BRIEF REPORT

Brief Report: Self-defining and Everyday Autobiographical Memories in Adults with Autism Spectrum Disorders

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Abstract Autobiographical memory impairments in autism spectrum disorders (ASD) have been attributed to a failure in using the self as an effective memory organisational system. To explore this hypothesis, we compared self-defining and everyday memories in adults with and without ASD. Results demonstrated that both groups were able to distinguish between self-defining and everyday memories, although the ASD group generated fewer specific memories overall. Despite qualitative similarities between the narratives of the two groups, the adults with ASD extracted less meaning from their narratives. Difficulties in eliciting meaning from memories suggests a failure in using past experiences to update the self. We therefore propose that the self-memory relationship might be static, rather than dynamic, in ASD.

Keywords Autism · Autobiographical memory · Self-defining memory · Meaning making

Introduction

Autobiographical memory comprises both events and information related to the self (Conway and Rubin 1993). It is stored hierarchically, at several different levels of specificity; these include lifetime periods (e.g., *"when I lived in X"*), general events (e.g., *"holidays in Y"*), and specific events (e.g., *"when I married Z"*) (cf. Conway and Pleydell-Pearce 2000). A further key characteristic of autobiographical memory is that it is organised around

goals of the self—autobiographical memories shape both our current and future goals, and, equally, personal goals exert control over what we remember (Conway and Pleydell-Pearce 2000). This self-memory relationship is dynamic, as both memories and goals are constantly being updated to correspond with one's current sense of self—a process termed 'self-coherence' (Conway et al. 2004).

A growing body of research has demonstrated that adults with autism spectrum disorders (ASD) experience difficulties in accessing memories of specific autobiographical events. Using a cueing methodology, in which participants generated specific and general autobiographical memories to word cues at speed, Crane et al. (2009b) found adults with ASD to take considerably longer than typical adults to retrieve memories of specific, but not general, autobiographical events. Crane and colleagues also manipulated the self-relevance of the cue words and found that whilst self-relevant cues facilitated both specific and general memory retrieval in typical adults, a corresponding relationship was only observed for *general* memories in the ASD group. They therefore suggested that the specific autobiographical memory difficulties faced by adults with ASD might be due to problems in using the self as an effective memory organisational system.

However, one limitation of the autobiographical memory cueing task is that it biases the retrieval of recent life events (Rabbitt and Winthorpe 1988), rather than memories that are most personally important to an individual (Jansari and Parkin 1996). Employing a different approach, Singer and Moffitt (1991–1992) developed a methodology for exploring 'self-defining memories'. These are recollections of highly significant life events that are vivid, evoke strong emotions, are frequently thought about, and are closely connected to other related memories, themes or issues in one's life. A further key feature of self-defining memories

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is the ability to learn lessons about the self from these events—a process known as 'meaning making' (Singer 2004). Meaning making enables a person to update their self-concept and personal goals with this newly acquired information, which, in turn, exerts control over remembering. The ability to extract meaning from memories is therefore a marker of a functional and dynamic self-memory system.

The current study compared self-defining and everyday autobiographical memories in adults with ASD, relative to an age, gender and IQ matched control group. There were three main aims of the study. The first aim was to establish whether adults with ASD could distinguish between self-defining and everyday memories as competently as typical adults. As previous research has found autobiographical memory to be less coherently organised around goals of the self in ASD, it was predicted that the self-defining and everyday memories retrieved by the ASD group might be less distinguishable than those of the control group. The second aim was to explore the content of retrieved memories, focusing on memory specificity, memory theme, and various other qualitative measures (e.g., references to emotions). In line with previous research, it was predicted that adults with ASD would generate fewer specific memories than typical adults. However, no predictions were made regarding the other qualitative measures. Finally, this study aimed to examine meaning making within memory narratives. As meaning making involves the dynamic interplay between memory and the self, and considering that the self-memory relationship is atypical in ASD, it was predicted that the ASD group would engage in meaning making to a lesser degree than the control group.

