes open. The interaction between interview condition and location approached significance, $F(1, 92) = 3.59$, $p = .06$, $\eta^2 = .04$, and simple effects analyses suggested that the eye-closure instruction was more helpful for participants interviewed inside, $F(1, 92) = 8.00$, $p < .01$, $\eta^2 = .08$, $d = .88$, than for participants interviewed outside ($F < 1$; see Figure 6.1).

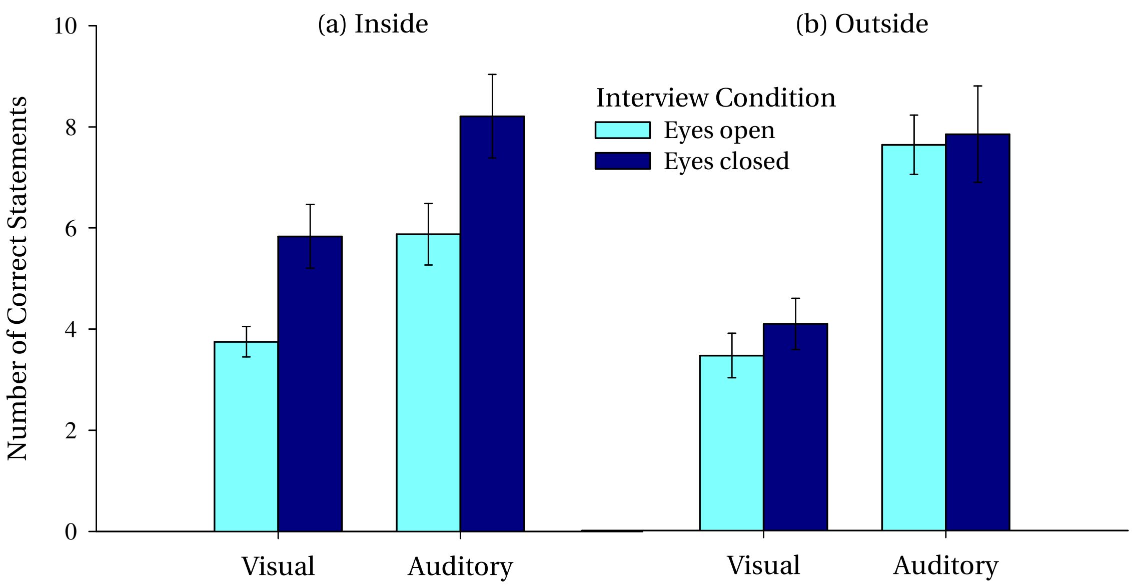

Figure 6.1 Experiment 6: Number correct in free recall. Mean number of correct visual and auditory statements provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

Participants reported significantly more auditory than visual correct details, $t(95) = 8.03$, $p < .001$, $\eta^2 = .58$. Because the respective number of visual and auditory details reported was not under experimental control, modality could not be included as an independent variable in the previous analysis. A separate 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVA on the square-root transformed number of visual details revealed significant main effects of interview condition, $F(1, 92) = 6.61$, $p < .05$, $\eta^2 = .06$, $d = .56$, and interview location, $F(1, 92) = 5.57$, $p < .05$, $\eta^2 = .05$, but no significant interaction between the two ($F < 1$). Participants in the eyes-closed condition reported 37.6% more visual details than participants in the eyes-open condition. In addition, participants interviewed inside reported 27.1% more visual details than participants interviewed outside. Another two-way ANOVA on the square-root transformed number of auditory details revealed no significant main effects of interview condition, $F(1, 92) = 1.26$, $p = .26$, or interview location ($F < 1$). There was a marginally non-significant interaction between interview condition and location, $F(1, 92) = 3.06$, $p = .08$, $\eta^2 = .03$, suggesting that eye-closure increased recall of auditory aspects for witnesses interviewed inside, $F(1, 92) = 4.13$, $p < .05$, $\eta^2 = .04$, $d = .66$, but not for witnesses interviewed outside ($F < 1$).

On average, participants reported 4.46 ($SD = 1.95$) out of 20 potential central details, and 7.21 ($SD = 4.12$) out of 73 potential peripheral details. Peripheral details significantly outnumbered central details, $t(95) = 7.40$, $p < .001$, $\eta^2 = .37$. Separate 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVAs showed that eye-closure resulted in a significant 33.0% increase in peripheral details, $F(1, 92) = 6.32$, $p < .05$, $\eta^2 = .06$, and a non-significant 13.9% increase in central details, $F(1, 92) = 2.18$, $p = .14$. There were no significant effects or interactions involving interview location (all ps > .07). Table 6.1 shows the frequency of different types of descriptions. Due to the low frequency of certain types of details, analysis of variance was not appropriate. However, at least numerically, eye-closure increased all types of details, save for descriptions of surroundings.

Table 6.1 Experiment 6: Number correct by type of description. Mean number of correct details reported in free recall by witnesses with eyes open or closed. Experimental conditions are collapsed over interview location.

	Interview Condition		
Type of Detail	Eyes open	Eyes closed	*Total*
Person	.73 (.14)	1.04 (.16)	*.89 (.11)*
Action	1.90 (.17)	2.40 (.19)	*2.15 (.13)*
Object	.79 (.18)	1.44 (.22)	*1.11 (.14)*
Surrounding	1.04 (.14)	1.02 (.14)	*1.03 (.10)*
Verbal	5.92 (.37)	7.13 (.57)	*6.52 (.34)*
Total	*10.35 (.55)*	*12.98 (.90)*	*11.67 (.54)*

Note. Standard errors in parentheses.

6.1.3.2 Proportion Correct in Free Recall

In free recall, participants generally volunteered few incorrect details (M = 1.14, SD = 1.46). The 96 participants together mentioned only 10 different incorrect details in total. These inaccuracies generally concerned the *source* of actions or statements rather than the content (i.e., who did or said what). As shown in Figure 6.2, the proportion of statements that were correct was high in all conditions. The distributions of the proportions could not be normalised, but non-parametric tests confirmed the non-significant results reported here (see Appendix B.4). A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) ANOVA on overall proportion correct revealed no main effects of interview condition, $F(1, 92) = 1.13$, $p = .29$, or interview location ($F < 1$), and no significant interaction between the two ($F < 1$). Separate ANOVAs for visual and auditory statements revealed no significant effects either (all ps > .16).

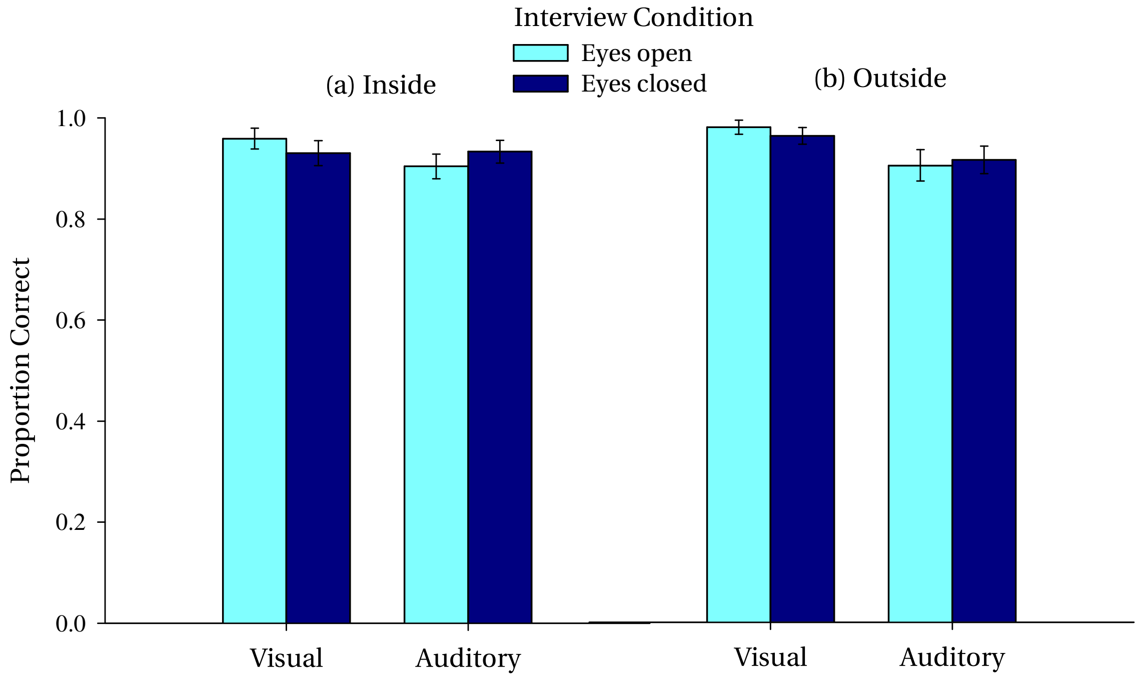

Figure 6.2 Experiment 6: Proportion correct in free recall. Mean proportion of visual and auditory statements that were correct, provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

6.1.3.3 Number Correct in Cued Recall

Figure 6.3 shows the total number of correct responses provided during questioning (i.e., fine-grain plus coarse-grain). A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) mixed ANOVA with repeated measures on the last factor was conducted on the total number of correct responses. There were no significant main effects of interview condition ($F < 1$), interview location ($F < 1$), or question modality ($F < 1$), and no significant interactions (all ps > .20). To examine whether the eye-closure effect depended on the specificity of the responses, separate analyses were conducted for fine-grain and coarse-grain correct responses.

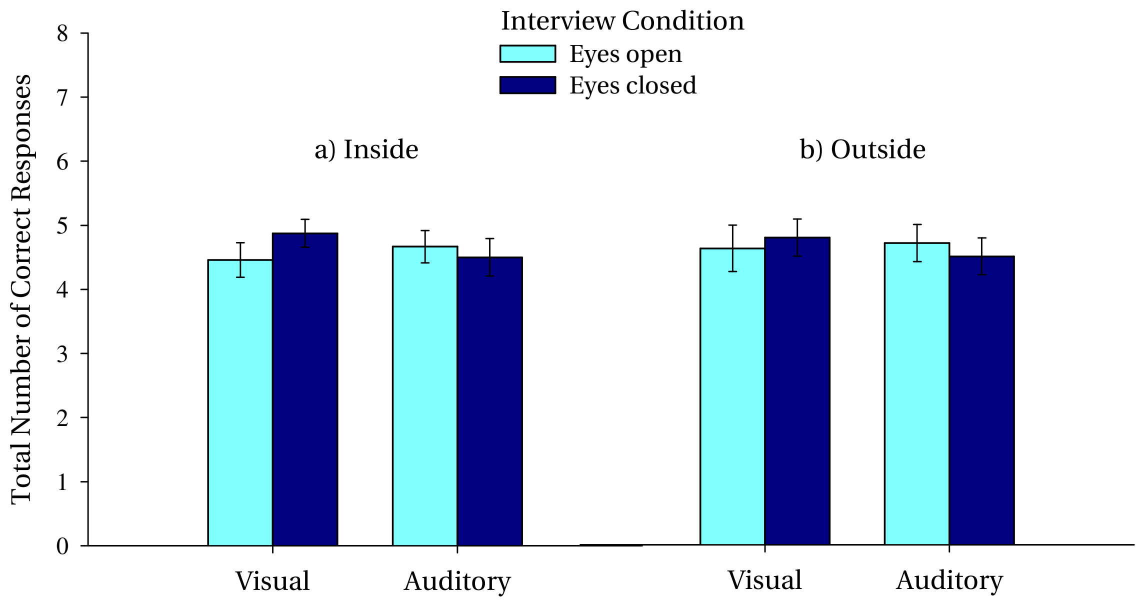

Figure 6.3 Experiment 6: Total correct in cued recall. Mean total number of correct responses to questions about visual and auditory aspects of the event provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

6.1.3.4 Fine-Grain Correct in Cued Recall

Figure 6.4 shows the number of fine-grain correct responses provided during questioning. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) mixed ANOVA on fine-grain correct recall revealed no significant main effects of interview condition ($F < 1$) or interview location ($F < 1$), but a significant effect of question modality, F (1, 92) = 6.85, $p < .05$, $\eta^2 = .06$. Participants were significantly more likely to provide fine-grain correct responses to questions about auditory details than to questions about visual details. Moreover, there was a significant interaction between interview condition and question modality, F (1, 92) = 6.85, $p < .05$, $\eta^2 = .06$. Participants who closed their eyes gave 23.8% more fine-grain correct answers to questions about visual aspects than participants who kept their eyes open, F (1, 92) = 4.40, $p < .05$, $\eta^2 = .05$, d = .43. For auditory aspects, eye-closure tended to decrease fine-grain correct recall, but this tendency was not significant, F (1, 92) = 1.51, $p = .22$. There were no other significant interactions (all Fs < 1).

