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CITY UNIVERSITY LONDON

Eyewitness Testimony by Adults with Autism Spectrum Disorder

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Thesis submitted in fulfilment

of the requirements for the degree of Doctor of Philosophy

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Declaration

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Preliminary note: Publications arising from the thesis to date

All of the experiments presented in this thesis have either been published or are currently under review. They have been formatted to match the rest of the thesis, but otherwise are presented in the same form and content in which they were submitted for publication. This inevitably means that there is some repetition, and experiments that are under review or published do not refer to literature that has been published since. A thorough and up-to-date literature review is, however, presented in the general introduction. Finally the pronoun ‘we’ is used in some of the chapters, as all papers were co-authored by my supervisor Professor Dermot Bowler.

Abstract

Eyewitness testimony is central to the criminal justice system, and may include that given by individuals with ASD. Despite the memory difficulties that are experienced by people with ASD, sparse research to date has examined the reliability of their testimony. This thesis presents a series of experiments that are aimed at exploring factors affecting eyewitness testimony in adults with ASD. Findings across five experiments suggest that individuals with ASD can recall as much and as accurately as their typical counterparts if they are interviewed appropriately. It seems that high-functioning ASD individuals at least are no more or less suggestible than their typical counterparts, and that both ASD and typical individuals modulate memory with arousal typically as demonstrated by their attenuated forgetting rates over time for arousing events compared to neutral events. However, a particularly pertinent finding from the present work was that the widely used police Cognitive Interview (CI) not only fails to increase the reporting of details by individuals with ASD, but it also significantly reduces their accuracy of recall. It seems that the main component of the CI - 'context reinstatement' - is problematic for individuals with ASD, not because they fail to encode an event with its contextual details to start with, but because they have difficulty in following the CI's series of verbal instructions in order to retrieve this context to trigger their memory of the event. Findings indicate that recall by individuals with ASD can in fact be aided by more supportive context cues: when they physically return to the same environmental context in which they encoded the event their recall is enhanced to that of their typical counterparts. These findings have important implications for ascertaining the reliability of reports given by witnesses with ASD and highlight that, whilst the CI should not be used to interview them, there may be appropriate context-supportive interviewing techniques that can help to enhance their recall. A number of future research directions are highlighted by the present findings. These are discussed along with the implications and limitations of this work in the final chapter.

Chapter 1: General Introduction

1.1. Overview of Chapter 1

The past fifty years have seen a growing number of researchers directing their attention to memory in Autism Spectrum Disorder (ASD). Despite this now substantial body of literature that demonstrates that individuals with ASD experience specific memory difficulties, hardly any work has examined how this transpires in their abilities as eyewitnesses to crimes. The principal aim of the work presented in the subsequent chapters is to contribute to theoretical and practical frameworks by investigating the efficacy of eyewitnesses with ASD under different conditions. The purpose of the present chapter is to set the scene for these subsequent chapters by providing a review of relevant background research relating to ASD and memory. This chapter begins by providing a brief overview of what ASD is and some of the theoretical accounts that have been put forward to explain the disorder. Discussion then centres on the very specific memory difficulties that are experienced by individuals with ASD. This is followed by a reflection on the memory factors that shape eyewitness testimony in typical individuals, followed by a discussion of the theoretical background for examining eyewitness testimony in ASD. This leads on to a presentation of the aims of the thesis. Finally a brief section considers some overarching issues relating to the recruitment, selection, and matching of participants, and how these were addressed in the current series of experiments.

1.2. Autism Spectrum Disorder

1.2.1. What is ASD?

Autism was first described by Kanner (1943) in a clinical description of 11 child cases of what he described as 'autistic disturbances of affective contact'. Since Kanner's early observations, more than 13,000 research papers on the condition have been published (ISI Web of Knowledge, 19 May 2011), and a number of attempts at formulating a diagnostic scheme have been made. Rutter (1978) suggested four criteria for defining autism, namely impaired social development, delayed and deviant language development, stereotyped play patterns and resistance to change, and the onset of these behavioural characteristics before the

individual reaches 30 months of age. At around the same time, Wing and Gould (1979) introduced the influential and now widely used term 'triad of impairments' to define autism, comprising: severe impairment in the development of reciprocal social behaviour, including abnormalities in developing peer relations and in using non-verbal communicative acts to modulate social interactions (such as eye contact, gestures, facial expressions, etc); communication difficulties, for example being unable to master pragmatic aspects of language and modulating their own language according to the social context and listener's needs; and finally impairments in imaginative thought. All of these develop instinctively in typical individuals, but for someone with ASD, the rules of these basic social behaviours must be explicitly learnt. Indeed, Kanner's early descriptions in 1943 emphasised an "autistic aloneness" and suggested that an inability to form typical affective contact with other people was innate in individuals with ASD, who "are able to establish and maintain an excellent, purposeful and "intelligent" relation to objects that do not threaten to interfere with their aloneness, but are from the start anxiously and tensely impervious to people" (p. 249). Kanner also noted significant language impairments in the children he described, who displayed either delayed or absent language development.

Around the same time that Kanner was studying children in the US, Asperger, unaware of the work of Kanner, was studying families with children in Vienna. In 1944 he published a paper describing four children with "Autistic Psychopathy", who were very similar to the children described by Kanner with characteristics marked by social isolation, but did not appear to have the severe language delays of Kanner's children (Asperger, 1944). Asperger's paper was published in German and was virtually unknown until it was translated into English in 1989, shortly after Wing (1981) had coined the term Asperger's Syndrome to refer to individuals with autistic traits similar to those described by Kanner but without the language difficulties. The lower-functioning subgroup that Kanner described is now commonly referred to as classic 'Kanner-type autism'. Asperger syndrome, on the other hand, is used to refer to individuals who have normal development of structural language but similar difficulties with social communication and rigid, stereotyped interests and behaviours (e.g., Gillberg, 1995).

The speculation by Wing (1981) that Kanner-type autism and Asperger's syndrome might be different disorders along a spectrum of related conditions led eventually to the term Autism Spectrum Disorder (ASD) being incorporated into the

two major diagnostic systems – the DSM-IV-TR (American Psychiatric Association, 2000) and the ICD-10 (World Health Organisation, 1993) – that are used to establish if an individual belongs on the autism spectrum. Both these sets of diagnostic criteria describe a range of disorders including Autistic Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified. The DSM-III was the first of the DSM revisions to include ASD, and its later version the DSM-IV-TR (American Psychiatric Association, 2000), alongside the ICD-10 (World Health Organisation, 1993), is now the generally accepted gold standard for defining ASD. According to the current DSM-IV-TR classification, for a diagnosis of ASD to be made, impairments in communication and social interaction, and restricted interests and activities must all be present before the individual is three years old. Individuals with Pervasive Developmental Disorder Not Otherwise Specified exhibit impairments in reciprocal social interactions, but do not meet the full criteria for a specific diagnosis of Autistic Disorder or Asperger Syndrome. Autistic Disorder and Asperger Syndrome are both used to describe individuals who present with an early onset of symptoms and repetitive and stereotyped patterns of behaviour, but as mentioned, language and cognitive abilities are significantly impaired in Autistic Disorder but not in Asperger Syndrome. However, there is little evidence to support this sub-classification of Asperger Syndrome, and some researchers now argue that the different nomenclatures simply reflect different instances of the same underlying spectrum of conditions (see Bowler, 2007). Nevertheless, this remains an issue of debate that requires further research. For the purposes of the present research it is the DSM-IV-TR framework that will be adopted here, and the term ASD will be used throughout this thesis.

Phenotype and prevalence of ASD

In the 70 years that have passed since Kanner's first descriptions of ASD, the broadening of our conception of the behavioural features of ASD have impacted upon estimates of prevalence of the condition. Whereas early estimates were around 4/10,000 (Lotter, 1966), today around 1% of the population are estimated to be affected by the condition (Baird, Simonoff, Pickles, Chandler, Loucas, Meldrum et al., 2006; Chakrabarti & Fombonne, 2001). The condition is around three to four times more common in males than females (Baird et al., 2006; Bertrand, Mars, Boyle, Bove, Yeargin-Allsopp & Decoufle, 2001), and approximately 25-45% of individuals with ASD have an IQ below 70, which is generally considered to be the

cut off for intellectual impairment (Baird et al., 2006; Chakrabarti & Fombonne, 2001).

Whilst twin studies implicate a strong genetic basis (e.g., Bailey et al., 1995; Folstein & Rutter, 1977; Le Couteur, Bailey, Goode & Pickles, 1996), identifying specific genetic factors is over-complicated by the heterogeneity amongst individuals on the autism spectrum. Indeed, the wide variations in its manifestation are why it is considered a spectrum disorder, with varying degrees of severity. At one end of the scale one might find an individual who is non-verbal, has no socially appropriate means of communicating with others, exhibits challenging behaviours such as self-injury or aggression and who needs a full-time carer throughout his or her adult life. At the other end of the spectrum is an individual who lives alone or with a partner or spouse, has a highly skilled and challenging job, a good command of language and is able to have balanced conversations with others, and some understanding (albeit a rote-learned one) of how another person might feel or behave under different circumstances. Thus, individuals with ASD form a rather heterogeneous group.

There is no known genetic or biological marker for ASD, and so the condition is diagnosed behaviourally. Reliable diagnoses can be made by clinicians from 24-36 months old using one of several diagnostic instruments involving a semi-structured interaction or interview with the individual themselves (e.g., Autism Diagnostic Observation Schedule, Lord, Rutter, DiLavore & Risi, 1999; The Adult Asperger Assessment, Baron-Cohen, Wheelwright, Robinson & Woodbury-Smith, 2005) or by an interview with a parent or caregiver in order to assess the individual's developmental history (e.g., Autism Diagnostic Interview – Revised, Rutter, Le Couteur, & Lord, 2003; Diagnostic Interview for Social and Communication Disorders, Leekam, Libby, Wing, Gould & Taylor, 2002).

1.2.2. Cognitive profiles and theoretical accounts of ASD

Since Kanner's early observations, a substantial body of research has accumulated showing that individuals with ASD have marked abnormalities in a number of domains that do not always fall within the three core areas of deficits currently used by the DSM-IV that were previously identified by Wing and Gould (1979) to define the disorder. For example, people with ASD are often reported to

show sensory and motor abnormalities (see Dawson & Watling, 2000 for a review), and demonstrate impairments in selective attention with difficulties in filtering out irrelevant information, which often leads to bombardment with sensory information and over-arousal (e.g., Burack, 1994; Ciesielski, Courchesne & Elmasian, 1990; Remington, Swettenham, Campbell & Coleman, 2009). People with ASD also demonstrate a number of affective abnormalities, including difficulties in perceiving and recognising emotional expressions in others (e.g., Hobson, 1991; Hobson, Ouston & Lee, 1988; Weeks & Hobson, 1987, but see Williams & Happé, 2010), a restricted sharing of affect (e.g., Kasari, Sigman, Mundy & Yirmiya, 1990; Yirmiya, Sigman, Kasari & Mundy, 1992), and restricted and inflexible use of context appropriate emotional expressions (e.g., Dawson, Hill, Spencer, Galpert & Watson, 1990; Kasari, Sigman, Baumgartner & Stipek, 1993). Furthermore, as will be discussed in the next section, they have rather specific memory impairments (see Boucher & Bowler, 2008).

Despite these affective and cognitive impairments however, other processes are intact or even enhanced in ASD. Kanner (1943), for example, described the excellent rote memory of individuals with ASD; an early but largely accurate observation (e.g., Mottron, Belleville, Stip, & Morasse, 1998). It is also consistently reported that people with ASD show enhanced perceptual processing of spatial information (e.g., Caron, Mottron, Rainville & Chouinard, 2004; Plaisted, Sweetenham & Reese, 1999; O'Riordan, Plaisted, Driver & Baron-Cohen, 2001; Pellicano, Gibson, Maybery, Durkin & Badcock, 2005). Traditionally, researchers have put forward theoretical accounts in attempts to explain parts of this rather distinctive profile of cognitive and behavioural strengths and weaknesses in ASD. Arguably the three most influential are theory of mind, executive function, and weak central coherence accounts. Whilst none of these theoretical positions can account for the complete cognitive, social, and affective profile of ASD, these accounts are worth briefly mentioning here.

Theory of mind accounts

The theory of mind (ToM) deficit account initially advocated by Baron-Cohen and colleagues (Baron-Cohen, Leslie & Frith, 1985; Baron-Cohen, 2001) proposed that individuals with ASD have difficulty in understanding that other people have thoughts and beliefs that differ from their own or from reality, and that it is a core deficit in ToM that underlies ASD. Support for this ToM deficit account of ASD

comes from experiments using classic 'false-belief' tasks (e.g., Baron-Cohen et al., 1985; Happé, 1995) that assess whether the individual understands that an action that they themselves have witnessed will not be known by another person unless that other person has also actually witnessed it. Individuals with ASD also tend to show impaired performance on tasks involving second order false beliefs; "he thinks that she thinks" (e.g., Baron-Cohen, 1989; Ozonoff, Pennington & Rogers, 1991, but see Bowler, 1992; Tager-Flusberg & Sullivan, 1994). Second order false beliefs are in some respects more important to everyday social situations. For example, difficulties in understanding other's minds makes understanding complex cognitive concepts such as deception, pretence, irony, and sarcasm, and predicting the behaviour of others on this basis, extremely difficult (e.g., Gillberg, 1995; Baron-Cohen, 2001). Moreover, in the context of eyewitness testimony, it is common in cross-examination for a barrister to suggest a detail to be untrue, which the witness knows is actually true and knows that the barrister also knows that this is true (e.g., Valentine & Maras, 2011). If individuals with ASD have difficulties with second order false beliefs, they are likely to experience great difficulties in coping with adversarial questioning styles.

This ToM account of ASD is, however, somewhat controversial. Since the increase in the past decade in the number of studies with individuals with ASD who have normal or above normal IQ, there is an accumulating body of evidence showing that many individuals with ASD do indeed show ToM competencies, at least in verbally mediated situations (Bowler, 1992; 1997; Dahlgren & Trillingsgaard, 1996). If the underlying social and communication difficulties that characterise ASD were the direct result of an impaired ToM then this higher functioning group who have ToM competencies should be able to adapt to appropriate levels of social behaviour, yet this does not occur (Loth, Gomez & Happé, 2008a). Klin, Saulnier, Sparrow, Cicchetti, Volkmar and Lord (2007), for example, reported that individuals with ASD were more than three standard deviations behind in their level of social adaptive behaviour based on their cognitive potential. Moreover, ToM deficits have also been observed in other disorders such as schizophrenia (e.g., Langdon, 2005; Ziv, Leiser & Levine, 2011), yet these individuals do not exhibit the same social impairments as individuals with ASD. Finally, a ToM account only addresses the social deficits associated with ASD; no implications are made for the presence of restrictive and repetitive patterns of behaviour and uneven pattern of intelligence (Hill, 2004), or for the strengths that are associated with ASD including enhanced

perceptual processing (e.g., Mottron, Dawson, Soulieres, Hubert & Burack, 2006), or excellent rote memories (see Happé & Frith, 1996).

Executive functioning accounts

Executive functions refer to a number of higher-order cognitive operations that allow the flexible shifting of attention, and the control and regulation of other abilities and behaviours. These include planning, working memory, mental flexibility, and inhibition (see Rabbitt, 1997). Individuals with ASD are known to have difficulties with a number of these functions (e.g., Bennetto, Pennington & Rogers, 1996; O'Hearn, Asato, Ordaz & Luna, 2008; Ozonoff & Jensen, 1999) and their poor performance on ToM tasks has been argued to reflect difficulties in shifting attention from their own viewpoint to another person's, rather than an inherent deficit in ToM *per se* (e.g., Russell, 1997). Ozonoff and Strayer (1997), for example, showed that children with ASD were able to inhibit a simple response (e.g., pressing a button for circles but not for squares) but had difficulty when required to shift from one response set to another (e.g., pressing a button for squares instead of circles).

These difficulties experienced by individuals with ASD have led to an executive function deficit being put forward as a possible explanation for the manifestation of autistic symptoms (e.g., Hughes & Russell, 1993; Hughes, Russell & Robbins, 1994; Ozonoff et al., 1991; Rumsey & Hamburger, 1988). More specifically, this difficulty in set shifting could lead to potential problems for an individual with ASD who finds him or herself in investigative interviewing situations, where the demands of an interview and the line of questioning frequently changes, particularly in the sorts of adversarial questioning styles that are seen in court.

Nevertheless, whilst an executive function account addresses the non-social aspects of ASD (Pennington & Ozonoff, 1996, Russell, 1997) and correlates with the severity of autistic behavioural features (Hill & Bird, 2006), it does not address the social aspects so well, and findings are often inconsistent and dependent on the different tasks used (see Hill, 2004, for a review). Further, as with ToM, some ASD individuals pass some executive functioning tasks (see Geurts, Corbett, & Solomon, 2009, for a review), and executive function deficits are not specific to ASD; they occur in a number of clinical disorders such as schizophrenia (see Elliot and Sahakian, 1995, for a review) and obsessive-compulsive disorder (e.g., Christensen, Kim, Dysken, and Hoover, 1992).

Central coherence accounts

Central coherence refers to the ability to integrate context, gist and meaning in order to see 'the bigger picture' (Frith, 1989). In the 1970s researchers started to suggest that individuals with ASD have a cognitive impairment in their ability to integrate pieces of information into their coherent wholes (Hermelin & O'Connor, 1970), which led to a 'weak central coherence' account of ASD being proposed by Frith (1989). For example, people with ASD tend to show superior ability on tests that measure visuo-spatial skills, such as the Embedded Figures Test (e.g., Edgin & Pennington, 2005; Jolliffe & Baron-Cohen, 2001) and the Block Design subtest of the Wechsler Adult Intelligence Scale (e.g., Jolliffe & Baron-Cohen, 1997; Shah & Frith, 1993). Shah and Frith (1993) argue that this is because they do not succumb to the overall form or gestalt of the designs that they are asked to reconstruct, and as a result find it easier to see their component parts.

The weak central coherence account assumes that individuals with ASD fail to process context due to a local processing bias, which is at the expense of global and contextual information (Happé, 1999). This view is largely supported by findings in the visuo-spatial domain, for example with evidence that people with ASD are less susceptible to visual illusions (Happé, 1996), do not process context-dependent information (Happé, 1997), and tend to notice minute changes in the environment, irrespective of the context of what that environment actually is (Loth, Gomez & Happé, 2008b). How weak central coherence translates in terms of eyewitness capabilities is largely unexplored to date, although McCrory, Henry and Happé (2007) have suggested that weak central coherence leads to a greater reliance on more generic cognitive resources during memory recall in ASD, and that gist-based organisational strategies to guide recall are impaired. Similarly, Loth et al. (2008a) have suggested that weak central coherence might affect cognitive processes such as schematisation and the hierarchical organisation of event schemas, so that details that are not central to the event are recalled well whilst memory for higher-order and more essential elements is diminished. Based on these findings of impaired understanding of the global meaning or generalisation of an event, one might expect individuals with ASD to actually be better eyewitnesses in certain circumstances than their typical counterparts; they may be less likely to 'fill in the gaps' in incomplete encoding or retrieval of an event based on the overall gist of the event. This notion is explored in Chapter 3.

Unlike ToM and executive function accounts, central coherence accounts can explain both the strengths and weaknesses associated with ASD, and are

supported by broader autism phenotype findings of enhanced local processing abilities in family members of individuals with ASD (Happé, Briskman, & Frith, 2001). However, evidence is mixed, with some reporting that global processing is present in ASD (e.g., Mottron, Burack, Iarocci, Belleville & Enns, 2003; Ozonoff, Strayer, McMachon & Filloux, 1994; Rinehart, Bradshaw, Moss, Brereton & Tonge, 2001). This has led to a shift from 'weak central coherence' to the term 'enhanced local processing' (Mottron & Burack 2001; Mottron et al., 2006), and from 'deficit' to 'cognitive style' (Happé, 1999). However even this enhanced local/perceptual processing account has difficulty explaining why social insight and communication are particularly impaired in ASD, even among very high functioning individuals.

In summary, it seems that there is no one single explanation for the full triad of social, communicative, rigid and repetitive difficulties in ASD. Evidence suggests that ASD may be explained by not one but a combination of all of these perspectives, with each individual scoring in varying degrees on each (see Happé, Ronald & Plomin, 2006 for a review). Other attempts to provide a psychological account of the diversity of behavioural features that characterise ASD have included studies of attention (e.g., Burack, 1994; Remington, Swettenham, Campbell, Coleman, 2009; Riby & Hancock, 2009; Sasson, Turner-Brown, Holtzclaw, Lam & Bodfish, 2008; Smith & Milne, 2009) and memory (see Boucher & Bowler, 2008). In the context of the present thesis, studies of memory provide an important way of gaining a better understanding of the difficulties faced by individuals with ASD. Understanding memory in this population enables us to appreciate how individuals with ASD perceive, understand, interpret, and reconstruct the world around them. There is consistent evidence from research over the past 50 years or so showing that individuals with ASD experience specific difficulties with their memory, particularly with recalling personal events and re-living experiences. The following section outlines these research findings on memory in individuals with ASD, and from the perspective of the present thesis, how their memory difficulties are likely to compromise their eyewitness testimony in certain situations.

1.2.3. Memory in ASD

Since the earliest descriptions of enhanced rote memory in ASD (Asperger, 1944; Kanner, 1943) there have been numerous accounts of superior memory for independent items or minute details by individuals with ASD. Anecdotally for

example, Stephen Wiltshire, who was diagnosed with ASD at the age of three, is famous for his ability to draw accurate and detailed landscapes after seeing them briefly only once. A number of other memory processes are also found to be intact in ASD. These include delayed recall (e.g., Bennetto et al., 1996; Rumsey & Hamburger, 1988; Williams, Goldstein & Minshew, 2005), free recall on single trials for unrelated items (e.g., Bowler et al., 2008b; Minshew & Goldstein, 2001; Renner et al., 2000), cued recall (e.g., Bennetto et al., 1996; Boucher & Lewis, 1989; Boucher & Warrington, 1976; Bowler, Matthews & Gardiner, 1997; Tager-Flusberg, 1991), priming (e.g., Bowler et al., 1997; Gardiner, Bowler & Grice, 2003), recognition (e.g., Bennetto et al., 1996; Bowler, Gaigg & Gardiner, 2008a; Bowler, Gardiner & Grice, 2000a; Bowler, Gardiner, Grice & Saavalainen, 2000b; Lind & Bowler, 2009; Minshew & Goldstein, 1993; Minshew, Goldstein, Muenz & Payton, 1992), and memory for facts (e.g., Bowler & Gaigg, 2008). Nevertheless these 'peaks' in memory performance are invariably accompanied by troughs (see Ben Shalom, 2003; Boucher & Mayes, in press; Bowler, Gaigg, & Lind, 2011).

Early work on memory in ASD highlighted the similarities to other groups with structural damage to the brain, such as those with medial-temporal lobe amnesia (Boucher & Warrington, 1976). Evidence also started to accumulate around this time suggesting a similar patterning of memory as seen in amnesic syndrome, such as reduced primacy but normal recency effects (e.g., Boucher, 1978; O'Connor & Hermelin, 1967), and impaired explicit but intact implicit memory (e.g., Boucher, 1981; Boucher & Warrington, 1976), which led early researchers to suggest an amnesic account of ASD. This theory was widely accepted for nearly two decades, until more recent research found that individuals with ASD can demonstrate intact implicit and explicit memory (e.g., Bennetto et al., 1996; Bowler, Matthews & Gardiner, 1997; Renner et al., 2000), and researchers began to move towards more general cognitive impairment explanations of memory dysfunctions, such as executive function deficits (Bennetto et al., 1996) or weak central coherence (López & Leekam, 2003). The following discussion now briefly considers in turn some of the specific memory difficulties that are experienced by individuals with ASD.

Episodic memory and recollecting personally experienced events

Episodic memory involves engaging in mental time travel in order to re-experience the spatio-temporal context of the event in question. Episodes in one's memory are characterised by the co-occurrence of elements of experience (e.g.,

having dinner in a particular place with a particular friend at a particular time), and are defined individually by the specific combination of these attributes that are unique to that episode. For an episode to be retrieved, its components need to be marked in such a way that their retrieval is in a bound unit. Early accounts of memory in ASD suggested an impaired episodic memory in the disorder (e.g., Boucher, 1981; Boucher & Warrington, 1976), and this account still holds today (e.g., Bowler, Gardiner & Gaigg, 2007; Bowler et al., 2000a; Lind & Bowler, 2010; and see Lind & Bowler, 2008, for a review).

For example, using a cueing methodology to examine personal episodic memory, Goddard, Howlin, Dritschel, and Patel (2007) found that adults with ASD took significantly longer than their matched comparison participants to retrieve specific memories, and recalled fewer of them. Similarly, Bruck, London, Landa and Goodman (2007) found that children with ASD recalled fewer details than typically developing children in response to autobiographical (life event) questions. In a second experiment in Bruck et al. (2007), ASD and typically developing children participated in a staged event. Again, the ASD group recalled fewer details from the staged events than the comparison group. However in both experiments the details that they did report were predominantly accurate, suggesting that children with ASD are more likely to either forget or fail to retrieve memories, but they are no more likely than typically developing children to make-up or confirm non-experienced events.

Crane and Goddard (2008) also reported a deficit in personal episodic memory in adults with ASD, but there were no differences between ASD and typical individuals for personal semantic memory (i.e. memory for timeless facts). Indeed, the ASD group reported significantly more non-personal semantic memory facts (category exemplars for British prime ministers in a 90 second timed generating task) than their matched comparison participants, indicating a preference for more factual processing. Using a range of methodologies to assess episodic memory (an autobiographical fluency task, an autobiographical interview task and a memory narrative task), Crane and Goddard showed that individuals with ASD have particular difficulties recalling personal episodic memories. These findings appear to indicate more of a specific deficit, where individuals with ASD fail to use self-involvement to facilitate their memory as people without ASD do; general autobiographical memory (including self-related semantic information) seems to be relatively intact whilst specific episodes are more difficult to retrieve, even with the aid of personal cues (Crane & Goddard, 2008). Whilst Crane and Goddard only

used explicit tests of memory, previous work utilising priming and recognition paradigms (Bowler et al., 1997; Bowler et al., 2004) suggests that such memories are implicitly intact in individuals with ASD; impairments appear to be more related to retrieval, rather than encoding mechanisms, which are eliminated when support is provided at test (see the task support hypothesis later in this chapter).

A substantial body of research has now demonstrated that the difficulties that individuals with ASD experience in recalling *personally experienced* events appear to be related to the role of the self (e.g., Crane, Goddard & Pring, 2009; Goddard et al., 2007; Klein, Chan & Loftus, 1999; Millward, Powell, Messer, & Jordan, 2000; Toichi, Kamio, Okada, Sakihama, Youngstrom, et al., 2002). Powell and Jordan (1993), for example, have suggested that it is a deficit of the personal aspect of episodic memory rather than episodic memory in general. This view is supported by converging lines of evidence, which suggest that individuals with ASD have a diminished self-awareness. For example, children with ASD show little interest in their own mirror image (e.g., Reddy, Williams, Costantini, & Lang, 2010), and fail to use appropriate pronouns, often referring to themselves in the third rather than the first person (Hobson, 1989, 1993). Moreover, in contrast to typical individuals who are better able to recall events that are performed by the self, children with ASD have been shown to recall events performed by themselves significantly less well than observed events that are performed by a peer (Boucher & Lewis, 1989; Russell & Jarrold, 1999; Millward et al., 2000; but see Lind & Bowler, 2009, and Williams & Happé, 2009). For example, Millward et al. (2000) compared memory for personally experienced events with memory for events performed by a peer by children with ASD, intellectual disabilities without ASD, and typically developing children. The ASD children were significantly better at recalling more information relating to that which their peer performed than they were on details that they themselves had personally experienced. The reverse was true for both the typically developing (IQ-matched) and intellectual disability (chronological age-matched) children. Millward et al. argue that their findings indicate that the memory processes of children with ASD are in some way impaired when they have to process personal information. These findings suggest that if an individual with ASD finds themselves as a participant in a crime, be it as an active witness, victim, or even perpetrator, they may find it difficult to recall what happened. A number of facets of memory might contribute to this episodic deficit in ASD, some of which will now be considered.

Organisation of memory and relational processing

Individuals with ASD tend to demonstrate differential patterning of recall across the positions of items in study lists, with diminished primacy (recall of early list items) and enhanced recency (recall of late list items) effects (e.g., Bowler, Limoges & Mottron, 2009; Renner et al., 2000). Alternative explanations to the amnesic account of memory impairments in ASD began to arise suggesting that these reduced primacy effects were due to a failure to effectively organise information in memory as opposed to a memory impairment *per se* (e.g., Renner et al., 2000). Pioneering experiments as early as 1967 by Hermelin and O'Connor showed that the advantage in remembering meaningful over random information that is seen in typical individuals is not evident in individuals with ASD. Hermelin and O'Connor (1967) asked children with ASD and children with learning disabilities who were matched on verbal mental age and digit span to recall two types of word lists – one comprised 12 random words, and the other comprised words from categories (e.g., colours). The children with learning disabilities reorganised and clustered words from the same categories in their recall significantly more than the children with ASD did. This and other early studies demonstrated that children with ASD recall lists of unrelated words at a similar rate to words or sentences that are arranged in a meaningful way (e.g., Hermelin & Frith, 1971), and that they fail to group words into conceptual categories when given a random list of words to remember (e.g., Hermelin & O'Connor, 1970). However, one of the problems for research of memory in ASD is related to the high variability of cognitive levels among individuals with the disorder. Although some researchers have reported that a failure to group items into conceptual categories leads to impaired free recall (e.g., Bowler et al., 1997; Tager-Flusberg, 1991), others report that this failure to strategically organise information does not impair free recall (e.g., Hermelin & O'Connor, 1970; Renner et al., 2000).

More recent research has found that whilst individuals with ASD demonstrate intact or even enhanced item-specific processing, they experience difficulty in processing relations among elements of an experience, for example, in processing a stimulus in relation to its context such as the time of day or location (Gaigg et al., 2008a). In light of this evidence it is hardly surprising that they demonstrate difficulties on tasks that assess episodic memory (e.g., Bowler et al., 2007; Bowler et al., 2000a, and see Lind & Bowler, 2008; Toichi, 2008), where details are processed in relation to temporal and contextual information that defines a specific

episode. Nevertheless, evidence also suggests that this difference in the way that material is organised in memory is more of a retrieval rather than an encoding problem. Tager-Flusberg (1991), for example, showed that whilst children with ASD failed to utilise semantic relations between words on a test of free recall to enhance their performance, on a cued recall test where participants were provided with category membership cues there was no difference between groups. Tager-Flusberg argued that these findings indicated that children had encoded the meanings of the words when they were presented, but had difficulties exploiting these semantic relations to aid their recall unless supported.

Others have since replicated this finding that, when recall is cued either by category membership or by a test of recognition, individuals with ASD are comparable to their typical counterparts in recalling more semantically-related materials (Boucher & Warrington, 1976; Bowler et al., 1997; Bowler, Gaigg & Gardiner, 2008b; Kamio & Toichi, 2007; Mottron, Morasse & Belleville, 2001; Tager-Flusberg, 1991; Toichi & Kamio, 2002). Bowler et al. (2008a) for example, presented participants with study words inside a red rectangle, and told them to ignore context words that were presented outside of the rectangle. Each word in the rectangle was accompanied by either a semantically related, or an unrelated context word (e.g., 'Wood' in the context of 'Tree' vs. 'Stone' in the context of 'Motor'). Participants were later asked to recall all words regardless of whether they were inside or outside the rectangle at study. Whilst the typical group recalled significantly more words outside of the rectangle if they were semantically related to the word inside the rectangle, the ASD group failed to benefit from the semantic relatedness of the to-be-remembered words and simultaneously presented context items on a free recall test. On a recognition test however, the ASD group's performance was enhanced by the semantic relatedness to a similar extent as the typical group, and they recalled more words if they were presented in the same context at study. Further support for the notion of this being a retrieval rather than encoding problem comes from work on illusory memories showing that individuals with ASD are sensitive to the semantic structure of study lists. Bowler et al. (2000b) showed that when presented with lists of words (e.g., *snow, winter, ice, wet, frigid, chilly, freeze, shiver, Arctic, frost*) that were strong associates of a lure word that is not presented (e.g., *cold*) individuals with ASD are equally as susceptible as their typical counterparts to falsely recall the non-presented lure words.

Gaigg, Gardiner and Bowler (2008), drawing on a paradigm by Hunt and Seta (1984), presented participants with a list of words that included varying instances of items belonging to different categories (for example, 2 Items of Fruit, 4 Professions, 8 Countries, 12 Animals, 16 Furniture). Because the relational nature of the items from the smaller categories is less obvious, effective recall of these categories is assumed to depend disproportionately on the availability of relational information. Effective recall from the larger categories, on the other hand, is thought to depend disproportionately on the availability of item-specific information in order to facilitate the differentiation of items within these categories. Gaigg et al. found reduced recall by individuals with ASD when categorical information was available to aid recall, in line with previous work (e.g., Bowler et al., 1997; Smith, Gardiner & Bowler, 2007; Tager-Flusberg, 1991, but see López & Leekam, 2003). That the ASD group showed reduced recall of the smaller, but the not larger, categories, indicated that they had difficulties in spontaneously employing relational, but not item-specific, memory processes. However, the authors also included a supported encoding condition, where task instructions required participants to sort items into their respective categories at the study phase. In this condition the ASD group performed similarly to the comparison group. What Gaigg et al. concluded from this is that rather than lacking the ability to process relational information at all, it is the ability to spontaneously deploy relational processing to aid recall in unsupported and novel situations that is the problem, and that supported learning environments promote relational processes in this group. These findings have important implications. If the difficulties in utilising meaningful information to aid recall are a retrieval rather than an encoding problem, there will be supportive strategies that can help individuals with ASD remember more – an imperative notion for eyewitness research. This task support hypothesis (Bowler et al., 1997, 2004) is discussed later.

Source monitoring and memory for context

Episodic events can be likened to a jigsaw puzzle, where the pieces need to come together in order to form the completed picture. They comprise a number of features - *when, where, who,* and other detailed information such as perceptual, temporal, spatial, semantic and affective elements (Johnson Hashtroudi, & Lindsay, 1993). These need to be linked together at encoding in order to form a bound coherent representation that makes that episode distinct from other episodes (Schacter, Norman & Koutstaal, 1998). If these features are not sufficiently bound

then source monitoring failures can occur, where one aspect or feature of the episode is retrieved but without the context of the rest of the episode. Thus the individual may recall an element of the experience but cannot recall which experience it was from (e.g., Squire, 1995). Alternatively, source monitoring failures can occur when the features of an episode are bound at encoding, but not enough information to pinpoint the source of the feature is present in the bound representation. For example it is often difficult to identify a specific episode of a repeated event, such as a commute to work, which shares many of the same features of other episodes. McClelland and colleagues suggest that bound episodes must be kept separate from one another in memory in order to be accessed separately at retrieval; failure to keep these patterns apart results in source monitoring failures where one cannot distinguish between episodes (McClelland, McNaughton & O'Reilly, 1995).

Recollective experiences require information that is encoded and stored in relation to spatial and temporal contextual information, whilst familiarity based recognition judgements can be mediated on the basis of available item-specific information alone. Findings tend to point to the impaired episodic memory in ASD being related to problems re-constructing the spatio-temporal features of the recollected episode. For example, individuals with ASD make more familiarity-based recognition judgements rather than drawing on contextual information to aid their remembering (e.g., Bowler et al., 2000a). Moreover, they are known to have intact or even enhanced item-specific memory, alongside diminished relational processing (e.g., Gaigg et al., 2008), suggesting that elements of an experience are not bound together in memory for this group, a view that sits well within a weak central coherence account of ASD.

According to Tulving (1985) episodic (autonoetic) memory differs from semantic (noetic) memory in that autonoetic consciousness refers to the experience of mentally reliving a past event (important for monitoring source and the hallmark of an episodic system), whilst noetic consciousness refers to an awareness of the detail but without the mental time travel. One method of distinguishing between these phenomenological experiences is to give participants a recognition test for a previously learned list. If the participant recognises the item as previously presented in the study list, they are asked whether they *remember* seeing the item – if they were able to retrieve some specific contextual information from seeing the word at study (e.g., the physical appearance of the word, what they were thinking at the

moment that the word was initially presented, the position of the word in the study list etc.), or whether they just *know* that they saw the word – if they recognised the word as from the study list but were unable to retrieve any specific contextual or associative details from encoding (cf. familiarity in the absence of recollection, Rajaram, 1993). Individuals with ASD tend to make fewer remember and more know responses compared to their typical counterparts on these tasks, suggesting an increased reliance on semantic memory to compensate for a poorer episodic memory (e.g., Bowler et al., 2000a, 2000b). In other words, one piece of the puzzle is retrieved but without the context of the rest of the episode; thus the individual may recall an element of the experience but not which experience it was from. However, whilst ASD and comparison groups differ quantitatively in their relative proportions of remember or know responses, more recent findings indicate that they are similarly affected by manipulations designed to enhance or diminish proportions of remember and know responses (Bowler, et al., 2007). This suggests that individuals with ASD may be qualitatively similar to typical individuals, but simply have fewer phenomenological experiences of remembering – a prerequisite for successful source monitoring.

The retrieval of contextual information is imperative in source monitoring. Such retrieval is thought to be mediated by executive functions, with which individuals with ASD are known to have difficulties. One measure of source memory is obtained by giving participants two lists of words to learn before asking them to recall words from just one of the lists. Bennetto et al. (1996) reported that participants with ASD made more intrusion errors than comparison participants from words that were not on the test list but had been on a previous list during recall trials on the California Verbal Learning Test. O'Shea, Fein, Cillessen, Klin and Schultz (2005) reported similar findings using more dynamic story stimuli, and greater difficulties for individuals with ASD have also been reported on tasks requiring recall of incidentally-encoded context (Bennetto et al., 1996; Bowler et al., 2004; Bowler et al., 2008a; Lind & Bowler, 2009).

Another method of assessing source monitoring is by using self-other judgements, where a participant must decide whether they performed an action themselves or whether it was performed by another person. However, findings using these self-other source monitoring tasks are somewhat mixed. Whilst some have reported undiminished self-other source monitoring in ASD (Farrant, Blades & Boucher, 1998; Hill & Russell, 2002; Williams & Happé, 2009), others report that this

is impaired in ASD (e.g., Hala, Rasmussen & Henderson, 2005; Lind & Bowler, 2009; Russell & Jarrold, 1999). Lind and Bowler (2009) asked children with ASD and matched comparison participants to either name pictures aloud themselves or watch the experimenter name the picture. In line with predictions, the ASD group demonstrated undiminished recognition memory with an ability to distinguish between old and new test items, but diminished source memory with difficulty in recalling who picked up and named each picture card. However, both ASD and comparison participants showed an enactment effect, with better source memory for items they had named themselves than items named by the experimenter. Lind and Bowler argue that their findings go against the notion that the problem experienced by individuals with ASD is more of a personal episodic one (otherwise an enactment effect would not be present); rather it is, they suggest, episodic memory itself that is impaired in this group. However, other findings regarding an enactment effect in ASD are inconsistent. Whilst some have reported that individuals with ASD do not show the typical enactment effect (Farrant et al., 1998; Hare, Mellor & Azmi, 2007) or even that they are have better memory for another person's actions over their own (Millward et al., 2000; Russell and Jarrold, 1999), others have reported a typical enactment effect in ASD (Williams & Happé, 2009).

Another facet of memory that is related to difficulties in monitoring source and is impaired in ASD is temporal order memory (e.g., Bennetto et al., 1996; Boucher, 1981; Boucher & Lewis, 1989; Poirier, Martin, Gaigg & Bowler, 2011). For example, Bennetto et al. (1996) showed participants with ASD and a matched comparison group a series of verbal concrete nouns and non-verbal representational drawings and asked them to judge which of the two stimuli had been presented more recently. The ASD group demonstrated impaired temporal order memory for verbal information. However, for visual information the findings were unclear, and Gras-Vincendon, Mottron, Salame, Bursztejn & Danion, 2007 also reported preserved temporal context memory for visual information in high-functioning individuals with ASD. As discussed, individuals with ASD experience difficulties with processing the relations amongst elements of an experience, whilst memory for the elements themselves is spared (Gaigg et al., 2008). It is therefore unsurprising that findings often show that individuals with ASD struggle to encode the temporal relationships between items in memory tasks, despite successful retrieval of the items themselves (Poirier et al., 2011).

These findings of impaired source memory in ASD are reasonably robust and are important for the present thesis in a number of ways. First, as examined in

Chapter 3, if an individual with ASD finds it difficult to remember where or when they learnt something, then they may confuse details that they heard from a co-witness or read in a newspaper account as being details that they actually witnessed themselves. Second, for the same reason they may be at greater risk of incorporating into their reports erroneous details that were gained through leading questions (that contain misinformation in the form of the desired answer in the question). This issue is also explored in Chapter 3. Third, recall of a specific event might be entrenched with details from other events if the witness has trouble remembering where or when they learnt something. Fourth, if a witness has difficulty pinpointing the source of their memories, they may have difficulty in recalling a specific episode of a repeated event or an event that is embedded in daily activities, such as a commute into work, which ultimately becomes semantic memory. Indeed, as discussed individuals with ASD are well documented to rely on semantic memory (i.e. memory for timeless facts) to compensate for their impaired episodic memory (e.g., Bowler et al., 2000a). Fifth, if individuals with ASD have difficulties recalling temporal order, then, as a witness they may have difficulty recalling the order in which details of an event occurred, which in a criminal case can mean the difference between convincing testimony versus diminished witness credibility.

Task support hypothesis

Despite these memory difficulties experienced by individuals with ASD, a body of evidence is accumulating to suggest that they can perform at a similar level to their typical counterparts if appropriate support is provided during the task. For example, whilst early work demonstrated that individuals with ASD do not make use of semantic relations among items to aid their memory recall, when cued recall or superordinate category cues are provided their recall is undiminished (Boucher & Warrington, 1976; Minshew et al., 1992). Indeed, the fact that individuals with ASD tend to show diminished performance on most memory tasks when test procedures are unsupported, as is the case in free recall, but not on supported tests such as cued recall or recognition, suggests that these impairments do not reflect an encoding problem and thus are open to effective support (see Bowler & Gaigg, 2008 for a review).

Gardiner, Bowler and colleagues (Bowler et al., 1997, 2004) proposed the task support hypothesis, whereby the memory impairments that are seen in ASD are largely eliminated when support for source is provided at test. For example, Bowler

et al. (2004) found that when participants, who had previously either actively generated a related word or were presented with the words in different formats at study, were 'supported' at test with cues asking them to select the appropriate activity or presentation type as well as the word, they performed similarly to the comparison group. By contrast, in the 'unsupported' condition, where participants were simply asked to recall the word without the corresponding action or presentation type, they performed significantly worse than the comparison group. This finding is consistent across a number of studies (e.g., Bowler et al., 1997; 2004; Gaigg et al., 2008). However Smith et al. (2007) suggest that participants need to actively engage with the support; simply instructing them how to use semantic relations was not enough in their study.

More recent work suggests that the task support hypothesis can be extended to encoding. Mottron et al. (2001) suggest that individuals with ASD have a 'low level' bias that leads to reduced processing of contextual information. However, a task that requires greater attention to the context might be supportive for individuals with ASD. Plaisted et al. (1999) reported that children with ASD's natural tendency to attend to the local properties of a stimulus can be countermanded if task instructions require attending to more global properties. Similarly, Gaigg et al. (2008) found that giving participants global orienting tasks during encoding, such as sorting words into categories, improved free recall for individuals with ASD to a similar extent as it did for their typical comparisons. That supportive procedures at encoding can enhance recall in ASD is interesting, but in investigative eyewitness contexts, there is not much that one can do about encoding. However, the task support hypothesis might have important uses for retrieval processes to facilitate eyewitness memory in ASD, a notion that is explored in Chapters 2 and 5.

Memory for emotionally arousing events

As noted earlier in this introduction, individuals with ASD demonstrate marked abnormalities in emotional behaviours and do not process emotional stimuli such as faces and social scenes in the same way that typical individuals do (Spezio, Adolphs, Hurley & Piven, 2007). Shultz (2005) has argued that individuals with ASD are relatively insensitive and inattentive to their social environment because of an abnormality of the amygdala – a limbic structure that is known to play a central role in responses to affective or emotionally charged stimuli (see Aggleton, 1992). The

amygdala is involved in the modulation of memory consolidation (e.g., Cahill & McGaugh, 1995, 1998; Canli, Zhao, Brewer, Gabrieli & Cahill, 2000), and in typical individuals, emotionally arousing events are better remembered and forgotten less than neutral non-arousing events (Bradley, Greenwald, Petry & Lang, 1992; Burke, Heuer & Reisberg, 1992; Cahill & McGaugh, 1998; Heuer & Reisberg, 1990; Kensinger & Corkin, 2003). However only four studies to date have specifically examined whether this is also the case for individuals with ASD, three of which have reported reduced enhancement effects of emotionally arousing material on memory in this group (Beversdorf, Anderson, Manning, Anderson, Nordgren, et al., 1998; Deruelle, Hubert, Santos, & Wicker, 2008; Gaigg & Bowler, 2008), and one has reported typical modulation of arousing stimuli to enhance recall (South, Ozonoff, Suchy, Kesner, McMahon, et al, 2008).