Method

Participants

Participants comprised 20 adults with ASD (10 males, 10 females[1]) and 20 typical control adults (10 males, 10 females). The ASD group was recruited through the National Autistic Society (UK), as well as local organisations, social groups and web pages for adults with ASD. Prior to inclusion in the study, each experimental participant had received a diagnosis of Asperger syndrome ($n = 18$) or

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[1] Despite the gender ratio of approximately 4:1 (males: females) in ASD, with ratios of around 6:1 reported for higher functioning samples (Fombonne 1999), an equal number of males and females participated in the current study. This was to assess the role of gender on autobiographical memory in ASD, in view of gender differences being previously reported on autobiographical memory tasks (e.g., Goddard et al. 1998; Pohl et al. 2005). However, the current study found no significant effects of gender on any of the variables in the current study, in either the ASD or control group.

high functioning autism ($n = 2$) from a Psychologist or Psychiatrist who was an expert in this area. A review of clinical records confirmed that all participants were diagnosed according to DSM-IV (American Psychiatric Association 2000) or ICD-10 (World Health Organisation 1993) criteria, excluding the requirement of unimpaired early language development (for the adults with Asperger syndrome), as this information was often unavailable. Nevertheless, none of the participants displayed any obvious structural or semantic language problems.

The typical control adults were matched to the ASD group on the basis of age, gender and verbal, performance and full-scale IQ. Control participants were recruited from a variety of Further and Higher education colleges, as well as local social groups. To confirm participants' diagnostic status, the Autism Spectrum Quotient (AQ) questionnaire (Baron-Cohen et al. 2001) was administered. The ASD group (mean = 36.70, SD = 5.31) scored significantly higher than the control group (mean = 13.05, SD = 7.92) on this self-report measure of autistic symptomatology, t (38) = 11.09, $p < .001$ ($r = .87$), one-tailed. In addition, 19/20 participants with ASD (95%) scored above the suggested cut-off of 26 on this measure (cf. Woodbury-Smith et al. 2005), whilst none of the control group did (Table 1).

Materials

Wechsler Abbreviated Scale of Intelligence

The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler 1999) was used to provide a measure of verbal, performance and full-scale IQ, for group matching purposes.

Autism Spectrum Quotient

The Autism Spectrum Quotient (AQ) (Baron-Cohen et al. 2001) is a 50-item self-report measure of autistic traits. Scores of 32 or above on this measure are indicative of clinical levels of autistic traits (Baron-Cohen et al. 2001), although a score of 26 or above has more recently been proposed as a useful cut-off for a clinic-referred sample (Woodbury-Smith et al. 2005). The AQ was used to confirm participants' diagnostic status.

Table 1 Participant demographics

	ASD group		Control group		Statistics		
	Mean	SD	Mean	SD	t	p	r
Age	36.55	11.62	35.45	11.75	.30	.77	.04
Verbal IQ	114.20	12.27	111.05	10.70	.87	.39	.12
Performance IQ	109.10	14.86	111.20	9.42	−.53	.60	.07
Full scale IQ	113.00	13.69	112.50	8.85	.14	.89	.02

Autobiographical Memory Tasks

Participants were asked to describe (a) up to five self-defining memories, and (b) up to five everyday memories, following instructions from Singer and Moffitt (1991–1992). A self-defining memory was described to participants as: A memory that is remembered very clearly and still feels important to you, even as you think about it; A memory that is linked to an important and enduring theme, issue, or conflict from your life; A memory that helps explain who you are as a person, and might be the memory that you would tell someone to help them understand you in a more profound way; A memory that is strongly linked to other related memories that share the same theme or concern; A memory that evokes strong emotions (either positive or negative); A memory that has been thought about frequently; A memory that is at least 1 year old.

