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Episodic Memory and Autonoetic Consciousness in Autistic Spectrum Disorders: The roles of self-awareness, representational abilities and temporal cognition

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Introduction

According to Schacter and Tulving (1994), human memory is subserved by a number of mind-brain systems including the episodic and semantic systems (see Gardiner, Chapter 1). The episodic system encodes and retrieves personally experienced event memories, which consist of complex collections of features including spatial, temporal and contextual information. Conversely, the semantic system is largely responsible for factual memory and general knowledge. These memories are not generally associated with spatial, temporal or contextual information. Crucially, retrieval from each system is associated with a distinct form of conscious awareness: episodic retrieval – or 'remembering' – involves autonoetic (self-knowing) consciousness, whereas semantic retrieval – or 'knowing' – involves noetic consciousness. Thus, semantic retrieval might involve, for example, bringing a known fact to mind, whereas episodic retrieval might involve remembering the particular episode during which that fact was learned. The episodic system underlies the capacity for 'mental time travel' (Suddendorf & Corballis, 1997; Wheeler, Stuss, & Tulving, 1997) – either mentally projecting oneself into the past

to *re-experience* an event or mentally "projecting oneself into the future to *pre-experience* [italics added] an event" (Atance & O'Neill, 2005, p.127).

Individuals with an autistic spectrum disorder (ASD) generally perform well on tasks that require semantic (or other) memory processes, but perform poorly on tasks that demand the support of the episodic system (see Chapters 12, 14, and 17; also Bennetto, Pennington, & Rogers, 1996; Minshew & Goldstein, 2001; Ben Shalom, 2003). This chapter aims to establish the reasons for this impairment in episodic remembering. The main thrust of our argument is to suggest that autonoetic consciousness is attenuated in people with an ASD. Before considering possible explanations, however, the prerequisites for the development of episodic memory (EM) in typical individuals will be considered. These prerequisites will be used as a framework for exploring the causes of the EM impairment in autism.

Prerequisites of Episodic Memory in Typical Development

In typical development, EM is not fully functional until at least 4;0 years of age. Although infants, toddlers, and young preschoolers show impressive memory retention, such achievements are likely to be manifestations of other memory systems (Cowan, 1997). The relatively late emergence of EM is likely to be due to the fact that young children cannot yet experience autonoetic consciousness. Wheeler et al. (1997) define autonoetic consciousness as the ability to mentally represent and become aware of subjective experiences in the past, present and future. It enables the kind of mental time travel that characterises episodic remembering. This form of consciousness is thought to

depend upon a number of interrelated cognitive abilities including having a concept of self, representational abilities that include a capacity for metarepresentation, and certain achievements in the domain of temporal cognition. Until each of these elements is in place children cannot become autonoetically conscious. We will begin our discussion by considering the typical developmental paths of these three likely prerequisites.

1. Development of the Self

The intuitive assumption that we each possess some kind of unitary core self – something akin to a soul – has given way, in psychology at least, to theories proposing various delineations of the self. For example, the most widely accepted distinction is between the self as the subject of experience – the *'I'* – and the self as the object of experience – the *'me'* (James, 1890). However, Neisser (1988) has developed a more elaborate taxonomy claiming that there are five forms of self-awareness: ecological, interpersonal, conceptual, private, and temporally extended self-awareness. Ecological and interpersonal self-awareness are perceptually based and early developing, together constituting implicit self-awareness (corresponding to James' notion of the 'I'). The former entails awareness of the body in relation to the physical environment, whereas the latter entails awareness of the self in relation to others in the social environment. Conceptual, private and temporally extended self-awareness are later maturing and representationally based, underpinning explicit self-awareness (the 'me'). Conceptual self-awareness occurs when the self becomes the object rather than merely the subject of thought. It entails having a concept of 'me' comprising of a set of beliefs about the self.

Private self-awareness refers to explicit, conceptual awareness of aspects of the self not accessible to others (e.g., awareness of internal mental states). Finally, temporally extended self-awareness is also conceptual but involves an additional temporal dimension, thereby endowing individuals with a sense of continuity in personal identity through time. These various types of self-awareness are likely to be interrelated/interdependent in that, for example, implicit forms of self-awareness serve as a foundation for explicit self-awareness. Nevertheless, each of these dimensions follows its own ontogenetic trajectory evolving throughout development particularly during early childhood, as outlined next.

