

Self-Disorders in Individuals with Autistic Traits: Contribution of Reduced Autobiographical Reasoning Capacities

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Abstract The present web-based study (N = 840) aimed to illuminate the cognitive mechanisms underlying self-disorders in autism. Initially, participants selected three self-defining memories. Then, we assessed their capacity to give meaning to these events (i.e., meaning making), their tendency to scrutinize autobiographical memory to better understand themselves (i.e., self-continuity function of autobiographical memory) and their clarity of self-concept. The results showed that individuals with high autistic traits (ATs) had a lower clarity of self-concept than control participants. Meaning making was also reduced in AT individuals and mediated the relation between AT and self-concept clarity. Our results suggest that the reduced clarity of self-concept in AT individuals is related to an impaired capacity to make meaning of important past life events.

Keywords Self · Autism · Autobiographical reasoning · Autobiographical memory

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Introduction

Both clinical and experimental studies have reported poorer psychological self-knowledge in individuals with autism spectrum disorder (ASD) relative to neurotypical (non-ASD) control participants. For instance, children with ASD have a reduced conscious awareness of their own mental states (Williams and Happé 2009, 2010) and emotions (Ben Shalom et al. 2006; Silani et al. 2008; Hill et al. 2004). Adults with ASD tend to use fewer self-statements to define themselves than neurotypical controls (Hobson and Lee 1998; Jackson et al. 2012; Tanweer et al. 2010) and select more abstract (Tanweer et al. 2010; e.g., “I am thoughtful”) and fewer social and psychological terms to define themselves (Jackson et al. 2012; Tanweer et al. 2010). These findings point to a reduced complexity and development of stable conceptual knowledge about the self in this population (Jackson et al. 2012; Tanweer et al. 2010). Importantly, this impoverishment of self-concept has been demonstrated independently of an impaired accuracy of self-concepts: In fact, when individuals with ASD are asked to describe themselves, their self-description is concordant with that of their close relatives (Klein et al. 1999). Disorders of self in autism usually have been addressed by the major cognitive theories of autism, particularly the impaired theory of mind (ToM) hypothesis (Baron-Cohen et al. 1985; Leslie and Frith 1987) and the executive dysfunction hypothesis (Ozonoff et al. 1991). In fact, the reduced capacity to comprehend the mental states of others (impaired ToM) reported in adults with ASD seems to be associated with their more global difficulty in identifying and describing their own mental states (Hill et al. 2004; Williams 2010). Executive dysfunction may also contribute to self-disorders through its negative impact on ToM capacities and to the language problems that are

typically reported in adults with ASD (e.g., Russell 1996; Liss et al. 2001; Pellicano 2007).

The notion of self is complex and multi-dimensional (e.g., Strawson 1999), and previous research has mainly focused on the content or the valence of self-knowledge. Therefore, little is known about the dynamic aspects of self, which refer to how items of self-knowledge are articulated with others and integrated into a clear and coherent representation of the self. A better understanding of not only how individuals with ASD define themselves but also how self-concepts are organized with one another is relevant to identifying alterations of the self in psychopathology (Stein and Markus 1994). Campbell et al. (1996) introduced the notion of “clarity of self-concept” to describe the degree to which “the contents of the self are clearly and confidently defined, internally consistent, and temporally stable” (p. 141). For example, individuals with low self-concept clarity are accustomed to changing their beliefs about themselves, spending time wondering about the type of person they are, and often experience that they are not really the person they appear to be. To the best of our knowledge, there is no study to date that has examined the issue of self in individuals with AT from the perspective of the clarity of self-concept. This perspective appears relevant to elucidate the mechanisms associated with the construction of a clear and stable representation of the self in this population, considering that the underlying mechanisms in individuals with ASD are reflected in individuals with AT, at least in part.

Several factors have been shown to influence clarity of self-concept. One of these factors refers to how people look at their past to better understand who they are. For example, participants with low self-concept clarity display an increased propensity to scrutinize their memory with the idea that reflecting on past events may help enhance self-continuity (Bluck and Alea 2008, 2009, 2011; Liao et al. 2015; Rasmussen and Habermas 2011). This possibility refers to the notion that autobiographical memory serves a particular function for the self (Berntsen and Rubin 2006; Bluck et al. 2005; Conway 2005). Additionally, the self-function of autobiographical memories concerns their use to maintain a sense of self over time (e.g., Conway et al. 2004; Habermas and Bluck 2000). Another factor that may influence the acquisition of a clear and stable representation of the self relates to the capacity to learn from important or challenging events that have had a critical impact on the person. Moffitt and Singer (1994) termed these personally significant events that influence the self “self-defining events” and considered them to be representative hallmarks for the self (Conway 2005; Conway et al. 2004) (e.g., “When my parents divorced, I was 12 years old. I became highly suspicious about enduring close relationships and I think this event had a dramatic influence on my

