Knowing me, knowing you: Self defining memories in adolescents with and without an autism spectrum disorder

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ABSTRACT

Background: Autobiographical memory plays a key role in self-understanding and psychological health. While deficits in autobiographical memory are well-established in autism, few studies have focused on adolescence; a critical period for the developing self and self-esteem.

Method: 16 adolescents with an autism spectrum disorder (ASD) and 16 typically developing adolescent controls matched for IQ and gender, were asked to provide three self-defining and three everyday memories. Participants rated their memories for emotional intensity, visual perspective and the extent to which they were self-revealing. Memories were independently rated as self-defining or everyday experiences, and according to their valence and theme. Self-esteem and depressed mood were further assessed with self-report questionnaires.

Results: There were no group differences in the ability to recognise self-defining memories as assessed by independent reports. Both groups also reported their self-defining memories to be more intense than their everyday memories. However adolescents with ASD, in contrast to non-ASD controls, reported self-defining memories to reveal less about them than everyday memories. Relative to controls, they retrieved fewer memories with an achievement theme and more memories with a recreational theme. The control group showed a bias towards retrieving positive rather than negative self-defining memories but the ASD group showed no such tendency. Self-esteem, but not mood was poorer in the ASD group and self-esteem was related to the retrieval of negative self-defining memories.

Conclusions: Adolescents with ASD exhibit an instable self-representation; they recognise the types of past experiences that define them but feel weak connections with these memories.

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1. Introduction

Autobiographical memories play a vital role in providing a coherent sense of self (Conway & Pleydell-Peace, 2000) and the manner in which past experiences are appraised can also regulate self-esteem and mood (Wilson & Ross, 2003). Autobiographical memory deficits are typical in individuals with an ASD (Bruck, London, Landa, & Goodman, 2007; Crane & Goddard, 2008; Crane, Goddard, & Pring, 2009; Goddard, Dritschel, Robinson, & Howlin, 2014) and these deficits are thought to contribute to poor self-understanding (Lind, 2010). Autobiographical memory impairment may also be a factor in the

increased incidence of mood disorder and low self esteem, frequently observed in ASD (cf. Ghaziuddin, Ghaziuddin, & Gredin, 2002; White, Oswald, Ollendick, & Scahill, 2009; Williamson, Craig, & Slinger, 2008). Given the importance of autobiographical memory in understanding self and psychological health and its potential as a mechanism for intervention (Dalgleish et al., 2014), it is not surprising that autobiographical memory research in ASD, has recently flourished. However several gaps in the literature remain. For example, few studies have directly examined the links between autobiographical memory deficits, self and mood. Furthermore, the period of adolescence has been neglected, with most studies subsuming this lifetime period within either child or adult research. The aim of the current study was to address these gaps and examine autobiographical memory in the context of mood and self-esteem in adolescents with and without an ASD.

Adolescence produces profound changes in self-understanding. It is a life-time period that is often troublesome in autism with the increasing incidence of depression emerging during this period (Tantam, 2000). Self-concept development in adolescence involves learning what differentiates one from others, leading to appraisals of competency that contribute to a sense of self-worth (Harter, 1999). Previous research on self-concept in adolescents with an ASD has shown that they perceive themselves to be less competent in a variety of domains including social, athletic, and peer likeability (Williamson et al., 2008). They also have lower overall global self worth compared to neurotypical adolescents (Jamison & Schuttler, 2015). Autobiographical memories provide an important source of psychological self-knowledge (Sebastian, Burnett, & Blakemore, 2008) that can also influence self-perceptions and self-esteem. In particular, self-defining memories (cf. Moffitt & Singer, 1994) are personally significant events that contain 'affective patterns and themes that stamp an individual's most important concerns' (Singer & Salovey, 1993, p. 4) and are closely tied to current working models of the self (Conway & Pleydell-Pearce, 2000). They are typically high in affective intensity and their valence is associated with quality of self perception; accordingly positive self-defining memories can enhance self esteem and negative memories may diminish self esteem (Cili & Stopa, 2015).