An everyday memory was described to participants as: A memory that was personally experienced, i.e., not a memory that a parent or sibling described to you, nor something that you read about or heard about through the media; A memory that is either important or unimportant to you; A memory that can be positive or negative in how it makes you feel, or it could be a memory that evokes little or no emotion; A memory that has been thought about many times or rarely; A memory that is at least 1 year old.

These instructions were presented to participants verbally, although a written reminder was also provided. Participants narrated each memory to the experimenter (LC), and responses were tape-recorded for later transcription and coding. Examples of self-defining and everyday memories retrieved by the ASD and control groups are provided in the "Appendix". After each memory was described, participants rated their memory on a series of seven-point scales adapted from the Memory Characteristics Questionnaire (Johnson et al. 1988). High scores on each of these measures are characteristic of a self-defining memory, and these were used to ensure that the self-defining and everyday memories retrieved by the ASD and control groups were distinguishable.

(a) *This memory reveals or says about me…* (1 = not very much, to 7 = a lot)
(b) *I remember this event…* (1 = hardly, to 7 = very well)
(c) *On a scale of vividness, this memory is…* (1 = not at all, to 7 = extremely)
(d) *On a scale of importance, this memory is…* (1 = not at all, to 7 = extremely)
(e) *Since it has all happened, I have thought about the event…* (1 = not at all, to 7 = many times)
(f) *On a scale of emotionality, this memory is…* (1 = not at all, to 7 = extremely)

The total number of memories retrieved per category, as well as the length of narratives, was calculated. Narratives were also coded by the researcher on the following measures:

Specificity

A reference to a specific autobiographical memory, i.e., an individual event, lasting no longer than a day (e.g., *"my first day at university"*) within the narrative was assigned a score of 1. If memories comprised individual events that lasted longer than a day (extended memories; e.g., *"when I was at University"*) or memories of repeated instances (categoric memories; e.g., *"Monday morning lectures"*), with no reference to a single event, a score of 0 was assigned.

Theme

Memories were assigned to one of seven categories of memory theme (as described by Thorne and McLean 2001):

1. *Life-Threatening Events*—this category comprised narratives structured around issues of life and death, or physical and mental well-being. These could involve risk to oneself, or another person. Examples include deaths, accidents, injuries or illnesses, sexual or physical assaults, and severe mental or physical illness.
2. *Recreation/Exploration*—these narratives centred on topics of recreation, play and exploration. Examples include hobbies, parties, travelling, holidays or sporting activities.
3. *Relationship*—relationship narratives emphasise a particular interpersonal relationship (usually involving a parent or a peer). Importantly, there must be some history to the relationship or evidence of emotional investment in the other person. Examples include first love, dissolution of a relationship, separation, reconciliation, or intimacy.
4. *Achievement/Mastery*—narratives emphasise either one's own or one's group/family attempts at mastery or accomplishment, irrespective of the outcome. Examples include passing or failing an exam, learning to drive, embracing a new religion, or establishing a new life (e.g., after family immigration).
5. *Guilt/shame*—narratives in this category emphasise issues of right and wrong. Examples include guilt about lying or hurting someone, or instances in which a moral or ethical decision is made.
6. *Drug, alcohol or tobacco use*—these narratives focus on the use of drugs, alcohol or tobacco for recreational or thrill seeking behaviours. Outcomes may be positive or negative. Examples include the first experience of smoking or taking drugs, or getting very drunk.

7. *Event not classifiable*—this category included any narrative that did not fit well into the above categories.

References to Emotion

As ASD is associated with impairments in emotional processing (Hill et al. 2004), with emotional material failing to facilitate memory retrieval in this group (Beversdorf et al. 1998; Goddard et al. 2007), each reference to an emotion within the narratives (e.g., *"I was really happy"*) was assigned a score of 1.

Sensory Elements

Unusual sensory processing has been commonly reported in adults with ASD (Crane et al. 2009a). Therefore, each explicit reference to a sensory element within the narrative (e.g., *"I remember the smell of the flowers"*) was assigned a score of 1.

