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**Personality traits, autobiographical memory and knowledge of self and others: a
comparative study in young people with Autism Spectrum Disorder**

Abstract

The relationship between dissociable components of autobiographical memory (e.g. semantic personality traits, episodic memory retrieval) and other cognitive skills that are proposed to enable one to develop a sense of self (e.g. introspection) have not previously been explored for children with Autism Spectrum Disorder (ASD). This study compared autobiographical memory (semantic and episodic) and knowledge of self (internal/external self-knowledge and introspection/mentalizing abilities) in children (aged 11-18 years) with high-functioning ASD and typically developing controls (Total $N = 48$). Novel and standard tasks were employed. Compared to typically developing controls, young people with ASD had autobiographical memory difficulties that were characterised by a reduction in the retrieval of semantic personality traits, with more initial prompts required to facilitate episodic memory retrieval and fewer episodic memories containing emotional and sensory information. Knowledge of the self and others was also impaired, with reduced introspection and poorer mentalizing abilities. Young people with ASD were also identified as presenting with an atypical relationship between autobiographical memory and self-knowledge, which was significantly different from typically developing controls. Test performance is discussed in relation to the functions of autobiographical memory, with consideration of how these cognitive difficulties may contribute to clinical practices and the social and behavioural characteristics of ASD.

Key Words: self-concept, theory of mind, externalising, mental states, CBT, Asperger

Impairments in theory of mind/mentalizing ability, introspection and autobiographical memory have been reported in Autism Spectrum Disorder (ASD; Baron-Cohen et al., 1985, Happé, 1994; McCrory et al., 2007; Robinson et al., 2009). It is not clear how such impairments may relate to the development of self-concept in ASD, i.e. the set of beliefs that an individual holds about themselves and which guides many aspects of social interaction and behaviour. Studies of adults with ASD have shown a dissociation between the impaired retrieval of personally experienced events and intact retrieval of general and personality based facts about the self (Crane and Goddard, 2008; Klein et al., 1999). In contrast, for children with ASD the retrieval of personally experienced events and general facts about the self have both been reported as impaired (Bruck et al, 2007; Goddard et al., 2014). To date, no studies have investigated knowledge of personality based facts (e.g. is helpful) for children with ASD, or the relationship between this form of semantic trait knowledge and the retrieval of episodic examples upon which it is built. Likewise, the ability of individuals with ASD to make judgments about personality based facts in relation to their self (introspection) and others (mentalizing) is unknown, with no tasks reported in the literature that concurrently explore both introspection and mentalizing ability. The present study aims to investigate the representation and retrieval of personality traits, associated episodic memories and the attribution of mental state knowledge about personality traits to their self and others for young people with ASD, with performance

compared to a control group of typically developing (TD) peers. Findings are anticipated to be of relevance to discussions regarding autobiographical memory and the cognitive components that may contribute to one's sense of self during development.

Self-Concept and Autobiographical Memory

Self-concept is an umbrella term that refers to processes and contents relating to one's self (Klein and Gangi, 2010). There is a lack of consensus about what constitutes self-concept, though from neuropsychological findings it has been proposed that developing a coherent sense of self may reflect a multiplicity of related, yet separable, processes and contents, including autobiographical memories, semantic personality traits, introspection, self-agency, self-ownership, personal temporality and the physical self (Klein and Gangi, 2010; Klein et al., 2004). The relative contributions and importance of each component is unclear, though autobiographical memory is thought to play a key role as it enables one to develop a consistent sense of self across time, engage in meaningful social interactions and use past experiences to guide thoughts and behaviours (Alea and Bluck, 2003; Baddeley, 1987; Cohen, 1998; Conway et al., 2004; Fivush, 2011; Pillemer, 2003). Autobiographical memory is typically considered to be a form of episodic memory, however, not all autobiographical knowledge is episodic, with personal facts about the self (e.g. date of birth, home address) reflecting information that is more semantic in nature. In addition, not all personal experiences are represented as specific memories, with different experiences of the same event (e.g.

journey to work) merging into general memories, or scripts, over time (Hudson and Nelson, 1986). Thus, autobiographical knowledge can be conceptualised as consisting of episodic and semantic information, with a distinction between the representation of generalised and specific episodic autobiographical memories.