Beversdorf et al. (1998) asked adults with ASD to try to remember a series of emotionally charged and neutral statements, and found that whilst the typical group recalled significantly more of the emotionally charged compared to neutral statements, the ASD group recalled a similar number of both types of statements. Evidence for comparable autonomic responses between typical and ASD individuals, such as startle responses to emotionally significant stimuli (Salmond, de Haan, Friston, Gadian, Vargha-Khadem et al., 2003) suggests that individuals with ASD are affected by arousing detail at the more basic level, but it is the way in which these physiological responses are modulated that is atypical. Indeed, Beversdorf et al. (1998) argue that abnormalities of the amygdala play an important role in the neuropathology underlying ASD.

More recently, Gaigg and Bowler (2008) reported that although individuals with ASD, like typical individuals, exhibited a free recall advantage for emotionally arousing and semantically related neutral as compared to unrelated neutral words on an immediate memory test, this advantage was not present on tests following a one hour or one day delay, as it was for the comparison group. Moreover, both the ASD and comparison group again exhibited similar levels of autonomic activity across the different stimuli, but the correlation between their autonomic and subjective ratings of arousal was significant only for the comparison and not the ASD group. Blair (1999) and Ben Shalom, Mostofsky, Hazlett, Goldberg, McLeod and Hoehn-Saric (2003) have also reported heightened autonomic responses to emotionally significant stimuli by the ASD group. However, these authors found that subjective arousal itself differentiated the ASD and comparison groups.

Gaigg and Bowler (2008) suggest that these findings lend further support for the notion that psychophysiological responses to emotionally significant stimuli do not modulate cognitive processes typically in ASD. Given the well-documented impaired utilisation of meaningful information to aid recall in ASD, one might argue that these impairments for memory of emotional events in ASD are due to details from an emotional version of events being more semantically related to one another than details from a neutral event, rather than the arousing effect of the material itself. Indeed, some have argued that the memory enhancement of arousing material in typical individuals is due to its semantic interrelatedness (e.g., Buchanan, Etzel, Adolphs, & Tranel, 2006). However, Gaigg and Bowler (2008) controlled for this possibility by including semantically-related neutral as well as unrelated neutral words. The comparison group remembered emotionally significant words better than unrelated neutral words but similarly to the related neutral words on the immediate test, but only emotive words were resistant to forgetting over time; the neutral words were forgotten at a similar rate regardless of whether they were related or not. However for the ASD group, the arousing words were forgotten over time. Similarly, Deruelle et al. (2008) examined whether the emotional valence of visual scenes affects recall in ASD. Typical individuals recognised negative images significantly better than neutral and positive images, which were recognised to a similar extent. However, the ASD group's performance was not affected by the emotional content of pictures. Moreover, despite this lack of effect of the emotional content within the ASD group, overall they performed similarly to the comparison group on neutral, positive and negative visual scenes, suggesting that the lack of memory enhancement by emotional images was not due to general memory impairments in ASD.

Gaigg and Bowler (2009) have argued that these findings indicate that individuals with ASD do form distinct representations of emotional information. They tested this notion using an illusionary memory paradigm whereby they asked participants to study lists of words (e.g., *Book, Nook, Cook, Look…. e.g., Cape, Tape, Shape, Nape*) that were orthographically related to a non-presented associate word. As predicted, they found that whilst typical individuals were much less likely to falsely remember emotionally significant lure words (e.g., *Rape*) than they were neutral lure words (e.g., *Hook*), individuals with ASD were as likely to experience illusory memories of emotionally charged words as they were neutral words. Gaigg and Bowler interpret these findings in terms of autonomic responses during

emotionally charged situations being atypically integrated with subjective perception of the experience at the time, leading to atypical consolidation of relevant information into long-term memory. Thus, individuals with ASD accumulate representations of emotionally significant information that are indistinct from their representations of neutral information (Gaigg & Bowler, 2009).

Despite findings from these studies suggesting that individuals with ASD are no more likely to remember emotionally significant stimuli then they are neutral stimuli, South and colleagues have argued that the few existing studies that use fear conditioning paradigms without a social element have found intact performance in ASD (e.g., Bernier, Dawson, Panagiotides & Webb, 2005). South et al. (2008) examined whether individuals with ASD exhibit abnormal processing of emotional stimuli or situations that are not socially relevant, but are nevertheless known to depend on the integrity of the amygdala. On a series of four experimental measures known to depend in part on amygdala function, but that had little overt social relevance, both the ASD and comparison groups demonstrated clear evidence of emotional facilitation on all four tasks, leading the authors to suggest that amygdala dysfunction in ASD may be specific to social information. However, of relevance to the present thesis regarding the *recall* of emotionally arousing events, only one of these measures was a memory task, and that was recognition based. Moreover, eyewitness events are highly unlikely to have little overt social relevance. It goes without saying that atypical modulation of emotionally arousing events on memory has important and very real implications for eyewitness testimony in ASD. This notion is explored in Chapter 4.

Given the limited work to date that has specifically examined eyewitness testimony is ASD, the remainder of this chapter outlines some of the most relevant research in eyewitness testimony in typical individuals, before discussing the few studies that have examined this in ASD, along with the aims of the thesis. Because all of the work presented in this thesis is either published or currently under review, most of the chapters contain some background on eyewitness testimony. Therefore a discussion of relevant factors that are not covered in the succeeding chapters, rather than an exhaustive review, is offered here.

1.3. Eyewitness testimony in typical individuals

Most investigative professionals agree that eyewitnesses are vital in providing major investigative leads (e.g., Berresheim & Weber, 2003; Kebbell & Milne, 1998), which in 2009 may have contributed to as many as 1,407,500 UK offenders being sentenced (Ministry of Justice, 2010). Moreover, research suggests that suspects are more likely to confess to a crime if they believe that eyewitness testimony is accurate (Kebbell, Hurren & Roberts, 2006). It is therefore imperative that research examines the reliability of eyewitness testimony under various conditions in order to understand how reliable a witness's report might be.

Historically the reliability of eyewitness testimony has been sometimes over estimated; a review of DNA exoneration cases in the USA suggests that eyewitness errors have played some part at least 75% of the convictions that were later overturned following DNA testing (www.innocenceproject.org). Broadly speaking, the memory process can be divided into three stages: encoding, storage, and retrieval (Melton, 1963), and errors can occur at each of these. The following section of this chapter considers eyewitness research in relation to each of these stages.

Encoding stage

There is little that anyone within the Criminal Justice System can do about factors that occurred at the encoding stage of memory for an eyewitness event. However, for reliability purposes it is useful to know if the encoding conditions experienced are likely to help or hinder a witness's memory for the event. A now substantial body of research has systematically examined this. Kassin, Tubb, Hosch and Memon (2001) surveyed 64 eyewitness experts in several countries with regards to this body of research on which factors are sufficiently reliable to present in court, and a number of encoding stage factors emerged that were considered by the experts to reliably influence eyewitness memory. These include the length of time the witness was exposed to the event, with a longer duration correlating with higher accuracy (e.g., Shapiro & Penrod, 1986), whether the witness was intoxicated at the time - alcohol has consistently been shown to impair both encoding and storage of details (e.g., Mintzer, 2007; Ray & Bates, 2006; Yuille & Tollestrup, 1990) and the 'weapon focus effect', where memory is improved for the weapon and details of the hand holding the weapon, but at the expense of memory for the face of the person wielding the weapon (e.g., Loftus, Loftus & Messo, 1987).

An eyewitness's perception and memory for an event is also affected by their attitudes and expectations (Loftus, 1979). For example, Greffeuille, Ginet and Guimond (2004) found that giving witness participants prior occupational information that induced a negative stereotype of the victim (e.g., that she was a nightclub hostess) led to them perceiving her behaviour prior to her subsequent sexual assault was more provocative than if they had received information that induced a positive stereotype (e.g., airport receptionist). As Bartlett (1932) pointed out, people typically organise their recall of past events in a way that makes sense of their present situation and is congruent with their current expectations (this notion of the memory being organised around schemas is discussed in more detail in the retrieval section below).

The effect of arousal has received a substantial amount of interest in the eyewitness literature, given that arousal modulates memory (Eysenck, 1976), and eyewitness events are often emotionally arousing. In an earlier version of the survey, Kassin, Ellsworth and Smith (1989), reported that the majority of eyewitness experts agreed that very high level of stress or arousal can impair the accuracy of eyewitness memory. However, in the more recent survey Kassin et al. (2001) reported much less consensus amongst experts that this was a reliable phenomenon. This reduced consensus is because the past 20 years has seen diverging findings concerning memory for negative emotional events. Whilst some researchers have found that negative events are remembered well (e.g., Brown & Kulik, 1977; Heuer & Reisberg, 1990; Yuille & Cutshall, 1986), others report that emotional events have a negative effect on memory (e.g., Clifford & Hollin, 1981; Clifford & Scott, 1978; Loftus & Burns, 1982).

Deffenbacher (1983) attempted to reconcile these findings by drawing on the concept of arousal as reflected by the Yerkes-Dodson Law (Yerkes & Dodson, 1908). That is, moderate levels of arousal lead to optimal performance, whilst very high and low levels of arousal are associated with poorer performance. This theory was later rejected by Christianson (1992), who argued instead that high arousal causes a narrowing of the range of factors to which the witness attends (e.g., Clifford and Hollin 1981; Easterbrook 1959), and powerful aspects of the crime may influence attention to the incident, such as the 'weapon focus' effect mentioned above which refers to a witness's concentration on a weapon to the exclusion of other details of a crime (Loftus *et al.* 1987). However, this relationship between arousal and memory is not straightforward. A meta-analysis by Deffenbacher, Bornstein, Penrod, and McGorty (2004) suggests that the effect of high levels of

stress depends on whether the emotion generates an *orienting* response or a *defensive* response (see also Christianson, 1987). An increase in palmar sweat gland activity combined with a decrease in heart rate is generally considered to be part of an orienting response, and is a common reaction to unpleasant stimulation that serves to focus the observer to the stimuli (see Hare, Wood, Britain & Shadman, 1971; Klorman, Weissberg & Wiesenfield, 1977). A defensive response is an aversive reaction that is associated with increased palmar sweat gland activity and increased cardiac activity and is typically evoked by strongly unpleasant or traumatic events (see Christianson, 1987). In support of this 'orienting response' view, Heuer and Reisberg (1990), who reported a memory enhancement for arousing events, found a downward turn in heart rate for participants who viewed an arousing version of a slide sequence on the first slide on which the memory advantage and emotionally arousing events began.

Nevertheless, it seems that this modulating effect of arousal on memory only applies when the arousal is actually caused by the to-be-remembered event, and not some other factor (Bower, 1987; Christianson, 1992). Christianson & Nilsson (1984), for example, presented participants with a series of either emotional or neutral faces, with each face accompanied by verbal descriptions. They found that words that were associated with the arousing faces were remembered less well than words that were presented with neutral faces. In order to examine to what extent these memory effects were mediated by a heightened level of arousal *per se* (independent of the emotional valence of the to-be-remembered material), Christianson and Mjörndal (1985) injected participants with either adrenalin or saline solution, and then presented them with the same neutral faces used in the Christianson & Nilsson (1984) study. There was no difference in recall or recognition performance between the two conditions, despite the fact that those in the adrenaline condition were brought to a high state of emotional arousal. Thus, it seems that emotional arousal that is induced by an external source from the to-be-remembered event does not have the same modulating effect on memory that arousal caused from the event itself does.

Anxiety can also affect how an event is encoded, by enhancing arousal or focussing attention towards threat-related stimuli (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007 for a meta-analysis). One method of measuring anxiety behaviourally is the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983). Trait anxiety refers the level of susceptibility to stress that an individual brings to a situation, whilst state anxiety is

the actual situational stress experienced at that given moment in time (Sorg & Whitney, 1992). Stressful events can have very different effects on memory depending on the state and trait anxiety levels of the individual. Eysenck and colleagues argue that individuals who are inherently anxious often demonstrate impairments in recalling memories because their attentional resources are diverted to task irrelevant concerns and worries (e.g., Eysenck & Byrne, 1994; Eysenck & Calvo, 1992; Eysenck & Mogg, 1992). Conversely, individuals who are high in state anxiety at the time of witnessing the event may allocate greater behavioural urgency and attentional resources towards the anxiety-provoking stimuli, leading to enhanced memory (e.g., Bar-Haim et al., 2007; Dresler, Mériau, Heekeren, van der Meer, 2009).

Storage stage

The storage stage refers to the intermediary period between witnessing the event and recalling it. Clearly, one of the biggest problems here is the decay of memory for the event: the longer the delay after witnessing an event, the greater the decay of the memory and subsequent reduction in the amount of information that can be recalled (Rubin & Wenzel, 1996). However, this relationship is not linear. Ebbinghaus (1885/1964) was the first to report that forgetting is rapid at first and then follows a slow decline. This phenomenon is now widely known as the forgetting curve, and is considered by the experts surveyed by Kassin et al. (2001) to be reliable enough to be presented in court. Thus the level of detail and accuracy of report provided by an eyewitness will depend on the length of time that has elapsed before they are interviewed. This relationship is also dependent on other factors, such as the arousal level of the event (e.g., Burke et al., 1992; Christianson, 1984; Levonian, 1967). As mentioned in the encoding stage section above, some researchers have reported negative effects of arousal on memory. Often these studies employed short retention intervals of one hour or less (e.g., Christianson, 1984; Christianson & Loftus, 1991; Clifford & Hollin, 1981; Clifford & Scott, 1978; Deffenbacher, 1983; Kebeck & Lohaus, 1986; Loftus & Burns, 1982; Siegel & Loftus, 1978). Over increasingly delayed test intervals, superior memory is often shown for high-arousal events compared to low-arousal events (Archer & Margolin, 1970; Berlyne, Borsa, Hamacher & Koenig, 1966; Bornstein, Liebel, & Scarberry, 1998; Burke et al., 1992; Christianson, 1984, 1992; Christianson & Loftus, 1991; Corteen, 1969; Farley, 1973; Folkard & Monk, 1980; Heuer & Resiberg, 1990; Kaplan & Kaplan, 1969; Maltzman, Kantor & Langdon, 1966; Sampson, 1969;

Schwartz, 1974; Uehling & Sprinkle, 1968). Christianson (1984) for example, showed that with a short retention interval, participants who viewed a neutral slide sequence performed better in a recognition test than participants who viewed an arousing sequence. With a longer retention interval, the pattern reversed and those who viewed the arousing slides outperformed participants who viewed the neutral version.

Walker (1967) argued that high-arousal events cause a state of higher cortical arousal than low arousal events do. This affects the *preservative consolidation of a memory trace*, which can last for a long period of time. For conditions of low arousal, there is only a small amount of non-specific neural activity, resulting in weak consolidation and subsequently poor long term memory performance. The poor performance in immediate memory that is sometimes found for an arousing compared to a neutral version of events indicates that the memory trace is not available to the person whilst the neural traces are actively consolidating (Kleinsmith & Kaplan, 1963, 1964).

Another factor that might also occur within the intermediary stage between witnessing the event and recalling it in the legal process is post-event misinformation (e.g., Loftus, Miller & Burns, 1978; McCloskey & Zaragoza, 1985; Meissner, 2002). In the classic misinformation paradigm pioneered by Elizabeth Loftus in the 1970s (see Loftus, 2005), participants view an event such as a film or a series of slides depicting an event. They later receive some items of misinformation about what happened in that event, often in the form of a narrative that was apparently written by another witness. When participants later try to recollect the event, they often go on to report the erroneous misinformation details that they read as details that they actually saw (e.g., Loftus et al., 1978; Loftus & Palmer, 1974).

Post-event misinformation can also be gained though co-witness discussion (e.g., Gabbert, Memon & Allen, 2003; Valentine & Maras, 2011; Wright, Self & Justice, 2000). Indeed, Paterson and Kemp (2006) surveyed real-life eyewitnesses and found that 86% had discussed their memory with a co-witness who was also present at the scene. Eyewitnesses rarely have a uniform view of an event (Tollestrup, Turtle & Yuille, 1994) and so one eyewitness may see something another one cannot, or may have a distorted view or perception of events. Therefore, if witnesses talk to one another their accounts can become contaminated. To test this, Gabbert et al. (2003) developed an ingenious paradigm whereby all participants viewed a video of theft, before discussing what they saw in

the video with their co-witness participant. Unbeknown to participants, each witness in a pair had seen a slightly different camera angle version of the same event; certain details could be seen from one version of the video that could not be seen from the other. As predicted, participants who discussed the video with a co-witness went on to erroneously incorporate details that could only have been gleaned from their co-witness into their subsequent reports, demonstrating how co-witnesses can be a powerful source of post-event misinformation.

A number of explanations have been put forward to explain this misinformation effect, a full discussion of which is beyond the scope of this thesis but briefly, the *trace alteration* account suggests that the new information becomes inextricably incorporated into the memory record of the original event, which then updates the original memory and the original version become inaccessible (e.g., Loftus, 1979). By contrast the *trace co-existence* theory suggests that both memories coexist so rather than the new memory (for the misinformation) overwriting the original memory (for the event), both memories coexist. Under this trace co-existence account the misinformation effect is caused by a retrieval failure, which is either due to *trace competition* (the stronger, more salient memory is retrieved, e.g., Bekerian & Bowers, 1983), or s*ource misattribution,* where the individual experiences difficulty in discriminating between the sources of two memories. When they are later presented with the erroneous information it may seem familiar, leading to the belief that this familiarity is due to encoding the information as part of the original event (e.g., Lindsay & Johnson, 1989). Other accounts of the misinformation effect posit the role of *informational influences* (e.g., Sherif, 1936) whereby a witness is dependent on another person for information in order to resolve their own uncertainty. The extent to which this happens is often related to whether the other person is perceived as being in a better situation to encode the event (see Wright, Memon, Skagerberg & Gabbert, 2009), and the perceived confidence with which they report their version of events (e.g., Schneider & Watkins, 1996).

How easily the event and the post-event misinformation can be discriminated can also determine how likely a witness is to accept the misinformation (see Johnson, Hashtroudi & Lindsay, 1993, for the source monitoring framework). Lindsay (1990) reported that participants made errors only in a condition that was designed to make the original and misleading episodes difficult to discriminate. In this case the original and misleading episodes were hard to discriminate because

the original slides were accompanied by a tape-recorded narrative that was in the same female voice as the post-event narrative, and the task instructions required participants to form visual images of the events described in the post-event narrative. Moreover, the final test occurred after a 48 hour retention interval. Thus, a witness who receives post-event misinformation that has overlapping features with the event and does not attempt to recall the event until quite some time has passed is more likely to incorporate this post-event misinformation into their accounts than a witness who receives no, or easily discriminated, post-event misinformation and recalls the event immediately.

Retrieval stage

Not only is research essential in understanding the probable reliability of a witness's testimony, it can also inform practice on developing appropriate support strategies to help the witness remember more. The conditions under which a witness recalls the event can be imperative to the testimony that they give. Whilst stress experienced at the time of witnessing can impair the *encoding* of the event (as discussed above), stress experienced at retrieval can hinder *recall* of the event (e.g., Buchanan, Tranel, & Adolphs, 2006; Farber & Spence, 1953; Kuhlmann, Piel, & Wolf, 2005; Tollenaar, Elzinga, Spinhoven, & Everaerd, 2008). Sarason (1984) suggested that a highly anxious person is more likely to misinterpret a question or to feel unable to access an answer, even if they are confident they know the answer. Consequently, highly anxious individuals also tend to be more susceptible to leading or suggestive questioning styles (e.g., Gudjonsson, 1988; Wolfradt & Meyer, 1998, but see Ridley & Clifford, 2004).

The familiarity and regularity of an event can also influence the ease and manner of episodic retrieval. When events are highly familiar they can take on a schematic form that depicts the *general* conditions and sequences of action (Schank & Abelson, 1977). Thus, when many similar events have been experienced, the individual events become less distinctive from each other (Bekerian & Dennett, 1993). Whilst this reliance on scripts reduces the effort involved in remembering, it can mean that memories are less accurate. For example, Bower, Black and Turner (1979) asked participants to read texts containing accounts of what happened during a visit to a doctor or a dentist before later recalling what they could remember from the text. Participants confused details that they actually read in the text with details about visiting a health professional that were unstated in the script. As Milne

and Bull (1999) suggest, instead of having to remember and encode all the details of each new event encountered, one can rely on scripts to make sense of the world and only encode new, distinctive information. This does mean, however, that memories can become distorted if the script does not quite fit; people tend to subconsciously 'fill in the gaps' in memory with information from their scripts. This notion is explored in relation to post-event misinformation and suggestibility in ASD in Chapter 3.

The experts surveyed by Kassin et al. (2001) agreed that the wording of questions has a powerful and reliable influence on the accuracy of witnesses' reports. This notion of 'suggestibility' has been defined as "the extent to which, within a closed social interaction, people come to accept messages communicated during formal questioning, as a result of which their subsequent behavioural response is affected" (Gudjonsson & Clark, 1986, pp. 4). This definition leaves open the possibility that an individual might acquiesce to a leading question because they genuinely believe this to be their memory for the event (i.e. a cognitive change), or that they know that their answer is incorrect but they are going along with the suggestion for some other reason, also known as compliance (i.e. a social change). The Gudjonsson Suggestibility Scales (Gudjonsson, 1997), which are discussed in more detail in Chapter 3, are a standardised measure of suggestibility and have scores that are thought to reflect both cognitive and social compliance factors. McCloskey and Zaragoza (1985) have argued that most studies that report post-event misinformation effects are actually solely the result of social bias and demand characteristics, rather than an actual memory impairment or alteration. They suggest that participants change their answers to avoid the cost of disagreement, comply with norms and to gain social acceptance. However other studies that have controlled for these social demand factors still report a misinformation effect, suggesting that genuine source confusion does at least play a role (Lindsay, 1990). Indeed, Zaragoza and Lane (1994) argue that "...the tendency for people to *believe* that they remember seeing items that were in fact only suggested to them is at the core of what it means for memory to be suggestible" (p. 944). The extent to which experimental tasks measure this is, however, another matter.

In a classic experiment by Loftus and Palmer (1974), participants were shown slides of a car accident involving a number of cars and were asked to describe what had happened, before being asked "how fast were the cars going when they smashed/collided/bumped/hit/contacted) each other?" One week later

they were asked this question again. Participants who were asked the question with the “smashed” verb estimated that the cars were travelling at 40.5mph; those who were asked the “contacted” question gave estimates of 31.8mph. Moreover, when asked “Did you see any broken glass?” (none was ever shown), participants who were asked the “smashed” question were more likely to report seeing broken glass than participants in the “contacted” condition. Numerous studies have since replicated and extended this finding using different paradigms, indicating that eyewitnesses’ reports are highly malleable under leading and suggestive styles of questions. It is surprising therefore that little work has examined the effect of such questioning styles in court, given that barristers frequently rely on leading questions when cross-examining witnesses (Kebbell, Hatton & Johnson, 2004). In the only such study to date that has experimentally examined this with adults, Valentine and Maras (2011) extended Gabbert et al’s co-witness paradigm (described in the storage stage section above) to introduce post-event misinformation into witness participants’ reports. Following a one-month delay, participants were cross-examined by a barrister whose protocol was to get the witness to reverse their statements on four critical items. The authors found that witnesses who had not been exposed to co-witness misinformation were just as likely to change their answers (from correct to incorrect) during cross-examination as were participants who were exposed to misinformation (from incorrect to correct). Thus cross-examination gets witnesses to change their testimony, irrespective of accuracy. A limitation of this study is that participants were not asked afterwards whether they genuinely believed their changed answers to be correct (i.e. a cognitive change) or whether they knew the correct answer but went along with the barristers suggestions for social reasons. Either way, these findings suggest that leading questions exert a powerful influence on witnesses’ reports and should not be used when questioning a witness, even at this later cross-examination stage in court.

During police investigations information is usually gathered from the witness by an interview, where more safeguards are now in place. Since remembering is a reconstructive process (e.g., Bartlett, 1932) interviews need to be supportive without contaminating real memories with thoughts or external suggestions. Whilst psychological research has long demonstrated the fallible nature of memory, it is only in the past 30 years or so that research has been instrumental in guiding the development of appropriate interview models to enhance both the *quantity* and the *quality* of reports. Following a number of high profile miscarriages of justice due to false confessions, juries no longer believed police officers who claimed that

suspects had voluntarily confessed to them. This led to concerns about police interviewing in general, and the Police and Criminal Evidence Act 1984 (PACE, Home Office, 1995) was put in place to restore faith in the Criminal Justice System. Stricter controls over police questioning were introduced, including the tape recording of interviews with suspects (Williamson, 1993), and fairer line-up identification procedures, such as the use of a live line-up with at least eight foils. These measures helped to expose the gap in research on techniques for interviewing suspects and led to a surge in investigators turning their attention to this area. Whilst PACE gave detailed guidance on interviewing and dealing with suspects, it provided very little guidance regarding witnesses.

In 1992 the PEACE model was introduced across England and Wales in response to judicial and public concern about witness interviewing standards (National Crime Faculty, 1996). It was developed by psychologists, lawyers and the police, and has since been widely adopted as best interviewing practice, having been designed as the framework for interviewing in any situation with any type of interviewee. PEACE is an acronym for the stages of the interview: Planning and preparation, Engage and explain, Account, Closure, and Evaluation. Within PEACE two styles of interviews are recommended: conversation management for suspects and more resistant witnesses, and the cognitive interview (CI) for all other witnesses. The CI was developed by American psychologists Ed Geiselman and Ron Fisher and colleagues in the mid-1980s (see Geiselman, Fisher, Mackinnon & Holland, 1986) as a means of improving the completeness and accuracy of eyewitness accounts following their analysis of hundreds of tape-recorded police interviews. These recordings revealed that officers appeared to have little awareness of the limitations of their interviewing practices as they made frequent interruptions, asked too many short-answer questions, and sequenced their questions inappropriately (Fisher, Geiselman & Raymond, 1987; George & Clifford, 1992). Whilst it has been modified since its earlier development in the 1980s (see Fisher & Geiselman, 1992), the CI is regarded by many as the single most important development in investigative interviewing techniques to date (e.g., Milne & Bull, 1999), and is discussed in more detail in the next Chapter, where its effectiveness for use with witnesses with ASD is explored.

Whilst effective witness interviewing techniques have been developed, there is still a long way to go before these are used appropriately in practice. In 2001, Clarke and Milne carried out an evaluation for the Home Office and found that the interviewing of victims and witnesses was far worse than that of suspects. It was

suggested that this was due to a lack of guidelines, witness interviews being perceived as inferior to suspect interviews, and the distractions that are present when the witness is interviewed in an environment such as their home, which is not under the control of the police. Clarke and Milne (2001) strongly recommended the tape recording of all interviews in order to encourage a reduction in the number of leading questions that are asked. Free recall is still considered one of the most successful and practical methods for obtaining the most reliable, full and accurate accounts from cooperative witnesses and suspects because the details that are given are not contaminated with the cognitive and social bias demands of a specific or leading question (see, e.g., Fisher & Schreiber, 2007; Weingardt, Toland & Loftus, 1994). Indeed, the core skills required by police interviewers are the ability to plan and prepare for interviews, the ability to establish rapport, and the ability to carry out effective listening and effective questioning (Dando, Wilcock & Milne, 2008). However, training is an issue: officers are initially taught how to interview witnesses during a one-week training course and this course also covers suspects and leaves just two days for them to learn techniques such as the CI (La Rooy & Dando, 2010). In a review of inexperienced police officers' perceptions and practical experiences of interviewing witnesses, Dando et al. (2008) reported that most agreed that the training they receive is not enough to prepare them with the knowledge and skills necessary to apply CI techniques appropriately. Nevertheless, changes since the 1984 PACE have certainly meant that there are much tighter controls over police interview practice than was previously the case, but it appears that more rigorous police training is needed if interviewing techniques such as the CI are to be appropriately applied to enhance both the quality and quantity of information that witnesses report.

Vulnerable witnesses: current guidelines

'Vulnerable witnesses' is a term generally used to describe a heterogeneous group of individuals including children, witnesses with a mental disorder, impaired intellectual or social functioning, physical disability, and intimidated witnesses (i.e. in fear or distress about testifying). This includes witnesses with ASD (Home Office, 2011). A number of risk factors suggest that vulnerable individuals may be over-represented within the Criminal Justice System as victims, witnesses, or even suspects (e.g., Allen et al., 2008; Petersilia, 2001; Williams, 1995). It is therefore crucial that they are interviewed appropriately.

In 1999, the Youth Justice and Criminal Evidence Act (Home Office, 1999) was introduced to help vulnerable and intimidated witnesses give the best evidence they can in criminal proceedings, by allowing them access to a range of 'special measures' in order to improve their evidence. These special measures include allowing a video recording to be made of the witness interview that could subsequently be admitted as evidence-in-chief, the screening of the witness from the accused, and the witness giving evidence by means of a live television link. By reducing the stress associated with a court case it was anticipated that the witness would be more confident and give better testimony. Under the Act, witnesses are eligible for this special assistance on the grounds of their vulnerability due to age or incapacity. The guidelines state that they must be under the age of 17 at the time of the hearing, or the court must consider that the quality of their evidence is likely to be diminished because they suffer from mental disorder, or otherwise have a significant impairment of intelligence and social functioning; or a physical disability or physical disorder.

In 2002 the Home Office prepared a document to accompany PACE: "*Achieving best evidence in criminal proceedings: guidance for vulnerable or intimidated witnesses, including children*" (Home Office, 2002). Amongst other things, the document emphasises the need for professionals at all stages of the legal process, including the police, social agencies, prosecution and defence to take account of the individual circumstances of each witness. The advice is extended to encompass three groups of support persons: where support is offered at the interview, prior to trial, or during the trial itself. Section 29 of the Special Measures in these 2002 guidelines permits the examination of witnesses through an intermediary (or social support at all stages of the investigation by way of a friend, relative or appropriate adult) who may be appointed by the court to assist the witness in giving their evidence in the courtroom. Intermediaries can be very useful in assisting vulnerable witnesses to give evidence (O'Mahoney, 2010), and also act as a safeguard against inappropriate questioning, for example by stepping in to stop the use of questions containing metaphors or irony with a witness who has ASD.

Whilst these guidelines are useful, it is important to understand how often and how effectively vulnerable witnesses are actually identified. The Home Office guidelines recommend that vulnerable witnesses should be identified as early as possible. However, at present no data exists pertaining to the frequency with which this actually occurs. The guidelines outline a number of demographic and behavioural indications to assist police officers in determining themselves whether a

witness might be considered vulnerable, including whether they attended a special school, have difficulties in remembering personal events or details, or demonstrate a language or verbal impairment. There is also some specific guidance on identifying the characteristics of witnesses with ASD, for example that they have difficulty in making sense of the world and in understanding relationships, understanding of the emotional pain or problems of others, and that "they may display great knowledge of certain topics and have an excellent vocabulary, but are likely to be pedantic, literal, and may have obsessional interests" (Home Office 2002, p. 58). High functioning individuals with ASD may often go undetected because their competent use of language and average or above average intelligence may present them as neurotypical (North, Russell & Gudjonsson, 2008). With the recent Autism Act Statutory Guidance (Department of Health, 2010), stating that local councils and local NHS bodies in England must improve identification and diagnosis of ASD in adults, it is hoped that more individuals who have ASD will be diagnosed. This will undoubtedly have a knock-on effect for more detailed recommendations concerning the treatment of witnesses, victims, and suspects who pass through the criminal justice system once it is recognised that these individuals constitute a significant proportion of these.

The Home Office guidelines give generic advice on interviewing vulnerable witnesses as a whole, but very little specific guidance for each sub-group such as those with ASD. This is surprising given the different memory difficulties experienced by individuals with ASD compared to individuals with intellectual disabilities for example, who tend to have broad deficits in memory encoding, storage and retrieval (e.g., Gudjonsson & Henry, 2003). The general guidance advocates the use of the CI and emphasises the importance of prior planning of interviews, focussing on the free recall account as much as possible, avoiding the use of abstract words or ideas, leading or suggestive questions, the use of negatives (e.g., "did the man *not* have a red hat?") or double negatives "(e.g., "is it *not* the case that the man did *not* have a red hat?"), and minimising legal or technical jargon. Since ASD is a spectrum disorder, many witnesses with ASD will have no problems with some of the technical questions that investigative professionals are advised against using. Moreover, at the time that these guidelines were written, the CI had not actually been tested for use with witnesses with ASD (the CI is tested in Chapter 2). Indeed, the guidance itself concedes that not a lot is known at present about techniques that may assist vulnerable witnesses (p. 73).

This 2002 guidance has since been updated (Home Office, 2007, 2011), and the more recent versions give some specific guidance on witnesses with ASD, although this is far from detailed. This includes the acknowledgment that "some witnesses may not be able to benefit from all of the CI procedures (e.g., young child witnesses and witnesses with ASD may well not be able to 'change perspective' and thus this component is not recommended)" (Home Office, 2011, p.93). Other guidance regarding witnesses with ASD notes that they may be frightened of expressions of emotion or shouting, fearful of unfamiliar stimuli including noise, colour and unknown people, not like people to come too close to them, not like to make direct eye contact, and prefer a consistent and stable environment. For example, if there is more than one interview, it is recommended that they should be carried out in the same place, with the same people in the same positions within the room (this would also apply to the courtroom situation if they have to appear on more than one day). This more specific guidance is certainly a step in the right direction. Nevertheless, as prominent eyewitness researcher Professor Ray Bull commented in a brief review of future eyewitness research directions, "One crucial area of activity that needs to be addressed is the low awareness of forensic psychology amongst those from the legal profession who in court try to question children or vulnerable adults. This lack of awareness of the findings of relevant research constrains the quality of the information provided by such witnesses and alleged victims, such that justice may not be achieved" (Bull, 2010, p.13). The aim of the present thesis is to explore how the memory difficulties that are experienced by people with ASD emerge in their abilities as eyewitnesses and how effective current police interviewing techniques are for them. It is hoped that this work will help to inform future guidelines to produce more detailed and specific guidance on how best to interview them and the factors that are most likely to affect their testimony.

1.4. Eyewitness testimony in ASD

The beneficial impact of appropriate interviewing techniques and increased understanding of the reliability of witnesses with ASD should not be underestimated. Individuals with ASD comprise approximately 1% of the population (Baird et al., 2006). A number risk factors, including their diminished insight into what others are thinking leading to exploitation by others (Howlin, 1997) and their repetitive and stereotyped interests (Allen et al., 2008), indicate that they may be over-represented within the Criminal Justice System as a witness, victim, or even as a perpetrator of

crime (but see Woodbury-Smith, Clare, Holland & Kearns, 2006). The National Research Council in the US suggests that individuals with ASD are between 4 and 10 times more likely to be victims of crimes (Petersilia, Foote & Crowell, 2001). Moreover, a study comparing offenders with ASD, non-offenders with ASD and typical individuals, reported that vulnerability to criminal offending in these individuals was associated with impaired recognition of the emotional expression of fear; a core characteristic of ASD (Woodbury-Smith, Clare, Holland, Kearns, Staufenberg & Watson, 2005). Despite these risk factors indicating that individuals with ASD may enter the Criminal Justice System, research that has examined how they fare as eyewitnesses is sparse. In fact, it appears that only three studies to date have specifically examined this: two with children and one with adults.

McCrory et al. (2007) used a live classroom event to compare eyewitness recall and suggestibility in 11-14 year-old children with ASD and their IQ-matched typically developing counterparts. Whilst the children with ASD freely recalled around a third less information than the typically developing children did, they were no less accurate with regards to the proportion of errors or incorrect details that they reported at this stage. Nevertheless, the ASD group were significantly less likely to mention the most salient or gist elements of the event, indicating that they may be less aware of information that is socially salient in the context of an event. However, the use of guided and specific questioning effectively reduced group differences to the extent that both groups reported a comparable number of event and socially salient details. Following free recall and specific questioning, children were then asked a series of leading questions. There was no difference between groups for suggestibility to misleading information, indicating that increasing the use of leading questions to elicit more detail in witnesses with ASD is likely to increase the reporting of details that did not occur in line with the suggested answer, but no more than is the case for typically developing children. However McCrory et al. caution against generalising these findings regarding comparable *suggestibility* between groups to having comparable *compliance*, and highlight the importance for further research to investigate whether individuals with ASD may be more likely to go along with propositions, whilst not necessarily accepting them as true.

Bruck et al. (2007) also reported poorer memory for a previously witnessed event by ASD compared to typical children, but again with no difference in suggestibility between the two groups. However, in a second experiment where participants completed an autobiographical questionnaire, Bruck et al. included

three “silly” items (e.g., “Have you ever helped a lady find a monkey in the park”). These were mixed in with the 12 life event questions in their questionnaire in order to ascertain that answers were reliable. As expected, the typically developing children were less suggestible to the silly questions than to the life event questions. The ASD children, however, were equally as suggestible to both types of questions. Bruck et al. have argued that because the ASD children were only more suggestible than the typical children for the silly questions, but not for the 12 more plausible life event questions, that this effect does not simply reflect a greater compliance to leading or suggestive questioning. Instead, it appears to reflect a constant pattern of compliance across suggestion type, whether it is related to what actually happened or not. So whilst the ASD and typical children were equally as suggestible to questions that were familiar to what actually happened, the typically developing children appeared to use their complete lack of unfamiliarity to never before heard false items to reject suggestions by the interviewer. By contrast, the children with ASD failed to use a lack of familiarity to identify the interviewer’s suggestions as a whole different version of events, meaning they were as suggestible to these questions as they were the more plausible questions (Bruck et al., 2007). These findings have important implications for legal questioning in real-life cases whereby children with ASD may be more susceptible to acquiesce to biased interviewers who either do not believe the child’s version of events, or wish to elicit an entirely different version of events from the ASD witness in order to defend or acquit a suspect. Whereas typical individuals appear to be resistant to such an outright change in versions of events, it is possible that children with ASD may be more malleable in their testimony. This notion is explored in Chapter 3.

In the third study to assess suggestibility in ASD, North, Russell and Gudjonsson (2008) used the Gudjonsson Suggestibility Scales (Gudjonsson, 1997) to measure suggestibility and compliance in adults with ASD. Chapter 3 discusses this study in more detail. North et al. reported that whilst the ASD group were more compliant (i.e. more likely to accede to a proposition put forward by another even though privately they disagree with it) than their matched comparison participants, in line with McCrory et al. (2007) and Bruck et al. (2007), they were no more or less suggestible than them. So from these existing studies one might tentatively suggest that individuals with ASD recall less information from an event, particularly with regards to gist or social salience, but they are no more or less suggestible than their typical counterparts. However these conclusions are based on three studies, two with children and one with adults. The final section of this chapter briefly considers

how the substantial body of memory research in ASD might be reflected in how well adults with ASD recall an eyewitnessed event.

Implications of the memory difficulties experienced by individuals with ASD for their eyewitness testimony

Taking into account the findings on memory in ASD, it is often the case that two contrasting predictions can be made as to how individuals with ASD will fare as eyewitnesses. On the one hand, a number of findings would suggest that their testimony might be less complete and less accurate than that of their typical counterparts. Take, for example, a *personally experienced event* that involves a strong *social element*, and the recall of which requires understanding of the *actions* that occurred *between people* in a specific *temporal order,* in addition to being *emotionally arousing.* On top of this imagine the witness is asked to recall this arousing event after prolonged *delays.* Most ASD researchers would agree that any of these elements could cause problems in remembering for an individual with ASD. Indeed, memory difficulties aside, their sensory differences such as a heightened sensitivity to noise, touch and light, might mean that they have difficulty in screening out sensory stimuli, particularly in new situations. Therefore if either the witnessed event itself (at encoding) or the retrieval environment such as the police suite is noisy, echoes, or has fluorescent or buzzing strip lighting (as is the case with many police stations), a witness with ASD may find it difficult to attend to the speaker and give testimony to the best of their ability.

On the other hand, if an individual with ASD witnesses an event as part of their obsessive interests and where the event is non-social in nature (e.g., involving online activities such as IT fraud), with arbitrary details (as is the case with a lot of crimes that are briefly witnessed where the 'bigger picture' is not always available), they may in fact make an excellent witness, over and above that of their typical counterparts. Similarly, if individuals with ASD rely less on context and follow more of an item-specific processing style they may be less likely to substitute gaps in their memory with details that fit with their 'schemas' for that type of event. On the same basis they might also be less susceptible to post-event misinformation, and if they do not have a ToM they may not pick up on the implicit demand of a questioner who is asking suggestive questions.

Either way, the specific and distinctive memory profile of individuals with ASD suggests that they may make rather different witnesses from that of their typical counterparts. Moreover, if their memories are encoded, stored and/or retrieved in a different way from typical individuals, the psychological principles on which current police interviewing techniques are based may simply not be effective for witnesses with ASD.

1.5. Aims of the thesis

Considering the strong theoretical bases for predicting impaired eyewitness testimony in certain situations but not others in ASD, it is surprising that we know virtually nothing about their abilities as eyewitnesses and how best to interview them. It is this gap in the literature that the following experimental chapters will try to fill. Chapter 2 examines how effective one of the most widely accepted police interviewing techniques, the Cognitive Interview, is for witnesses with ASD. Chapter 3 explores suggestibility in ASD over two experiments, one of which examines schema-related misinformation effects, and the other utilises a standard suggestibility scale to examine how susceptible individuals with ASD are to leading questions and negative feedback, and how this correlates with several psychological trait measures. Chapter 4 investigates whether emotionally arousing events are better remembered over time than neutral events, and Chapter 5 examines how mentally versus physically reinstating the context that was experienced at encoding affects their subsequent recall of the event. Finally, Chapter 6 attempts to draw these findings together and discusses the implications for theoretical and practical frameworks, along with limitations of this work and implications for future research.

1.6. Participants

Details of participants, including their age, IQ, and matching data are reported in the method section for each experiment separately. However, throughout the experiments reported in this thesis a number of overarching principles for recruiting and matching participants applied. These are briefly described in this section.

ASD participants were recruited on the basis that they had previously received a formal diagnosis of ASD from local health authorities and/or experienced

clinicians. This diagnosis was confirmed by a review of available medical records or assessment with the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999) to confirm that they met DSM-IV (American Psychiatric Association, 2000) criteria for ASD. ADOS scores were only used as exclusion criteria where participants provided a statement of their diagnosis that did not include sufficient detailed information about their developmental history. Participants included in the present series of experiments who were unable to provide such details all met relevant cut-offs for an ASD on the ADOS assessment (all participants also provided brief statements regarding their diagnosis).

The majority of the ASD and typical comparison participants were recruited from a pre-existing database that was set up by members of the Autism Research Group at City University. These participants had initially replied to advertisements posted in newspapers and autism media outlets, before being screened for other impairments or illnesses that might have affected their performance on research-related tasks (see below), and IQ-tested using the Wechsler Adult Intelligence Scales, Third Edition (WAIS-III, Wechsler, 1997). Since ASD is much more common in males than females every effort was made to ensure that this ratio was represented by the proportions of both ASD and comparison participants, since sex differences can be found on certain tasks (e.g., Voyer & Hou, 2006).

With the exception of Experiment 3, ASD participants were individually matched to comparison participants based on their IQ scores. However, individuals with ASD often show an uneven profile of cognitive strengths, and standardised intelligence tests such as the WAIS tend to reveal large discrepancies between verbal and performance IQ in ASD, with a peak subtest score on the Block Design task, and lower verbal IQ relative to performance IQ (e.g., Lincoln, Courchesne, Kilman & Elmasian, 1988, but see Volkmar, Klin, Siegel, Szatmari, Lord et al., 1994). This inevitably leads to difficulties recruiting typical individuals who have similar cognitive profiles to act as comparison matches. It also means that the full-scale IQ of the ASD group is 'averaged out' between verbal and performance IQ scores and so it is not always a particularly informative indicator of the cognitive profile of an individual with ASD. As the types of tasks that are of most relevance to the present thesis rely on verbal abilities, coupled with the difficulties in finding typical individuals with such uneven cognitive profiles, ASD and comparison participants were individually matched on verbal IQ first and foremost, whilst at the same time it was ensured that group averages did not differ on performance or full-scale IQ overall. Also on the subject of IQ, the experiments reported in the present

thesis included ASD participants who had an IQ within the normal range. Whilst findings from research with higher functioning individuals are generally seen as 'purer' because results are not confounded with the effects of intellectual impairment, it does of course mean that they have limited generalisability to individuals on the broader spectrum, since approximately 25-45% of individuals with ASD have an IQ below 70 (e.g., Baird et al., 2006; Chakrabarti & Fombonne, 2001).

Another issue taken into consideration for the present thesis concerns the potential presence of other co-occurring conditions. ASD often co-occurs with psychiatric or specific clinical conditions such as anxiety (Gillot, Furniss & Walter, 2001), depression (see Stewart, Barnard, Pearson, Hasan & O'Brien, 2006), and Tourette syndrome (Baron-Cohen, Scahill, Izaguirre, Hornsey & Robertson, 1999). It can also co-occur with non-specific conditions such as speech and language disorders (Rapin & Dunn, 2003), hearing impairments (Rosenhall, Nordin, Sandström, Ahlsén & Gillberg, 1999) and visual impairments (Pring 2005). Co-occurring disorders have obvious and important implications for research. Firstly, we need to know that any difference between groups is due to the ASD, and not the co-occurring condition or the medication being taken to treat it. For example, an individual with ASD with co-occurring depression may be taking an antidepressant such as amitriptyline, which can produce memory loss (e.g., Spring, Gelenberg, Garvin & Thompson, 1992); thus, any memory impairments shown on tasks may be a result of the medication rather than the ASD itself. Similarly if an individual has a visual impairment this has obvious implications for their performance on eyewitness tasks, and if they have a speech and language disorder this will affect their understanding of questions and their ability to give comprehensible reports in interviews. Therefore the present series of experiments limited the number of participants with a co-occurring disorder or those taking medication known to affect memory to a minimum. All participants were also English-speaking and were selected on the grounds that English was their first language. However, routine records were not kept of participants' ethnicity.