Self Versus Other

Previous research has demonstrated that individuals with ASD often fail to use information about the self to facilitate memory retrieval (Crane et al. 2009b; Millward et al. 2000). Therefore, the extent to which the memory was focused on the self or others was scored on a seven-point Likert scale (1 = *memory largely focused on others*, to 7 = *memory largely focused on self*).

Meaning Making

Two kinds of meaning making were coded—*lesson learning* and *gaining insight* (cf. McLean and Thorne 2001). Lesson learning involves the reporter stating that they learnt a specific lesson from the event, which could have implications for their behaviours in other similar situations (e.g., *'my uncle died of alcoholism…I learned not to get addicted to a substance that could actually control me'*). Gaining insight involves the reporter inferring meaning from the situation that extends beyond the specific behaviour described, and concerns a larger area of one's life (e.g., *'my brother died last year…I learned to live life to the fullest and appreciate every day'*). Each memory that extracted a type of meaning (either lesson learning or gaining insight) was assigned a score of 1.

Two independent raters (one of whom was blind to group membership) coded all memories retrieved by the ASD and control participants on each of the above measures. Inter–rater reliability was satisfactory (Pearson's correlations >.79; kappa coefficients >.75).

Procedure

This study was part of a larger investigation into autobiographical memory in adults with ASD. First, the AQ (and a questionnaire unrelated to the current study; see Crane et al. 2009b) was completed and returned by post. One week later, participants were tested individually at Goldsmiths, University of London, or in their own homes. During the testing session, the WASI was administered first, followed by a memory task unrelated to the current study (see Crane et al. 2009b). Following this, participants were asked to recall up to five self-defining and five everyday memories (order of recall was counterbalanced across participants). Immediately after the participant narrated each memory, they completed a short questionnaire about the event(s). The total testing time was approximately 90–120 min.

Results

Number of Memories Retrieved

A 2 (group: ASD or control) × 2 (memory type: self-defining or everyday) mixed design analysis of variance (ANOVA) revealed that there was no significant difference between the overall number of memories retrieved by the ASD (mean = 3.15, SD = 1.33) and control (mean = 3.22, SD = 1.13) groups, $F (1, 36) = .04$, $p = .85$ ($\eta_{p}^{2} = .001$). There was, however, a significant main effect of memory type, $F (1, 38) = 4.58$, $p = .04$ ($\eta_{p}^{2} = .11$), which was qualified by a significant interaction effect, $F (1, 38) = 4.58$, $p = .04$ ($\eta_{p}^{2} = .11$). Bonferroni corrected within-group ANOVAs revealed this to be due to the control group retrieving significantly fewer self-defining (mean = 2.60, SD = 1.39) than everyday (mean = 3.85, SD = 1.35) memories, $F (1, 19) = 12.98$, $p = .002$ ($\eta_{p}^{2} = .41$), whilst there was no significant difference between the mean number of self-defining (mean = 3.15, SD = 1.50) and everyday (mean = 3.15, SD = 1.87) memories retrieved by the ASD group, $F (1, 19) < .001$, $p = 1.00$ ($\eta_{p}^{2} < .001$). Despite this, independent-samples ANOVAs found there to be no significant difference between the number of self-defining, $F (1, 38) = 1.44$, $p = .24$ ($\eta_{p}^{2} = .04$), or everyday, $F (1, 38) = 1.84$, $p = .18$ ($\eta_{p}^{2} = .05$), memories retrieved by the two groups.