Autobiographical Memory in ASD

For adults with ASD, the retrieval of specific memories and memories associated with auto-noetic consciousness has been shown to be significantly reduced (Chaput et al., 2013; Crane and Goddard, 2008; Crane et al., 2009, 2010; Goddard et al., 2007; Lind and Bowler, 2010; Tanweer et al., 2010). The amount of information recalled is similar to comparison groups, but the type of information recalled has been reported as atypical. For example, Crane et al (2010) found an increase in sensory elements (i.e. information pertaining to senses), different thematic content (e.g. relationship, achievement/mastery) and a reduction in the amount of meaning extracted or lessons learnt. Similarly, Tanweer et al. (2010) found that adults with ASD generated fewer social statements and more abstract, trait-linked identities than controls, with both memory and self-identity characterised by a lack of specificity. Adults with ASD have also been reported to be more likely to take an observer (third-person) perspective during memory retrieval, indicating a reduction in mentally re-experiencing past events from their own point of view (Lind and Bowler, 2010). Nevertheless, despite autobiographical memory difficulties being noted, adults with ASD have been found to

exhibit the same types of patterns in memory retrieval in response to cue manipulation as TD controls (Crane et al., 2012). The retrieval of facts about the self has been reported as intact for adults with ASD (Crane and Goddard, 2008). Interestingly, Klein and colleagues (1999) reported the case of RJ, a 21-year old male with high-functioning ASD, who despite being able to recall detailed semantic knowledge of personality traits (e.g. kind) was impaired in his ability to recall autobiographical examples upon which his trait knowledge was built. Thus, for adults with ASD there appears to be a dissociation between the impaired retrieval of personally experienced events and intact retrieval of facts about the self, i.e. impaired episodic autobiographical memory alongside spared semantic memory.

Only a handful of studies have looked at autobiographical memory retrieval for children with ASD (Bruck et al., 2007; Goddard et al., 2014; Losh and Capps, 2003). In line with the adult studies, these studies have shown that compared to TD controls children with ASD have difficulty retrieving specific autobiographical memories, generate impoverished narratives of personal experiences and require more prompting for elaboration. In contrast to the adult studies, however, children with high-functioning ASD have been reported to be poorer than TD controls at recalling personal facts about their self (e.g. home address). A failure to exhibit typical self-referential processing effects during memory recall has also been reported, with deficits associated with reduced mentalizing abilities, poorer social functioning and more self-reported autistic

traits (Henderson et al., 2009; Lombardo et al., 2007). Reduced memory for actions produced by the self relative to others (self-enactment effects) has also been reported (Millward et al., 2000; Russell and Hill, 2001; Russell and Jarrold, 1999). The retrieval of semantic trait knowledge and associated episodic autobiographical memories has not previously been investigated for children with ASD (in fact, this has only been explored in a single adult case, RJ). Thus, this study aims to contribute to current discussions by using a novel task to explore the retrieval of both personality traits and associated episodic autobiographical memories for young people with ASD.

Mentalizing and Introspection Ability

Of particular relevance to discussions regarding the development of self-concept for children with ASD is the ‘theory of mind’ or ‘mentalizing’ account of autism. Theory of mind or ‘mentalizing’ refers to the ability to attribute mental states to the self and others, and to predict behaviour on the basis of such states (Premack and Woodruff, 1978). However, deficits in mentalizing abilities have not been universally reported (Bowler, 1992; Happé, 1994) and studies have found that impaired mentalizing abilities are more likely to reflect inaccuracies in attributing the mental states of others, rather than an absence of attempts to do so (Happé, 1994). The ability to attribute internal mental states to the self (i.e. introspection) has also been reported to be at least as impaired as the ability to attribute internal mental states to others (Baron-Cohen et al. 1991; Fisher et al., 2005; Perner et al., 1989; Williams and Happé, 2009). For example,

Williams and Happe (2009) found that children with ASD found it more difficult to identify and report their own false belief than to identify and report that of another person. Similarly, adolescents and adults with ASD have been found to be more likely to cite a comparison individual (e.g. close friend) as knowing as much, or more, about their internal mental states as they did than TD controls (Dritschel et al., 2010; Mitchell and O’Keefe, 2008). In line with these findings, Lind (2010) proposed a distinction between internal (first person-perspectives) and external (observable actions/movements) self knowledge, with impaired development of the former but not the latter for children with ASD.

In contrast to this view, however, preserved introspection abilities have been found on a variety of self-report measures in clinical studies. For example, following the delivery of an anxiety intervention significant changes in pre- and post-treatment scores have been documented for children with high-functioning ASD (Chalfant et al., 2007). Similarly, for adults with high-functioning ASD, scores on self-report measures of mental state attribution have been reported to correlate significantly with performance on tasks of mentalizing ability (Spek et al., 2009). These studies highlight the need for a comparative group study to explore self-report introspection and mentalizing abilities in children with ASD and TD controls. The relationship between these cognitive skills, which are proposed to enable one to develop a sense of self, and the dissociable

components of autobiographical memory have also not previously been explored for children or adults with ASD.