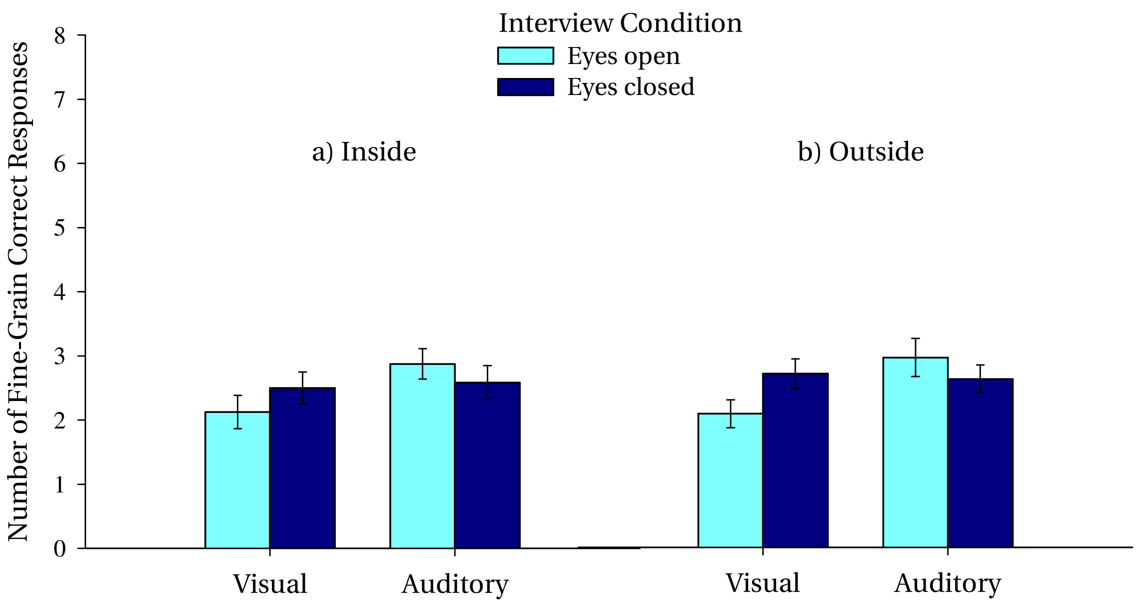

Figure 6.4 Experiment 6: Fine-grain correct in cued recall. Mean number of fine-grain correct responses to questions about visual and auditory aspects of the event provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

6.1.3.5 Coarse-Grain Correct in Cued Recall

Figure 6.5 shows the number of coarse-grain correct responses provided by participants. Prior to analysis, the distributions of the data for coarse-grain recall of visual and auditory aspects were normalised by log-transformation. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) mixed ANOVA on the log-transformed number of coarse-grain correct answers revealed no significant main effects of interview condition ($F < 1$) or interview location ($F < 1$), but a significant effect of question modality, $F(1, 92) = 9.21$, $p < .01$, $\eta^2 = .09$. Participants gave significantly more coarse-grain correct answers to questions about visual aspects than to questions about auditory aspects. There were no significant interactions (all *p*s > .31).

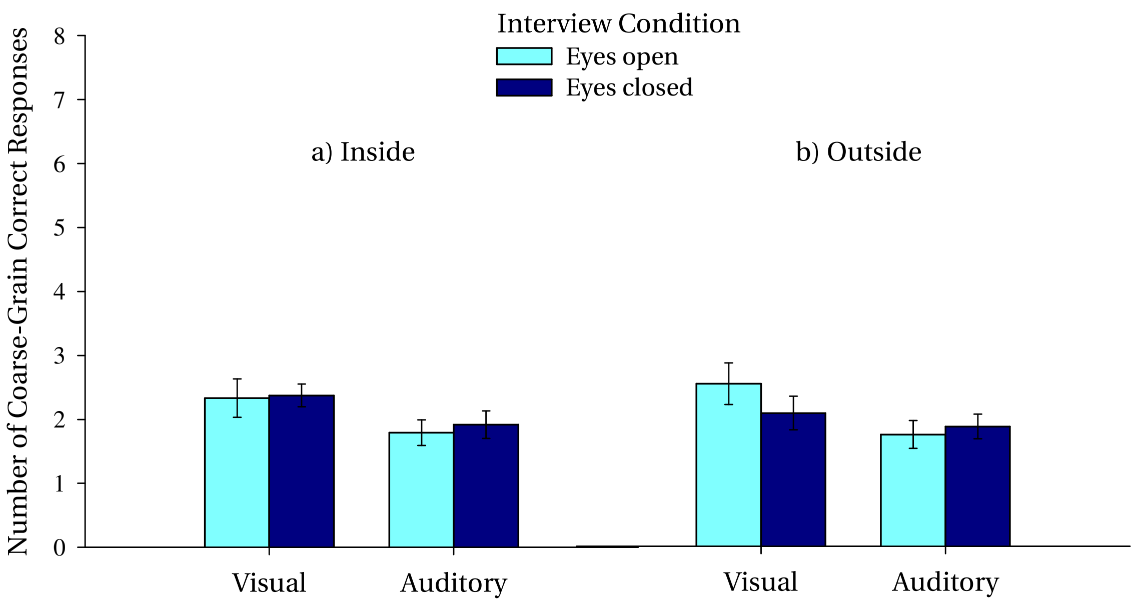

Figure 6.5 Experiment 6: Coarse-grain correct in cued recall. Mean number of coarse-grain correct responses to questions about visual and auditory aspects of the event provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

6.1.3.6 Proportion Correct in Cued Recall

On average, participants answered 1.09 out of the 16 interview questions incorrectly (*SD* = 1.46). Some examples of incorrect responses can be found in Appendix A.3. The proportion of responses provided during questioning that were correct is displayed in Figure 6.6. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Question Modality: visual, auditory) mixed ANOVA on proportion correct revealed no significant main effects of interview condition ($F < 1$), interview location ($F < 1$), or question modality, F (1, 92) = 2.16, p = .15. There were also no significant interactions (all *F*s < 1).

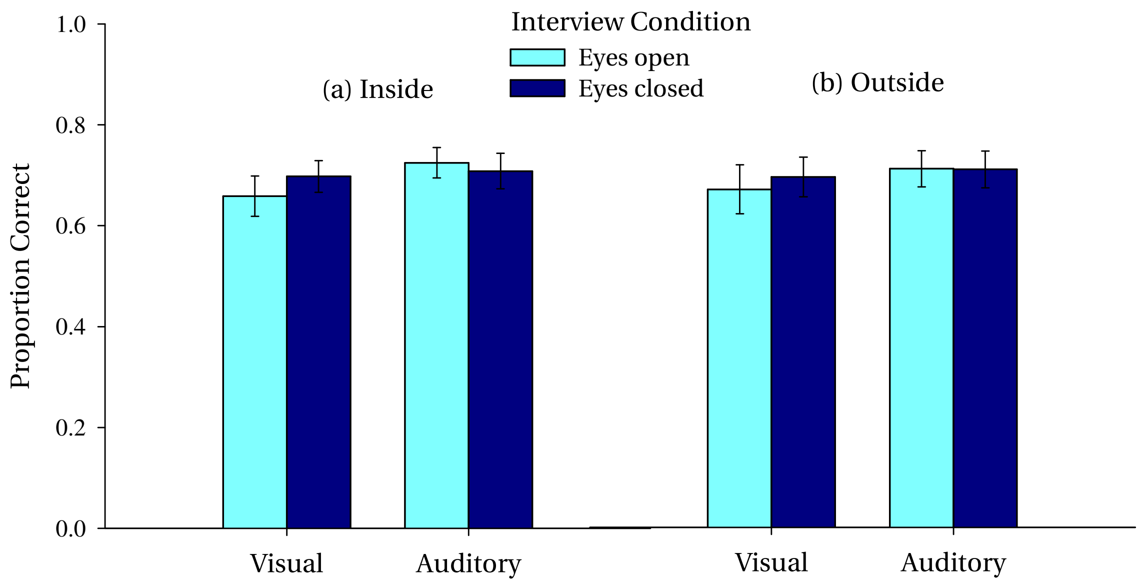

Figure 6.6 Experiment 6: Proportion correct in cued recall. Mean proportion of answers that were correct, in response to questions about visual and auditory aspects of the event, provided by participants interviewed (a) inside in a quiet location or (b) outside on the street. Error bars represent standard errors.

6.1.3.7 Confidence

Confidence ratings on a scale of 0 to 100% were obtained for all answered questions. For the confidence analysis, fine-grain and coarse-grain correct responses were again collapsed for the sake of simplicity. First, the effect of interview condition and location on average confidence ratings for correct and incorrect responses was examined (see Figure 6.7). The distributions for confidence ratings were normalised by inverting and square-root transforming the data.

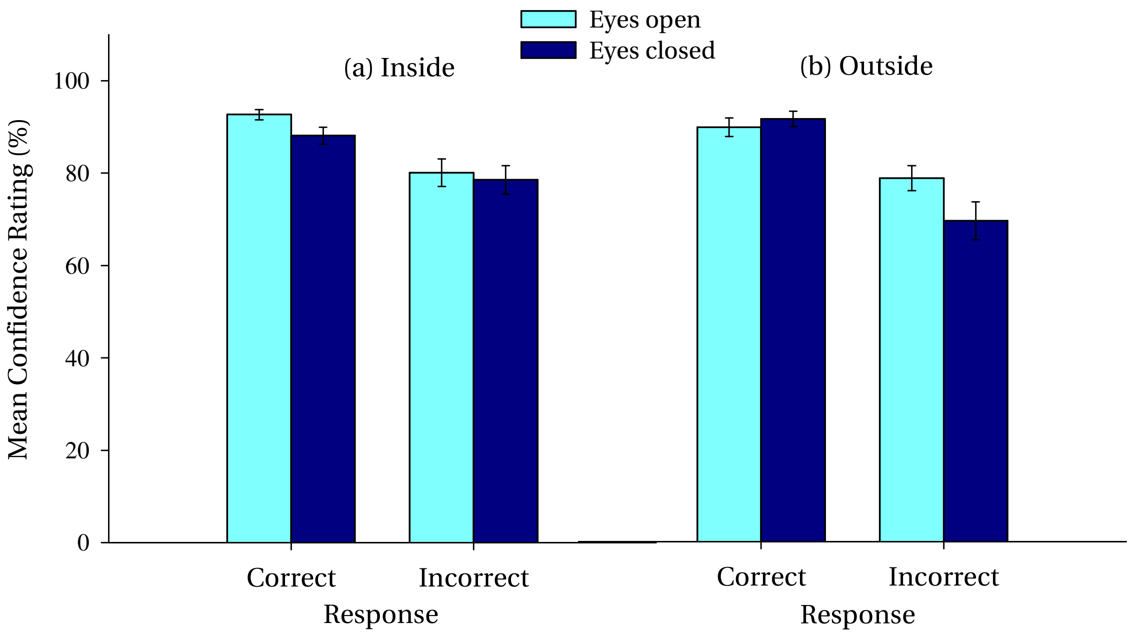

Figure 6.7 Experiment 6: Mean confidence ratings. Average confidence ratings (0 = not confident at all; 100 = extremely confident) for correct and incorrect responses provided (a) inside in a quiet location or (b) outside on the street, by participants with eyes open or closed.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Interview Location: inside, outside) x 2 (Type of Response: correct, incorrect) mixed ANOVA with repeated measures on the last factor was conducted on the transformed mean confidence ratings. There was a significant main effect of type of response, F (1, 89) = 44.08, $p < .001$, $\eta^2 = .32$: participants gave higher confidence ratings for correct responses than for incorrect responses. There were no significant main effects of interview condition, F (1, 89) = 1.07, $p = .30$, or interview location ($F < 1$), but there was a significant three-way interaction, F (1, 89) = 5.20, $p < .05$, $\eta^2 = .32$. This interaction is illustrated in Figure 6.7. For witnesses interviewed inside, eye-closure decreased confidence in both correct and incorrect responses, and this decrease was marginally significant for correct responses, F (1, 89) = 3.80, p = .05, η^2 = .04, but not significant for incorrect responses (F < 1). For witnesses interviewed outside, eye-closure reduced confidence only for incorrect responses, but this decrease failed to reach significance, F (1, 89) = 2.69, p = .10. There were no other significant interactions (all ps > .12).

Second, it was investigated whether generally confident rememberers were also generally accurate. The average confidence rating per participant was not significantly correlated with the proportion of responses that were correct, r = .07, p = .50. Separate analyses revealed no significant general confidence-accuracy (CA) correlations in either of the interview conditions, although the correlation was somewhat higher for the eyes-open group, r = .25, p = .08, than for the eyes-closed group, r = -.12, p = .42. Nevertheless, these correlation coefficients did not differ significantly from each other, Fisher's z = 1.79, p = .07. Similarly, the general CA correlation was not significantly affected by interview location, Fisher's z = .18, p = .37 (inside: r = .18, p = .22; outside: r = -.01, p = .96).

Third, point-biserial correlations between confidence in a particular response and accuracy of that response were calculated. All participants together provided 1276 responses in total, and there was a significant and relatively large specific CA correlation, r_{pb} = .48, p < .001. Separate analyses showed that the correlation was similar across interview conditions, Fisher's z = .29, p = .58 (eyes-open: r_{pb} = .47, p < .001; eyes-closed: r_{pb} = .49, p < .001) and across interview locations, Fisher's z = .67, p = .50 (inside: r_{pb} = .46, p < .001; outside: r_{pb} = .49, p < .001). In sum, if a response was provided with a high level of confidence, it was quite likely to be accurate.

Fourth, a calibration technique was used to plot the proportion of correct responses against participants' confidence ratings. The calibration graph is depicted in Figure 6.8.