unsuccessful sentimental life.”). These authors also highlighted that self-defining events can alter the self when they are interpreted in light of or linked to previous self-knowledge by means of reflective processes called “autobiographical reasoning” (Blagov and Singer 2004; Habermas and Köber 2015; McLean et al. 2007; Singer et al. 2013). In fact, giving meaning to experiences that challenge the current view of ourselves helps to compensate for the effects of disruptions to the sense of self-continuity (Habermas and Köber 2015). Other studies have shown that a more coherent and meaningful understanding of personal experiences may improve mental health (Allé et al. 2015; Baerger and McAdams 1999; Park 2010).

The literature on autobiographical memory in autism shows that adults with ASD have difficulty accessing detailed memories of their past (e.g., Bruck et al. 2007; Crane et al. 2009; Crane and Goddard 2008; Goddard et al. 2007; Tanweer et al. 2010) and consciously reliving past personal events (Bowler et al. 2000; Lind et al. 2014; Tanweer et al. 2010). Autobiographical memory is a critical function for understanding another’s mental state, as it enables retrieval of relevant events from the past that might help us disambiguate a social scenario (Corcoran and Frith 2003; Mehl et al. 2010). Accordingly, two studies demonstrated an association between ToM capacities and autobiographical memory performance in adults with ASD (Adler et al. 2010; Crane et al. 2013). In addition to ToM deficits, abnormal perceptual skills in autism also contribute to an impaired ability to construct visual scenes, and more specifically, to construct visual representations of past personal events (Lind et al. 2014); this result supports the lack-of-central-coherence hypothesis (Frith 1989). Moreover, executive dysfunction has been shown to be involved in the reduced capacity to access specific and detailed events of the past (Piolino et al. 2010; Dalgleish et al. 2007; see also for review, Williams et al. 2007) and also accounts for impairments in autobiographical memory for adults with ASD (Crane et al. 2013; see also Goddard et al. 2014). Importantly, adults with ASD also have difficulty with drawing meaning from “self-defining events” (Crane et al. 2010). This demonstrates that the autobiographical reasoning processes are impaired in adults with ASD. This impairment might result from the executive dysfunction found in ASD, as suggested by previous research with patients who were diagnosed with schizophrenia and present executive deficits (Berna et al. 2011; Allé et al. 2015). The weakening of autobiographical reasoning processes may thus represent one factor implicated in a deficient construction of self in this population. However, because these studies did not examine the relationship between measures of the self and autobiographical reasoning capacities more directly, these relationships remain hypothetical.

The aim of the present study was to examine the role of autobiographical reasoning in maintaining a clear and stable representation of the self in participants with high levels of autistic traits. We were particularly interested in how individuals give meaning to past events and scrutinize their autobiographical memory to better understand themselves. Our statistical analysis was performed in two steps. First, we compared scores of clarity of self-concept and meaning making and self-function of autobiographical memory between individuals with high levels versus low levels of autistic traits. Second, we examined the relationship between these variables in the full sample through a mediation analysis. Based on the previous research findings reviewed above, and considering the impaired ToM capacities and executive dysfunction found in individuals with autistic traits in particular (Best et al. 2008; Christ et al. 2010), we predicted that individuals with autistic traits have a reduced clarity of self-concept and a reduced capacity to give meaning to self-defining past events. We also hypothesized that reduced meaning making contributes to the impairment of self-concept clarity. We did not expect lower scores of self-function of autobiographical memory in individuals with high autistic traits (to our knowledge, this score has never been used for group comparisons), but we expected that self-function of autobiographical memory may significantly mediate the relationship between autistic traits and impaired self-concept clarity.

Methods

The study was conducted over the Internet. Participants were recruited via WISO-Panel, a participant pool with German-speaking members who had registered to be invited to participate in web-based studies. In total, 12,134 people from all walks of life received the link to the study, and responses were collected over 1 week. Participants gave their informed consent after receiving a short description of the purpose of the study (“In the present study we are interested in investigating several aspects and functions of your autobiographical memory. We would like to understand better how and why you are thinking back to your past.”).