Current Study

This is a preliminary study, of what is a very complex area, that sought to inform discussions and future research on of self-concept by exploring the cognitive constructs of autobiographical memory, introspection and mentalizing abilities in children with ASD. A novel autobiographical memory task was developed to assess semantic personality traits and associated episodic memory retrieval in relation to different aspects of the self. Self-perceived introspection and mentalizing abilities were assessed using an extended version of the self-knowledge task described by Dritschel et al. (2010) and Mitchell and O’Keefe (2008). The original task assessed introspection in relation to internal aspects of the self only. This extended task assessed *both* introspection and mentalizing ability in relation to knowledge of *both* internal and external personality traits in relation to *both* the self and other people. A classic task of mentalizing ability was also administered (Reading the Mind in the Eyes Task for Children; Baron-Cohen et al., 2001). Thus, the current battery of tasks provides a novel approach to assessing autobiographical memory and knowledge of the self and others for children with ASD.

The study tested the following predictions: compared with typically developing matched controls children with ASD will 1) show increased difficulties retrieving

semantic and episodic autobiographical memories, with fewer specific episodic memories and more prompts required for memory retrieval 2) show reduced introspection and mentalizing abilities in relation to knowledge of their own and a close others' internal personality traits (mental states), but not external personality traits (behaviours), and 3) [given that autobiographical and mental state knowledge are hypothesised to be related and contribute to one's self-concept], there will be an atypical relationship between autobiographical memory retrieval and internal mental state attribution.

Method

Participants

Participants were involved in larger research project, focussing on autobiographical memories, self-concept and mood. In total 53 young people participated in the study. The final sample consisted of 48 participants; 24 young people with ASD and 24 TD controls matched on the basis of gender, age, IQ and receptive vocabulary. Criteria for inclusion were an IQ of 70 or above, aged 11 to 18 years and English as a first language. Additional criteria for the experimental group were a formal diagnosis of ASD from a multidisciplinary diagnostic team that included a Psychiatrist or Child Psychologist on the basis of current diagnostic criteria (DSM-IV; APA, 1994). Participants were excluded from the typically developing (TD) control group if they had a history of special needs, or known developmental or neurological abnormalities.

Participants with ASD were recruited through support groups associated with the National Autistic Society, mainstream schools and a convenience sample obtained via e-mail circulars to university staff and students. Control participants were randomly selected on the basis of date of birth from a local Mainstream Secondary School and Sixth Form College. Written parental and participant consent was obtained prior to testing. Ethical approval was received from the local ethics committee (REC Reference Number: PNM/09/10-106). Five participants were excluded as they did not meet matching criteria. Participant characteristics are reported in Table 1.

-----Table 1 about here -----

Measures of Control and Independent Variables

Intellectual functioning was assessed using the two-subtest version (*Matrix Reasoning* and *Vocabulary*) of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). Receptive vocabulary was assessed using the British Picture Vocabulary Scale (BPVS; Dunn et al., 1997). The Social Communication Questionnaire (SCQ; et al., 2003) was used to confirm the diagnosis of ASD, with all participants scoring above the clinical cut-off.ⁱ

Dependent Variable Measures

ⁱ The SCQ was not given to controls as it was considered ethically inappropriate to administer this measure to typically developing children for whom there were no social-communication concerns.

Semantic Episodic Autobiographical Memory (SEAM) Task: This was a novel task designed to assess the retrieval of semantic personality traits and episodic autobiographical memories in response to five personality trait cues (family, school, happy, sad and in general). Participants were first asked to generate personality traits by considering what type of person they were in response to the cue. They were then asked to recall an episodic memory that reflected them being that type of person. Participants were encouraged to generate as many personality traits as possible and select the one they considered to be most representative. If participants initially produced a general memory they were prompted to recall a specific example (e.g. can you think of a specific time when that happened?), with children given one prompt during memory retrieval to maximise the amount of information generated (e.g. can you tell me anything else about that?). Responses were audio recorded for transcription. See Appendix A for additional information on verbal task instructions and prompts given to aid specific memory retrieval.

To assess semantic autobiographical knowledge the number of personality traits produced was recorded. To assess episodic autobiographical knowledge each memory was scored for memory type (specific or general) in accordance with previously reported criteria (Goddard et al., 2007; 2014; Williams and Dritschel, 1988). *Specific memories* were defined as an event particular to one day (e.g. 6th birthday), with *general memories* sub-classified as either *categoric* or *extended*. Categoric memories referred to

multiple occurrences of an event (e.g. going to scouts). Extended memories referred to a single event that occurred over an extended period of time (e.g. holiday in France). The number of items participants required prompts for prior to specific memory retrieval were recorded, as were the total number of memories where children generated additional information following a general memory prompt. The number of memories that included references to *sensory details* and *emotional details* were recorded. Sensory details were defined as information perceived by the senses (e.g. I sniffed the flowers). Emotional details were defined as references to affective responses (e.g. I felt happy, it made me laugh). Reliability analyses were conducted for all dependent variables, with one of the raters being blind to participants' group membership. Cohen's Kappa ranged from .77 to .90.