Few studies have directly considered how autobiographical memory deficits in individuals with an ASD may impact self-representations. A recent study by Berna et al. (2016) examined how autistic traits within the general population affected both the abilty to draw meaning from self-defining memories, and an individual's clarity of self-concept. Self-concept clarity refers to the extent to which 'self' is experienced as internally consistent, temporally stable and confidently defined. This was measured by questionnaire where participants made judgements of agreement on items such as "My beliefs about myself seem to change very frequently". Results revealed a relationship between autistic traits and self concept clarity that was mediated by the ability to extract meaning from self-defining memories. This finding suggests a direct link between self-deficits and difficulties in using autobiographical memories as a source of self-understanding. Similar effects have been found in adults with an ASD diagnosis. Crane et al. (2010) hypothesized that adults with an ASD would have difficulty identifying self-defining memories such that ratings on qualities typically characteristic of these memories (eg. vividness, emotionality and the extent to which they were self-revealing) would not differ from everyday memories. Difficulties were assumed, due to the purported weaker sense of self in individuals on the AS. However, contrary to predictions, self-defining memories were distinguishable from everyday memories in a similar manner to those of a non-autistic control group. Although, in line with Berna et al. (2016), the ASD group relative to controls appeared to extract less meaning from these memories. Thematic analysis also revealed fewer achievement themes and more recreation themes in the self-defining memories of the ASD group compared to controls.

There are no studies to date that have considered the self-defining memories of adolescents with an ASD. Yet the developing complexity of self during this period and potential for low self-esteem, make this age group a pertinent target for research. Therefore the current study aimed to further understanding of self-memory processes in ASD by comparing the self-defining memories of adolescents with and without an ASD. It was hypothesized that characteristic qualities of self defining memories (i.e., emotional intensity, self-relevance and meaning making) would be less apparent in the self defining memories of adolescents with an ASD compared to age and IQ matched typically developing controls, due to delays and or deficits in the developing self. Self-defining memories were also predicted to be less distinguishable from everyday memories on these qualities, compared to those of a control group. The predictive power of self-defining memories on mood and self-esteem was also explored. Attention was given to memory valence, and it was predicted that the ASD group compared to controls, would report lower self-esteem and lower mood and that this would be related to fewer positive self-defining memories and more negative self-defining memories. An additional quality of memory explored was its visual perspective since visualising a memory from a first person perspective has been hypothesized as a key characteristic of self-defining memories (Libby & Eibach, 2002). Previous research by Lind and Bowler (2010) has demonstrated an increased incidence of observer memories in adults with an ASD compared to controls. This, they reasoned, was indicative of a diminished level of re-experiencing. Thus we also expected more memories to be experienced from an observer perspective in the ASD group relative to controls.

2. Methods

2.1. Participants

All participants (both ASD and control) were recruited from mainstream secondary schools with a specialist resource provision for autism. The sample comprised 16 participants with an ASD (14 males, 2 female) and 16 control participants. Criteria for inclusion were a full-scale IQ of 70 or above and age between 13 and 17. In addition, for the experimental group, a

formal diagnosis of an ASD from a multidisciplinary team that included either a psychologist or psychiatrist was required and a score of 15 or greater on the Social Communication Questionnaire (SCQ; Rutter, Bailey, & Lord, 2003). The mean SCQ score for the ASD group was 23.07 (*SD* = 4.54). Control participants did not have an ASD diagnosis and were matched with the ASD group for age, gender, and full scale IQ. There were no statistically significant differences between groups on either of the control variables (see Table 1).

2.2. Measures of independent and control variables

2.2.1. Social Communication Questionnaire (SCQ, Rutter et al., 2003)

A 40-item checklist for completion by parents or carers. The SCQ is a screening tool for ASD that has established validity (Chandler et al., 2007). A score of 15 or above is indicative of an ASD diagnosis.

2.2.2. Wechsler Abbreviated Scale of Intelligence (WASI, Wechsler, 1999)

Full scale IQ was obtained using the two-subtest version (matrix reasoning and vocabulary) in order to reduce testing time.

2.3. Measures of dependent variables

2.3.1. Self-Perception Profile for Adolescents (SPP Harter, 2012)

This self-report measure takes a multidimensional approach to the system of self (Harter, 1999). It consists of 45 items, each scored on a 4 point scale, that assess an individual's evaluation of competence in 8 domains (scholastic, athletic, physical appearance, job, romantic appeal, behavioural conduct and close friendship). It also yields a score for global self-worth that is independent of competence scores in the aforementioned domains and which is akin to Rosenberg's (1979) concept of overall self-esteem. Higher scores indicate improved opinions of self.

2.3.2. Centre for Epidemiological Studies Depression Scale for Children (CES-DC) (Weissman, Orvaschel, & Padian, 1980)

A valid and reliable measure of depressed mood in children and adolescents (Weissman et al., 1980). It consists of 20 items scored on a 4-point scale with higher scores reflecting greater levels of depressed mood with a score of 15 as suggestive of depressive symptoms.