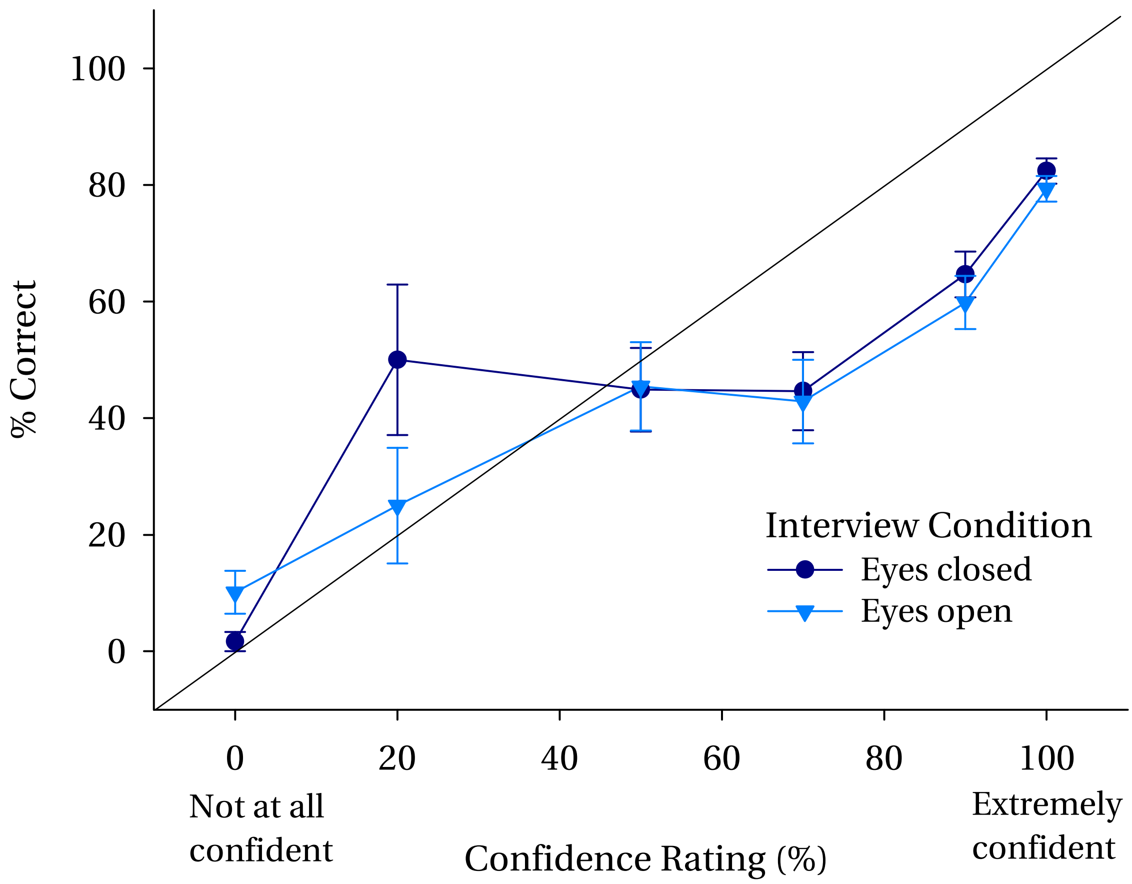

Figure 6.8 Experiment 6: Confidence-accuracy calibration. Mean percentage correct by confidence rating for the eyes-open and eyes-closed conditions. The black line denotes perfect calibration. Errors bars represent standard errors.

To provide more stable estimates of percentage correct, confidence ratings were collapsed into six categories (0%, 1–39%, 40–59%, 60–79% 80–99%, 100%).[25] Accuracy in each confidence category was compared with the weighted mean confidence rating in that category. The calibration graph looks somewhat different from the calibration graphs in Experiments 2, 3, and 5 (see pages 100, 134, and 166, respectively); in the present study, participants tended to be *over*confident in their responses. Visual inspection of Figure 6.8 suggests that there was little difference between the eyes-open and eyes-closed group for confidence ratings of 40% and higher. There seemed to be a

[25] The confidence categories were slightly different from those used in Experiment 5, because the distribution of the confidence ratings was not the same (e.g., the number of '0%' ratings in the present experiment was sufficient to comprise a category of its own). However, the data pattern reported here was similar to the pattern observed when applying the categorisation used in Experiment 5.

few differences at the lower end of the scale, but no clear pattern emerged. These findings will be addressed in the Discussion.

6.1.3.8 Witness Characteristics

The present study replicated the eye-closure effect with a sample of witnesses from various racial backgrounds. Due to the small number of participants of each racial group per interview condition, witness race could not be included in an ANOVA. Nevertheless, two interesting trends are worth mentioning. First, in free recall, eye-closure increased *number* correct to a similar extent for all racial groups (Hispanic, African-American, Caucasian, Asian, and Other race), but substantially increased *proportion* correct only for African-American participants (from .86 in the eyes-open condition to .97 in the eyes-closed condition). Second, in cued recall, eye-closure did not affect *proportion* correct for any of the racial groups, but substantially increased *number* correct only for Caucasian participants (from 8.33 in the eyes-open condition to 10.56 in the eyes-closed condition). In sum, it seems that the effect of eye-closure on recall may vary depending on the race of the witness, although the present data do not provide clear evidence regarding this issue.

It was possible, however, to investigate the role of gender in the eye-closure effect. For free recall, a 2 (Interview Condition: eyes open, eyes closed) x 2 (Witness Gender: male, female) ANOVA on the square-root transformed number of correct statements revealed no significant main effect of witness gender ($F < 1$), and no interaction between gender and interview condition ($F < 1$). Similarly, a 2 x 2 ANOVA on proportion correct in free recall revealed no main effect of gender ($F < 1$) and no interaction between gender and eye-closure ($F < 1$). Separate analyses for visual and auditory statements in free recall also revealed no gender differences in number or proportion correct (all ps > .16). In sum, male and female participants performed equally well in free recall, and eye-closure had similar effects for both genders. However, there were some gender differences in cued recall, which are depicted in Figure 6.9.

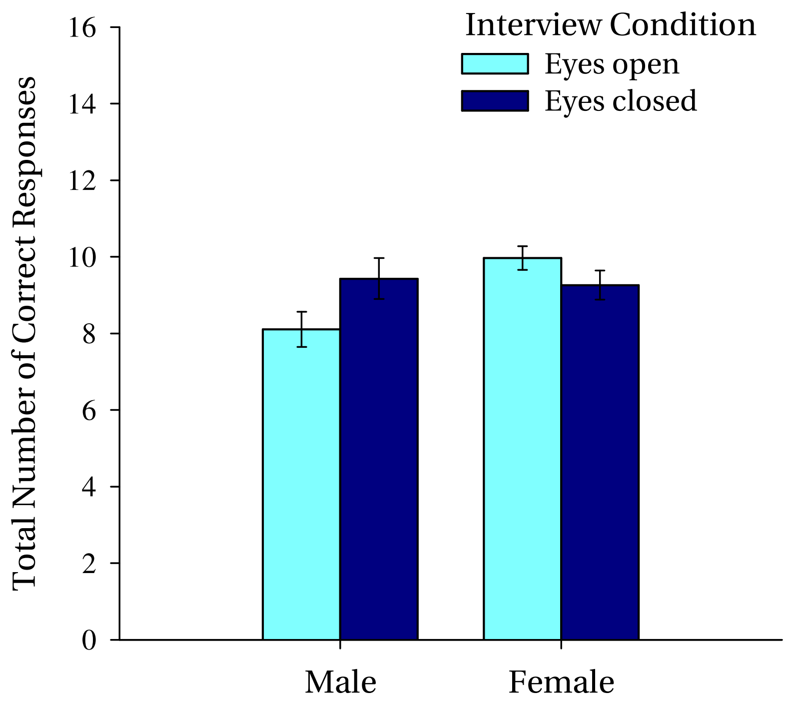

Figure 6.9 Experiment 6: Role of witness gender in cued recall. Mean total number of correct responses during questioning provided by male and female participants. Error bars represent standard errors.

A 2 (Interview Condition: eyes open, eyes closed) x 2 (Witness Gender: male, female) x 2 (Question Modality: visual, auditory) ANOVA on the total number of correct responses provided in cued recall revealed a significant main effect of witness gender, $F\,(1, 92) = 4.17$, $p < .05$, $\eta^2 = .04$, and a significant interaction between gender and interview condition, $F\,(1, 92) = 6.01$, $p < .05$, $\eta^2 = .06$. There were no other significant interactions involving gender (both *F*s < 1). As shown in Figure 6.9, female participants performed better on the cued recall test than male participants. However, eye-closure was more helpful for male participants, bringing their performance up to the level of the female participants. Simple effects analyses showed that eye-closure significantly increased number correct for male participants, $F\,(1, 92) = 4.38$, $p < .05$, $\eta^2 = .05$, $d = .59$, but did not significantly affect number correct for female participants, $F\,(1, 92) = 1.75$, $p = .19$. Another three-way mixed ANOVA on the proportion correct in cued recall revealed no significant main effects or interactions involving witness gender (all *p*s > .10). In sum, eye-closure helped male, but not female, witnesses to provide more correct responses during questioning. The implications of this finding will be addressed in the Discussion.

Finally, the influence of witness gender on confidence ratings was assessed. A 2 (Interview Condition: eyes open, eyes closed) x 2 (Witness Gender: male, female) x 2 (Type of Response: correct, incorrect) mixed ANOVA on transformed mean confidence ratings revealed no significant main effects or interactions involving witness gender (all Fs < 1). Similarly, no different patterns based on gender were observed for general CA correlations, specific CA correlations, or CA calibration.

6.1.4 Discussion

The present findings provide evidence that closing the eyes helps eyewitnesses to recall a verbal altercation that they witnessed in real life. This is an important extension of the eye-closure effect, since reports about a verbal argument can provide the police with potentially relevant information in the investigation of violent crimes (cf. Murdoch & Ross, 1990; Pihl & Peterson, 1995; Pittman & Handy, 1964). In addition, the present study was the first to replicate the eye-closure effect in a racially diverse sample from the United States. Unlike in Experiment 3, eye-closure in immediate free recall in the present study significantly increased the amount of visual information reported, by 37.6%, without harming testimonial accuracy. Eye-closure tended to increase recall of various aspects of the witnessed event, including information that could be relevant in police investigations (e.g., descriptions of persons and actions). In cued recall, eye-closure did not have a significant main effect, but it did help witnesses to retrieve 23.8% more fine-grain correct answers to questions about visual aspects of the witnessed scene. The difference between free and cued recall will be further addressed in the General Discussion (section 7.2.2).

6.1.4.1 Interview Location

Prior to the experiment, two competing hypotheses were formulated concerning the role of interview location in the eye-closure effect. On the one hand, the *distraction hypothesis* predicted that witnesses interviewed outside would benefit more from eye-closure, since it would help them to block out the severe distractions in the environment (which was not as necessary for witnesses interviewed inside). On the other hand, the *context hypothesis* predicted that witnesses interviewed inside would benefit more from eye-closure, since it would help them to spontaneously reinstate the context of the witnessed event (which was not as necessary for witnesses interviewed outside). In free recall, there was a marginally significant interaction between eye-closure and location, suggesting that eye-closure was most effective for witnesses interviewed inside. This finding provides more support for the context hypothesis than for the distraction hypothesis.

The finding that context effects were seemingly more powerful than distraction effects is somewhat surprising in light of the fact that the context dependent memory phenomenon is somewhat unreliable and does not always replicate (e.g., Godden & Baddeley, 1980; Hygge et al., 2003; McSpadden et al., 1988). However, the inconsistency between this observation and the current findings may be due the nature of the to-be-remembered stimuli. In most studies on context-dependent memory, the learning material is unrelated to the encoding environment itself. In the present study, on the other hand, the encoding environment was part of the event memory. If eye-closure facilitated spontaneous mental context reinstatement (Caruso & Gino, 2011; Fisher & Geiselman, 1992), it would have brought back memories that were intricately related to that context. For example, Smith (1988) shared an anecdote about his father returning to his former house in Texas after 42 years. When his father saw the house, he suddenly remembered how an armadillo climbed up the drain pipe one day. Although seeing the drain pipe would probably not have cued memories of words learned while looking at the drain pipe, it is an effective reminder of a story *involving* the drain pipe. In sum, the context effect may be more powerful when the context is an integral part of the memory. In line with this reasoning, however, we would have expected that eye-closure would also have increased the number of details recalled about the surroundings of the event, which was not found in the present study. Therefore, this tentative explanation of the findings requires further investigation.

An alternative explanation of the finding that eye-closure was not effective for witnesses interviewed outside could be that the auditory distractions outside were simply too severe to overcome. Perfect et al. (2011) found that eye-closure could overcome auditory distraction posed by bursts of white noise, but it is uncertain whether this finding would extend to more realistic auditory distractions. In the present study, witnesses interviewed outside could hear the traffic rushing by and people walking past. Unlike white noise, cars and people are potentially dangerous, and monitoring this potential danger in the environment (even with eyes closed) could have distracted witnesses from the task at hand. Future research could compare the distraction hypothesis and the context hypothesis more directly by varying the similarity of context and the level of distraction independently. Thus, future research could examine the eye-closure effect in four conditions: same-context/quiet-environment, same-context/noisy-environment, different-context/quiet-environment, and different-context/noisy-environment. If eye-closure is most effective in a context that is dissimilar from the encoding context, regardless of the level of distractions in the environment, this would provide support for the context hypothesis. If eye-closure is most effective in a noisy environment, regardless of context similarity, this would provide support for the distraction hypothesis.

From an applied perspective, the present findings should not discourage the use of eye-closure for witnesses interviewed outside. After all, eye-closure did not harm eyewitness testimony in free recall for witnesses interviewed outside, and it actually helped them to retrieve slightly more fine-grain correct answers to questions about visual details. Thus, although the marginally significant interaction between eye-closure and interview location in free recall is theoretically interesting, the current findings do not warrant the conclusion that the eye-closure instruction should not be used when witnesses are interviewed outside.

6.1.4.2 Confidence

As in Experiment 2, eye-closure tended to reduce participants' confidence in their responses provided during cued recall. In the present study, this tendency was most pronounced for correct responses provided by witnesses interviewed inside, and for incorrect responses provided by witnesses interviewed outside. It is unclear why this three-way interaction occurred.

Given that the simple effects related to the interaction were not significant, this result needs to be replicated before any meaningful conclusions can be drawn. Unlike the previous experiments, participants in the present study tended to be overconfident rather than underconfident. In addition, participants who closed their eyes in the present study were not generally more underconfident than participants who kept their eyes open. The effect of eye-closure on confidence will be further discussed in section 7.2.5.

There are at least three potential explanations for the finding that participants in the present study were not as underconfident as participants in the previous experiments. First, it could be due to cultural differences; perhaps, students in New York are typically more confident in their answers than students in York. Second, it could be due to the type of event; perhaps, people are more confident in the responses they give about an event that they personally experienced than in the responses they give about an event that they watched on video. Third, it could be due to the confidence scale; perhaps, rating confidence on a scale of 0 to 100% induces people to provide higher ratings than rating confidence on a scale of 1 to 5. The latter explanation seems unlikely in light of the results obtained in Experiment 5 (see section 5.3.3.5), in which the same confidence scale was used, yet no overconfidence was observed. To distinguish between the first two explanations, future research could assess the confidence-accuracy relationship for recall of the same event presented either live or on video (cf. Ihlebæk et al., 2003), in samples from different countries.