Self-Knowledge Interview (SKI): The SKIⁱⁱ was developed to assess who has the authority on knowledge of one's self (self-knowledge) and who has the authority on knowledge of a comparison individual (other-knowledge). It was an extended version of the self-knowledge task described by Dritschel et al. (2010) and Mitchell and O'Keefe (2008). Self- and other-knowledge was assessed for six internal personality traits (ill,

ⁱⁱ The SKI was based on the task described by Dritschel, et al. (2010) and Mitchell and O'Keefe (2008), however, in these studies children were only asked about who has the authority on knowledge of one's self about internal mental states. The cue 'happy' was also substituted with 'relaxed' as significantly higher rates of authority were consistently attributed to comparison individuals for this cue than other internal cues.

tired, sad, relaxed, daydreaming, what type of person they are) and six external personality traits (dressed smartly, good at sums, running fast, reading well, eating lots of sweets, good at tidying up). Control questions about their own and the comparison individual's favourite television program were included. For all questions, level of knowledge was rated using a 10-point Likert scale (0=low knowledge, 10=high knowledge).

Participants were first asked to identify a comparison individual. For self-knowledge questions, participants rated *their own* and then their perception of the *comparison individual's* expertise. For other-knowledge questions, participants rated their perception of the *comparison individual's* and then *their own* expertise. Participants were asked to give a reason for each rating to ensure they were generating ratings on the basis of their experiences. Task instructions were read out loud and a visual thermometer representing the 10-point scale was used as a reminder. See appendix A for further information on this task and examples of verbal instructions given to participants.

The SKI generated four internal and four external knowledge scores: *SK-self* (participant's knowledge of themselves), *SK-other* (comparison individual's knowledge of the participant), *OK-self* (participant's knowledge of comparison individual), *OK-other* (comparison individual's knowledge of themselves). For each scale (SK-self, SK-other, OK-self and OK-other), scores were out of 60 and reflected a summation of the

child's level of knowledge ratings (out of 10) to the six internal or external personality trait cues. For the internal questions; SK-self assessed introspection (i.e. knowledge of own internal mental states), SK-other assessed second order mentalizing ability (i.e. mentalizing about the other person's ability to attribute internal mental states to them), OK-self assessed perceived mentalizing ability (i.e. evaluation of participant's ability to attribute internal mental states to the other person) and OK-other assessed mentalizing ability (i.e. attribution of internal mental state knowledge to the other person).

Reading the Mind in the Eyes Task for Children (Eyes task): The Eyes Task (Baron-Cohen et al., 2001) was used to assess the ability to attribute internal mental states to others. Participants were shown 28 photographs of male and female faces with only the eye region showing. They were instructed to look carefully at the picture and then to choose the word (out of 4 displayed) that best described what the person was thinking or feeling. Performance was scored for the total number correct.

Procedure

Participants were tested individually in their respective schools or at home for approximately 60 to 90 minutes. Tasks were presented in a fixed order, with screening measures prior to experimental measures. The SEAM and SKI followed an ABA design, with administration of either the self/other-knowledge questions first, followed by the memory task and then the alternative question type (i.e. self/other-knowledge). Administration was alternated between participants in each group to achieve equal

randomisation. The Eyes Task was administered last. The parents of children with ASD completed the SCQ.

Statistical Analysis

SEAM task: The data were non-normally distributed with the assumption of homogeneity of variance violated across more than half the variables. The data were analysed using non-parametric Mann-Whitney tests, with exact statistics reported.

SKI: For the control questions, a 2(group: ASD or TD) x 2(knowledge type: SK [programme I like] or OK [programme comparison individual likes]) x 2(rating: self or other) mixed design analysis of variance (ANOVA) was conducted. Separate 2(group) x 2(knowledge type: SK or OK) x 2(rating: self or other) ANOVAs were conducted for internal and external questions. Significant main effects were explored using independent or paired samples *t*-tests, as appropriate (Note: Analyses were also conducted on the basis of difference scores between self and other ratings, with no differences in significant research findings).

Eyes task: A single outlier was identified in the TD group (score=12),ⁱⁱⁱ therefore this participant was excluded from analyses. Data was analysed using an independent samples *t*-test.

ⁱⁱⁱ The difference between this score and the mean of the remaining control group was assessed using the modified *t*-test for single cases (Crawford & Garthwaite, 2002), with a significant difference identified, $t(23) = 3.85, p < .001$.