Ideally each experiment would involve a completely new cohort of participants, in order to best represent the wider population of ASD and typical counterparts. Inevitably in the present series of experiments however there was some degree of overlap, with a number of participants taking part in more than one of the experiments reported here. A full list of participants and which experiments they participated in is reported in Appendix 1.

Finally, all experimental procedures used in this thesis adhered to the ethical guidelines set out by the British Psychological Society and were approved by the University's Senate Ethical Committee.

Chapter 2: The cognitive interview for eyewitnesses with Autism Spectrum Disorder

2.1. Overview of Chapter 2

As discussed in Chapter 1, a substantial body of research has examined memory in ASD. However, this research has tended to use words or simple pictures as stimuli. Very little research has examined memory for more complex events, and virtually none has examined eyewitness memory in ASD. The research presented in Chapter 2 aimed to examine the quantity and quality of reports of a previously witnessed event provided by witnesses with ASD compared to their matched typical counterparts. In addition, the commonly used method of police interviewing, the Cognitive Interview, was compared with a standard structured interview in order to examine the reports of ASD and typical comparison witnesses under different interviewing techniques. This paper was published in the *Journal of Autism and Developmental Disorders* (Maras & Bowler, 2010), and is presented in the form in which it was submitted for publication.

2.2 Abstract

The Cognitive Interview (CI) is one of the most widely accepted forms of interviewing techniques for eliciting the most detailed, yet accurate reports from witnesses. No research, however, has examined its effectiveness with witnesses with autism spectrum disorder (ASD). Twenty-six adults with ASD and 26 matched typical adults viewed a video of an enacted crime, and were then interviewed with either a CI, or a Structured Interview (SI) without the CI mnemonics. Groups did not differ on the quantity or quality of their reports when interviewed with a SI, however, when interviewed with a CI the ASD group was significantly less accurate. Findings indicate that investigative professionals should be cautious in relying on the CI to interview witnesses with ASD.

2.3 Introduction

Eyewitness evidence is central to the criminal justice system. In 2007, 1.78 million UK offenders were found guilty or cautioned (UK Ministry of Justice, 2008) and 87% of police officers indicated that eyewitnesses usually or always provided major investigative leads (Kebbell & Milne, 1998). Inaccurate or incomplete testimony can lead to wrongful conviction or acquittal (Huff, Rattner, & Sagarin, 1996) and so reliable interviewing techniques are imperative in eliciting the most detailed yet accurate reports from witnesses. The Cognitive Interview (CI) is now one of the most widely used and accepted forms of interviewing in both the US and the UK (Fisher & Geiselman, 1992; Geiselman, 1984), and is currently taught to all police recruits in the UK (Dando & Milne, 2009). The CI has been shown to elicit detailed, yet accurate, reports from adult witnesses (Davis, McMahon & Greenwood, 2005; Kohnken, Milne, Memon & Bull, 1999), children (Geiselman & Padilla, 1988; Memon, Wark, Bull & Koehnken, 1997), older witnesses (Wright & Holliday, 2007b) and witnesses with learning disabilities (referred to in the US as mental retardation) (Milne, Clare & Bull, 1999). Due to the effectiveness of the CI across these various witness groups, recent UK guidelines have recommended that all 'vulnerable witnesses' be interviewed with this technique (*Achieving best evidence in criminal proceedings: Guidance for vulnerable and intimidated witnesses, including children*. Home-Office, UK, 2002), including witnesses with Autism Spectrum Disorder (ASD), whose patterning of memory strengths and weaknesses may render the CI ineffective.

ASD affects approximately 1% of the UK population (Baird, Simonoff & Pickles et al., 2006) and is clinically characterised by deficits in reciprocal social interaction and communication in the presence of repetitive and stereotyped patterns of behaviour (American Psychiatric Association, 2000; World Health Organisation, 1993). Although current diagnostic classification systems distinguish between Autistic Disorder, Asperger Disorder and Pervasive Developmental Disorder Not Otherwise Specified (e.g., American Psychiatric Association, 2000), there is little evidence to support this sub-classification and some scientists now argue that the different nomenclatures simply reflect different instances of the same underlying spectrum of conditions (see Bowler, 2007). Nevertheless, this remains an issue of debate that requires further research. Relevant to the current manuscript is the fact that individuals from across the Autism Spectrum exhibit a rather unique pattern of memory strengths and weaknesses (Bowler & Gaigg, 2008; Boucher, Mayes & Bigham, 2008) that may render certain aspects of the CI ineffective. Before

discussing this unique memory profile in more detail, we briefly outline what the CI comprises.

The CI is based on two basic principles of how memory typically operates; that retrieval of an event will be enhanced if the context experienced at recall matches that experienced during encoding (Fisher & Geiselman, 1992; Roediger, Weldon, Challis, & Craik, 1989; Tulving & Thompson, 1973), and that memories are stored as interconnected nodes that provide multiple retrieval routes (Tulving, 1974). On the basis of these principles the CI was constructed to comprise four stages: (a) context reinstatement (CR), (b) imagery-guided questioning (QU), (c) change the order of recall (CO), and (d) change the perspective of recall (CP). In CR witnesses are encouraged to mentally reconstruct the external (physical) and internal (subjective) states that they experienced during the witnessed event before freely reporting as many details of the event as possible. Recall of trivial or incomplete details is encouraged (under the 'report all' instruction) since important facts may be elicited that co-occurred with seemingly unimportant events (Geiselman, Fisher, Mackinnon, & Holland, 1986). CR is followed by QU in which witnesses are asked open-ended questions based on what they said during their first free recall attempt. Further details are elicited by asking witnesses to summon and describe mental images of the event, for example focusing on the best image they have of the victim in order to describe their clothing. During CO witnesses are then asked to recall the events in a different order, for example starting with the last thing they witnessed and working backwards in detail until they report the first thing they witnessed. Finally, the witness is asked to recall the event from a different perspective (CP), for example from the perspective of another person or imagining they were positioned in a different location (Fisher & Geiselman, 1992). All four of these mnemonic strategies elicit more detailed descriptions of a recalled event because witnesses are encouraged to access their memory through different routes (e.g., Schank & Abelson, 1977). The effectiveness of this strategy, however, depends on how a person stores a memory in the first-place and a substantial amount of evidence indicates that individuals with ASD may do so rather differently than typical individuals (e.g., Bowler & Gaigg, 2008).

Although individuals with ASD demonstrate relatively unimpaired performance on some memory tasks (Bennetto, Pennington, & Rogers, 1996; Minshew & Goldstein, 1993; Renner, Klinger, & Klinger, 2000) a substantial amount of experimental work suggests that they may experience certain difficulties when trying to recall a witnessed crime. For example, they demonstrate deficits in the

recognition of faces (e.g., Blair, Frith, Smith, Abell, & Cipolotti, 2002), in the episodic recollection of personally experienced events (e.g., Bowler et al., 2000a; Bruck, London, Landa, & Goodman, 2007), and in the organisation of information in memory (Bowler et al., 2000b; Bowler, Matthews, & Gardiner, 1997; Tager-Flusberg, 1991). They also sometimes struggle to recall where, when, how or from whom they learnt something (Bowler, Gardiner, & Berthollier, 2004; Bennetto et al., 1996), and both neural and theoretical perspectives suggest that individuals with ASD experience difficulties in binding elements of an experience together in memory (e.g., Bowler et al., 1997; Bowler, Gaigg & Gardiner, 2008a; Brock, Brown, Boucher, & Rippon, 2002; Gaigg, Gardiner & Bowler, 2008; Parkin, 1997). Moreover, neural approaches implicating the frontal lobes in the neuropathology of ASD would lead to the prediction that such individuals would have an increased tendency to confabulate (e.g., Bachevalier & Loveland, 2006; Dornburg & McDaniel, 2006; Kopelman, Guinan, & Lewis, 1995; Moscovitch & Melo, 1997; Parkin, 1997; Schacter, Kagan & Leichtman, 1995; Stuss, Alexander, Lieberman, & Levine, 1978; Turner, Cipolotti, Yousry, & Shallice, 2008).

As this brief overview suggests, there are several reasons why one might expect individuals with ASD to experience difficulties in recalling witnessed events. What is less apparent is whether this pattern of difficulties may adversely affect the efficacy of CI techniques with witnesses with ASD. On the one hand, previous evidence suggests that individuals with ASD fare better on tests of memory that provide support for the retrieval of previously learned stimuli (Bowler, et al., 1997). For instance, although individuals with ASD have difficulties spontaneously recalling the context in which certain words were learnt, their performance is similar to comparison individuals if they can choose their answer from a number of options (Bowler et al., 2004). Similarly, although individuals with ASD may be worse at spontaneously recalling lists of words (e.g., Gaigg et al. 2008), their performance is no worse than that of typical individuals on word-stem completion tests in which typical and ASD individuals have a similar tendency to complete word-fragments with words they saw on a previous list (Gardiner, Bowler & Grice, 2003). Such observations suggest that at least the context reinstatement element of the CI might be similarly effective for ASD and typical witnesses.

There are, however, also reasons why one might expect the CI to be rather ineffective, and perhaps even detrimental to the witness accounts of individuals with ASD. First, it is important to note that the cognitive mnemonics utilised in the CI may qualitatively differ from the kind of retrieval support provided in experimental

laboratory tasks such as those just described. Another reason why one might doubt the efficacy of the CI in ASD is that elements of the interview, such as context-reinstatement, assume that memories about details of the event are somehow bound to memories of the context. In other words, reinstatement of the context is thought to provide a direct route to memories of other elements of the event. Given that individuals with ASD seem not to bind elements of an experience in memory as typical individuals do (e.g., Bowler & Gaigg, 2008), context reinstatement might fail to enhance the recall of witnesses with ASD. Similar doubts can be raised about the change-order (CO) and change-perspective (CP) mnemonics. Since individuals with ASD experience impairments in temporal cognition (Boucher, 2001), the CO mnemonic might fail to enhance recall and the memory binding difficulties just mentioned may also render CP mnemonics ineffective. Indeed, based on the implication of frontal lobe involvement in the pathology underlying ASD (e.g., Bachevalier & Loveland, 2006), one might even speculate that the use of mnemonic strategies may elicit an unusual number of confabulations and inaccurate details in individuals with ASD.

As the above discussion demonstrates, it is far from clear whether investigative police officers should or should not rely on the CI when interviewing witnesses with ASD. Instead of speculating about this issue, we present here the first evaluation of the CI in the context of eyewitness testimonies of individuals with ASD. In this context, the aim of the proposed study was to compare the eyewitness reports of a video recorded crime of adults with and without ASD and to contrast the effectiveness of a SI and CI in this context. Although our study was primarily exploratory in nature, we did formulate the tentative predictions that (a) individuals with ASD would provide less complete but not less accurate eyewitness reports, and that (b) the cognitive mnemonics would lead to an increase in the reporting of incorrect and confabulated details by the ASD witnesses. We also examined whether accuracy differs for individuals with ASD specifically for details that are well-established in existing CI research; that is those pertaining to Persons, Actions, Surroundings or Objects. This is of value from both theoretical and applied perspectives, and based on the social and binding deficits in ASD, we expected that this group might have lower accuracy for details pertaining to Persons and Actions.

2.4 Method

Participants

Twenty-six individuals with ASD (18 male, 8 female) and 26 typical individuals (18 male, 8 female) took part in this study. Comparison participants were individually matched to the ASD participants within 7 points of Verbal IQ as measured by the WAIS-R or WAIS-III UK (Wechsler, 1997), and groups did not differ on Performance IQ, Full Scale IQ, or age. Thirteen participants from the ASD group and their individually matched comparison were randomly assigned to either the Cognitive Interview (CI) or Structured Interview (SI) conditions, provided that IQ scores and age were similarly distributed across the two conditions. 2 x 2 ANOVAs (Group x Interview) for chronological age, verbal IQ, performance IQ, and full-scale IQ found no significant main effects or interactions. Table 2.1 summarises these data.

Individuals with ASD were diagnosed by clinicians using a range of approaches, and a review of records and/or assessment with the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore & Risi, 1999) confirmed that all met DSM-IV criteria for ASD excluding the requirement for absence of clinically significant delay or abnormality of language development. Clinical diagnoses were checked against the DSM-IV criteria, and diagnoses were accepted only if explicit information on the criteria were present in the letter of diagnosis. The comparison group was recruited from an existing database via local newspaper advertisements and none had a history of neurological or psychiatric illness. Two of the participants with ASD were taking medication for depression, and one was taking an anticonvulsant. Analysis of the data when these participants were removed did not affect the overall pattern of results reported below. Participants were paid standard university fees for their participation.

Table 2.1

Age and IQ scores for the ASD and comparison groups, within each interview condition (standard deviations in parentheses)

	ASD (N = 26)	**Comparison (N= 26)**
Cognitive Interview (N = 26)	(n = 13)	(n = 13)
Age (years)	37.08 (10.97)	44.62 (9.18)
VIQ[a]	109.23 (10.90)	112.08 (13.56)
PIQ[b]	108.23 (16.62)	107.38 (15.00)
FIQ[c]	109.54 (13.29)	110.85 (14.92)
Structured Interview (N = 26)	(n = 13)	(n = 13)
Age (years)	40.54 (13.85)	37.92 (14.08)
VIQ[a]	113.23 (15.43)	112.12 (14.61)
PIQ[b]	110.08 (15.16)	110.77 (15.05)
FIQ[c]	113.23 (16.75)	112.46 (16.61)

a Verbal IQ; b Performance IQ; c Full-scale IQ (WAIS-R UK or WAIS-III UK) (all non-significant)

Materials

A 50 second video clip produced by Surrey Police for police interviewing training purposes was used as the stimulus. The video clip depicted a drug transaction and stabbing in a car park and was rich in quantifiable information relating to Persons, Actions, Surroundings, and Objects.

Each participant was interviewed for their memory of the video clip with either a Structured Interview (SI) or Cognitive Interview (CI). Both SIs and CIs followed the structure recommended by government to professionals who interview witnesses, including that outlined by the *Achieving Best Evidence* guidelines (Home Office, 2002). The SI served as a good control condition as it followed an identical structure to the CI and differed only on the additional CI techniques (see Appendix

2). In order to draw direct comparisons across interview types and in line with Milne et al. (1999), all interviews were structured as: rapport and explain aims, free recall, 'can you remember more?' prompt, questioning, second retrieval attempt, third retrieval attempt, and closure. The CI differed from the SI in use of context reinstatement, instructions to report everything and concentrate hard, reverse order during the second retrieval attempt, and changing the perspective in the third retrieval attempt. These followed the protocols described by Fisher and Geiselman (1992). Interview protocols are given in Appendices 2 and 3.

The first author conducted all of the interviews. She attended a police Cognitive Interview training course run by Surrey Police. Six pilot practice interviews (three SIs and three CIs) were conducted and recordings were checked back to ensure that protocols were being sufficiently followed without bias prior to the study.

Procedure

Participants were tested individually and were naive to the purpose of the study so that they were not primed to remember the video clip knowing they would be tested for recall. They were instructed that they would watch a short clip containing some mild violence and swearing, and would then complete some other unrelated tasks. The video clip was presented on a large projector screen. Each participant was instructed that the researcher was unaware of the contents of the clip and would wait outside the room until the clip had finished. Following presentation of the video clip each participant was taken into a different room (to avoid spontaneous context reinstatement), and completed an unrelated filler task (the Embedded Figures Test: Witkin, Oltman, Raskin & Karp, 1971) lasting around 30 minutes. Both before and after the filler task participants were engaged in conversation with the researcher about events unrelated to the video clip in order to build rapport. They were then interviewed in this second room, with either a SI or CI.

Prior to interviews participants were informed that the purpose of the study was to investigate the best ways that the police and other legal officials might interview eyewitnesses to get the best reports from them, and were instructed to treat the interview as they would a real-life police interview. At the beginning of the interview the participant was reminded that the researcher had not themselves seen the video clip, and that their task was to describe as accurately as possible what they saw from the beginning of the video clip. They were instructed that if they could

not remember certain details not to guess and that it was ok to say that they “don't know” or to correct the interviewer when appropriate.

In the first free recall stage of both interview types participants were asked to describe from the beginning of the video clip what they could remember. In CIs this was preceded by the interviewer spending around ten minutes encouraging the participant to mentally reinstate the context (see Appendix 3), in addition to the instruction to “report all” and “concentrate hard”. In all interviews free recall was uninterrupted by the interviewer until the participant had finished speaking and was waiting for the next instruction, at which point they were asked if they could remember anything else (“remember more” prompt).

Following best interviewing recommendations (e.g., Home Office, 2002) in the questioning phase participants were asked primarily open questions based on what they had said in the free recall phase (e.g., can you tell me anything more about the girl”); closed questions were kept to a minimum and leading and misleading questions were avoided. Where participants had previously referred to them in the free recall phase, questions probed for more details relating to the people involved (Persons), what they did (Actions), where they were (Surroundings), and what objects were present, including cars or packages (Objects), with the aim of both interview types to elicit as much information as possible from the participant. In CIs questioning was imagery-guided and participants were encouraged to activate and probe images of the events in question (e.g., “you said that there was a well-built man. Please can you focus really hard on that image you have of him. When you have a clear image please can you describe him to me?”). In the third and fourth stages of SIs participants were asked to again freely recall what they saw happen from the beginning of the clip. In the third (reverse order) stage of CIs participants were asked what the last thing they saw happen was, and then in as much detail as possible what happened just before that, working backwards until they reported the first thing that they saw happen. In the fourth (change perspective) stage of CIs participants were asked to recall again in as much detail as possible what they saw happen, but this time to imagine that the video had been filmed from above and to recall as if they were looking down on the same events from a birds-eye perspective.

Interview coding

All interviews were audio-recorded, transcribed, and scored against the original transcript of the video clip using a technique developed by Memon et al. (1997). The video was transcribed for each unit of detail that occurred. Any details reported by participants that did not figure in the original transcript but were confirmed as present in the video were added to transcription of the clip to provide an exhaustive list of details. The final video clip transcription contained 419 units of information, and each of these details was coded according to whether it related to a Person (177), Action (116), Surrounding (44), or Object (82).

Each detail reported by the participant was coded against the transcript of the video clip as either correct if it was present in the video, incorrect if it was inconsistent with the video (e.g., "the girl was wearing a red hat" when it was actually white), or confabulated if it was not present in the video (e.g., "another car drove up"). One point was given for each unit of information provided by participants, for example "the Man with long hair (P) had the package (O) in his right hand (A) and ran away from the stockier man (A) with the girl (P)" would be coded as 5 correct points: 2 Person correct, 2 Action correct, and 1 Object Correct. Subjective statements of opinion (e.g., "he looked a bit shifty") were ignored. Details were only scored the first time that they were reported and were classified according to which interview stage they were reported in. Accuracy scores were also calculated by dividing the number of correct details reported by the total number of details reported (i.e. correct + incorrect + confabulated). A second independent rater scored 12 randomly selected interview transcripts (3 in each group x condition) against the video clip transcription and the resulting Person's correlations of the two coders' scores were: $r_{correct} = .93$, $p < .0001$, $r_{incorrect} = .92$, $p < .0001$, $r_{confabulated} = .88$, $p < .0001$.

Statistical analyses

Initially, we examined the data for distribution of normality and outliers. One ASD participant was identified as an outlier due to a high rate of confabulations and low accuracy. Analyses were carried out with and without this participant and findings changed only marginally. For this reason, in line with the diversity inherent in ASD, this participant was included in the analyses. Analyses examined recall in relation to correct, incorrect, and confabulated details, and accuracy scores.

Analyses also examined whether these details related to Persons, Actions, Surroundings, and Objects, and at which interview stage they were recalled between groups and interview types. Interaction effects were explored by means of 2x2 (group x interview) and 2x4 (within interview type: group x interview stage, and group x detail type) factorial ANOVAs, and follow-up *t*-tests were used to test simple effects. Estimates of effect size, Cohen's *d*, are reported.

2.5 Results

In the following analyses there are three major comparisons: across interviews ignoring groups; across groups ignoring interviews; and between groups but within interviews. Findings are reported according to which of these comparisons is being made.

Interview duration and number of questions asked

In order to account for any differences that might arise from a difference in the number of questions asked during the questioning phase a two-way ANOVA was conducted with interview and group as fixed factors. There was no difference in the number of questions asked between groups, F (1, 48) = 1.29, p = .26, or interviews, F (1, 48) = .75, p = .39.

Interview duration was measured from the start of witnesses' first free recall and excluded instructions and cognitive components of CIs. A two-way ANOVA revealed a significant difference in interview duration between interviews F (1, 48) = 21.89, p < .0001. In line with previous findings, CIs were significantly longer (M = 21.69 mins, SD = 7.47) than SIs (M = 13.35, SD = 5.38), which could be attributed to witnesses in the CI taking longer to respond and providing more information; this is not surprising given that the aim of the CI is to elicit more information. There were, however, no differences in interview duration between groups, F (1, 48) = 2.90, p = .10, suggesting any between group differences in recall were not related to interview duration.[1]

[1] Although previous studies (e.g. Wright & Holliday, 2007a; b) have used interview duration as a covariate in analyses, it was deemed that this would have provided a somewhat circular argument for findings in the present study; if witnesses spent more time talking they would naturally come up with more detail.

Did the ASD group differ from the comparison group and was this based on interview type?

A 2 x 2 (group x interview) ANOVA revealed no significant main effects of group for correct, F (1, 48) = 2.26, p = .13, Cohen's d = .41, incorrect, F (1, 48) = 1.76, p = .19, Cohen's d = .37, or confabulated, F (1, 48) = 1.02, p = .32, Cohen's d = .28, details overall. There was however a significant main effect of group for accuracy, F (1, 48) = 5.24, p < .05, Cohen's d = .63; overall the ASD group were significantly less accurate (Mean = .83, SD = .09) than were the comparison group (Mean = .87, SD = .07).

There was also a main effect of interview type. CIs elicited significantly more correct details (Mean = 95.35, SD = 35.54) than SIs did (Mean = 71.08, SD = 18.69), F (1, 48) = 10.09, p < .005, Cohen's d = .88, without eliciting significantly more incorrect, F (1, 48) =1.90, p = .18, Cohen's d = .38, or confabulated details, F (1, 48) = .83, p = .37, Cohen's d = .25, or a reduction in accuracy, F (1, 48) = .06, p = .82, Cohen's d = .07.

There were no group x interview interactions for correct, F (1, 48) = 2.74, p = .10, or confabulated details, F (1, 48) = 1.68, p = .20. There were significant group x interview interactions for incorrect details, F (1, 48) = 4.11, p < .05, and accuracy scores, F (1, 48) = 7.33, p < .05. Follow-up t-tests revealed that when interviewed with CIs, the ASD group reported significantly more incorrect details (Mean = 15.62, SD = 7.19) than did the comparison group (Mean = 10.46, SD = 3.82), t (24) = 2.28, p < .05, Cohen's d = .89. The ASD group were also significantly less accurate (Mean = .80, SD = .09) than were the comparison group (Mean = .90, SD = .05), t (24) = 3.55, p < .005, Cohen's d = 1.39, when interviewed with CIs. Moreover, whilst the comparison group recalled significantly more correct details with CIs compared to SIs, t (24) = 5.19, p < .0001, Cohen's d = 2.04, there was no such increase in reporting of correct details between interview types for the ASD group, t (18) = .86, p = .40, Cohen's d = .34. In fact, the ASD group reported a significantly higher number of incorrect details in the CI compared to the SI, t (24) = 2.21, p < .05, Cohen's d = .87 (see Table 2.2).

When interviewed with SIs, there were no significant differences between groups for correct, t (24) = .12, p = .90, Cohen's d = .05, incorrect, t (24) = .52, p = .61, Cohen's d = .20, or confabulated details, t (24) =.28, p = .78, Cohen's d = .11, or in accuracy scores, t (24) = .30, p = .77, Cohen's d = .12.

Table 2.2

Mean number of correct, incorrect and confabulated details, and accuracy scores for ASD and comparison groups within Structured and Cognitive Interviews (standard deviations are in parentheses)

	Cognitive Interview				Structured Interview			
	Correct	Incorrect	Confab	Accuracy	Correct	Incorrect	Confab	Accuracy
ASD	83.15 (43.32)	15.62[bd] (7.19)	3.00 (4.71)	.80[a] (.09)	71.54 (22.43)	10.38[d] (4.61)	1.23 (2.45)	.86 (.07)
Comp	107.54[c] (20.81)	10.46[b] (3.82)	1.15 (1.52)	.90[a] (.05)	70.62[c] (14.97)	11.46 (5.92)	1.46 (1.71)	.85 (.77)

[a] significant between group difference $p < .005$

[b] significant between group difference $p < .05$

[c] significant between interview difference $p < .005$

[d] significant between interview difference $p < .05$

In order to clarify where the problem lies for the ASD group with the CI, we ran two additional analyses; firstly to look at the types of details that were reported, and secondly to examine whether groups differed between stages of the CI. The main group differences reported earlier were between accuracy and incorrect details. Given that these two types of details are not independent from one another, and accuracy is a more sensitive measure that takes into account incorrect details and confabulations, further analyses were conducted for accuracy scores only.

Accuracy scores were calculated for Person, Action, Surrounding and Object details respectively. A 2 (group) x 2 (interview) x 4 (detail type) ANOVA revealed a significant group x detail type interaction for accuracy, F (3, 144) = 6.69, $p < .001$. There was no interview x detail type interaction, F (3, 144) = 1.41, $p = .24$, or group x interview x detail type interaction, F (3, 144) = .23, $p = .87$. In line with findings reported earlier, there was a significant group x interview interaction, F (1, 48) = 8.91, $p < .005$. Follow-up t-tests showed significant between group differences for accuracy for Person details, t (18) = 3.51, $p < .005$, Cohen's d = 1.35, and Action details, t (14) = 3.66, $p < .005$, Cohen's d = 1.46. Within the comparison group, there

was also a significant difference between interviews for surrounding details, t (24) = 2.22, $p < .05$, Cohen's d = .87 and within SIs there was a significant difference between groups for surrounding details, t (20) = 2.79, $p < .05$, Cohen's d = 1.09 (see Table 2.3).

Table 2.3

Mean accuracy scores for ASD and comparison groups within Structured and Cognitive Interviews for Person, Action, Surrounding and Object details (standard deviations are in parentheses)

	Cognitive Interview				**Structured Interview**			
	Person	Action	Surround	Object	Person	Action	Surround	Object
ASD	.74[a]	.80[a]	.95	.82	.81	.89	.96[b]	.87
	(.11)	(.14)	(.07)	(.09)	(.08)	(.09)	(.07)	(.14)
Comp	.86[a]	.95[a]	.94[c]	.88	.81	.91	.86[bc]	.86
	(.58)	(.39)	(.75)	(.95)	(.12)	(.10)	(.12)	(.11)

[a] significant between group difference $p < .005$

[b] significant between group difference $p < .05$

[c] significant between interview difference $p < .05$

Group differences for accuracy between stages of the CI were examined. A 2 (group) x 2 (interview) x 4 (interview stage) ANOVA did not reveal significant group x stage, F (2, 141) = .52, p = .67, interview x stage, F (2, 141) = .90, p = .42, or group x interview x stage interactions, F (2, 141) = .57, p = .59 (see Table 2.4). Thus the different stages did not affect the ASD and comparison groups differentially. Again there was a group x interview interaction for accuracy, F (1, 47) = 5.94, $p < .05$.

Table 2.4

Mean accuracy scores for ASD and comparison groups within Structured and Cognitive Interviews for interview stages 1, 2, 3 and 4 (standard deviations are in parentheses)

	Cognitive Interview				Structured Interview			
	1	2	3	4	1	2	3	4
	CR	QU	CO	CP	Free recall	QU	Recall 2	Recall 3
ASD	.89[ab] (.09)	.71[ab] (.10)	.71 (.30)	.72[ab] (.27)	.95[b] (.05)	.79[b] (.09)	.89 (16)	.89[b] (.16)
Comp	.95[a] (.03)	.82[a] (.09)	.88 (.19)	.89[a] (.17)	.93 (.07)	.79 (.10)	.88 (.16)	.86 (.21)

[a] significant between group difference $p < .05$

[b] significant between interview difference $p < .05$

2.6 Discussion

This is the first study to investigate the CI for use with ASD individuals. The findings show that people with ASD are as accurate and provide as detailed eyewitness reports as do typical individuals when interviewed with a SI. However, in contrast to typical individuals, not only does the CI fail to increase the number of correct details reported by individuals with ASD, when interviewed with a CI, they report significantly more incorrect details, and are consequently significantly less accurate than their typical counterparts. These findings undoubtedly indicate that investigative professionals should be cautious in relying on the CI to interview witnesses with ASDs.

Compared to typical individuals, individuals with ASD reported significantly more incorrect details that in turn made them significantly less accurate when interviewed with a CI. That these incorrect details pertained to Persons and Actions is not surprising given that ASD is characterised by interpersonal difficulties coupled with difficulties with agent-centred second order representations that are fundamental to understanding actions and actors' intentions over time (e.g., Baron-Cohen, Leslie, & Frith, 1985; Leslie, 1987). The lower accuracy scores for Person

details reported by the ASD group are also not surprising considering the social impairments that characterise ASDs, in addition to difficulties in domains such as face processing (Blair et al., 2002) and gaze perception (e.g., Ashwin, Ricciardelli, & Baron-Cohen, 2009). Indeed previous work using eye-tracking techniques has indicated that ASD individuals spend less time than do typical individuals viewing people and faces in social situations (Mercadante, Macedo, Baptista, Paula, & Schwartzman, 2006; Riby & Hancock, 2009; Riby & Hancock, 2008), and future work would be valuable in utilising these eye tracking techniques to examine the role of directed attention on salient social and person aspects of an event and its effect on subsequent memory recall in an eyewitness paradigm. That the ASD group were significantly more accurate for Surrounding details when interviewed with SIs is not unexpected given that these types of details can be relatively separated from person and action details and might rely on more of a rote memory strategy. The comparison group were significantly more accurate for Surrounding details in CIs compared to SIs, and this again is more of an artefact of the way that the two interviews operate; in the CI, particularly the change perspective stage, witnesses are encouraged to think about this type of detail. Moreover, if ASD witnesses have difficulty with the CI mnemonics, it follows that this interview type will not lead to an increase in accuracy for surrounding details, as is the case for typical individuals.

Findings that the ASD group were significantly less accurate than their typical counterparts at a similar rate on all stages of the CI is also unsurprising given previous work indicating relational processing difficulties in ASD (Bowler & Gaigg, 2008). This account argues that representations of elements of complex events are not marked in a way that enables subsequent retrieval of these elements as an integrated whole. In this context, our findings suggest that the task support hypothesis (Bowler et al., 2004) is useful only up to a point; support is beneficial if clues to the content of the recalled material are provided at test. When clues to the memory process are provided, as in the CI, then overall accuracy is compromised. It is possible that individuals with ASD either do not encode, store, or have difficulty retrieving contextual information surrounding an event in the same way as typical individuals, or that these contextual details are not bound with their memory for details of the event itself; if there is looser item-context binding, then CR would naturally be a less effective cue. Moreover, when asked to mentally reinstate the context and then report the event, not only does CR fail to increase the amount of correct details reported, it also decreases their accuracy by confounding their

original memory leading them to go on to erroneously report incorrect details. This was found despite an explicit warning to only report accurate information and not to guess or fabricate, and may have been further exacerbated by the 'report all' instruction which emphasises quantity, even if seemingly minor, insignificant or partial.

Another possible explanation for these findings relates to the degree to which the crime stimulus was emotionally arousing. Empirical work has demonstrated that whilst typical individuals show reduced forgetting rates for arousing stimuli, this is not so for individuals with ASD (Gaigg & Bowler, 2008). Thus, if emotionally arousing events are forgotten at a higher rate for ASD individuals than is the case for typical individuals, the comparison group would have had a stronger trace on which to base context reinstatement and retrieval in the CI compared to the ASD group. This might explain the between group differences that were present for CIs but not SIs, and future research that controls for the effect of emotionally arousing stimuli would be fruitful. CR appears to present a real problem for witnesses with ASD, as does the 'activate and probe an image' questioning stage, most likely due to the imagery-guided style of questioning which are like a series of mini context reinstatements. Difficulties with the CO stage for the ASD group were also expected considering previous work which has demonstrated diminished temporal order memory in ASD (Bennetto *et al.*, 1996). Although a difference in accuracy at this stage just failed to reach statistical significance (p = .06), findings were in the predicted direction, with lower accuracy for the ASD group relative to the comparison group. Differences in accuracy were, however, statistically significant at the CP stage, which is not surprising given that individuals with ASD are known to have difficulties adopting a frame of reference other than their own and have difficulties on spatial working memory tasks (Minshew et al., 1999; Morris, Rowe, Fox, *et al.*, 1999; Williams, Goldstein, Carpenter & Minshew, 2005; Williams, Goldstein & Minshew, 2006). These findings warrant further clarification in furture research, from both an applied and also a theoretical perspective.

We acknowledge limitiations in the present study; our sample was limited to individuals with ASD who had normal or above normal intellectual functioning; future research would be well placed to examine this with individuals who have developmental delays, or those with co-morbid disorders. The possibility of a floor effect operating for some of the confabulated details is also acknowledged, which

makes any conclusions regarding no between group differences for the confabulated data somewhat tentative. Furthermore, coding (which was in line with previous research, e.g., Memon et al., 1997) did not distinguish between major errors (e.g., the sex of the perpetrator) and minor errors (e.g., the colour of the fence in the background) made by participants, nor the types of correct and incorrect details given in terms of whether they were central versus peripheral to the crime, or whether they were at the gist versus verbatim level. Despite these limitations, our findings strongly suggest that the CI should not be used to interview witnesses with ASD; in real life, the reconstruction of an event based on the testimony of an individual with ASD interviewed with the CI is likely to be inaccurate. Findings highlight a need for further research to examine this in more detail, in addition to an exploration of what the best and most appropriate interviewing strategies for individuals with ASD would be in order to obtain the most forensically relevant information. On a positive note, that the ASD group did not differ from typical individuals when interviewed with a SI is encouraging, and suggests that when interviewed appropriately, are just as valuable as witnesses as are typical individuals.

Chapter 3: Schema-Related Misinformation Effects and Psychometric Correlates with Recall and Suggestibility in ASD

3.1 Overview of Chapter 3

Experiment 1 (Chapter 2) demonstrated that individuals with ASD recall fewer details of a witnessed event and are less accurate than their typical counterparts when interviewed with the CI. It is possible that this is because they qualitatively differ from typical individuals in how they store representations of an event, meaning that the CI may be based on memory principles that simply do not apply in ASD. If this is the case then they might be less susceptible to schema-related misinformation. Schemas involve sequences of actions within particular spatial-temporal contexts, and previous work has demonstrated that typical eyewitnesses often rely on event schema to the detriment of their accuracy, leaving them vulnerable to schema-related post-event misinformation. The aim of Experiment 2 was to examine whether individuals with ASD might also be susceptible to these schema-related misinformation effects. This paper was published as a brief report in the *Journal of Autism and Developmental Disorders* (Maras & Bowler, 2011).

Experiment 3 extended these findings to explore how individuals with ASD score on various measures that are known to correlate with suggestibility, such as state-trait anxiety, depression, fear of negative evaluation, self-esteem, and paranoia. Given the contrasting predictions that can be made regarding the suggestibility of individuals with ASD, coupled with the very limited work to date that has examined this, the purpose of Experiment 3 was to replicate and extend a study by North, Russell and Gudjonsson (2008) using a standardised measure of suggestibility, the Gudjonsson Suggestibility Scales (Gudjonsson, 1997), and examine whether scores on this scale correlate with the psychological trait 'risk factors' in ASD. Experiment 3 is currently under review as a brief report with *Research in Autism Spectrum Disorders* (Maras & Bowler, under review).

3.2 Experiment 2: Schema consistent misinformation effects in eyewitnesses with autism spectrum disorder

3.2.1. Abstract

A number of studies have demonstrated schema-related misinformation effects in typical individuals, but no research to date has examined this with witnesses with autism spectrum disorder (ASD), despite their impaired ability to generate core elements that define everyday events. After witnessing slides depicting a bank robbery, 16 adults with ASD and 16 matched comparison individuals were exposed to post-event misinformation that was either schema typical or atypical. Consistent with previous work, the comparison group went on to report more schema typical misinformation than atypical misinformation. However, so too did the ASD group, suggesting that individuals with ASD do have understanding of the causal links between events, persons and actions, an important finding from both theoretical and applied perspectives.

3.2.2 Introduction

Event schemas are general event representations containing schematically organised knowledge and sequences of actions within particular spatial-temporal contexts; useful in organising information in memory and understanding different events (Schank & Abelson, 1977). However these schemas can have a negative effect such as when eyewitnesses spontaneously use them to aid their memory for a previously witnessed event of a particular type, and erroneously recall typical details even when the details were not actually seen (Holst & Pezdek, 1992).

Schema-related misinformation (e.g., Hekkanen & McEvoy, 2005; Luna & Migueles, 2008; Roediger, Meade & Bergman, 2001) and false memory effects (e.g., Garcia-Bajos & Migueles, 2003; Holst & Pezdek, 1992; Tuckey & Brewer, 2003a, 2003b) have been demonstrated in eyewitness paradigms with typical individuals. However no research to date has examined this with witnesses with high-functioning autism, despite their well-documented difficulties in event memory and memory organisation. Individuals with autism spectrum disorder (ASD) have reduced generalisation and global understanding of the meaning of an event; reduced influence of schematic expectations on spontaneous attention is evidenced

by their slower response in detecting scene unrelated objects (Loth et al., 2008b). They also show reduced generalised event knowledge in narratives (Loveland & Tunali, 1993) and an impaired ability to spontaneously generate core elements defining everyday events including going to a restaurant or the cinema (Volden & Johnson, 1999). The ASD participants in that study were nevertheless able to predict what would happen next in these events when given a number of choices.

The perceptual schema model (Biederman, 1981) and the priming model (Friedman, 1979) both explain the facilitating effect of context in typical individuals by the priming of the presentation of contextual scenes with stored representations of schema-consistent information. Previous research using the cognitive interview (Fisher & Geiselman 1992; Geiselman 1984), which involves the reinstatement of contextual details experienced at the time of encoding, found that this technique not only failed to increase the number of correct details reported by individuals with ASD, but also significantly reduced their accuracy (Maras & Bowler, 2010). It is possible that individuals with ASD qualitatively differ from typical individuals in how they store representations of an event, which would go some way to explaining the damaging effect of this interviewing technique on recall accuracy. However, if indiviuals with ASD rely less on typical schemas to organise event details in memory, they may be less susceptible to schema-related post-event misinformation than are typical individuals. We aimed to examine this possibility by introducing schema typical and atypical post-event misinformation for a previously witnessed bank robbery, an event for which most individuals are likely to have well-established schemas, before examining how witnesses with ASD compare to a typical matched comparison group in subsequently reporting this misinformation erroneously. We predicted that the ASD group would be less susceptible to accepting typical post event misinformation than the comparison group, and that whilst the comparison group would make significantly more schema-typical than atypical intrusions, there would be no such difference in the number of typical versus atypical intrusions made by the ASD group. We also examined participants' free recall for details from the event, and in line with previous research (e.g., Bowler et al., 2000b) predicted that the ASD group would recall significantly fewer correct details than the comparison group.

3.2.3 Method

Participants

Sixteen individuals with ASD (14 male, 2 female) and 16 typical individuals (12 male, 4 female) took part in this study. Comparison participants were individually matched to the ASD participants within 7 points of Verbal IQ as measured by the WAIS-R or WAIS-III UK (Wechsler, 1997), and groups did not differ on Performance IQ, Full Scale IQ, or age. One-way ANOVAs (Group x Interview) for chronological age, verbal IQ, performance IQ, and full-scale IQ found no significant main effects or interactions. Table 3.1 summarises these data.

Individuals with ASD were diagnosed by clinicians using a range of approaches, and a review of records and/or assessment with the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore & Risi, 1999) confirmed that all met DSM-IV criteria for ASD excluding the requirement for absence of clinically significant delay or abnormality of language development. Clinical diagnoses were checked against the DSM-IV criteria, and diagnoses were accepted only if explicit information on the criteria were present in the letter of diagnosis. ASD participants were recruited from autism support groups and societies, and an extended network of adults with ASD via internet forums and advertisements in the Greater London and South East of England area. The comparison group was recruited from an existing database via local newspaper advertisements and none had a history of neurological or psychiatric illness. All participants were native British speakers. Participants were paid standard university fees for their participation.

Table 3.1

Age and IQ scores for the ASD and comparison groups (standard deviations in parentheses)

	ASD (N = 16)	**Comparison (N= 16)**
Age (years)	37.25 (12.59)	45.00 (10.67)
VIQ[a]	110.06 (13.00)	111.38 (15.43)
PIQ[b]	108.31 (13.64)	106.75 (15.43)
FIQ[c]	110.06 (13.65)	110.00 (16.36)

a Verbal IQ; b Performance IQ; c Full-scale IQ (WAIS-R UK or WAIS-III UK) (all non-significant)

Materials

The witnessed event comprised a slide sequence of stills taken from a video of a staged bank robbery previously used by Tuckey and Brewer (2003b). A total of 27 slides (see Appendix 4) were presented on a 17" monitor at a rate of 4 seconds per slide. They depicted two robbers wearing balaclavas approaching and entering a bank. One of the robbers approached the counter and demanded money from a female member of staff. The robber took the money and approached the door of the bank to leave, and as it opened looked up at the camera. Both robbers exited the bank and were seen running away. Misinformation was presented in the form of a mock newspaper extract (see Appendix 5). The extract contained an account of the bank robbery together with some related but irrelevant information (the rise in robberies over the past year in the UK and abroad). The extract also reported ten incorrect details that were not seen in the slides, five of which were schema typical (the robbers stuffed the money into a bag; one was carrying a gun; the customer was forced to the floor; the cashier was forced to put her hands up; one of the robbers kept watch), the other five were schema atypical (they removed their balaclavas; they held the door open for a customer before entering the bank; one the robbers had a can of cola in his hand; the cashier initially laughed at the robbers; one of the robbers poked his tongue out at the CCTV camera). To disguise this misinformation manipulation, we also included details that were correctly reported as having been seen in the slides. Typicality of items was determined by previous normative work (Garcia-Bajos, Migueles & Anderson 2009; Tuckey & Brewer, 2003a; 2003b), and from a small pilot study by the present authors. Items were then rated by a second independent rater who was blind to the first rater's coding. The second rater scored each detail in the final transcription according to whether they were schema typical, atypical, or schema irrelevant. An inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among raters. The inter-rater reliability for the raters was found to be Kappa = .74 ($p < .0001$), 95% CI (.60, .87).

Filler tasks comprised of two questionnaires ('attitudes to crime and punishment'). The recall questionnaire contained 19 questions, ten of which pertained to the misinformation details. The other nine questions were filler questions and were used to again disguise the critical questions (see Appendix 6). Filler questions only referred to information seen in the slide sequence (e.g., "what

was the name of the bank?"), whereas the critical misinformation questions referred to details that were only read in the extract (e.g., "what did the robbers do with the money?" referred to the misinformation "stuffed the money into a bag").

Procedure

Participants were tested individually and informed that they would view a series of still slides taken from a video of a bank robbery before answering some questions relating to their attitudes toward crime and punishment (to maintain the cover story for the experiment and persuade participants that we really were interested in their attitudes to crime and punishment). Following presentation of the slides participants completed one of the filler tasks lasting around 20 minutes.

They were then exposed to misinformation and told they were to read an extract from a newspaper clipping about the bank robbery they had previously viewed slides of. Participants were allowed to read through the narrative at their own pace. Following completion of this and the other filler task (again lasting approx. 20 minutes) participants were given the surprise memory test and asked to write down in as much detail as they could recall everything they could remember from the slides. Participants were explicitly warned at this point to only report what they had seen in the slides. Following free recall, participants were presented with the recall questions and again warned to only answer with information they actually saw in the slides. After each question participants were asked to indicate how confident they were that their answer was correct on a 7-point Likert-scale (1 not at all; 7 very confident).

Free recall coding

Each detail provided by participants in their free recall was coded against the original transcript for the slides as being correct or incorrect, and whether it was schema typical, atypical, or irrelevant. Subjective statements of opinion (e.g., "he looked a bit shifty") were ignored, and details were only scored the first time that they were reported. Accuracy scores were also calculated by dividing the number of correct details reported by the total number of details reported (i.e. correct + incorrect).

Misinformation questions coding

Answers to each of the five typical and five atypical misinformation-related questions were scored as intrusions if the critical item of misinformation was incorporated.

Statistical analyses

Initially, we examined the data for distribution of normality and outliers. Three ASD participants were identified as outliers due to a high rate of correct details, high rate of incorrect details, and low accuracy respectively. Analyses were carried out with and without these participants and findings changed only marginally. For this reason, in line with the diversity inherent in ASD, they were included in the analyses. Analyses examined free recall in relation to correct and incorrect details, and accuracy scores overall, before examining proportions of the incorrect details given in terms of whether they were previously read in the extract or new errors, and whether they were schema typical or atypical. Analyses then examined whether participants erroneously reported details that were only read in the extract (and not seen in the slides) in response to specific questions, and whether these differed depending on whether they were schema typical or atypical. Estimates of effect size, Cohen's *d*, are reported.