Participants were first asked to answer questions relating to their age, sex and the existence of known psychiatric diagnoses, psychiatric or psychotherapeutic treatments and use of current medications.

Participants

A total of 2624 participants accepted the invitation to participate in the study, but substantial attrition was

observed during the study such that 1698 participants completed all questionnaires before they were administered the SCCS (see below “[The Self-Concept Clarity Scale \(SCCS\)](#)” section). At that point, participants were randomly selected to complete the AQ assessing autistic traits (see below “[Autism Questionnaire \(AQ\) Short Version](#)” section) or another questionnaire (these data are presented here: Berna et al. 2016). A total of 840 participants completed the AQ. Next, we excluded participants older than 60 years ($n = 173$) to avoid possible confounds related to memory loss in older age and those more generally relating to autistic traits. In addition, we excluded participants who disclosed that they were taking daily antipsychotics, as those individuals may have a current diagnosis for a psychotic disorder ($n = 13$). We did not exclude people who reported lifetime psychiatric diagnoses due to frequent misdiagnoses between schizophrenia and ASD (Crivelli and Rocca 2013) and the comorbidities between ASD and mood disorders (Mattila et al. 2010; Vannucchi et al. 2014). The final sample included 654 individuals.

Individuals scoring above the cut-off score of 17 in the AQ ($n = 80$) were considered as having high autistic traits (i.e., scores above 1.3 *SD* in our sample). The control group consisted of 80 “neurotypical” people with AQ total scores below 0.5 *SD* (i.e., 12.5). For each participant in the high-autistic group, one control individual was selected who was matched to the individual in the high-autistic group in terms of age, gender and education level.

Self-Defining Memories

Participants were first asked to recall three self-defining memories, i.e., memories that best correspond to the following instructions (Singer and Moffitt 1991): (a) it is at least 1 year old; (b) it is a memory from your life that you remember very clearly and that still feels important to you; (c) it is a memory that helps you to understand who you are as an individual and might be a memory you would tell someone else if you wanted that person to understand you in a basic way; and (d) it may be a memory that is positive or negative, or both, in how it makes you feel now (the only important aspect is that it leads to strong feelings); and (e) it is a memory that you have thought about many times. It should be familiar to you like a picture you have studied or a song you have learnt by heart. Participants were invited to give a short title to these three memories. This title was later used to display the event for the ratings of the memory characteristics that subsequently appeared on three pages for each memory. A detailed description of the events themselves was not required.

Characteristics of the Memories

On the second page, participants were asked to give their age at the time of the event and to rate the vividness of the memory, the emotional valence and intensity at the time of remembering, and the strength of their memory of the event using 7-point scales (Johnson et al. 1988). These characteristics were assessed to ensure the expected lower meaning making capacities in AT individuals were not due to the selection of events that differed in terms of emotional valence and intensity or the remoteness of events from events selected by the control group.

Scale to Assess Meaning Making (SMM)

Participants were asked to complete a scale that measured meaning making associated with self-defining memories (6 items on 5-point Likert-type scale with 1 = totally disagree and 5 totally agree; Wood and Conway 2006) (e.g., “Having had this experience, I have more insight into who I am and what is important to me”; “I feel that I have grown as a person since experiencing this past event”). This scale has high reliability with a Cronbach’s $\alpha = .86$ (Wood and Conway 2006), whereby α ranged from .75 to .86 across the three self-defining memories in our study.

Centrality of Events Scale (CES)

The short version (7 items on 5-point Likert-type scale with 1 = totally disagree and 5 = totally agree) of the Centrality of Events Scale (Berntsen and Rubin 2006) assessed the extent to which the events had become a reference point for personal identity (e.g., “I feel that this event has become a central part of my life story”; “This event has become a reference point for the way I understand myself and the world”). Cronbach’s α was .92 in the original publication (Berntsen and Rubin 2006) and ranged from .84 to .91 across the three self-defining memories.