Relationships between variables: Correlational analysis was used to examine the relationship between semantic personality traits, episodic autobiographical memories, introspection (SK-self), second order mentalizing ability (SK-other), perceived mentalizing ability (OK-self) and mentalizing ability (OK-other). Fisher r-to-z transformation was used to assess the significance of the difference between the ASD and TS correlation coefficients.

Results

SEAM Task

The scores for the number and type of memories recalled and analysis of memory content on the SEAM task are shown in Table 2. Children with ASD produced significantly fewer semantic personality traits than TD controls. ~~In contrast to Prediction 1~~ However, there was no significant group difference for the total number of episodic memories recalled, or the number rated as specific, categoric or extended. Compared with TD controls, children with ASD required more initial prompts to generate specific autobiographical memories and recalled significantly fewer memories that contained emotional and sensory details. The total number of items for which prompts were given to facilitate episodic memory retrieval did not differ between groups.

-----Table 2 about here -----

SKI

Table 3 shows participant ratings and *t*-test statistics for questions on the SKI. For the control questions there was no significant main effect of group [ASD/TS] or rating [self/other], $F(1,45) = .37, p = .55, \eta^2 = .008$, $F(1,45) = .17, p = .68, \eta^2 = .005$, respectively. There was a significant main effect of knowledge type [SK/OK], $F(1, 45) = 8.90, p < .01, \eta^2 = .17$, with a significant interaction between knowledge type and rating, $F(1,45) = 95.48, p < .0001, \eta^2 = .68$. Paired samples *t*-tests indicated that this interaction reflected both groups as judging themselves to have more knowledge than the comparison individual for their favourite television program [SK-self>SK-other], but less knowledge than the comparison individual for the comparison individual's favourite television program [OK-self<OK-other].

-----Table 3 about here -----

Internal personality trait cues (mental states): There was no significant main effect of group [TD/ASD], $F(1,45) = 2.43, p = .12, \eta^2 = .05$, or knowledge type [SK/OK], $F(1,45) = 0.22, p = .64, \eta^2 = .01$. There was a significant main effect of rating [self/other], $F(1,45) = 16.66, p < .001, \eta^2 = .27$, which was qualified by significant interactions with group and knowledge type, $F(1,45) = 6.30, p < .01, \eta^2 = .12, F(1,45) =$

21.44, $p < .001$, $\eta^2 = .32$, respectively. Children with ASD rated themselves as knowing significantly less about the comparison individual's mental states than TD controls [OK-self], $t(45) = 2.42$, $p < .05$, $r = .34$. There was no significant difference between groups for the level of knowledge the participant rated themselves as knowing about their own mental states [SK-self], or the amount of knowledge the comparison individual was attributed with having about the participants or their own mental states [SK-other and OK-other, respectively] ($p > .05$).

External personality traits (behaviours): There was no significant main effect of group [TS/ASD] $F(1,45) = 3.51$, $p = .07$, $\eta^2 = .07$, or knowledge type [SK/OK], $F(1, 45) = 1.14$, $p = .29$, $\eta^2 = .03$. There was a significant main effect of rating [self/other], $F(1, 45) = 18.27$, $p < .001$, $\eta^2 = .29$, with the ASD group rating the comparison individual as having more knowledge about their behaviours than themselves [SK-self < SK-other]. In contrast, the TD group rated the comparison individual as having a similar level of knowledge about their behaviours as themselves [SK-self = SK-other]. Both groups attributed the comparison individual as knowing more about their own behaviours than themselves [OK-self < OK-other].

Eyes Task

The ASD group was significantly poorer at attributing internal mental states from pictures of the eye region than TD controls (ASD mean=18.79, sd=2.62; TD control mean=20.34, sd=2.12), $t=2.24, p<.05, r=.32$.

Relationships Between Variables

For both groups there was a highly significant positive correlation between introspection [SK-self] (i.e. rating of level of knowledge they held about their own mental states) and mentalizing ability [OK-other] (i.e. ratings of level of mental state knowledge they attributed to the other person). There was also a highly significant positive correlation between perceived mentalizing ability [OK-self] (i.e. ratings of their ability to attribute mental states to others) and second order mentalizing [SK-other] (i.e. level of knowledge they attributed the other person with having about their (participants) mental states). In contrast to TD controls, the ASD group exhibited a significant positive correlation between scores on measures of introspection and second order mentalizing [SK-self/SK-other]. In contrast to children with ASD, the TD control group exhibited a significant positive relationship between the retrieval of semantic personality traits and all other variables. There was a statistical difference between ASD and TD correlation coefficients for the relationship between semantic personality traits and introspection [SK-self] ($z=2.1, p<0.01$), second order mentalizing [SK-other] ($z=1.61, p<0.05$) and perceived mentalizing [OK-self] ($z=1.88, p<0.05$).