6.1.4.3 Witness Characteristics

The present study replicated the eye-closure effect in a racially diverse sample from the United States, as opposed to the predominantly Caucasian samples from the United Kingdom used in previous studies. Interestingly, the patterns observed in the present study suggests that eye-closure may have different types of benefits for different racial groups, but the sample sizes in each racial group were too small to draw any conclusions. Nevertheless, it would not be unthinkable that eye-closure is more effective for certain individuals than for others. For instance, the effectiveness of mental context reinstatement has been found to depend on individual differences such as cognitive style

(Emmett et al., 2003), and cognitive styles and abilities may vary across different racial groups (Rushton & Jensen, 2005). The role of individual differences in the eye-closure effect could be an interesting avenue for future research.

Overall, female witnesses in the present study provided more correct responses during questioning than male witnesses. This finding is consistent with previous research showing that women tend to outperform men on episodic memory tasks (Chipman & Kimura, 1998; Herlitz et al., 1999; Herlitz et al., 1997; Lewin & Herlitz, 2002). More surprising, however, was the finding that eye-closure improved cued recall for male witnesses but not for female witnesses. This finding was particularly surprising considering that the eye-closure effect in previous studies was found with samples including predominantly female participants. Because the gender difference in the effectiveness of eye-closure in cued recall was relatively small, and because no gender differences were observed in free recall, the evidence regarding this issue is as of yet inconclusive. Furthermore, there are at least two potential explanations of the present findings that are not based on cognitive differences between sexes per se. First, male witnesses could have benefited more from eye-closure because they were more distracted by the interviewer when they had their eyes open (all interviewers in the present study were female). Second, eye-closure may have had a larger impact for male participants because their cued recall performance was poorer overall. For instance, Emmett et al. (2003) found that mental context reinstatement was more effective for witnesses who generally exhibited poorer memory performance than for witnesses who generally performed well. In sum, future studies need to replicate the gender difference in the eye-closure effect under more controlled conditions (e.g., systematically varying the gender of the interviewer) before it can be concluded that eye-closure helps male but not female witnesses.

6.1.4.4 Conclusion

The present study extended the eye-closure effect to recall of a forensically relevant live event, in a racially diverse sample of witnesses. This finding increases the ecological validity of the research, providing a stronger argument that the findings will replicate in real-life contexts. In addition, eye-closure was found to be more effective for witnesses who were interviewed in a quiet environment that was different from the context of the to-be-remembered event, than for witnesses who were interviewed in a noisy environment that was similar to the context of the event. This finding promotes our theoretical understanding of the eye-closure effect, and points to important avenues for future research to compare the context hypothesis and the distraction hypothesis more directly. The experiment presented in this chapter was the final experiment of the thesis. The next chapter will summarise the results of all experiments and reflect on the theoretical and practical implications of the findings.

6.2 Chapter Summary

- The eye-closure effect was extended to recall of a forensically relevant live event.
- Eye-closure increased the amount of information reported in free recall without harming the testimonial accuracy of that information.
- Eye-closure was particularly beneficial for recall of visual information, and increased the report of different types of information (in terms of centrality and content).
- Eye-closure increased fine-grain correct but not coarse-grain correct responses to questions about visual aspects of the witnessed events.
- Eye-closure was particularly beneficial for witnesses interviewed inside in a quiet environment, suggesting that spontaneous context reinstatement may play a role in the eye-closure effect.
- Witnesses in the present study tended to be overconfident in their responses, but eye-closure tended to reduce mean confidence.
- Female witnesses performed better in cued recall, but eye-closure tended to be more effective for male witnesses in cued recall.

Chapter 7
Summary and General Discussion

In the final chapter of this thesis, I will consider the theoretical and practical implications of the research findings. First, I will provide an overview of the research aims and the main findings, followed by a discussion of six themes recurring throughout the thesis. I will then present the findings from a survey of police interviewers, which assessed whether implementation of the eye-closure instruction in practice would be useful and feasible. In the final part of the chapter, I will discuss the main limitations of the research and provide a number of suggestions for future research.

7.1 Research Aims and Main Findings

The overall goal of the present thesis was to investigate the benefits of eye-closure on eyewitness memory. The first aim was to examine whether the eye-closure effect extends to realistic situations. The second aim was to explore the theoretical underpinnings of the eye-closure effect. Here, I will present a brief overview of the main findings with respect to each research question (see section 2.4.2). The findings will be discussed in more detail in the next section.

1. Closing the eyes was found to be more beneficial for recall of visual details than for recall of auditory details (Experiments 1, 2, 3, 5, 6).
2. Eye-closure mostly affected fine-grain rather than coarse-grain recall (Experiments 2, 3, 5, 6), but increased recall of both central and peripheral details (Experiments 2, 3, 6).
3. The eye-closure instruction did not impair testimonial accuracy in free recall (Experiments 3, 6), and even tended to improve testimonial accuracy in cued recall (Experiments 1, 2, 3, 5).

4. Eye-closure tended to reduce rather than inflate participants' confidence in their responses (Experiments 2, 3, 5, 6).
5. The eye-closure effect was extended to recall of several violent events, and was found to be equally effective for violent and non-violent events (Experiments 1, 2).
6. Eye-closure benefits were observed not only for cued recall, but also for free recall (Experiments 3, 6).
7. Eye-closure was still effective when recall was tested after a week and repeated retrieval attempts (Experiment 3).
8. No evidence was obtained for an "ear-closure" effect (Experiment 4).
9. Visual and auditory distractions in the interview environment caused general and modality-specific impairments in recall performance (Experiment 5).
10. The eye-closure effect was extended to recall of a realistic verbal altercation experienced live on the street, and was found to be more pronounced for witnesses interviewed in a quiet location than for witnesses interviewed on the street (Experiment 6).

7.2 Recurring Themes

The main findings will be discussed in light of six themes: the type of to-be-remembered event, the format and timing of recall, testimonial accuracy, the type of information recalled, general and modality-specific interference, and the level of confidence expressed by witnesses. For each theme, theoretical and practical implications will be discussed.

7.2.1 Type of Event

7.2.1.1 Summary

Across experiments, the eye-closure instruction was found to be effective for different types of events. In Experiments 1 and 3, eye-closure helped witnesses to remember the visual details of a brief video clip of a violent event. In

Experiments 2 and 5, closing the eyes improved recall of both violent and non-violent versions of longer video clips. In Experiment 6, eye-closure improved recall of a verbal altercation that was experienced live by unsuspecting witnesses. In sum, the eye-closure effect seems to be robust across violent and non-violent events, and across videotaped and live events.

7.2.1.2 Theoretical Implications

Perfect and colleagues (2008) found that eye-closure improved recall of mundane events, and the experiments presented in this thesis show that the effect extends to recall of violent events, which were confirmed to be emotionally arousing in terms of subjective ratings and electrodermal activity. This suggests that the processes underlying the eye-closure effect are independent of the processes associated with the impact of emotional arousal on memory (e.g., Christianson, 1992; Deffenbacher et al., 2004). Furthermore, eye-closure improves recall for both videotaped and live events (cf. Perfect et al., 2008). Crucially, this also applies when the live event is forensically relevant (Experiment 6). This suggests that the processes underlying the eye-closure effect are also independent of the processes associated with the differences between recall of videotaped and live events (Ihlebæk et al., 2003). In sum, despite potential differences in recall of certain events, eye-closure seems to be beneficial across different types of events.

7.2.1.3 Practical Implications

The finding that eye-closure was beneficial for recall of both violent and non-violent events suggests that the eye-closure instruction may be recommended for use in police interviews concerning violent and non-violent crime alike. The finding that eye-closure improved recall of a personally experienced verbal altercation comes as close as ethically possible to the real circumstances faced by eyewitnesses. Since violent crime is often preceded by a verbal argument (Murdoch & Ross, 1990; Pihl & Peterson, 1995; Pittman & Handy, 1964), testimony about an altercation may provide useful information in a criminal investigation, such as who initiated the quarrel. The next section will reflect upon the role of recall format and timing in the eye-closure effect.

7.2.2 Recall Format and Timing

7.2.2.1 Summary

In free recall, eye-closure was found to increase the amount of visual information reported during an immediate interview (Experiment 6) and during a one-week delayed interview (Experiment 3) by approximately 37%. However, eye-closure during immediate free recall in Experiment 3 did not significantly affect recall performance. In cued recall, the benefits of eye-closure were mostly limited to fine-grain correct recall of visual information, with somewhat more modest effect sizes (increases of 13.0%, 29.7%, 33.3%, and 23.8% in visual fine-grain recall in Experiments 1, 2, 5, and 6 respectively), except when witnesses were interviewed after a week (increase of 42.7% in Experiment 3).

7.2.2.2 Theoretical Implications

When memory was tested in immediate free recall, eye-closure was effective in Experiment 6 but not in Experiment 3. Although this discrepancy is difficult to explain, it could potentially be due to differences in experimental methodology. For instance, the retention interval between the event and the interview was not only slightly longer in Experiment 6 (five minutes as opposed to two minutes), but it was also filled with more meaningful events (crossing four busy streets and having a conversation with the interviewer, as opposed to backwards spelling of animal names in a quiet experimental room). Thus, it is possible that for participants in Experiment 3, the memory of the event was still fresh in their minds, whereas for participants in Experiment 6, the intervening events reduced the accessibility of the memory. In that case, increasing accessibility to retrieval cues by closing the eyes would have been more beneficial for participants in Experiment 6 than for participants in Experiment 3. Some support for this explanation can be found in the performance in the eyes-open conditions: participants who kept their eyes open in immediate free recall in Experiment 3 reported approximately 35 statements on average, whereas the same group in Experiment 6 reported only about 10 statements. Unfortunately, it is impossible to compare performance across experiments directly, due to methodological differences. For instance, the difference in the number of statements could also have been due to the fact that Experiment 3 concerned a videotaped event, whereas Experiment 6 concerned a live event (cf. Ihlebæk et al., 2003).

There was a slight tendency for the eye-closure effect to be more pronounced in free recall than in cued recall. Similarly, studies with adults assessing the effectiveness of the Cognitive Interview and mental context reinstatement tend to find greater benefits in free recall (e.g., Davis et al., 2005; Emmett et al., 2003; Ready et al., 1997). This tendency might be explained in light of the nature of the retrieval task. Free recall provides witnesses with the opportunity to report everything that was encoded, and eye-closure can help them to retrieve this information. Cued recall, on the other hand, targets specific aspects of the event, which may have never been encoded in the first place (Wagstaff et al., 2010). Eye-closure may facilitate retrieval of information that was encoded, but it cannot facilitate retrieval of information that was never encoded. Therefore, although eye-closure has the potential to improve cued recall to some extent (for questions about information that was actually encoded), it should have the greatest impact in free recall (see also Wagstaff et al., 2004; 2010; 2011).

The tendency for eye-closure to have greater benefits in free recall than in cued recall seems to be closely related to the tendency for eye-closure to have greater benefits during delayed recall than during immediate recall. Caruso and Gino (2011) found that eye-closure induces spontaneous mental simulation of events, which should facilitate reinstatement of the context of the to-be-remembered event (Fisher & Geiselman, 1992). Mental context reinstatement increases accessibility to relevant retrieval cues (S. M. Smith, 1979; S. M. Smith & Vela, 2001; Thomson & Tulving, 1970), which is most helpful in a situation in which few such cues are available (Eich, 1995; S. M. Smith, 1988). Therefore, eye-closure should be most effective when few cues are available, either due to recall format (free as opposed to cued recall), or due to retention interval (delayed as opposed to immediate recall).

7.2.2.3 Practical Implications

From an applied point of view, the finding that eye-closure was, if anything, *more* effective after a delay of a week is promising. In real life, eyewitnesses typically experience delays between witnessing an event and being interviewed about it (Fisher & Geiselman, 1992; Flin et al., 1992; Gabbert et al., 2009), and the findings from Experiment 3 suggest that eye-closure can still be helpful after such a delay. Furthermore, the findings suggest that eye-closure cannot only help witnesses to repeat previously reported information, but can also help them to retrieve *new* information from memory. This may lead to important new investigative leads in police investigations.

Overall, eye-closure improved recall performance in nearly all studies, and even when eye-closure did not have significant benefits (in immediate free recall in Experiment 3), it did not harm recall performance either. In some cases, the amount of additional information elicited as a result of eye-closure (e.g., 42.7% in delayed cued recall in Experiment 3) rivalled the amount of additional information elicited with the Cognitive Interview (in their meta-analysis, Köhnken et al., 1999, reported a 41% increase as a result of the Cognitive Interview). In other experiments, the amount of additional information elicited was somewhat smaller. However, given that the eye-closure instruction requires virtually no training and no additional interview time, it could still serve as useful alternative in cases in which conducting a full Cognitive Interview is not feasible. Moreover, unlike the Cognitive Interview, the eye-closure instruction was associated with an increase in testimonial accuracy in cued recall, which will be discussed in the next section.

7.2.3 Testimonial Accuracy

7.2.3.1 Summary

Overall, testimony provided in free recall was more likely to be accurate (proportions correct above .90) than testimony provided in cued recall (proportions correct around .70). In free recall, eye-closure did not improve or harm testimonial accuracy. In cued recall, eye-closure increased testimonial accuracy in all experiments except Experiment 6, in which it did not improve or impair testimonial accuracy.

7.2.3.2 Theoretical Implications

Koriat and Goldsmith's (1996) strategic control model provides a useful framework for explaining the increase in testimonial accuracy in cued recall as a result of eye-closure. According to the model, in response to a question, witnesses generate a number of candidate items from memory. They then select the best candidate response, and monitor the likely accuracy of this response. Based on this monitoring process, they then decide whether to volunteer the response or not. Koriat and Goldsmith's model suggests two potential mechanisms that could explain the finding that eye-closure increased the proportion of answers that were correct. First, eye-closure may have helped witnesses to retrieve more candidate answers from memory, thereby increasing the likelihood that one of them would be correct. Second, eye-closure may have helped witnesses to monitor the accuracy of the candidate items, thereby increasing the likelihood that they selected the correct answer from among the other candidate items. In either case, the eye-closure instruction seems to affect the quality of the best-candidate response, rather than the willingness to volunteer that response (see also Perfect, Andrade, & Syrett, 2011).