Implicit self-awareness: the ecological and interpersonal selves

A considerable amount of evidence suggests that infants are endowed with rudimentary ecological and interpersonal self-awareness soon after birth (Rochat, 1995). For instance, 24-hour-old neonates show significantly more rooting responses (orienting towards perioral cheek stimulation) when they receive external stimulation from an experimenter's hand than when they are 'self-stimulated' by the experimenter moving the infant's own hand to their cheek (Rochat & Hespos, 1997). Such selective responsiveness demonstrates self/non-self discrimination and, therefore, a degree of ecological self-awareness. That newborns will learn to suck on a pacifier at a specific rate in order to see or hear a pleasant stimulus such as a picture or their mother's voice (e.g., Siqueland & DeLucia, 1969; DeCasper & Fifer, 1980), shows that they can also exert intentional control over their behaviour, revealing that they have a sense of 'agency' – a critical

hallmark of the ecological self (Neisser, 1995; Gibson, 1995). Agency involves implicitly distinguishing between self-caused and environmentally caused changes in perceptual experience. It involves perceiving oneself as the centre of control of one's own action-generated experiences and recognising one's responsibility for particular changes in perceptual experience (Russell, 1996). Interpersonal self-awareness is clearly evident among 2-month-olds. Infants of this age readily engage in 'protoconversations' with their caregivers (Murray & Trevarthen, 1985) – mutually regulated, coordinated interactions involving turn-taking and imitation of vocal, facial, and gestural expressions (Trevarthen & Aitken, 2001) – that show clear awareness of the self in relation to another. That babies exert intentional control in these social exchanges indicates a clear sense of agency in the interpersonal domain also.

Explicit self-awareness: the conceptual, private and temporally extended selves.

Conceptual self-awareness. Only in the second year of life do children become reflexively – conceptually – self-aware. A number of concurrent developments, including the emergence of self-conscious emotions, personal pronoun use, and a set of explicit beliefs about the self, are considered to be expressions of conceptual self-awareness. However, mirror self-recognition (MSR) is widely regarded as the litmus test of conceptual self-awareness.

In the classic form of the MSR paradigm (Amsterdam, 1972), a familiar adult surreptitiously marks the child's face with brightly-coloured pigment under the pretence of wiping their face clean. The experimenter then assesses the child's response to their

reflection. Touching the mark is generally thought to indicate the presence of a self-concept and indeed it would appear to imply at least a basic conceptual knowledge of one's typical facial appearance (but see Mitchell, 1993, 1997; Loveland, 1986, 1993; and Hobson, 1990, for alternative explanations). Studies reliably show the mean age of success in this task to be 18 months (Anderson, 1983; Courage, Edison & Howe, 2004; Lewis & Ramsey, 2004). Blushing, shy smiling, gaze aversion, and preening are taken to be expressions of embarrassment and pride, both of which are examples of self-conscious emotions. Even the earliest studies of MSR noted these reactions among 21- to 24-month-olds when they were confronted with their reflections (Amsterdam, 1972). Unlike earlier emerging basic emotions, such as fear and joy, self-conscious emotions involve cognitive support and necessarily involve a self-concept, since they are emotions *about* the self (Lewis, Sullivan, Stanger, & Weiss, 1989; Lewis, 1994; Tracy & Robins, 2004). They involve self-evaluative processes whereby one's representation of self is compared to a socially defined standard. Thus, in the case of pride, one has exceeded accepted standards and in the case of embarrassment, one has violated those standards.

The use of personal pronouns to refer to the self is the least controversial marker of conceptual self-awareness. For example, using the terms 'my' and 'mine' to denote ownership implies a concept of self. Moreover, appropriate use of the terms 'me' and 'you' signifies a sophisticated explicit differentiation of self and other, suggesting that the child represents self and other as distinct individuals. Only individuals who make such an explicit distinction can use the terms correctly because, unlike proper names, their meanings shift according to who is speaking – the speaker is always 'I' or 'me' and the listener is always 'you' (Bates, 1990). For example, if a parent and child were to look

into a mirror together, the parent would say "that's you" whilst pointing to the child's reflection, not "that's me", and yet by 22 to 24 months toddlers can correctly label their own mirror image as "me" (Lewis & Ramsey, 2004; Courage, Edison, & Howe, 2004). Thus, when toddlers begin using these terms, one can confidently infer that they have a self-concept to which they are referring.