Discussion

The current study aimed to explore the relationship between autobiographical memory and the self among young people with ASD, aged 11-18 years. Compared with TD controls, a selective pattern of impaired and preserved performance was identified across the domains of autobiographical memory (semantic and episodic) and the self (introspection/mentalizing abilities and internal/external self-knowledge), with evidence of atypical relationships between these cognitive constructs for young people with ASD.

In relation to memory retrieval, young people with ASD recalled significantly fewer personality traits than TD controls. In contrast, they recalled a typical number and type of episodic memories, though required more initial prompts to facilitate memory retrieval and generated fewer memories containing emotional and sensory information. The retrieval of a normal number of episodic memories, with an increase in initial prompts and atypical memory specification is in line with previous research (Crane et al., 2010; Goddard et al., 2014). The reduced retrieval of personality traits is a new finding that has emerged from using the SEAM task. The finding that young people with ASD did not differ from TD controls for the type (i.e. specific or general) of memories recalled was somewhat unexpected, but consistent with findings reported in an adult study (Crane et al., 2013). It is conjectured that this may reflect the unique nature of the task, with the initial retrieval of personality traits (i.e. semantic knowledge

about the self) priming associated autobiographical knowledge structures, thereby facilitating memory retrieval processes.

The extended SKI task generated novel findings regarding the perception of mentalizing and introspection abilities for young people with ASD. As might be anticipated, individuals with ASD perceived themselves as knowing significantly less about other people's internal mental states than typically developing young people, with poorer performance also reported on the objective measure of mentalizing (Eyes task). Somewhat unexpected however, was the finding that young people with ASD perceived someone close to them (typically a family member) as knowing more about their own (ASD participant's) behaviours than themselves, which was in contrast to the comparison group. Both young people with ASD and TD controls perceived themselves and the close other to have a similar amount of knowledge about their own (participant's) mental states.

The finding that young people with ASD considered themselves and the close other to hold a similar amount of knowledge about their own internal mental states was in contrast to studies using the original version of this task, where individuals with ASD were reported to cite the close other as the 'expert' on their inner experiences (Dritschel et al., 2010; Mitchell and O'Keefe, 2008). In these studies, however, individuals with ASD only differed from the comparison group for the cue of 'happy'^{iv}, which was

^{iv} In the current study the internal mental state cue 'happy' was replaced with the cue 'relaxed'

proposed by the authors to reflect the increased number of ‘physical’ signs available for judging happiness relative to other mental states. The current findings, which have been generated by using an extended version of the original task, provide support for this hypothesis. They also indicate a distinction between the representation of internal and external personality traits for young people with ASD, with them perceiving themselves as knowing less about their own behaviours than someone close to them.

During typical development, a distinction has been proposed between the *objective* evaluation of behaviours and *subjective* measurement of mental states, with the former requiring comparative judgements and the latter requiring qualitative judgements (Burton and Mitchell, 2003). This suggests that for young people with ASD introspection abilities may vary as a function of objective or subjective evaluation processes. Hence, it is tentatively proposed that perceived knowledge of physical (behavioural) aspects of the self may be more impaired than perceived knowledge of psychological (mental state) aspects of the self due to reduced confidence and/or competence in making comparative judgements about their self relative to others. Exploring subjective and objective evaluation processes using experimental paradigms for young people with ASD would be of relevance to these discussions.

In terms of the relationship between cognitive components proposed to contribute to one’s sense of self, for typically developing young people, a significant relationship was found between semantic personality traits and episodic

autobiographical memories, introspection and mentalizing abilities. For young people with ASD this relationship was not observed. This supports the notion that different aspects of autobiographical memory and the self may dissociate during development (Klein and Gangi, 2010; Klein et al., 1999; 2004). It also suggests that the typical processes that contribute to the cohesive development of distinct aspects of autobiographical memory and the self are absent for young people with ASD, which suggest that children with ASD may be drawing on different processes to generate judgements about the self and others. In line with the previous literature, both groups exhibited a significant positive relationship between introspection and mentalizing abilities, however, for young people with ASD there was an additional relationship between introspection and perceived mentalizing abilities (i.e. how well you think you can attribute mental states to others). This suggests young people with ASD may use introspection as a compensatory strategy when attributing internal mental states to others, which may contribute to the more liberal attribution of their own beliefs and knowledge states to others. However, it should be noted that the SKI task required subjective judgements about the self and others, therefore future studies using objective measures are required to help validate current findings and the mechanisms that may contribute to the development of one's sense of self in children with ASD.