Self-Report Memory Characteristics Questionnaire

To confirm the distinction between self-defining and everyday memories, participants rated each retrieved

memory on a series of seven point scales, with high scores on these measures being characteristic of a self-defining memory (see Table 2). A series of 2 (group) × 2 (memory type) mixed design ANOVAs revealed that participants rated self-defining memories higher than everyday memories on the basis of: how much the memory reveals about them, $F (1, 38) = 54.43, p < .001 (\eta_p^2 = .62)$, how well the event was remembered, $F (1, 38) = 17.38, p < .001 (\eta_p^2 = .34)$, vividness, $F (1, 38) = 6.94, p = .01 (\eta_p^2 = .17)$, importance, $F (1, 38) = 50.79, p < .001 (\eta_p^2 = .61)$, thought frequency, $F (1, 38) = 45.04, p < .001 (\eta_p^2 = .57)$ and emotionality, $F (1, 36) = 46.29, p < .001 (\eta_p^2 = .56)$. There were no significant main effects of participant group on any of these variables (p's > .10), nor were there any significant interaction effects (p's > .10). This suggests that both the ASD and control groups were able to distinguish between events in the self-defining and everyday memory categories to a similar degree.

Length of Narrative

Examination of the total number of words spoken per memory revealed there to be no significant difference between volume of narrative in the ASD and control groups, $F (1, 36) = 1.20, p = .28 (\eta_p^2 = .03)$. However, significantly more words were spoken when describing self-defining memories (ASD mean = 254.51, SD = 143.69; control mean = 218.15, SD = 144.64) than everyday memories (ASD mean = 167.06, SD = 137.95; control mean = 127.63, SD = 73.74), $F (1, 36) = 15.66, p < .001$

$(\eta_p^2 = .30)$. There was no significant interaction effect on this variable, $F (1, 36) = .05, p = .82 (\eta_p^2 = .001)$, suggesting that this effect was consistent across groups.

Memory Specificity

The mean percentages of memories classed as specific were analysed using a 2 (group) × 2 (memory type) mixed design ANOVA. This revealed that the ASD group (mean = 66.92, SD = 33.76) retrieved fewer specific memories than the control group (mean = 80.46, SD = 22.04), $F (1, 36) = 2.82, p = .05 (\eta_p^2 = .07)$. However, there was no significant difference between the mean percentage of specific memories retrieved in the self-defining (mean = 76.96, SD = 34.22) or everyday (mean = 70.42, SD = 37.43) memory categories, $F (1, 36) = .94, p = .34 (\eta_p^2 = .02)$, nor was there a significant interaction effect, $F (1, 36) = .16, p = .69 (\eta_p^2 = .004)$.

Theme

Self-defining memories were coded by the researcher into one of seven categories of memory theme (see Fig. 1). However, the majority of everyday memories fell into the 'event not classifiable' category (e.g., '*A bee flew in my office at work*', '*I remember being in my aunt's house, sleeping on the floor*'), so these were not analysed further. As illustrated in Fig. 1, there was a trend towards control participants retrieving a higher percentage of achievement/ mastery memories than the ASD group ($U = 135.5$,

Table 2 Mean self-report ratings for self-defining and everyday autobiographical memories in the ASD and control groups

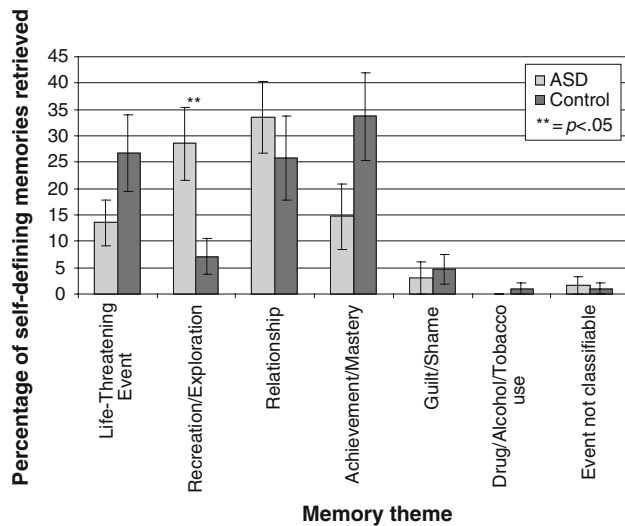|	Group	Self-defining memories		Everyday memories	
		Mean	SD	Mean	SD
How much this memory reveals about the reporter	ASD	6.05	1.00	4.42	1.83
	Control	5.79	.96	3.64	1.19
	Total	5.91	.98	4.01	1.55
Vividness	ASD	5.06	.87	4.23	1.47
	Control	4.52	.95	4.05	1.05
	Total	4.77	.94	4.13	1.25
Importance	ASD	5.02	.94	3.78	1.16
	Control	4.75	1.16	2.97	1.00
	Total	4.90	1.06	3.40	1.36
How well the event is remembered	ASD	5.98	.91	5.47	1.50
	Control	6.31	.70	5.00	1.23
	Total	6.15	.81	5.22	1.36
Thought frequency	ASD	5.56	1.24	4.28	1.68
	Control	5.50	1.30	3.60	1.11
	Total	5.53	1.26	3.92	1.43
Emotionality	ASD	5.56	1.24	4.28	1.68
	Control	5.50	1.30	3.60	1.11
	Total	5.53	1.27	3.94	1.40

