

# Development of Autobiographical Memory in Autism Spectrum Disorders

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Remembering our past is a key component of psychological well-being, serving several important personal and social functions. Memories provide us with an understanding of who we are, maintaining our sense of self over time (Conway, 2005). They assist us in personal problem solving by providing a database from which we can reason and develop effective strategies (Williams, 1996). Drawing on past experience can play a role in emotion regulation, as low moods may be tempered by recalling positive memories (Wilson, Gunn, & Ross, 2009). Memory also supports our social world, as sharing our life story with others allows us to forge and cement new attachments (Neisser, 1978; Nelson, 1993).

Given the substantial role that autobiographical memory plays in psychological health, it is not surprising that a considerable amount of research on the topic has occurred within the context of different mental health conditions. In this respect, autism spectrum disorder (ASD) has been highlighted, and there is now a substantial research base demonstrating a variety of autobiographical memory deficits that characterise this condition and underlie some of the difficulties associated with it. The aim of this chapter is to review the current status of knowledge on autobiographical memory in children with autism. I begin by reflecting on the concept of autobiographical memory and review theoretical perspectives on its emergence in typical development in order to provide a setting for considering how autism may affect this process. I then discuss the findings arising from autism developmental research, focusing on autobiographical memory access, accuracy, content, and detail. Finally, I review some of the mechanisms that underlie impairments in autobiographical memory and consider the research implications for best practice in eliciting the memory reports from children with autism.

## Autobiographical Memory: The Concept

Central to our current understanding of autobiographical memory development is the knowledge that memory is made up of several dynamically integrated systems.

Of particular relevance is Tulving's (1972) distinction between semantic and episodic memory. The former refers to factual knowledge, for example, knowing that Madrid is the capital of Spain. The latter describes event memories where knowledge is contextualized within time and place (e.g., "the last party I attended"). A further requirement of episodic memory (Tulving, 2002) is that its retrieval is accompanied by auto-noetic consciousness, that is, an awareness of self during the processing of the event giving rise to a felt sense of "remembering" at recall. In contrast, semantic memory, involves noetic consciousness leading to a sense of "knowing" where self-referential information at encoding is unavailable at retrieval.

Historically, autobiographical memory was viewed as synonymous with episodic memory, but there are several reasons why this assumption is no longer valid. First, the semantic/episodic distinction has its counterpart within autobiographical memory. Semantic personal memory contains personal facts such as date of birth, the names of schools attended, and knowledge of the personality traits we possess. Episodic autobiographical memory comprises all personal experiences located in time and place (Conway & Rubin, 1993). We might then conclude that it is personal event memory that is synonymous with episodic memory, but while it undoubtedly provides a foundation for autobiographical memory (Nelson & Fivush, 2004), there are several ways in which autobiographical event memory can be distinguished from episodic memory *per se*. First, the *content* of autobiographical memory is essentially self-referential; it contains information about "me." Thus, while my memory of the steps involved in preparing dinner last night is episodic in nature, it is unlikely to become part of my autobiographical memory as it does not have relevance to me and for my life history. Indeed, some (e.g., Fivush, 2011) have argued for a distinction between "truly autobiographical" and "purely episodic" with the former recalled in reference to a continuous sense of self, and the latter, a sequence of events remembered independently of self-involvement. Thus, while babies and toddlers are capable of remembering events encoded at a single time point (e.g., Rovee-Collier & Hayne, 2000), these memories are not attached to a representation of a continuous self (Fivush, 2011) and are therefore not examples of autobiographical memory. The reconstructive nature of autobiographical memory provides a second argument for demarcating it from episodic memory. Unlike paradigms within nonpersonal episodic memory, research often focuses on quality of recall rather than whether it is an accurate representation of events. For example, autobiographical memories can be recalled at different levels of abstraction from a specific memory of an individual event (e.g., my first day at work) to a more general memory that summarizes experience by category (e.g., returning to boarding school after a holiday) or across extended time frames (my holiday in Sri Lanka) (Conway & Rubin, 1993).

### **Theories of Autobiographical Memory Development: Implications for Autism**

Our ability to remember our past develops gradually, and it has been commonly reported that our very early life experience yields no enduring memories. A period originally referred to as infantile amnesia, the phenomenon has attracted a long history of research. One of the earliest studies by Henri and Henri (1898) found that

adults' earliest recollections usually pertained to the ages between 2 and 4 years, a subsequently robust and reliable finding. Freud (1963) believed that much earlier event memories existed, but were repressed due to inappropriate sexual content, rendering them inaccessible. A contrasting popular view was that earlier event memories were not possible as biological immaturity or a lack of language representation prevented the encoding, storing, or retrieval of events. We now know that this is not the case. It has been demonstrated in the laboratory that even babies as young as 6 months have the memory capability of recalling a sequence of events, learned at one particular time (Rovee-Collier, 1999). However, while we now know that very young, preschool children can remember events, these memories do not persist over time and memories are only deemed autobiographical if they have some element of perseverance. Using a longitudinal design, Peterson, Warren, and Short (2011) showed that while young children's earliest memories could date prior to the age of two years, these memories were unlikely to be recalled at a later testing time two years later.