2.3.3. Self-defining and everyday memory task

Adapted from Singer and Moffitt (1992) and modified for use with adolescents, participants were asked to describe three self-defining memories and three everyday memories. A self-defining memory was described as 'A memory that would help me understand the kind of person you are or would tell me something about yourself. It should be something that you feel strongly about and something you have thought about a lot since it happened. It should be at least 6 months old'. An everyday memory was described to participants as 'A memory that you personally experienced. It doesn't have to tell me anything about who you are as a person and it can be something you feel either strongly or weakly about. It should be at least 6 months old.' Participants were required to narrate memories to the experimenter and interviews were recorded for accuracy in transcription. Where required, participants were prompted for detail and encouraged towards specific retrieval. After memory retrieval, participants rated their memories on three dimensions adapted from the Memory Characteristics Questionnaire (Johnson, Foley, Suengas, & Raye, 1988). These included emotional intensity rated on a 5 point scale (1 = very weak to 5 = very strong) and, on a 3 point scale, the extent to which memories were self-revealing, (1 = not very much to 3 = a lot). The primary visual perspective (field or observer) from which participants reported to have experienced each memory was also recorded. Visual images were used to illustrate the difference between field and observer perspectives.

In order to examine participants' ability to identify self-defining versus everyday memories, the narratives were blind rated for memory type by two independent raters giving a percentage score of memories correctly identified. Narratives were also rated for valence, meaning making and theme in order to explore differences between groups. Inter-rater agreement on all measures was acceptable and disagreements were resolved by discussion (kappa coefficients > 0.79). Valence was coded as positive, negative or neutral and where memories contained both positive and negative elements, ratings pertained to the outcome valence. Each memory was coded for meaning making with a score of 1 given where there was evidence that memories provided insight or lesson learning (cf. McLean & Thorne, 2001). Themes were adapted from the description provided by McLean and Thorne (2001) as detailed below.

Table 1
Mean age and IQ and gender ratio for ASD and control matched sample.

	ASD (n = 16 Mean (SD)	Control (n = 16) Mean (SD)	t	p	Cohen's d
Age (months)	162.13 (19.93)	165.31 (16.86)	0.46	0.65	0.21
Full Scale IQ	104.94 (11.53)	106.69 (9.73)	0.49	0.63	0.18
Male:Female	14:2	14:2			

- Life threatening events: Events where physical or emotional well-being may have been affected. Examples include death of a close relation or friend or illness.
- Recreation/exploration: examples include hobbies, parties, travelling, holiday or sporting activities.
- Relationship: emphasises a particular interpersonal relationship. Importantly they must reference to relationship history or emotional investment in another person. Examples include first love, dissolution of a relationship, reconciliation or intimacy.
- Achievement/mastery: narratives emphasise either ones own or one's group/family mastery or accomplishment, irrespective of that outcome. Examples include passing or failing an exam.
- Guilt/shame: events that emphasise issues pertaining to right or wrong. Examples include guilt about lying or hurting someone or instances in which a moral or ethical decision is made.
- Event not classifiable: this category included any narrative that did not fit strongly in the above categories.

2.4. Procedure

Participants were tested individually at their home or school. The testing session lasted approximately 60 min. Task order was fixed with the WASI administered first, followed by the Self-defining and Everyday Memory Task, SSPA and CES-DS. The study gained ethical approval from Goldsmiths, University of London Ethics Committee (Psychology) and was conducted in accordance with British Psychological Society guidelines on ethics.

3. Results

Data were first screened to ensure that the requirements for parametric testing were met. Where data violated assumptions of normality or variance, non-parametric tests were employed.