7.2.3.3 Practical Implications

Unlike hypnosis (Dinges et al., 1992; Erdelyi, 1994; Kebbell & Wagstaff, 1998), eye-closure did not impair testimonial accuracy in free recall, and actually improved accuracy in cued recall in nearly all experiments. This finding has important implications for police interviewers. Unlike an increase in quantity, an increase in quality of eyewitness testimony would likely go unnoticed in practice, since it is often impossible to establish the accuracy of testimony provided by real eyewitnesses. The current findings suggest that eye-closure may not only increase the number of correct answers provided in response to questions posed by the police interviewer, but that it may also decrease the number of incorrect answers provided. Thus, the eye-closure instruction may have two benefits in practice; one that is relatively easy to detect (i.e., the increase in quantity in free recall), and one that is more difficult to detect, but crucial in police investigations (i.e., the increase in quality in cued recall).

7.2.4 Modality, Grain Size, and Content

7.2.4.1 Summary

Across all experiments, eye-closure was found to be most beneficial for recall of visual information. The interaction between interview condition and modality was significant in Experiments 1, 3, 5, and 6, and marginally significant in Experiment 2. In cued recall, eye-closure predominantly affected fine-grain rather than coarse-grain recall of visual details, although it increased coarse-grain recall irrespective of modality in Experiment 1. When information centrality was examined in Experiments 2, 3, and 6, eye-closure was found to benefit recall for both central and peripheral details (but not gist). Furthermore, eye-closure enhanced recall of information varying in content, including person, action, object, and verbal descriptions (Experiment 6).

7.2.4.2 Theoretical Implications

Experiments 3 and 6 permitted a detailed analysis of the type of information that witnesses choose to report in free recall. According to Fisher and Geiselman (1992), "most people seem to have a preference for describing the visual characteristics of a scene rather than the auditory properties" (p. 111). This pattern was confirmed in Experiment 3, but the reverse pattern was observed in Experiment 6. The difference is probably due to the nature of the event. In Experiment 6, participants witnessed a verbal interaction in real life, and were probably paying most attention to what was said (since it would supposedly determine where they would be going to take part in the experiment). In Experiment 3, participants watched a video of a violent act, and were likely paying most attention to what was seen (since the violence was predominantly visual in nature). Crucially, even though participants in Experiment 6 reported mostly auditory details, the benefits of eye-closure were still predominantly observed for the recall of visual details. This suggests that the tendency for eye-closure to be more effective for recall of visual information (observed across all experiments) was not simply due to the dominance or difficulty of visual information as opposed to auditory information.

In most experiments presented in this thesis, eye-closure did not affect coarse-grain recall (except in Experiment 1). However, eye-closure increased fine-grain correct recall of visual aspects in *all* experiments. If one assumes that the retrieval of fine-grain information from memory relies on mental imagery to a greater extent than the retrieval of coarse-grain information does (see section 3.2.1.2), this finding provides support for the idea that eye-closure facilitates mental imagery (e.g., Caruso & Gino, 2011; Wais et al., 2010). According to participants' self-reports in Experiment 2, eye-closure indeed encouraged the use of mental imagery; unexpectedly, however, it was particularly associated with increased self-reported use of *auditory* imagery. Thus, it seems that the eye-closure effect is not limited to a modality-specific facilitation of mental imagery, but rather facilitates various forms of imagery (at least according to self-report data). Regardless of the theoretical interpretation of the findings, the results obtained in the thesis provide support for the usefulness of a distinction based on grain size (e.g., Goldsmith et al., 2002; Yaniv & Foster, 1995), since eye-closure had a different impact on fine-grain and coarse-grain recall.

7.2.4.3 Practical Implications

Information obtained from witnesses is considered the single most important determinant in solving crimes (Fisher, 1995; Kebbell & Milne, 1998; Milne & Bull, 2003b). The experiments presented in this thesis show that eye-closure improves recall of specific visual aspects of the witnessed event. This type of information has the potential to be highly relevant in criminal investigations. For instance, eye-closure may help the witness to remember the colour of the offender's car (see also the Washington sniper case discussed in section 2.1.5), or perhaps even part of the car's license plate. Such detailed visual information could aid the police in finding a suspect. In sum, the information gain in detailed visual information as a result of eye-closure may help the police solve crimes, which could have a significant impact in society.

In both experiments involving free recall measures, participants reported more peripheral details than central details. This is not surprising, given that only a limited number of details can be considered 'central' to an event, whereas the number of peripheral details is potentially infinite (see also

Heuer & Reisberg, 1990). Importantly, eye-closure increased the report of central details as well as peripheral details. The effect was somewhat more pronounced for peripheral details, but it should be noted that this type of detail (e.g., the colour of the car) can be highly relevant in criminal investigations.

In Experiment 6, reported details were coded on the basis of content. Although the low frequency of certain types of descriptions precluded statistical analysis, witnesses who closed their eyes tended to recall more information about persons, actions, objects, and verbal utterances than witnesses who kept their eyes open. Thus, it seems that, just like the Cognitive Interview (e.g., Holliday, 2003a, 2003b; A. M. Wright & Holliday, 2007), the eye-closure instruction has the potential to enhance the recall of different types of information. If replicated, this finding means that eye-closure in real eyewitness interviews can help the police obtain information that is relevant to their investigation, such as descriptions of the perpetrator's appearance and actions.

7.2.5 General and Modality-Specific Interference

7.2.5.1 Summary

Eye-closure was consistently found to have greater benefits for recall of visual information than for recall of auditory information. To examine the auditory counterpart of this finding, Experiment 4 investigated whether "ear-closure" (as opposed to irrelevant speech) would benefit recall of auditory information, but no significant effects were found. Experiment 5 addressed the impact of visual and auditory distractions more directly, and found that each caused both general and modality-specific impairments in recall performance.

7.2.5.2 Theoretical Implications

Two main hypotheses have been put forward to explain the eye-closure effect: the *cognitive load hypothesis* and the *modality-specific interference hypothesis.* The cognitive load hypothesis is based on Glenberg's (1997) embodied cognition account, which holds that memory retrieval and environmental monitoring are two concurrent tasks competing for cognitive resources. Therefore, if environmental distractions are blocked out by closing the eyes, general improvements in retrieval performance should be observed. The modality-specific interference hypothesis is based on findings that visuospatial tasks interfere specifically with the vividness of *visual* images retrieved from long-term memory (Baddeley & Andrade, 2000). Therefore, blocking out visual distractions in the environment through eye-closure is thought to particularly benefit recall of visual information. Although these two hypotheses have previously been construed as being mutually exclusive (e.g., Perfect, Andrade, & Eagan, 2011; Perfect et al., 2008), the findings presented in this thesis suggest that they might be additive.

By fitting the data obtained in Experiment 5 to the Cognitive Resources framework, a more detailed picture was obtained regarding general and modality-specific effects of sensory distractions in the interview environment. Although the exact calculation of percentages relies on a number of theoretical assumptions and is specific to the conditions of the experiment, the Cognitive Resources framework provides the opportunity to go beyond the simple conclusion that both types of processes play a role. The framework may be applied to different data sets to obtain a more reliable estimate of the relative impact of general and modality-specific interference. For instance, the data obtained in a recent experiment by Perfect, Andrade and Syrett (2011) could be fitted to the framework, to assess to what extent the visual-distraction stimulus used in their experiment caused general or modality-specific impairments in episodic recall. Judging from their data display (see Figure 1 in their article), it is likely that the percentages obtained by fitting the data for their experiment would be similar to the percentages obtained for Experiment 5. In sum, the Cognitive Resources framework may be used in future research to clarify the nature of the impairment caused by sensory distractions, thereby providing more insight into the processes underlying the effects observed when such distractions are eliminated through eye-closure.

7.2.5.3 Practical Implications

From an applied point of view, the question to what extent the eye-closure effect is driven by general or modality-specific processes is not vitally important. Nevertheless, practitioners will likely find it useful to know what type of information can be facilitated by eye-closure. For instance, if the investigative interview concerns evidence pertaining to a criminal conversation, eye-closure might be less helpful than if it concerns evidence pertaining to the appearance or actions of a perpetrator. On the other hand, 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" context (cf. Campos & Alonso-Quecuty, 2006; Pezdek & Prull, 1993; Yarmey, 1992).

7.2.6 Confidence

7.2.6.1 Summary

The significant confidence-accuracy (CA) correlations obtained across experiments suggested that (a) generally confident rememberers also tended to be generally accurate, and (b) responses provided with a high level of confidence were also likely to be accurate. However, CA calibration revealed that witnesses in Experiments 2, 3, and 5 (but not 6) tended to be underconfident in their responses. Despite the fact that eye-closure increased testimonial accuracy, it tended to reduce witnesses' confidence in their responses. Therefore, the underconfidence observed in CA calibration was particularly pronounced for witnesses who had their eyes closed.

7.2.6.2 Theoretical Implications

Previous research has shown that eyewitnesses are typically overconfident in their identification decisions (e.g., Brewer & Day, 2005; Brewer & Wells, 2006; Sauer et al., 2010) as well as in their (fine-grain) responses to questions about narratives and events (Goldsmith et al., 2005; Weber & Brewer, 2008). In the present research, however, witnesses in all experiments except Experiment 6 (involving the live altercation in New York) tended to be *under*confident in their responses. The discrepancy between experiments did not seem to be a result of the confidence scale used in Experiment 6 (0-100% instead of 1-5), since the same scale was used in Experiment 5. Participants in Experiment 6 tended to be more confident than participants in Experiment 5, in both correct (90% versus 84%) and incorrect (77% versus 59%) responses, even though they were less likely to be accurate in cued recall (mean proportion correct: .70 versus .83). As explained in section 6.1.4.2, the difference between the two experiments could be due to the nature of the sample (New York participants compared to York participants) or to the nature of the event (a live event compared to a videotaped event).

It has been argued that CA calibration provides a clearer picture of the relationship between confidence and accuracy than CA correlations do (Juslin et al., 1996; Olsson, 2000). The experiments presented in the present thesis were the first to investigate the effect of eye-closure on confidence-accuracy calibration. Interestingly, witnesses who had their eyes closed failed to adjust their confidence ratings in accordance with their higher level of accuracy. In fact, in Experiment 2, eye-closure was found to significantly reduce overall confidence. One potential explanation for the reduction in confidence could be related to participants' meta-cognitive processes. Examining confidence in identification decisions, Brewer et al. (2002) found that participants who reflected on the encoding conditions and the characteristics of their identification decision displayed better CA calibration than participants who did not reflect on these issues. In the present study, participants who had their eyes closed (or looked at a blank screen) did not display superior CA calibration, but they generally provided more conservative confidence ratings. It is possible that closing the eyes facilitates reflection on the retrieval process, perhaps increasing witnesses' awareness of the difficulty of the retrieval task. Consistent with this awareness, witnesses may have adjusted their confidence ratings downwards. Although speculative, this potential explanation of the increase in underconfidence observed as a result of eye-closure warrants further investigation.

7.2.6.3 Practical Implications

Because witnesses who closed their eyes were generally less confident in their responses, witnesses with their eyes open tended to be closer to perfect confidence-accuracy calibration. Ideally, of course, we would like eye-closure to reduce confidence in incorrect responses, while *increasing* confidence in correct responses. Nevertheless, the tendency towards underconfidence associated with eye-closure is arguably preferable to the confidence inflation observed as a result of hypnosis (Dywan & Bowers, 1983; Sheehan et al., 1984; Zelig & Beidleman, 1981). After all, confidently-held false memories may have dangerous consequences (e.g., Gross et al., 2005; Scheck et al., 2003; Wagenaar, 1996), whereas the consequences of less confidently-held accurate memories are typically less detrimental.

7.3 Survey of Police Interviewers

The findings presented in this thesis suggest that eye-closure has the potential to improve eyewitness memory. Therefore, it is imperative to investigate whether the eye-closure instruction could be implemented in real police interviews, and whether it would make a difference in practice (e.g., if the majority of police interviewers are already asking witnesses to close their eyes, then implementation of the instruction will probably not have much of an impact). In order to obtain some preliminary answers to these questions, a number of experienced police officers from various European countries were surveyed during a European Police College training course on police interviewing. In this section, I will first describe who the participants were and how the data were gathered, after which I will present some relevant findings from the survey.

7.3.1 Method

7.3.1.1 Participants

Twenty-seven course participants took part in the survey. Three participants indicated that they did not have direct experience with interviewing eyewitnesses, and were therefore excluded from the analysis. Of the remaining participants, 18 were male and 6 were female, with a mean age of 42.75 years (SD = 6.91). They came from 19 different European countries (the number of participants from each country is specified between brackets): Denmark (3), Ireland (2), Poland (2), Sweden (2), Austria (1), Belgium (1), Cyprus (1), Finland (1), France (1), Germany (1), Italy (1), Latvia (1), Lithuania (1), Luxembourg (1), Portugal (1), Slovakia (1), Slovenia (1), Spain (1), and the United Kingdom (1). Exactly half indicated that they were currently involved with interviewing witnesses, and the other half indicated that they had been involved with interviewing witnesses in the past. On average, participants had been employed in law enforcement for 19.42 years (SD = 9.00), and had between 3 and 30 years experience with interviewing eyewitnesses (M = 15.04, SD = 8.59).

7.3.1.2 Materials and Procedure

In May 2011, I was invited to give a 2.5-hour lecture on eyewitness memory and eye-closure during the opening session of the European Police College (CEPOL) course no. 90 entitled “Police Interviews”, taking place in Stockholm, Sweden. Prior to the start of my presentation, I asked the course participants to complete the survey (see Appendix D.1). Of most interest to the present purposes are the question whether the interviewers were already using the eye-closure instruction (question 3D) and whether they thought it would be feasible to implement in practice (question 5D). The interviewers received no instructions or explanations prior to completing the survey. The surveys were distributed and each course participant completed it individually at their desk. Once each participant had completed it, all surveys were collected and the lecture started.