Thinking About Life Experiences (TALE) Scale

Next, participants completed the short form of the Thinking About Life Experiences (TALE) scale (15 items on a 5-point Likert-type scale, with 1 = almost never and 5 = very frequently) (Bluck and Alea 2011; Rasmussen and Habermas 2011). This scale assesses how often people think back about or talk about past experiences of their life and the three main functions of autobiographical memory (self, social, directive) that are supported by the acts of thinking or talking about the past (Alea and Bluck 2003; Pillemer 1992). The TALE comprises three subscales of 5 items each that all begin with the following statement: “I think back over or talk about my life or certain periods of

my life...” and ends differently depending on the function assessed. For instance, the self-continuity function is assessed with the following statement: “... when I want to feel that I am the same person that I was before”. The directive function involves the use of autobiographical memories in problem solving and guiding present and future thinking and behaviour (Pillemer 2003) (e.g., “... when I believe that thinking about the past can help guide my future”). The social function concerns the way people use their past to initiate or maintain social bonds, elicit empathy or intimacy, or inform (Alea and Bluck 2003; Pillemer 1992) (e.g., “... when I want to maintain a friendship by sharing memories with friends”). Cronbach’s α ranged from .74 to .83 in the original publication and from .81 to .85 in our study.

The Self-Concept Clarity Scale (SCCS)

The Self-Concept Clarity Scale (Campbell et al. 1996) assesses the extent to which the contents of an individual’s self-concept are clearly and confidently defined, internally consistent, and temporally stable. The SCCS consists of 12 items on a 5-point Likert-type scale (with 1 = strongly disagree and 5 = strongly agree) (e.g., “I spend a lot of time wondering about what kind of person I really am” or “My beliefs about myself seem to change very frequently”). SCCS has good internal consistency ($\alpha = .86$) and test–retest reliability ($r = .79$) with a single general factor (Campbell et al. 2003). In our study, Cronbach’s α was .91.

Autism Questionnaire (AQ) Short Version

Finally, respondents completed the German-validated short version of the Autism Questionnaire (Freitag et al. 2007), highlighting autistic characteristics. It comprises 33 items that are rated on a 4-point Likert scale (with 1 = definitely agree, 2 = slightly agree, 3 = slightly disagree, 4 = definitely disagree). The AQ taps three dimensions: social interaction/spontaneity ($n = 1$, e.g., “I prefer doing things with others rather than on my own”), imagination/creativity ($n = 9$, e.g., “I find making up stories easy”) and communication/reciprocity ($n = 11$, e.g., “I enjoy social chit-chat”). Freitag et al. (2007) showed a good discriminative validity and good screening properties with a cut-off score of 17 (sensitivity, 88.9 %; specificity, 91.6 %). For the present study, Cronbach’s α ranged from .68 to .82 for the total and subscale scores.

Statistical Analyses

The mean rating scores of the three self-defining memories were used for statistical analyses. Separate Student’s *t* tests

were conducted in order to compare memory ratings and both scores and subscores for the SCSS, CES and TALE scales.

To examine whether the TALE self-function subscore or meaning making (SMM) mediated the relationship between autistic traits (AQ total score) and self-concept clarity (SCCS), an ordinary least squares path analysis using a bootstrapping approach (Hayes 2009) was conducted on the full sample ($n = 667$). Mediation was investigated by directly testing the significance of the indirect effect of the independent variables (AQ) on the dependent variable (SCCS) through the mediators (TALE self-function, SMM). This indirect effect was quantified as the product of the effects of the independent variable (IV) on the mediator (a) and of the mediator on the dependent variable (DV) (b), while controlling for the direct effect of the IV (c'). Bootstrapping estimated the indirect point effects and associated 95 % confidence intervals (CI) derived from the mean of 10,000 bootstrap samples. A bias-corrected bootstrapping procedure was chosen as this is considered the most powerful approach to detecting statistical mediation (Fritz and MacKinnon 2007). Indirect effects were deemed statistically significant when the bias-corrected CI did not include zero (Preacher and Hayes 2008). Statistical analyses were completed using SPSS software (v.22) and an additional macro, named *process* (Preacher and Hayes 2008). All variables were entered into the mediation analyses simultaneously.

Results

The mean age of our participants in both groups was 41.0 years ($SD = 11.4$), and 43.9 % of both groups were men (36/82) (see Table 1).

Among the individuals with high autistic traits (AT), 44 (55.0 %) disclosed that they had received a psychiatric diagnosis in contrast to 26 (32.5 %) of the neurotypical individuals ($\chi^2 < .01$). The diagnoses reported included mostly depression and anxiety disorders (see Table 1). Five (6.3 %) AT individuals disclosed that they had received a diagnosis of schizophrenia and 4 (5.0 %) had received a diagnosis of bipolar disorder compared with one (1.3 %) neurotypical individual reporting a diagnosis of bipolar disorder. However, the percentage of participants under current psychotropic medication (antipsychotics excluded) did not differ significantly between the groups, with 30 AT individuals (37.3 %) and 25 neurotypical individuals (31.3 %) taking daily psychotropic medication. Antidepressants and anxiolytic/hypnotic drugs were the most frequently reported drugs.