3.1. Self-Defining and everyday memory task

We first checked that participants understood task instructions by comparing the number of self-defining versus everyday memories correctly identified by an independent rater. This revealed no differences between groups (unrelated t $(30) = 0.19$, $p = 0.85$; Cohen's $d = 0.007$; ASD mean number incorrectly identified: 1.27, SD = 1.03 vs control mean: 1.20, SD = 0.95). To test our hypothesis that the self-defining and everyday memories of the ASD group would be less distinguishable on qualities of a] emotional intensity b] self revealing rating and] visual perspective, we employed a series of 2 (Group: ASD vs. control) $\times$ 2 (Memory type: self defining versus everyday) ANOVAs. There was a statistically significant main effect of memory type on emotional intensity ($F(1,30) = 23.26$, $p = 0.001$, $\eta p^2 = 0.44$) as self defining memories were rated more intense than everyday memories (self-defining: mean intensity: 3.76, SD = 0.85 vs. everyday: mean intensity:
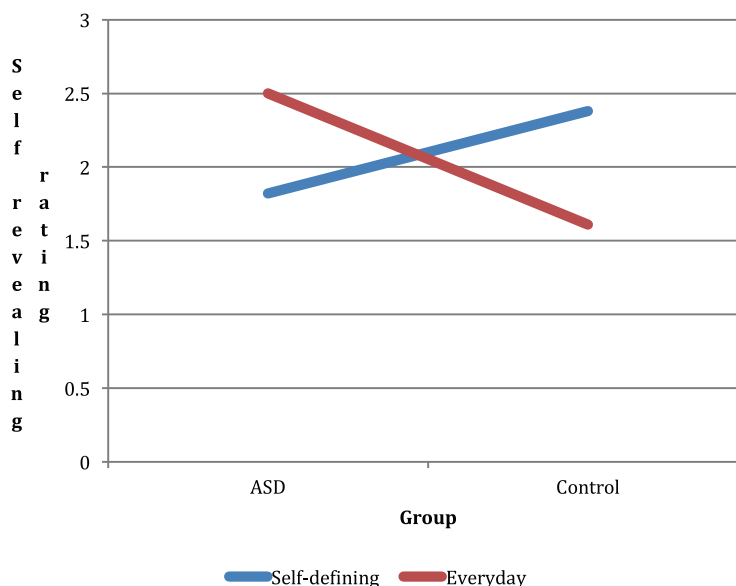

Fig. 1. Mean self revealing ratings of self defining and everyday memories for ASD and control groups.

3.07, SD = 0.81). However contrary to our prediction, this effect did not significantly interact with group ($F_{(1,30)}$ = 0.05., p = 0.83, ηp^2 = 0.002) nor was the group main effect significant ($F_{(1,30)}$ = 0.01, p = 0.90, ηp^2 = 0.002). As regards self revealing ratings, there were no significant main effects for either memory type ($F_{(1, 30)}$ = 0.09, p = 0.76, ηp^2 = 0.003) or group ($F_{(1,30)}$ = 1.31, p = 0.26, ηp^2 = 0.04). However a statistically significant interaction effect emerged in support of our hypothesis ($F_{(1,30)}$ = 27.92, p = 0.001, ηp^2 = 0.48) and is shown in Fig. 1. Post hoc comparisons (Bonferonni t's) revealed the control group to rate their self-defining memories as significantly more self-revealing than their everyday memories; in contrast, the ASD group rated their everyday memories to be significantly more self-revealing than their self-defining.

Visual perspective was examined by comparing groups on the percentage of memories that were deemed to be experienced with a field perspective. Contrary to that hypothesized, groups did not differ, ($F_{(1,30)}$ = 2.06, p = 0.16, ηp^2 = 0.06), (AS field mean = 61.46, SD = 26.15 vs. control field mean = 52.09, SD = 21.28). There was also no significant group main effect ($F_{(1,30)}$ = 1.06, p = 0.31, ηp^2 = 0.03) or significant group × memory type interaction ($F_{(1,30)}$ = 0.1.07, p = 0.31, ηp^2 = 0.03).

We then explored memories using the experimenter ratings. We first analysed the number of memories rated as either positive or negative with a 3 way (group: ASD vs. control x memory type: self-defining vs. everyday × emotion valence: positive vs. negative) mixed *ANOVA*. Statistically significant main effects for both emotion valence ($F_{(1,30)}$ = 15.68, p = 0.001, ηp^2 = 0.34) and memory type ($F_{(1,30)}$ = 9.10, p = 0.005, ηp^2 = 0.23) emerged, as more positive than negative memories were recalled (positive mean: 3.00, SD = 1.41 vs. negative mean: 1.34, SD = 1.23) and self defining memories were more likely to have an emotional content than everyday memories (self defining mean: 2.47, SD = 0.67 vs everyday mean: 1.87, SD = 0.91). The group main effect was not significant ($F_{(1, 30)}$ = 0.22, p = 0.65, ηp^2 = 0.007) nor were the two way interactions (valence × group: $F_{(1,30)}$ = 2.02, p = 0.17 ηp^2 = 0.06; valence × memory type $F_{(1,30)}$ = 2.53, p = 0.12, ηp^2 = 0.08; group × memory type: $F_{(1,30)}$ = 2.04, p = 0.16, ηp^2 = 0.06), however a trend towards a statistically significant three way interaction emerged ($F_{(1.30)}$ = 4.15, p = 0.05, ηp^2 = 0.14). Given our *apriori* hypothesis that the ASD group would have fewer positive self-defining memories and more negative self-defining memories than the control group, we examined the two-way (Group × Valence) analysis on self-defining memories alone. This yielded a statistically significant main effect of valence ($F_{(1,30)}$ = 13.97, p = 0.001, ηp^2 = 0.32) qualified by a significant interaction effect ($F_{(1,30)}$ = 6.03, p = 0.001, ηp^2 = 0.17). Post hoc analyses (Bonferroni t's) revealed a bias towards positive content and away from negative content in the self-defining memories of the control group; a bias that was absent in the ASD group (see Table 2).