Overall, the available evidence suggests that explicit self-awareness in the form of the conceptual self is first apparent in typically developing children between 15 and 24 months. However, the conceptual self undergoes considerable elaboration over time. Its development involves the gradual acquisition of a set of beliefs about the self, knowledge of personal characteristics, features and traits (e.g., Neisser, 1997). In its earliest stages, the self-concept consists mainly of beliefs about physical traits and abilities (e.g., "I have brown hair"; "I can skip"), only later extending to psychological and social traits (e.g., "I'm shy"; "I have lots of friends") (Damon & Hart, 1988). Thus, ecologically grounded elements of conceptual self-awareness are earlier to develop than interpersonally grounded elements.

The private self. Private self-awareness emerges somewhat later than basic conceptual self-awareness. It involves conceptual awareness of private experiences – of one's own mental life. It thus relies on 'theory of mind' (ToM), which is defined as the conceptual system that underlies the ability to impute mental states to self or other (Perner, 2000). Children come to appreciate mental states such as desires, intentions and beliefs between the ages of about 3;0 to 5;0 years, and their ability to attribute these states to self and other appears to develop in parallel (Gopnik & Meltzoff, 1994). Thus, the development of

a ToM endows the child with the kind of introspective self-knowledge that characterises private self-awareness, allowing them to go beyond simply *having* private experiences to include the additional awareness *that* they have them.

The temporally-extended self. Temporally extended self-awareness also emerges at around 4;0 years. It involves awareness of the relations between present, past and future states of self. It is essentially awareness of one's place in, and continued existence through, time and appears to depend upon the capacity for autonoetic consciousness (Moore & Lemmon, 2001). Povinelli, Landau, and Perilloux (1996), developed a task to investigate the development of this form of self-awareness. They introduced a temporal component into the traditional MSR test to create the *delayed self-recognition* (DSR) paradigm. Experimenter and child were filmed playing a game in which the child was praised by patting them on the head. Whilst praising the child, the experimenter covertly placed a large sticker on top of their head. After a delay of three minutes, the pair watched the recording and the child's response was assessed. The test is designed to establish whether the child understands the causal relation between this 'past self' represented on the television screen and the 'present self' who is watching the recording. Reaching for the sticker is taken as evidence for a temporally extended concept of self (but, for alternative explanations, see Zelazo, Sommerville & Nichols, 1999; and Suddendorf, 1999). Most 4;0 year olds, but few 3;0 year olds, can locate the sticker on their head (Povinelli, Landau, & Perilloux, 1996; Povinelli & Simon, 1998; Suddendorf, 1999; Zelazo, Sommerville, & Nichols, 1999; Lemmon & Moore, 2001).

We will now address the question of how these developments in self-awareness relate to the emergence of EM. A number of researchers have argued for a causal link between self-awareness and EM, agreeing that *explicit* self-awareness must be involved, since autonoetic awareness necessitates directing attention onto a mental representation of the self. However, there is controversy over the *level* of explicit self-awareness required. Howe and Courage (1993) have claimed that the emergence of conceptual self-awareness, as indexed by MSR, is the critical developmental precursor for remembering personally experienced events. However, it can be argued that the MSR task does not capture the kind of self-awareness involved in autonoetic remembering.

Wheeler et al. (1997, p.335) suggest that "autonoetic consciousness affords individuals the possibility to apprehend their subjective experiences throughout time and perceive the present moment as both a continuation of their past and a prelude to their future". Firstly, the ability to 'apprehend subjective experiences' seems to imply private self-awareness, since it involves focussing attention directly on private experiences. The quote also focuses on the temporality of autonoetic consciousness. This is also highlighted in a second quote in which it is argued that episodic retrieval involves the understanding that "the self doing the [re] experiencing now is the same self that did it originally" (Wheeler et al., 1997, p.349). This seems to require a concept of self that is extended in time and is represented as such. Thus, autonoetic awareness would seem to involve elements of both private and temporally extended self-awareness. It does not seem likely that these high level forms of self-awareness are necessary for MSR.