AT individuals had significantly lower scores on the self-concept clarity than did controls ($d = 0.61$). AT

individuals also had significantly lower scores for the TALE social function subscore ($d = 0.38$); the other TALE scores and subscores did not differ significantly between groups. Memory ratings of vividness, strength and emotional intensity did not differ significantly between groups, but the mean valence of self-defining memories was significantly lower in the AT group than in the control group ($d = 0.45$). The CES score did not differ significantly between groups, but the SMM was significantly lower in AT individuals ($d = 0.43$) (see Table 2).

The mediation analysis showed that autistic traits (AQ) indirectly influenced self-concept clarity (SCCS) through their effect on meaning making (SMM). As seen in Fig. 1, AQ was negatively correlated to SMM ($a = -0.028$), and SMM was negatively correlated to SCCS ($b = -1.997$). The bias-corrected bootstrap CI for the indirect effect ($a \times b$) was above zero (SMM: 0.02–0.10). Thus, there was evidence that autistic traits influence the clarity of self-concept independently of their effect on meaning making ($c' = -0.764$); however, the mediator significantly increased this negative effect ($c = -0.709$). In contrast and contrary to our hypothesis, the TALE self-function did not significantly mediate the relationship between autistic traits and SCCS.

The results remained unchanged when people who reported that they had received a diagnosis of schizophrenia ($n = 7$) or bipolar disorder were excluded ($n = 12$).

Discussion

The main finding of the present study is that individuals with high levels of autistic traits have a less clear and stable representation of self (i.e., low self-concept clarity) than neurotypical individuals. This reduction is related to their impaired capacity to reason about past important life events and to make meaning of these events (i.e., meaning making). However, it does not seem to be influenced by the more general tendency to scrutinize one's past to better understand oneself. Our results confirm previous findings that have attested to an impoverished self-knowledge in individuals with ASD (Hobson and Lee 1998; Jackson et al. 2012; Tanweer et al. 2010) and extend these findings by showing that the way that self-knowledge is dynamically organized and articulated (as reflected by self-concept clarity) is also reduced in AT individuals.

The self-defining memories selected by individuals with autistic traits were rated as highly central to the self, indicating that these individuals understood well the instructions to retrieve self-defining memories and did not select trivial events. However, although these memories were considered an integral part of their self, AT individuals had more difficulty finding the meaning in these

Table 1 Socio-demographic characteristics of individuals with high autistic traits and neurotypical control participants

	Individuals with autistic traits (<i>n</i> = 80) <i>M</i> (<i>SD</i>)	Neurotypical controls (<i>n</i> = 80) <i>M</i> (<i>SD</i>)	χ^2
Age	41.0 (11.4)	41.0 (11.6)	0.03
Sex (male)	36 (45.0 %)	36 (45.0 %)	0.00
Level of education			0.60
No degree (yet)	1 (1.3 %)	2 (1.9 %)	
9 years of school	9 (11.3 %)	7 (8.8 %)	
O-levels	28 (35.0 %)	29 (36.2 %)	
A-levels	20 (25.0 %)	20 (25.0 %)	
University	20 (25.0 %)	20 (25.0 %)	
Doctorate	2 (2.5 %)	2 (2.5 %)	
Employment status			8.22
Working	36 (45.0 %)	43 (53.8 %)	
Pupil/student	17 (21.3 %)	17 (21.3 %)	
Retired	4 (5.0 %)	5 (6.3 %)	
Unemployed	13 (16.3 %)	7 (8.8 %)	
Parental leave	5 (6.3 %)	0 (0.0 %)	
Other	5 (6.3 %)	9 (10.0 %)	
Reported lifetime diagnoses			8.23**
No psychiatric diagnosis	36 (45.0 %)	54 (67.5 %)	
Depression	35 (43.8 %)	20 (25.0 %)	
Anxiety disorder	17 (21.3 %)	8 (10.0 %)	
Personality disorder	10 (12.5 %)	3 (3.8 %)	
PTSD	6 (7.5 %)	4 (5.0 %)	
Schizophrenia	5 (6.3 %)	0 (0.0 %)	
Bipolar disorder	4 (5.0 %)	1 (1.3 %)	
Eating disorder	5 (6.3 %)	6 (7.5 %)	
Substance/alcohol use disorder	4 (5.0 %)	6 (7.5 %)	
OCD	3 (3.8 %)	1 (1.3 %)	
Reported current psychotherapy			7.03**
No psychotherapy	55 (68.8 %)	69 (86.3 %)	
Ambulatory	15 (18.8 %)	5 (6.3 %)	
Certified psychotherapist	11 (13.8 %)	3 (3.8 %)	
Reported current medication			0.69
No medication	50 (62.5 %)	55 (68.8 %)	
Antidepressants	17 (21.3 %)	11 (13.8 %)	
Tranquilizers	7 (8.8 %)	3 (3.8 %)	
Hypnotics	7 (8.8 %)	4 (5.0 %)	
Stimulants	1 (1.3 %)	0 (0.0 %)	
Antipsychotics	0 (0.0 %)	0 (0.0 %)	