Ratings for meaning making revealed few incidences of explicit references to lessons learnt. Out of the 96 memory narratives gathered for each group, 4/96 identified meaning making from the ASD group and 9/96, for the comparison group. Therefore no further analysis was undertaken. Figs. 2 and 3 illustrate the memory themes of both self-defining and everyday memories for both groups. There were no significant differences in themes for everyday memories (ps > 0.1). With respect to self-defining memories however, the ASD group retrieved significantly more memories with a recreation theme (U = 61, p = 0.01, r = 0.48) whereas the control group retrieved significantly more memories with an achievement theme than the ASD group (U = 74, p = 0.04, r = 0.39).

3.2. Depression and self esteem

Scores on the CDES yielded unequal between group variance and therefore Mann Whitney was employed to analyse group differences and revealed no significant difference in mean score (U = 85, p = 0.1; r = 0.28, ASD group mean: 12.31, SD = 5.61 vs control mean: 8.81, SD = 3.18). *MANOVA* was employed to examine group differences in perceived competence on the various facets of self esteem. The ASD group scored lower overall ($F_{(9, 22)}$ = 14.89, p = 0.001, ηp^2 = 0.86) indicating lower levels of self esteem. Univariate between group *ANOVAs* showed that the ASD group reported poorer self-perceptions in all domains other than physical and school competence. Fig. 4 shows mean scores for each group by competence domain.

3.3. Relationship between valence of self-defining memories and indices of psychological health

Global self-esteem and depression score were employed as our measures of psychological health. Relationships between these measures and the number of positive and negative self-defining memories were examined using Pearson Product Moment Correlations (Table 3). Given the large number of correlation analyses undertaken, alpha was set at p < 0.01 in order to reduce the chance of making a type 1 error. Across all participants, as predicted, a statistically significant negative correlation was revealed between the number of negative self-defining memories and self-esteem. Within group correlation

Table 2
Mean number of emotional memories (max = 3) by valence (positive vs negative), memory type (self-defining/everday) × group (ASD/Control). Standard deviations shown in brackets.

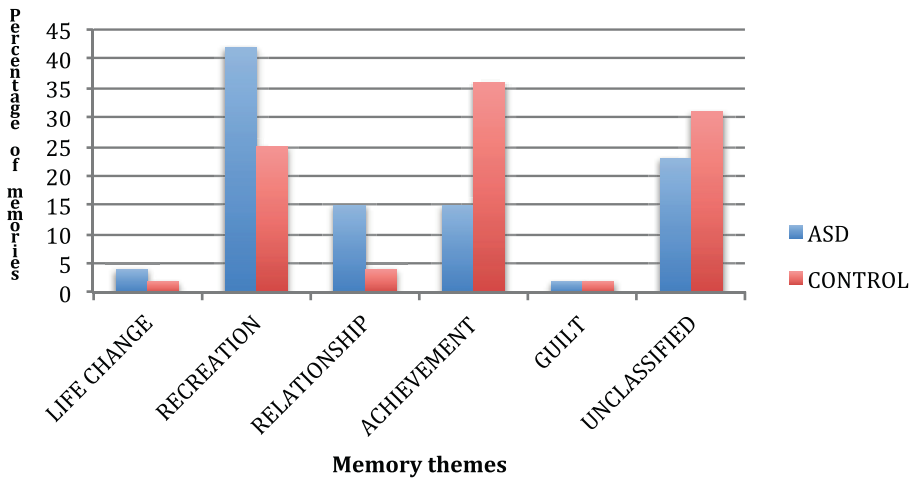| Group	Memory type Self-defining		Everyday	
	Positive	Negative	Positive	Negative
ASD (n = 16)	1.38 (1.02)	1.00 (0.97)	1.31 (1.06)	0.75 (0.77)
Control (n = 16)	2.19 (0.91)	0.37 (0.62)	1.06 (0.87)	0.63 (0.80)