7.3.2 Results and Discussion

In this section, only the findings relevant to the present purposes will be discussed. However, a complete overview of the survey findings can be found in Appendix D.2. Table 7.1 depicts the frequency of use for each of the interview methods listed on the survey.

Table 7.1 Survey: Use of interview methods. Each number represents the number of police interviewers who selected the respective frequency.

	Frequency of Use				
Interview Method	*never*	*on rare occasion*	*some-times*	*often*	*always*
Small talk	0	1	6	6	11
Report everything	2	4	2	5	10
Report only if certain	4	6	6	6	1
Close eyes	9	3	9	2	1
Other	13	0	2	2	2

Note. Not all rows add up to *N* = 24, because some participants failed to provide a rating for some of the interview methods.

When asked how often they instructed witnesses to close the eyes while reporting about the witnessed event, nine police interviewers indicated that they *never* gave this instruction; twelve interviewers reported that they did so *on rare occasion* or *sometimes*; and only three interviewers indicated that they *often* or *always* instructed witnesses to close their eyes. Indeed, the eye-closure instruction was used less often than any of the other potential interview methods mentioned in the survey.

Table 7.2 shows that most interviewers indicated that implementation of the eye-closure instruction would be somewhat or very feasible.

Table 7.2 Survey: Feasibility of interview methods. Each number represents the number of police interviewers who selected the respective rating on a five-point scale ranging from very infeasible to very feasible.

	very infeasible		**Feasibility**		*very feasible*
Interview Method	*1*	*2*	*3*	*4*	*5*
Small talk	0	0	1	5	18
Report everything	0	4	2	7	10
Report only if certain	5	6	5	4	4
Close eyes	1	1	8	8	6

Note. Not all rows add up to *N* = 24, because some participants failed to provide a rating for some of the interview methods.

Nevertheless, a significant minority reported that the eye-closure instruction would be "neither feasible nor infeasible". The group discussion with the police interviewers at the end of the session clarified this fairly ambivalent response. A number of police interviewers thought that the eye-closure instruction might not be feasible because some eyewitnesses may be reluctant to close their eyes. This idea is in line with Doherty-Sneddon et al.'s (2001) observation that eye-closure makes participants feel uncomfortable, although this observation was not confirmed in the self-report ratings of comfort in Experiment 3. However, as suggested by one of the police interviewers, the expectations of a real eyewitness are likely to differ substantially from the expectations of a research participant, who comes to the laboratory prepared to comply with experimental instructions. Fortunately, most police interviewers also believed that any potential reluctance on the part of the eyewitness can be overcome in most cases by explaining to the witness why it helps to close the eyes, and by making it clear that the interviewer will remain in his seat (which should reduce the need to monitor the environment; cf. Glenberg, 1997).

7.3.3 Conclusion

The primary aim of the survey was not to provide a representative sample of police interviewers in Europe (unfortunately, the sample was too small for this purpose), but rather to explore whether the eye-closure instruction could make a difference in practice. First of all, only three out of 24 interviewers indicated using the instruction often or always, suggesting that there is scope for improvement. Second, most interviewers indicated that it would be feasible to implement the eye-closure instruction in police interviews, particularly if the benefits of eye-closure were explained to the witness. Thus, this preliminary investigation suggests that practical implementation of the eye-closure instruction would be useful and feasible.

7.4 Limitations

Although the research presented in this thesis made a number of important contributions to the previous literature, it also had a number of limitations. Most of these limitations have been discussed throughout the thesis, but this section will provide an overview of the three most important limitations.

7.4.1 Distinction between Distraction and Imagery

It is difficult to determine the mechanisms underlying the eye-closure effect, because the intensity of environmental distractions is probably inversely related to (spontaneous) use of mental imagery. Thus, blocking out distractions in the environment seems to facilitate mental imagery (Caruso & Gino, 2011), and it is unclear to what extent the improvement in recall performance associated with eye-closure is due to a reduction in distractions *per se*, as opposed to the increase in mental imagery resulting from that reduction. In future research, statistical modelling approaches might be used to investigate to what extent the association between eye-closure and recall performance is mediated by (self-reported) use of mental imagery (see e.g., Baron & Kenny, 1986). Furthermore, future researchers could attempt to manipulate the use of mental imagery independently through imagery instructions (cf. Paivio, 1969). For instance, the instruction to close the eyes and the instruction to form a mental image could be combined in a factorial design. Based on previous research combining the eye-closure instruction with mental context reinstatement and focused meditation (Wagstaff et al., 2010; Wagstaff et al., 2011), it is predicted that the eye-closure instruction and the imagery instruction will each improve recall performance independently (compared to no instructions), but that the *combination* of both instructions will be most effective.

Although more sophisticated experimental designs might shed more light on the role of mental imagery in the eye-closure effect, the experimental study of mental imagery remains problematic. First of all, the concept of mental imagery is difficult to define and even more difficult to measure. Many studies on mental imagery rely on self-report measures, even though people often lack insight into their own cognitive processes (e.g., Loftus & Loftus, 1980; Merckelbach & Wessel, 1998). Neuroimaging techniques may provide a more objective measure of mental imagery (cf. Wais et al., 2010), but because complex cognitive processes tend to be associated with complex patterns of neural activation, interpretation of these findings can be difficult. Another problem with the study of mental imagery is that certain individuals may not be able to use mental imagery effectively. For instance, Marks (1973) found that individuals who reported vivid mental imagery performed significantly better on a recall test than individuals who reported poor mental imagery. If the eye-closure effect is (partly) mediated by mental imagery, then the instruction might not be as effective for witnesses who are unable to use mental imagery effectively. Future research could compare the effectiveness of the eye-closure instruction in groups differing in their ability to use mental imagery (which could be measured through both self-report and neuroimaging techniques).

7.4.2 Filler Activities

In the present research, participants engaged in various different activities during the interval between the witnessed event and the investigative interview. In Experiments 1, 3, and 4, participants were asked to spell animal names backwards; in Experiments 2 and 5, participants completed a word finder puzzle; and in Experiment 6, participants engaged in casual conversation with another person while crossing several busy streets. Each of these activities likely involves visual components (i.e., visualising the words to spell them backwards, locating existing words amongst a jumble of letters, and monitoring social cues and potential dangers on the street, respectively) as well as auditory components (i.e., spelling of words; subvocal rehearsal of words to be found, and engaging in conversation, respectively). Nevertheless, the different types of activities might engage visual and auditory processes to a different extent. For instance, if we assume that backwards spelling disrupts auditory processes more than visual processes, this might explain why participants in Experiments 1, 3, and 4 gave fewer correct responses to questions about auditory details than to questions about visual details. However, the disadvantage for recall of auditory details was also observed when a different, and arguably more visually-oriented, distracter task (a word finder puzzle) was used in Experiments 2 and 5. Experiment 6 was the only experiment in which an *advantage* for recall of auditory details was observed, which may have been due to the fact that witnesses engaged in a very different type of filler activity (i.e., walking on the street while engaging in social interaction), but it may also have been due to the nature of the witnessed event (see section 7.2.4.2). In sum, the nature of the distracter task may have influenced subsequent recall performance, but the present experiments do not provide adequate insight into the nature of this influence.

In addition, and perhaps more importantly, the nature of the distracter task may have influenced the effectiveness of eye-closure during the subsequent interview. As explained in section 7.2.2.2, there was an inconsistency in the eye-closure effect in immediate free recall between Experiments 3 and 6. Due to the methodological differences between these two experiments, it is impossible to determine the cause of this inconsistency, but it may well have been due to the nature and length of the interval between the witnessed event and the interview. Thus, participants in Experiment 3 engaged in a backwards spelling task for two minutes, whereas participants in Experiment 6 engaged in casual conversation while crossing streets for approximately five minutes. To examine whether the effectiveness of eye-closure depends more on the *length* of the delay between the event and the interview, or more on the type of *activity* taking place during that delay, future research should disentangle these two confounding factors, while keeping other methodological variables (e.g., type of event) consistent. In line with previous research showing that retrieval performance is more affected by intervening events than by time delay (e.g., Baddeley & Hitch, 1977), it is expected that the type of activity will have a larger impact than the length of the delay.

In conclusion, due to confounding factors, the research presented in this thesis is poorly equipped to provide insight into the influence of the filler activities on subsequent recall performance and the eye-closure effect. Future research should investigate this issue in further detail.

7.4.3 Ecological Validity

A recurring problem in experimental research on eyewitness memory is the lack of ecological validity. The types of events to which experimental participants are exposed are often highly dissimilar from the types of events typically experienced by real eyewitnesses of violent events. Even though the experiments in the present thesis were the first to examine the effect of eye-closure on recall of violent events (as opposed to mundane events; Perfect et al., 2008), the events in Experiments 1 to 5 were videotaped rather than live events. Ihlebæk et al. (2003) found that recall of videotaped events tends to be more complete and more accurate than recall of live events. Hence, experiments studying recall of videotaped events might overestimate the recall performance of witnesses of live events. To improve ecological validity, unsuspecting witnesses in Experiment 6 were exposed to a forensically relevant live event. However, unlike the videotaped events, this event did not involve violence. Therefore, the question remains whether eye-closure will be effective in improving recall of real-life violent events experienced by real eyewitnesses.

Due to ethical constraints, the limitation discussed above can probably not be overcome in experimental research. However, there was an additional problem with ecological validity in Experiment 6 that could potentially be improved in future research. In Experiment 6, mock witnesses were informed prior to the investigative interview that the witnessed altercation had been staged. Thus, even though the participants did not know the purpose of the study at the time of encoding, they were no longer under the impression that they were real eyewitnesses at the time of retrieval. This may have influenced their retrieval performance; for instance, they may not have placed much importance on providing accurate testimony (despite the incentive of potentially winning $50 if they scored in the top 25%). In future research, it would be better to debrief participants at the end of the experiment, rather than prior to the interview. For instance, participants could be informed that the senior experimenter has asked for their testimony about what happened during the verbal altercation, in order to determine what the consequences for the research assistants should be. If this kind of cover story is used in future research, mock witnesses will be aware that their testimony might have consequences, just like the testimony of real eyewitnesses. Although these consequences might not be as severe as the consequences involved in real criminal cases, this experimental set-up would be more realistic than the set-up used in Experiment 6.

7.5 Future Research

The findings obtained in the thesis prompted many questions for future research. As mentioned in the previous section, future research is required to improve a number of limitations in the research. In addition, a number of new research questions may be assessed in future work. In this section, four main avenues of potential new research will be outlined.

7.5.1 Eyewitness Identifications

The experiments presented in the thesis have shown that closing the eyes during an interview can help eyewitnesses to remember more details about the witnessed event. However, most wrongful convictions do not result from erroneous reporting of event details, but rather from mistaken eyewitness identifications (Connors et al., 1996; Gross et al., 2005; Rattner, 1988; Scheck et al., 2003; Wells et al., 1998). Therefore, it would be highly relevant to investigate whether eye-closure can also improve eyewitness identifications. To date, only one (unpublished) study has examined the eye-closure effect in the context of eyewitness identification (Potts, 2011). The study was designed to examine how eye-closure affects *verbal overshadowing* (i.e., witnesses are less likely to make a correct identification if they describe the perpetrator prior to the identification; Schooler & Engstler-Schooler, 1990). In the study, participants viewed a brief video clip and were asked to provide a verbal description of the woman in the clip, either with eyes open or with eyes closed. Eye-closure significantly reduced the number of incorrect statements provided about general features (e.g., age, race, height), as well as the number of unverified (subjective) statements about facial features, but had no significant effect on the number of correct statements provided. Crucially, eye-closure during the verbal description had no significant effect on subsequent identification accuracy.

However, eye-closure in the Potts (2011) study was confounded with verbal overshadowing. Future research could investigate whether eye-closure improves identification accuracy when witnesses are not required to provide a verbal description of the target prior to viewing the line-up. Indeed, various studies have found that reinstatement of context prior to the identification decision improves identification accuracy (Cutler et al., 1987a; Krafka & Penrod, 1985; Malpass & Devine, 1981b; Shapiro & Penrod, 1986), although some other studies have failed to replicate this effect (Davies & Milne, 1985; Sanders, 1984). Because eye-closure is likely to facilitate mental simulation of the witnessed event (Caruso & Gino, 2011; Fisher & Geiselman, 1992; Wais et al., 2010), it is expected that the instruction to close the eyes will render the mental context reinstatement procedure more effective. For this reason, it is hypothesised that eyewitnesses will be more likely to make a correct identification if they close their eyes and reflect on the perpetrator's appearance prior to viewing the line-up.

7.5.2 Misinformation

Section 2.1.4.2 briefly touched upon the influence of misleading information on memory for witnessed events. Thus, when eyewitnesses encounter misleading information after the event, for instance in the form of leading questions (Loftus, 1975) or another witness (e.g., Luus & Wells, 1994), they often incorporate that misinformation into their own testimony (for a review, see Loftus, 2005). One interesting avenue for further research is to study the impact of eye-closure on the misinformation effect. Given that eye-closure tended to enhance testimonial accuracy in the experiments presented in this thesis, it is hypothesised that eye-closure during a recall test after exposure to misinformation will also reduce the likelihood that the misinformation is incorporated into subsequent testimony. Perhaps a more interesting question, however, is what happens when witnesses close their eyes while listening to the misinformation itself. Two competing hypotheses can be formulated with regards to this question.

If eye-closure facilitates concentration on the task at hand (Glenberg, 1997; Glenberg et al., 1998), it should help witnesses to detect discrepancies between their own memory of the event and the erroneous information presented to them (Tousignant et al., 1986). This process should lead to a reduction in susceptibility to misinformation. However, if eye-closure inspires visualisation of the presented misinformation (Caruso & Gino, 2011; Wais et al., 2010), these vivid mental images may subsequently be more difficult to distinguish from the original memory. This process should lead to an increase in susceptibility to misinformation. It is possible that the effect of eye-closure on susceptibility to misinformation depends on the way in which the misinformation is presented. For instance, if the presentation begins with an instruction to form a mental image of the presented information, one could hypothesise that eye-closure will lead to the formation of vivid images and therefore increase susceptibility to misinformation. However, if the presentation does not include an imagery instruction, and instead commences rather quickly with the presentation of inaccurate items, one could hypothesise that eye-closure will enhance witness's ability to detect errors and therefore reduce susceptibility to misinformation. To test these predictions, a future study could manipulate the order of presentation of the misinformation (imagery instruction first compared to inaccurate items first).