Infantile amnesia is now more commonly referred to as "childhood amnesia," reflecting adults' fewer memories relating to the period between 2 and 7 years of age than can be explained by normal rates of forgetting (Pillemer & White, 1989). In general, theories subscribe to the view that memories of early life do not endure because the brain has not sufficiently developed to support the cognitive, emotional, and social developments associated with autobiographical memory's onset. Theories vary in the importance they give to key features in development. These include self-representation, the ability to mentally travel in time, a theory of mind (ToM), language, the ability to use narrative structure, and the quality of social interactions. Developmental deficits in many of these variables have been reported in autism leading to the prediction of a development trajectory that is both delayed and/or qualitatively different.

### The importance of self

The notion of self as intrinsic to autobiographical memory is evident in Brewer's (1986) widely accepted definition, "memory for information related to the self." The notion of a qualitatively different self in autism has a long history, with the early descriptions of Kanner (1943) and Asperger (1944) referring to a condition of extreme self-focus or egotism. Disruptions in autobiographical memory might therefore be expected in children with this condition since some version of self is a ubiquitous hypothesized mechanism in autobiographical memory development. However, since the self is multifaceted and as not all aspects are impaired in autism (Lind, 2010), the extent of impairment would depend on which particular aspect of self is implicated.

Howe and Courage (1993, 1997) gave the "cognitive self," embodying the "I" and the "me," the primary status in the emergence of autobiographical memory. The self acts as a medium through which events are understood as happening to "me" and forms a base around which to organize and retrieve experiences. Rudimentary elements of a cognitive self in typical development appear at approximately 18 months to 2 years of age as toddlers show the ability to recognize themselves in the mirror (Lewis & Brooks-Gunn, 1979). Self-recognition is further signalled by language development, in particular, correct first-person pronoun usage ("I" and "me") denoting the

child's capacity to self-reference. In autism, while mirror-self recognition is largely intact in children from 3.5 years of age, problems with correct pronoun usage are common and can persist into adulthood (Lind, 2010).

Supporting Howe and Courage's cognitive self-theory is the finding that there are some reports of adults' earliest memories that date back to the second year of life (Usher & Neisser, 1993). Nonetheless, memories from this early period of around two years of age are extremely sparse, suggesting a rudimentary self-concept as signalled by visual self-recognition, which is not a sufficient condition for a fully functioning autobiographical memory system. This early self-concept is rooted in the present moment and other theorists (e.g., Perner & Ruffman, 1994; Povinelli, 2001; Klein, Cosmides, German, & Gabriel, 2004) have argued that an understanding of oneself as extending in time is required for autobiographical memory development. An extended self-concept denotes the ability to understand and represent change over time, a process referred to as diachronic thought (Suddendorf & Corballis, 1997). Using an adapted mirror recognition task, Povinelli, Landaux, & Perriloux (1995) showed this ability to reliably emerge around the ages of 4–5 years as typically developing children became able to recognize delayed video images of themselves. According to Povinelli (2001), children are only able to develop a fully functioning autobiographical memory once they are able to recognize themselves from the past because "remembering" requires the ability to project oneself backward through mental representation.

Children with autism can also recognize themselves from delayed video images (Lind & Bowler, 2009) and would therefore have the capacity for early autobiographical memory if delayed self-recognition was the definitive test of an extended self. However, children with autism fail to benefit from encoding material self-referentially (vs. phonologically) (Toichi et al., 2002), and it has been suggested that this denotes a disruption in extended self in a psychological sense (Lind, 2010) and that this would have implications for the emergence of a fully functioning autobiographical memory system.

The growing complexity of the typically developing self is intertwined with a deepening understanding of mind; the capacity for meta-representational thought and a theory of mind enable the child to understand the perceptual origins of their own (and others') knowledge. These latter metacognitive developments have also been highlighted as forming the basis for true autobiographical memory recollection (Perner & Ruffman, 1995). Autobiographical memory and theory of mind are related through meta-representation, which allows the linking of psychological states from the past to present. There is a significant amount of support for Perner and Ruffmans' theory; for example, the findings that demonstrate children's ability on theory of mind tasks to relate to the extent to which they participate in conversations with their mother about the past (Welch-Ross, 1997).

The theory of mind hypothesis of autism has of course stimulated a vast amount of research; while children with autism make developmental gains in this skill, its acquisition is certainly delayed (Steele, Joseph, & Tager-Flusberg, 2003). Furthermore, while some autistic children can pass certain theory of mind tests, they are more likely to be using problem-solving mechanisms than social insight as evidenced by research demonstrating the activation of different brain areas during these tasks compared to typically developing children (Tager-Flusberg, 2007). Thus, a theory of mind deficit is likely to delay and impair autobiographical memory in autism.

Moreover, self-awareness and auto-noetic consciousness have also been implicated in autobiographical memory development and deficits in these other metacognitive abilities are also reported in children with autism. For example, recognition of their own psychological state is impaired (Williams, 2010), and they report a reduced self-understanding (Dritschel, Wisley, Goddard, Robinson, & Howlin, 2010).

Theory of mind, self-awareness, and auto-noetic consciousness share a common developmental pathway, and there is considerable (but not total) overlap in the brain regions recruited during their activation (Spreng, Mar, & Kim, 2009; Rabin et al., 2010). Separating the trajectory of these processes in order to identify the primary mechanism that underlies onset of autobiographical memory has proved difficult due to their symbiosis. Together, the cognitive theories point toward the important metacognitive developments in the first four to five years of life as the crucial mechanisms underlying the onset of autobiographical memory (Souhay, Guillery-Girard, Pauly-Takacs, Wojcik, & Eustache, 2013). Since autism is associated with deficits in these metacognitive abilities, some degree of autobiographical memory impairment would be expected. However, another set of theories have focused on autobiographical memory function rather than mechanisms and argue that while cognitive developments are necessary, they alone are not sufficient; autobiographical memory develops and functions within a sociocultural as well as personal context.