Fig. 1 Mean percentages of self-defining memories retrieved according to theme in the ASD and control groups

$p = .06$), whereas the ASD group retrieved a higher percentage of memories in the recreation/exploration category ($U = 118.5$, $p = .01$). There were no significant differences between the ASD and control groups for the other memory theme categories (p's > .10).

References to Emotions

The number of references to emotion within the narratives correlated with the total number of words spoken (for both self-defining and everyday memories) in the ASD and control groups (r values ranged from .56 to .75). Therefore, references to emotions within the narratives were analysed using a 2 (group) × 2 (memory type) mixed design analysis of covariance (ANCOVA), controlling for volume of narrative (i.e., the total number of words spoken per memory). This revealed there to be no significant difference between the number of references to emotions in the ASD (mean = 1.43, SD = 1.13) and control (mean = 1.44, SD = 1.31) groups, $F (1, 35) = 1.33$, $p = .26$ ($\eta_p^2 = .04$), but there was a significant effect of memory type, $F (1, 35) = 4.53$, $p = .04$ ($\eta_p^2 = .11$). Inspection of the means revealed that this was due to self-defining memories (mean = 2.08, SD = 2.02) containing a greater number of references to emotions than everyday memories (mean = .79, SD = .94). A non-significant interaction effect, $F (1, 35) = .01$, $p = .91$ ($\eta_p^2 < 001$), suggested that this effect was consistent across groups.

References to Sensory Elements

As volume of narrative did not correlate with the numbers of sensory elements reported in the current study, this variable was not included as a covariate in the analysis. A 2

(group) × 2 (memory type) ANOVA revealed there to be no significant differences between references to sensory elements in the ASD or control groups, $F (1, 38) = 1.30$, $p = .26$ ($\eta_p^2 = .03$), nor was there a difference on this variable as a function of memory type, $F (1, 38) = .62$, $p = .45$ ($\eta_p^2 = .02$). There was, however, a significant interaction effect, $F (1, 38) = 5.24$, $p = .03$ ($\eta_p^2 = .12$). Bonferroni-corrected within samples ANOVAs revealed that this was due to there being no significant difference between the number of references to sensory elements in the self-defining (mean = .91, SD = 1.34) and everyday (mean = .62, SD = .86) memories of the ASD group, $F (1, 19) = .76$, $p = .39$ ($\eta_p^2 = .04$), whereas the control group referred to sensory elements significantly more in their everyday (mean = .85, SD = .86) than self-defining (mean = .21, SD = .34) memories, $F (1, 19) = 9.08$, $p = .007$ ($\eta_p^2 = .32$). Independent samples ANOVAs further revealed that whilst there was no significant difference between references to sensory elements in the everyday memories of the ASD and control groups, $F (1, 19) = .89$, $p = .35$ ($\eta_p^2 = .02$), the ASD group referred to sensory elements within their self-defining memories significantly more than the control group, $F (1, 19) = 5.36$, $p = .01$ ($\eta_p^2 = .16$).