Evidence that EM depends upon private self-awareness is provided by studies showing relationships between performance on ToM tasks and EM tasks (Naito, 2003; Perner, Kloo, & Gornick, in press). For example, Perner and Ruffman (1995) found a correlation between free recall, which is thought to rely primarily on the episodic system, and ToM tests measuring understanding of own knowledge states. The likely role of temporally extended self-awareness is supported by studies showing relationships between DSR and EM. Welch-Ross (2001) found that children who demonstrated DSR showed significantly greater episodic recall in mother-child conversations about past events than children who did not show DSR. Similarly, Lemmon and Moore (2001) found a significant correlation between DSR and an EM measure, which involved remembering the temporal order of events in a sticker finding game.

2. The Development of Representational Abilities

We turn now to the second of the likely developmental prerequisites of EM. Changes in representational abilities are relevant not only in terms of their direct role in the development of autonoetic consciousness and EM but also in terms of the developments in self-awareness that were described above. According to Perner's (1991) representational theory of mind, prior to 18 months of age infants are limited to primary representations which faithfully model the currently perceived state of affairs. Representational skills post 18 months, however, reach a new level of sophistication, with an emerging capacity for secondary representation which allows the child to hold in

mind multiple, even contradictory, representations of the world which can be differentiated from and compared to a primary representation of reality.

It has been suggested that conceptual self-awareness relies upon this capacity for secondary representation (Perner, 1991; Suddendorf & Whiten, 2001; Asendorpf, Warkentin, & Baudonnière, 1996). Thus, in the case of mirror self-recognition, the 18-month-old is able to hold in mind a stable representation of their typical facial appearance (no mark) and compare it to a veridical, primary representation of their currently perceived reflected image (marked). The infant must recognise the discrepancy between these two representations and use this information to initiate appropriate behaviour – i.e., trying to remove the mark. Prior to the transition from primary to secondary representation, perceptions of self are in a state of constant flux, and self-representations are largely online. At this stage, stable characteristics cannot be attributed to the self and, therefore, there can be no enduring concept of self. Primary representations, although sufficient for ecological and interpersonal self-awareness, are not adequate for conceptual self-awareness.

Developments in representational skill also directly affect the capacity for autonoetic awareness. Autonoetic awareness involves focussing attention on one's own mental states. This capacity for thinking about thoughts – or ToM – involves the ability to metarepresent, i.e., to represent representations as representations (Perner, 1991). EM retrieval involves the explicit understanding that what is being brought to mind is a *mental representation* of a past experience. The memory is identified *as* a memory. Without metarepresentation there is no awareness of the propositional attitude (e.g. 'I remember that') assumed in relation to the information held in mind. It is

metarepresentation that underlies the distinction between noetic and autonoetic awareness. Thus, without metarepresentation, memories would involve (semantic) knowing rather than (episodic) remembering as shown below in (i) and (ii) respectively.

(i) I went to the shop and bought milk.

(ii) [I remember that] I went to the shop and bought milk

A number of authors have argued for the role of metarepresentation in EM development (Perner & Ruffman, 1995; Perner, 2000; Perner, 2001; Welch-Ross, 1995; Welch-Ross, 2001; Nelson & Fivush, 2004). Temporally extended self-awareness may also rely upon metarepresentation because it involves understanding present, past and possible future self-representations *as* (alternative) representations of the same temporally extended coherent self (Povinelli, 1995; Povinelli & Simon, 1998; Perner, 2001).

3. The Development of Temporal Cognition

Certain developments in temporal cognition are also thought to be prerequisites of EM because, unlike semantic memories, episodic memories involve explicitly thinking about the past. More specifically, EM involves representing remembered events as specific past events that occurred at particular times (McCormack & Hoerl, 2001). For this, events need to be understood as unique and unrepeatable. This clearly distinguishes episodic memories from the generalised script-like memories that dominate in early childhood.