#### Social factors: Interaction, narrative construction, and attachment

Much of remembering involves verbal communication, and as children develop the rudiments of language, they begin to talk about their pasts (Reese, 2002). Social-cultural theories argue that social interaction is fundamental to autobiographical memory development because it is through interaction with caregivers, that the child learns what is socially significant, and therefore, memorable (Nelson, 1993). These theories (e.g., Nelson & Fivush, 2004) draw support from the plethora of studies demonstrating a link between the quality and quantity of mothers' memory talk and their children's memory development. In particular, "elaborative" mothers who engage their preschool children in detailed conversation about the past and ask open-ended questions resulting in rich memory representations produce children who develop detailed and coherent autobiographical memories. In contrast, low elaborative mothers who encourage children in memory talk with closed questions requiring yes/no responses produce children who develop less detailed and coherent autobiographical memories (see Bauer, 1997, for review).

Deficits in social communication, a core feature of autism, will most likely impact on the quality of social interaction between parent and child. For example, children with autism are more likely than typically developing children to ignore mothers' attempts at communication (Doussard-Roosevelt, Joe, Bazhenara, & Porges, 2003; Jones & Schwartz, 2009) and research shows how this might affect the reminiscence style of mothers of children with autism. Goldman and DeNigris (2015) compared mother-child dyads involving autistic, other (non-autistic) developmentally disabled, and typically developing children in the strategies they used to encourage conversation about the past. Although there were no differences in the number of events, length of conversations, and turns taken, mothers of autistic children were more likely to ask direct questions and make more factual corrections than mothers of typically developing children. Goldman and DeNigris

suggested that these mothers asked more questions than comments because the former were less likely to be ignored than the latter.

Sharing memories is facilitated by language, which in turn, enables an understanding of both self and others in a social context. Language is therefore purported to be an essential ingredient of autobiographical memory. Although language is sometimes absent or impaired in children with autism, this generally occurs with mental retardation (Boucher, 2003), and many children with autism and normal IQ have well-developed language form and vocabularies (Rumpf, Kamp-Becker, Becker, & Kauschke, 2012). However, more nuanced aspects of language such as narrative structure and use of internal state language are affected, and these deficits may help elucidate difficulties in both talking about the past and building a coherent life story. It has been argued that the ability to use narrative is critical because it provides a structure for understanding the meaning of events in relation to self and others (e.g., Fivush, Habermas, Waters, & Zaman, 2011). In turn, single narrative events form the basis for refinements in self-understanding by contributing to the development of a personal life narrative (Habermas & Bluck, 2000) and this emerges during adolescence as the individual begins to reason about the past rather than merely retrieve it (Habermas & Paha, 2001). Internal state language is also critical to the development of the self-memory system (Fivush & Nelson, 2006). This proposition is supported by research demonstrating that as mothers' place greater reflection on the thoughts and emotions of past events, their children show better theory of mind skills (Bird & Reese, 2006) and richer autobiographical memories featuring more references to internal states (Rudek & Haden, 2005). Research examining narrative ability in children with autism has revealed a mixed pattern of intact and impaired skills. In general, structure, length, and syntactic complexity are largely unaffected, but the narratives are less coherent compared to those of typically developing children (Diehl, Bennetto, & Young, 2006); references to cognitive and emotional states within narratives are also reduced (e.g., Rumpf et al., 2012).

More recently, the social perspective on autobiographical memory development has been extended to include the influence of social emotional bonds on remembering. For example, Chae, Goodman, and Edelstein (2014) presented a model that emphasized parent/child attachments. Drawing attention to the finding that early memories more often represent negative than positive events, they argue that remembering has an evolutionary role that enhances the chances of survival through keeping safe attachments. Accordingly, the encoding, organization, and retrieval of negative events are key and how children process negative events varies according to how their needs have been met and their subsequent attachment to caregiver. Avoidant-attached children, for example, regulate negative affect during an event by reduced encoding, resulting in impoverished recall. Conversely, securely attached children have parental support in down-regulating negative experiences that enables greater attentional resources to be deployed during the encoding of events.

Debate regarding the parent-child attachment in autism has a long history, and a full consideration of this issue is beyond the scope of this chapter. Suffice to say, Bettelheim's (1967) controversial "refrigerator mother" hypothesis of autism has been widely discredited, and research shows mothers of children with autism to be equally sensitive as mothers of children without autism (van Ijzendoorn et al., 2007). However, less secure attachments to caregivers are evident in children with autism compared to comparison children (Rutgers, Bakermans-Kranenburg, van Ijzendoorn, & van Berckalaer-Onnes, 2004). While attachment insecurity becomes less apparent

in more cognitive-able children, it has been suggested that high functioning children might be attaching in a different way, using effortful cognitive strategies to compensate for difficulties (Taylor, Target, & Charman, 2008). Difficulties in emotion processing that are fundamental to autism (Uljarevic & Hamilton, 2013) are also likely to impact on ability to emotionally connect, and together, these factors may contribute to a delayed onset of autobiographical memory.