References to Self or Others

References to self or others were scored on a seven point Likert scale, where 1 = *memory focuses largely on others*, and 7 = *memory focuses largely on self*. A 2 (group) × 2 (memory type) ANOVA revealed there to be no significant effect of participant group on this variable (ASD mean = 4.44, SD = .90; control mean = 4.66, SD = .52), $F (1, 37) = .87$, $p = .36$ ($\eta_p^2 = .02$), but there was a significant main effect of memory type, $F (1, 37) = 20.27$, $p < .001$ ($\eta_p^2 = .35$). This was due to self-defining memories (mean = 5.01, SD = .74) involving the self significantly more than everyday memories (mean = 4.10, SD = 1.13). A non-significant interaction effect, $F (1, 37) = .03$, $p = .85$ ($\eta_p^2 = .001$), suggested that this effect was consistent across groups.

Meaning Making

The number of instances in which participants reported gaining insight or learning a lesson from a memory were combined and divided by the total number of memories retrieved. As no participants in the ASD group, and just two participants in the control group, extracted meaning from everyday memories, only the self-defining memory data was analysed further. A Mann Whitney U test revealed that control adults (mean = 32.25, range = 0–100) extracted a significantly higher percentage of meaning from their

narratives than the adults with ASD (mean = 7.33, range = 0–40), ($U = 119.00$, $p = .01$).

Discussion

To summarise, this study elicited narratives of self-defining and everyday autobiographical memories from a group of adults with ASD and a control group matched for age, gender and IQ. Despite some qualitative similarities between the narratives of the two groups, the ASD group generated fewer specific memories than control participants and the themes of the narratives also differed. Sensory elements were also more prominent in the self-defining memories of the ASD group. Finally, results demonstrated that the adults with ASD extracted less meaning from their memories than control adults.

Both self-report and experimenter ratings demonstrated that adults with ASD could distinguish between self-defining and everyday autobiographical memories as competently as typical adults. Despite this, and consistent with previous research (e.g., Crane and Goddard 2008; Crane et al. 2009b; Goddard et al. 2007), the ASD group retrieved fewer specific memories than the control group. Qualitative analyses of the narratives provides one possible explanation for this; whilst the narratives of the control adults referred to achievement/mastery events to a greater extent than those of the ASD group, the memories of the adults with ASD centred more heavily on recreation/exploration. Inspection of the narratives suggested that the recreation/exploration activities were largely general in nature (e.g., *"skiing has always been a big part of my life"*), whereas achievement events often centred on one specific day (e.g., *"when I received my exam results"*). Although it was not possible to statistically test this assumption, given the relatively small numbers of memories retrieved per participant, examination of how the content of the narratives affects the quality of memories in ASD is an important avenue for future research.

Overall, despite differences in the specificity and themes of the memories generated by the ASD and control groups, the narratives of the two groups did display some qualitative similarities; self-report ratings revealed the self-defining and everyday memories of the ASD and control groups to be equivalent, and experimenter ratings found both groups to refer to emotions and the self/others to a similar degree. However, group differences were observed when examining references to sensory elements within the narratives; whilst there was no significant difference between the number of references to sensory elements within the everyday memories of the ASD and control groups, adults with ASD referred to sensory elements significantly more than the control group when narrating self-defining memories. This finding could reflect the relative importance of sensory abnormalities to adults with ASD (cf. Crane et al. 2009a), and this is an issue that warrants further, more systematic investigation.

Another important difference between the narratives of the ASD and control groups concerns how the adults with ASD extracted significantly less meaning from their narratives than control adults. Meaning making is a highly adaptive behaviour, enabling a person to update their self-concept and personal goals with these newly learned lessons. Following this, the self influences what one remembers, ensuring a state of self-coherence (cf. Conway et al. 2004). Engaging in meaning making is therefore an indicator of an intact and dynamic self-memory system. The inability of adults with ASD to use their memories in this way suggests that the self-memory relationship might be static, rather than dynamic, in this group.