McCormack and Hoerl (2001) suggest that EM relies on 'temporal perspective taking' abilities, which, in turn, rely upon having a concept of time that incorporates both 'nonperspectival' and 'perspectival' temporal frameworks. According to their theory, nonperspectival temporal frameworks are conceptual structures that represent the relationships between events located at different points in time, whereas perspectival temporal frameworks represent the temporal location of events in relation to one's own temporal location. Infants of less than 1;0 year can imitate novel event sequences in the correct order (Bauer, 1997), thereby showing that they represent the temporal order of event sequences – they have a non-perspectival temporal framework. That children comprehend and use tense correctly to describe past and anticipated future events by the time they are 2;6 years old (e.g., Weist, 1989) suggests that by this age they have at least a rudimentary perspectival temporal framework. It is not, however, until around 4;0 years of age that children can engage in the kind of temporal perspective taking that McCormack and Hoerl argue is fundamental to EM. That is, the ability to imagine events and their relations to each other from a different temporal perspective whilst monitoring the relation between one's present temporal point of view and the one generated in imagination or recalled from memory. This is only possible once metarepresentational ability has developed, because it crucially depends upon understanding that one's current perspective is just one of many possible perspectives. One must not only occupy (in imagination) different temporal perspectives but also explicitly conceive of them *as* temporal perspectives.

Autonoetic remembering also seems to require an understanding of temporal-causal relationships. Although fairly young children have a basic understanding of

causality (e.g., Bullock & Gelman, 1979), it is not until around 4;0 years of age that they realise that more recently occurring events are likely to bear a more direct causal relation to present circumstances than events located in the more distant past (Povinelli et al., 1999). Povinelli et al. (1999) suggest that 3;0 year olds have difficulty comprehending the 'causal arrow of time' – i.e., conceiving of time as a sequence of chronologically ordered, causally related episodes – and that this may be related to changes in self-concept. Indeed, children's ability to make temporal-causal inferences dramatically improves between the ages of 3;0 and 5;0 years (McCormack & Hoerl, 2005). Povinelli and colleagues suggest that, without an appreciation of the causal arrow of time as well as a capacity for metarepresentation, a child cannot understand the causal relation between present, past and future states of self, and thus cannot entertain a temporally-extended representation of self or experience autonoetic consciousness.

How Might Diminished Episodic Memory in Autism Be Explained?

We now return to the question of why EM is attenuated in people with ASDs. Evidence relating to the development of self-awareness, representational ability and temporal cognition in autism is reviewed, building on material presented in the three main sections of the first part of the chapter. From our review of the evidence, it is concluded that impairments across all three prerequisites for EM contribute to impaired autonoetic consciousness and hence impaired EM in autism.

1. Impaired self-awareness in people with autism?

The ecological and interpersonal self.

Russell (1996) has suggested that autism involves impairments in self-awareness at the most primitive – ecological – level, hypothesising a fundamental impairment in self-monitoring and, hence, an impaired sense of agency. However, studies have shown that children with ASDs do have awareness of their own agency in the physical/ecological domain. Russell and Hill (2001) and Williams and Happé (in preparation), for example, found that children with autism were capable of identifying which of a number of moving dots displayed on a computer screen, one of which they were able to move with the computer's mouse, was under their control. More generally, individuals with ASDs (who do not have co-morbid diagnoses of dyspraxia) have few difficulties in engaging with the physical world, suggesting they are aware of their bodies in relation to the physical environment and that ecological self-awareness is largely intact.

By contrast, individuals with ASDs appear to be less aware of themselves in relation to other people. Many characteristics of autism suggest that interpersonal self-awareness is severely impaired (e.g., Neisser, 1988; Hobson, 1990, 1993; Loveland, 1993; Tomasello, 1995). In typical development, interpersonal self-awareness is obtained through early social interaction, imitation, turn-taking and so on. However, because social interaction among children with ASDs is so impoverished, they cannot acquire the usual wealth of self-relevant information available through such experiences. Some children with autism show indifference to other people, treating them as objects rather than as beings with whom one can meaningfully and contingently interact. Even in less

severe cases, interactions tend to be stereotyped and lacking in reciprocity (DSM-IV, American Psychiatric Association, 1994). The difficulty may be with monitoring self in relation to other in order to coordinate action. Perhaps a specific problem of 'interpersonal agency'?

The conceptual self.