The sociocultural theories previously discussed have contributed an understanding of both how we organize our experiences and why we remember. Language, narrative skill, and the desire to attach and communicate with others are proposed as key mechanisms in autobiographical memory development. Given the social impairments, together with the cognitive deficits associated with autism, it would be extremely surprising if remembering the personal past was not in some way affected. In typical development, research has highlighted age-related changes in the quality and quantity of autobiographical event memories. Although young children are able to recall the gist of events their memories resemble *generalized scripts* rather than specific memories (Nelson, 1978). Ageing brings greater memory specificity, and detail as representations become based more on auto-noetic consciousness (Picard, Reffuveille, Eustance, & Piolino, 2009). Here, the self, autobiographical memory, and social communication develop in symbiosis. However, in autism, there is some evidence in adults that the self-memory links may be more tenuous as correlations between event memory access and social functioning are less apparent (Crane, Goddard, & Pring, 2013). Understanding how these links fail to integrate in childhood could have valuable implications for intervention, but first we need to gather a comprehensive description of how autobiographical memory development is characterized.

## Autobiographical Memory in Children with Autism

### Access, accuracy, and detail

Our understanding of how autism affects a child's personal memory is still relatively limited with very few research studies devoted to this area. The first recorded investigation of past event memory in autism was conducted by Boucher (1981) and focused on children's ability to remember a sequence of events in which they had participated earlier on in the day. Children with autism performed more poorly than language-matched controls when asked freely to recall activities such as "What did we/you do?" However, when cued, (e.g., "I bought a pencil and some paper, what did you have to do?"), their performance was no different to controls. Results were replicated in a later study (Boucher & Lewis, 1989) that examined memory for activities undertaken several months previously. Once again, children showed difficulties with free recall of events that were ameliorated when recall conditions were supported by cues. Deficits therefore appeared to be one of retrieval rather than encoding.

As these studies were conducted within a broader context of episodic memory with their focus on accurate recall of a sequence of events, it was not possible to ascertain whether findings reflected a general episodic memory impairment or a particular memory deficit for personal events. A later study by Millward, Powell, Messer, and Jordan (2000) provided evidence suggesting the latter. They were interested in how involvement of the self affected memory processes. Using a similar paradigm to

Boucher and Lewis (1989), Millward et al. investigated recall of activities undertaken during a trip to the park. Events were experienced either personally or vicariously in children (aged 12–16 years) with ASD and severe language delay compared to typically developing control children (aged 5–6 years) matched on language ability. In typically developing children (and adults), we would expect memory for personally experienced events to be superior since the self represents a deeper level of encoding than processing events in relation to others (Rogers, Kuiper, & Kirker, 1977). Whereas this was indeed the case for control children, the ASD group had greater difficulty recalling activities they had performed themselves than activities they had observed another child perform. The authors concluded that autobiographical memory difficulties in autism were therefore due to a “lack of experiencing self.” This landmark study paved the way for understanding how the interdependency of self and memory may be disrupted in autism.

The methodologies of Boucher and Lewis (1989) and Millward et al. (2001) employed controlled stimuli, and free and cued recall to assess the accuracy of encoding. The experimental control that these methodologies offer has several benefits, in particular, the accuracy of recall can be established. Recall accuracy may be a particularly appropriate measure of memory in groups with moderate-severe language difficulties where memory narratives are limited by poor verbal ability. However, in real life, the investigator has no control over the encoding situation with personal event memories accrued naturally. Therefore, an alternative, and arguably more ecological approach to examining children’s memories of events is to probe how children recall their own idiosyncratic life experiences. It is, of course, much more difficult to assess the veridicality of these accounts, but in the context of autobiographical memory’s social and personal functions, while “truth” is a crucial consideration, reconstruction nevertheless that influences ongoing behavior. Examining autobiographical memory in this context has meant a focus on high-functioning autism as the methodologies employed typically rely on verbal reports.

There is now a substantial body of autism research concerning adults’ memories of naturally occurring personal events. Findings have been consistent in demonstrating a difficulty in accessing specific events (i.e., individual events recalled within context and usually referring to one particular day). There are few empirical studies devoted to children, but the evidence that does exist suggests that specific memory difficulties appear in childhood. Specific memory difficulties have frequently been characterized in terms of over generality and as lacking in detail. Losh and Capps’ (2003) investigation into narrative thinking in autism provided an initial insight into how autism might impact the recall of naturally accumulating event memories. Twenty-eight high-functioning children with autism between the ages of 8 and 14 years were compared with typically developing controls on narrative ability in two contexts: accounts of personal experience and construction of a story in response to a picture book. For the personal narrative task, children were asked to tell a story about themselves. Various prompts were offered when necessary, and when responses were overly general, they were prompted for specific events. Losh and Capps reported the narrative ability of both groups to share many similarities. For example, they produced a similar number of narratives that were of similar length, and both groups’ narratives were longer for personal experiences than for the picture book story. However, children with autism required more prompts for elaboration, and while not explicitly stated, this appears to suggest a difficulty in accessing specific events in the absence of retrieval support.