This suggestion is consistent with the Enhanced Perceptual Functioning model of Mottron and colleagues (Mottron and Burack 2001; Mottron et al. 2006), who argue that the relationship between high and low level cognitive processes is atypical in ASD. More specifically, they suggest that the superiority of perceptual processing in this group is highly disruptive to other higher level cognitive abilities (e.g., meaning making). The apparent inability of the ASD group to engage in meaning making also concords with research by Bowler and colleagues (Bowler and Gaigg 2008; Bowler et al. 2008; Gaigg et al. 2007), who propose that relational memory (the ability to identify meaningful links between to-be-remembered items) is an area of difficulty in this group. As organising memories around a concept of the self and engaging in meaning making are forms of relational encoding, the current study provides further support for this theory.

However, it is possible that the ASD group were able to extract meaning from memories, but simply failed to report instances of lesson learning or gaining insight within their narratives. Indeed, the task instructions merely asked participants to *describe* the memory—there was no explicit requirement to report meaning from the memories. This is consistent with White et al.'s (2009) recent finding that individuals with ASD experience a particular difficulty with open-ended cognitive tasks—tasks on which there are various potential approaches with which one may respond and participants must decide on the most appropriate course of action (White et al. 2009). White and colleagues suggest that these difficulties may be due to a failure in 'implicit mentalising'—the ability to appreciate the inherent requirements of a task and respond to the social expectations of the experimenter. It is therefore important for future research to explore whether adults with ASD can identify meaning from their narratives, and whether they can use this information to update their sense of self. This

may have significant implications for therapeutic interventions in this group; encouragement towards identifying and learning from past experience may improve social skills, such as social-problem solving, in ASD (cf. Goddard et al. 2007).

To conclude, this research demonstrated that adults with ASD could distinguish between self-defining and everyday autobiographical memories to a similar degree as typical adults. It also confirmed previous reports that adults with ASD are less likely than typical controls to retrieve specific autobiographical memories, focusing instead on more general events. This may be related to the thematic content of the narratives, with the ASD group remembering events that bias retrieval at the general event level. Adults with ASD also appear to engage in meaning making to a lesser degree than typical adults. As meaning making involves the dynamic interplay between memory and the self, this implies that the self-memory system might be static, rather than dynamic, in ASD. Further research is necessary to identify whether adults with ASD can identify meaning from their memories and use past experiences to update their sense of self.

Appendix: Examples of Self-Defining and Everyday Autobiographical Memories in the ASD and Control Groups

Self-defining Memory (ASD, Female, Age 22)

When I got my AS Level results at school, which were probably the best results I've had. And I was really pleased about them because I was, well, I was pleased and disappointed at the same time. And basically I'd done quite well because I got three As and a B but I was really upset about getting a B and I sort of just remember getting really upset about the B and not knowing what, and then I realised that I was only four marks away from an A and I was really upset about that, but yeah, that is quite, that is a memory I've had to recall quite a lot so yeah, that is quite important.

Self-defining Memory (Control, Female, Age 21)

Basically my uncle died of alcoholism last year in October, so that was about a year ago, the whole family were obviously devastated by the event, but the thing that I

actually learnt from it was not to actually get addicted to a substance that could actually control me and to monitor the amount I drink, and also not to drink and drive and to seek help if I ever did wish to go down that avenue and it's also bought my family closer together because now we're kind of more open about how we really feel so no one will ever feel the need to shut themselves out to the world and let something like alcohol control them.

Everyday Memory (ASD, Male, Age 48)

It's when I was younger, I used to like going to a place called Guildford Castles, it's a place where I used to like playing and I quite often think about the place and I often think about what it looks like.

Everyday Memory (Control, Male, Age 44)

What comes to mind this time last year, and what we're gonna do this year, and that's buy a Christmas tree, which is at Ruxley garden centre and I remember it because I was surprised how much they cost, for a tree, and my wife was saying it's worth spending a little bit more to get a nice tree.

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