OCD obsessive compulsive disorder, PTSD post-traumatic stress disorder

* $p < .05$; ** $p < .01$; *** $p < .001$

events, which indicates that individuals with AT are able to subjectively feel that these events have altered their personality (as reflected by the CES score) but were impaired in their capacity to achieve a better understanding of and to personally grow from these events (as reflected by the

SMM score). Our result is in keeping with previous findings by Crane et al. (2010) who reported an impaired ability for patients with autistic syndrome disorder to explicitly draw meaning from self-defining memories. Moreover, the mediation analyses conducted on the full

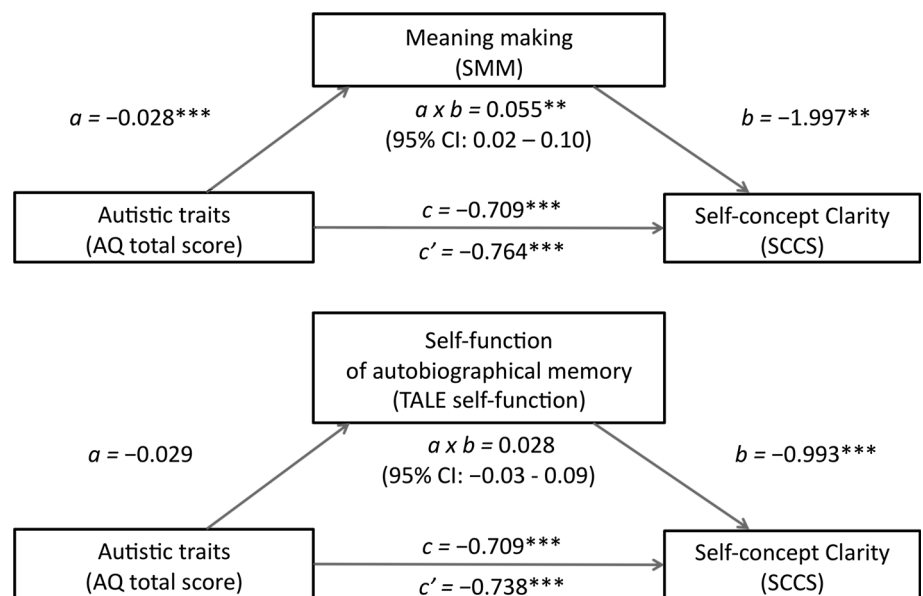
Table 2 Ratings of individuals with high autistic traits and neurotypical control participants

	Individuals with autistic traits (<i>N</i> = 80) <i>M</i> (<i>SD</i>)	Neurotypical controls (<i>N</i> = 80) <i>M</i> (<i>SD</i>)	<i>t</i> (158)	<i>d</i>
AQ				
Total score	19.98 (3.12)	9.13 (4.01)	-19.09***	2.71
Communication/reciprocity	5.25 (2.13)	3.58 (2.17)	-4.93***	0.77
Imagination/creativity	6.69 (2.36)	2.73 (2.07)	-11.29***	1.91
Social interaction/spontaneity	8.04 (2.11)	2.83 (2.30)	-14.95***	2.27
SCCS				
SCCS	36.75 (9.64)	42.87 (9.96)	3.94***	0.61
CES	3.69 (0.80)	3.76 (0.61)	0.61	0.11
SMM	3.73 (0.67)	3.98 (0.58)	2.54*	0.43
TALE				
Total score	42.41 (11.87)	45.71 (9.73)	1.92	0.34
Self-continuity function	13.26 (4.49)	14.30 (3.62)	1.61	0.29
Social function	13.74 (4.60)	15.49 (4.66)	2.39*	0.38
Directive function	15.41 (4.34)	15.93 (3.47)	0.83	0.15
Ratings of self-defining memories				
Age	25.35 (11.56)	26.19 (9.19)	0.51	0.09
Memory strength	5.72 (1.10)	5.88 (0.84)	1.00	0.19
Memory vividness	5.78 (1.13)	5.98 (0.79)	1.36	0.25
Emotional intensity	5.38 (1.18)	5.50 (1.05)	0.69	0.11
Emotional valence	3.65 (1.84)	4.43 (1.72)	2.76**	0.45