Bruck, London, Landa, and Goodman (2007) conducted one of the first explicit investigations of autobiographical memory in children with autism and explored semantic and episodic autobiographical memory as well as suggestibility. For the purposes of this chapter, I refer only to their findings on autobiographical event memory. They probed memory for recent (within the past 6 months) and remote (prior to 2 years) events using a semi-structured interview, in 30 children with high-functioning autism (i.e., IQ above 70) aged between 5 and 10 years. They compared both the quality and accuracy of their reports with age-matched (but not IQ-matched) typically developing children. Target events to be recalled were specified by the experimenter (e.g., first day at kindergarten) and by parents who selected from a list of typical childhood events (e.g., going on an airplane trip) that were pertinent to their child. Event memory was also explored with a yes/no recognition procedure where judgments were made as to whether specified events (e.g., getting lost in the park) had occurred. Accuracy was assessed for both the event recollections and the yes/no recognitions by parents' stating whether their own memory of the event was consistent or inconsistent with their child's. Bruck et al. reported impaired memory access in autism relative to typically developing children as their event memory narratives were less detailed (i.e., contained fewer mean number of utterances). This provides some contrast to Losh and Capps' (2003) findings described earlier. The younger age of Bruck et al.'s participants and/or the greater constraints of their retrieval task that specified the types of memories required may provide some explanation for the differences between the studies when assessing level of detail.

With respect to accuracy, Bruck et al. (2007) reported that children with autism were more likely to have forgotten that an event had occurred (as established by their parents), but they were not more likely, relative to typically developing controls, to confabulate. Bruck et al.'s study has been particularly valuable in demonstrating that asking children with autism to report on their past experience can produce reliable information as their recollections, while limited in information, nonetheless related to "true" events. The study also indicated a delayed onset of autobiographical memory in autism as younger children were particularly prone to forgetting, and impoverished memory reports were particularly apparent for the distant past. One limitation of the study was that the control group was not IQ-matched, although analysis of covariance revealed no effect of IQ on memory.

The aforementioned studies helped form the basis for my colleagues and my research into the developmental trajectory of autobiographical memory in autism (Goddard, Dritschel, & Howlin, 2014a; Goddard, Dritschel, Robinson, & Howlin, 2014b). We wanted to know more about specific memory difficulties, for example whether they were affected by the richness of cues offered at retrieval. Our research benefited from a relatively large sample of 63 children between the ages of 8 and 17 years with an autism spectrum diagnosis and 63 typically developing children matched on age, IQ, and receptive vocabulary. We used three methods for eliciting specific event memories. The cueing task paradigm is the most commonly used test of specific memory retrieval. Originally devised by Galton (1879), this task requires respondents to produce, at speed, memories of individual events cued by single words. In our study, cues pertained to positive and negative emotions, and neutral words and children's understanding was first established through the accuracy of their definitions of these words.

The strength of this ubiquitous assessment tool is that it provides a reliable index of specificity and it has been extremely useful for understanding how autobiographical

memory is organized (Conway & Bekerian, 1987). Its emphasis on speed and specificity means that it is a cognitive demanding task that is highly dependent on executive processes; it requires the elaboration of a cue into a description with which to search and identify appropriate cases within memory. However, its ecological validity is somewhat questionable since in everyday life memories frequently pop into mind (Bernsten, 1996) rather than requiring a strategic search through the memory stores. Therefore, in addition to this task, we developed a semi-structured interview that prompted children to recall in much detail as possible recent events that had happened over the past week and more distant memories, including the very first thing that they could remember. Episodic autobiographical memory was further compared with its semantic counterpart via the Children's Autobiographical Memory task (Bekerian, Dhillon, & O'Neil, 2001) that systematically questions children about facts and events from different lifetime periods (for the purposes of this chapter, I refer only to the event memory data). Data were analyzed in order to compare children in terms of autism diagnosis and age, with children grouped into younger (8–12.4 years) versus older (12.5–17 years) age groups.

Across all memory tasks, children with autism showed significant difficulties in recalling autobiographical events that were manifested in several ways. They were significantly more likely than typically developing children to fail to retrieve any experience that matched the demands of the various tasks, and when they did recall, they showed a significant propensity toward retrieving categorical general memories where control children were more able to retrieve specific memories. Other research has also demonstrated specific memory deficits in autism. For example, Maister, Simons, and Plaisted-Grant (2013) asked 14 high-functioning children with autism and 14 typically developing controls between the ages of 11 and 13 to recall three specific autobiographical memories in as much detail as possible. They scored specificity in a slightly different way; memory narratives were analyzed for both episodic details and general details where no specific spatiotemporal context was given. Results demonstrated that the narratives of the autism group contained significantly fewer episodic and more general utterances. There is therefore a growing research base demonstrating specific memory deficits in autism to emerge in childhood. The question arises as to why these difficulties manifest.

In the context of emotion understanding, research has shown a tendency for children with autism to refer to nonspecific time frames. Losh and Capps (2006) asked children to discuss with an experimenter times when they had experienced both simple and complex emotions. They noted a tendency to recall emotional experience in a much more schematic, nonspecific way compared to typically developing children, and concluded that this was likely due to an impoverished emotional experience. Our data, however, suggested that nonspecific memory is a more universal than an emotion specific effect, as word valence on the cueing task had no effect on the specificity of memories retrieved. Our data showed that neutral cues were just as likely to elicit nonspecific memories.