There is clear evidence that children with autism do develop an explicit concept of self, albeit one that is somewhat developmentally delayed. What is striking, however, about the self-concepts of these children is their markedly atypical quality. Given that early implicit self-awareness is thought to serve as a foundation for later explicit forms of self-awareness, it is no surprise that interpersonally, but not ecologically, grounded components of explicit self-awareness are impaired in autism. So, for example, MSR is relatively intact, whereas self-conscious emotion, pronoun use, and beliefs about the self are all atypical, as outlined below. Children with autism are capable of *mirror self-recognition* at the appropriate mental age (Ferrari & Matthews, 1983, Spiker & Ricks, 1984; Neuman & Hill, 1978; Dawson & McKissick, 1984). However, successful performance on the task is not evidence of *intact* conceptual self-awareness. It merely suggests that these individuals have conceptual self-knowledge of their typical facial appearance – they have mental representations of what they look like. It is worth noting here that the fact that MSR is relatively unimpaired in children with autism, whereas EM is impaired, weakens Howe and Courage's (1993) claim that MSR marks the critical cognitive change underlying EM.

The interpersonally grounded component of conceptual self-awareness has been explored in studies of children's conscious awareness of themselves in social situations. In particular, the experience of *self-conscious emotion* is clearly interpersonally grounded. Factors such as personal responsibility, normative standards, and the role of an audience, have been identified as important for the experience of these emotions (Capps, Yirmiya, & Sigman, 1992). None of the MSR studies carried out with children with ASDs reported the kind of self-conscious affective reactions that occur among typically developing children in this test. More generally, it seems that individuals with autism are less likely to spontaneously experience these emotions (see Faran & Ben Shalom, Chapter 5). They do not show the characteristic changes in facial expression, posture or gestures that are associated with these emotional states (Kasari, Chamberlain, & Bauminger, 2001). For example, although they experience pleasure, they are less likely to experience pride, in response to a personal achievement (Kasari, Sigman, Baumgartner, & Stipek, 1993). It is possible, however, that the problem here lies not with conceptual self-awareness but, rather, with lack of awareness of the presence of others or lack of awareness of social standards. It has also been reported that they are less likely to empathise with others (Sigman, Kasari, Kwon, & Yirmiya, 1992). This is important because the capacity for empathy entails an understanding that self is like other, whilst also representing self and other as distinct individuals. Reduced empathising capacity may, therefore, reflect an impaired concept of self, at least at an emotional level.

There is also an autism-specific deficit in another of the established behavioural markers of conceptual self-awareness: *personal pronoun use*. Since Kanner's (1943) seminal paper, it has been widely acknowledged that individuals with autism tend to have

difficulty using personal pronouns such as 'I', 'you' and 'me'. In young children with autism, pronoun reversal errors are relatively common (Tager-Flusberg, 1989; Lee, Hobson & Chiat, 1994). Indeed, the problem exists over and above any general language impairment, and is so prevalent that it is used as a diagnostic criterion for autism (Le Couteur, Lord, & Rutter, 2003). Typical patterns of difficulty include treating pronouns as if they were proper names attached to a fixed referent - saying, for example, "You want a drink" in order to request a drink for themselves. Other characteristic difficulties include substituting third person pronouns such as 'he' or 'she' or proper names for first person pronouns (Jordan, 1989). Using third person labels in this way circumvents the problem of shifting referents involved in pronoun use. Appropriate pronoun use is clearly an interpersonally grounded facet of conceptual self-awareness, since it requires an understanding of self in relation to others.

Lee and Hobson (1998) assessed conceptual self-knowledge using Damon and Hart's (1988) self-understanding interview to compare the *beliefs about the self* of a group of children and adolescents with autism to those of a matched comparison group. Their results fit the emerging pattern, in that ecologically grounded conceptual self-knowledge was intact but interpersonally grounded conceptual self-knowledge was impaired. Specifically, participants with autism produced significantly more, but qualitatively similar, descriptions of their physical and active characteristics, relative to the comparison group. Self-descriptive statements of psychological and social characteristics, on the other hand, differed qualitatively from those of comparison children and, in the latter instance, quantitatively, in that they produced significantly fewer descriptions that fell into the social category.

The private self.

Autism clearly entails a serious impairment in private self-awareness. This may be regarded as a specific manifestation of the ToM impairment associated with autism. Individuals with ASDs have difficulty not only with understanding others' mental states but also with understanding their own. For example, children with autism have equal difficulty attributing knowledge or ignorance to self or other depending upon whether that person has had informational access to that knowledge (e.g., though seeing or being told about a piece of information) (Perner, Frith, Leslie, & Leekam, 1989; Kazak, Collis, & Lewis, 1997). Furthermore, they find it difficult to distinguish their own intended from unintended actions. In particular, when their unintended actions have a desirable outcome they show a tendency to claim that their action was, in fact, deliberate (Philips, Baron-Cohen, & Rutter, 1998; however, Russell & Hill, 2001, failed to replicate this finding). This suggests an impairment of introspective awareness – difficulty with conceptualising their own mental processes.

These problems appear to extend to the emotional domain also. Again, individuals with autism are not only impaired in identifying emotions in others but also in processing their own emotional states. In a recent study, Hill, Berthoz, and Frith (2004) asked adult participants to complete a questionnaire assessing own emotion processing. They found that, compared to a typically developing comparison group, participants with high-functioning autism reported greater difficulties in identifying and describing their feelings and showed a greater propensity for externally oriented thinking. Similarly, Ben Shalom et al. (2006) reported that children with ASDs showed normal physiological emotional reactions, as measured by galvanic skin response, but impaired ability to report these

emotions. Thus, impaired private self-awareness is evident in adults as well as children with ASDs.

Frith and Happé (1999) suggest that those high-functioning individuals who do develop some introspective awareness (many individuals produce elaborate autobiographical accounts) have done so through a "slow and painstaking learning process" (Frith & Happé, 1999, p.2), developing a qualitatively different kind of self-consciousness. In a study of three adults with Asperger syndrome, Hurlburt, Happé, and Frith (1994) did, indeed, find that self-reported inner experiences differed markedly from those reported by typically developing individuals. Specifically, participants with Asperger syndrome reported thoughts that were concrete and factually based comprising mainly visual images. Most intriguingly, they did not report any form of inner speech and tended not to report emotions or bodily sensations. This suggests that private selfawareness, like conceptual self-awareness, is qualitatively different in individuals with ASDs.

The temporally extended self.

In a recent study of delayed self-recognition, Lind and Bowler (in preparation) found that children with ASDs tended to remove the sticker only when asked explicitly to do so. By contrast, comparison children tended to remove the sticker without direct prompting. These results are suggestive of impaired temporally extended self-awareness. There is also indirect evidence of such an impairment. Young typically developing children who fail DSR, tend to label past self-images such as photographs and video recordings using their own name, rather than saying 'me' (Povinelli, Landau, & Perilloux, 1996). Taking a

third person stance, by using a proper name, may well indicate an inability to identify with the depicted image (past self-representation), which would require a sense of personal continuity through time. Indeed, it is at least possible that those children who labelled the image using their proper name were not recognising the videos/photographs as themselves but, rather, showing a simple learned association between 'that face' and 'that name'. Lind and Bowler (in preparation) found that participants with ASD were significantly more likely than comparison participants to label their own video image using their proper name. Lee, Hobson and Chiat (1994) also found that, in contrast to comparison children, even fairly verbally able children with autism showed this same propensity to use proper names in a photograph naming task. This observation is suggestive of an impairment, or delay in the development of, a temporally extended self in children with autism.

To summarise, let us once again consider how Neisser's (1988) five kinds of self-awareness, as described in the section on the development of self in typical children, manifest themselves in people with autism. The evidence reviewed earlier in the chapter suggests that although ecological self-awareness is probably intact, interpersonal self-awareness is not. Conceptual self-awareness is also atypical, as is evident from, amongst other things, abnormal pronoun use, self-conscious emotion and the formation of beliefs about the self that have social connotations. If autonoetic consciousness depends upon explicit self-awareness, it can be inferred that anything that disrupts this development may potentially impact upon EM. Impairments in conceptual, private and temporally extended self-awareness are likely to contribute directly to the EM impairment in autism.

Impairments in interpersonal self-awareness may have indirect effects through altering the development of explicit self-awareness.

The claim that impaired sense of self contributes to EM impairments in autism is consistent with the fact that individuals with ASDs have particular difficulties when memory tasks demand a high degree of self-involvement (e.g., Russell & Jarrold, 1999; Millward, Powell, Messer, & Jordan, 2000; see also Toichi, Chapter 8). However, it is clear that EM depends upon more than self-awareness. As explained above it requires certain (related) representational and temporal-cognitive skills. This is discussed below.

2. Impaired representational abilities?

The same underlying difficulty in ToM/metarepresentation that leads to impairments in private self-awareness is also likely to impact upon the capacity of people with ASDs to experience autonoetic consciousness. Consequently, much of the evidence reported in the section on private self-awareness in autism is relevant here. Impaired performance on ToM tasks is usually interpreted as the result of difficulty with metarepresentation – with conceptualising mental states. Metarepresentational problems would mean that individuals with autism would not be aware of their own propositional attitudes to the information in their own minds. Thus, memories could not be identified *as* memories and, therefore, could not be consciously reflected upon as memories. This might explain why recall in autism seems to be dominated by knowing rather than remembering (Bowler et al., 2000, 2007).

3. An impairment of temporal cognition?

As mentioned above, mental time travel requires past or future oriented thinking. Problems with these forms of cognition may well contribute to the observed impairments. Both clinical and anecdotal accounts suggest that people with autism have a "poor intuitive sense of time" (Boucher, 2001, p.111). It is notable, also, that cognitive problems in autism include difficulty in both thinking backwards (episodic remembering) and thinking forwards (planning) though time (e.g., Bowler, Gardiner, & Grice, 2000; Ozonoff, Pennington, & Rogers, 1991).

Very little work directly assessing temporal cognition in autism has been reported. Recently, however, Boucher, Pons, Lind & Williams (2007) found that children and adolescents with ASDs were impaired relative to a matched comparison group on a number of tests designed to assess the ability to use temporal concepts in thinking and reasoning. Of particular note was the fact that the experimental group had significantly more difficulties with both past and future oriented thinking. So, for example, one of the tests involved presenting the children with a picture of a seaside scene and asking them to describe what was happening. Participants with autism were less likely to describe possible antecedents or consequents of the currently depicted state of affairs. Unlike comparison children, who produced descriptions such as "That man's lying on the mat – he'll get sunburned if he's not careful", children with autism tended to describe the scene primarily in terms of the present moment, producing descriptions such as "There's a person surfing. And someone sunbathing". These problems with past and future oriented thinking were not related to performance on a battery of tests of theory of mind

suggesting that difficulties with temporal cognition – particularly the ability to make temporal-causal inferences – could contribute to EM impairments independently of difficulties associated with impaired metarepresentation. What we do not yet know, however, is whether individuals with autism can form and coordinate perspectival and non-perspectival temporal frameworks. If this ability were to be impaired then it may well contribute to EM impairments.

Summary

Experimental evidence shows that individuals with autism have diminished EM and the self-involved, time-related experiences of autonoetic awareness that accompany this kind of remembering. The aim of this chapter was to establish the cause, or causes, of this impairment. There are a number of possible explanations, as is evident from a review of the prerequisites for the development of EM in typically developing children. These include the normal development of self-awareness. It has been claimed, for example, that the development of a self-concept indexed by successful mirror self-recognition is the critical prerequisite for EM. Related to the development of self are changes in representational abilities, from primary to secondary representations, to metarepresentation. A third prerequisite for the development EM is an ability to think and reason about time. Impaired metarepresentation is often considered to offer a sufficient explanation of impaired EM in autism. Whilst accepting that diminished ability to conceive of one's own mental states could impact on EM in various ways, an explanation in terms of impaired metarepresentational ability may be too strong in view of the

evidence that there is some residual self-awareness in relation to memory in this population. Moreover, there is some evidence of impaired temporal cognition in people with ASDs, occurring independently of any impairment of metarepresentational abilities. Impaired temporal cognition is consistent with our suggestion that people with ASDs have an impoverished concept of the temporally extended self. We also present evidence that the development of self is abnormal in people with autism at the foundational stage of an implicit interpersonal self, and argue that this has secondary effects on the acquisition of an explicit self-concept. What remains to be explained is how evolving conceptions of self and of events strung out in time are related, and how they interact with other areas of psychological functioning.

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