7.5.3 Different Contexts

The eye-closure instruction has the potential to be useful in any type of context in which people are expected to recall information. For instance, in an educational context, closing the eyes prior to answering exam questions might improve exam performance. For instance, Glenberg et al. (1998) found that university students who were instructed to close their eyes performed significantly better on general knowledge and mathematics questions than students who kept their eyes open (see also Phelps et al., 2006, for similar research with 5-year old children). This research could be extended to more ecologically valid educational settings. For instance, future research with students on a university course could compare a group of students that was informed about the benefits of eye-closure during the exam with a group that was simply informed about the importance to concentrate during the exam. Real grades obtained for (formative) assessments could be compared across groups to examine the effectiveness of eye-closure in a realistic educational setting.

In medical settings, doctors could advise their patients to close their eyes while recounting their medical history. Fisher and Quigley (1992) found that the Cognitive Interview significantly improved recall of foods eaten, which could be relevant for medical diagnoses of food poisoning or allergies. Similarly, the Cognitive Interview has been found to improve recall of daily physical activities from the distant past (Fisher, Falkner, Trevisan, & McCauley, 2000). However, in these studies, use of the Cognitive Interview came with considerable practical costs in terms of interview time, interviewer training, and coding of responses. The eye-closure instruction may prove to be a more cost-effective method of improving recall in medical contexts. Finally, some psychotherapists still use hypnosis to facilitate the retrieval of childhood memories (Lindsay & Read, 1995; Poole, Lindsay, Memon, & Bull, 1995). Given that, unlike hypnosis, the eye-closure instruction does not seem to increase false memories or inflate confidence, it might be a suitable alternative for use in psychotherapy. In sum, the eye-closure instruction may prove to be helpful in a wide range of settings besides eyewitness testimony.

7.5.4 Field Research

Perhaps the most important direction for future research is to test the eye-closure instruction in a field setting. Although laboratory research provides an excellent opportunity to test the eye-closure effect in a controlled environment (e.g., it allows for an assessment of testimonial accuracy), it does not provide sufficient evidence for the effectiveness of the eye-closure instruction in real life. For instance, although watching violent videos increases physiological arousal (see Experiment 2), laboratory studies cannot simulate the levels of arousal experienced by real eyewitnesses of violent crime (see also Yuille & Cutshall, 1986). Therefore, it is crucial to establish whether the eye-closure instruction is effective with real eyewitnesses, before recommending it for use by police interviewers. Future field studies could randomly assign real eyewitnesses to receive either the instruction to close their eyes or no instruction. Although it would not be possible to examine the effect of eye-closure on the accuracy of eyewitness testimony in real life, it would be possible to assess the amount of information obtained from witnesses. It is expected that, like experimental participants, real eyewitnesses will report more information if they have their eyes closed during the investigative interview.

7.6 Conclusion

Taken together, the experiments presented in this thesis show that closing the eyes can substantially increase the amount of accurate information obtained from eyewitnesses. The findings suggest that sensory distractions in the interview environment demand cognitive resources, causing both general and modality-specific impairments in eyewitness recall. Interference from these distractions can be overcome by closing the eyes or looking at a blank visual field during the interview. The benefits of eye-closure were observed across five different experiments: in free and cued recall, for recall of forensically relevant videotaped and live events, in different interview locations, across different eyewitness samples, for different types of information, and after a delay of a week. Although it is not suggested that the eye-closure instruction should replace the Cognitive Interview altogether, it could certainly serve as a simpler alternative when interview time or police resources are relatively limited. In sum, the current findings suggest that the eye-closure instruction can make a significant contribution to police interviewing.

Appendices

Appendix A

Interview Questions and Example Responses[26]

A.1 Experiment 1, 3, and 4

A.1.1 Questions Addressing Visual Aspects

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”.

[26] Question numbers refer to the original order in which questions were asked

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”.

A.1.2 Questions Addressing Auditory Aspects

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”.

A.2 Experiment 2 and 5

A.2.1 "Lost" – violent version[27]

A.2.1.1 Questions Addressing Visual/Central Aspects

1. The clip starts with the four survivors, two of them male. Can you describe the hair of each of the men?
   a. *Fine-grain correct:* "one had black curly hair and one was bald".
   b. *Coarse-grain correct:* "one had black hair".
   c. *Incorrect:* "one had blonde hair".

12. How does the man with the eye patch treat the gunshot wound?
   a. *Fine-grain correct:* "he takes out the bullet with tweezers and stitches up the wound".
   b. *Coarse-grain correct:* "he stitches up the wound".
   c. *Incorrect:* "he puts a bandage on it".

15. How does the fight start?
   a. *Fine-grain correct:* "the man with the eye patch throws the jug at the other man".
   b. *Coarse-grain correct:* "the man with the eye patch starts it".
   c. *Incorrect:* "the man with the eye patch kicks the woman".

16. Once the woman has her rifle pointed at the man with the eye patch, what does she do?
   a. *Fine-grain correct:* "she kicks him in the face".
   b. *Coarse-grain correct:* "she kicks him".
   c. *Incorrect:* "she hits him with the back of the rifle".

20. When the bald man says he's checked every nook and cranny of the place, what does the curly-haired man do?
   a. *Fine-grain correct:* "he lifts up the carpet and shows a trap door".
   b. *Coarse-grain correct:* "he shows a trap door".
   c. *Incorrect:* "he walks away".

A.2.1.2 Questions Addressing Visual/Peripheral Aspects

2. When they are in the bushes, what are they holding?
   a. *Fine-grain correct:* "binoculars and guns".
   b. *Coarse-grain correct:* "guns".
   c. *Incorrect:* "a torch".

5. When the curly-haired man walks to the house, what animal or animals does he see?
   a. *Fine-grain correct:* "a horse and a cat".
   b. *Coarse-grain correct:* "a cat".
   c. *Incorrect:* "cows".

[27] The "Lost" violent video was used for Experiment 5.

6. Where on his body does the curly-haired man get shot?
    a. *Fine-grain correct:* "on his left upper arm".
    b. *Coarse-grain correct:* "on his arm".
    c. *Incorrect:* "on his leg".

11. What does the man with the eye patch do to prepare before treating the gunshot wound?
    a. *Fine-grain correct:* "he puts vodka on a cloth and disinfects the tweezers with a lighter".
    b. *Coarse-grain correct:* "he uses vodka".
    c. *Incorrect:* "he drinks a glass of vodka".

19. Who ties up the man with the eye patch?
    a. *Fine-grain correct:* "the woman and the curly-haired man".
    b. *Coarse-grain correct:* "the woman".
    c. *Incorrect:* "the bald man".

A.2.1.3 Questions Addressing Auditory/Central Aspects

3. When they are in the bushes, what object are they talking about?
    a. *Fine-grain correct:* "the satellite dish".
    b. *Coarse-grain correct:* "about something on top of the house".
    c. *Incorrect:* "a bomb".

7. What does the curly-haired man shout when he's on the ground after being shot?
    a. *Fine-grain correct:* "he says his name and that his plane crashed".
    b. *Coarse-grain correct:* "his name".
    c. *Incorrect:* "don't shoot".

13. According to the curly-haired man, why did the 'hostiles' let the man with the eye patch stay in his house?
    a. *Fine-grain correct:* "because he is one of them".
    b. *Coarse-grain correct:* "because he is working with them"
    c. *Incorrect:* "because they didn't know he was there".

14. According to the curly-haired man, why are he and the woman still sitting there?
    a. *Fine-grain correct:* "because he is not alone".
    b. *Coarse-grain correct:* "because there are more of them"
    c. *Incorrect:* "because they don't know what to do".

18. How did the curly-haired man know that the man with the eye patch was not alone?
    a. *Fine-grain correct:* "the stirrups on the horse outside were set up for someone much shorter than the man with the eye patch".
    b. *Coarse-grain correct:* "something was set up for a shorter person"
    c. *Incorrect:* "he sensed it".

A.2.1.4 Questions Addressing Auditory/ Peripheral Aspects

4. Where does the older woman say she'll wait for them?
   a. *Fine-grain correct:* "by the stream".
   b. *Coarse-grain correct:* "by the water".
   c. *Incorrect:* "in the cabin".

8. How many people crashed on the island, according to the curly-haired man?
   a. *Fine-grain correct:* "over 40 people".
   b. *Coarse-grain correct:* "somewhere between 30 and 50 people".
   c. *Incorrect:* "200 people".

9. Where does the man with the eye patch say the medical kit is?
   a. *Fine-grain correct:* "in the kitchen on the top shelf".
   b. *Coarse-grain correct:* "on the shelf".
   c. *Incorrect:* "in the medicine cabinet".

10. How did the man with the eye patch say that he survived the war?
    a. *Fine-grain correct:* "by not participating in it".
    b. *Coarse-grain correct:* "he likes being alone" *(note: he said this right after he said that he survived the war by not participating in it).*
    c. *Incorrect:* "he killed them all".

17. What does the curly-haired man say once the man with the eye patch is knocked out on the floor?
    a. *Fine-grain correct:* "get some rope".
    b. *Coarse-grain correct:* "we need to tie him up"
    c. *Incorrect:* "run away".

A.2.2 "Lost" – non-violent version

A.2.2.1 Questions Addressing Visual/Central Aspects

1. The clip starts with the four survivors, two of them male. Can you describe the hair of each of the men?
5. Once they are inside the house, what does the woman open?
7. Once they are inside the house, what does the bald man look at?
12. What game is the bald man playing on the computer?
19. What do you see on the computer screen after "you win"?

A.2.2.2 Questions Addressing Visual/Peripheral Aspects

2. When they are in the bushes, what are they holding?
6. What was in the fridge?
8. At one point, the bald man is holding some papers – what colour pen was used to write comments on it?
11. What key does the bald man press to start playing the computer game?
18. What does it say on the side of all the white folders that the curly-haired man is looking at?

A.2.2.3 Questions Addressing Auditory/Central Aspects

3. When they are in the bushes, what object are they talking about?
10. What is the purpose of the station?
15. According to the curly-haired man, why did the ‘hostiles’ let the man with the eye patch stay in his house?
16. According to the curly-haired man, why are he and the woman still sitting there?
17. According to the curly-haired man, what do they see in the cellar?

A.2.2.4 Questions Addressing Auditory/ Peripheral Aspects

4. Where does the older woman say she’ll wait for them?
9. How long ago did the man with the eye patch come to the island?
13. What does the man with the eye patch say about the game?
14. According to the bald man, what does our ability to cheat make us?
20. When the bald man enters 38 for mainland communication, what does the man on screen say?

A.2.3 “Survivors” – violent version

A.2.3.1 Questions Addressing Visual/Central Aspects

2. When the man meets the boys in the forest, what do you see him do?
6. With what weapon do the boys injure the man?
8. What do the boys do to the car?
16. What is the first thing the boys do as soon as the man walks into the house?
18. What happens when the tall blond boy does not give the man his knife back after he has asked twice?

A.2.3.2 Questions Addressing Visual/Peripheral Aspects

1. When the two boys are in the forest, what is the taller boy holding?
4. When the group of boys goes to hunt, what is the blond boy in front holding?
7. Where on his body does the man get shot?
15. What have the boys done to the painting next to the door?
17. What do the boys do to the man after they have hit him?

A.2.3.3 Questions Addressing Auditory/Central Aspects

3. When the man meets the boys in the forest, what does he say?
11. What does the man say his job is, as last of the family?
12. What does the woman ask when she hears what house it is?
13. What does the woman say she needs to do?
20. What does the man say to the tall blond boy at the end?

A.2.3.4 Questions Addressing Auditory/Peripheral Aspects

5. When the boys say they should eat the rabbit, what does the man say?
9. When they’re in the car, what does the woman ask the man?
10. What does the man say when he shows the woman the cave?
14. Why does the woman think she will be welcome at the house?
19. When the small boy has been stabbed, what does the man order the boys to get?

A.2.4 "Survivors" – non-violent version

A.2.4.1 Questions Addressing Visual/Central Aspects

2. When the man meets the boys in the forest, what do you see him do?
6. After the man has said that he will eat them, what do the boys do?
7. How does the man escape the boys?
17. What does the woman do when she finds out it is not her son?
18. What does the boy do after saying that the woman is not his mum?

A.2.4.2 Questions Addressing Visual/Peripheral Aspects

1. When the two boys are in the forest, what is the taller boy holding?
4. When the group of boys goes to hunt, what is the blond boy in front holding?
8. Before she encounters the man, what is the woman in the car doing?
11. When they are in the cave, where is the man sitting?
14. What does the woman take out of her bag and give to the man?

A.2.4.3 Questions Addressing Auditory/Central Aspects

3. When the man meets the boys in the forest, what does he say?
12. What does the man say his job is, as last of the family?
13. What does the woman ask when she hears what house it is?
15. What does the woman say she needs to do?
20. When they arrive at the house, what does the man say to the boys?

A.2.4.4 Questions Addressing Auditory/Peripheral Aspects

5. When the boys say they should eat the rabbit, what does the man say?
9. When they're in the car, what does the woman ask the man?
10. What does the man say when he shows the woman the cave?
16. Why does the woman think she will be welcome at the house?
19. When the man and the woman walk up to the house, what does she say to him?

A.3 Experiment 6

A.3.1 Questions Addressing Visual Aspects

1. Where did you meet with Sarah and Julia?
   a. *Fine-grain correct:* "on the corner of 56th street and 10th avenue".
   b. *Coarse-grain correct:* "on the corner".
   c. *Incorrect:* "in front of the library".

2. What clothes was Julia/Sarah wearing?[28]
   a. *Fine-grain correct:* "white jeans and a blue top".
   b. *Coarse-grain correct:* "a blue top".
   c. *Incorrect:* "jeans and a red top".
4. Which animals did you see on the papers that Sarah was holding?
   a. *Fine-grain correct:* "an elephant and a butterfly".
   b. *Coarse-grain correct:* "an elephant".
   c. *Incorrect:* "a tiger".