Moreover, reduced specificity was apparent across all tasks including those without an obvious emotion component. We might argue that children with autism have a more restricted lifestyle yielding fewer life experiences on which to draw. Insistence on “sameness” might mean that nothing much stands out as memorable and explains the tendency toward retrieving categorical memories, where similar experiences are subsumed into a thematic representation. However, reduced life experience cannot

explain difficulty in recognizing a match between life experience and a memory cue. We found that while children with autism required a greater number of prompts than typically developing children, they were frequently able to use these prompts to retrieve memories that previously seemed inaccessible. Difficulties here then appear to be more one of access than encoding and are consistent with Bowler, Matthew, and Gardiner's Task Support Hypothesis (1997). This states that individuals with autism have inefficient memory organizing strategies as they fail to encode and store relational aspects of information. Therefore, providing support at recall with cues to the initially encoded material can improve their memory performance. More recently, support has been qualified to exclude temporal information because research within an episodic memory paradigm found performance was facilitated with location cues but not with temporal cues (Bowler, Gaigg, & Gardiner, 2015). The authors argue that temporal source is unhelpful because of the inherent difficulties with diachronic thinking (Boucher, Pons, Lind, & Williams, 2007) and time perception (Martin, Poirier, & Bowler, 2010) in autism. Unfortunately, we did not systematically examine the kinds of prompts given in our study, but prompts were aimed at providing a richer context for retrieval. Interestingly, prompts often featured temporal cues (e.g., when asking for the earliest memory, prompting with *before you went to school*) as well as emotion/activity cues (e.g., *"a special day out doing something you really liked"*). The relative support that different cues to autobiographical memory retrieval provide in autism is a fruitful line of further investigation.

Examining the level of details in memories in autism has produced inconsistent findings. Maister et al. (2013) reported no group effect with respect to the number of overall details contained within memories, and this is similar to the findings of Losh and Capps (2003) who found no reduction in length of personal narratives in autism. Conversely, other studies have reported more impoverished memory reports in autism. For example, our findings (Goddard et al., 2014b), like those of Bruck et al. (2007), showed that even when children with autism generated specific memories, they were still significantly less detailed than their control counterparts. Methodological differences across studies may well explain these inconsistencies. Studies reporting no reduction in detail allowed greater freedom in the types of memories to be recalled, whereas those reporting reduced detail used more restrictive cues of memory. This corresponds with verbatim reports, particularly those of parents of children with autism, who often indicate that their children are capable of producing highly detailed memory accounts. Often, however, these are not in response to parental questioning, but arise seemingly spontaneously. Thus, children with autism may be able to experience involuntary retrieval of events on which they can report in detail, but rigid and inflexible thinking may reduce their ability for voluntary retrieval where an effortful match between target cue and experience is required. Deficits may then manifest in situations where memory has a functional role such as where memories are required in response to a social interaction or where memories are required for personal problem solving or mood repair.

How maturation might affect memory in autism is unclear. Deficits could become more pronounced as emerging meta-memory skills give typically developing children a greater advantage with the use of more complex memory strategies. Alternatively, deficits may ameliorate as language and cognitive development in autism support the development of compensatory strategies. The cross-sectional nature of research to date has limited conclusions in this area. There is one longitudinal study that has

attempted to address this issue. A single case study reported by Bon, Baleyte, Piolino, Desgranges, Eustache, and Guillery-Girard (2013) described Simon, a high-functioning boy with autism at three time points—initially at 8 years, 14 months later, and finally, after a further 17-month gap. They tested autobiographical memory by prompting for target events across three different lifetime periods—the current year, previous year, and early school years. Results were compared with existing data from typically developing groups. Simon displayed memory deficits at all three testing sessions. Memory for events pertaining to the current year was particularly poor, and memory for events in the past year impaired to a lesser extent, but memory for the early years showed no significant differences. The authors argued that the early autobiographical memories of Simon showed no impairment because, like the comparison group, they were not truly autobiographical but rather fragments of events. They concluded that Simon’s autobiographical memory remained developmentally delayed from age 7 years onward and that this extended to the final testing session. Developmental delay was indicated by a lack of detail and lack of specificity in his personal memories.

Other research has attempted to address the developmental question with age group comparisons and within group differences in recalling recent and remote events. This cross-sectional research has also provided evidence for a later onset of autobiographical memory. In our research, we asked children to estimate their age at earliest memory. Age reports were comparable to typically developing children in both younger and older age groups. Moreover younger children, regardless of autism diagnosis reported being younger at the time of their earliest memory than older children, an effect previously found in typical development (Peterson et al., 2011). These data are in line with Bon et al.’s (2013) findings, and also suggest early episodic memory processes to be intact in autism. These early memories are unlikely to reflect truly autobiographical recollections; indeed, in our research, the early memories were typically dated between the ages of 2 and 3 years, earlier than the often assumed onset of autobiographical memory. Qualitative analyses of memory narratives from remote time periods demonstrate impairments in autism (Bruck et al., 2007; Goddard et al., 2014b), suggesting a delay in onset of true autobiographical memory. There is evidence, however, that developmental gains are then in line with those of typically developing children. In our research, we observed age effects on several of our memory indices with older children outperforming their younger counterparts; however, none of these effects were qualified by autism status, suggesting a similar rate of development in both typically developing and autistic children.

Of interest, our research revealed that asking children with autism to report what they had done over the past week did not reveal access problems (Goddard et al., 2014a; Goddard et al., 2014b). These memories might be of a different quality, more reflective of episodic memories, inasmuch as describing a sequence of events than truly autobiographical events. However, one finding that runs counter to this suggestion is that these recent memories frequently contained references to emotion states apparently demonstrating the critical involvement of self, the quintessential ingredient of autobiographical memory. It is difficult to know whether or not these memories would consolidate and persist. It would seem unlikely given that the events pertained to generally routine behaviors (e.g., “What happened before going to bed last night?”).