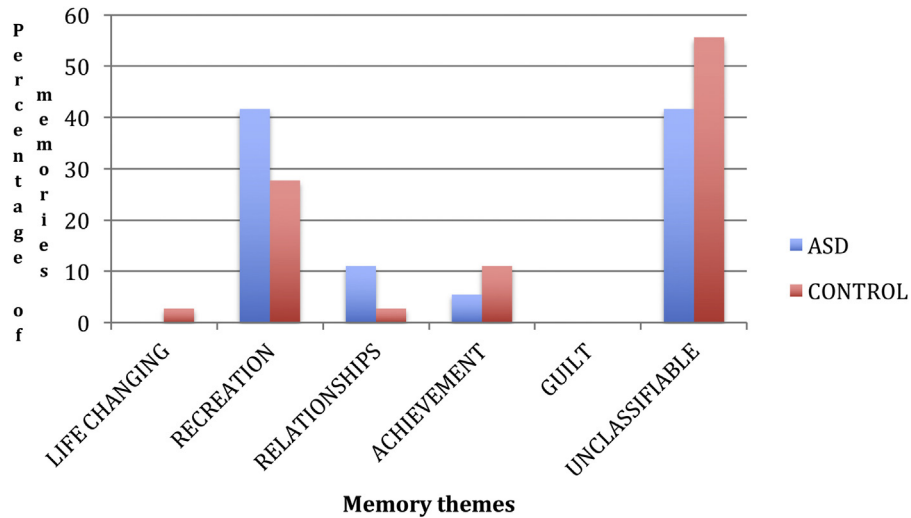**Fig. 2.** Mean percentage of self-defining memories by theme.

Fig. 3. Mean percentage of everyday memories by theme.

did not reach significance although observation of the correlation coefficients suggested that the effect was largely carried by the ASD group as the correlation was close to 0 in the controls. In order to examine whether the relationship between negative memories and self-esteem was specific to self-defining memories, we also observed the correlation between everyday negative memories and self-esteem. This revealed a coefficient close to 0 (Pearson's $r = 0.08$, $p = 0.67$) that was significantly different to that found for self-defining memories ($z = 2$, $p = 0.05$, two-tailed). There was also a statistically significant negative relationship between depression and self-esteem across all participants; which remained significant when considering the control group alone. All other correlations did not reach statistical significance.

4. Discussion

The current study aimed to build on what is already known about autobiographical memory in ASD by examining self-defining versus everyday memories in the context of mood and self-esteem in adolescents with and without an ASD diagnosis. Results demonstrated that while the ASD group could identify and distinguish self-defining from everyday memories as shown by independent ratings, they failed to recognise these experiences as a special means of self-understanding. Both groups reported self-defining memories to be more emotionally intense than everyday memories and against this background, adolescents with autism may have shied away from this intensity and preferred to focus on their
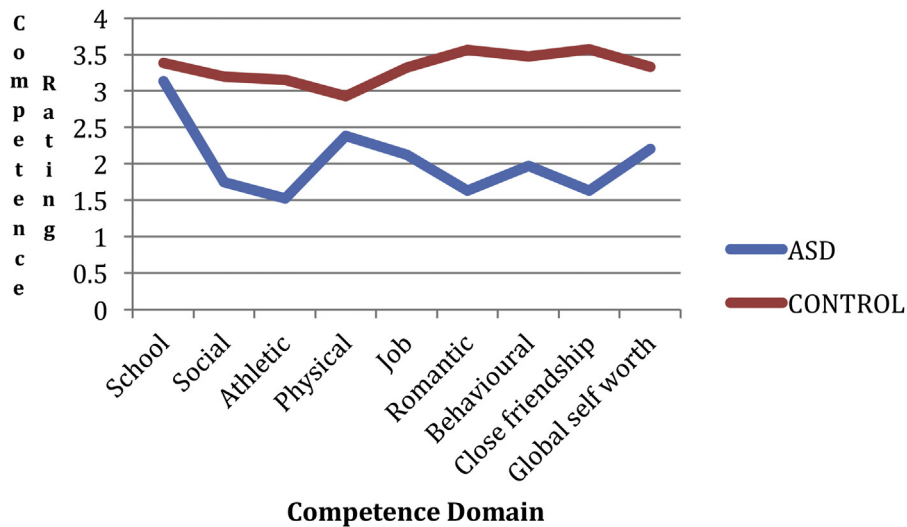
Fig. 4. Mean self-esteem scores by domain for ASD and Control groups.
NB. Groups significantly differ at $p < 0.01$ on all domains other than School and Physical.