AQ Autism Questionnaire, SCCS Self-Concept Clarity Scale, CES Centrality of Events Scale, SMM Scale to assess Meaning Making, TALE Thinking About Life Experiences scale

* $p < .05$; ** $p < .01$; *** $p < .001$

Fig. 1 Results of the mediation analysis. Note CI confidence interval, AQ Autism Questionnaire, SMM Scale to assess Meaning Making. c' = direct effect, $a \times b$ = indirect effect, c = total effect. * $p < .05$; ** $p < .01$; *** $p < .001$



sample demonstrated the negative consequence of the reduced meaning-making capacities for self-concept clarity in psychopathological situations: autistic traits were negatively associated with meaning making, which in turn had a

deleterious impact on the clarity of self-concept. Reduced meaning making may thus represent one mechanism accounting for the difficulty of individuals with autistic traits to experience themselves in terms of a coherent and

stable representation of their self. Alternative cognitive theories of autism are also important to consider for interpreting our results. In fact, through its negative impact on language skills (Pellicano 2007), executive dysfunction in AT individuals (Christ et al. 2010) may contribute to their difficulties with reasoning about past events (Berna et al. 2011; Allé et al. 2015) and expressing their own mental states (e.g., Russell 1996; Liss et al. 2001; Pellicano 2007). Similarly, the impaired ToM abilities reported in AT individuals (Best et al. 2008) may account for their difficulties with apprehending their own mental states (Williams 2010) and finding the lessons contained in self-defining past events that generally involve complex social situations. In other words, it might be argued that impairment of executive functions or ToM could represent third variables affecting why there is reduced autobiographical reasoning abilities and self-concept clarity in AT individuals. Nevertheless, our results provide new insights by showing that meaning making mediates the role of autistic traits on self-concept clarity. Due to the constraints of the web-based design of our study, we were unable to include measures of executive functioning or ToM. However, to tease apart the role of executive function and ToM in our results, further studies including other mediation analyses should explore more specifically whether and how these factors influence the relationship between autobiographical reasoning capacities and clarity of self-concept.

The negative correlation between meaning making and clarity of self-concept along the autistic continuum suggests that the meaning attached to self-defining events may be dysfunctional in subjects with high autistic traits because it contributes to less instead of more clarity of self-concept. This finding is important as it nuances the view that the ability to give meaning to important life events contributes itself to a more coherent and structured representation of the self (Blagov and Singer 2004). The type of meaning associated with these events appears to be a more critical factor that influences how those life events are integrated into the self and have consequences for the nature of self-representations. This result is in line with Waters et al. (2013), who challenged the classical view that drawing meaning from self-defining memories has positive consequence for psychological well-being and the self (McLean and Pratt 2006; Pasupathi et al. 2001; Singer et al. 2013). In fact, Waters et al. (2013) showed that university students with symptoms of post-traumatic stress disorder who had a better ability to give a meaning to past traumatic events did not show better adjustment or well-being.

Individuals with AT did not differ from neurotypical controls in their tendency to scrutinize their past to better understand themselves. Moreover, this tendency was negatively correlated with the clarity of self-concept, which is in line with previous results (Bluck and Alea 2009;

Rasmussen and Habermas 2011). These results support the notion that one important function of autobiographical memory is to ground the self, with the consequence that people with low self-concept clarity are more driven to look at their past as a way to improve self-concept clarity (see for discussion, Bluck and Alea 2009). In keeping with the fact that both meaning making and the tendency to scrutinize one's past represent complementary aspects of autobiographical reasoning (Bluck and Alea 2009; Rasmussen and Habermas 2011), our results show that the deficit observed in AT individuals does not concern the overall propensity to reason about the past, but instead involves making sense of particular events that have dramatically influenced their life. In contrast, AT individuals less frequently used autobiographical memory to maintain social bonds or elicit intimacy, reflecting the impaired social functioning that characterizes AT individuals.