### Memory for internal states

Autobiographical memories are accompanied by key phenomenological characteristics that distinguish them from nonpersonal episodic memories. They are frequently vivid, emotional, contain references to internal states, and embody self-reflection and personal temporality (Klein et al., 2004). These features contribute to the felt sense of reliving or mental time travel associated with autobiographical retrieval (Rubin, 1986). Emotion has been shown to particularly enhance autobiographical memory, yielding more durable (Brown & Kulik, 1977) and detailed accounts of events (St. Jacques & Levine, 2007). Emotion gives meaning to memories, and emotional memories are often associated with the pursuit of personal goals (Conway & Pleydell-Pearce, 2001).

We know that children with autism are characterized by difficulties in understanding both their own and others' emotions, particularly when emotions are complex (Losh & Capps, 2006). Research examining the use of internal state language has produced mixed results and inconsistent findings may be explained by the context within which internal state language has been explored (Kristen, Vuori, & Sodian, 2015). In the autobiographical memory domain, findings are also inconsistent with some research reporting reduced mental state references in event narratives (King, Dockerell, & Stuart, 2013) and other research (Goddard et al., 2014a; Goddard et al., 2014b) demonstrating internal state language (thoughts, beliefs, but excluding emotions) to not be affected by autism diagnosis. When considering emotions in isolation, however, a more consistent pattern of difficulty is seen, with fewer references to emotions in memory narratives (Brown, Morris, Nida, & Baker-Ward, 2012) particularly when pertaining to early experiences (Goddard et al., 2014a; Goddard et al., 2014b).

A lack of emotion in memory narratives may be connected to more general problems in narrative style where children with autism have difficulty contextualizing emotions within "causal explanatory frameworks" (Losh & Capps, 2006). Goldman (2008) elicited personal narratives of events such as "a visit to the hospital" and "last weekend" from children with autism, typically developing children, and a group of children with a developmental language disability. Narratives were coded across a range of qualitative dimensions. Of particular relevance to autism were references to evaluative states (i.e., how the narrator felt about aspects of events). This was significantly reduced compared to both control groups, demonstrating that reduced emotion in narratives to be specific to autism rather than a concomitant of language difficulties. Furthermore, Goldman noted that whereas an appreciation of narrative structure was apparent in children with autism, their personal narratives lacked high points making the relevance of their life stories unclear.

The evidence to date shows memory for emotional experiences to be impaired in children with autism, particularly in relation to early memories. In line with social interactional theories, emotion difficulties in autism may contribute to a delayed onset of autobiographical memory. In neurotypical populations, emotion valence acts as an important dimension in organizing autobiographical memory (Schulkind & Woldorf, 2005). Although maturation in autism facilitates emotion encoding (as evidenced by increased reference to emotion states in recent memories; Goddard et al., 2014a; Goddard et al., 2014b), the paucity of emotional information when recalling the past suggests that emotion is a less powerful tag for children with autism.

### Cognitive mechanisms underlying event memory deficits

Few studies have considered autobiographical memory deficits in the context of general memory abilities. Despite a large body of research on general memory in autism, findings have been inconsistent. This is likely due to the heterogeneity of the condition, and the diversity of intellect and autism severity in research samples. However, some inconsistency can be explained by the complexity of the to-be-remembered material that different studies have employed. Generally, memory for relatively low-level verbal and visual material is intact with impairments emerging when stimuli becomes increasingly complex and where organizational strategies (such as applying semantic relatedness) would be beneficial (Williams, Goldstein, & Minschew, 2006).

Our research examined the correlations between verbal and visual general memory, and indices of autobiographical memory performance. We thought that visual memory processing might be of particular importance since visual images frequently accompany autobiographical memory retrieval and impairments in autobiographical memory have been reported in individuals with compromised visual ability due to either neurological damage (e.g., Ogden, 1993) or because they are born blind (Goddard & Pring, 2001). Our data revealed no verbal memory impairment in children with autism, being equally able to recall lists of random words both immediately after presentation and after a delay; a finding consistent with previous studies also suggesting intact verbal memory in autism (Diehl, Bennetto, & Young, 2006; Williams et al., 2006).

With respect to story recall, a more complex verbal stimuli, there was also no impairment. This contrasted with performance on the visual memory tasks: Here, the ability to recognize previously presented faces and learn spatial locations was impaired in our children with autism, which was apparent when tested both at short and longer intervals. However, visual memory did not seem to be the underlying cause of their autobiographical memory deficits. Regression analyses with visual and verbal memory as predictors of indices of specific event autobiographical memory were nonsignificant for both typically developing and autism groups. Thus, while children with autism exhibit both deficits in visual general memory and difficulties in accessing specific autobiographical memories, these impairments are relatively independent.

The executive function theories of autism (Pennington & Ozonoff, 1996; Russell, 1997) explain problems associated with social and everyday behaviors in terms of frontal lobe dysfunction. Problems in cognitive flexibility, inhibition, planning, and self-monitoring have all been reported (although findings tend to vary and depend on task difficulty and presentation; Robinson, Goddard, Dritschel et al., 2009). Executive deficits are also proposed to be at the core of general memory problems in autism (Bennetto, Pennington, & Rogers, 1996) and in autobiographical memory retrieval, executive resources are involved where retrieval requires the formation of a memory description for searching and verifying target matches to a memory cue (Shallice, 1988).

Two studies, to date, have examined how executive function deficits relate to autobiographical memory difficulties in children with autism. Maister et al. (2013) examined working memory, set shifting, verbal fluency, and inhibition as correlates of the number of episodic details contained with memories. Set shifting was the only variable emerging as significant—the better children with autism were on this task, the more episodic details they produced within their memories. We also examined set shifting,

verbal fluency, and inhibition as predictors of autobiographical memory albeit with some slightly different findings. While we also found set shifting to predict some aspects of autobiographical memory performance, namely, the ability to remember very recent events (Goddard et al., 2014b), verbal fluency proved to be the most prominent predictor of access to specific event memories (Goddard et al., 2014a; Goddard et al., 2014b). It is arguable what verbal fluency really is a measure of; it is probably comprised of several facets, including set shifting and generativity. It involves the spontaneous generation of many exemplars to a given cue. Our autobiographical memory retrieval tasks also involved retrieving a specific memory to a cue. It would seem then that generating suitable descriptions of a target cue is problematic in autism. In the context of autobiographical memory, children with autism may find it difficult to see the relevance of their past in response to cues within their current environment.

As noted previously, research in this area is in its infancy, and there are many other potential mechanisms underlying autobiographical memory deficits in children with autism that, as yet, remain unexplored. Symptom heterogeneity also provides new avenues for exploring individual differences in autobiographical memory performance. There is already some evidence that being female offers protection against deficits and that this may be related to improved social communication abilities (Goddard et al., 2014b). Protection may also be proffered by intact cognitive flexibility (Maister et al., 2013). While autobiographical memory deficits in autism often appear subtle, a comprehensive understanding of their underlying mechanisms will help to inform interventions aimed at improving the personal and social lives of children and adults with autism.

### **Summary of Findings and Implications for Eliciting Event Memories in Autism**

Difficulties in generating specific events memories in autism emerge at around the age of 5 years with memory narratives characterized by a paucity of detail and lack of both emotion references and causal links between event sequences. It is difficult to unequivocally establish whether impairments lie at encoding, storage, or retrieval stages as separating these processes is problematic (Roediger & Gynn, 1996). However, one primary barrier to retrieval appears to be in identifying target memories to match retrieval cues that might arise out of the cognitive rigidity that is characteristic of autism. Within a forensic setting, narrative questioning might therefore be met with a failure to spontaneously retrieve key elements of an event. Since there is evidence that prompting can ameliorate this difficulty, interviewers might be advised to use more directed questioning in order to increase both the specificity and detail of memories retrieved. We do not know for certain what kinds of prompts are likely to be most beneficial and research is needed to discover whether temporal information serves to facilitate or constrain retrieval in autism. However, it is clear that eliciting event memories from children with autism can be maximized by questioning that seeks to enrich and broaden retrieval cues.

With respect to encoding processes, our research suggests that recognition of emotional states leads to an increase in memory for recent events (Goddard et al., 2014a,

2014b). We do not know whether our observation of increased emotion recognition and preserved recent memory in autism was due to natural development or the result of interventions being delivered within the school settings. Nevertheless self-monitoring is an intervention worth exploring; encouraging children with autism to observe and record specific events may serve to enhance their autobiographical memory that could have a subsequent positive impact on their social function. Self-management interventions that focus on increasing self-awareness has already proved effective for managing stereotypies (i.e., repetitive or ritualistic movements) and decreasing disruptive behaviour (Yeung & Yeung, 2015). Training in self-managing memory processes so that events are encoded in reference to their meaning for the self, could also have positive effects on remembering.

One limitation of the findings reviewed here is that they are based on data collected within a social interaction between a child and stranger that requires a verbal exchange. The social demands of this paradigm will almost certainly be increased for the child with autism and the pressures of social interaction may deflect their attention from the task of retrieval and obscure their true abilities. Moreover, the target of memory retrieval is often determined by the investigator, and accordingly, based on events that are memorable within the context of neurotypical individuals. Memories arise from a focus of attention, and children with autism may well focus on different things. These issues have particular implications for interviewing children with autism in a forensic setting where the presence of an unknown interviewer is likely to create additional stress. Alternate modes that do not rely on verbal interaction may lessen the additional demands placed on the child. For example, requesting written or pictorial responses to questions presented in written form or orally by a familiar other will reduce the social demands of the interview situation and may facilitate memory recall.

We have not as yet captured all of the nuances of remembering in children with autism, and future research would benefit from creative methods of inquiry that can most accurately reflect this process in real life. Many questions remain unanswered, for example, the extent to which children with autism experience involuntary recollection, engage in silent reflection, and potentially develop compensatory strategies for their autobiographical memory difficulties. Understanding how children with autism remember their personal lives will not only aid the development of interview techniques for eliciting accurate memory reports, but will also permit us to devise optimal interventions for improving well-being.

### **Take-Home Points**

- Children with autism have difficulty in accessing specific autobiographical memories.
- The specific memories that they recall in response to adults' elicitations are less detailed, contain fewer references to their own emotions and cognitive states, and are less coherent.
- Specific personal memory impairments in autism are independent of general memory function, but related to poor cognitive flexibility.
- Autobiographical memory difficulties may be ameliorated by providing prompts that steer children toward appropriate retrieval cues.
- Interview techniques that minimize the demands of a social setting are more likely to be successful in evoking detailed event memories.



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