Table 3
Pearson's correlation coefficients for relationship between mood and self esteem and number of positive self-defining memories.

	Global self-esteem			Depression		
	ASD n = 16	Control n = 16	Overall n = 24	ASD n = 16	Control n = 16	Overall n = 32
Number of positive self-defining Memories	0.28	0.16	0.43	−0.23	−0.01	−0.28
Number of negative self-defining memories	−0.59	−0.06	−0.54[*]	0.35	−0.17	−0.22
Depression: CDES	−0.32	−0.65[*]	−0.56[*]			

[*] $p < 0.01$, two tailed.

everyday experiences for self-understanding. Nevertheless, results suggested that it is these self-defining, rather than everyday memories that exert an influence on their self-esteem; a reduced bias towards positive memories (relative to controls) was evident in the ASD group and lower global self-esteem was linked to a propensity towards negative self-defining memories.

Previous research has shown that adults with an ASD extract less meaning and insight from their self-defining memories and have a less stable sense of self. Our data, originating from a sample of adolescents, are in line with these findings but suggest that there be developmental differences in meaning making. Both ASD and control groups infrequently mentioned incidences of lesson learning from their past suggesting that active reflection and analysis of experience may emerge later in typical adolescent development (cf. McClean, 2005). Berna et al. (2016) showed that individuals high on autistic traits were more likely to agree that their beliefs about themselves were changeable and that they spent less time wondering about the kind of person that they were. Our data also point to instable/weak representations of self. Interestingly our ASD adolescents recognised the kinds of personal experiences that allowed others to define them, but they did not themselves relate to these experiences, referring instead to their equally positive, but less emotional, everyday memories for examples of self. The increased emotional intensity of self-defining memories may have served to confuse rather than strengthen self-representations. Individuals with autism have less coherent personal narratives (Losh & Capps, 2003) and problems in emotion processing (Hill, Berthoz, & Frith, 2004) may go some way to explain why our adolescents with autism had different versions of self for their own versus others' understanding. (Appendix A describes self defining and everyday memories of ASD participants and gives a flavour of the kind of everyday experiences that are deemed as more self-revealing in this group).

It is widely accepted that autobiographical memory plays an important function in self-understanding. Conway and Pledell-Pearce's model (2004) suggests that working goals of the self initiate and guide retrieval towards long term memories associated with self-understanding. Our finding that adolescents with autism have weak connections with experiences that they recognise on one level as self-defining, points towards a reduced symbiosis between self understanding and memory in autism. This may result in a less stable self-representation due to a failure to explicitly recognise the relevance of past experiences. Our findings add to other research that also suggests impaired function of

autobiographical memory in ASD. For example, in the domain of personal problem-solving where autobiographical memories provide a database for generating solutions (Williams, 1996), it has been demonstrated that adults with autism retrieve appropriate memories when cued by problem scenarios, but fail to use the information contained within those memories for generating strategies (Goddard, Dritschel, Howlin, & Patel, 2007). Together these findings suggest that ASD is associated with a difficulty in drawing on the knowledge contained within autobiographical memories for ongoing cognitive tasks such as understanding self and solving personal problems.

Despite a reduced identification with self-defining memories in the ASD group, these memories nevertheless exerted an influence on their self-concepts through self-esteem; moreover self-esteem was lower in the ASD group compared to controls. Adolescence is a critical period for self-esteem development and individuals with an ASD are clearly vulnerable. Positive self-esteem requires positive images (Hulme, Hirsch, & Stopa, 2012) and our data showed the importance of a bias towards positive memories when identifying self-defining (but not everyday) experiences. Our ASD group did not show this effect and lower levels of self-esteem were related to negative self-defining memories. Lack of bias would appear to reflect a failure of memory function rather than reduction in the number of positive experiences. Overall, groups did not differ on the number of positive and negative memories retrieved but the controls were more able to direct their memory search towards positive targets when retrieving self-defining memories.

Thematic analysis indicated achievement to be a more common goal for the control group relative to those with an ASD, who in turn focused more on recreation themes. Interestingly these effects mirror those of Crane et al. (2013) and suggest that ASD and non-ASD differences in the thematic goals of self-defining memories remain stable. This is important because it may highlight a vulnerability and negativity related to achievement in domains that become important during adolescence. A propensity towards a variety of goals may be driven by cognitive flexibility that in turn may impact self-complexity. Examining variability in theme distribution across self-defining memories was beyond the scope of this study. However future research that examines how cognitive flexibility relates to the frequency and variability of themes could be helpful for enhancing our understanding of self representation in ASD.