3.2.4 Results

Free recall

Accuracy of free recall

Mean numbers of correct and incorrect details recalled by the two groups and their accuracy scores are set out in Table 3.2. Inspection of the means shows that the ASD group recalled fewer correct details but more incorrect details than the comparison group, and also had a lower overall accuracy rate. This impression was confirmed by a one-way ANOVA, which showed that the ASD group were significantly less accurate than the comparison group, F (1, 30) = 7.91, $p < .05$, Cohen's $d = .99$, and that this was indeed reflected by the ASD group reporting significantly fewer correct details, F (1, 30) = 8.02, $p < .05$, Cohen's $d = 1.00$, and marginally significantly more incorrect details, F (1, 30) = 4.02, $p = .054$, Cohen's *d*

= .70 than the comparison group. Thus, the ASD group were significantly worse in terms of both quantity and quality of recall.

Table 3.2

Mean number of correct and incorrect details, and accuracy scores for free recall by ASD and comparison groups (standard deviations are in parentheses)

	Correct[a]	Incorrect[b]	Accuracy[a]
ASD	19.00 (10.37)	2.56 (2.94)	.90 (.10)
Comparison	27.50 (6.04)	1.00 (1.03)	.97 (.03)

[a] significant between group difference $p < .005$; [b] $p = .054$

Source of errors

Read vs. New errors

In order to examine whether, compared to the comparison group, the ASD group were reporting a higher proportion of inaccurate details that they had read in the extract, or whether they were erroneously reporting more new errors not previously read, we conducted a one-way ANOVA with proportions of errors that were for details previously presented in the extract, and proportions of errors for details that were new. These proportions were calculated by dividing by the total number of errors each participant had made. Inspection of the means in Table 3.3 and subsequent ANOVA confirmed that the ASD and comparison group did not differ in the proportion of errors they made for details that they had previously read in the extract. Nor did they differ for the proportion of their errors that were new details that were neither seen in the slides nor presented in the extract, all *F*'s < 1.00, *ns.*

Typical vs. Atypical correct and incorrect details.

We also examined typicality of correct and incorrect details. As can be seen by inspection of the means in Table 3.3, and confirmed by a one-way ANOVA, there was no difference between groups for the proportion of correct details that were typical, F (1, 30) = 1.08, p = .31, Cohen's d = .37, or atypical, F (1, 30) = .02, p = .90, Cohen's d = .04. There was also no difference between groups for the proportion of errors that were typical, F (1, 20) = .31, p = .59, Cohen's d = .23, or atypical, F (1, 20) = .60, p = .45, Cohen's d = .28. A 2 (group: ASD vs. comparison) x 2 (schema: typical vs. atypical) mixed ANOVA did however reveal a main effect of schema typicality, F (1, 20) = 8.87, p < .01, Cohen's d = .94. A significantly higher proportion of errors were for details that were schema typical (Mean = .37, *SD* = .43) than details that were atypical (Mean = .07, *SD* = .14). There was no group x typicality interaction, F (1, 20) = .08, p = .78, indicating that both groups similarly made more schema typical than atypical errors (due to floor effects, we were unable to analyse within read only and new errors for typical and atypical details).

Table 3.3

Mean proportion of errors made in free recall for details that had been previously read in the extract, details that were neither seen in the slides nor read, details that were typical, and details that were atypical for ASD and comparison groups (standard deviations are in parentheses)

	Source of errors			
	Read	New	Schema Typical	Schema Atypical
ASD	.32 (.41)	.68 (.41)	.42 (.42)	.09 (.13)
Comparison	.32 (.46)	.68 (.46)	.32 (.46)	.05 (.15)

Specific questions

Mean numbers of typical and atypical intrusions made in response to the questions by the two groups are set out in Table 3.4. Inspection of the table shows that the ASD and comparison groups both made more typical than atypical intrusions, but the groups did not appear to differ from one another on the number of

intrusions they made for each type. This impression was confirmed by a 2 (group: ASD vs. comparison) x 2 (schema: typical vs. atypical) mixed ANOVA, which revealed a significant main effect of type of intrusions, F (1, 30) = 22.43, p < .001, Cohen's d = 1.27; participants made more typical intrusions (Mean = 1.53, SD = 1.24) than atypical ones (Mean = .28, SD = .63). There was not a significant interaction between typicality of intrusions and group, F (1, 30) = .51, p = .48; the groups were similar in that they made more schema-typical intrusions than they did atypical ones. Next we examined whether confidence differed for typical vs. atypical intrusions, and whether both groups reported these intrusions with similar rates of confidence in the accuracy of their answers. There was no main effect of confidence between typical and atypical intrusions, F (1, 4) = 2.37, p = .20, Cohen's d = .45, nor was there a significant group x typicality interaction for confidence, F (1, 4) = 1.40, p = .30; both groups reported typical and atypical intrusions with similar rates of confidence (see Table 3.4).

Table 3.4

Mean numbers of intrusions made by ASD and comparison groups and mean confidence with which they were made (standard deviations are in parentheses)

	Schema Typical Intrusions		**Schema Atypical Intrusions**	
	Mean intrusions	Mean confidence	Mean intrusions	Mean confidence
ASD	1.75 (1.34)	4.87 (1.47)	.31 (.79)	3.11 (2.83)
Comp	1.31 (1.14)	5.05 (1.54)	.25 (.45)	4.75 (2.22)

3.2.5 Discussion

Our study examined free recall and schema-related misinformation effects in witnesses with ASD. We found that the ASD group recalled fewer correct details and were less accurate than their matched comparison group in their free recall for a previously witnessed event, which is in line with some previous research (e.g.,

Bennetto, Pennington & Rogers, 1996; Bowler et al., 2000a) but inconsistent with others (e.g., Maras & Bowler, 2010; Renner, Kilner & Klinger, 2000). Coupled with previous research showing that individuals with ASD can recall as much and as accurately as typical individuals when support is provided at test (Bowler, Gardiner & Berthollier, 2004), this finding highlights the need for future work to assess effective retrieval strategies for use in investigative eyewitness contexts to increase both the quantity and quality of details that they recall. That the ASD group did not differ from the comparison group in the types of errors that they made (typical, atypical, read, or new) suggests that individuals with ASD are equally likely to erroneously report schema typical details, and are as susceptible to confuse source from a post-event extract as are typical individuals. Both groups made more schema typical than atypical errors, suggesting that individuals with ASD do use existing schemas to aid their memory leading them to erroneously report schema-consistent but inaccurate details.

We also found that both ASD and typical individuals were more likely to go on to report previously presented misinformation that was schema typical than information that was atypical, and that both groups did so with similar rates of confidence. This is at odds with some previous research (e.g., Loveland & Tunali, 1993; Volden & Johnson, 1999), while other work suggests that higher functioning ASD individuals do use event schemas and that this is related to factors such as theory of mind (Loth et al., 2008a). This suggests that individuals with ASD do have some understanding of the causal relationship between events, persons and actions, and previous findings of an impairment for these types of details when interviewed with a cognitive interview (Maras & Bowler, 2010) highlights the necessity for further examination as to why this is.

Our finding of no difference between groups for schema-related intrusions appears to pose problems for the weak central coherence account (WCC, Frith, 1989) in that a local processing style might not necessarily mean global processing impairments and reduced susceptibility to schema-related misinformation effects. However the latest version of the WCC account (Happé & Frith, 2006) argues that individuals with ASD have a detail-focussed cognitive style that does not necessarily lead to a difficulty in 'seeing the bigger picture'. The present study did not specifically assess local versus global processing of details *per se*, and we acknowledge that some of the details may have reflected more global elements central to the event schema (e.g., robbers carrying a gun in a bank robbery), whilst

others may have reflected more local elements not central to the story (e.g., the cashier being forced to stick her hands up). However, a full examination of this was beyond the scope of this paper. We do however acknowledge the limitations of the present study, including the modest sample size, the fact that the sample was restricted to high-functioning individuals with ASD, and the close to ceiling effect for accuracy score for the typical group. It should also be noted that whilst we found no difference between groups in susceptibility to schema-related misinformation, this was essentially for *event* schemas. It is possible that group differences would be present on paradigms that utilise *person* schemas. For example, Greffeuille et al. (2004) found that typical individuals were heavily influenced by stereotypes of a victim when making retrospective evaluations of her behaviour prior to her victimisation. Given that individuals with ASD are known to experience difficulties in ascribing actions, behaviours and intentions to people, it is likely that they may not be as susceptible to making such person schema related errors. This would be a fruitful avenue for future work to explore.

Nevertheless, the present study is the first of its kind to examine schema-related misinformation effects in witnesses with ASD. That they are just as susceptible to these misinformation effects as are typical witnesses is important from both theoretical, in terms of WCC, and applied perspectives. Findings indicate that practitioners should be aware that witnesses with ASD are as susceptible to schema-related misinformation effects as typical witnesses.

3.3 Experiment 3: Psychological trait correlates of suggestibility and compliance in Autism Spectrum Disorder

3.3.1 Abstract

The present study examined interrogative suggestibility and compliance in individuals with autism spectrum disorder (ASD), and whether this is associated with a number of individual difference measures. Adults with ASD and their typical counterparts completed the Gudjonsson Suggestibility Scales (GSS), Gudjonsson Compliance Scale (GCS), and measures of state-trait anxiety, self-esteem, fear of negative evaluation by others, and paranoia. The ASD and comparison groups did not differ on any of the GSS measures, and in contrast to previous research (North, Russell & Gudjonsson, 2008), there was no difference between groups on the GCS, despite the ASD group reporting significantly higher paranoia. Different patterns of correlation were found between the psychological trait measures and compliance within each group.

3.3.2 Introduction

There are several theoretically-based reasons to suspect that, as eyewitnesses, individuals with Autism Spectrum Disorder (ASD) might be more susceptible to suggestive questioning styles than their typical counterparts. For example, their well-documented difficulties in monitoring the source of their memories (e.g., Bennetto et al., 1996; Bowler et al., 2004) imply that if they are less able to monitor where they first encoded details then they might be more susceptible to suggestions pertaining to these details. Moreover, individuals with ASD experience difficulty in consciously recollecting contextual elements of an experience, and instead rely more on feelings of familiarity to guide their memory (e.g., Bowler et al., 2000a). Therefore, a suggested detail that induces feelings of familiarity might be erroneously judged to have occurred in the witnessed event. Finally, individuals with ASD's impaired social skills, which often lead to increased social anxiety (e.g., Kuusikko, Pollock-Wurman, Jussila, Carter, Mattila, et al., 2008), could make them more predisposed towards compliance and a desire to please the interviewer.

On the other hand, one could also predict that individuals with ASD might actually be less suggestible than their typical counterparts. Their social difficulties,

for example, could make them less likely to pick up on the subtleties of the questioner's intent. Bowler and Worley (1994) utilised Asch's (1951) line judgement task in examining susceptibility to social influence in adults with ASD. The ASD group gave more correct answers in the line judgment task than their typical counterparts, indicating less inclination to conform to social influence (however this difference was not statistically significant, possibly because of the very small sample size used). Bowler and Worley also noted that ASD participants were more likely to adopt a consistently conforming or non-conforming strategy, and were less likely to make eye contact, communicate with the confederates or comment on the task. Furthermore, the ASD group were more likely to describe the experiment as a line-judgement task than their typical counterparts were (who indicated at least some suspicion as to the real purpose of the study), indicating that they were less influenced by social conformity factors. Moreover, a tendency towards a more local processing style (rather than seeing 'the bigger picture') can often, particularly in higher functioning individuals, lead to an intact rote memory with memorization of facts without necessarily understanding the relationships among them (e.g., Happé & Frith, 2006). Taken together with findings of diminished utilization of the semantic or associative relatedness between items to aid their recall (Bowler, Gaigg & Gardiner, 2008a, 2008b), witnesses with ASD might be less inclined to 'fill in the gaps' with semantically related, but inaccurate, details. However, previous work (Maras & Bowler, 2011) has demonstrated that witnesses with ASD are no less likely than their typical counterparts to incorporate post-event misinformation from an extract into their subsequent reports if it fits with their existing schema for that type of event. An important question remains as to whether individuals with ASD are equally, or more, susceptible to suggestive *questioning styles* that suggest the desired answer in the question; if suggestions give rise to feelings of familiarity these might in turn be falsely attributed to actual memories.

A number of psychological measures are known to correlate with suggestibility and compliance in typical individuals. These include state and trait anxiety (e.g., Wolfradt, Meyer, 1998, but see Ridley & Clifford, 2004), lower self-esteem (e.g., Gudjonsson, Sigurdsson, Brynjólfsdóttir & Hreinsdóttir, 2002) fear of negative evaluation by others (e.g., Wright, London & Waechter, 2010), and paranoia (see Gudjonsson et al, 2002). Since individuals with ASD tend to score higher on these measures (e.g., Blackshaw, Kinderman, Hare & Hatton, 2001; Green, Gilchrist, Burton & Cox, 2000; Kuusikko, Pollock-Wurman, Jussila, Carter,

Mattila et al., 2008), it follows that they may well be more suggestible to certain types of questioning. North, Russell and Gudjonsson (2008) tested this notion using the Gudjonsson Suggestibility Scales (GSS, Gudjonsson, 1997).

The GSS (version 1 and its parallel GSS 2) form a standardised measure of suggestibility for a previously heard narrative. Participants are asked a set of leading questions twice; the first time indicates how much they *Yield* to leading questions, and the second time indicates how much they *Shift* their responses after being given negative feedback about their first response. Alongside the GSS is the Gudjonsson Compliance Scale (GCS, Gudjonsson, 1997), which is a self-reported measure of *compliance* thought to reflect an eagerness to please and avoid conflict and confrontation. This differs from suggestibility in that an individual who scores highly on compliance might consciously go along with suggestions even though privately they do not agree with them, largely in order to please others or avoid conflict or confrontation (Gudjonsson & Clark, 1986). North et al. (2008) administered the GSS, GCS, and four psychological trait measures to assess anxiety and depression, fear of negative evaluation or reactions by others, and paranoia to 26 adults with ASD and 27 gender- and IQ-matched typical comparisons. Although the ASD group were susceptible to many of the risk factors for increased suggestibility, with higher scores on all of the psychological trait measures, they did not differ from their comparisons on any of the GSS measures. North et al. suggested that they were not able, or willing, to shift their responses following negative feedback, a view that sits nicely within an executive functioning account of ASD (e.g., Ozonoff et al., 1991). Alternatively, North et al. suggested that the ASD group failed to recognise that the motivations or intentions of the interviewer were to elicit a different response by providing negative feedback, as would be predicted by the theory of mind deficit hypothesis of ASD (e.g., Baron-Cohen et al., 1985). However, the ASD group did score significantly higher on the GCS, indicating that they may be more eager to please or to avoid conflict and confrontation, thus making them more prone to respond compliantly to the requests and demands of the interviewer.

North et al. concluded that individuals with ASD might be more vulnerable to accept an interviewer's suggestions in an interrogative interview than people from the general population, even if they do not hold this information as actually being true. Moreover, this higher compliance might make them more susceptible to exploitation by others and be more at risk of bowing to pressure to commit offences. This has important practical implications and warrants replication. Therefore the

purpose of the present experiment was to extend the findings of North et al. (2008) with a different sample of participants and using different psychological measures. Since individuals with ASD tend to score lower on measures of self-esteem (e.g., Williamson, Craig & Slinger, 2008), and low self-esteem has been shown to correlate with suggestibility (e.g., Baxter, Jackson & Bain, 2003) this was included as an additional measure. In line with North et al. (2008), we predicted that the ASD and comparison groups would not differ on any of the GSS scores, but that the ASD group would score significantly higher on the GCS measuring compliance, in addition to scoring higher on state-trait anxiety, paranoia, fear of negative evaluation, and significantly lower on self-esteem.

3.3.3 Method

Participants

Participants were tested on an ongoing basis alongside participation in other unrelated tasks. Thirty-two participants with ASD (24 male and 8 female) and 30 non-ASD typical participants (22 male and 8 female) took part in total. However, due to time limitations and the rolling nature of ongoing participation on an opportunistic basis, not all participants completed all of the measures (see materials and procedure section below). Individuals with ASD were diagnosed by clinicians using a range of approaches, and a review of records and/or assessment with the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore & Risi, 1999) confirmed that all met DSM-IV criteria for ASD excluding the requirement for absence of clinically significant delay or abnormality of language development. Clinical diagnoses were checked against the DSM-IV criteria, and diagnoses were accepted only if explicit information on the criteria were present in the letter of diagnosis. The comparison group was recruited from an existing database via local newspaper advertisements and none had a history of neurological or psychiatric illness. Groups did not differ on age, verbal IQ, performance IQ, or full-scale IQ as measured by the WAIS-R or WAIS-III UK (Wechsler, 1997). Table 3.5 summarises these data. Participants were paid standard university fees for their participation.

Table 3.5

Age and IQ scores for the ASD and comparison groups (standard deviations in parentheses)

	ASD (N = 32)	**Comparison (N= 30)**
Age (years)	39.44 (12.35)	42.03 (12.45)
VIQ[a]	112.87 (14.38)	109.47 (14.39)
PIQ[b]	110.42 (16.38)	104.70 (14.73)
FIQ[c]	113.00 (15.86)	107.93 (15.13)

a Verbal IQ; b Performance IQ; c Full-scale IQ (WAIS-R UK or WAIS-III UK) (all non-significant)

Materials and procedure

Participants were tested individually at City University London on the basis that they were visiting to take part in other (unrelated) tasks. All participants who had time permitting completed the following measures in same order:

The State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983) is composed of two 20-item questionnaires. Each item (e.g., "I feel calm") gives four possible responses depending on how much the participant agrees that each statement applies to them. One questionnaire asks participants to answer based on how they feel at that given moment in time, to give a *state* anxiety score, and the other questionnaire requires participants to answer based on how they feel in general, to give a *trait* anxiety score. Higher scores represent higher levels of reported anxiety (n ASD = 31; n comparison = 28).

The Rosenberg Self-Esteem Scale (Rosenberg, 1965) is a 10-item scale. Items (e.g., "on the whole, I am satisfied with myself") are answered on a four-point scale, with higher scores representing higher levels of reported self-esteem (n ASD = 30; n Comparison = 27).

The Brief Fear of Negative Evaluation Scale (Leary, 1983) is a 12-item scale. Items (e.g., "I am afraid that people will find fault with me") are answered on a five-

point scale, with higher scores representing higher fear of negative evaluation by others (n ASD = 31; n comparison = 27).

The Paranoia Scale (Feningstein & Vanable, 1992) is a 20-item scale. Items (e.g., “it is safer to trust no one”) are answered on a five point scale, with higher scores representing higher paranoia (n ASD = 31; n comparison = 27).

The self-reported version of the *GCS* (Form D, Gudjonsson, 1997) is a 20-item (e.g., “I give in easily when I am pressured”) true/false questionnaire, with higher scores representing higher reported compliance (n ASD = 28; n comparison = 26).

The GSS 2 (Gudjonsson, 1997) involves participants listening to an audio narrative lasting approximately two minutes (see Appendix 7), before immediately recalling everything that they can remember. This gives ‘immediate recall’ scores, for the number of *correct* details they report, in addition to the number of *distortions* (i.e. incorrect reporting of details that were present), *fabrications* (reporting of details that were not present at all), and total *confabulations* (the sum of the number of distortions and fabrications). Following this free recall they are asked 20 questions, 15 of which are leading in that they suggest an incorrect desired answer in the question (Appendix 7). Participants are scored one point for each leading question that they acquiesce to in their answers, giving a *Yield 1* score. The participant then receives interrogative pressure in the form of negative feedback regardless of their actual performance, before answering the 20 questions again to give a *Yield 2* score. A *Shift* score is calculated as the number of times that the participant shifts their answer when asked a second time around, irrespective of whether this change is towards or away from accuracy. A *total suggestibility* score is calculated from the sum of Yield 1 and Shift. Participants’ completed the GSS 2 only if it was not preceded by other memory tasks (n ASD = 20; n comparison = 19), and their free recall and responses to questions were audio-recorded. The GSS 2 and GCS were administered and scored in line with the Gudjonsson (1997) Suggestibility Scales Manual, which has clear scoring criteria and guidelines. Following North et al. (2008), we administered the GSS 2 for immediate recall.

3.3.4 Results

An examination of the Shapiro-Wilk statistic revealed that a number of the variables significantly violated assumptions of normality: state anxiety, W (37) = .89, p < .001; self-esteem, W (37) = .93, p < .05; GSS distortions, W (37) = .88, p < .001; fabrications, W (37) = .66, p < .001; total confabulations, W (37) = .88, p < .001; Yield 1, W (37) = .82, p < .001; Yield 2, W (37) = .87, p < .001; Shift, W (37) = .84, p < .001; and total suggestibility, W (37) = .85, p < .001. The non-parametric Mann-Whitney test was used in place of t tests to examine differences between groups on each of the measures. Bonferroni corrections were applied for multiple comparisons, so all effects are reported at a .004 level of significance. There were no differences between the ASD and comparison groups on the psychological measures of state anxiety (U = 324.5, p = .10, Cohen's d = .54[2]), self-esteem (U = 358, p = .45, Cohen's d = .25), or fear of negative evaluation (U = 313, p = .10, Cohen's d = .53). However the ASD group scored significantly higher than the comparison group on the paranoia measure (U = 213.5, p < .001, Cohen's d = .96) and marginally significantly higher on trait anxiety (U = 268.5, p = .01, Cohen's d = .66).

There were no differences between groups on any of the GSS measures; free recall (U = 157.5, p = .51, Cohen's d = .26), distortions (U = 162, p = .59, Cohen's d = .22), fabrications (U = 133.5, p =.14, Cohen's d = .34), total confabulations (U = 144.5, p = .29, Cohen's d = .37), Yield 1 (U = 160, p = .39, Cohen's d = .13), Yield 2 (U = 160, p = .40, Cohen's d = .29), Shift (U = 158.5, p = .37, Cohen's d = .38), or total suggestibility (U = 145.5, p = .21, Cohen's d = .33). Groups also did not differ on the GCS measure of compliance (U = 308.5, p = .34, Cohen's d = .25). These data are summarised in Table 3.6.

[2] Cohen's *d* scores were calculated by means and standard deviations of the sample

Table 3.6

Central tendency for each of the measures for the ASD and comparison groups

	Mean(standard deviation)		**Median (range)**	
	ASD	Comp	ASD	Comp
State Anxiety	39.19 (13.82)	33.04 (8.55)	37.00 (20-72)	33.00 (20-53)
Trait Anxiety	49.81 (11.50)	42.29 (11.33)	49.00 (27-71)	42.00 (26-65)
Self-Esteem	19.40 (6.18)	20.85 (5.24)	20.00 (8-28)	22.00 (6-28)
Fear of Negative Evaluation	26.26 (11.76)	21.00 (7.74)	26.00 (7-48)	21.00 (7-40)
Paranoia**	29.90 (15.25)	17.33 (10.56)	30.00 (3-63)	16.00 (3-39)
GSS Recall	20.70 (7.02)	22.36 (5.58)	22.00 (5-33)	23.00 (13-30)
GSS Distortions	2.05 (1.76)	1.69 (1.51)	2.00 (0-6)	1.50 (0-6)
GSS Fabrications	1.10 (1.41)	.67 (1.13)	1.00 (0-6)	0 (0-4)
GSS Total Confabulations	3.15 (2.30)	2.33 (2.17)	2.50 (0-8)	2 (0-9)
Yield 1	3.05 (3.02)	2.63 (3.44)	2.50 (0-11)	1 (0-10)
Yield 2	5.60 (4.39)	4.32 (4.49)	4.50 (0-12)	3 (0-14)
Shift	4.60 (3.72)	3.32 (3.00)	2.50 (1-12)	2 (0-11)
GSS Total Suggestibility	8.10 (6.30)	6.00 (6.33)	6.00 (1-21)	4 (0-20)
GCS Compliance	9.29 (4.33)	8.27 (3.91)	9.50 (1-18)	8 (2-17)

** p <.004

In order to examine whether each of the psychological measures correlated with the suggestibility and compliance measures for both ASD and comparison groups, we calculated Spearman's rho correlation coefficients for each of these separately for ASD and comparison participants. As can been seen in Table 3.7, paranoia was the only measure to correlate with any of the GSS suggestibility measures for both the ASD and comparison groups. However a different pattern emerged for the GCS measure of compliance; GCS scores correlated with state anxiety and fear of negative evaluation by others for the ASD group, whilst for the comparison group GCS scores correlated with trait anxiety, self-esteem, and fear of negative evaluation.

Table 3.7

Correlations of the GSS measures of Yield 1, Yield 2, Shift, and total suggestibility, and the GCS measure of compliance, with each of the psychological measures separately for the ASD and comparison groups

	ASD					**Comparison**				
Psych Measure	Yield 1	Yield 2	Shift	Total Suggest	GCS	Yield 1	Yield 2	Shift	Total Suggest	GCS
State Anxiety	.21	.20	.24	.24	**.53****	.20	.42	.39	.34	.39
Trait Anxiety	-.04	-.04	.14	.02	.28	.49	.47	.42	.45	**.48****
Self-esteem	.26	.23	-.01	.13	-.25	-.34	-.18	-.23	-.29	**-.47****
Fear of Neg Eval	.00	-.02	.01	.04	**.45****	.32	.50	.35	.39	**.52****
Paranoia	.21	**.55****	.49	.52	.06	**.69****	.52	.53	**.66****	.33

All tests are one one-tailed directional tests, ** p <.004

Given that the ASD group scored significantly higher on the paranoia scale, and that their scores on this scale were significantly associated with their Yield 2 GSS suggestibility scores, it is surprising that they were no more suggestible than their typical counterparts. However there was a much larger range in paranoia scores for the ASD group (3-63) than the comparison group (3-39). We ran a scatter plot in order to examine whether it was a few particularly high paranoia-scoring individuals with ASD who subsequently had high Yield 2 scores; leaving the rest of the ASD group with relatively low paranoia and low Yield 2 scores. This notion is supported by inspection of the scatter plot in Figure 3.1.

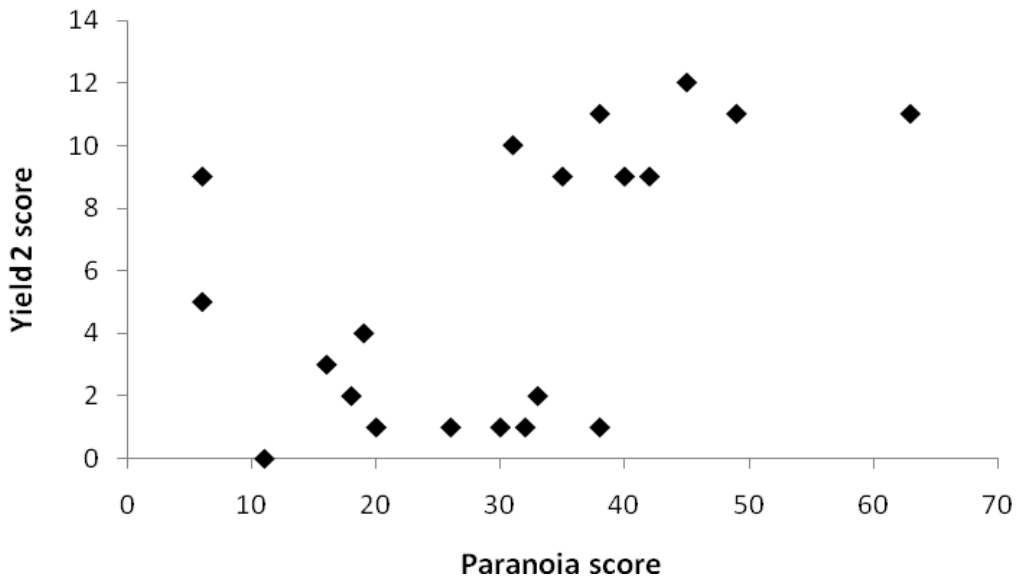

Figure 3.1

Scatter plot showing the relationship between paranoia scores and Yield 2 scores for the ASD group

3.3.5 Discussion

The aim of the present study was to replicate and extend findings from North et al. (2008) to examine whether adults with ASD were more suggestible than their

typical counterparts, and whether their suggestibility and compliance scores were predicted by a number of psychological measures. In line with North et al. (2008), the ASD and comparison groups did not differ on any of the GSS memory or suggestibility measures. This is not surprising given that individuals with ASD have difficulty understanding other peoples' knowledge and beliefs; yielding to leading questions or an increase in response change might indicate that they understood the motivational desires of the questioner. Moreover, given that memory recall correlates with suggestibility, with individuals with impaired intellectual functioning being more suggestible (e.g., Clare & Gudjonsson, 1993), it is possible that because the high-functioning group included in the present study's recall memory was good they were able to use this to resist suggestive questioning styles. Future work should extend these findings to see how lower-functioning individuals with ASD perform on the GSS, and whether this differs from their IQ-matched non-ASD comparisons; based on the reasoning just described they might actually be less suggestible.

Also in line with North et al. was the finding that the ASD group scored significantly higher on self-reported paranoia (and marginally significantly higher on trait anxiety), which is unsurprising considering the social and change-coping difficulties that individuals with ASD face throughout their lives (e.g., Gillott & Standen, 2007). However, there were a number of discrepancies between the present findings and those of North et al. Firstly, we failed to find a difference between groups on the fear of negative evaluation scale (although it should be noted that the non-significant difference was in the same direction as that found by North et al). Secondly, we found no difference between the groups on the GCS measure of compliance (although again it should be noted that the ASD group did score non-significantly higher on this measure).

It is possible that the equivalent scores between groups on the state anxiety and fear of negative evaluation scales offset higher compliance scores in our ASD group. However, it is important to consider the methodological limitations of the current study and the heterogeneity of ASD when considering such conclusions. We did consider the possibility that the large range of scores on a number of the psychological trait measures were due to the same minority of participants with ASD being high-scorers of on most of the self-report measures, but this turned out not to be the case; a number of different individuals had high scores on one measure but normal scores on others. There is also the issue of self-selecting bias in the

recruitment of our participants; it is possible that individuals with ASD who volunteer for research are more able to cope with the day-to-day demands of everyday life and have lower anxiety, higher self-esteem and fear negative evaluation less than the ASD population in general (hence the lack of difference on these measures between groups). This might have led to their comparable reported compliance to the comparison group.

More paranoid individuals tend to demonstrate less compliance because of a lack of interpersonal trust (e.g., Gudjonsson & Clark, 1986, but see Gudjonsson et al., 2002). Thus it is also possible that the higher paranoia scores by the ASD group could have countered any compliant tendencies that they might have had (however this explanation should be considered with caution given that we failed to find a correlation between paranoia and compliance in the present study). Alternatively the current findings may stand, and individuals with ASD are in fact no more compliant than their typical counterparts. Lemanek, Stone and Fishel (1993) reported that, in a parent-child behavioural context, children with ASD were actually *less* compliant than their non-ASD peers. The forensic implications of these discrepant findings clearly warrant further clarification.

Given that the ASD group scored significantly higher on the paranoia scale, and that their scores on this scale were significantly associated with their Yield 2 GSS suggestibility scores, it is at first glance somewhat surprising that they were no more suggestible on the Yield 2 than their typical counterparts. However as noted in the results section this might be due to a relative split in the data, with a few particularly high paranoia-scoring individuals with ASD who had high suggestibility scores, and the rest of the ASD group who had low paranoia scores and were equally or even less suggestible than their typical comparisons. Moreover, the Paranoia scale was designed to measure trait suspiciousness and tendencies to mistrust others (Feningstein & Vanable, 1992), but in ASD participants it might have been measuring something different, such as a very literal cognitive style. Incidentally it was noted during testing that a number of ASD participants made comments such as “well of course I sometimes feel as if I’m being followed; there’s CCTV cameras following your every move in the towns and cities”, or “if you think about it adverts are always trying to influence your mind; they want you to like and buy their products!” In other words, it is possible that the ASD participants simply took each statement very literally rather than answering based on how suspicious they actually were. Research exploring this notion is sparse and warrants

clarification, although Blackshaw et al. (2001) have suggested that increased paranoia in ASD may be related to concerns of threat from others, which stems from a confusion or perplexity about social rules. Either way, from a forensic perspective, our findings indicate that individuals with ASD are as suggestible as their typical counterparts, and that their suggestibility to yield to leading questions when asked a second time is associated with this measure of paranoia but not with other psychological trait measures, such as anxiety, which are known to correlate with suggestibility in typical individuals.

To conclude, findings from the present study suggest that individuals with ASD are as suggestible and compliant as their typical counterparts, but their suggestibility and compliance cannot be predicted by the same psychological trait measures as for typical individuals. Future work is needed to confirm that individuals with ASD are not more compliant than their typical counterparts, and extend these findings to examine whether suggestibility and compliance in ASD can be more reliably predicted by other psychological trait variables.

Chapter 4: Memory for emotionally arousing events over time by individuals with autism spectrum disorder

4.1 Overview of Chapter 4

One of the principles of the CI is that memories are stored as a series of interconnected nodes, so a single memory can be triggered in a number of different ways. Experiments 2 and 3 demonstrated that individuals with ASD rely on top-down processes to the detriment of their memory accuracy similarly to typical individuals. This suggests that they do generalise events and form associations between details, implying that the CI is not ineffective because event details are not triggered through associations with other details (such as contextual details in the case of the context reinstatement component of the CI).

An alternative explanation for the CI's ineffectiveness is that emotionally significant events are differentially modulated with memory in ASD. Experiment 1 found that, following a 30 minute to one hour delay, when interviewed with the CI the ASD group were less accurate and recalled fewer details of a previously witnessed video of a stabbing than their typical counterparts. Previous research shows that emotionally arousing events are forgotten less over time than neutral events by typical individuals. Since ASD is characterised by difficulties in processing emotional information it is possible that some of these details for the (presumably arousing) video may have been forgotten by the ASD group, whilst they were maintained by the typical group. It may be that the SI lacked enough cues to detect this, whilst the CI, with its instructions to "report all" combined with context reinstatement, leads to this increased forgetting rate by the ASD group compared to comparisons to become apparent. Experiment 4 explored this notion by testing recall rates of an emotionally arousing event compared to a neutral event over increasing time delays. This experiment forms part of a two-experiment paper that is currently in press with *Emotion* (Maras, Gaigg & Bowler, in press). The other experiment of this paper was carried out by a colleague and is not reported here.

4.2 Abstract

Emotionally arousing events are typically better remembered and more resistant to forgetting than neutral events. Findings from word list paradigms suggest that this may not hold for individuals with Autism Spectrum Disorder (ASD), who also tend to be less accurate as eyewitnesses under some circumstances. To test whether attenuated effects of arousal on memory may be responsible for poorer eyewitness testimonies in ASD, we asked adults with and without the disorder to view either arousing or neutral versions of a video clip before assessing their memory for the material. Both groups exhibited increases in psychophysiological arousal during the arousing as compared to the neutral version of the video, and both groups also demonstrated a memory advantage for the arousing event. Contrary to predictions, these observations indicate that stimulus induced arousal modulates memory for naturalistic events relatively typically in ASD.

4.3 Introduction

It is now well established that emotionally arousing events are better remembered and less likely forgotten than equivalent neutral events (e.g., Bornstein, Liebel, & Scarberry, 1998; Christianson & Loftus, 1991; Christianson, 1992; Heuer & Resiberg, 1990). Witnessed criminal events are often emotionally arousing, and witnesses can be asked by the police and other legal officials to recall what they have seen on a number of occasions, ranging from immediately after witnessing the event to days, months, or even years later. Maras and Bowler (2010) recently found that individuals with Autism Spectrum Disorder (ASD) were significantly less accurate in their eyewitness reports for a negative emotional event than comparison individuals when interviewed with a Cognitive Interview (Fisher & Geiselman, 1992). Here we ask whether the inaccuracies in eyewitness reports in ASD may be the result of abnormalities in the way that the emotional nature of criminal events modulates memory in this disorder.

Autism Spectrum Disorder is a set of pervasive developmental conditions that are clinically defined by abnormalities in reciprocal social and communicative behaviours and an inflexible adherence to routinised patterns of thought and behaviour (American Psychiatric Association, 2000). ASD affects approximately 1%

of the population but a number of risk factors indicate that individuals with ASD may be over-represented within the Criminal Justice System either as witnesses or victims of crime (Hare, Gould, Mills & Wing, 1999; Petersilia, 2001). For example their diminished insight into what others are thinking can lead to exploitation by others (Howlin, 1997) and their repetitive and stereotyped interests can lead them to frequent places (e.g., train stations) where crimes are more common (Allen et al., 2008). This literature indicates an overwhelming need for research to examine eyewitness testimony in ASD, particularly because the very sparse work in this area to date suggests that individuals with ASD recall a previously witnessed event less completely and/or less accurately than comparison groups (Maras & Bowler, 2010, 2011; McCrory et al., 2007).

The defining reciprocal social impairments of ASD are *inter alia* characterised by difficulties with emotion related processes such as understanding, empathising and reciprocating emotional expressions in others (e.g., Dawson, Hill, Spencer & Galpert, 1990; Hobson, 2002; Kasari, Sigman, Mundy, & Yirmiya, 1990). It is therefore possible that people with ASD do not exhibit the same memory advantage for arousing as compared to neutral events as typical participants do, thus contributing to the poorer eyewitness testimonies in this disorder. To date, only four studies have examined whether individuals with ASD exhibit a typical memory advantage for emotionally significant information and the results from these are rather mixed. Beversdorf and colleagues (Beversdorf et al., 1998) found that high-functioning adults with ASD did not show enhanced memory for emotionally charged compared to neutral sentences like typically developed adults do. Similarly Deruelle et al. (2008) reported no effect of emotional content on memory in an ASD group when positive, negative and neutral images were used as stimuli. By contrast, South and colleagues (South, Ozonoff, Suchy, Kesner, McMahon, et al. 2008) found no differences between individuals with and without ASD in terms of their enhanced memory for emotionally salient as compared to neutral words. Finally, Gaigg and Bowler (2008) also failed to note differences between ASD and comparison individuals when assessing memory for emotionally charged and neutral words on an immediate test of memory. However, when these authors assessed memory again following a 1-hour and 1-day delay, the advantage for emotional material had faded for the ASD group whilst it had increased for the typical comparison group.

Together the evidence concerning memory for emotional material in ASD would seem to suggest that the emotional nature of witnessed events (e.g., accidents or crimes) may not enhance the memory of witnesses with ASD as

reliably as that of typical witnesses, particularly if memory for the event is probed following long delays. What may further exacerbate poor eyewitness testimonials in ASD is the possibility that witnessed events do not elicit the same kind of emotional responses in this disorder in the first place, thus altering not only *how* the event is encoded into memory but also *what* is attended to and hence encoded. We use the term 'arousal' here to encompass an affective response to stimuli as demonstrated by a change in physiological activity (e.g., an increase or decrease in heart rate) and/or subjective appraisals of arousal for the stimuli (see Andrew, 1974 for a review). Again, the evidence in relation to this issue is somewhat mixed. On the one hand, several studies indicate that individuals with ASD exhibit relatively typical psychophysiological responses, such as increases in Galvanic Skin Responses, to emotionally salient stimuli (e.g., Ben Shalom et al., 2003; Gaigg & Bowler, 2008; Salmond, de Haan, Friston, Gadian, Vargha-Khadem et al., 2003), which would suggest that they may orient relatively typically toward emotionally salient events. On the other hand, there are also reports of differences in the emotional responses of individuals with ASD (Ben Shalom et al., 2003; Blair, 1999; Bölte, Feineis-Matthews & Poustka, 2008) particularly when witnessing others in distress (Corona, Dissanayake, Arbelle, Wellington & Sigman, 1998). Moreover, there is considerable behavioural evidence that emotionally salient information does not capture the attention of individuals with ASD typically (Ashwin, Wheelwright & Baron-Cohen, 2006; Corden, Chilvers & Skuse, 2008; Gaigg & Bowler, 2009; but see South et al., 2008) and that they spend less time attending to people's faces when viewing complex social scenes (Klin, Jones, Schultz, Volkmar & Cohen, 2002a), which is particularly relevant to eyewitness reports (see Maras & Bowler, 2010). Thus, differences in how individuals with ASD respond and attend to emotional information may compound, or even be responsible for, atypicalities in how witnessed events are encoded and later retrieved from memory.

In order to test the prediction that memory is atypically modulated by emotional factors in ASD, we drew on and modified experimental paradigms developed by Heuer and Reisberg (1990) and Bornstein et al. (1998), which involves presenting participants with an event that is either entirely neutral or includes an emotionally salient event (in this case a man being shot). Memory for the event is assessed three times: immediately, following a one hour delay, and again one day later. It is consistently found that memory for the emotional event in such paradigms is enhanced (see Reisberg & Heuer, 2004 for a review).

Furthermore, to ascertain whether individuals with ASD exhibit atypical emotional responses to relevant events, Heart Rate was monitored whilst participants viewed the video clip.

4.4 Method

Participants

Twenty-four individuals with a diagnosis of ASD (20 male; 4 female) and 24 typically developed comparison individuals (17 male; 7 female) took part in this experiment. ASD participants were diagnosed according to DSM-IV criteria (American Psychiatric Association, 2000) by experienced clinicians. Scores on the ADOS Communication (range = 1-5, mean = 2.71, SD= 1.45; cut off = 2) and Reciprocal Social Interaction subscales (3-12, mean = 7.23, SD = 2.79; cut off = 4) were available for 22 of the 24 ASD participants and these were largely in line with the independent clinical diagnosis from health professionals in the UK. Two participants did not meet the research cut off for the combined ADOS score of 7 (one participant because they failed to reach the Communication cut off, and one because they failed to reach the reciprocal social interaction cut off). Since clinical records were available to confirm their diagnosis we retained these participants in all analyses. Similarly the two ASD participants for whom no ADOS observations were available had a clear clinical statement of their diagnosis and were therefore also retained in the analysis.

Comparison participants were all in good health and reported no family history of psychiatric or neurological illness. Participants were randomly allocated to either the 'Arousing' or 'Neutral' clip version of the experiment, with the constraint that all sub-groups were matched in terms of chronological age and Wechsler Full-Scale IQ. Table 4.1 provides relevant psychometric data for participants as a function of experimental condition. There were no differences between groups or arousal conditions, or group x arousal interactions for the measures of IQ or age (all Fs < .59, ps >.68).

Table 4.1

Age and IQ scores for the ASD and comparison groups, within each arousal condition (standard deviations in parentheses)

Condition (Clip version)	ASD (N = 24)	Comparison (N= 24)
Arousing (N = 24)	(n = 12)	(n = 12)
Age (years)	40.00 (11.98)	43.33 (10.40)
Verbal IQ	111.67 (13.77)	109.92 (14.90)
Performance IQ	105.75 (14.83)	109.00 (15.27)
Full-scale IQ	109.92 (15.14)	110.33 (15.92)
Neutral (N = 24)	(n = 12)	(n = 12)
Age (years)	41.00 (12.55)	43.25 (14.40)
Verbal IQ	114.18 (9.42)	111.33 (14.47)
Performance IQ	109. 91 (15.28)	106.42 (10.64)
Full-scale IQ	113.64 (11.27)	109.83 (13.66)

Materials

Participants viewed a short scene from a certificate 15 rated film (UK accreditation) that had already been successfully used for a similar purpose in previous work (Bornstein et al, 1998). Both versions were set in a graveyard and began by showing a kneeling man laying flowers on a grave and a priest walking around the graveyard. The middle segment then began and differentiated the emotional and neutral versions of the film. In the emotional version a male protagonist approached, pulled a gun from his cloak and shot the man who was kneeling down in the back of the head. He then aimed the gun at the priest who was watching before backing slowly away. The neutral version contained the same characters in the same setting but the plot concentrated on non-violent events that focused on the priest, who in this version was going about his business without witnessing the crime. Both versions then concluded with identical end segments showing the priest going over to the injured man (no injury was visible but implied) and reading him the last rites (See Appendix 8 for further details). Thus, although

both versions of the film can be regarded as negative in the sense that they were about a man being fatally injured, only the arousing version illustrated this explicitly and graphically. Both versions lasted a total of 91 seconds, with the beginning, middle and end segments being of approximately equal durations. Permission was obtained from the film company to edit and use the film for the purpose of this study.

Throughout the video clip, participants' heart rate was measured using conductive adhesive electrodes attached to each wrist with a reference electrode attached to the elbow. Electrocardiograms (ECG) were monitored using PowerLab system (ADInstruments Ltd. 2004a), and Chart 5 software (ADInstruments Ltd. 2004b) was used to compute beats-per-minute (bmp) for each of the three segments of the clip (beginning, middle and end) [3]. Beats per minute was chosen as the most appropriate method (rather than heart rate variability) for analyses given that the segments of interest were of relatively long durations (around 30 seconds each). Therefore, beats per minute was suitable for detecting increases or decreases in heart rate in response to the different segments of the clips. A square-root transformation was applied to normalise the data and visual inspection of all raw data confirmed the absence of movement artefacts.

Procedure

Participants were tested individually and informed that the purpose of the study was to assess their patterns of physiological reactions to neutral or arousing video stimuli, and how their physiological responses related to their subjective experiences of arousal. They were informed that they were about to watch a short video and that they should not specifically try to remember the details but instead simply watch it as if they were watching an event in real life. The ECG electrodes were attached and participants were asked to relax into a comfortable position in front of the computer screen and the video clip was then played. Immediately after the clip had finished playing and the heart rate equipment was removed, participants were asked to rate how arousing they found the clip on a scale of 1 to 5 (1 = not at all arousing; 5 = very arousing). Next, participants were given a surprise memory test. They were asked to write down everything they could recall from the clip in as much detail as they could, with no time constraints on how long they had to do this.

[3] Galvanic Skin Responses were also measured throughout the experiment. This data contained a lot of noise and, for simplicity, only heart rate (beats per minute) is reported here.