8. When Julia and Sarah did not agree on the animal assignment, what did you see Julia do?
   a. *Fine-grain correct:* "she tried to grab the papers and all the papers dropped on the floor".
   b. *Coarse-grain correct:* "she tried to look at the papers herself".
   c. *Incorrect:* "she pushed her".

9. What colours were the papers that dropped on the floor?
   a. *Fine-grain correct:* "yellow, pink, white and green".
   b. *Coarse-grain correct:* "one was green".
   c. *Incorrect:* "blue".

10. What happened to the papers after they had dropped on the floor?
   a. *Fine-grain correct:* "the experimenter picked them up and handed them back to Sarah".
   b. *Coarse-grain correct:* "they were picked up".
   c. *Incorrect:* "Sarah picked them up".

12. Where did the experimenter touch Sarah?
   a. *Fine-grain correct:* "on her left upper arm".
   b. *Coarse-grain correct:* "on her arm".
   c. *Incorrect:* "on her right shoulder".

16. What did Sarah do right before she left?
   a. *Fine-grain correct:* "she handed the experimenter the papers and waved".
   b. *Coarse-grain correct:* "she waved".
   c. *Incorrect:* "she threw the papers on the floor".

[28] Half of the participants were asked about Julia and half about Sarah; interviewers never asked about the clothes which their own character had been wearing.

A.3.2 Questions Addressing Auditory Aspects

3. Once you met with the colleagues, who started to speak to you first and what did they say?
   a. *Fine-grain correct:* "Julia introduced herself and said that they would tell us where we would be going for the experiment".
   b. *Coarse-grain correct:* "Julia started".
   c. *Incorrect:* "Sarah started".

5. Why did they need to know your participant numbers?
   a. *Fine-grain correct:* "the numbers were linked to animals, which represented rooms".
   b. *Coarse-grain correct:* "to assign us to rooms".
   c. *Incorrect:* "to keep a record".

6. When the first participant gave Sarah his/her number, which animal did she assign to him/her?
   a. *Fine-grain correct:* "tiger".
   b. *Coarse-grain correct:* "some sort of cat".
   c. *Incorrect:* "bear".

7. And what animal did Julia think he/she should have been assigned?
   a. *Fine-grain correct:* "turtle".
   b. *Coarse-grain correct:* "some sort of reptile".
   c. *Incorrect:* "tiger".

11. After the papers were picked up, what did the experimenter say to the participants?
   a. *Fine-grain correct:* "she said sorry and that it did not look very professional".
   b. *Coarse-grain correct:* "she apologised".
   c. *Incorrect:* "she told us to ignore the research assistants".

13. When and where did Sarah say that Julia had been rude to her before?
   a. *Fine-grain correct:* "this morning over breakfast at Starbucks".
   b. *Coarse-grain correct:* "this morning".
   c. *Incorrect:* "yesterday".

14. What did Julia call Sarah at the end?
   a. *Fine-grain correct:* "a big baby".
   b. *Coarse-grain correct:* "a baby".
   c. *Incorrect:* "stupid".

15. What did Sarah say to the participants right before she left?
   a. *Fine-grain correct:* "That's it, I am done, sorry about the drama".
   b. *Coarse-grain correct:* "she apologised".
   c. *Incorrect:* "she told us to leave".

Appendix B
Non-Parametric Tests

B.1 Introduction

The distributions for some of the variables in the thesis violated assumptions of parametric tests. Where possible, I normalised the distributions through data transformations or replacement of outliers. However, for a number of variables, the distributions could not be normalised. In these cases, non-parametric tests were conducted in conjunction with parametric tests, to verify the parametric findings. The results of these non-parametric tests are reported here. Each table shows the type of main effect or contrast that was tested, the non-parametric test statistic, the significance value, the effect size, and whether the parametric test results were confirmed or not (yes/no).

B.2 Experiment 1

Table B.1 Experiment 1: Fine-grain correct.

Effect	**Test Statistic**	***p***	***η²***	**Parametric confirmed?**
Interview Condition (IC)	*U*[29] = 362.00	.62	< .01	yes
Question Modality (QM)	***T*[30] = 221.50**	**< .01**	**.17**	**yes**
*IC * QM interaction*				
IC effect: visual	*U* = 335.00	.34	.02	yes
IC effect: auditory	*U* = 281.00	.06	.06	yes

Note. Effects displayed in bold are significant at $p < .05$.

[29] The statistic *U* refers to the Mann-Whitney test (Mann & Whitney, 1947).
[30] The statistic *T* refers to the Wilcoxon signed-rank test (Wilcoxon, 1945).

B.3 Experiment 2

Table B.2 Experiment 2: Total correct.

Effect	Test Statistic	p	η^2	Parametric confirmed?
Interview Condition (IC)	**U = 243.00**	**.01**	**.11**	**yes**
Type of Video (TV)	T = 541.00	.63	< .01	yes
Question Modality (QM)	**T = 45.00**	**< .01**	**.59**	**yes**
Question Centrality (QC)	**T = 404.00**	**< .01**	**.12**	**yes**
*QC * TV interaction*				
QC effect: non-violent	**T = 165.00**	**< .01**	**.26**	**yes**
QC effect: violent	T = 495.00	1.00	< .01	yes

Note. Effects displayed in bold are significant at $p < .05$.

B.4 Experiment 5

Table B.3 Experiment 5: Total correct.

	Effect	Test Statistic	p	Parametric confirmed?
1.	**Interview Condition**	**$H(3)$[31] = 16.66**	**< .01**	**yes**
	Question Modality	**T = 596.00**	**.01**	**yes**
2.	*Interaction between type of distraction (TD) & modality*			
	TD effect: visual	U = 219.50	.59	yes
	TD effect: auditory	U = 162.00	.29	yes
3.	Blank-screen v. eyes-closed	U = 242.50	.24	yes

Note. Effects displayed in bold are significant at $p < .05$.

[31] The statistic *H* refers to the Kruskal-Wallis test (Kruskal & Wallis, 1952).

Table B.4 Experiment 5: Fine-grain correct.

	Effect	Test Statistic	*p*	Parametric confirmed?
1.	**Interview Condition**	***H*(3) = 16.33**	**< .01**	**yes**
	Question Modality	***T* = 1514.00**	**< .01**	**yes**
2.	*Interaction between type of distraction (TD) & modality*			
	TD effect: visual	*U* = 235.50	.32	yes
	TD effect: auditory	*U* = 139.00	.09	yes
3.	Blank-screen v. eyes-closed	*U* = 247.50	.20	yes

Note. Effects displayed in bold are significant at $p < .05$.

Table B.5 Experiment 5: Coarse-grain correct.

	Effect	Test Statistic	*p*	Parametric confirmed?
1.	Interview Condition	*H*(3) = 3.41	.33	yes
	Question Modality	***T* = 193.50**	**< .01**	**yes**
2.	*Interaction between type of distraction (TD) & modality*			
	TD effect: visual	*U* = 190.50	.79	yes
	TD effect: auditory	*U* = 220.50	.57	yes
3.	Blank-screen v. eyes-closed	*U* = 156.00	.22	yes

Note. Effects displayed in bold are significant at $p < .05$.

Table B.6 Experiment 5: Proportion correct.

	Effect	Test Statistic	p	Parametric confirmed?
1.	**Interview Condition**	**$H(3) = 15.41$**	**< .01**	**yes**
	Question Modality	$T = 1216.50$	.96	yes
2.	*Interaction between type of distraction (TD) & modality*			
	TD effect: visual	$U = 260.50$	.10	yes
	TD effect: auditory	$U = 143.50$	.13	yes
3.	**Blank-screen v. eyes-closed**	**$U = 274.00$**	**.04**	**no**

Note. Effects displayed in bold are significant at $p < .05$.

B.5 Experiment 6

Table B.7 Experiment 6: Proportion correct.

Statements	Effect	Test Statistic	p	η^2	Parametric confirmed?
Total	Interview Condition	$U = 1134.00$	.89	< .01	yes
	Interview Location	$U = 1135.00$	.90	< .01	yes
Visual	Interview Condition	$U = 947.00$	.10	.03	yes
	Interview Location	$U = 979.50$	.21	.02	yes
Auditory	Interview Condition	$U = 980.00$	.23	.02	yes
	Interview Location	$U = 1068.5$	.63	< .01	yes

Note. None of the effects were significant at $p < .05$.

Appendix C

Retrieval Strategies Form

MEMORY RETRIEVAL STRATEGIES

We are interested in what kind of strategies you used to remember the video clips. Please tick all strategies that you used for (at least one of) the video clips, and write any other strategies in the space provided.

Possible Strategies:	Used?
Remembered the main story line and constructed the details from there	
Concentrated hard on remembering the video clip	
Visualised / pictured the video clip in my mind's eye	
Replayed the voices and sounds in my head	
Pure guessing	
Didn't use any memory retrieval strategies	
…	
…	

Do you think closing your eyes during the interview (would have) helped to remember the visual and/or auditory information from the video clip? Please tick an answer for each type of information.

Closing my eyes (would have) helped	For visual information	For auditory information
Yes		
No		
Maybe		
Don't know		

Appendix D

Survey of Police Interviewers

D.1 Survey

Survey on Eyewitness Interviewing

1. Do you have direct experience with interviewing eyewitnesses?

_____ Yes, am currently involved with interviewing witnesses

_____ Yes, I have been involved with interviewing witnesses in the past

_____ No (please go to question 4 on the other side of this page)

2. Please indicate how often you interview (or have interviewed) eyewitnesses at each of the following locations. For each, please circle a number.
(1 = never, 2 = on rare occasion, 3 = sometimes, 4 = often, 5 = always)

A. At the police station in a designated interview space
1 2 3 4 5

B. At the police station in another space
1 2 3 4 5

C. At another location *inside* (please describe __________________________________)
1 2 3 4 5

D. At or near the scene of the crime
1 2 3 4 5

E. At another location *outside* (please describe _________________________________)
1 2 3 4 5

3. Please indicate how often you use (or have used) each of the methods listed below in eyewitness interviews. For each, please circle a number.
(1 = never, 2 = on rare occasion, 3 = sometimes, 4 = often, 5 = always)

A. Small talk to get the witness at ease
1 2 3 4 5

B. Instruct witness to report every single detail
1 2 3 4 5

C. Instruct witness to report only details about which (s)he is certain
1 2 3 4 5

D. Instruct witness to close the eyes while reporting about the witnessed event
1 2 3 4 5

E. Other (please describe ____)
1 2 3 4 5

4. Please indicate whether you think the methods listed below are helpful to improve the quality of eyewitness testimony. For each, please circle a number.
(1 = very unhelpful, 2 = somewhat unhelpful, 3 = neither unhelpful nor helpful, 4 = somewhat helpful, 5 = very helpful)

A. Small talk to get the witness at ease
1 2 3 4 5

B. Instruct witness to report every single detail
1 2 3 4 5

C. Instruct witness to report only details about which (s)he is certain
1 2 3 4 5

D. Instruct witness to close the eyes while reporting about the witnessed event
1 2 3 4 5

E. Other (please describe ____)
1 2 3 4 5

5. Please indicate whether you think the methods listed below would be feasible to implement in eyewitness interviews. For each, please circle a number.
(1 = very infeasible, 2 = somewhat infeasible, 3 = neither infeasible nor feasible, 4 = somewhat feasible, 5 = very feasible)

A. Small talk to get the witness at ease
1 2 3 4 5

B. Instruct witness to report every single detail
1 2 3 4 5

C. Instruct witness to report only details about which (s)he is certain
1 2 3 4 5

D. Instruct witness to close the eyes while reporting about the witnessed event
1 2 3 4 5

6. About you

Sex: M F (circle one)

Age: _________

Country of residence: __________________________

Number of years employed in law enforcement: ________________________________

Number of years experience with witness interviewing: _____________________________

Many thanks for completing this survey!

D.2 Survey Findings

This section presents the survey findings that were not addressed in Chapter 7.

Table D.1 Question 1: Interviewing experience. Each number represents the number of police interviewers who selected the respective frequency.

Experience	
Currently involved	12
Involved in the past	12
Not involved	3

Table D.2 Question 2: Interview location. Each number represents the number of police interviewers who selected the respective frequency.

	Frequency of Use				
Interview Location	*never*	*on rare occasion*	*some-times*	*often*	*always*
Designated interview room	3	2	8	10	1
Other room at police station	3	3	5	6	5
Other location inside	6	2	2	5	0
At/near scene of crime	7	4	6	6	1
Other location outside	7	5	2	5	0

Note. Not all rows add up to N = 24, because some participants failed to provide a rating for some of the interview methods.

Table D.3 Question 4: Helpfulness of interview methods. Each number represents the number of police interviewers who selected the respective rating on a five-point scale ranging from very unhelpful to very helpful.

	very unhelpful		**Helpfulness**		*very helpful*
Interview Method	*1*	*2*	*3*	*4*	*5*
Small talk	0	1	0	7	16
Report everything	1	3	0	9	11
Report only if certain	6	4	5	6	3
Close eyes	2	1	5	13	3
Other	15	0	0	2	2

Note. Not all rows add up to N = 24, because some participants failed to provide a rating for some of the interview methods.

Glossary

ANOVA	analysis of variance
BIS	behavioural inhibition system
BAS	behavioural activation system
BPM	beats per minute
CA	confidence-accuracy
cf.	*confer* (compare)
CI	cognitive interview
doi	digital object identifier
EDA	electrodermal activity
e.g.	*exempli gratia* (for example)
et al.	*et alia* (and others)
HF	high frequency
HRV	heart rate variability
i.e.	*id est* (that is)
LF	low frequency
M	mean
MCR	mental context reinstatement
NV base	baseline preceding the non-violent video
NV video	non-violent video
p.	page
PPG	photoplethysmography
SCR	skin conductance response
SD	standard deviation
v.	*versus* (against)
V base	baseline preceding the violent video
VHF	very high frequency
VLF	very low frequency
V video	violent video

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