During typical development, declarative memory representations are thought to be transformed into autobiographical memories through introspection, with semantic

autobiographical knowledge derived from episodic autobiographical memories (Conway et al., 2004; Klein et al., 2004). Overall, the current findings suggest that whilst young people with ASD are able to reflect and use their own experiences to inform their understanding of their self and other people, the way in which knowledge about the self is derived from these acts of introspection is atypical. Due to the bi-directional relationship proposed between autobiographical memory and the self, it is speculated that difficulties with introspection may also contribute to the atypical specification of autobiographical memories and poorer use of the self as an effective memory organisational principle. Thus, it can be cautiously conjectured that together these difficulties may impact upon the social and directive functions of autobiographical memory, and may contribute to the ASD phenotype due to problems forming social relationships and using past experiences to guide future behaviours and manage change.

Clinical Implications

In clinical practice, modified cognitive-behavioural therapy (CBT) is commonly used to support social skill development and reduce symptoms of anxiety for individuals with ASD (e.g. Attwood, 2003; Bauminger, 2007; Chalfant et al., 2007; Wood et al., 2009; Sofronoff et al., 2005). The recall of specific memories to identify behavioural or emotional triggers is a core component of CBT, as such weaker autobiographical memory access mechanisms and more impoverished memory representations are likely to impinge upon this process. However, the findings of the

current study suggest that the retrieval of specific episodic autobiographical memories may, for some individuals with ASD, be supported by the prior retrieval of associated semantic autobiographical knowledge. Thus, in clinical practice it is possible that the use of personality trait based prompts may facilitate the retrieval of specific autobiographical memories (e.g. asking the individual to think about ‘what type of person they are’ in the situation). Developing a set of ‘rules’ for thinking about personal experiences may also help children with ASD identify lessons learnt and consider how this knowledge could be used to guide future behaviours (e.g. short and long term outcomes, impact on self/others).

Another novel finding of the current study was that young people with ASD were more likely to cite a close other as knowing more about their behaviours than themselves, but not their mental states. Interestingly, young people with ASD were as competent as TD controls at making comparative judgements about other people’s behaviours. This suggests that in clinical practice adopting ‘third person perspectives’ may be a useful tool for challenging distorted cognitions or behaviours. For example, it is speculated that for some individuals with ASD, using video feedback strategies where individuals make judgements about their self relative to others may facilitate their ability to extract knowledge and meaning about their own actions, whilst enhancing awareness of how they are perceived by others. Finally, the finding that young people with ASD did not differ from TD controls in relation to their perceived ability to

introspect about internal mental states provides support for the use of self-report measures to identify mental health concerns and monitor therapeutic change. The current study highlights the need for future research to explore these potentially promising areas, with a greater understanding of the processes that contribute to one's self concept during development anticipated to be of relevance to clinical practices.

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Tables

Table 1: Participant characteristics

	TD Controls (N=24)	ASD (N=24)		
	Means (SD)	Means (SD)	<i>t</i>	<i>p</i>
	Range	Range		
Age	14;05 (25.30)	14;06 (25.13)		
(years;months)	11;05 – 18;05	11;01 – 18;07	.55	.58
Full Scale IQ	103.63 (9.90)	104.25 (11.84)	.20	.84
	84 – 126	72 – 134		
BPVS (ss)	104.25 (13.41)	104.63 (19.07)	.08	.94
	82 – 130	73 – 160		
SCQ	-	23 (8.59)		
		13 – 38		
Male : Female	20:4	20:4		

Table 2: Scores for the number, type and content of memories recalled

Memory analysis	TD (N=24)	ASD (N=24)	z	p	r	
	Median (SD)	Median (SD)				
Semantic personality traits	11.00 (6.23)	9.44 (3.09)	2.85	<.01	.42	
Episodic autobiographical memories						
Type	Specific	3.50 (1.02)	3.00 (1.62)	1.00	.32	.14
	Categoric	1.00 (0.83)	1.00 (1.38)	1.01	.29	.15
	Extended	0.00 (0.66)	0.00 (0.53)	1.26	.28	.18
	TOTAL ^Δ	5.00 (0.28)	5.00 (0.87)	1.25	.32	.18
Content	Initial prompts	0.00 (.28)	0.00 (1.12)	3.04	<.01	.44
	Total prompts	4.46 (2.50)	5.00 (3.84)	0.66	.51	.10
	Emotional details	5.00 (1.99)	3.50 (1.56)	2.35	<.01	.34
	Sensory details	3.00 (1.45)	2.00 (1.69)	2.02	<.05	.29

^ΔRange of 0 to 5 memories

Table 3: Participant ratings for SKI control, internal and external knowledge questions and *t*-test statistics