Following some unrelated tasks lasting around an hour, participants were again asked to write down everything they could remember from the clip, including all the details they had previously written and any extra details they might remember. Participants were then given a sealed envelope containing instructions for a third recall attempt and a self addressed envelope for returning this by post. They were asked not to open or look at the contents until the following day. Receipt of completed forms and follow-up phone calls confirmed that all participants had completed their recall forms the day after initial testing.

Coding and preliminary analyses

The same discrete details reliably identified by Bornstein et al. (1998) in each version of the film were used to code participants' free recall. There were 45 details in the arousing version and 43 details in the neutral condition. Both versions contained 18 details in the beginning segment and 14 details in the end segment. The arousing version of the middle segment contained 13 details and the neutral version contained 11 details (Appendix 8). To enable comparisons between clip version segments we calculated proportions separately for each participant by dividing the total number of reported details by the total possible number of details in that segment. If a participant reported a detail that was not seen in the clip at all, or was inaccurate this was coded as an error. A second independent rater scored eight randomly selected interview transcripts (two in each group x condition) against the video clip transcription and the resulting Person's correlations of the two coders' scores were: $r_{correct} = .98$, $p < .0001$, $r_{incorrect} = .86$, $p < .01$.

Tests for normality and outliers revealed one ASD participant who recalled a high proportion of details. Inclusion of this participant changed the findings for only one analysis, which is reported below. We analysed the data with the main question in mind of whether each group's recall was differentially affected by arousal over the different delay periods.

4.5 Results

Memory Data

The free recall data of Experiment 4 are set out in Table 4.2. A 2 (group: ASD vs. comparison) x 2 (arousal: neutral vs. arousing clip versions) x 3 (segment: beginning vs. middle vs. end) x 3 (delay: immediate vs. one hour vs. one day) ANOVA was carried out to examine the data. There was a main effect of arousal, F (1, 44) = 17.78, $p < .001$, $r = .54$, and significant segment x arousal interaction, F (2, 74) = 3.66, $p < .05$, $r = .22$, reflecting higher recall of details in the arousing (mean = .34, SD = .13) than in the neutral version (mean = .21, SD = .10), particularly in relation to the middle segment of the clip (ts at all three time delays > 2.74, ps < .05). The recall data also yielded a marginally significant effect of group with ASD individuals recalling a smaller proportion of correct details (mean = .25, SD = .15) than the comparison group (mean = .31, SD = .11), F (1, 44) = 3.51, $p = .068$, r = .27. When the participant earlier identified as an outlier was removed from the data, this difference was significant, F (1, 43) = 6.62, $p < .05$, $r = .37$ (mean ASD = .23, SD = .12; mean comparison = .31, SD = .11). Importantly, however, there was no group x arousal interaction, F (1, 44) = 1.86, *ns,* $r = .20$. Neither the group x segment, F (2, 74) = 1.25, *ns*, $r = .13$, or group x segment x arousal interaction, F (2, 74) = 1.49, *ns*, $r = .14$ were significant, suggesting that the emotional salience of the video clip modulated memory relatively similarly in both groups.

In relation to the effect of time delay on recall, whilst there was not a main effect of delay, F (2, 74) = 1.97, $p = .15$, $r = .16$, there was a significant delay x arousal interaction, F (2, 73) = 3.66, $p < .05$, $r = .22$, whereby there was no difference in the proportion of recall over time for participants who viewed the arousing version (all ts < 1.00, *ns*), whereas participants in the neutral condition recalled significantly fewer details after one day (mean = .19, SD = .10) than they did immediately after watching the clip (mean = .23, SD = .10), t (23) = 2.76, $p < .05$, Cohen's $d = .35$. The data were also characterised by a marginal delay x group interaction, F (2, 74) = 2.91, $p = .06$, $r = .19$, but no higher-order interactions, suggesting that the emotional salience of the video clips modulated memory relatively similarly in both groups. Follow up t-tests revealed that whilst there was no difference between groups in the proportion of details recalled on the immediate or one day tests (ts < 1.41, ps > .17), the ASD group recalled marginally significantly

fewer details than the comparison group after one hour, t (46) = 1.90, p = .06, Cohen's d = .55. These data are summarised in Table 4.2.

Table 4.2

Summary t-test results comparing the proportion of details recalled from the arousing and neutral versions of the video clip for ASD and comparison participants for each of the three time delays of recall (standard deviations are in parentheses).

	ASD (n = 24)			Comparison (n = 24)		
Video	*Immediate*	*1 Hour*	*1 Day*	*Immediate*	*1 Hour*	*1 Day*
Arousing	.35 (.15)	.32 (.16)	.35 (.16)	.34 (.10)	.36 (.12)	.35 (.10)
Neutral	.17 (.08)	.16 (.09)	.14 (.08)	.28 (.10)	.26 (.10)	.24 (.09)
t	3.63	2.99	3.87	1.49	2.17	2.82
df	17	18	16	22	22	22
p	< .005	< .01	< .001	*ns*	< .05	< .01
Cohen's *d*	1.50	.91	1.66	.60	.91	1.16

We also analysed errors. A 2 (group) x 2 (arousal) x 3 (segment) x 3 (delay) ANOVA revealed a significant delay by group interaction, F (1, 176) = 3.11, p < .05, r = .13. Post-hoc tests revealed that this was due to the ASD group making significantly more errors on the immediate test, t (30) = 2.56, p < .05, Cohen's d = .74. There was no difference in error rates between groups, however, on the tests one hour, t (46) = .15, *ns*, Cohen's d = .04, or one day later, t (46) = .82, *ns*, Cohen's d = .06 suggesting that incorrectly recalled information, like correctly recalled details, are forgotten more rapidly by individuals with ASD. No other main effects or interactions for errors were significant (all Fs < 2.69, ps > .09).

Psychophysiological Responses and Subjective Ratings

Analysis of participants' subjective ratings of arousal revealed a significant main effect of arousal, F (1, 176) = 4.97, $p < .05$, $r = .32$: the arousing version yielded higher ratings (Mean = 2.85, SD = 1.14) than the neutral version (Mean = 2.17, SD = .96). There was no main effect of group, F (1, 44) = .370, *ns*, $r = .09$, nor a group x arousal interaction, F (1, 44) = .37, *ns*, $r = .10$.

Next we examined participants' averaged heart rate for each version of the clip in the beginning, middle, and end segments. There was a significant main effect of segment, F (2, 86) = 4.02, $p < .05$, $r = .21$, but no main effects of group, F (1, 43) = .12, *ns*, $r = .05$, or arousal, r (1, 43) = .02, *ns*, $r = .02$, or significant interactions for segment x group, F (2, 86) = 1.93, *ns*, $r = .15$, segment x arousal, F (2, 86) = .33, *ns*, $r = .06$, or segment x group x arousal, F (2, 86) = .38, *ns*, $r = .07$. Post-hoc paired t-tests to follow up the main effect of segment revealed that heart rate significantly dropped from the beginning (mean = 73.05, SD = 12.66) to the middle (mean = 72.24, SD = 11.94) segment, t (46) = 2.47, $p < .05$, Cohen's $d = .07$, and significantly rose from the middle to the end (mean = 72.77, SD = 12.10) segment, t (46) = 2.17, $p < .05$, Cohen's $d = .04$. There was no difference in heart rate between the beginning and end segments, t (46) = 1.01, *ns*, Cohen's $d = .02$, indicating that the main effect of segment was due to a significant drop in the middle segment of the clip in both arousing and neutral conditions.

Although not justified by a significant segment x arousal interaction, because we predicted that arousal would be modulated more in the arousing version of the clip for both groups we carried out planned comparisons across groups within each arousal condition. Within the arousing condition a similar pattern emerged: participants' heart rates significantly decreased between the beginning (mean = 72.95, SD = 11.27) and middle (mean = 71.89, SD = 11.07) segments, t (22) = 2.41, $p < .05$, Cohen's $d = .09$, and marginally significantly increased from the middle to end (mean = 72.55, SD = 10.85) segments, t (22) = 1.93, $p = .067$, Cohen's $d = .06$, with no difference between the beginning and end segments, t (22) = .99, *ns*, Cohen's $d = .04$. Within the neutral condition, however, there was no difference in heart rate between any of the clip segments (beginning mean = 73.16, SD = 14.12; middle mean = 72.59, SD = 12.95; end mean = 72.98, SD = 13.43, all ts < 1.17, ps > .26). A decrease in heart rate is thought to be part of an orienting response, and is a common reaction to unpleasant stimulation (e.g., Hare, Wood, Britain & Frazelle,

1971). Increased cardiac activity is thought to be part of defensive response, evoked by strongly unpleasant or traumatic stimulus events (e.g., Christianson, 1987). The stimuli used here were likely to be less overtly threatening than a real life situation, and it seems that they *may* have evoked an orienting response in our participants. However, it must be noted that given the lack of a significant segment x arousal interaction or main effect of arousal, caution is warranted in formulating this conclusion. These findings are in line with Heuer and Reisberg (1990), who found a downward turn in heart rate for the arousal group on the first slide from which the emotionally arousing events began. However what is of most interest of the present findings is that the ASD group exhibited similar apparently orienting responses as the comparison group to the arousing clip version.

4.6 Discussion

The present research aimed to extend previous work on memory for emotional material in ASD (e.g., Gaigg & Bowler, 2008) in order to determine whether atypicalities in this domain may be responsible for relatively poorer eyewitness reports in this population (Maras & Bowler, 2010). Several lines of evidence led us to predict that when presented with eyewitness stimuli, the typical comparison group would remember an emotional version of an event better and forget it less over time than a neutral version, whilst we expected no such modulation for a group of ASD individuals. This prediction was primarily based on three sets of findings. First, several studies indicate that individuals with ASD do not exhibit a typical memory advantage for emotionally salient material (Beversdorf, 1996; Deruelle et al., 2008), particularly when memory is assessed over time (Gaigg & Bowler, 2008). Second, there is evidence to suggest that individuals with ASD may not attend to the type of information (e.g., people in distress) that is critical in the context of eyewitness situations (e.g., Corona et al., 1998). And finally Maras and Bowler (2010) have shown that the Cognitive Interview, which encourages the mental reinstatement of contextual information such as the feelings one experienced at the time of witnessing an event, proves detrimental to the eyewitness testimonials of individuals with ASD.

Despite the converging evidence for our predictions, our findings indicated that both individuals with and without a diagnosis of ASD demonstrate enhanced

memory for, and diminished forgetting rates of, emotionally salient as compared to neutral videoed events. This contrasts the observations of previous studies on memory for emotional sentences (Beversdorf et al, 1998) pictures (Deruelle et al., 2008) and words (Gaigg & Bowler, 2008) in ASD, but is in line with another report on memory for emotional words in ASD by South and colleagues (2008). Thus, findings from studies which have examined memory for emotional material in ASD are rather inconsistent and at present it remains unclear what factors determine whether or not emotional factors modulate memory typically in ASD or not. The type of material, mode of presentation and delay between study and test varies considerably across the few relevant studies to date, and future studies should seek to vary these factors systematically. In addition, more work is needed at the more basic level of understanding the subjective and physiological components of emotional responses of individuals with ASD. In the present experiment ASD participants *may* have exhibited similarly orienting physiological responses (with a decrease in heart rate) to arousing as compared to neutral material as comparison participants. Whilst post-hoc analyses yielded significant differences between the segments in the arousing version but not the neutral version, this was not qualified by a higher-order segment x arousal interaction. Therefore it cannot be firmly concluded that our arousal manipulation actually resulted in a difference in arousal between conditions. Moreover, enhanced physiological arousal in ASD is consistent only with some previous findings (e.g., Gaigg & Bowler, 2008; Ben Shalom et al, 2003; Salmond et al, 2003), but not others (e.g., Ben Shalom et al., 2003; Blair, 1999; Bölte, et al., 2008; Corona et al., 1998). Thus, more systematic work such as that by Bölte and colleagues (2008) is needed to resolve how individuals with ASD respond to, and subjectively experience emotional material. One avenue for future work that might prove particularly fruitful would be to examine orienting versus defensive responses to a variety of stimuli in ASD and to assess how these distinct responses modulate remembering in this group. Similar to the present study, Sigman, Dissanayake, Corona and Espinosa (2003) found that ASD children, like their matched typical counterparts, demonstrated an orienting response with decreased heart rate to affective social stimuli that were presented in a video clip. A study by Corona et al. (1998), however, reported that their ASD children did not demonstrate an orienting response to seeing an experimenter appear in distress in real life. As Sigman et al. (2003) point out, it would be worth considering the effect of watching a video versus seeing the events in real life on physiological responses (and their subsequent modulation with memory) by individuals with ASD.

Issues concerning emotions aside, the present experiment provides evidence of relatively poorer recall abilities in ASD overall. The present findings suggested that the free recall reports of individuals with ASD were characterised by increased rates of errors and less complete recall. A substantial body of empirical work shows that ASD is characterised by a profile of specific memory strengths and weaknesses. For example, whilst free recall is often found to be diminished, when test procedures that provide more support for the studied material, such as cued recall or recognition, are used individuals with ASD usually show intact performance (see Bowler & Gaigg, 2008). Our findings are consistent both with this existing empirical work showing that free recall procedures pose particular difficulties for individuals with ASD (see Bowler & Gaigg, 2008), and with more applied previous research, demonstrating poorer eyewitness testimony in ASD (Maras & Bowler, 2010, 2011). Taken together these findings indicate that more generic recall difficulties, rather than specific abnormalities with recalling emotional information, may be responsible for the difficulties in recalling eyewitness events experienced by individuals with ASD. In this context, however, it is important to note that generalisation of the current findings to real-life eyewitness events is limited by a number of considerations. First, participants recalled details about a videoed event and were aware from the outset that the depicted events were staged, which could have attenuated arousal, or at least the overt social relevance of the event. Second, one needs to take into account the difference between laboratory research, where emotional arousal is assumed to reach a certain criterion, and real life situations, where emotional arousal might well exceed that criterion and consequently begin to have a negative effect on later memory (see Christianson, 1992). Third, we did not specifically match the neutral and arousing versions for distinctiveness so it could be argued that the arousing version was better recalled because it was more distinctive (but see Gaigg & Bowler, 2008). However, most criminal events are both arousing and distinctive, so for the purposes of applying this to real-life eyewitness testimony as well as for theoretical purposes, we chose to have emotional and neutral versions regardless of distinctiveness.

Despite these caveats, our findings make an important contribution both to the ASD and to the eyewitness literature. They indicate that arousal can modulate remembering in ASD for the kinds of stimuli that witnesses are likely to experience, which suggests that as eyewitnesses, individuals with ASD are as likely to demonstrate enhanced recall of details for emotionally arousing events as are typical witnesses.

Chapter 5: Context Reinstatement Effects in ASD

5.1 Overview of Chapter 5

Findings from Experiment 4 indicate that stimulus induced arousal modulates memory relatively typically in ASD. These findings therefore fail to explain why, when interviewed with a CI, individuals with ASD become significantly less accurate at recalling a previously witnessed arousing event. As discussed in the following chapter, several converging lines of research suggest that it might be the context reinstatement procedure that poses a particular problem. Experiment 5 explored whether individuals with ASD are less accurate because they fail to encode the context (as their local/detail focussed processing style would imply), or whether it is difficulties in retrieving context that is the problem. If the latter conjecture is accurate, this would suggest that more context-supportive interview strategies would aid the recall of witnesses with ASD. This experiment is currently in press with the *British Journal of Psychology* (Maras & Bowler, in press).

5.2 Abstract

The Cognitive Interview is among the most widely accepted forms of police interviewing techniques; however, it is ineffective for witnesses with Autism Spectrum Disorder (ASD). One of its main components involves mentally reinstating the internal and external context that was experienced at encoding. We report evidence indicating that it is the mental reinstatement instructions in the absence of any physical cues that individuals with ASD find difficult. In more supported conditions where they physically return to the same environment in which they learnt the material, they recall as much as their typical counterparts. Our findings indicate that recall in ASD is aided by context, but only when supported by the physical environment. These findings have important implications for investigative interviewing procedures for witnesses with ASD.

5.3 Introduction

Police interviewing techniques in the UK and USA have improved substantially in the past 25 years. The Cognitive Interview (Fisher & Geiselman, 1992; Geiselman, Fisher, Firstenberg, Hutton, Sullivan, et al., 1984) is an evidence-based technique which is now taught to police interviewers as part of their specialist interviewing training to elicit more details from witnesses but without compromising their accuracy (Home Office, 2007). The Cognitive Interview is based on two basic memory principles: First, that recall will be enhanced if the context that is experienced at retrieval matches that experienced at encoding (Tulving & Thomson, 1973). This is achieved by 'context reinstatement' - encouraging the witness to mentally relive both the internal (subjective thoughts and feelings etc) and external (physical and environmental) contextual details that they experienced prior to and during the witnessed event, before going on to freely recall everything that they can from the event, even seemingly trivial or partial details. The second principle is that memories are stored as a series of interconnected nodes, so a single memory can be accessed in a number of different ways (Anderson & Pichert 1978). This is done by asking the witness to recall the events in a different order or from a different perspective (but see Boon & Noon, 1994).

A number of studies have demonstrated that the Cognitive Interview is effective in increasing the amount of correct details reported without a concomitant increase in incorrect details with a number of different groups, including adult witnesses (see Memon, Meissner & Fraser, 2010), children (e.g., Geiselman & Padilla, 1988), older witnesses (e.g., Wright & Holliday, 2007) and witnesses with intellectual disabilities (e.g., Milne, Clare & Bull, 1999). In the only study to date to examine the Cognitive Interview with witnesses with autism spectrum disorder (ASD) however, it not only failed to increase the amount of correct details that they reported, it also significantly reduced their accuracy (Maras & Bowler, 2010).

ASD encompasses a range of pervasive developmental disorders including Autistic Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified, all of which are clinically defined by abnormalities in the domains of communication and socio-emotional behaviour, and the presence of narrow, stereotyped and repetitive patterns of behaviour and interests (American Psychiatric Association, 2000). It has been argued that deficits in reciprocal social behaviour are at the core of ASD (e.g., Constantino & Todd, 2003; Mundy, Sigman

& Kasari, 1994; Kanner, 1943). It is not surprising therefore, that when Maras & Bowler (2010) broke each detail that participants recalled down in terms of whether it pertained to a person, action, surrounding, or object, the ASD group recalled significantly fewer person and action details, but did not differ from their typical comparisons on the number of surrounding or object details that they recalled. However social deficits are not the only features of ASD; individuals with ASD also present with a rather unique cognitive profile, including very specific memory difficulties. Whilst they tend to demonstrate intact or even enhanced abilities in some domains such as rote memory (e.g., Kanner, 1943; Mottron, Belleville, Stip, & Morasse, 1998), they show impairments in other areas including the ability to spontaneously exploit the semantic relations between items to aid their recall (e.g., Gaigg, Gardiner & Bowler, 2008; Hermelin & O'Connor, 1967; Tager-Flusberg, 1991) and in recalling personally experienced events (e.g., Crane & Goddard, 2008; Klein, Chan & Loftus, 1999; Lind & Bowler, 2010).

Indeed, several converging lines of evidence suggest that individuals with ASD would have great difficulty with the context reinstatement component of the Cognitive Interview, which might explain why Maras and Bowler (2010) found this interview to be so ineffective for witnesses with ASD. First, they have diminished memory for source or incidentally encoded context, particularly in unsupported conditions where the context has to be recalled rather than recognised (Bowler, Gardiner & Berthollier, 2004; Bowler, Gaigg & Gardiner, 2008). In the aging literature difficulties with monitoring the source of memories have been linked to problems in the kinds of processes that context reinstatement requires, namely in binding features of source (i.e. context) -relevant information together with the to-be-remembered details in the first place at encoding (e.g., Chalfonte & Johnson, 1996), and then later spontaneously considering these context details at retrieval (e.g., Henkel, Johnson & DeLeonardis, 1998). If individuals with ASD do not encode the event with its context or if they have difficulty in later recalling the context, then it is unsurprising that the context reinstatement procedure of the Cognitive Interview is ineffective.

Second, on tests of recognition individuals with ASD tend to rely more heavily on feelings of familiarity (e.g., 'know' responses) and report fewer instances of consciously recollecting vivid contextual details that were associated with the item at encoding (e.g., 'remember' responses). Tulving (1985) argues that 'remembering' involves mental time travel to re-create the spatio-temporal context of the

recollected episode. This is exactly the process that is required by context reinstatement, and individuals with ASD are known to have difficulties with this (e.g., Lind & Bowler, 2010).

Third, individuals with ASD perform well on tasks that rely on item-specific processing, which focus on individual items of information without any reference to relations among them, and poorly on relational processing tasks (Gaigg et al., 2008). Context reinstatement is based on the exploitation of the relations between context and event details to trigger more details from memory. If individuals with ASD witness a crime and process the event details in isolation from the crime's situation or context, then context reinstatement is likely to be ineffective.

Context utilisation difficulties in ASD: a problem with encoding or retrieval?

Nevertheless, these context utilisation difficulties in ASD appear to be more of a retrieval rather than an encoding problem: individuals with ASD can remember the context in more supported conditions, for example, they demonstrate diminished recall but intact recognition for incidentally encoded contextual details. Bowler et al. (2008) reported that ASD participants failed to make use of context to aid their memory on tests of recall, but on recognition tests they utilised context words that were presented at study to enhance their memory performance to a similar degree as typical individuals. It seems, therefore, that individuals with ASD will only make use of context if it is more explicitly presented to them at recall. Indeed, "…cognition in ASD is more rooted in the here-and-now rather than in information that has to be brought to mind in a way that is not immediately cued by the current situation…" (Bowler et al., 2008, p. 997). If utilising context is a retrieval rather than an encoding problem, then effective interview procedures might at least be possible to aid recall for individuals with ASD. It is possible that being physically back in the same context rather than solely trying to recreate the context mentally in the absence of any physical cues may enhance recall for individuals with ASD. This is a contention that fits well within a source support framework, where difficulties in remembering the source of information are largely eliminated in more supported retrieval conditions (see Bowler et al., 2004).

Previous work has demonstrated that, in addition to the positive effects of mental context reinstatement procedures, typical individuals can also remember

more if they return to the same room at test than if they recall in a different room (e.g., Davies & Milne, 1985; Fernandez & Alsono, 2001). In an early study by Smith (1979), for example, participants were asked to recall (without mental context reinstatement instructions) previously learned lists of words in either the same room in which they learnt them or in a different room. Participants who recalled the word lists in the same room recalled significantly more words than the group who recalled the lists in a different room from study. The purpose of the present study was to see if individuals with ASD might also benefit from physically returning to the same environmental context at recall.

We presented participants with ASD and their typical counterparts with photographs of everyday scenes, rich in a variety of different but quantifiable details. One hour later each participant was interviewed for their memory for these photographs using the context reinstatement procedure followed by free-recall. However for half of participants this was carried out in a Different Room from which the photographs were initially viewed (in line with Maras & Bowler, 2010), and for the other half of participants this was back in the Same Room where they had initially viewed the photographs. The aim of the present study was two-fold. First, to extend previous findings (Maras & Bowler, 2010) and confirm that context reinstatement poses a problem for individuals with ASD. Our first prediction therefore is that when interviewed using a context reinstatement procedure in a Different Room, ASD witnesses would recall significantly fewer correct details and with lower accuracy than their typical counterparts. This would replicate some of the findings from Maras and Bowler (2010). Our second aim was to examine whether this problem with context reinstatement results from a failure to store context at all in relation to memories for the to-be-remembered event details, in which case physically returning to the Same Room in which the to-be remembered event was witnessed would make no difference to their recall, or whether it is more of a retrieval problem. If the latter is the case we would expect that context can in fact enhance recall if more context support is provided by carrying out testing in the room where the event was witnessed. To summarise, we predicted (1) less complete and less accurate recall by the ASD group when mental context reinstatement procedures were carried out in a Different Room from where the witnessed scenes were viewed, and (2) that when physically back in the Same Room, the ASD group's recall would improve to levels comparable with those of the comparison group. Moreover, based on Maras and Bowler (2010) we also predicted

equivalent rates of quantity and accuracy of recall for details pertaining to surroundings and objects in both groups, but that the ASD group would show less complete and less accurate recall for details pertaining to persons and actions in both test conditions.

5.4 Method

Participants

Twenty eight individuals with ASD (23 males, 5 females) formally diagnosed by qualified clinicians took part. A review of available records and/or assessment with the Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore & Risi, 1999) confirmed that they all met DSM-IV (American Psychiatric Association, 2000) criteria for Autistic Disorder or Asperger's Disorder. A comparison group of 28 typical individuals (15 males, 13 females)[4] were recruited through local newspaper advertisements. No participants in either group were taking psychotropic medication, and none had any psychiatric or neurological disorder. ASD and comparison participants were matched on verbal IQ (Wechsler Adult Intelligence Scale Third UK Edition, Wechsler, 1997) and age. Fourteen participants from the ASD group and 14 comparison participants were randomly assigned to either the Same Room or Different Room conditions, provided that IQ scores and age were similarly distributed across the two conditions. A 2 x 2 (Group x Room) ANOVA found no significant main effects of Group (all *F*s < .42, *p*s > .52), Room (all *F*s < 1.21 *p*s > .28), or Group x Room interactions (all *F*s < .38 *p*s > .54) for verbal IQ, performance IQ, full-scale IQ. There were also no main effects or interactions for age (all *F*s <

[4] There was an unequal male-female ratio in each group, which was reflected by a significant association between participant group (ASD or comparison) and gender, χ^2 (1) = 5.24, p<.05. However there were no differences between male and female comparison participants or between male and female ASD participants in terms of correct details, errors, or accuracy (all *ts* < 1.19, *ps* >.28). For this reason, combined with the lack of previous research to suggest that gender should influence recall by the conditions used in the present research, we included this unequal male-female participant ratio.

1.35, *p*s > .25). Table 5.1 summarises these data. Participants also completed the Autism Spectrum Quotient (AQ, Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001). None of the comparison participants exceeded the minimum cut off score for ASD of 32 (maximum = 23), and a 2 (Group) x 2 (Room) ANOVA for AQ scores revealed no main effect of Room, F (1, 48) = .44, p= .51, r = .10, or Group x Room interaction, F (1, 48) = .29, p = .60, r = .08. There was however a main effect of Group, F (1, 48) = 165.52, p < .001, r = .88; as expected the ASD group scored significantly higher than the comparison group on this measure.

Table 5.1

Age, IQ and AQ scores for the ASD and comparison groups (standard deviations in parentheses), and effect sizes for differences within each group and within each room condition

	ASD (N = 28)	**Comparison (N= 28)**	**Between group difference effect size *r***	**Between room (within group) condition effect size *r***	
				ASD	**Comparison**
Same Room (N = 28)	(n = 14)	(n = 14)			
Age (years)	37.85 (11.07)	41.00 (12.75)	.13	.18	.14
Verbal IQ	112.23 (14.49)	109.14 (15.12)	.10	.11	.06
Performance IQ	109.38 (15.23)	105.79 (17.32)	.11	.16	.14
Full-scale IQ	112.15 (15.10)	108.29 (16.99)	.12	.15	.03
Autism Spectrum Quotient	37.62 (6.56)	13.54 (4.29)	.91	.12	.02
Different Room (N = 26)	(n = 14)	(n = 14)			
Age (years)	41.77 (10.64)	44.29 (10.99)	.12		
Verbal IQ	108.85 (15.23)	110.93 (16.75)	.06		
Performance IQ	103.69 (19.64)	101.29 (15.46)	.07		
Full-scale IQ	107.31 (17.46)	107.21(17.41)	.00		
Autism Spectrum Quotient	41.38 (21.69)	13.31 (6.91)	.66		

Materials

The to-be-remembered stimuli consisted of four photographs of everyday scenes (titled ‘camping’, ‘shopping’, ‘dinner’, and ‘launderette’), each sourced via an internet search (see Appendix 9 for the photographs used). Scenes were selected that were different from one another but all rich in quantifiable details relating to Persons, Actions, Surroundings, and Objects. Scenes were presented via Microsoft Office PowerPoint on a 19” monitor at a rate of one per 20 seconds. Each scene was followed by a 5-second blank black slide and a 7-second instruction slide for the proceeding slide, which informed participants that they were about to see a photograph of an everyday scene and that their task was to describe everything that they could see in the scene in as much detail as possible, including what was happening.

Procedure

Participants were tested individually. The room in which the slides were presented was the same for all participants, and was chosen as it was notably different from the usual laboratory testing room (where interviews took place in the Different Room condition) in terms of location, size, layout and décor. The order in which the slides were presented was varied randomly for each participant. Following presentation of the slides participants completed unrelated filler tasks lasting around one hour in a different room (to avoid spontaneous context reinstatement). Both before and after the filler tasks participants were engaged in conversation by the researcher about events unrelated to the slides.

Following this one-hour delay participants were interviewed about their memory for the slides in either the Same Room in which they watched them, or in a Different Room. Participants in the Same Room condition were seated in the same seat facing the same PC monitor as before (which was now switched off). All participants were interviewed for their memory of the slides using the context reinstatement procedure, which was followed by free-recall. In order to follow best practice guidance, interviews followed the same structure (up until the questioning phase) outlined by the Achieving Best Evidence guidelines (UK Home Office 2007), and Fisher and Geiselman (1992). This protocol included building rapport with the participant, explaining the aims of the interview, instructions to report everything (no

matter how small or trivial it may seem) and to concentrate hard. Prior to interviews participants were informed that the purpose of the study was to investigate the use of part of a police interview that is frequently used to help witnesses to remember more, called context reinstatement, and the procedure was fully explained to them in lay language. Participants were told not to worry if they could not remember certain details and not to guess.

The context reinstatement procedure took around 10 minutes and encouraged participants to focus on all aspects of their experience prior to and during encoding, including the internal (e.g., how the participant was feeling, what they were thinking) and external (e.g., what the environment around looked like) states, before attention was focussed on each slide in turn. This procedure began from 're-tracing their steps' on their arrival to their journey into the room where they saw the slides, focussing on the room, where they were sitting, picturing the PC monitor in front of them, building up a clear mental picture of the first instruction slide and then that changing to the first photograph. Participants were instructed to focus hard and build up a clear mental picture of the photograph in question, noting every small detail, focusing on where the scene was taking place (i.e. where the photograph was taken), what the environment around looked like, what people were involved, what they were wearing, doing, how they were behaving, etc. Finally this was followed by free-recall for each slide. Participants were guided though mini context-reinstatements for each slide in the same order in which they were presented at study, following which they were asked to recall everything in as much detail as they could from that slide. Free-recall for each slide was uninterrupted by the interviewer until the participant had finished speaking and had indicated that was all they could recall for that slide. The interviewer then moved on to the next slide that was presented. The first author conducted all of the interviews, and had previously attended a police Cognitive Interview training course run by Surrey Police. Whilst the experimenter was not blind to the hypotheses of the study, the instructions and context reinstatement protocol were standardised so that all participants received the same instructions and context reinstatement procedure in each condition.

Coding and Scoring

All interviews were audio-recorded and transcribed, and details were scored against an original transcript for the slides using a technique developed by Memon, Wark, Bull and Koehnken (1997). Each slide was transcribed for each unit of detail that occurred to form the original transcript. Any details reported by participants that were not included in the original transcript but were confirmed as present in the slide were added to the original transcription of the slides to provide an exhaustive list of details. Each detail was further coded according to whether it related to a Person, Action, Surrounding, or Object. A second independent scorer blindly scored each detail in the final transcription according to which type of detail it was. Inter-rater reliability was good, Kappa = .89, $p < .0001$, 95% CI (0.85, 0.93).

Each detail reported by the participant was coded against the original transcript of details from the respective slide as either *correct* if it was present in the photograph (e.g., "the man was sitting on the bench"), or *incorrect* if it was either inconsistent with the slide (e.g., "the man was sitting on the washing machine") or not present in the slide at all (e.g., if in fact there was no man sitting down). One point was given for each new unit of information provided by participants, for example ''one man (Person) is sitting (Action) on a bench (Object) reading aloud (Action) to another man (Person)" would be coded as five correct points: two Person correct, two Action correct, and one Object correct. Subjective statements of opinion (e.g., ''he looked a bit shifty'') were ignored. A second independent rater scored eight randomly selected interview transcripts (two in each group x condition) against the video clip transcription and the resulting Pearson's correlations between the two raters were: $r_{correct} = .98$, $p < .0001$, $r_{incorrect} = 0.85$, $p < .01$. Accuracy scores were calculated by dividing the number of correct details by the total (i.e. correct + incorrect) details reported.

5.5 Results

Overall recall

Our first step was to examine overall recall using a multivariate ANOVA, with Group (ASD vs. Comparison) and Room (Same vs. Different) as the between participant fixed factors, and correct details, incorrect details, and overall accuracy as the dependent variables. The multivariate result was significant for Group, Pillai's

Trace = .14, F (3, 50) = 2.75, p < .05, but not Room, Pillai's Trace = .08, F (3, 50) = 1.42, p = .25, and was marginally significant for the Group x Room interaction, Pillai's Trace = .12, F (3, 50) = 2.22, p = .09. Univariate tests revealed a main effect of Group for accuracy, F (1, 52) = 5.52, p < .05, r = .31. The ASD group were significantly less accurate (mean = .91, SD = .06) than the comparison group (mean = .95. SD = .04), although there were no main effects of Group for overall correct, F (1, 52) = 1.56, p = .22, r = .17, or incorrect details, F (1, 52) = 3.31, p = .08, r = .24. Although Table 5.2 suggests that the effect of the Same Room compared to the Different Room was more pronounced in the ASD group than the comparison group, these interactions were only marginally significant for accuracy, F (1, 52) = 3.32, p = .07, r = .25, and correct details, F (1, 52) = 3.36, p = .07, r = .25, and not significant for incorrect details, F (1, 52) = .12, p = .732, r = .05.

Did being back in the same room facilitate recall for the ASD group?

Although not justified by a significant interaction (p = .07), our *a priori* predictions that the ASD group would benefit more from recalling the photographs in the Same Room compared to in a Different Room, led to us carry out planned comparisons. We first examined differences between participants. These revealed that whereas the ASD group recalled significantly fewer details than the comparison group in the Different Room condition, t (26) = 2.20, p < .05, r = .38, there was no difference between groups in the Same Room condition, t (26) = .41, p = .69, r = .08. A similar pattern emerged for accuracy, where the ASD group were significantly less accurate than the comparison group when interviewed in a Different Room, t (18) = 2.50, p < .05, r = .43, but when interviewed in the Same Room there was no difference in accuracy between the two groups, t (26) = .48, p = .64, r = .09.

Comparisons were also made within groups, and these indicated that the ASD group reported significantly more correct details if they were interviewed in the Same rather than a Different Room, t (26) = 2.51, p < .05, r = .43, but there was no such increase in correct details between rooms for the comparison group, t (26) = .04, p = .97, r = .01. Table 5.2 summarises these data.

Table 5.2

Mean number of correct and incorrect details, and accuracy scores for ASD and comparison groups within Same and Different Room conditions (standard deviations are in parentheses)

	Same Room			Different Room		
	Correct	Incorrect	Accuracy	Correct	Incorrect	Accuracy
ASD	66.43[b] (21.55)	5.79 (3.85)	.92 (.03)	46.86[ab] (19.69)	5.93 (4.48)	.89[a] (.07)
Comparison	63.36 (18.13)	4.43 (2.38)	.93 (.04)	63.07[a] (19.25)	3.93 (2.67)	.94[a] (.03)

[a] significant between group difference $p < .05$; [b] significant between room difference $p < .05$

What types of details were reported, and did these differ between groups?

In line with previous work (Maras & Bowler, 2010), we next examined where these differences between groups and rooms lay in terms of the types of details that were reported. A 2 (Group) x 2 (Room) x 4 (Detail Type: Person, Action, Surrounding, Object) mixed ANOVA revealed a significant Group x Detail Type interaction for the number of correct details that were reported, F (3, 156) = 4.77, $p < .01$, $r = .17$, and Group x Detail Type interaction for accuracy scores, F (3, 156) = 2.92, $p < .05$, $r = .14$. No other Detail Type interactions were significant (all $Fs < 1.74$, $ps > .16$). Follow-up t-tests revealed that groups did not differ on the number of correct details, t (54) = .70, $p = .49$, $r = .09$, or their accuracy, t (54) = .86, $p = .39$, $r = .12$, for Surrounding details, or on the number of correct details, t (54) = .15, $p = .88$, $r = .02$, or accuracy, t (54) = .38, $p = .71$, $r = .05$, for Object details. However, the ASD group reported significantly fewer correct details, t (54) = 2.18, $p < .05$, $r = .28$ and had lower accuracy, t (54) = 2.58, $p < .05$, $r = .33$, for Person details, and reported fewer correct details, t (54) = 2.51, $p < .05$, $r = .32$, with lower accuracy, t

(54) = 2.01, $p < .05$, $r = .26$, for Action details than the comparison group. Table 5.3 summarises these data.

Table 5.3

Mean accuracy scores and number of correct details reported by ASD and comparison groups for Person, Action, Surrounding and Object details (standard deviations are in parentheses)

	Correct details				Accuracy			
	Person[a]	Action[a]	Surround	Object	Person[a]	Action[a]	Surround	Object
ASD	15.54 (8.86)	11.86 (4.31)	14.61 (7.22)	14.64 (6.45)	.84 (1.12)	.91 (.10)	.95 (.06)	.94 (.06)
Comp	20.21 (7.13)	14.75 (4.30)	13.36 (6.13)	14.89 (6.05)	.91 (.06)	.95 (.06)	.97 (.05)	.94 (.09)

[a] significant between group difference $p < .05$

5.6 Discussion

In line with our predictions, when interviewed with a context reinstatement procedure in a Different Room from which they witnessed the to-be-remembered scenes, adults with ASD recalled significantly fewer details and were less accurate than their typical counterparts. When interviewed back in the Same Room however, the ASD group recalled as many correct details, and were just as accurate as the comparison group. These findings have important implications for police interviewing techniques. It appears that people with ASD are aided by context, but only when they return to the original location in which the stimuli were encoded do the Cognitive Interview techniques result in successful recall.

Limitations on participant availability prevented the present study testing whether individuals with ASD benefit simply from physically returning to the encoding environment with no effect of verbal context instructions. Ideally this would be done by including a third group who are asked to recall the slides in the Same Room with no context reinstatement procedure. It is therefore difficult to ascertain from the present findings alone whether physically returning to the environmental context is effective because it provides scaffolding *for* the context reinstatement instructions, thus supporting the mental time travel that the Cognitive Interview encourages. Alternatively it is possible that this physical context reinstatement works independently of the mental context reinstatement mnemonic by encouraging spontaneous engagement in mental time travel without the need for any external context reinstatement instructions. We acknowledge that the lack of a third condition is a major limitation of the present study, and future work should explore whether physical context reinstatement without the mental instructions is similarly effective in enhancing recall for individuals with ASD.

Nevertheless, since previous research (Maras & Bowler, 2010) which directly compared a context reinstatement condition with a recall without context reinstatement condition found that context reinstatement failed to increase the amount of correct details that were reported by the ASD group, it seems safe to assume that the traditional mental context reinstatement procedure alone is ineffective for individuals with ASD. This finding is reinforced by the present study's finding that the ASD group were significantly worse than the comparison group when interviewed with context reinstatement in a Different Room. Thus it seems that only when individuals with ASD have the support of returning to the physical context where the event or study material was learnt are they able, when encouraged, to engage successfully in mental time travel and thus recall details of the witnessed event accurately. Whether the mental context reinstatement instructions are important or not in combination with the physical context reinstatement remains to be seen, however, and caution is warranted in interpreting these findings until future work that includes a critical third condition without mental context reinstatement instructions has clarified this issue.

In line with our predictions and with previous findings (Maras & Bowler, 2010), the ASD group recalled fewer correct details and were less accurate for details which pertained to Persons and Actions, whilst there were no such differences between groups for details which pertained to Surroundings or Objects.

A lack of significant group x room x detail type interaction suggests that this more physical form of context reinstatement (i.e. in the Same Room condition) does not have a differential effect on improving the types of details that are reported . It would be worthwhile for future work to explore whether there are interviewing techniques that can specifically enhance the reporting of Person and Action details by witnesses ASD.

Whilst at first glance the finding that the comparison group's recall did not differ between Same and Different Room conditions is surprising, some previous work has also found a lack of physical context effect when combined with a mental context reinstatement procedure. Smith (1979) for example found that whilst memory for previously learnt lists was better when tested in the Same Room than Different Room, this difference was eliminated when in a second experiment an additional group of participants were tested in a different room and instructed to recall the original learning environment: their recall was enhanced to a similar level to that of the group who were tested in the same room. It seems then that context reinstatement was already effective for the comparison group to the point that being back in the Same Room was superfluous. Context reinstatement did not aid the ASD group's recall however, meaning that there was scope for improvement by physically being back in the Same Room.

The limitations that apply to most laboratory eyewitness research also apply here. The static photographs used here are very different from real-life dynamic events and it is possible that they triggered more of an associative type of memory, as opposed to narrative memory which might be more common for eyewitness events. Since individuals with ASD tend to show intact associative memory (e.g., Minshew, Goldstein, Muenz, & Payton, 1992; Williams, Goldstein & Minshew, 2006), we cannot rule out this explanation. Future work should extend these findings using more dynamic stimuli to control for this possibility. It is also possible that context reinstatement is ineffective for individuals with ASD not because of the way in which their memories are stored with or without context, but because of the language requirements and online processing that the context reinstatement procedure demands. Individuals with ASD have difficulties in both of these domains (e.g., Darmala, Keller, Kana, Cherkassky, Williams, et al., 2010; Gabig, 2008; Joseph, McGrath & Tager-Flusberg, 2005). Physically returning to the same environment allows the individual similar support as the traditional context reinstatement, but without the language and working memory demands. Future work is needed to

clarify the relative contributions of these different types of demands on recall performance under context reinstatement. In addition, whilst the present findings may well prove useful if witnesses are able to re-visit the location of the witnessed event, there are obvious practical issues with this, and findings are limited to memory for single events in a unique setting. Cases of repeated offences, or those in the witness's own home, are unlikely to be better recalled by revisiting the scene because of contamination with other unrelated memories. Finally, such real-life events are likely to be more arousing than static scenes. Since arousal can facilitate or impede memory performance (see, e.g., Christianson, 1992), caution is needed when generalising these findings.

Nevertheless, the present study has important implications for helping individuals with ASD to recall more detail in investigative interviews. Whilst it will often not be possible to interview a witness in same place in which they witnessed an event, the present work suggests that there may be interviewing strategies, such as the use of photographs as context reinstatement aids, which might enhance recall in witnesses with ASD. Future work should explore such options.

Chapter 6: General Discussion

6.1. Overview of Chapter 6

The aim of the research presented in this thesis was to explore eyewitness testimony in adults with ASD. The present series of experiments assessed their capabilities as witnesses under the current police interviewing techniques, their susceptibility to misinformation effects and suggestive questioning styles, and how well they recall emotionally arousing eyewitness events over increasing time delays. This chapter presents an overview of this research in relation to different facets of eyewitness testimony and discusses the implications of these findings for some of the more dominant theoretical accounts of ASD. The strengths and limitations of the current series of experiments are discussed, along with the implications of these findings from an applied forensic perspective and areas for future research.

6.2. The capabilities of individuals with ASD as eyewitnesses

At the beginning of this thesis, it was noted that adults with ASD experience specific memory difficulties, although very limited research until now has examined how these memory difficulties might impact upon their capabilities as an eyewitness. The experiments reported in this thesis extended and applied previous empirical findings to more complex stimuli by drawing on existing eyewitness paradigms from the typical literature. Experiment 1 found that the widely used Cognitive Interview (CI) fails to increase the amount of correct details that witnesses with ASD report, and that it actually reduces their accuracy. The remaining experiments investigated possible explanations as to why the CI is so ineffective for witnesses with ASD (discussed later in this chapter), in addition to exploring other related eyewitness factors, which are outlined below.

Do adults with ASD have difficulty recalling witnessed events?

Experiment 1 demonstrated that individuals with ASD can recall as many details from a dynamic crime video as their typical counterparts (when interviewed with a standard structured police interview without the CI's mnemonics). Similarly,

Experiment 3 indicated that individuals with ASD are capable of freely recalling a previously heard audio narrative in as much detail and as accurately as their typical counterparts. Experiment 5 indicated that, when more contextual support is given at interview in the form of physically returning to the environmental context, their recall is also comparable in terms of both completeness and accuracy to their matched typical counterparts. At first glance these findings are encouraging and suggest that individuals with ASD do recall as much as their typical counterparts.

There were, however, some inconsistencies in the findings. Experiments 2 and 4 found that individuals with ASD freely recalled fewer correct details and were less accurate than their typical counterparts for a previously viewed slide sequence of photographs (Experiment 2) and video (Experiment 4). These disparate findings mirror those from established empirical work, where some researchers have reported intact free recall in ASD (e.g., Bennetto et al., 1996; Bowler et al., 1997; Minshew & Goldstein, 1993, 2001; Mottron et al., 2001; North et al., 2008; Renner et al., 2000; Rumsey & Hamburger, 1988), whilst others have indicated that free recall is diminished in ASD (e.g., Boucher, 1981; Boucher & Warrington, 1976; Bowler et al., 2008b; McCrory et al., 2007; Smith et al., 2007). However, it should be noted that the IQs of some of the samples from this previous research were quite low, or very mixed. Whilst the samples used in the present series of experiments were relatively homogenous in terms of their IQ within the higher range, they were nevertheless different samples (albeit with some degree of overlap). Therefore the present discrepant findings might have simply reflected the performance of different individuals from a heterogeneous ASD population. Alternatively, performance may be undiminished on one occasion but impaired on another, depending on the subtleties of the task. Consequently it would seem that high-functioning individuals with ASD *sometimes* recall less than their typical counterparts.