Our study supports the notion that disorders of self are not limited to patients with full ASD but that they also extend along the autistic continuum. The intensity of autistic traits was negatively correlated with the degree of self-concept clarity. However, it is worth mentioning that a reduced clarity of self-concept has been previously reported in other clinical or psychopathological conditions, such as anxiety disorder (Stopa et al. 2010) or psychosis (Cicero et al. 2013; Evans et al. 2015). Personality dimensions, such as high neuroticism, low agreeableness, or low conscientiousness (Costa and McCrae 1992), are also associated with low self-concept clarity (Campbell et al. 1996). Therefore, we cannot exclude that the relationship observed between autistic traits and self-concept clarity may reflect the influence of other potentially overlapping psychopathological dimensions that were not assessed in our study. Further studies in large population samples are necessary to tease apart the psychopathological dimensions that contribute most to the reduced self-concept clarity in clinical populations.

Some limitations of our work should be acknowledged. First, web-based studies inherently have access to a biased population, a limitation that is usually encountered in studies conducted with undergraduate students, but with greater emphasis. More specifically, disabled people who are online have been shown to differ in important ways from disabled people who are not online (Lenhart et al. 2003) such that the generalization of our findings to clinical populations with ASD should be undertaken with caution. Second, information reported on the psychiatric diagnosis, psychotherapy and medications were only declarative and could not be confirmed by additional external evaluations. Third, a substantial attrition was observed in our study as 926 out of 2624 (35.3 %) individuals stopped before reaching the last questionnaire. However, it is worth noting that the vast majority of individuals who stopped the study

did so at the very beginning (809 out of 926, 87.4 %) when they were asked to give a title to their three self-defining memories. Fourth, due to the web-based format of our study, measures of meaning making were not based on the analyses of the content of memory narratives, as is usually done (Blagov and Singer 2004). However, Wood and Conway (2006) reported that these scales were suitable to assess meaning making. Fifth, we hypothesized above that meaning making could be dysfunctional in AT individuals, but this hypothesis is also limited by the fact that the type of meaning drawing upon past events could not be analysed. Moreover, our interpretation of the mediation analysis remains cautious, as we cannot make conclusions regarding the direction of the correlation. In fact, one may also hypothesize that AT individuals engage less in meaning making because they have a less clear self-concept. Similar questions have been discussed regarding the relationship between self-concept clarity and the propensity to examine one's past (see Bluck and Alea 2009, p. 1091). Further studies asking for specific details pertaining to the contents of meaning making (see Berna et al. 2011, for an example) are needed to address these limitations. These studies also must explore further the relationship between meaning making and self-concept clarity.

To conclude, this study encompasses one of the first attempts to examine the aspects of autobiographical reasoning that may underlie the weakness of self-concept in people with autistic traits. The results suggest that the difficulty experienced with giving meaning to past events supports the reduced clarity of self-representation in this population. Further studies are needed to confirm this tentative result with individuals clinically diagnosed with autism spectrum disorder. If confirmed, our findings may have clinical implications and encourage the use of narrative-oriented psychotherapies that target both the ability to give a meaning to past events and the type of meaning drawn by patients (see Singer and Salovey 2005). Basically, adults presenting with autistic traits and/or poor social skills may be encouraged—first in an individual setting and then in a group setting—to examine past events of their life that have dramatically influenced their personality or some of their life decisions. The next step would be to invite these people to reflect with the therapist on the meaning attached to each particular event, particularly those for which no explicit meaning is spontaneously mentioned. Some conclusions associated with particular life events could also be questioned, particularly when they contribute to maintaining negative self-views or erroneous beliefs about others. Narrative therapy has proven useful with patients with schizophrenia and other clinical conditions associated with severe disorders of self (e.g., Roe et al. 2010; Smorti et al. 2010). Similar approaches may also be helpful for individuals with ASD and help them

achieve a clearer understanding of their life and of their self. These psychotherapeutic interventions might be particularly relevant at a younger age, with children presenting either with autistic traits or ASD. In fact, teaching them to build stable bridges between aspects of their identity and events of their life that support these aspects might help them to improve coherence and possibly engenders more diversity to the representation of their self.

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Author Contribution FB and SM designed the study and wrote the first complete draft of the manuscript. ASG is responsible for the Wiso-Panel network. FB and JS performed the statistical analyses. All authors provided substantial modifications to the manuscript and approved its final version.

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Compliance with Ethical Standards

Conflict of interest FB has received a speaker honorarium from Astra Zeneca, Lundbeck, Janssen-Cilag, and Bristo-Meyers-Squibb. ASG, JS, RC, JMD, CVCL, SM declares that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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