Question Type	Knowledge Topic	Rating	TD (N=24) Mean (SD)	ASD (N=24) Mean (SD)
Control	Self favourite television program	Self	6.96 (1.49)	8.07 (1.94)
		Other	3.88 (2.46)	4.04 (2.70)
		<i>t</i>	5.10	5.56
		<i>p</i>	<.001	<.001
		<i>r</i>	.59	.63
	Internal	Comparison individual's favourite television program	Self	4.92 (2.99)
Other			8.04 (1.46)	8.11 (2.19)
		<i>t</i>	5.76	5.72
		<i>p</i>	<.001	<.001
		<i>r</i>	.64	.64
Internal		Knowledge about myself (SK)	Self	47.96 (5.15)
	Other		44.42 (8.83)	43.75 (8.18)
	<i>t</i>		1.88	1.11
	<i>p</i>	.07	.28	
	<i>r</i>	.36	.23	

		Self ⁺	44.13 (8.03)	37.80 (9.85)
	Knowledge	Other	49.83 (5.38)	48.70 (7.23)
	about	<i>t</i>	3.07	4.67
	comparison	<i>p</i>	<.01	<.001
	individual (OK)	<i>r</i>	.41	.71
		Self	47.04 (4.95)	42.91 (8.52)
	Knowledge	Other	47.33 (5.41)	46.94 (6.11)
	about myself	<i>t</i>	.26	2.44
	(SK)	<i>p</i>	.80	<.02
		<i>r</i>	.04	.49
External		Self	44.70 (8.18)	40.70 (8.65)
	Knowledge	Other	48.36 (5.85)	46.30 (8.29)
	about	<i>t</i>	2.69	2.43
	comparison	<i>p</i>	<.01	<.02
	individual (OK)	<i>r</i>	.49	.46

⁺ significant between group difference at $p < 0.05$ (see text)

Table 4: Correlations between specific autobiographical memory, semantic personality traits, introspection and mentalizing ability scores

		Semantic personality traits		Introspection (SK-self)		Second order mentalizing (SK-other)		Perceived mentalizing (OK-self)		Mentalizing (OK-other)	
		TD	ASD	TD	ASD	TD	ASD	TD	ASD	TD	ASD
		(N=24)	(N=24)	(N=24)	(N=24)	(N=24)	(N=24)	(N=24)	(N=24)	(N=24)	(N=24)
Specific auto-biographical memory	<i>r</i>	.49	.30	.15	-.27	.05	-.16	.18	-.16	.37	-.27
	<i>p</i>	<.01	.16	.47	.20	.81	.46	.41	.45	.07	.22
Semantic personality traits	<i>r</i>			.65**	.11	.42*	-.05	.43*	-.12	.54	.28
	<i>p</i>			<.001	.62	<.05	.83	<.05	.60	<.01	.21
Introspection (SK-self)	<i>r</i>					.21	.56	.38	.33	.66	.71
	<i>p</i>					.32	<.01	.70	.12	<.001	<.001
Second order	<i>r</i>							.70	.58	.10	.38

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mentalizing (SK-other)	<i>p</i>	<.001	<.01	.63	.07
Perceived mentalizing (OK-self)	<i>r</i> <i>p</i>			.12 .58	.18 .41

Statistically significant difference between ASD and TD correlation coefficients at *

$p < 0.05$

and

** $p < 0.01$

(one-tailed)

Appendix 1

Semantic Episodic Autobiographical Memory Task

For the retrieval of semantic personality traits, young people were asked “*what type of person are you when you are [with your family]?*” For the retrieval of autobiographical episodic memories, young people were asked: “*can you think a memory that tells me about you being a <personality trait> type of person [when you are with your family]?*” To support the recall of specific memories, participants were encouraged to recall a memory that 1) they had thought about a lot, 2) could remember clearly 3) brings on strong emotions, 4) still feels important and 5) helps explain what type of person they are. Instructions and an example were verbally presented, together with a written reminder of memory characteristics.

Self-Knowledge Interview

To identify a comparison individual, young people were asked “*who you are closest to or who helps you most in your daily life?*” For self-knowledge questions, participants were then asked to rate their own expertise “*how well do you know when you [feel.../are...].*” and then the comparison individual’s expertise “*how well does <comparison individual> know when you [feel.../are...].*” For other-knowledge questions, participants were asked to rate the comparison individual’s expertise, “*how well does <comparison individual> know when they [feel.../are...].*” and then their own

expertise, “*how well do you know when <comparison individual> [feels.../is...].*” To ensure participants were rating expertise on the basis of their or the comparison individual’s knowledge, they were asked to give a reason for each rating “*how do you know when...*”. These responses were not analysed as visual inspection indicated that the reasons given did not differ between children with ASD and controls.