The findings of unimpaired free recall in Experiment 5, where the ASD group recalled as much and as accurately as the comparison group, are not surprising given that this involved more supported recall conditions by being back in the same room, and are consistent with the task support hypothesis (Bowler et al., 1997, 2004). These findings are important because they suggest that whilst individuals with ASD may freely recall less than their typical counterparts, if more support is provided for them they will recall as much and as accurately as typical individuals. However, a consistent finding in the present thesis (Experiments 1 and 5) is that individuals with ASD recall fewer details that pertain to Persons and Actions. This is

not surprising considering the social impairments that characterise ASD, coupled with previous findings of diminished attention to social cues by individuals with ASD when observing social situations (e.g., Klin, Jones, Schultz, Volkmar, & Cohen, 2002a, Klin, Jones, Schultz, Volkmar, & Cohen, 2002b). ASD and comparison participants did not, however, differ in their reporting of details relating to Surroundings and Objects. These findings are again not surprising; one would not expect individuals with ASD to have difficulty in recalling non-social aspects of an event, particularly given that these can be recalled using more of a rote strategy. The practical implications of these findings are that when relying on an ASD witness's report for evidence, details that relate to Surroundings and Objects are likely to be more reliable than details that pertain to Persons and Actions. Future work should examine whether there are more supportive interview techniques that can specifically help to increase the quantity and accuracy of these details.

Are adults with ASD more or less suggestible than typical individuals?

Experiments 2 and 3 explored how suggestible individuals with ASD are to misleading post-event misinformation, leading questions and negative feedback. Converging lines of empirical work show that individuals with ASD have difficulty with monitoring the source of their memories (e.g., Bowler et al., 2004), rely more on semantic memory and feelings of familiarity to compensate for their impaired episodic memory (e.g., Bowler et al., 2000a) and have heightened social anxiety (e.g., Kuusikko, Pollock-Wurman, Jussila, Carter, Mattila, et al., 2008). This suggests that they might be more suggestible than their typical counterparts. However Experiments 2 and 3 demonstrated that, in line with previous research (McCrory et al., 2007; North et al., 2008), adults with ASD were no more or less suggestible than their typical counterparts to misinformation and leading questions.

Although previous research that has examined the schematic organisation of events by individuals with ASD has produced mixed findings, some work suggests that higher functioning ASD individuals at least do use event schemas to some degree (e.g., Loth et al., 2008a). This conjecture is supported by the findings from Experiment 2, where both ASD and comparison participants equally went on to erroneously incorporate more misinformation into their subsequent reports if it fits with their existing schemas of what normally happens in that type of event. Moreover, both groups also made more schema-typical errors in their free recall for new details that were not previously presented as misinformation. This suggests that

both ASD and typical individuals rely on event schema to the detriment of their accuracy, which also leaves them vulnerable to schema-related post-event misinformation. From an associative network model perspective (e.g., Anderson, 1976; Anderson & Bower, 1973; Bower, 1967), this also suggests that, like typical individuals, when a generic node is activated through schema-related information for individuals with ASD this activation spreads to episodic nodes to trigger reporting of other schema-related items that were not actually witnessed (e.g., Hekkanen & McEvoy, 2005; Schank, & Abelson, 1977). One of the principles of the CI is that activation of contextual nodes during the context reinstatement procedure (or of multiple retrieval nodes in the case of the change order and change perspective procedures) enhances recall by spreading activation to nodes that represent the event details, thus triggering the reporting of more details (see, e.g., Memon & Stevenage, 1996). Findings from Experiment 2 therefore suggest that it is not an activation problem *per se* that causes the CI to be detrimental for individuals with ASD, since clearly there is some spreading activation of nodes. Otherwise they would not go on to erroneously freely recall more unseen schema-related details, nor would they recall more schema-typical misinformation details.

Experiments 2 and 3 are important because they indicate that individuals with ASD are equally as suggestible as their typical counterparts to different influences: misinformation gleaned though reading an account of the event, leading questions, and negative feedback. Future research should extend this work to see if these findings still stand when other forms of suggestive influences are encountered. Given the social difficulties that characterise ASD it would be interesting to see if they are as susceptible to co-witness conformity effects if they discuss the event with a co-witness who reports a slightly different version (e.g., Gabbert et al., 2003).

How well do individuals with ASD recall emotionally arousing events?

A substantial body of research showing that ASD is characterised by difficulties in emotional processing domains (e.g., Dawson et al., 1990; Hobson, 1991; Kamio, Wolf & Fein, 2006; Kasari et al., 1990; Yirmiya et al., 1992), coupled with the memory deficits inherent in the disorder (see Bowler & Gaigg, 2008) suggests that individuals with ASD would have difficulty in recalling a previously witnessed emotionally arousing event. Indeed, findings from Experiment 1, where

participants recalled a previously witnessed video of a (presumably arousing) stabbing, showed that the retrieval of negative emotional events was enhanced by using the mnemonic techniques of the CI for typical individuals, but had a negative effect on recall by ASD participants. The context reinstatement procedure works by reinstating, amongst other things, the feelings and internal states that were experienced at encoding. Therefore an atypical relationship between arousal and memory in ASD might explain the findings from Experiment 1. Findings from Experiment 4, however, suggest that this is not the case; both ASD and comparison groups recalled more details from an arousing version of an event then they did from a neutral version of the same event.

Moreover, in contrast to previous findings with word lists (Gaigg & Bowler, 2008), both groups showed increased forgetting rates over a one-day delay for the neutral version, whilst details for the arousing version were not forgotten over increasing delays. Both groups also appeared to demonstrate enhanced physiological arousal for the arousing over the neutral version, suggesting that the event may have elicited an orienting response in arousal and indicating that arousal may typically modulate memory for individuals with ASD for this type of event. As discussed in Chapter 4, a possible explanation for the discrepant findings between Gaigg and Bowler (2008) and Experiment 4 is that the former used word lists whilst the latter used more dynamic video stimuli, which may have formed more of an interesting narrative than lists of unrelated words. This might have led to more of an orienting response to the stimuli (see, e.g., Christianson, 1992 for a review). This notion of typical modulation of memory by arousal for more dynamic stimuli in ASD is strengthened by the findings from Experiment 1 of Maras, Gaigg and Bowler (in press), which also reported reduced forgetting rates over time for an arousing version of a slide sequence and accompanying narrative similarly for both groups (but see the methodological considerations and future research suggestions sections later in this chapter).

The implication from these findings is that individuals with ASD are similarly affected by arousing events, remembering them equally as well as their typical counterparts and forgetting them less than neutral events. However, this conclusion is tentative given that it is based on the findings from just two studies in the laboratory. Future work should explore this using more real-life eyewitness events that are experienced in real time rather than viewed on a video or in slides. Future

work should also vary the valence of the arousal by comparing memory for positively versus negatively arousing events.

It should be noted that Experiment 4 found a group x delay interaction for incorrect details, where the ASD group made more errors on the immediate test only. This finding is interesting because it suggests that either memory is consolidated over time for this group to form a more accurate representation of events, or that incorrect details are simply forgotten over time. The lack of interaction of these errors with clip version (i.e. arousing versus neutral) suggests that individuals with ASD may not discriminate between arousing or neutral details in the types of errors that they make. This notion is particularly pertinent given recent findings by Gaigg and Bowler (2009), who reported that whereas comparison participants were less susceptible to illusory memories for emotional compared to neutral stimuli, the ASD group were just as likely to falsely recall non-presented emotional stimuli as they were neutral stimuli. The implications of these findings in an eyewitness context are immense. However, again they need to be interpreted with caution given the need for replication. Tentatively, however, they suggest that witnesses with ASD *might* be more likely than typical witnesses to make errors when recalling an arousing event on an immediate recall attempt, but that these errors ebb with repeated retrieval events over time. This is an important conjecture that warrants further exploration in future research.

Why do adults with ASD experience difficulty with the context reinstatement component of the cognitive interview?

In addition to considering how individuals with ASD fare as eyewitnesses under different conditions, Experiments 2, 3, 4 and 5 also explored factors that might explain why, in Experiment 1, the CI was so ineffective for interviewing witnesses with ASD. Experiments 2 and 3 utilised misinformation and suggestibility paradigms to explore whether individuals with ASD differ from typical individuals in how they store representations of an event. However findings from these two experiments indicate that both ASD and typical individuals are more influenced by top-down processes to erroneously accept more schema-congruent misinformation and acquiesce to leading questions. This suggests that individuals with ASD do have some understanding of the causal relationship between events, and implies that the

CI is not ineffective because their memories are not triggered through spreading activation between episodic nodes in a similar way to typical individuals.

A second explanation for the negative effects of the CI is that arousal atypically modulates memory in ASD. Thus, following the 30 minute to 1 hour delay after watching an arousing video of a stabbing in Experiment 1, some of the arousing details may have been forgotten by the ASD group, but maintained by the comparison group. It could be the case that the SI simply lacked enough cues to detect this after this relatively short delay whilst the CI, with its instructions to report all combined with context reinstatement, meant that the increased forgetting rate by the ASD group became apparent even after just 30 minutes from watching the video. However findings from Experiment 4 showed that both ASD and typical groups recalled an arousing event better over time than they did a neutral event.

A third explanation for the CI being problematic for individuals with ASD relates to the role of context in memories. The context reinstatement mnemonic of the CI enhances the recall of typical individuals on the basis that memories are bound in context, and if retrieval processes tap contextual details then memories become more accessible. A number of converging lines of research suggest that individuals with ASD have difficulty with the context reinstatement procedure of the CI because of the mental imagery instructions and the requirement to remember contextual details in order to trigger event details. This interpretation led to the rationale for Experiment 5.

For example, early accounts of impaired free recall (e.g., Boucher, 1981; Boucher & Warrington, 1976) and diminished use of semantic categorisation to aid recall in ASD (e.g., Boucher & Warrington, 1976; Hermelin & Frith, 1971; Hermelin & O'Connor, 1967) have been replaced by later findings that individuals with ASD *can* in fact recall as well as their typical counterparts and make use of category information to aid their recall if more supported test procedures are used, such as cued recall or recognition tests (e.g., Bowler et al., 1997; Bowler et al., 2004; Tager-Flusberg, 1991). These findings suggest that the problem for individuals with ASD lies not at encoding but at retrieval. It seems that the same also applies with encoding and exploiting contextual information to aid memory. For example, Bowler et al. (2007) reported that whilst individuals with ASD failed to spontaneously utilise incidentally encoded context to aid their performance on a free recall test, on a recognition test their performance was enhanced by context information. Moreover,

recent work suggests that individuals with ASD have difficulty with the sort of 'mental time travel' that the context reinstatement procedure requires (e.g., Lind & Bowler, 2010). These suggestions raise the important question of whether the specific difficulties experienced by adults with ASD when interviewed with the CI are more related to encoding or retrieval problems.

Drawing on these converging findings, Experiment 5 explored the notion that the context reinstatement procedure of the CI is problematic for individuals with ASD not because they fail to encode the context or bind it with memory for event details in the first place, but because they have difficulty with mentally retrieving the context in order to trigger their memory for the event details. Findings from Experiment 5 replicated those from Experiment 1: the context reinstatement procedure leads to witnesses with ASD recalling fewer correct details becoming less accurate than their typical counterparts. However, findings also showed that when more supported context test procedures were used by the participant being physically back in the same environmental context (similar to previous research using recognition tests), their recall was as complete and as accurate as that of their typical comparisons. These findings mirror existing empirical work and provide further support for the task support hypothesis (Bowler et al., 2004): individuals with ASD perform worse than typical individuals on unsupported memory tests but where more appropriate support is given their recall is comparable. These findings also have important practical implications: the CI is unsuitable for individuals with ASD; however a modified form of context reinstatement can help them to recall more. To say that returning to the scene of the crime would enhance the recall of witnesses with ASD would be somewhat of an overstatement, given that this conjecture is based on one study in a laboratory for memory of static photographs rather than a real-life crime event. Nevertheless these findings do provide a platform for future work to build upon, which is discussed in more detail in the future research section 6.6 below.

6.3. Implications for theoretical accounts of ASD

Whilst the main focus of this thesis was from an applied perspective, it is important to consider how findings fit within the current theoretical frameworks of ASD discussed in Chapter 1. These theoretical accounts have been proposed in an attempt to account for the core deficits of ASD. Whilst a thorough consideration of the present findings in light of all of the theoretical accounts is beyond the scope of

this thesis, this section does offer a brief reflection of how some of the present findings fit within the three most dominant theories of ASD.

Theory of mind accounts

All of the experiments reported in this thesis assessed episodic memory, with some findings indicating diminished episodic memory (Experiments 2 and 4), and others finding intact episodic memory in ASD (Experiments 1, 3, and 5). Several researchers have suggested that a core deficit in ToM underlies ASD (e.g., Baron-Cohen et al., 1985) and, in the literature on typically developing children, Perner and colleagues (Perner, 2001; Perner & Ruffman, 1995; Perner, Kloo & Gornik, 2007) have suggested that episodic memory depends inherently on the same representational mechanisms that are thought to underlie ToM. If both of these accounts are correct, then the argument follows that individuals with ASD should have difficulty in episodically recollecting events. According to Perner, in order to episodically recollect an experience, one needs to understand what is being brought to mind during the process of remembering; essentially episodic recollection involves the meta-representation of a past experience, in the same way as does understanding another individual's mental state. In Perner's defence however, there are several explanations for the present findings. First, it is likely that most of the participants who took part in the present series of experiments had at least some ToM abilities; all participants were 'high-functioning' and previous research has demonstrated that not all individuals with ASD fail ToM tasks (e.g., Bowler, 1992, 1997; Dahlgren & Trillingsgaard, 1996). Second, findings of undiminished episodic memory are inconsistent in the present thesis, thus it could be that the ASD group's intact performance in Experiments 1, 3 and 5 was either through rote learning mechanisms, or, in the case of Experiments 1 (questioning stage) and 5 (returning to the physical context), more supported test procedures. Third, it may in fact be that ToM and episodic recollection are atypically related in ASD (Lind & Bowler, 2009), in which case even if the present participants did have impaired ToM abilities this might not necessarily have impacted upon their remembering in the same way that it would have done for typical individuals.

Experiments 1 and 5 found that the ASD group recalled fewer details pertaining to persons and actions, whilst not differing from the comparison group in their recall of surrounding and object details. Whilst these findings could be interpreted in a number of different ways, they do fit nicely within the ToM account.

A number of studies have reported that individuals with ASD are impaired in their ability to represent mental states, such as beliefs or intentions, and that they have difficulties with agent-centred second order representations that are necessary for understanding actions between people (e.g., Baron-Cohen et al., 1985; Blair et al., 2002; Leslie, 1987). Consequently one would expect individuals with ASD, if they have a diminished ToM and thus impaired ability to understand goal-directed actions, to have difficulties interpreting the causal actions between individuals, which would lead to problems both with encoding these details to start with, and then later trying to recall them. Remembering surrounding and object details, on the other hand, need not require understanding of the causal relationships between items or second order beliefs, and so findings of unimpaired recall by the ASD group for these details in Experiments 1 and 5 are unsurprising.

Inconsistent with a ToM account, however, are findings from Experiments 2 and 3. In Experiment 2 both ASD and comparison participants relied on schema-related misinformation more than schema-unrelated misinformation, to the detriment of their accuracy. The development of event schemas requires a number of ToM abilities, including forming mental representations of events and understanding how actions are causally linked through the individuals involved in the event and their intentions, thoughts and expectations (Loth et al., 2008a). Thus, if ToM were a core deficit of ASD, one would predict that individuals with ASD would not develop typical event schemas and consequently that they would be no more susceptible to schema-related misinformation than to schema-unrelated misinformation. Indeed some previous work has reported an impaired ability to generate event schemas in ASD (e.g., Loth et al., 2008a; Loveland & Tunali, 1993; Trillingsgaard, 1999). Others, however (including Experiment 2 of the present thesis), have found that individuals with ASD do utilise typical event schemas (e.g., Loveland & Tunali, 1991; Volden & Johnston, 1999).

Findings from previous work that has divided ASD participants into ToM 'failers' and ToM 'passers' (Loth et al., 2008a) suggests that individuals with ASD who are able to pass ToM tasks are also able to generate core elements of events and describe these in a generalised fashion. However, their descriptions are still somewhat rigid and they have difficulty in allowing for flexible aspects of events that are not fundamental to the overall gist of the event. It is possible that the present sample of participants included individuals with ASD who had ToM abilities which meant that they also had relatively intact event knowledge or schemas. It is also possible that when ASD individuals do demonstrate ToM abilities they 'bootstrap'

them rather than them being innately present (e.g., Happé, 1995), which explains why their event narratives are often found to be largely intact (perhaps again by bootstrapping), but the more detailed aspects of event schemas such as optional acts or 'slot fillers' are still diminished. It is possible that the paradigm used in Experiment 2 was simply not sensitive enough to detect differences between groups in aspects of event schemas such as allowing for the more flexible components of events, for example whether the customer service desk was open. Future work should extend this misinformation paradigm but with more sensitive hierarchical measures of slots (central actions that always occur for that type of event) and slot-fillers (details within those central actions that may or may not occur for that type of event), and comparing recall of these with ToM ability measures using a more heterogeneous participant sample that includes ToM 'failers'.

Finally, a ToM account would predict that individuals with ASD would actually be *less* susceptible to suggestive questioning styles than their typical counterparts; presumably without a ToM they would fail to recognise that the motivations or intentions of the interviewer were to elicit a different response. However Experiment 3 found that individuals with ASD were as suggestible to leading questions and, importantly, that they were just as likely to change their responses following negative feedback from the interviewer. This suggests that they do have some understanding of the interviewer's intent otherwise they would not have shifted their responses (irrespective of their accuracy). Alternatively however, it is possible that one could predict individuals with ASD are actually *more* suggestible, because their ToM impairment means they have difficulty in determining appropriate levels of trust. Thus one explanation is that these two predictions based on a ToM deficit simply cancelled each other out, leaving individuals with ASD no more or less suggestible than their typical counterparts. This notion would be worth exploring in future work using independent ToM variables and exploring their relationship to suggestibility in ASD, with one measure to assess recognition of other's beliefs and intentions, and another to assess ability to gauge appropriate levels of trust. However findings from Experiment 3 suggesting that the ASD group were equally as *compliant* as their typical counterparts suggest that higher-functioning individuals, at least, are able to gauge appropriate levels of trust. Nevertheless since these compliance findings are in contrast to North et al. (2008) they warrant further investigation.

Executive functioning accounts

As discussed in Chapter 1, individuals with ASD have limited mental flexibility and experience difficulty with 'set shifting', leading some theorists to propose that ASD is primarily an executive function deficit (see, e.g., Hill, 2004). It is therefore surprising that, in Experiment 3, the ASD participants were just as likely to shift their answers following negative feedback from the interviewer as the typical group were. Moreover, some of the present findings that show intact episodic recollection are also in contrast to an executive functioning account of ASD, since this requires the shifting of attention from an observer view of the present moment to a field perspective of the past to recall a previously witnessed event in its spatio-temporal context (e.g., Clarys, Bugaiska, Tapia & Baudouin, 2009; Della Sala, Laiacona, Spinnler, & Trivelli, 1993; Holland & Rabbitt, 1990).

There are, however, a number of possible interpretations for these findings. As with the ToM account, individuals with ASD do not fail all tasks that measure executive function (e.g., Baron-Cohen, Wheelwright, Stone & Rutherford, 1999; Griffith, Pennington, Wehner, & Rogers, 1999; Hill & Russell, 2002; Russell & Hill, 2001), and so it is possible that the degrees or types of executive functioning demanded by some of the present experiments were not those that are severely affected in ASD. For example, a number of studies have demonstrated that individuals with ASD pass tasks that tap response inhibition (e.g., Eskes, Bryson & McCormick, 1990; Griffith et al., 1999; López, Lincoln, Ozonoff & Lai, 2005; Ozonoff & Jensen, 1999; Ozonoff & Strayer, 1997). If they are able to inhibit their responses to leading or suggestive questions this may make them *no more* suggestible than their typical counterparts. Similarly, some researchers have reported intact set shifting, particularly in high-functioning ASD individuals (e.g., Goldberg, Mostofsky, Cutting, Mahone, Astor, et al., 2005; Landa & Goldberg, 2005; Minshew et al., 1992; Schneider & Asarnow, 1987). Thus the high-functioning participant sample in the present experiments may have been *no less* likely to shift their answers following negative feedback. Alternatively, it may be that the paradigm used to measure shifting of answers in Experiment 3 was not a sensitive enough measure of executive function to detect a deficit. With respect to the undiminished episodic recollection demonstrated in some of the experiments, again this may have reflected intact set shifting abilities. Alternatively, as discussed in the ToM section above, this was simply because intact episodic memory was usually only found where more

supported test procedures were used. Where less support was given in other experiments, ASD episodic memory performance was diminished.

Finally, the findings from Experiment 1, particularly where the change perspective component of the CI was problematic for the ASD group, are very much in line with an executive function deficit in ASD, since to imagine what the events looked like from a different perspective requires the ability to not only shift attention from the seen perspective to the imagined one, but also to hold these images in working memory in the process. It is also somewhat unsurprising that context reinstatement posed a problem since this requires following a series of complex verbal instructions and integrating these with their visuo-spatial memory for the event, which places large demands on executive functions that are impaired in ASD such as working memory (e.g., Bennetto et al., 1996; Griffith et al., 1999; Landa & Goldberg, 2005; Russell, Jarrold, & Henry, 1996). It seems then, that executive function impairments are consistent with the pattern of findings from the present research, and future work would be valuable in assessing to what extent different eyewitness abilities depend on different executive functions, and exploring appropriate interviewing techniques that might alleviate these demands.

Central coherence accounts

Several theorists have argued that individuals with ASD have difficulty integrating individual details into a coherent whole, and thus they fail to 'see the bigger picture' (e.g., Frith, 1989). However some of the findings from the present research are inconsistent with such early weak central coherence accounts, the most obvious being those from Experiment 2, where both groups incorporated more schema typical misinformation than atypical misinformation into their accounts. These findings suggest that the local processing style in ASD is not always at the expense of global processes, and therefore fit better within more recent variations of central coherence accounts, that individuals with ASD have a detail-focussed processing style that is not necessarily accompanied by a deficit in holistic or integrative processing (e.g., Happé & Frith, 2006; Mottron & Burack 2001; Mottron et al., 2006; Plaisted 2001). However even these later detail-focussed processing style accounts might still predict that individuals with ASD would be less suggestible to leading questions and misinformation; if an individual is focussed more on the individual details that comprise the greater whole, one would expect that they would be less likely to acquiesce to misleading questions about these details. Findings

from Experiments 2 and 3 however imply that this is not the case. This suggests either that external sources such as the perceived intent of the questioner exert a very strong influence in swaying answers even for detail (but see ToM section above), or more simply that their detail-focus is still subject to the same memory fallibility as typical individuals' in the sort of verbal testing paradigms used in the present experiments. This latter explanation is supported by previous work showing that individuals with ASD may perform more poorly when verbal test procedures are used (e.g., Bennetto et al., 1996; Happé, 1994; Kamio & Toichi, 2000)

Previous findings in support of weak central coherence accounts show that individuals with ASD have diminished performance on tasks that involve spontaneously utilising context (e.g., Happé, 1997; Joliffe & Baron-Cohen, 2001) and that they tend to show enhanced performance on tasks where the performance of typical individuals is hindered by context (e.g., Shah & Frith, 1983). Considered in light of such findings, it is therefore unsurprising that Experiment 1 found that individuals with ASD have difficulty with the context reinstatement component of the CI. Findings from Experiment 5, however, suggest that there is at least some 'central coherence' (otherwise their recall would not have been aided by returning to the physical context), but that more supported cueing is needed in order to reveal this coherence for them to exploit the context. A similar line of reasoning regarding more supported interviewing procedures would also apply to the mixed findings of impaired and intact episodic recollection across the present series of experiments, since this process relies on the binding of specific details of information to form the bigger picture (Schacter et al., 1998).

Finally, whilst the coding of recall in Experiments 1 and 5 did not specifically assess gist versus verbatim details, findings that the ASD group recalled fewer person and action details, but as many surrounding and object details as the comparison group, alludes to a more detail-focussed processing style. Remembering details of surroundings and objects may rely less on holistic processing, whilst person and action details may require more attention to the bigger picture such as the underlying story, theme, or intentions of the characters involved. Indeed, previous research suggests that children with ASD recall more verbatim details but have difficulty recalling the gist of an event (McCrory et al, 2007). It would be interesting to see if adults with ASD also provide more verbatim details with fewer references to the overall gist of an event. This could be done by utilising scoring procedures that specifically examine free recall for this, followed by the use of specific questions pertaining to gist and verbatim respectively to see whether

individuals with ASD can understand and report central or gist aspects of an event when cued.

Connectivity accounts of ASD

More recent accounts of ASD have shifted away from the 'big three' theories and towards a more cohesive account of the underlying neural mechanisms to explain the behavioural manifestations of the disorder. One such account proposes that ASD is marked by cortical underconnectivity that results in a deficit of integration of information at the neural and cognitive levels, and that the cognitive deficits in ASD are most likely to arise on tasks that require *integrative* higher level processing (Just, Cherkassky, Keller & Minshew, 2004). This cortical underconnectivity theory is supported by neuroimaging findings showing that individuals with ASD experience difficulty integrating information from different domains, such as verbal and visual processing (e.g., Just et al., 2004; Kana, Keller, Cherkassky, Minshew & Just, 2006; Koshino, Carpenter, Minshew, Cherkassky, Keller & Just, 2005).

A full discussion of this theory in light of the present findings is beyond the scope of this thesis, but it is worth briefly mentioning here because the current findings fit well within it. Most pertinent of these is the finding that the traditional context reinstatement procedure, which relies on the individual integrating a series of *verbal* instructions with their *visuo-spatial* memory of an event, fails to enhance recall for people with ASD. Moreover, when individuals with ASD physically return to the witnessing environment (thus removing or reducing these verbal to visuo-spatial integration demands), their recall is enhanced. This underconnectivity account, therefore, has important implications for improving the eyewitness reports of people with ASD with the use of more supportive interviewing techniques that minimise demands on verbal-visual integration. This notion is discussed in more detail in the future research section below.

6.4. Implications for the reliability of witnesses with ASD and interviewing implications for investigative professionals

The research reported in this thesis provides insights into how well high-functioning ASD adults recall a previously witnessed event under different conditions. This has implications for their abilities as certain kinds of eyewitnesses to real crimes, and how best to interview them. For example, findings have implications

for the abilities of witnesses with ASD to recall events that they observed. However, findings are limited in that inferences cannot be made about how well they can recall events in which they were actively involved or victimised, or about events in which they were the perpetrator. Nevertheless, the most striking finding from this research is that one of the most widely researched, used, and academically accepted forms of police interviewing, namely the Cognitive Interview, should not be used for interviewing witnesses with ASD. A number of factors that have been discussed in this thesis are likely to contribute to the CI's ineffectiveness, in particular the context reinstatement component. A second important implication from the present series of experiments is that whilst the context reinstatement component of the CI is particularly problematic by itself, individuals with ASD can be aided by context if they physically return to the environment in which they witnessed the event, rather than if they try to mentally return to it under the context reinstatement instructions alone. This finding has the very tentative implication that in some cases witnesses with ASD might benefit from more supported context reinstatement by returning to the scene of the crime, however further work is needed before such as statement can be made with authority (see section 6.6 below for future research).

Another important implication from the present work is that individuals with ASD can recall an event in as much detail and as accurately as typical individuals, but only if they are interviewed appropriately: more supported interview procedures and open-ended questions appear to produce the most detailed yet reliable evidence from them. However, the work presented in this thesis suggests that whilst they are no more suggestible than typical individuals, leading questions and exposure to misinformation should always be avoided, particularly those for details which are schema-congruent for that type of event. Findings also provisionally indicate that, like their typical counterparts, witnesses with ASD remember events that are emotionally arousing better than they do neutral events, particularly where increasing time has elapsed from witnessing the event to recalling it. However given the non-real life event used in Experiment 4 this conjecture should be interpreted with caution and inferences cannot be made regarding how the emotional valence of events affects their recall.

With regards to appropriate interviewing techniques, it is one thing to speculate from empirical research about what would work best, but quite another to implement it when a busy police officer finds themselves interviewing a witness with ASD at short notice in practice. It has been reported that police officers often feel

that they do not receive enough training on interviewing typical witnesses as it is (ACPO, 2004; Clarke & Milne, 2001; Dando et al., 2008), and it seems that they may have their work cut out on other aspects of training and policing to be fully informed on specific aspects of vulnerable witnesses, or specifically witnesses with ASD. Forces in England, Wales and Northern Ireland currently have five levels of investigative interviewing training ranging from probationers at tier 1, uniformed investigators and detectives at tier 2, specialist interviewers for vulnerable, intimidated and significant witnesses, and suspects in major crimes at tier 3, supervisors at tier 4, and interview advisers at tier 5 who comprise a small number of skilled interviewers who are called in to assist with the planning of major and/or complex interviews (ACPO, 2001). Somewhere in between tiers 3 and 5 investigative interviewers could be more informed about the specific memory profile of individuals with ASD and how best to interview them.

In conjunction with the National Autistic Society, police forces in England and Wales have recently introduced the use of an 'Autism Alert Card', which an individual with ASD can carry with them at all times to alert the police and other emergency services that they have an ASD. This card will undoubtedly prove useful in raising awareness of ASD amongst investigative professionals. In an ideal situation, it *might* be appropriate if an individual who declares to a police officer that they have an ASD is referred to a more knowledgeable or specially trained investigator who has received higher tier training for interview, or that the officer seeks advice from his superior as to what interviewing techniques should or should not be used. Needless to say, however, this best practice may be little more than a work in progress and given the sparse work on which these conclusions are based more work is needed before firm recommendations can be made. More research is also needed on interview mnemonics that *are* effective for witnesses with ASD, given these recent findings that have informed us about what does *not* work.

6.5. Methodological considerations

Limitations of the present series of experiments have largely been mentioned throughout this thesis. However there are some overarching methodological issues that are worth briefly mentioning here. Firstly, there is the issue inherent in all eyewitness research: the trade-off between experimental control and ecological validity. All of the experiments reported in this thesis used either static photographs

or videoed events. The chief reason for this being that very limited work to date has explored eyewitness testimony in ASD, and previous work on memory in ASD has predominantly used word lists and other non-event like stimuli. Thus photographs and videos were a progressive step up from this in terms of ecological validity and provided a base from which future work can extend using real-life to-be-remembered events.

A second issue also related to the stimuli used was that they were all distinct from personal involvement on the part of the participant. As noted in Chapter 1, previous work suggests that individuals with ASD may have difficulties recalling *personally experienced* events (e.g., Bruck et al., 2007; Crane & Goddard, 2008; Crane et al., 2009; Goddard et al., 2007; Klein et al., 1999; Millward et al., 2000). Moreover, they may not show the enactment effect that typical individuals do. That is, they often fail to show superior memory for tasks that they have performed themselves over tasks that they have seen another person perform (e.g., Farrant et al., 1998; Hare et al., 2007; Millward et al., 2000; Russell & Jarrold, 1999, but see Lind & Bowler, 2009; Williams & Happé, 2009). It is therefore imperative that future work examines how well individuals with ASD recall personally experienced eyewitness events and those in which they were an active participant – it may be these types of events that witnesses with ASD particularly struggle to recall. This is an acknowledged limitation of the present work. However, as noted, it was intended to be an initial exploration on which future work can build.

On a related note, the findings indicating that individuals with ASD have attenuated forgetting of emotionally arousing events over time are also restricted to events that are passively observed; it is possible arousal may be differentially modulated when the event or actions within the event are actually directed towards the witness. For example, typical individuals remember moderately arousing events better than low–arousal or neutral events, but this memory advantage can decrease and false memories increase once arousal reaches and exceeds a certain criterion (see, e.g., Christianson, 1992; Corson, & Verrier, 2007). Given that individuals with ASD tend to experience increased social anxiety and difficulties in coping with change, anticipation, sensory stimuli and unpleasant events (e.g., Cath, Ran, Smit, van Balkom & Comijs, 2008; GIllott & Standen, 2007), this criterion may be somewhat lower in ASD, particularly where they have more personal involvement in the event in question.

Another limitation of the present work is that the participant sample comprised only high-functioning adults with ASD, who had IQs in the normal or above normal range. This means that the present participant sample is not entirely representative since approximately 55% of the ASD population is characterised by developmental delays in global cognitive functioning with an IQ< 70 (Baird et al., 2006). One of the reasons for not including lower-functioning individuals in the present series of experiments is that in testing high-functioning individuals with ASD one can more definitively conclude that any impairments (or indeed enhancements) in performance is because of the ASD, and not because of some underlying cognitive deficits. Intellectual disability in itself has consequences for memory (see Lifshitz, Shtein, Weiss & Vakil, 2011, for a meta-analysis), and it was therefore deemed important for the present research to begin by exploring how having an ASD affects an individual's ability as an eyewitness without clouding the results with additional memory impairments. This does mean, however, that these current findings with high-functioning individuals should be interpreted cautiously when attempting to generalise to lower-functioning individuals with ASD. Inferences can only really be made for the wider ASD population once research has been specifically conducted with lower functioning individuals.

Finally, caution is warranted in formulating conclusions from the present series of experiments where no significant group differences were found. Some of the present results yielded medium effect sizes, but differences between groups were not statistically significant, which may be due to small sample sizes. Thus, the possibility of a Type II error, where significant differences were present but there was insufficient power to detect them, cannot be ruled out (Neyman & Pearson, 1928). At the time of designing these experiments, there was no previous research of this kind on which to base power analyses. Future work is needed to extend these paradigms with larger groups of participants, whose size is determined by a prior power analysis, to see whether the non-significant findings still stand.

6.6. Future research

A number of potentially fruitful opportunities for future research have arisen from the present findings, most of which have been mentioned throughout this thesis. However there are a number of avenues which have either not already been mentioned or would be particularly pertinent for future research to explore:

Context reinstatement

Findings from Experiments 1 and 5 indicate that the traditional context reinstatement procedure of the CI fails to enhance recall by individuals with ASD as it does for typical individuals, and it actually has the opposite effect of reducing their accuracy. Findings from Experiment 5 suggest that it is not because individuals with ASD do not encode the context in the first place; in fact they can utilise context if more support is available for retrieving the context (i.e. by physically returning to the environmental context). These findings are important because they suggest that appropriate interviewing techniques can enhance their recall. However, the lack of a third condition in Experiment 5 where participants return to the same room and recall the event but without the mental context reinstatement procedure means that these findings are limited in that they do not tell us whether it is simply returning to the environmental context that enhances their recall, or whether it is returning to the environmental context *in combination* with the mental context reinstatement procedure. Therefore one of the first lines of enquiry for future work is to examine this using this third condition (and of course with a more dynamic or real-life event).

There are also several explanations for why the mental context reinstatement procedure is difficult for individuals with ASD which warrant further detailed exploration. One possibility is that they have difficulty integrating the verbal instructions that are given by the interviewer with their visuo-spatial memory for contextual event details of the event. This supposition is supported by findings from the neuroimaging literature showing that individuals with ASD have cortical underconnectivity and fail to fully integrate language with imagery or visuo-spatial information (e.g., Just et al., 2004; Kana et al., 2006). If the mental context reinstatement procedure is problematic because of the language-to-mental imagery demands, then removing these demands should alleviate the problem. Future work could explore whether this conjecture is accurate by including the third condition as noted above.

In addition to language-to-mental imagery integration, the context reinstatement procedure also places demands on working memory and requires the witness to follow a series of complex verbal instructions in order to evoke contextual detail. Individuals with ASD are known to experience difficulties with both working memory and in following complex verbal instructions (e.g., Goldstein, Minshew & Siegel, 1994; Koshino et al., 2005; Poirier & Martin, 2008). These difficulties may be responsible for making the context reinstatement procedure - with its demands on

working memory and reliance on the witness following a series of complex verbal instructions to evoke mental images from memory - a very difficult one for them to follow. Future work could explore this contention by seeing whether scores on language tests, such as the Clinical Evaluation of Language Fundamentals – Fourth Edition (CELF-4), which measures ability to follow directions and understanding syntax, predict recall when participants are interviewed with the mental context reinstatement procedure.

In addition to gaining a better understanding of the reasons why the context reinstatement procedure is problematic for individuals with ASD, it is also important for future work to explore effective interview mnemonics, since it will rarely be possible for a witness to return to the scene of the crime to recall it. Neuroimaging and behavioural findings showing that individuals with ASD rely more heavily on visuo-spatial rather than verbal styles of processing (e.g., Kamio & Toichi, 2000; Koshino et al., 2005; Whitehouse, Maybery & Durkin, 2006), in addition to theoretical conjectures such as task support hypothesis (Bowler et al., 2004) and findings from Experiment 5 all suggest that individuals with ASD would benefit from viewing *photographs* of contextual aspects of the event to aid their recall. Indeed, evidence from applied work such as teaching intervention programs for individuals with ASD involving picture exchange communication (e.g., Bondy & Frost, 2001; Mesibov, Shea, & Schopler, 2005) demonstrates that using pictures increases comprehension in ASD by eliminating reliance on abstract words and concepts. Together these findings strongly suggest that photographs might be more useful as a context reinstatement aid to evoke mental imagery than the traditional verbal instructions, and highlight an important area for future research to explore.

Personally experienced eyewitness events

As noted in the methodological considerations section above, a limitation of the present work is that the to-be-remembered events consisted of a video, audio narrative, or slide sequence of photos - none of which involved the participant as anything other than a passive observer. In real life, witnesses do not have such a uniform view of events (Tollestrup et al.,1994), often assuming a more active role in events, for example being forced to the floor in the case of an armed robbery (Yuille & Tollestrup, 1992). As discussed, an accumulating body of research suggests that individuals with ASD experience difficulty in recalling personally experienced events and they often fail to show a memory enhancement for events that they have performed themselves over events that they have observed another person perform.

These findings suggest that if an individual with ASD finds themselves as a *participant* in a crime, be it as an active witness, victim, or even perpetrator, they may find it difficult to recall what happened. It is important for future work to examine in an eyewitness context how well individuals with ASD recall a passively observed event versus one in which they were an active participant. If individuals with ASD recall events in which they were actively involved less well than details that they passively observed as a bystander, not only does this give legal professionals some indication of the reliability of their different types of reports, but it also suggests that different interviewing techniques may be appropriate depending on how the event was experienced.

Arousal

Undoubtedly eyewitnessed events are often arousing. It is therefore important that future work explore the modulation of different levels and valences of arousal on the recall and forgetting rates of a witnessed event. This is particularly important given that ASD is characterised by difficulties in emotional processing (e.g., Boraston, Blakemore, Chilvers & Skuse, 2007) and that failures in the amygdala have been implicated to be at the core of ASD (e.g., Shultz, 2005). Although Experiment 4 found that an arousing event was forgotten less over time than a neutral event by both ASD and typical participants, the event witnessed was a passively observed one and the valence and level of arousal were not manipulated (although increases in heart rate by both groups for the arousing clip version indicated heightened physiological arousal). As noted in the methodological considerations section above, it is possible that an event that is personally experienced will be more arousing than one that is observed on a video, particularly for individuals with ASD with their social anxiety and apprehension over unpredictable events. Future work could explore whether arousal that is personally relevant or threatening differentially modulates memory compared to arousal that is caused by passively observed events that have no consequences for the observer.

Moreover, it is also possible that valence might be an important factor in how arousing events are modulated with memory for individuals with ASD. In the typical literature, for example, valence plays an important role and negatively valenced details are more likely to be remembered than positively valenced or neutral detail (e.g., Brandt, Sunram-Lea, & Qualtrough, 2006). Indeed, recent neuroimaging work with typical individuals shows that arousal increases the strength of amygdala connections to its efferent brain regions for negative information, but arousal

induced through positive information decreases the strength of these connections (Steinmetz, Addis & Kensinger, 2010). It is possible that paradigms that use very negatively valenced events may be more likely to detect differences in the modulation of memory and arousal between ASD and typical individuals, and future work could explore this in more detail by systematically varying the valence of the to-be-remembered event.

Temporal order

The coding systems that are usually utilised in the eyewitness literature and that were adopted in the present series of experiments code details in isolation from one another, and do not specifically examine how recall conveys the relations between them. This is vital if investigators are to understand the chain of events that unfolded and the order in which they occurred. Whether a witness reports that they saw the suspect leave the scene before or after the victim was stabbed can be critical in the prosecution or defence of a witness. Experimental work suggests that individuals with ASD often experience difficulties in recalling temporal order, for example in judging which of two stimuli were presented more recently (e.g., Bennetto et al., 1996) or processing the relations amongst elements of an experience (e.g., Gaigg et al., 2008), despite successful retrieval of the items themselves (e.g., Poirier et al., 2011). Such previous work examining temporal order in ASD has used simple stimuli such as words or digits, and future work is needed to investigate how individuals with ASD recall the order of details of a more dynamic witnessed event. If, as would be predicted by the previous empirical work with words and digits, individuals with ASD have difficulty recalling the temporal order of event details, there may be appropriate interview strategies that could help by providing more support with temporally-structured questions or instructions. For example, Lorraine Hope at the University of Portsmouth has recently developed an interview tool in the form of an actual time line to support typical witnesses sort the details of an event into their correct temporal order.

Suggestibility under cross-examination

Whilst the present findings seem fairly robust in showing that individuals with ASD are no more or less suggestible than their typical counterparts, it would be interesting to see if this is still the case under more adversarial styles of suggestive questioning such as cross-examination. There are a number of factors that might predict that under such circumstances individuals with ASD would be more suggestible. It seems likely that arousal would again play a role here. Experiment 3

found that, consistent with previous research (e.g., Cath et al., 2008; North et al., 2008), individuals with ASD have higher trait anxiety. It follows then that anxiety provoking situations such as cross-examination in court may increase their levels of arousal and susceptibility to suggestive questioning styles (e.g., Wolfradt & Meyer, 1998). Moreover, difficulties with executive functions and in following complex verbal dialogue may mean that witnesses with ASD have difficulty comprehending the sort of long-winded multiple part questions with complex syntax that barristers tend to favour, even when they are questioning witnesses with intellectual disabilities (e.g., Kebbell et al., 2004).

It may also be difficult to for individuals with ASD to comprehend why they are being challenged on details to which they know the barrister already knows the answer. Even higher-functioning individuals who have 'bootstrapped' a ToM (e.g., Happé, 1995) are likely to struggle with double negative questions (e.g., "is it *not* the case that the weapon was *not* visible before the attack?"), and accusatory styles of questioning for details that they have already clarified in previous interviews and they know that the barrister also knows. It would also be interesting to explore this with children with ASD, whom even if high-functioning would at best only be starting to develop the ability to bootstrap a ToM.

Lower functioning individuals with ASD and children

Needless to say, it will be important for future work to extend the current findings to individuals on the broader autism spectrum. As previously noted the present sample of participants only included high-functioning adults. Theoretically, there is little reason to suspect that the pattern of findings found in the present work should not still stand with children and adults who have accompanying intellectual impairment (albeit if with poorer performance overall). However, an important next step for future work will be to extend and modify the present paradigms to test children and adults on the wider autism spectrum.

6.7. Concluding remarks

The importance of understanding of the reliability of witnesses with ASD and appropriate interviewing techniques for them should not be underestimated given that their patterns of behaviours, interests, and social impairments mean that they are likely to be over-represented in the criminal justice system as either a victim or a witness of a crime. Yet limited research to date has examined this. Overall, the experiments presented in this thesis contribute to our understanding of eyewitness testimony in ASD. As well as elucidating the relative abilities of individuals with ASD to recall a previously witnessed event, the research has indentified interviewing techniques that should not be used, and has highlighted directions for future research to explore the use of interview techniques that will aid their recall. Witnesses with ASD are likely to freely recall fewer details than their typical counterparts, however this does not appear to impact their susceptibility to misinformation or suggestive questioning styles any more than typical witnesses. It is important for future research to explore how well individuals with ASD recall events that they have personally experienced, and where existing techniques are ineffective, to develop appropriate interviewing techniques that will enhance their recall.

References

ACPO (2001). *Investigative interviewing strategy.* Wybosten: National Centre for Policing Excellence.

ACPO (2004). *Management of volume crime*. Bramshill: National Centre for Policing Excellence.

ADInstruments. (2004a). PowerLab Data acquisition unit (ML845) with SCR amplifier (ML116). ADInstruments Pty Ltd.

ADInstruments. (2004b). Chart 5 v5.2 07. ADInstruments Pty Ltd.

Aggleton, J. P. (1992). *The amygdala: Neurobiological aspects of emotion, memory, and mental dysfunction*. New York: Wiley-Liss.

Allen, D., Evans, C., Hider, A., Hawkins, S., Peckett, H., & Morgan, H. (2008). Offending behaviour in adults with Asperger syndrome. *Journal of Autism and Developmental Disorders, 38,* 748-758.

American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders, Fourth Edition (DSM-IV)*. American Psychiatric Press: Washington DC.

Anderson, J. R. (1976). *Language, memory, and thought*. Oxford: Lawrence Erlbaum.

Anderson, J. R., & Bower, G. H. (1973). *Human associative memory*. Oxford: V. H. Winston & Sons.

Anderson, R. C., & Pichert, J. W. (1978). Recall of previously unrecallable information following a shift in perspective. *Journal of Verbal Learning & Verbal Behavior, 17*, 1-12.

Andrew, R. J. (1974). Arousal and the Causation of Behaviour. *Behaviour*, *51*, 135-164.