Given the lack of bias towards positive self-defining memories and the lower reported self-esteem of the ASD group, it is surprising that they did not also report significantly higher levels of depressed mood. Moreover, while a significant relationship between mood and self-esteem was observed in the control group, this was not the case for the group with ASD. Williamson et al. (2008) also detected low self-esteem in adolescents with ASD relative to controls in the context of comparable levels of depressed mood. Similarly Jamison and Schuttler (2015) showed a non-existent relationship between global self-esteem and quality of life in adolescent girls with autism, a relationship that was statistically significant in non-autistic controls. Our data are in line with these studies and contribute further to the suggestion that there may be weaker links between self-perception and mood in autism.

Previous autobiographical memory research found a reduced bias towards a field perspective in memory retrieval in ASD relative to controls (Lind & Bowler, 2010). Our study found no evidence of group differences. Our null findings may be due to the methodology employed. Lind and Bowler (2010) cued specific memories with different time periods, the majority of which pertained to time-periods of less than a month, whereas we requested memories that were at least six months old. Older memories are more likely to be of observer perspective (Nigro & Neisser, 1983) and it has also been argued that an observer visual perspective play a particular role in self-defining memories (cf. Libby, Eibach, & Gilovich, 2005). These differences may have served to weaken a bias towards field perspective previously observed in control groups.

The study has several limitations. In particular, the sample size was small and findings need to be replicated with larger samples to ensure reliability. While power analyses indicated sufficient power to detect medium effects sizes for our main hypothesis regarding qualities of self-defining versus everyday memories, our study may have been underpowered for detecting potentially smaller effects for visual perspective and levels of depression. Also, the methodology relied on participants' ability to introspect and make subjective ratings on the contents of their mind. Attributing visual perspective can, arguably be a difficult judgement to make and we had no method of establishing the veridicality of participants' reports. Thus findings may not accurately reflect autobiographical memory processes.

In conclusion this study showed the importance of identifying positive rather than negative, experiences as examples of self. Adolescents with ASD failed to direct their retrieval towards positive self-defining memories and reported that they felt less aligned with their self-defining memories compared to non-autistic controls.This might have been an attempt to protect themselves from negative material. However correlational analysis revealed self-defining rather than everyday memories to impact their self-esteem. Developing a strong and stable concept of self is a prerequisite for understanding others and for developing good social skills; it is also implicated in self-regulation (Matson, Matson, & Rivet, 2007). More research is needed to understand the mechanisms underlying self-representations in adolescents with ASD and how they relate to psychological health. Our data suggest that initiatives aimed at strengthening the connections between self, memory and mood may be an effective target for intervention.

Conflicts of interest

The authors have no conflicts of interest to declare.

Acknowledgement

We are very grateful to the young people, schools and parents who were involved with this study.

Appendix A. Examples of self-defining and everyday memories of adolescents with an AS condition.

Self-defining memories

A trait I have is feeling less safe than others would feel. Especially if someone is angry in the Croft and can't control it. When I was in year 7, September 2013. One of the boys charged at me, it was an angry bull charge and if one of the teacher wasn't there I would have been hurt.

Strange how other people can go to school and not worry about every lesson. Why do they follow trends when they can wear comfy clothes? A girl from school was mean to me one day, this was at the beginning of year 6, she called me a 'special needs freak', she seemed to find that so easy . . . it made it difficult for me to go to school.

I am a greedy person. In year 7 we were playing with two bouncy balls, one was blue and one was orange and they had a marbled effect running throughout both. There were three of us – Me, Tom and Ethan. I am a man of violence, I wanted one of the bouncy balls and they wouldn't give it up. So, I snatched it and a fight broke out and I fell out with my friends but eventually we resolved it.

Everyday memories

Again, in year 3 in Primary School, I made up a short series of books about a character called Bob. Whatever he touched, would turn into the colour of his choice. He had to turn everything into colour to create freedom, I named the books too.

A while ago, was last year, when dad first started working at a new school. We visited one lunch; it was a long journey as the school was a long way away. We went to Sainsbury's and I had a pasta pot, prawn cocktail and a sprite. My brother ran out as he doesn't like the smell of tuna.

Quite far back, about 5 years ago, I was playing Age of Empires 2 as the Chinese in the colour red, the map was gold rush, and I was playing against the Britons. I made a border around the gold on a cliff, which allowed me to win. I had a sense of success as I wasn't good at the game then.

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