Archer, B. U., & Margolin, R. R. (1970). Arousal effects in intentional recall and forgetting. *Journal of Experimental Psychology, 86,* 8-12.

Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgments. In *Groups, leadership and men; research in human relations.* (pp. 177-190). Oxford: Carnegie Press.

Ashwin, C., Ricciardelli, P., & Baron-Cohen, S. (2009). Positive and negative gaze perception in autism spectrum conditions. *Social Neuroscience, 4*, 153-164.

Ashwin, C., Wheelwright, S., & Baron-Cohen, S. (2006). Finding a face in the crowd: Testing the anger superiority effect in Asperger Syndrome. *Brain and Cognition, 61,* 78-95.

Asperger, H. (1944). Autistic psychopathy in childhood (trans). In U. Frith (Ed.), *Autism and Asperger Syndrome* (pp. 37–92). Cambridge University Press: Cambridge, UK, 1991.

Bachevalier, J. & Loveland, K. A. (2006). The orbitofrontal-amygdala circuit and self-regulation of social-emotional behavior in autism*. Neuroscience & Biobehavioral Reviews, 30*, 97-117.

Bailey, A., Le Couteur, A., Gottesman, I., & Bolton, P. (1995). Autism as a strongly genetic disorder: Evidence from a British twin study. *Psychological Medicine, 25*, 63-77.

Baird, G., Simonoff, E., Pickles, A., Chandler, S., Loucas, T., Meldrum, D., & Charman, T. (2006). Prevalence of disorders of the autism spectrum in a population cohort of children in South Thames: the Special Needs and Autism Project (SNAP). *Lancet, 368*, 210-215.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin, 133*, 1-24.

Baron-Cohen, S. (1989). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry, 30,* 285-297.

Baron-Cohen, S. (2001). Theory of mind and autism: A review. In L. M. Glidden (Ed.), *International review of research in mental retardation: Autism (vol. 23).* (pp. 169-184). San Diego, CA US: Academic Press.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition, 21*, 37-46.

Baron-Cohen, S., Scahill, V. L., Izaguirre, J., Hornsey, H., & Robertson, M. M. (1999). The prevalence of Gilles de la Tourette syndrome in children and adolescents with autism: A large scale study*. Psychological Medicine, 29*, 1151-1159.

Baron-Cohen, S., Wheelwright, S., Robinson, J., & Woodbury-Smith, M. (2005). The Adult Asperger Assessment (AAA): a diagnostic method. *Journal of Autism and Developmental Disorders, 35*, 807-819.

Baron-Cohen, S., Wheelwright, S., Skinner, R., Martin, J., & Clubley, E. (2001). The Autism-Spectrum Quotient (AQ): Evidence from Asperger syndrome/high-functioning autism, males and females, scientists and mathematicians. *Journal of Autism and Developmental Disorders, 31*, 5-17.

Baron-Cohen, S., Wheelwright, S., Stone, V., & Rutherford, M. (1999). A mathematician, a physicist and a computer scientist with Asperger syndrome: Performance on folk psychology and folk physics tests. *Neurocase, 5,* 475-483.

Bartlett, F. C. (1932). *Remembering: a study in experimental and social psychology*. Oxford: Macmillan.

Baxter, J. S., Jackson, M., & Bain, S. A. (2003). Interrogative suggestibility: interactions between interviewees' self-esteem and interviewer style. *Personality and Individual Differences, 35*, 1285-1292.

Bekerian, D. A., & Bowers, J. M. (1983). Eyewitness testimony - were we misled. *Journal of Experimental Psychology-Learning Memory and Cognition, 9*, 139-145.

Bekerian, D. A., & Dennett, J. L. (1993). The cognitive interview technique: Reviving the issue. *Applied Cognitive Psychology, 7*, 275-297.

Ben Shalom, D. (2003). Memory in autism: Review and synthesis. *Cortex, 39*, 1129-1138.

Ben Shalom, D., Mostofsky, S. H., Hazlett, R. L., Goldberg, M. C., McLeod, D. R., & Hoehn-Saric, R. (2003). Intact galvanic skin responses and impaired self reports in response to emotional pictures in high-functioning autism. In P. Shinnick-Gallagher & A. Pitkanen & A. Shekhar & L. Cahill (Eds.), *Amygdala in Brain Function: Basic and Clinical Approaches* (Vol. 985, pp. 501-504). New York: New York Acad Sciences.

Bennetto, L., Pennington, B. F., & Rogers, S. J. (1996). Intact and impaired memory function in autism. *Child Development*, *67*, 1816-1835.

Berlyne, D. E., Borsa, D. M., Hamacher, J. H., & Koenig, I. D. (1966). Paired-associate learning and the timing of arousal. *Journal of Experimental Psychology, 72*, 1-6.

Bernier, R., Dawson, G., Panagiotides, H., & Webb, S. (2005). Individuals with autism spectrum disorder show normal responses to a fear potential startle paradigm. *Journal of Autism and Developmental Disorders, 35*, 575-583.

Berresheim, A., & Weber, A. (2003). Structured witness interviews and their effectiveness - Empirical findings on training success and evidentiary quality. *Kriminalistik, 57,* 757-770.

Bertrand, J., Mars, A., Boyle, C., Bove, F., Yeargin-Allsopp, M. & Decoufle, P. (2001). Prevalence of autism in a United States population: the Brick Township, New Jersey,investigation. *Pediatrics, 108*, 1155-61.

Beversdorf, D. Q., Anderson, J. M., Manning, S. E., Anderson, S. L., Nordgren, R. E., Felopulos, G. J., Nadeau, S. E., Heilman, K. M., & Bauman, M. L. (1998). The effect of semantic and emotional context on written recall for verbal language in high functioning adults with autism spectrum disorder. *Journal of Neurology, Neurosurgery & Psychiatry, 65*, 685-692.

Biederman, I. (1981). Do background depth gradients facilitate object identification? *Perception, 10,* 573-578.

Blackshaw, A. J., Kinderman, P., Hare, D. J., & Hatton, C. (2001). Theory of mind, causal attribution and paranoia in Asperger syndrome. *Autism, 5*, 147-163.

Blair, R. J. R. (1999). Psychophysiological responsiveness to the distress of others in children with autism. *Personality and Individual Differences, 26*, 477-485.

Blair, R. J. R., Frith, U., Smith, N., Abell, F., & Cipolotti, L. (2002). Fractionation of visual memory: Agency detection and its impairment in autism. *Neuropsychologia, 40,* 108-118.

Bölte, S., Feineis-Matthews, S., & Poustka, F. (2008). Brief report: emotional processing in high-functioning autism – physiological reactivity and affective report. *Journal of Autism and Developmental Disorders, 38,* 776-781.

Bondy, A., & Frost, L. (2001). The picture exchange communication system. *Behavior Modification, 25*, 725-744.

Boon, J., & Noon, E. (1994). Changing perspectives in cognitive interviewing. *Psychology, Crime & Law, 1*, 59-69.

Boraston, Z., Blakemore, S.-J., Chilvers, R., & Skuse, D. (2007). Impaired sadness recognition is linked to social interaction deficit in autism. *Neuropsychologia, 45,* 1501-1510.

Bornstein, B. H., Liebel, L. M., & Scarberry, N. C. (1998). Repeated testing in eyewitness memory: A means to improve recall of a negative emotional event. *Applied Cognitive Psychology, 12*, 119-131.

Boucher, J. (1978). Echoic memory capacity in autistic children. *Journal of Child Psychology and Psychiatry, 19*, 161-166.

Boucher, J. (1981). Memory for recent events in autistic-children. *Journal of Autism and Developmental Disorders, 11*, 293-301.

Boucher, J. (2001). 'Lost in a sea of time': Time parsing and autism. In C. Hoel & T. McCormack (Eds.), *Time and Memory: issues in Philosophy and Psychology*, pp. 111-135. Oxford: Oxford University Press.

Boucher, J., & Bowler, D. (2008). *Memory in autism: Theory and evidence*. New York: Cambridge University Press.

Boucher, J., & Lewis, V. (1989). Memory impairments and communication in relatively able autistic children. *Journal of Child Psychology and Psychiatry, 30*, 99-122.

Boucher, J., & Mayes, A. (in press). *Memory*. Oxford: Oxford University Press.

Boucher, J., & Mayes, A., & Bigham (2008). Memory, language and intellectual ability in low-functioning autism. In J. Boucher & D. M. Bowler (Eds.), *Memory in Autism*, pp. 330-349. Cambridge: Cambridge University Press.

Boucher, J., & Warrington, E. K. (1976). Memory deficits in early infantile autism: Some similarities to the amnesic syndrome. *British Journal of Psychology, 67*, 73-87.

Bower, G. (1967). A multicomponent theory of the memory trace. In K. W. Spence & J. T. Spence (Eds.), *The psychology of learning and motivation: I.* Oxford: Academic Press.

Bower, G. H. (1987). Commentary on mood and memory. *Behaviour Research and Therapy, 25*, 443-455.

Bower, G. H., Black, J. B., & Turner, T. J. (1979). Scripts in memory for text. *Cognitive Psychology, 11*, 177-220.

Bowler, D. M. (1992). Theory of mind in Aspergers syndrome. *Journal of Child Psychology and Psychiatry, 33*, 877-893.

Bowler, D. M. (1997). Reaction times to mental state and non-mental state questions in false belief tasks by high-functioning individuals with autism. *European Child & Adolescent Psychiatry, 6*, 160-165.

Bowler, D.M. (2007). *Autism spectrum disorders: Psychological theory and research*. New York: John Wiley & Sons Ltd.

Bowler, D.M., & Gaigg, S. B. (2008). Memory in ASD: enduring themes and future prospects. In J. Boucher & D. M. Bowler (Eds.), *Memory in Autism*, pp. 330-349. Cambridge: Cambridge University Press.

Bowler, D. M., Gaigg, S. B., & Gardiner, J. M. (2008a). Effects of related and unrelated context on recall and recognition by adults with high-functioning autism spectrum disorder. *Neuropsychologia, 46*, 993-999.

Bowler, D. M., Gaigg, S. B., & Gardiner, J. M. (2008b). Subjective organization in the free recall learning of adults with Asperger's syndrome. *Journal of Autism and Developmental Disorders, 38,* 104-113.

Bowler, D., Gaigg, S., & Lind, S. (2011). Memory in autism: Binding, self, and brain. In I. Roth & P. Rezaie (Eds). *The autism spectrum: Research reviews.* Cambridge: Cambridge University Press.

Bowler, D. M., Gardiner, J. M., & Berthollier, N. (2004). Source memory in adolescents and adults with Asperger's syndrome. *Journal of Autism and Developmental Disorders, 34*, 533-542.

Bowler, D. M., Gardiner, J. M., & Gaigg, S. B. (2007). Factors affecting conscious awareness in the recollective experience of adults with Asperger's syndrome. *Consciousness and Cognition: An International Journal, 16*, 124-143.

Bowler, D. M., Gardiner, J. M., & Grice, S. J. (2000a). Episodic memory and remembering in adults with Asperger syndrome. *Journal of Autism and Developmental Disorders, 30*, 295-304.

Bowler, D. M., Gardiner, J. M., Grice, S., & Saavalainen, P. (2000b). Memory illusions: False recall and recognition in adults with Asperger's syndrome. *Journal of Abnormal Psychology, 109*, 663-672.

Bowler, D. M., Limoges, E., & Mottron, L. (2009). Different verbal learning strategies in autism spectrum disorder: Evidence from the Rey Auditory Verbal Learning Test. *Journal of Autism and Developmental Disorders, 39*, 910-915.

Bowler, D. M., Matthews, N. J., & Gardiner, J. M. (1997). Asperger's syndrome and memory: Similarity to autism but not amnesia. *Neuropsychologia, 35*, 65-70.

Bowler, D. M., & Worley, K. (1994). Suggestibility to social influence in adults with aspergers syndrome – a research note. *Journal of Child Psychology and Psychiatry, 35*, 689-697.

Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering pictures: Pleasure and arousal in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 379-390.

Brandt, K. R., Sunram-Lea, S. I., & Qualtrough, K. (2006). The effect of glucose administration on the emotional enhancement effect in recognition memory. *Biological Psychology, 73*, 199-208.

Brock, J., Brown, C. C., Boucher, J., & Rippon, G. (2002). The temporal binding deficit hypothesis of autism. *Development and Psychopathology, 14*, 209-224.

Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition, 5,* 73-99.

Bruck, M., London, K., Landa, R., & Goodman, J. (2007). Autobiographical memory and suggestibility in children with autism spectrum disorder. *Development and Psychopathology, 19*, 73-95.

Buchanan, T. W., Etzel, J. A., Adolphs, R., & Tranel, D. (2006). The influence of autonomic arousal and semantic relatedness on memory for emotional words. *International Journal of Psychophysiology, 61*, 26-33.

Buchanan, T. W., Tranel, D., & Adolphs, R. (2006). Impaired memory retrieval correlates with individual differences in cortisol response but not autonomic response. *Learning & Memory, 13,* 382-387.

Bull, R. (2010). *Forensic Update, Special 100th Issue.* Winter 2009/2010. Leicester: The British Psychological Society, *100,* 13.

Burack, J. A. (1994). Selective attention deficits in persons with autism: Preliminary evidence of an inefficient attentional lens. *Journal of Abnormal Psychology, 103*, 535-543.

Burke, A., Heuer, F., & Reisberg, D. (1992). Remembering emotional events. *Memory & Cognition, 20,* 277-290.

Cahill, L., & McGaugh, J. L. (1995). A novel demonstration of enhanced memory associated with emotional arousal. *Consciousness and Cognition: An International Journal, 4,* 410-421.

Cahill, L., & McGaugh, J. L. (1998). Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neurosciences, 21*, 294-299.

Canli, T., Zhao, Z., Brewer, J., Gabrieli, J. D. E., & Cahill, L. (2000). Event-related activation in the human amygdala associates with later memory for individual emotional response. *The Journal of Neuroscience, 20,* RC99.

Caron, M. J., Mottron, L., Rainville, C., & Chouinard, S. (2004). Do high functioning persons with autism present superior spatial abilities? *Neuropsychologia, 42*, 467-481.

Cath, D. C., Ran, N., Smit, J. H., van Balkom, A. J. L. M., & Comijs, H. C. (2008). Symptom overlap between autism spectrum disorder, generalized social anxiety disorder and obsessive-compulsive disorder in adults: A preliminary case-controlled study. *Psychopathology, 41*, 101-110.

Chakrabarti, S., & Fombonne, E. (2001). Pervasive developmental disorders in preschool children. *JAMA: Journal of the American Medical Association, 285*, 3093-3099.

Chalfonte, B. L., & Johnson, M. K. (1996). Feature memory and binding in young and older adults. *Memory & Cognition, 24*, 403-416.

Christensen, K. J., Kim, S. W., Dysken, M. W., & Hoover, K. M. (1992). Neuropsychological performance in obsessive-compulsive disorder. *Biological Psychiatry, 31*, 4-18.

Christianson, S-Å. (1984). The relationship between induced emotional arousal and amnesia. *Scandinavian Journal of Psychology, 25*, 147-160.

Christianson, S-Å. (1987). Emotional and autonomic responses to visual traumatic stimuli. *Scandinavian Journal of Psychology, 28,* 83-87.

Christianson, S-Å. (1992). Emotional-stress and eyewitness memory - a critical-review. *Psychological Bulletin, 112*, 284-309.

Christianson, S-Å., & Loftus, E. F. (1991). Remembering emotional events: The fate of detailed information. *Cognition and Emotion, 5,* 81-108.

Christianson, S-Å., & Mjörndal, T. (1985). Adrenalin, emotional arousal and memory. *Scandinavian Journal of Psychology, 26*, 237-248.

Christianson, S-Å., & Nilsson, L.-G. (1984). Functional amnesia as induced by a psychological trauma. *Memory & Cognition, 12*, 142-155.

Ciesielski, K. T., Courchesne, E., & Elmasian, R. (1990). Effects of focused selective attention tasks on event-related potentials in autistic and normal individuals. *Electroencephalography & Clinical Neurophysiology, 75*, 207-220.

Clare, I. C. H., & Gudjonsson, G. H. (1993). Interrogative suggestibility, confabulation, and acquiescence in people with mild learning disabilities (mental handicap): Implications for reliability during police interrogations. *British Journal of Clinical Psychology, 32*, 295-301.

Clarke, C., & Milne, R. (2001). *National evaluation of the PEACE investigative interviewing course*. Police Research Award Scheme. London: Home Office.

Clarys, D., Bugaiska, A., Tapia, G. r., & Baudouin, A. (2009). Ageing, remembering, and executive function. *Memory, 17,* 158-168.

Clifford, B. R., & Hollin, C. R. (1981). Effects of the type of incident and the number of perpetrators on eyewitness memory. *Journal of Applied Psychology, 66*, 364-370.

Clifford, B. R., & Scott, J. (1978). Individual and situational factors in eyewitness testimony. *Journal of Applied Psychology, 63*, 352-359.

Constantino, J. N., & Todd, R. D. (2003). Autistic traits in the general population: A twin study. *Archives of General Psychiatry, 60*, 524-530.

Corden, B., Chilvers, R., & Skuse, D. (2008). Emotional modulation of perception in Asperger's syndrome. *Journal of Autism and Developmental Disorder, 38,* 1072-1080.

Corona, R., Dissanayake, C., Arbelle, S., Wellington, P., & Sigman, M. (1998). Is affect aversive to young children with autism? Behavioural and cardiac responses to experimenter distress. *Child Development, 69,* 1494-1502.

Corson, Y., & Verrier, N. (2007). Emotions and false memories: Valence or arousal? *Psychological Science, 18,* 208-211.

Corteen, R. S. (1969). Skin conductance changes and word recall. *British Journal of Psychology, 60,* 81-84.

Crane, L., & Goddard, L. (2008). Episodic and semantic autobiographical memory in adults with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 38*, 498-506.

Crane, L., Goddard, L., & Pring, L. (2009). Specific and general autobiographical knowledge in adults with autism spectrum disorders: The role of personal goals. *Memory, 17*, 557-576.

Dahlgren, S. O., & Trillingsgaard, A. (1996). Theory of mind in non-retarded children with autism and Asperger's syndrome: A research note. *Journal of Child Psychology and Psychiatry, 37*, 759-763.

Dando, C., Wilcock, R., & Milne, R. (2008). The cognitive interview: Inexperienced police officers' perceptions of their witness/victim interviewing practices. *Legal and Criminological Psychology, 13*, 59-70.

Darmala, S. R., Keller, T. A., Kana, R. K., Cherkassky, V. L., Williams, D. L., Minshew, N. J. & Just, M. A. (2010). Cortical underconnectivity coupled with preserved visuospatial cognition in autism: Evidence from an fMRI study of an embedded figures task. *Autism Research, 3,* 273-279.

Davies, G., & Milne, A. (1985). Eyewitness composite production: A function of mental or physical reinstatement of context. *Criminal Justice and Behavior*, *12*, 209-220.

Davis, M. R., McMahon, M., & Greenwood, K. M. (2005). The Efficacy of Mnemonic Components of the Cognitive Interview: Towards a Shortened Variant for Time-Critical Investigations. *Applied Cognitive Psychology, 19,* 75-93.

Dawson, G., Hill, D., Spencer, A., & Galpert, L. (1990). Affective exchanges between young autistic children and their mothers. *Journal of Abnormal Child Psychology, 18,* 335-345.

Dawson, G., & Watling, R. (2000). Interventions to facilitate auditory, visual, and motor integration in autism: a review of the evidence. *Journal of Autism and Developmental Disorders, 30,* 415-421.

Deffenbacher, K. A. (1983). The influence of arousal on reliability of testimony. In S. M. A. Lloyd-Bostock & B. R. Clifford (Eds.), *Evaluating witness evidence* (pp. 235-251). New York: Wiley.

Deffenbacher, K. A., Bornstein, B. H., Penrod, S. D., & McGorty, E. K. (2004). A Meta-Analytic Review of the Effects of High Stress on Eyewitness Memory. *Law and Human Behavior, 28,* 687-706.

Della Sala, S., Laiacona, M., Spinnler, H., & Trivelli, C. (1993). Autobiographical recollection and frontal damage. *Neuropsychologia, 31,* 823-839.

Department of Health. (2010). *Implementing Fulfilling and Rewarding Lives: Statutory guidance for local authorities and NHS organisations to support implementation of the autism strategy.* London: Department of Health.

Deruelle, C., Hubert, B., Santos, A., & Wicker, B. (2008). Negative emotion does not enhance recall skills in adults with autistic spectrum disorders. *Autism Research, 1,* 91-96.

Dornburg, C. C., & McDaniel, M. A. (2006). The cognitive interview enhances long-term free recall of older adults. *Psychology and Aging, 21*, 196-200.

Dresler, T., Mériau, K., Heekeren, H. R., & van der Meer, E. (2009). Emotional stroop task: effect of word arousal and subject anxiety on emotional interference. *Psychological Research/Psychologische Forschung, 73,* 364-371.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review, 66*, 183-201.

Ebbinghaus, H. (1885/1964). *Memory: A contribution to experimental psychology* (trans. H. A. Ruger & C. E. Bussenius). New York: Dover.

Edgin, J. O., & Pennington, B. F. (2005). Spatial cognition in autism spectrum disorders: superior, impaired, or just intact? *Journal of Autism and Developmental Disorders, 35*, 729-745.

Elliott, R., & Sahakian, B. J. (1995). The neuropsychology of schizophrenia: Relations with clinical and neurobiological dimensions. *Psychological Medicine, 25*, 581-594.

Eskes, G. A., Bryson, S. E., & McCormick, T. A. (1990). Comprehension of concrete and abstract words in autistic children. *Journal of Autism and Developmental Disorders, 20,* 61-73.

Eysenck, M. W. (1976). Arousal, learning, and memory. *Psychological Bulletin, 83*, 389-404.

Eysenck, M. W., & Byrne, A. (1994). Implicit memory bias, explicit memory bias, and anxiety. *Cognition and Emotion, 8,* 415-431.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6*, 409-434.

Eysenck, M. W., & Mogg, K. (1992). Clinical anxiety, trait anxiety, and memory bias. In S-Å Christianson (Ed.), *The handbook of emotion and memory: Research and theory.* (pp. 429-450). Hillsdale, NJ: Lawrence Erlbaum.

Farber, I. E., & Spence, K. W. (1953). Complex learning and conditioning as a function of anxiety. *Journal of Experimental Psychology, 45*, 120-125.

Farley, F. H. (1973). Memory storage in free recall learning as a function of arousal and time with homogeneous and heterogeneous lists. *Bulletin of the Psychonomic Society, 1*, 187-189.

Farrant, A., Blades, M., & Boucher, J. (1998). Source monitoring by children with autism. *Journal of Autism and Developmental Disorders, 28*, 43-50.

Fenigstein, A., & Vanable, P. A. (1992). Paranoia and self-consciousness. *Journal of Personality and Social Psychology, 62*, 129-138.

Fernandez, A.N., & Alonso, M. A. (2001). The relative value of environmental context reinstatement in *free recall. Psicología, 22*, 253-266.

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

Fisher, R. P., Geiselman, R. E., & Raymond, D. S. (1987). Critical analysis of police interview techniques. *Journal of Police Science and Administration, 15,* 177-185.

Fisher, R. P., & Schreiber, N. (2007). Interview protocols for improving eyewitness memory. In M. P. Toglia & J. D. Read & D. F. Ross & R. C. L. Lindsay (Eds.), *The handbook of eyewitness psychology, Vol I: Memory for events*. (pp. 53-80). Mahwah, NJ US: Lawrence Erlbaum.

Folkard, S., & Monk, T. H. (1980). Circadian rhythms in human memory. *British Journal of Psychology, 71,* 295-307.

Folstein, S., & Rutter, M. (1977). Infantile autism: A genetic study of 21 twin pairs. *Journal of Child Psychology and Psychiatry, 18*, 297-321.

Friedman, A. (1979). Framing pictures: The role of knowledge in automatized encoding and memory for gist. *Journal of Experimental Psychology: General, 108*, 316-355.

Frith, U. (1989). *Autism: Explaining the enigma*. Oxford: Blackwell.

Gabbert, F., Memon, A., & Allan, K. (2003). Memory conformity: Can eyewitnesses influence each other's memories for an event? *Applied Cognitive Psychology, 17,* 533-543.

Gabig, C. S. (2008). Verbal working memory and story retelling in school-age chidlren with autism. *Language, Speech, and Hearing Servives in Schools, 39,* 498-511.

Gaigg, S. B., & Bowler, D. M. (2008). Free recall and forgetting of emotionally arousing words in autism spectrum disorder. *Neuropsychologia, 46,* 2336-2343.

Gaigg, S. B., & Bowler, D. M. (2009). Illusory memories of emotionally charged words in autism spectrum disorder: Further evidence for atypical emotion processing outside the social domain. *Journal of Autism and Developmental Disorders, 39*, 1031-1038.

Gaigg, S. B., Gardiner, J. M., & Bowler, D. M. (2008). Free recall in autism spectrum disorder: The role of relational and item-specific encoding. *Neuropsychologia, 46*, 983-992.

Garcia-Bajos, E., & Migueles, M. (2003). False memories for script actions in a mugging account. *European Journal of Cognitive Psychology, 15*, 195-208.

Garcia-Bajos, E., Migueles, M., & Anderson, M. C. (2009). Script knowledge modulates retrieval-induced forgetting for eyewitness events. *Memory, 17*, 92-103.

Gardiner, J. M., Bowler, D. M., & Grice, S. J. (2003). Further evidence of preserved priming and impaired recall in adults with Asperger's syndrome. *Journal of Autism and Developmental Disorders, 33*, 259-269.

Geiselman, R. E. (1984). Enhancement of eyewitness memory: An empirical evaluation of the cognitive interview. *Journal of Police Science & Administration, 12*, 74-80.

Geiselman, R. E., Fisher, R. P., Firstenberg, I., Hutton, L. A., Sullivan, S. J., Avetissian, I. V., & Prosk, A. L. (1984). Enhancement of eyewitness memory: An empirical evaluation of the cognitive interview. *Journal of Police Science & Administration, 12,* 74–80.

Geiselman, R. E., Fisher, R. P., Mackinnon, D. P., & Holland, H. L. (1986). Enhancement of eyewitness memory with the cognitive interview. *American Journal of Psychology, 99,* 385-401.

Geiselman, R. E., & Padilla, J. (1988). Cognitive interviewing with child witnesses. *Journal of Police Science and Administration, 16,* 236-242.

George, R. C., & Clifford, B. (1992). Making the most of witnesses. *Policing, 8*, 185-198.

Geurts, H. M., Corbett, B., & Solomon, M. (2009). The paradox of cognitive flexibility in autism. *Trends in Cognitive Sciences, 13*, 74-82.

Gillberg, C. (1995). Autism and its spectrum disorders: Epidemiology and neurobiology. *Japanese Journal of Child and Adolescent Psychiatry, 36*, 342-369.

Gillott, A., Furniss, F., & Walter, A. (2001). Anxiety in high-functioning children with autism. *Autism, 5,* 277-286.

Gillott, A., & Standen, P. J. (2007). Levels of anxiety and sources of stress in adults with autism. *Journal of Intellectual Disabilities, 11,* 359-370.

Goddard, L., Howlin, P., Dritschel, B., & Patel, T. (2007). Autobiographical memory and social problem-solving in Asperger syndrome. *Journal of Autism and Developmental Disorders, 37,* 291-300.

Goldberg, M. C., Mostofsky, S. H., Cutting, L. E., Mahone, E. M., Astor, B. C., Denckla, M. B., & Landa, R. J. (2005). Subtle Executive Impairment in Children with Autism and Children with ADHD. *Journal of Autism and Developmental Disorders, 35*, 279-293.

Goldstein, G., Minshew, N. J., & Siegel, D. J. (1994). Age differences in academic achievement in high-functioning autistic individuals. *Journal of Clinical and Experimental Neuropsychology, 16*, 671-680.

Gras-Vincendon, A., Mottron, L., Salame, P., Bursztejn, C., & Danion, J.-M. (2007). Temporal context memory in high-functioning autism. *Autism, 11*, 523-534.

Green, J., Gilchrist, A., Burton, D., & Cox, A. (2000). Social and psychiatric functioning in adolescents with Asperger syndrome compared with conduct disorder. *Journal of Autism and Developmental Disorders, 30*, 279-293.

Greffeuille, C., Ginet, M., & Guimond, S. (2004). Memory accuracy of eyewitnesses in a case of rape: Effects of stereotypes and gender. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition, 22*, 479-496.

Griffith, E. M., Pennington, B. F., Wehner, E. A., & Rogers, S. J. (1999). Executive functions in young children with autism. *Child Development, 70,* 817-832.

Gudjonsson, G. H. (1988). Interrogative suggestibility: Its relationship with assertiveness, social-evaluative anxiety, state anxiety and method of coping. *British Journal of Clinical Psychology, 27*, 159-166.

Gudjonsson, G. H. (1997). *The Gudjonsson Suggestibility Scales Manual*. Hove, UK: Psychology Press.

Gudjonsson, G. H., & Clark, N. K. (1986). Suggestibility in police interrogation: A social psychological model. *Social Behaviour, 1,* 83-104.

Gudjonsson, G. H., & Henry, L. (2003). Child and adult witnesses with intellectual disability: The importance of suggestibility. *Legal and Criminological Psychology, 8*, 241-252.

Gudjonsson, G. H., Sigurdsson, J. F., Brynjólfsdóttir, B., & Hreinsdóttir, H. (2002). The relationship of compliance with anxiety, self-esteem, paranoid thinking and anger. *Psychology, Crime & Law, 8*, 145-153.

Hala, S., Rasmussen, C., & Henderson, A. M. E. (2005). Three types of source monitoring by children with and without autism: the role of executive function. *Journal of Autism and Developmental Disorders, 35*, 75-89.

Happé, F. G. E. (1994). Wechsler IQ profile and theory of mind in autism: A research note. *Journal of Child Psychology and Psychiatry, 35,* 1461-1471.

Happé, F. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development, 66*, 843-855.

Happé, F. G. E. (1996). Studying weak central coherence at low levels: Children with autism do not succumb to visual illusions. A research note. *Journal of Child Psychology and Psychiatry, 37*, 873-877.

Happé, F. G. E. (1997). Central coherence and theory of mind in autism: Reading homographs in context. *British Journal of Developmental Psychology, 15*, 1-12.

Happé, F. (1999). Autism: Cognitive deficit or cognitive style? *Trends in Cognitive Sciences, 3*, 216-222.

Happé, F., Briskman, J., & Frith, U. (2001). Exploring the cognitive phenotype of autism: Weak 'central coherence' in parents and siblings of children with autism: I. Experimental tests. *Journal of Child Psychology and Psychiatry, 42*, 299-307.

Happé, F., & Frith, U. (1996). The neuropsychology of autism. *Brain: A Journal of Neurology, 119*, 1377-1400.

Happé, F., & Frith, U. (2006). The weak coherence account: detail-focused cognitive style in autism spectrum disorders. *Journal of Autism and Developmental Disorders, 36*, 5-25.

Happé, F., Ronald, A., & Plomin, R. (2006). Time to give up on a single explanation for autism. *Nature Neuroscience, 9*, 1218-1220.

Hare, D. J., Gould, J., Mills, R., & Wing, L. (1999). *A preliminary study of individuals with autistic spectrum disorders in three special hospitals in England.* London: National Autistic Society.

Hare, D. J., Mellor, C., & Azmi, S. (2007). Episodic memory in adults with autistic spectrum disorders: Recall for self- versus other-experienced events. *Research in Developmental Disabilities, 28*, 317-329.

Hare, R., Wood, K., Britain, S., & Frazelle, J. (1971). Autonomic responses to affective visual stimulation: Sex differences. *Journal of Experimental Research in Personality, 5,* 14-22.

Hekkanen, S. T., & McEvoy, C. (2005). Source monitoring in eyewitness memory: Implicit associations, suggestions, and episodic traces. *Memory & Cognition, 33*, 759-769.

Henkel, L. A., Johnson, M. K., & De Leonardis, D. M. (1998). Aging and source monitoring: Cognitive processes and neuropsychological correlates. *Journal of Experimental Psychology: General, 127*, 251-268.

Hermelin, B., & O'Connor, N. (1967). Remebering of words by psychotic and subnormal children. *British Journal of Psychology, 58,* 213-218.

Hermelin, B., & O'Connor, N. (1970). *Psychological experiments with autistic children.* Oxford: Pergamon.

Hermelin, B., & Frith, U. (1971). Psychological studies of childhood autism: Can autistic children make sense of what they see and hear? *The Journal of Special Education, 5,* 107-117.

Heuer, F., & Reisberg, D. (1990). Vivid memories of emotional events: The accuracy of remembered minutiae. *Memory & Cognition, 18*, 496-506.

Hill, E. L. (2004). Evaluating the theory of executive dysfunction in autism. *Developmental Review, 24*, 189-233.

Hill, E. L., & Bird, C. M. (2006). Executive processes in Asperger syndrome: Patterns of performance in a multiple case series. *Neuropsychologia, 44,* 2822-2835.

Hill, E. L., & Russell, J. (2002). Action memory and self-monitoring in children with autism: Self versus other. *Infant and Child Development, 11*, 159-170.

Hobson, R. P. (1989). Beyond cognition: A theory of autism. In G. Dawson (Ed.), *Autism: Nature, diagnosis, and treatment.* (pp. 22-48). New York: Guilford Press.

Hobson, R. P. (1991). Methodological issues for experiments on autistic individuals' perception and understanding of emotion. *Journal of Child Psychology and Psychiatry, 32,* 1135-1158.

Hobson, R. P. (1993). The emotional origins of social understanding. *Philosophical Psychology, 6,* 227-249.

Hobson, R.P. (2002). *The Cradle of Thought.* London: Pan MacMillan.

Hobson, R. P., Ouston, J., & Lee, A. (1988). Emotion recognition in autism: Coordinating faces and voices. *Psychological Medicine, 18*, 911-923.

Holland, C. A., & Rabbitt, P. M. (1990). Autobiographical and text recall in the elderly: An investigation of a processing resource deficit. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 42*, 441-470.

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

Home Office. (1985). Police and Criminal Evidence Act 1984 (s. 66), *Codes of Practice*. London: HMSO.

Home Office. (1999). *Youth Justice and Criminal Evidence Act.* London: HMSO.

Home Office (2002). *Achieving the best evidence in criminal proceedings: Guidance for vulnerable and intimidated witnesses, including children*. London: HMSO.

Home Office. (2007). *Achieving Best Evidence in Criminal Proceedings: Guidance on interviewing victims and witnesses, and using special measures (second edition).* London: HMSO.

Home Office (2011). *Achieving Best Evidence in Criminal Proceedings: Guidance on interviewing victims and witnesses, and guidance on using special measures (third edition).* London: HMSO.

Howlin, P. (1997). *Autism: Preparing for adulthood*. London: Routledge.

Huff, C. R., Rattner, A., & Sagarin, E. (1996). *Convicted but innocent: Wrongful convictions and public policy.* London: Sage.

Hughes, C., & Russell, J. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism. *Developmental Psychology, 29*, 498-510.

Hughes, C., Russell, J., & Robbins, T. W. (1994). Evidence for executive dysfunction in autism. *Neuropsychologia, 32*, 477-492.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin, 114*, 3-28.

Jolliffe, T., & Baron-Cohen, S. (1997). Are people with autism and Asperger syndrome faster than normal on the Embedded Figures Test? *Journal of Child Psychology and Psychiatry, 38,* 527-534.

Jolliffe, T., & Baron-Cohen, S. (2001). A test of central coherence theory: Can adults with high-functioning autism or Asperger syndrome integrate objects in context? *Visual Cognition, 8*, 67-101.

Joesph, R. M., McGrath, L. M. & Tager-Flusberg, H. (2005). Executive dysfunction and its relation to language ability in verbal school-age children with autism. *Developmental Neuropsychology, 27,* 361-378.

Just, M. A., Cherkassky, V. L., Keller, T. A., & Minshew, N. J. (2004). Cortical activation and synchronization during sentence comprehension in high-functioning autism: Evidence of underconnectivity. *Brain: A Journal of Neurology, 127*, 1811-1821.

Kamio, Y., & Toichi, M. (2000). Dual access to semantics in autism: Is pictorial access superior to verbal access? *Journal of Child Psychology and Psychiatry, 41,* 859-867.

Kamio, Y., & Toichi, M. (2007). Memory illusion in high-functioning autism and Asperger's disorder. *Journal of Autism and Developmental Disorders, 37*, 867-876.

Kamio, Y., Wolf, J., & Fein, D. (2006). Automatic processing of emotional faces in high-functioning pervasive developmental disorders: an affective priming study. *Journal of Autism and Developmental Disorders, 36,* 155-167.

Kana, R. K., Keller, T. A., Cherkassky, V. L., Minshew, N. J., & Just, M. A. (2006). Sentence comprehension in autism: Thinking in pictures with decreased functional connectivity. *Brain: A Journal of Neurology, 129*, 2484-2493.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*, 217-250.

Kaplan, R., & Kaplan, S. (1969). The arousal-retention interval interaction revisited: The effects of some procedural changes. *Psychonomic Science, 15*, 84-85.

Kasari, C., Sigman, M. D., Baumgartner, P., & Stipek, D. J. (1993). Pride and mastery in children with autism. *Journal of Child Psychology and Psychiatry, 34,* 353-362.

Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1990). Affective sharing in the context of joint attention interactions of normal, autistic, and mentally retarded children. *Journal of Autism and Developmental Disorders, 20,* 87-100.

Kassin, S. M., Ellsworth, P. C., & Smith, V. L. (1989). The general acceptance of psychological-research on eyewitness testimony - a survey of the experts. *American Psychologist, 44,* 1089-1098.

Kassin, S. M., Tubb, V. A., Hosch, H. M., & Memon, A. (2001). On the 'general acceptance' of eyewitness testimony research: A new survey of the experts. *American Psychologist, 56*, 405-416.

Kebbell, M. R., Hatton, C., & Johnson, S. D. (2004). Witnesses with intellectual disabilities in court: What questions are asked and what influence do they have? *Legal and Criminological Psychology, 9*, 23-3

Kebbell, M. R., Hurren, E. J., & Roberts, S. (2006). Mock-suspects' Decisions to Confess: The Accuracy of Eyewitness Evidence is Critical. *Applied Cognitive Psychology, 20,* 477-486.

Kebbell, M. R., & Milne, R. (1998). Police officers' perceptions of eyewitness performance in forensic investigations. *The Journal of Social Psychology, 138,* 323-330.

Kebeck, G., & Lohaus, A. (1986). Effect of emotional arousal on free recall of complex material. *Perceptual and Motor Skills, 63*, 461-462.

Kensinger, E. A. (2009). Remembering the details: Effects of emotion. *Emotion Review, 1*, 99-113.

Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition, 31*, 1169-1180.

Klein, S. B., Chan, R. L., & Loftus, J. (1999). Independence of episodic and semantic self-knowledge: The case from autism. *Social Cognition, 17*, 413-436.

Kleinsmith, L. J., & Kaplan, S. (1963). Paired-associate learning as a function of arousal and interpolated interval. *Journal of Experimental Psychology, 65,* 190-193.

Kleinsmith, L. J., & Kaplan, S. (1964). Interaction of arousal and recall interval in nonsense syllable paired-associate learning. *Journal of Experimental Psychology, 67*, 124-126.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002a). Visual fixation patterns during viewing of naturalistic social situations as predictors of social competence in individuals with autism. *Archives of General Psychiatry, 59*, 809-816.

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002b). Defining and quantifying the social phenotype in autism. *The American Journal of Psychiatry, 159*, 909-916.

Klin, A., Saulnier, C. A., Sparrow, S. S., Cicchetti, D. V., Volkmar, F. R., & Lord, C. (2007). Social and communication abilities and disabilities in higher functioning individuals with autism spectrum disorders: the Vineland and the ADOS. *Journal of Autism and Developmental Disorders, 37,* 748-759.

Klorman, R., Weissberg, R. P., & Wiesenfeld, A. R. (1977). Individual differences in fear and autonomic reactions to affective stimulation. *Psychophysiology, 14*, 45-51.

Kohnken, G., Milne, R., Memon, A., & Bull, R. (1999). The cognitive interview: A meta-analysis. *Psychology, Crime & Law, 5,* 3-27.

Kopelman, M. D., Guinan, E. M., & Lewis, P. D. R. (1995). Delusional memory, confabulation and frontal lobe dysfunction: A case study in De Clerambault's syndrome. *Neurocase, 1*, 71-77.

Koshino, H., Carpenter, P. A., Minshew, N. J., Cherkassky, V. L., Keller, T. A., & Just, M. A. (2005). Functional connectivity in an fMRI working memory task in high-functioning autism. *Neuroimage, 24*, 810-821.

Kuhlmann, S., Piel, M., & Wolf, O. T. (2005). Impaired memory retrieval after psychosocial stress in healthy young men. *Journal of Neuroscience, 25*, 2977-2982.

Kuusikko, S., Pollock-Wurman, R., Jussila, K., Carter, A. S., Mattila, M.-L., Ebeling, H., Pauls, D. L., & Moilanen, I. (2008). Social anxiety in high-functioning children and adolescents with autism and Asperger syndrome. *Journal of Autism and Developmental Disorders, 38*, 1697-1709.

Landa, R. J., & Goldberg, M. C. (2005). Language, social, and executive functions in high functioning autism: a continuum of performance. *Journal of Autism and Developmental Disorders, 35,* 557-573.

Langdon, R. (2005). Theory of Mind in Schizophrenia. In B. F. Malle & S. D. Hodges (Eds.), *Other minds: How humans bridge the divide between self and others.* (pp. 323-342). New York: Guilford Press.

La Rooy, D. L., & Dando, C. Witness interviewing. In G. J. Towl & D. A. Crighton (Eds.), *Forensic psychology.* (pp. 195-209): Ipswitch, MA: Wiley-Blackwell.

Le Couteur, A., Bailey, A., Goode, S., & Pickles, A. (1996). A broader phenotype of autism: The clinical spectrum in twins. *Journal of Child Psychology and Psychiatry, 37*, 785-801.

Leary, M. R. (1983). A brief version of the fear of negative evaluation scale. *Personality and Social Psychology Bulletin, 9*, 371-375.

Leekam, S. R., Libby, S. J., Wing, L., Gould, J., & Taylor, C. (2002). The Diagnostic Interview for Social and Communication Disorders: Algorithms for ICD-10 childhood autism and Wing and Gould autistic spectrum disorder. *Journal of Child Psychology and Psychiatry, 43*, 327-342.

Lemanek, K. L., Stone, W. L., & Fishel, P. T. (1993). Parent-child interactions in handicapped preschoolers: The relation between parent behaviors and compliance. *Journal of Clinical Child Psychology, 22*, 68-77.

Leslie, A. M. (1987). Pretense and representation: The origins of 'theory of mind.'. *Psychological Review, 94*, 412-426.

Levonian, E. (1967). Retention of information in relation to arousal during continuously-presented material. *American Educational Research Journal, 4,* 103-116.

Lifshitz, H., Shtein, S., Weiss, I., & Vakil, E. (2011). Meta-analysis of explicit memory studies in populations with intellectual disability*. European Journal of Special Needs Education, 26,* 93-111.

Lincoln, A. J., Courchesne, E., Kilman, B. A., & Elmasian, R. (1988). A study of intellectual abilities in high-functioning people with autism. *Journal of Autism and Developmental Disorders, 18,* 505-524.

Lind, S., & Bowler, D. (2008). Episodic memory and autonoetic consciousness in autistic spectrum disorders: The roles of self-awareness, representational abilities and temporal cognition. In J. Boucher & D. Bowler (Eds.), *Memory in autism: Theory and evidence.* (pp. 166-187). New York: Cambridge University Press.

Lind, S. E., & Bowler, D. M. (2009). Recognition memory, self-other source memory, and theory-of-mind in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 39*, 1231-1239.

Lind, S. E., & Bowler, D. M. (2010). Episodic memory and episodic future thinking in adults with autism. *Journal of Abnormal Psychology, 119*, 896-905.

Lindsay, D. S. (1990). Misleading suggestions can impair eyewitnesses' ability to remember event details. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*, 1077-1083.

Lindsay, D. S., & Johnson, M. K. (1989). The eyewitness suggestibility effect and memory for source. *Memory & Cognition, 17,* 349-358.

Loftus, E. F. (1979). Reactions to blatantly contradictory information. *Memory & Cognition, 7,* 368-374.

Loftus, E. F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory, 12,* 361-366.

Loftus, E. F., & Burns, T. E. (1982). Mental shock can produce retrograde-amnesia. *Memory & Cognition, 10*, 318-323.

Loftus, E. F., Loftus, G. R., & Messo, J. (1987). Some facts about 'weapon focus'. *Law and Human Behavior, 11*, 55-62.

Loftus, E. F., Miller, D. G., & Burns, H. J. (1978). Semantic integration of verbal information to a visual memory. *Journal of Experimental Psychology-Human Learning and Memory, 4,* 19-31.

Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning & Verbal Behavior, 13,* 585-589.

López, B., & Leekam, S. R. (2003). Do children with autism fail to process information in context? *Journal of Child Psychology and Psychiatry, 44*, 285-300.

López, B. R., Lincoln, A. J., Ozonoff, S., & Lai, Z. (2005). Examining the relationship between executive functions and restricted, repetitive symptoms of autistic disorder. *Journal of Autism and Developmental Disorders, 35*, 445-460.

Lord, C., Rutter, M., DiLavore, P., & Risi, S. (1999). *Autism Diagnostic Observation Schedule–Generic*. Los Angeles: Western Psychological Services.

Loth, E., Gomez, J. C., & Happé, F. (2008a). Event schemas in autism spectrum disorders: The role of theory of mind and weak central coherence. *Journal of Autism and Developmental Disorders, 38,* 449-463.

Loth, E., Gomez, J. C., & Happé, F. (2008b). Detecting changes in naturalistic scenes: Contextual inconsistency does not influence spontaneous attention in high-functioning people with autism spectrum disorder. *Autism, 1*, 179-188.

Lotter, V. (1966). Epidemiology of autistic conditions in young children: I. Prevalence. *Social Psychiatry, 1,* 124-137.

Loveland, K. A., & Tunali, B. (1991). Social scripts for conversational interactions in autism and Down syndrome. *Journal of Autism and Developmental Disorders, 21*, 177-186.

Loveland, K. A., & Tunali, B. (1993). 'Narrative language in autism and the theory of mind hypothesis: A wider perspective'. In S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds.), Understanding other minds. *Perspectives from autism* (pp. 247–266). Oxford: Oxford University Press.

Luna, K. & Migueles, M. (2008). Typicality and misinformation: Two sources of distortion. *Psicologica, 29,* 171-187.

Maltzman, I., Kantor, W., & Langdon, B. (1966). Immediate and delayed retention, arousal, and the orienting and defensive reflexes. *Psychonomic Science, 6*, 445-446.

Maras, K. L. & Bowler, D. M. (2010). The cognitive interview for eyewitnesses with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 40,* 1350-1360.

Maras, K. L. & Bowler, D. M. (2011). Brief report: schema consistent misinformation effects in eyewitnesses with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 41*, 815-820.

Maras, K. L. & Bowler, D. M. (in press). Context reinstatement effects on eyewitness memory in autism spectrum disorder. *British Journal of Psychology.*

Maras, K. L., Gaigg, S. B. & Bowler, D. M. (in press). Memory for emotionally arousing events over time in autism spectrum disorder. *Emotion.*

McClelland, J. L., McNaughton, B. L., & O'Reilly, R. C. (1995). Why there are complementary learning systems in the hippocampus and neocortex: Insights from the successes and failures of connectionist models of learning and memory. *Psychological Review, 102,* 419-457.

McCloskey, M., & Zaragoza, M. (1985). Misleading postevent information and memory for events - arguments and evidence against memory impairment hypotheses. *Journal of Experimental Psychology-General, 114*, 1-16.

McCrory, E., Henry, L. A., & Happé, F. (2007). Eye-witness memory and suggestibility in children with Asperger syndrome. *Journal of Child Psychology and Psychiatry, 48*, 482-489.

Meissner, C. A. (2002). Applied aspects of the instructional bias effect in verbal overshadowing. *Applied Cognitive Psychology, 16*, 911-928.

Melton, A. W. (1963). Implications of short-term memory for a general theory of memory. *Journal of Verbal Learning and Verbal Behavior, 2*, 1-21.

Memon, A., & Köhnken, G. (1992). Helping witnesses to remember more: The cognitive interview. *Expert Evidence*, 39-49.

Memon, A., Meissner, C. A., & Fraser, J. (2010). The cognitive interview: A meta-analytic review and study space analysis of the past 25 years. *Psychology, Public Policy, & Law, 16,* 340-372.

Memon, A., & Stevenage, S. V. (1996). Interviewing witnesses: What works and what doesn't. *Psycholoquy, 7.*

Memon, A., Wark, L., Bull, R., & Koehnken, G. (1997). Isolating the effects of the cognitive interview techniques. *British Journal of Psychology, 88*, 179-197.

Mercadante, M. T., Macedo, E. C., Baptista, P. c. M., Paula, C. S., & Schwartzman, J. S. (2006). Saccadic movements using eye-tracking technology in individuals with autism spectrum disorders. *Arquivos de Neuro-Psiquiatria, 64*, 559-562.

Mesibov, G. B., Shea, V., & Schopler, E. (2005). *The TEACCH Approach to Autism Spectrum Disorders.* New York: Kluwer.

Millward, C., Powell, S., Messer, D., & Jordan, R. (2000). Recall for self and other in autism: Children's memory for events experienced by themselves and their peers. *Journal of Autism and Developmental Disorders, 30*, 15-28.

Milne, R., & Bull, R. (1999). *Investigative interviewing: Psychology and practice.* Chicester: Wiley.

Milne, R., Clare, I. C. H., & Bull, R. (1999). Using the cognitive interview with adults with mild learning disabilities. *Psychology, Crime & Law, 5,* 81-99.

Ministry of Justice (2008). Criminal Statistics: England and Wales 2007 Statistics Bulletin.

Ministry of Justice (2010). *Criminal Statistics: England and Wales 2009 Statistics bulletin.* Retrieved from http://www.justice.gov.uk/publications/statistics.htm.

Minshew, N. J., & Goldstein, G. (1993). Is autism an amnesic disorder? Evidence from the California Verbal Learning Test. *Neuropsychology, 7,* 209-216.

Minshew, N. J., & Goldstein, G. (2001). The pattern of intact and impaired memory functions in autism. *Journal of Child Psychology and Psychiatry, 42*, 1095-1101.

Minshew, N. J., Goldstein, G., Muenz, L. R., & Payton, J. B. (1992). Neuropsychological functioning nonmentally retarded autistic individuals. *Journal of Clinical and Experimental Neuropsychology, 14,* 749-761.

Minshew, N. J., Luna, B., & Sweeney, J. A. (1999). Oculomotor evidence for neocortical systems but not cerebellar dysfunction in autism. *Neurology, 52*, 917-922.

Mintzer, M. Z. (2007). The acute effects of alcohol on memory: A review of laboratory studies in healthy adults. *International Journal on Disability and Human Development, 6*, 397-403.

Morris, R. G., Rowe, A., Fox, N., Feigenbaum, J. D., Miotto, E. C., & Howlin, P. (1999). Spatial working memory in Asperger's syndrome and in patients with focal frontal and temporal lobe lesions. *Brain and Cognition, 41*, 9-26

Moscovitch, M., & Melo, B. (1997). Strategic retrieval and the frontal lobes: Evidence from confabulation and amnesia. *Neuropsychologia, 35*, 1017-1034.

Mottron, L., Belleville, S., Stip, E., & Morasse, K. (1998). Atypical memory performance in an autistic savant. *Memory, 6*, 593-607.

Mottron, L., & Burack, J. A. (2001). Enhanced perceptual functioning in the development of autism. In J. A. Burack & T. Charman & N. Yirmiya & P. R. Zelazo (Eds.), *The development of autism: Perspectives from theory and research.* (pp. 131-148). Mahwah, NJ US: Lawrence Erlbaum.

Mottron, L., Burack, J. A., Iarocci, G., Belleville, S., & Enns, J. T. (2003). Locally oriented perception with intact global processing among adolescents with high-functioning autism: Evidence from multiple paradigms. *Journal of Child Psychology and Psychiatry, 44*, 904-913.

Mottron, L., Dawson, M., Souliéres, I., Hubert, B., & Burack, J. (2006). Enhanced perceptual functioning in autism: an update, and eight principles of autistic perception. *Journal of Autism and Developmental Disorders, 36,* 27-43.

Mottron, L., Morasse, K., & Belleville, S. (2001). A study of memory functioning in individuals with autism. *Journal of Child Psychology and Psychiatry, 42*, 253-260.

Mundy, P., Sigman, M., Kasari, C., Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. J. (1994). The theory of mind and joint-attention deficits in autism. In *Understanding other minds: Perspectives from autism*. (pp. 181-203). New York: Oxford University Press.

National-Crime-Faculty. (1996). *Investigative interviewing: A practical guide*. Bramshill, UK: National Crime Faculty and National Police Training.

Neyman, J. & Pearson, E. S. (1928). On the use and interpretation of certain test criteria for purposes of statistical inference. Part I and II. *Biometrika, 20*, 174-240, 263-294.

North, A. S., Russell, A. J., & Gudjonsson, G. H. (2008). High functioning autism spectrum disorders: an investigation of psychological vulnerabilities during interrogative interview. *Journal of Forensic Psychiatry & Psychology, 19,* 323-334.

O'Connor, N. & Hermelin, B. (1967) Auditory and visual memory in autistic and normal children. *Journal of Mental Deficiency Research*, *11*, 126-131.

O'Hearn, K., Asato, M., Ordaz, S., & Luna, B. (2008). Neurodevelopment and executive function in autism. *Development and Psychopathology, 20*, 1103-1132.

O'Mahony, B. M. (2010). The emerging role of the registered intermediary with the vulnerable witness and offender: Facilitating communication with the police and members of the judiciary. *British Journal of Learning Disabilities, 38,* 232-237.

O'Riordan, M. A., Plaisted, K. C., Driver, J., & Baron-Cohen, S. (2001). Superior visual search in autism. *Journal of Experimental Psychology: Human Perception and Performance, 27*, 719-730.

O'Shea, A. G., Fein, D. A., Cillessen, A. H. N., Klin, A., & Schultz, R. T. (2005). Source memory in children with autism spectrum disorders. *Developmental Neuropsychology, 27*, 337-360.

Ozonoff, S., & Jensen, J. (1999). Specific executive function profiles in three neurodevelopmental disorders. *Journal of Autism and Developmental Disorders, 29*, 171-177.

Ozonoff, S., Pennington, B. F., & Rogers, S. J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry, 32,* 1081-1105.

Ozonoff, S., & Strayer, D. L. (1997). Inhibitory function in nonretarded children with autism. *Journal of Autism and Developmental Disorders, 27*, 59-77.

Ozonoff, S., Strayer, D. L., McMahon, W. M., & Filloux, F. (1994). Executive function abilities in autism and Tourette syndrome: An information processing approach. *Journal of Child Psychology and Psychiatry, 35*, 1015-1032.

Parkin, A. J. (1997). The neuropsychology of false memory. *Learning and Individual Differences, 9,* 341-357.

Paterson, H. M., & Kemp, R. I. (2006). Co-witnesses talk: A survey of eyewitness discussion. *Psychology, Crime & Law, 12*, 181-191.

Pellicano, E., Gibson, L., Maybery, M., Durkin, K., & Badcock, D. R. (2005). Abnormal global processing along the dorsal visual pathway in autism: A possible mechanism for weak visuospatial coherence? *Neuropsychologia, 43*, 1044-1053.

Pennington, B. F., & Ozonoff, S. (1996). Executive functions and developmental psychopathology. *Journal of Child Psychology and Psychiatry, 37*, 51-87.

Perner, J. (2001). Episodic memory: Essential distinctions and developmental implications. In C. Moore & K. Lemmon (Eds.), *The self in time: Developmental perspectives.* (pp. 181-202). Mahwah, NJ: Lawrence Erlbaum.

Perner, J., Kloo, D., & Gornik, E. (2007). Episodic memory development: Theory of mind is part of re-experiencing experienced events. *Infant and Child Development, 16,* 471-490.

Perner, J., & Ruffman, T. (1995). Episodic memory an autonoetic consciousness: Developmental evidence and a theory of childhood amnesia. *Journal of Experimental Child Psychology, 59*, 516-548.

Petersilia, J. R. (2001). Crime victims with developmental disabilities - A review essay. *Criminal Justice and Behavior, 28*, 655-694.

Petersilia, J., Foote, J., & Crowell, N. A. (2001). *Crime victims with developmental disabilities: Report of a workshop*. Washington, DC: National Research Council.

Plaisted, K. C. (2001). Reduced generalization in autism: An alternative to weak central coherence. In J. A. Burack & T. Charman & N. Yirmiya & P. R. Zelazo (Eds.), *The development of autism: Perspectives from theory and research.* (pp. 149-169). Mahwah, NJ US: Lawrence Erlbaum.

Plaisted, K. C., Swettenham, J., & Rees, L. (1999). Children with autism show local precedence in a divided attention task and global precedence in a selective attention task. *Journal of Child Psychology and Psychiatry, 40*, 733-742.

Poirier, M., & Martin, J. S. (2008). Working memory and immediate memory in autism spectrum disorders. In J. Boucher & D. M. Bowler (Eds.), *Memory in Autism* (pp. 231-248). Cambridge: Cambridge University Press.

Poirier, M., Martin, J. S., Gaigg, S. B., & Bowler, D. M. (2011). Short-term memory in autism spectrum disorder. *Journal of Abnormal Psychology, 120,* 247-252.

Powell, S. D., & Jordan, R. R. (1993). Being subjective about autistic thinking and learning to learn. *Educational Psychology, 13*, 359-370.

Pring, L. (2005). Autism and blindness: Building on the sum of their parts. In *Autism and blindness: Research and reflections.* (pp. 1-9). Philadelphia, PA US: Whurr Publishers.

Rabbitt, P. (1997). *Methodology of Frontal and Executive Function*. Hove UK: Psychology Press.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory & Cognition, 21*, 89-102.

Rapin, I., & Dunn, M. (2003). Update on the language disorders of individuals on the autistic spectrum. *Brain & Development, 25*, 166-172.

Ray, S., & Bates, M. E. (2006). Acute alcohol effects on repetition priming and word recognition memory with equivalent memory cues. *Brain and Cognition, 60,* 118-127.

Reddy, V., Williams, E., Costantini, C., & Lang, B. (2010). Engaging with the self: Mirror behaviour in autism, Down syndrome and typical development. *Autism, 14*, 531-546.

Reisberg, D. & Heuer, F. (2004). Memory for Emotional Events. In *Memory and emotion.* (pp. 3-41). New York: Oxford University Press.

Remington, A., Swettenham, J., Campbell, R., & Coleman, M. (2009). Selective attention and perceptual load in autism spectrum disorder. *Psychological Science, 20*, 1388-1393.

Renner, P., Klinger, L. G., & Klinger, M. R. (2000). Implicit and explicit memory in autism: Is autism an amnesic disorder? *Journal of Autism and Developmental Disorders, 30*, 3-14.

Riby, D., & Hancock, P. J. B. (2009). Looking at movies and cartoons: Eye-tracking evidence from Williams syndrome and autism. *Journal of Intellectual Disability Research, 53*, 169-181.

Riby, D. M., & Hancock, P. J. B. (2008). Viewing it differently: Social scene perception in Williams syndrome and autism. *Neuropsychologia, 46*, 2855-28600.

Ridley, A. M., & Clifford, B. R. (2004). The Effects of Anxious Mood Induction on Suggestibility to Misleading Post-event Information. *Applied Cognitive Psychology, 18,* 233-244.

Rinehart, N. J., Bradshaw, J. L., Moss, S. A., Brereton, A. V., & Tonge, B. J. (2001). A deficit in shifting attention present in high-functioning autism but not Asperger's disorder. *Autism, 5*, 67-80.

Roediger, H. L., III, Meade, M. L., & Bergman, E. T. (2001). Social contagion of memory. *Psychonomic Bulletin & Review, 8*, 365-371.

Roediger, H. L., III, Weldon, M. S., Challis, B. H., & Craik, F. I. M. (1989). Explaining dissociations between implicit and explicit measures of retention: A processing account. In *Varieties of memory and consciousness: Essays in honour of Endel Tulving.* (pp. 3-41). Hillsdale, NJ: Lawrence Erlbaum.

Rosenberg, M. (1965). *Society and the Adolescent Self-Image*. Middletown, CT: Wesleyan University Press.

Rosenhall, U., Nordin, V., Sandström, M., Ahlsén, G., & Gillberg, C. (1999). Autism and hearing loss. *Journal of Autism and Developmental Disorders, 29*, 349-357.

Rubin, D. C., & Wenzel, A. E. (1996). One hundred years of forgetting: A quantitative description of retention. *Psychological Review, 103*, 734-760.

Rumsey, J. M., & Hamburger, S. D. (1988). Neuropsychological findings in high-functioning men with infantile autism, residual state. *Journal of Clinical and Experimental Neuropsychology, 10*, 201-221.

Russell, J. (1997). *Autism as an executive disorder*. New York: Oxford University Press.

Russell, J., & Hill, E. L. (2001). Action-monitoring and intention reporting in children with autism. *Journal of Child Psychology and Psychiatry, 42*, 317-328.

Russell, J., & Jarrold, C. (1999). Memory for actions in children with autism: Self versus other. *Cognitive Neuropsychiatry, 4,* 303-331.

Russell, J., Jarrold, C., & Henry, L. (1996). Working memory in children with autism and with moderate learning difficulties. *Journal of Child Psychology and Psychiatry, 37,* 673-686.

Rutter, M. (1978). Diagnosis and definitions of childhood autism. *Journal of Autism & Childhood Schizophrenia, 8*, 139-161.

Rutter, M., Le Couteur, A., & Lord, C. (2003). *ADI-R: The Autism Diagnostic Interview-Revised.* Los Angeles, CA: Western Psychological Services.

Salmond, C. H., de Haan, M., Friston, K. J., Gadian, D. G., & Vargha-Khadem, F. (2003). Investigating individual differences in brain abnormalities in autism. In U. Frith & E. Hill (Eds.), *Autism: Mind and brain.* (pp. 247-265). New York: Oxford University Press.

Sampson, J. R. (1969). Further study of encoding and arousal factors in free recall of verbal and visual material. *Psychonomic Science, 16*, 221-222.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. *Journal of Personality and Social Psychology, 46,* 929-938.

Sasson, N. J., Turner-Brown, L. M., Holtzclaw, T. N., Lam, K. S. L., & Bodfish, J. W. (2008). Children with autism demonstrate circumscribed attention during passive viewing of complex social and nonsocial picture arrays. *Autism Research*, *1*, 31-42.

Schacter, D. L., Kagan, J., & Leichtman, M. D. (1995). True and false memories in children and adults: A cognitive neuroscience perspective. *Psychology, Public Policy, and Law, 1*, 411-428.

Schacter, D. L., Norman, K. A., & Koutstaal, W. (1998). The cognitive neuroscience of constructive memory. *Annual Review of Psychology, 49,* 289-318.

Schank, R. C., & Abelson, R. P. (1977). *Scripts, plans, goals and understanding: An inquiry into human knowledge structures*. Oxford: Lawrence Erlbaum.

Schneider, S. G., & Asarnow, R. F. (1987). A comparison of cognitive/neuropsychological impairments of nonretarded autistic and schizophrenic children. *Journal of Abnormal Child Psychology: An official publication of the International Society for Research in Child and Adolescent Psychopathology, 15*, 29-45.

Schneider, D. M., & Watkins, M. J. (1996). Response conformity in recognition testing. *Psychonomic Bulletin & Review, 3*, 481-485.

Schultz, R. T. (2005). Developmental deficits in social perception in autism: The role of the amygdala and fusiform face area. *International Journal of Developmental Neuroscience, 23,* 125-141.

Schwartz, S. (1974). Arousal and recall: Effects of noise on two retrieval strategies. *Journal of Experimental Psychology, 102,* 896-898.

Shah, A., & Frith, U. (1993). Why do autistic adults show superior performance on the block design task? *Journal of Child Psychology and Psychiatry, 34*, 1351-1364.

Shapiro, P. N., & Penrod, S. (1986). Meta-analysis of facial identification studies. *Psychological Bulletin, 100*, 139-156.

Sherif, M. (1936). *The psychology of social norms*. Oxford: Harper.

Siegel, J. M., & Loftus, E. F. (1978). Impact of anxiety and life stress upon eyewitness testimony. *Bulletin of the Psychonomic Society, 12*, 479-480.

Sigman, M., Dissanayake, C., Corona, R., & Espinosa, M. (2003). Social and cardiac responses of young children with autism. *Autism*, *7*, 205-216.

Smith, S. M. (1979). Remembering in and out of context. *Journal of Experimental Psychology: Human Learning and Memory, 5*, 460-471.

Smith, B. J., Gardiner, J. M., & Bowler, D. M. (2007). Deficits in free recall persist in Asperger's syndrome despite training in the use of list-appropriate learning strategies. *Journal of Autism and Developmental Disorders, 37*, 445-454.

Smith, H., & Milne, E. (2009). Reduced change blindness suggests enhanced attention to detail in individuals with autism. *Journal of Child Psychology and Psychiatry, 50*, 300-6.

Sorg, B. A., & Whitney, P. (1992). The effect of trait anxiety and situational stress on working memory capacity. *Journal of Research in Personality, 26*, 235-241.

South, M., Ozonoff, S., Suchy, Y., Kesner, R. P., McMahon, W. M., & Lainhart, J. E. (2008). Intact emotion facilitation for non-social stimuli in autism: Is amygdala impairment in autism specific for social information? *Journal of the International Neuropsychological Society, 14*, 42-54.

Spezio, M. L., Adolphs, R., Hurley, R. S. E., & Piven, J. (2007). Abnormal use of facial information in high-functioning autism. *Journal of Autism and Developmental Disorders, 37,* 929-939.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *State-Trait Anxiety Inventory for Adults.* Palo Alto: Consulting Psychologists Press.

Spring, B., Gelenberg, A. J., Garvin, R., & Thompson, S. (1992). Amitriptyline, clovoxamine and cognitive function: A placebo-controlled comparison in depressed outpatients. *Psychopharmacology, 108*, 327-332.

Squire, L. R. (1995). Biological foundations of accuracy and inaccuracy in memory. In D. L. Schacter (Ed.), *Memory distortions: How minds, brains, and societies reconstruct the past.* (pp. 197-225). Cambridge, MA: Harvard University Press.

Steinmetz, K. R. M., Addis, D. R., & Kensinger, E. A. (2010). The effect of arousal on the emotional memory network depends on valence. *NeuroImage, 53*, 318-324.

Stewart, M. E., Barnard, L., Pearson, J., Hasan, R., & O'Brien, G. (2006). Presentation of depression in autism and Asperger syndrome: A review. *Autism, 10*, 103-116.

Stuss, D. T., Alexander, M. P., Lieberman, A., & Levine, H. (1978). An extraordinary form of confabulation. *Neurology, 28*, 1166-1172

Tager-Flusberg, H. (1991). Semantic processing in the free-recall of autistic children – further evidence for a cognitive deficit. *British Journal of Developmental Psychology, 9*, 417-430.

Tager-Flusberg, H., & Sullivan, K. (1994). A second look at second-order belief attribution in autism. *Journal of Autism and Developmental Disorders, 24*, 577-586.

Toichi, M. (2008). Episodic memory, semantic memory and self-awareness in high-functioning autism. In J. Boucher & D. Bowler (Eds.), *Memory in autism: Theory and evidence.* (pp. 143-165). New York: Cambridge University Press.

Toichi, M., & Kamio, Y. (2002). Long-term memory and levels-of-processing in autism. *Neuropsychologia, 40,* 964-969.

Toichi, M., Kamio, Y., Okada, T., Sakihama, M., Youngstrom, E. A., Findling, R. L., & Yamamoto, K. (2002). A lack of self-consciousness in autism. *The American Journal of Psychiatry, 159,* 1422-1424.

Tollenaar, M. S., Elzinga, B. M., Spinhoven, P., & Everaerd, W. (2008). Long-term outcomes of memory retrieval under stress. *Behavioral Neuroscience, 122,* 697-703.

Tollestrup, P. A., Turtle, J. W., & Yuille, J. C. (1994). Actual victims and witnesses to robbery and fraud: An archival analysis. In D. F. Ross & J. D. Read & M. P. Toglia (Eds.), *Adult eyewitness testimony: Current trends and developments.* (pp. 144-160). New York: Cambridge University Press.

Trillingsgaard, A. (1999). The script model in relation to autism. *European Child & Adolescent Psychiatry, 8,* 45-49.

Tuckey, M. R., & Brewer, N. (2003a). How schemas affect eyewitness memory over repeated retrieval attempts. *Applied Cognitive Psychology, 17*, 785-800.

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

Tulving, E. (1974). Cue-dependent forgetting. *American Scientist, 62,* 74-82.

Tulving, E. (1985). Memory and Consciousness. *Canadian Psychology-Psychologie Canadienne, 26*, 1-12.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*, 352-373.

Turner, M. S., Cipolotti, L., Yousry, T. A., & Shallice, T. (2008). Confabulation: Damage to a specific inferior medial prefrontal system. *Cortex, 44*, 637-648.

Uehling, B. S., & Sprinkle, R. (1968). Recall of a serial list as a function of arousal and retention interval. *Journal of Experimental Psychology, 78,* 103-106.

Valentine, T. & Maras, K. L. (2011). The effect of cross-examination on the accuracy of adult eyewitness testimony. *Applied Cognitive Psychology, 25,* 554-561.

Volden, J., & Johnston, J. (1999). Cognitive scripts in autistic children and adolescents. *Journal of Autism and Developmental Disorders, 29*, 203-211.

Volkmar, F. R., Klin, A., Siegel, B., Szatmari, P., Lord, C., Campbell, M., Freeman, B. J., Cicchetti, D.V., Rutter, M., Kline, W., Buitelaar, J., Hattab, Y., Fombonne, E., Fuentes, J., Werry, J., Stone, W., Kerbeshian, J., Hoshino, Y., Bregman, J., Loveland, K., Szymanski, L. & Towbin, K. (1994). Field trial for autistic disorder in DSM-IV. *The American Journal of Psychiatry*, *151*, 1361-1367.

Voyer, D., & Hou, J. (2006). Type of items and the magnitude of gender differences on the Mental Rotations Test. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale, 60,* 91-100.

Walker, E. L. (1967). Arousal and the memory trace. In D. P. Kimble (Ed.), *The organization of recall* (Vol. 2, pp. 186-233). New York: New York Academy of Sciences.

Wechsler, D. (1997). *Manual for the Wechsler Adult Intelligence Scale (3rd ed).* San Antonio, TX: The Psychological Corporation.

Weeks, S. J., & Hobson, R. P. (1987). The salience of facial expression for autistic children. *Journal of Child Psychology and Psychiatry, 28,* 137-151.

Weingardt, K. R., Toland, H. K., & Loftus, E. F. (1994). Reports of suggested memories: Do people truly believe them? In D. F. Ross & J. D. Read & M. P. Toglia (Eds.), *Adult Eyewitness Testimony: Current Trends and Developments.* (pp. 3-26). New York: Cambridge University Press.

Whitehouse, A. J. O., Maybery, M. T., & Durkin, K. (2006). Inner speech impairments in autism. *Journal of Child Psychology and Psychiatry, 47*, 857-865.

Williams, C. (1995). *Invisible victims: Crime and abuse against people with learning disabilities*. London: Jessica Kingsley Publishers.

Williams, D. L., Goldstein, G., Carpenter, P. A., & Minshew, N. J. (2005). Verbal and spatial working memory in autism. *Journal of Autism and Developmental Disorders, 35*, 747-756.

Williams, D. L., Goldstein, G., & Minshew, N. J. (2005). Impaired memory for faces and social scenes in autism: Clinical implications of memory dysfunction. *Archives of Clinical Neuropsychology, 20*, 1-15.

Williams, D. L., Goldstein, G., & Minshew, N. J. (2006). The profile of memory function in children with autism. *Neuropsychology, 20*, 21-29.

Williams, D., & Happé, F. (2009). Pre-conceptual aspects of self-awareness in autism spectrum disorder: The case of action-monitoring. *Journal of Autism and Developmental Disorders, 39*, 251-259.

Williams, D. & Happé, F. (2010). Recognising 'social' and 'non-social' emotions in self and others: a study of autism. *Autism: The International Journal of Research and Practice, 14,* 285-304.

Williamson, T. M. (1993). From interrogation to investigative interviewing: Strategic trends in police questioning. *Journal of Community & Applied Social Psychology, 3*, 89-99.

Williamson, S., Craig, J., & Slinger, R. (2008). Exploring the relationship between measures of self-esteem and psychological adjustment among adolescents with Asperger Syndrome. *Autism, 12*, 391-402.

Wing, L. (1981). Asperger's syndrome: A clinical account. *Psychological Medicine, 11*, 115-129.

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: epidemiology and classification. *Journal of Autism and Developmental Disorders, 9, 11*-29.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. (1971). *Manual for the Embedded Figures Test.* Palo Alto, CA: Consulting Psychologist Press.

Wolfradt, U., & Meyer, T. (1998). Interrogative suggestibility, anxiety and dissociation among anxious patients and normal controls. *Personality and Individual Differences, 25*, 425-432.

Woodbury-Smith, M. R., Clare, I. C. H., Holland, A. J., & Kearns, A. (2006). High functioning autistic spectrum disorders, offending and other law-breaking: findings from a community sample. *Journal of Forensic Psychiatry & Psychology*, *17*(1), 108-120.

Woodbury-Smith, M. R., Clare, I. C. H., Holland, A. J., Kearns, A., Staufenberg, E., & Watson, P. (2005). A case-control study of offenders with high functioning autistic spectrum disorders. *Journal of Forensic Psychiatry & Psychology, 16,* 747-763.

World Health Organization (1993). *International Classification of Diseases*, *Tenth Revision.* World Health Organization: Geneva: WHO.

Wright, A. M., & Holliday, R. E. (2007a). Enhancing the recall of young, young-old and old-old adults with cognitive interviews. *Applied Cognitive Psychology, 21*, 19-43.

Wright, A. M., & Holliday, R. E. (2007b). Interviewing cognitively impaired older adults: How useful is a cognitive interview? *Memory, 15,* 17-33.

Wright, D. B., London, K., & Waechter, M. (2010). Social anxiety moderates memory conformity in adolescents. *Applied Cognitive Psychology, 24*, 1034-1045.

Wright, D. B., Memon, A., Skagerberg, E. M., & Gabbert, F. (2009). When eyewitnesses talk. *Current Directions in Psychological Science, 18,* 174-178.

Wright, D. B., Self, G., & Justice, C. (2000). Memory conformity: exploring misinformation effects when presented by another person. *British Journal of Psychology, 91,* 189-202.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology & Psychology, 18*, 459-482.

Yirmiya, N., Sigman, M. D., Kasari, C., & Mundy, P. (1992). Empathy and cognition in high-functioning children with autism. *Child Development, 63*, 150-160.

Yuille, J. C., & Cutshall, J. L. (1986). A case study of eyewitness memory of a crime. *Journal of Applied Psychology, 71,* 291-301.

Yuille, J. C., & Tollestrup, P. A. (1990). Some effects of alcohol on eyewitness memory. *Journal of Applied Psychology, 75*, 268-273.

Yuille, J. C., & Tollestrup, P. A. (1992). A model of the diverse effects of emotion on eyewitness memory. In S.-Å. Christianson (Ed.), *The handbook of emotion and memory: Research and theory*. (pp. 201-215). Hillsdale, NJ: Lawrence Erlbaum.

Zaragoza, M. S., & Lane, S. M. (1994). Source misattributions and the suggestibility of eyewitness memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 20,* 934-945.

Ziv, I., Leiser, D., & Levine, J. (2011). Social cognition in schizophrenia: Cognitive and affective factors. *Cognitive Neuropsychiatry, 16*, 71-91.

Appendices

Appendix 1: Overlap between participants and experiments

ASD participants (X denotes participation):

Participant:	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
AS33	X	X	X	X	X
AS34	X	X	X	X	X
AS35	X	X	X		X
AS69	X	X	X	X	X
AS78	X		X		
AS79	X	X	X	X	X
AS83	X		X		
AS88					X
AS94					X
AS99	X	X	X	X	X
AS101	X		X	X	
AS102		X	X		X
AS103					X
AS105	X	X	X	X	
AS107				X	X
AS109	X	X	X	X	X
AS111			X	X	X
AS112			X		
AS113		X	X	X	
AS116	X	X	X	X	
AS119	X	X	X	X	X
AS120	X	X	X	X	X
AS121	X	X	X		
AS122	X		X		
AS126	X		X	X	X
AS127				X	X
AS128	X		X		
AS129	X		X	X	X
AS131	X		X		
AS133	X	X	X	X	X
AS135	X	X	X	X	X
AS171	X		X		X
AS189			X	X	X
AS190	X		X	X	X
AS191	X		X		
AS193				X	X
AS195			X	X	X
AS196			X	X	X
AS198					X

Comparison participants (X denotes participation):

Participant	Experiment 1	Experiment 2	Experiment 3	Experiment 4	Experiment 5
C63	X		X		
C74	X	X		X	X
C78	X	X	X	X	X
C81				X	
C87				X	X
C89	X		X	X	X
C100			X		
C101	X		X		
C104			X		
C107	X	X	X	X	
C108					X
C111				X	X
C114	X	X	X	X	X
C115				X	X
C117	X	X	X	X	X
C122	X	X	X	X	X
C123	X		X		
C134	X		X	X	X
C136	X	X	X	X	X
C140	X	X	X		X
C143	X	X	X		X
C144			X	X	
C159	X		X		
C185	X	X	X	X	X
C187	X	X	X	X	X
C188	X	X	X		
C189	X		X		
C190	X	X	X	X	
C191	X	X	X	X	
C197	X				
C200	X	X	X	X	X
C201					X
C204	X		X		
C206	X		X	X	
C207			X	X	
C2O9				X	
C210	X	X		X	
C214				X	X
C215			X		X
C216					X
C217					X
C218					X
C221					X
C222			X		X

C224	X
C225	X
C226	X

Appendix 2: Structured and Cognitive Interview protocol (Experiment 1)

Italics = Cognitive Interviews only

- Rapport and explain aims
    - Reiterate that interviewer blind to contents of video
    - Explain that participant will be asked to go over events a few times; motivate to repeatedly recall
    - Don't guess; ok to say “don't know”
    - ‘*Report all’ (no matter how trivial)*
    - *Concentrate hard*
    - Transfer control
    - Any questions
- **Stage 1:**
    - *Context reinstatement:*
    - Free recall
    - Remember more’ prompt
- **Stage 2:** Questioning
    - *Activate and probe an image*
    - Open questions based on what participant said in free recall
    - Witness-compatible wording (e.g., if they use the term ‘guy’ then interviewer asks about the ‘guy’ rather than the man
    - Minimal closed questions for follow-up details
    - No leading questions
    - Don't guess; ok to say “don't know”
- **Stage 3:** Second retrieval attempt/ *reverse order*
- **Stage 4:** Third retrieval attempt/ *change perspective*

- Closure

Appendix 3: Context reinstatement protocol (Experiment 1)

What we are going to do is called context reinstatement, where you remember other things that you saw and felt just before you watched the video clip. This will help you to remember better.
In a few minutes I am going to ask you to tell me everything that you can remember.

In order for you to recall to the best of your memory I would like to you contextually remember the environment just before you saw the events unfold – what you could see, hear, sense, how you felt – and use this information to guide your recall.

I will go through this very slowly, so that you can relax and take it all in in order to build up a clear picture in your mind. This will take several minutes before you speak to build up a really clear picture of the clip in your mind. Please try to relax, concentrate and focus really hard with each instruction that I give. Although this might seem like a series of questions I don't want you to answer them, they are just there so that you can build up a clear picture in your mind. At the end I will ask you to tell me what happened, not now, so in the meantime try to relax and take it all in.

If you close your eyes it will help you to focus, I will just look down here.

I would like you to clear your head of all other thoughts. Try to blank everything else from your mind, and focus only this task [5secs]

Think about how you were feeling when you came in here today [10secs]

Now picture yourself as you went into in the room where you watched the video [10secs].

Focus on that room [10secs]

Remember where you were sitting [5secs] *and how the chair felt* [5secs]

Think about the lights [5secs] *and noises* [10secs] *in the room just before the video started* [10secs]

Remember your mood when you started watching the video [5secs]*. How were you feeling?* [5secs].

How was your physical state? [5secs]

Now picture the screen ahead of you [10secs]

Build up a clear mental picture of that moment and visualise it [10secs].

Remember what the colours in the video were like [5secs].

Think about the noises you heard in the video [10secs]

Visualise where the event is taking place and what the scene or environment around looks like. Take in these surroundings and mentally note everything that you see [10secs]

Visualise what people are involved, what they look like, what they are wearing, what they are doing and how they are behaving [10secs]

Think about everything that you saw, noting every single detail, no matter how small or irrelevant it may seem, even if it seems trivial [10secs]

Back in this context you should be able to see the videotape in your mind. Picture the events you saw in the video as if they were happening right now before your eyes [10secs]

I'd like you to keep picturing and remembering what you saw. When you are ready please explain to me, in every detail, what you saw from the beginning of the videotape to the end – as you tell me keep your eyes closed and concentrate and focus on that image in your mind. Don't leave anything out, even if it seems only partial or not significant. Take your time.

As you run through what happened, try to replay the event in your head, as if it were a video that is replaying before you, which you are watching right now.
When you are ready, please tell me everything you saw.

Appendix 4: Slides used for Experiment 2

Adapted from a video by Tuckey and Brewer (2003)

Appendix 5: Misinformation extract used in Experiment 2

The following is an excerpt from a newspaper about the robbery that you earlier viewed slides of. Please read it carefully.

Police are on the hunt for two men for armed robbery following the ANZ bank robbery in Newton, near Adelaide, Australia.

The men stole AUS$1500 worth of notes from the bank last Friday. The officer leading the hunt for the pair denied suggestions that they had botched catching the bank robbers when they missed them by minutes.

Chief Superintendent Darren Oakely said that after a traffic warden relayed a report of a white van and suspicious activity on a nearby street, officers were there as soon as possible. "Unfortunately we were not here in time," he told a news conference outside the bank yesterday. "When officers arrived the culprits had gone.

"That was not the police's fault, it was not a botched police investigation - I want to nail that."

The police team returned to the bank last night with an identical white Ford Transit box van as that used by the robbers in a bid to nudge the memory of passers-by.

He said CCTV camera footage showed the van - with the fake registration S439 ADA - had been in the side street outside the bank between 11.15 and 11.30am on Wednesday.

The Chief Superintendent said the van had still not been recovered.

CCTV footage from inside the bank shows the pair entering the bank at 11.18am. One of them held the door open for a customer leaving the bank before entering themselves. The cashier on duty at the time, who has requested not to be named, was forced to hand over money after one of the men threatened her with a gun. She initially laughed at the demand but eventually handed the money to the robber.

Her colleague also on duty at the time was forced to stick her hands up and was unable to press the emergency call for help button installed by the bank 12 months ago following a robbery in the nearby Commonwealth Bank of Australia branch.

Whilst one of the men demanded the money from the cashier, his accomplice kept watch over the people. The accomplice, who had a can of coke in his hand throughout the robbery, is thought to also be linked to a mob gang from Sydney. He forced a customer present in the bank at the time to get down on the floor throughout the incident. She was afterwards treated for shock at the local hospital.

The CCTV footage shows one of the men poking his tongue out at the camera whilst his accomplice stuffed the money into a bag. Chief Superintendent Darren Oakely says he is confident the police will catch the culprits, who removed their balaclavas before fleeing the bank.

“We believe these men might be linked to other robberies in Victoria. We are making urgent call of appeal for witnesses or those who might know the men to come forward. Unfortunately no one has come forward as yet, but would urge anyone who has any suspicions to

contact Newton Police immediately”. Other banks in the area have been contacted to make sure they are taking extra precautions, especially while the robbers are on the loose.

Bank robberies are up in cities across the UK, USA, and Australia this year and, although the reason is unclear, the down economy is a suspect

"The economy is driving some of this," says Mike Payne, chief security officer for Commonwealth Bank of Australia and former assistant director of the National Crime Authority. "

Payne said Commonwealth Bank of Australia analysts study the interplay between the increase in bank heists and foreclosures, credit defaults and unemployment rates.

"We haven't drawn any conclusions yet, but we are certainly looking at it," he said.

A similar pattern is emerging in the USA. Bank robberies in the Houston metro area alone has more than doubled this year to 189, compared with 92 at the same time last year, according to FBI spokesman David Abrams.

Abrams said bank robbery numbers fluctuate annually, but overall change usually is slight.

"I've seen trends go up and down," he said. "But I've never seen anything really double."

In the UK bank robberies are also on the rise with 783 recorded nationwide this year, up from 614 last year. London is particularly affected with 10 percent of the nation's branches but 39 percent of its bank robberies

Bank robberies peaked in 2001 with more than 900 heists recorded around the UK, according to Home Office figures. Robberies declined after that, rising slightly in 2005, before increasing nearly 10% in 2007. National figures for 2009 are not complete.

Chief superintendent Lee Vance of the Metropolitan Police doesn't buy the economy argument. "If you are a criminal, you're a criminal," he said.

Vance said London has suffered recession-like conditions, but he does not know how much that has to do with the increase in bank robberies.

"There really are just a lot more desperate people out there right now," he said.

Appendix 6: Recall questions used in Experiment 2

(Questions referring to misinformation are in italics for the purposes of this appendix)

Please answer the following questions based only on what you saw in the slides.

Please answer each question in as much detail as you possibly can, and for each answer you provide please indicate how confident you are that your answer is correct.

(1) What was the main robber wearing?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(2) What did he threaten the cashier with?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(3) Which of the robbers entered the shop first?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(4) What did he do just before entering the bank?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(5) How did the robbers disguise their faces?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(6) What did they do with their disguises?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(7) What was the other robber wearing?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(8) What role did he play in the robbery, what was he doing?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(9) ***What did he have in his hand?***

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(10) Where did the employee take the money from to give to the robber?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(11) What was she wearing?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(12) How did she behave when she was told to hand over the money?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(13) What was the other employee forced to do?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(14) What was the name of the bank?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(15) What was the customer forced do whilst the robbery took place?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(16) What did the robbers do with the money?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(17) Who else was present in the bank?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(18) What did one of the robbers do when he saw the CCTV camera?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

(19) Which robber left the bank first?

How confident are you that your answer is correct?

Not very confident 1 2 3 4 5 6 7 *Very confident*

Appendix 7: Transcribed GSS story and questions used in Experiment 3

Transcribed audio narrative (from Gudjonsson, 1987):

Anna and John/ were a happily married couple/ in their thirties./ They had three children,/ two boys/ and a girl./ They lived in a small bungalow/ which had a swimming pool/ in the garden./ John worked in a bank/ and Anna worked in a bookshop/ with her sister/ Maria./ One Tuesday/ morning/ in July/ the couple were leaving the house/ to go to work/ when they saw a small boy/ going down a steep slope/ on a bicycle/ and calling for help./ Anna and John ran after the boy/ and John caught hold of the bicycle/ and brought it to a halt./ The boy appeared very frightened/ but unhurt/ and said that the brakes on his bicycle had broken./ Anna and John recognized the boy,/ whose name was William./ He was the youngest/ son of their neighbours/ who worked for a well-known/ travel agency/ in a nearby town./ Sometimes in the winter months/ the two couples had gone skiing together/ but the children of both families/ had preferred to stay with their grandparents/ who lived in the country./

GSS2 questions:

1. Were the couple called Anna and John?
2. Did the couple have a dog or a cat?
3. Did the boy's bicycle get damaged when it fell on the ground?
4. Was the husband a bank director?
5. Did the couple live in a small bungalow?
6. Did the boy on the bicycle pass a stop sign or traffic lights?
7. Was the boy frightened of the big van coming up the hill?
8. Did the boy have some minor bruises as a result of the accident?
9. Was the boy's name William?
10. Did the boy drop the books he had been carrying whilst riding the bicycle?
11. Was Anna worried that the boy might be injured?
12. Did John grab the boy's arm or shoulder?
13. Did the couple recognize the boy?
14. Did the boy commonly ride the bicycle to school?
15. Was the boy taken home by Anna or John?
16. Was the boy allowed to stay away from school on the day of accident?
17. Did the couple's children sometimes stay with their grandparents?
18. Was the boy frightened of riding the bicycle again?
19. Was the weather wet or dry when the accident happened?
20. Did the couple have a skiing cottage in the mountains?

All questions except numbers 1, 5, 9, 13, and 17 are leading questions which refer to details which were not heard in the narrative

Appendix 8: Sequence of events for arousing and neutral video versions (Experiment 4)

[From Bornstein et al., 1998]

Beginning segment - both versions (18 details)

1. Occurred during the day
2. It was a rainy day
3. Man puts flowers on grave
4. Man kneels on ground
5. Man says something
6. Man kisses a picture
7. The picture is on the grave
8. A priest is walking around the cemetery
9. Priest sees the man kneeling
10. A man walks up behind the kneeling man
11. Second man is Caucasian male
12. Second man is wearing a black robe
13. Second man is wearing a beret
14. Second man has a moustache
15. Second man has a beard
16. Second man has brown hair
17. Second man is of medium height
18. Second man is of medium build

Middle segment

Arousing version (13 details)

1. Second man speaks to kneeler
2. Kneeler turns his head
3. Second man pulls gun from cloak
4. Gun has silencer on it
5. Second man shoots kneeler
6. He shoots him one time
7. Kneeler is wounded in chest or back
8. Blood splatters on statue
9. Kneeler falls onto grave
10. Killer aims gun at fallen man's head
11. Priest says 'For God's sake, No!
12. Killer aims gun at priest

Middle segment

Neutral version (11 details)

1. Second man speaks to kneeler
2. Kneeler turns his head
3. Priest looks up to the sky
4. Priest closes umbrella
5. Priest looks on the ground
6. Priest picks something up off ground
7. Priest places object on top of grave
8. Priest walks around a corner
9. Puddles seen on pathways
10. Priest shakes umbrella
11. Close-up of statues on graves

13. Killer backs up

End segment – both versions (14 details)

1. Second man/killer squats on ground
2. Second man/killers picks up something
3. Second man/killer backs slowly away
4. Second man/killer walks off
5. Priest goes to fallen man
6. Fallen man is not dead yet
7. Priest starts to pray
8. A (third) man is standing behind a nearby grave
9. The man is watching the priest
10. The man has blond hair
11. The man is wearing an overcoat
12. The man is wearing a tie
13. The man is wearing a white shirt
14. The man is Caucasian

Appendix 9: Photographs of scenes used for Experiment 5

a) Camping Scene:

b) Dinner Scene

c) Laundrette Scene:

d) Shopping Scene: