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Article *in* Memory · August 2009

DOI: 10.1080/09658210902960211 · Source: PubMed

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Running Head: Autobiographical memory in autism

Autobiographical knowledge is stored hierarchically, at both specific and general levels of representation. It has also been proposed that the self is the structure around which autobiographical memories are organised. The current series of studies assessed whether the autobiographical memory difficulties observed in adults with autism spectrum disorders (ASD) could be due to problems in using the self as an effective memory cue. A series of cueing paradigms were used to assess the accessibility of both specific and general autobiographical knowledge relating to (i) currently pursued goals (either high or low in self-concordance) and (ii) goals that participants were not currently pursuing. Results demonstrated that whilst event-specific knowledge was impaired in the ASD group, general event knowledge appeared relatively intact. Moreover, whilst both event-specific and general event knowledge were organised around goals of the self in control participants, a corresponding relationship was only observed for general event knowledge in the ASD group.

Acknowledgements: This work was supported by the Economic and Social Research Council (grant number: PTA-030-2005-00091); and the University of London Central Research Fund. We would like to thank Susannah Gilmour and Sally Robinson for assistance in coding the data, the anonymous reviewers of this paper for their helpful comments and suggestions, and all those who participated in the studies.

Specific and general autobiographical knowledge in adults with autism spectrum disorders: the role of personal goals

Autism is a lifelong neurodevelopmental disorder characterised by impairments in social communication and interaction, and by the presence of restricted, repetitive and stereotyped patterns of behaviour, interests and activities (American Psychiatric Association, 2000). There are wide variations in the manifestation of autism and it is therefore commonly accepted that autism is a spectrum disorder that varies in severity between individuals. Consequently, the term 'autism spectrum disorder' (ASD) is often used to refer to the different variants of the condition (cf. Wing, 1981). This broad term encompasses both 'classic' autism (Kanner, 1943), typically involving the presence of learning disabilities and language delay, as well as high functioning autism and Asperger syndrome (Asperger, 1944/1991), which involve the core autistic symptoms, average or above average IQ, and, in Asperger syndrome, no history of language or cognitive delay (American Psychiatric Association, 2000).

Although not included within the diagnostic criteria for ASD, memory difficulties have been commonly reported in this group (see Boucher & Bowler, 2008, for a review). In particular, a growing body of research has demonstrated autobiographical memory impairments in ASD. Using a cue word methodology, in which participants were required to generate specific autobiographical memories in response to word cues at speed, Goddard, Howlin, Dritschel, & Patel (2007) found adults with ASD to generate significantly fewer specific memories than age, gender and IQ matched controls, and to take significantly longer to do so. This specific autobiographical

memory deficit also appeared to be largely independent of general memory difficulties in this group.

These results were subsequently extended by Crane & Goddard (2008), who reported a dissociation between different aspects of autobiographical memory in adults with ASD. Specifically, whilst memory for personally experienced events (episodic autobiographical memory) was impaired in this group (as found by Goddard et al., 2007), memory for personal facts (semantic autobiographical memory) was relatively intact. Moreover, examination of both episodic and semantic autobiographical memories across different lifetime periods suggested a 'reminiscence bump' (cf. Rubin, Wetzler, & Nebes, 1986) in the control group, with the adolescent and early-adult time periods facilitating memory recall, whereas this pattern was notably absent in the adults with ASD.

The reminiscence bump reflects the importance of the adolescent and early adult lifetime periods in the development of a stable self-identity (Erikson, 1980), in the emergence of a social identity (Holmes & Conway, 1999) and in the maturation of the self (Fitzgerald, 1988). These important links between autobiographical memory and the self have been formalised by Conway & Pleydell-Pearce (2000) in their self-memory system model. In this model, an 'autobiographical knowledge base' stores information at several different levels of specificity; these include lifetime periods (e.g., '*when I was at college'*), general event knowledge (e.g., *'attending lectures'*) and event-specific knowledge (e.g., *'my first lecture'*). A further key premise of this theory is that what we remember is strongly influenced by the goals of the 'working self'; a component that modulates access to the autobiographical knowledge base by

successively shaping retrieval cues. These retrieval cues are used to activate autobiographical knowledge structures, leading to the emergence of autobiographical memories.

This model was empirically tested by Moberly & MacLeod (2006), who assessed the role of goal pursuit on the accessibility of both event-specific and general event knowledge. Consistent with Conway & Pleydell-Pearce's (2000) model, Moberly & MacLeod found that retrieval cues relating to currently pursued goals (relative to goals that were not currently being pursued) facilitated the speed at which both event-specific and general event knowledge were retrieved; for example, the goal of *'performing well academically'* could enhance the accessibility of related memories such as *'receiving my exam results'* or *'revising for exams'*. Moberly & MacLeod also found that goals pursued for intrinsically motivating reasons ('self-concordant goals'; e.g., *'I want to go to University because I really enjoy learning'*), relative to goals pursued for externally motivating reasons ('non-self-concordant goals'; e.g., *'I want to go to University to please my parents*') facilitated the accessibility of general, but not specific, autobiographical knowledge. Considering the important role of goal self-concordance for general, but not event-specific, levels of knowledge, Moberly & MacLeod suggested that general event knowledge might be more closely connected to a person's sense of self than event-specific knowledge.

The relationship between the self and memory has been widely studied in ASD (e.g., Hill & Russell, 2002; Lind & Bowler, 2008; Millward, Powell, Messer, & Jordan, 2000), but the majority of this research has focused on children. In one of the few studies to assess the self and memory in adults with ASD, Toichi et al. (2002) found

self-referential (vs. semantic or phonological) encoding of words to yield superior performance on an incidental memory task in typical adults (a phenomenon known as the ‘self-reference effect’, cf. Rogers, Kuiper, & Kirker, 1977). However, a corresponding pattern was not observed in adults with ASD. Similar results were obtained by Lombardo, Barnes, Wheelwright, & Baron-Cohen (2007), who found an attenuated self-reference effect in adults with ASD on a recognition memory task. Taken together, these results suggest that adults with ASD fail to use self-referential information as an effective memory cue. However, to date, no studies have assessed the role of the self on autobiographical memory retrieval in ASD.

Theoretically, there are several reasons to suspect that the links between the self and autobiographical memory would be impaired in ASD. Bowler, Gardiner, & Grice (2000), for example, demonstrated that adults with ASD have diminished autonoetic consciousness (a sense of self-recollection during the mental re-experiencing of a past event, cf. Gardiner, 2001). As autonoetic remembering is characteristic of a functional autobiographical memory system (Wheeler, Stuss, & Tulving, 1997), this implies that adults with ASD would display impairments on tasks linking the self and memory. Further, Perner (2000) proposed that autonoetic consciousness relies on theory of mind abilities (the ability to reflect on the mental states of both self and others); a notion supported by empirical studies (e.g., Perner, Kloo, & Gornik, 2007). As it is now a well-established phenomenon that individuals with ASD display impairments in theory of mind (Baron-Cohen, Leslie, & Frith, 1985), this further suggests that the links between autobiographical memory and the self would be impaired in this group.

The current studies used cueing paradigms to assess the role of currently pursued goals on the accessibility of event-specific knowledge and general event knowledge in adults with and without ASD. On the event-specific knowledge task, it was predicted that the ASD group would generate fewer specific memories than control participants, and would take significantly longer to do so (as found by Goddard et al., 2007). It was further hypothesised that whilst the control group would use information pertaining to currently pursued goals to facilitate the accessibility of event-specific knowledge (as found by Moberly & MacLeod, 2006), a corresponding relationship would not be observed in the ASD group. Regarding general event knowledge, it was predicted that the control group would use goal-related cues (particularly those high in self-concordance) to facilitate the accessibility of general event knowledge (as found by Moberly & MacLeod, 2006). However, as no studies have assessed general event knowledge in adults with ASD, or the role of the self on this level of retrieval, no predictions were made regarding the pattern of results in this group.

Study 1

Method

Participants

In total, 56 adults participated in this study: 28 adults with ASD (14 males, 14 females) and 28 typical control adults (14 males, 14 females)[1]. The ASD group was recruited via the National Autistic Society (UK), as well as local organisations, support groups and web pages for adults with ASD. All experimental participants had received a formal diagnosis of ASD from a Psychologist or Psychiatrist experienced in the field of autism; of these, 25 were diagnosed with Asperger syndrome, and the

remaining three had received a diagnosis of high functioning autism. A review of records confirmed that all experimental participants had been diagnosed according to DSM-IV (American Psychiatric Association, 2000) or ICD-10 (World Health Organisation, 1990) criteria, excluding the requirement of an absence of early language delay (for the adults with Asperger syndrome), as this information was often unavailable. Despite this, none of the participants demonstrated any current abnormalities in structural/syntactic aspects of their language. To support their diagnoses, the Autism-Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) was administered. Participants with ASD (mean = 34.93, SD = 6.90) scored significantly higher than the control group (mean =14.64, SD = 7.46) on this measure of autistic symptomatology, t (54) = 10.56, $p < .01$ (r = .82), one-tailed. In addition, whilst 26/28 (92.86%) of the participants with ASD scored above the suggested cut-off of 26 on this measure (Woodbury-Smith, Robinson, Wheelwright, & Baron-Cohen, 2005), none of the control participants did. The typical control group was recruited from a variety of local Further and Higher Education colleges, as well as local social groups. They were group matched to the participants with ASD on verbal, performance and full-scale IQ, and were individually matched on the basis of age and gender (see Table 1 for participant demographics).

(Table 1 about here)

Materials

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

matching purposes. The WASI is a widely used measure of general ability when there is no need to provide a full cognitive profile. In addition, correlations with the Wechsler Adult Intelligence Scale (WAIS-III, Wechsler, 1999b) are high (verbal IQ = .88, performance IQ = .84, full-scale IQ = .92).

Autism Spectrum-Quotient (AQ): The AQ (Baron-Cohen et al., 2001) is a 50-item self-report questionnaire assessing levels of autistic traits. It comprises ten questions assessing five different areas: attention switching, attention to detail, communication, imagination and social skill. Participants are asked to rate their behaviours in each of these areas on a four-point scale (strongly agree, agree, disagree, strongly disagree). A score of 32 out of 50 on this measure is indicative of clinically significant levels of autistic traits, 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 has excellent test-retest reliability (Baron-Cohen et al., 2001) and 83% discriminative validity (Woodbury-Smith et al., 2005), which is consistent with the number of participants scoring above 26 in the current sample.

General event knowledge task: To assess general event knowledge, a computer-based task (adapted from Moberly & MacLeod, 2006) was administered. In this task, participants were seated in front of a 12" Toshiba Portege M300 laptop computer and were asked to place one index finger on a *Yes* key and one on a *No* key (which corresponded to the *z* and *m* keys, respectively). They were then informed that a series of short (two-word) phrases would appear on the screen (e.g., *romantic experiences*). The participants' task was to decide whether or not they had generally experienced that event in their own life. Participants had *4000ms* to respond with a *Yes* or *No*

response to each short phrase and were told that although they were to make their decisions as quickly as possible, they should ensure that they consider their response before pressing a key. It was also emphasised to participants that there was no need to think of a specific memory before making a decision and that the task was purely related to their rough impressions of whether or not they had generally experienced the event (the full instructions for this task are presented in Moberly & MacLeod, 2006).

Five practice trials were administered, to ensure that all participants understood the task requirements. Following the practice trials, the experimental task was administered, which comprised 50 goal phrases[2], as well as 10 filler items (see Appendix 1 for all goal phrases used in this task). These phrases were presented to each participant in a different random order. Three raters that were blind to the purpose of the study rated the semantic correspondence of the goal items to the two-word phrases on a 7-point scale (1 = *very poor match* and 7 = *very good match*). The mean rating for the goal items and goal phrases across the three raters was 6.07; a figure consistent with that reported by Moberly & MacLeod (2006).

Although participants responded to all 50 goal phrases, only responses to three self-concordant, three non-self-concordant and three non-goal cues were analysed. To determine which items were to be included in the analysis as the goal and non-goal items, participants were asked to complete a goal selection from one week before the testing session, in which they selected all the goals that they were currently pursuing from the 50 goal items listed in Appendix 1. Then, at the end of the testing session, participants completed at goal rating form, to determine which items were to be

included in the analysis as the self-concordant and non-self-concordant goals. The goal rating form was a measure taken from Moberly & MacLeod (2006), based on research by Ryan & Connell (1989), in which participants rated each of the goals that they previously endorsed (on the goal selection form) on the following motivational measures: (1) Intrinsic motivation (*"Do you pursue the goal because of the fun and enjoyment it provides you?"*), (2) Identified regulation (*"Do you pursue this goal because you really think it's an important goal to have?"*), (3) Introjected regulation (*"Do you pursue this goal because you would feel ashamed, guilty or anxious if you didn't?"*), (4) External regulation (*"Do you pursue this goal because somebody else wants you to or because the situation demands it?"*). Ratings comprised a 9-point scale, where 1 = *not at all for this reason*, and 9 = *completely for this reason*. The introjected and external regulation scores (low self-concordance) were then subtracted from the intrinsic motivation and identified regulation scores (high self-concordance) to provide an overall index of goal self-concordance (max = +16, min = -16). In line with the procedures adopted by Moberly & MacLeod (2006), the three goals with the highest self-concordance ratings were analysed as the self-concordant goals, and the three goals with the lowest ratings became the non-self-concordant goals. In the event of a tie, one of the goal items was randomly selected for inclusion in the analysis.

After rating each of the goals on the self-concordance measures, participants were then asked to rate each of their selected goals on the basis of commitment (*"How committed are you to this goal?"*, where 1 = *not at all committed* and 9 = *extremely committed*), difficulty (*"How difficult is it for you to achieve this goal?"*, where 1 = *not at all difficult* and 9 = *extremely difficult*), self-efficacy (*"To what extent do you have the skills and resources necessary to achieve this goal?"*, where 1 = *I have none*

of the necessary skills and resources and 9 = *I have all of the necessary skills and resources*) and thought frequency (*"Approximately how often do you think about this goal?"*, where 1 = *about once a year or less frequently*, 2 = *about once a month*, 3 = *about once a week*, 4 = *about once a day*, and 5 = *several times a day*), as each of these have been previously associated with goal self-concordance (see Moberly & MacLeod, 2006).

The dependent variable on this task was the mean latency to the accessibility of general event knowledge for the self-concordant, non-self-concordant and non-goal items. This was calculated in line with the procedures adopted by Moberly & MacLeod (2006), in which latencies to responses were taken in milliseconds, except on trials in which participants reported that they had not generally experienced the goal item (i.e. they pressed the *No* key), in which case it was reasoned that the participant was unable to access general event knowledge relating to these items and a maximum latency of 4000*ms* was assigned.

Event-specific knowledge task: Event-specific knowledge was assessed using a cue-word task adapted from Moberly & MacLeod (2006). In this task, participants were presented with a series of cue words and were asked to generate a memory of a specific autobiographical event (a memory of a particular event, lasting no longer than a day, cf. Conway & Rubin, 1986) in response to each cue word, at speed. At the start of the task, participants were provided with examples of appropriate specific (and inappropriate general) memories, and at least two practice words were administered, to ensure that all participants fully understood the task instructions. At the end of the

task, participants were also asked to confirm the task instructions to the experimenter (cf. Dalgleish et al., 2007), which all participants were able to do.

Retrieved memories were either coded as specific memories (meeting the criteria outlined above), memory failures (in which no memory was retrieved) or general memories (which comprised both repeated instances of an event, e.g., *"when I have lectures"*, as well as single events lasting longer than a day, e.g., *"when I was at University"*). In the event that a participant failed to retrieve a specific memory in response to a cue word, they were prompted to retrieve a particular instance (*"Can you think of a particular time, one specific instance?"*). Although cumulative latencies to specific memory retrieval were recorded using a stopwatch (in seconds), only first responses to cue words were analysed for specificity (cf. Williams & Broadbent, 1986). Inter-rater reliability for this coding scheme was assessed by two raters (one of whom was blind to participant's group membership) on all retrieved memories. Cohen's Kappa revealed this to be satisfactory (FIGURE).

Although emotionally-valenced words have traditionally been used as memory cues (e.g., Williams & Broadbent, 1986), a series of goal-related items were used as cues in the current study (see Appendix 1). As previously mentioned, participants were asked to complete a goal selection form one week before the testing session, on which they selected a series of goals that they were currently pursuing. Cue words related to the goal items were presented to participants in the order that the goals appeared on the goal selection form. In response to each cue, participants were instructed to report a specific autobiographical memory as quickly as they could, within 60 seconds. To ensure that the revised list of goal cues were representative of the goal items, three

raters that were blind to the purpose of the study rated the extent to which each cue word was representative of its corresponding goal item, where a score of 1 indicated a *very poor match* and a score of 7 indicated a *very good match*. The overall mean rating for goal items and specific memory cues was 5.19 (out of 7); a figure consistent with the correspondence ratings reported by Moberly & MacLeod (2006).

Although each goal item that participants selected (as well as three randomly selected non-goals) were used as memory cues on this task, only six goal-related items were included in the analysis; three self-concordant goals and three non-self-concordant goals. The dependent variables on this task were the mean numbers of specific memories retrieved overall, and the mean latency to specific memory retrieval as a function of goal type.

Procedure

This study was completed as part of a larger investigation into autobiographical memory in adults with and without ASD. Each participant was tested individually in a quiet room, either at Goldsmiths, University of London, or in their own homes. One week prior to testing, participants were asked to complete and return the goal selection form, the AQ, and a series of questionnaires unrelated to the current study. During the testing session, the WASI was administered first, followed by the general event knowledge task. A series of tasks unrelated to the current hypotheses (assessing general memory, executive function and theory of mind) were then administered (which lasted approximately 90 minutes), before participants completed the event-specific knowledge task. Finally, at the end of the testing session, participants completed a goal rating form for each of their previously endorsed goals, to determine

which goals were to be analysed as the self-concordant and non-self-concordant goals, and to obtain ratings of commitment, difficulty, self-efficacy and thought frequency, for each of the goal items.

Results

Goal selection

Firstly, the total number of currently pursued goals selected by the ASD and control groups was analysed. An independent samples t-test revealed no significant differences between the mean number of goals selected by each group (ASD mean = 19.21, SD = 8.49; control mean = 18.14, SD = 5.52), t (54) = 0.56, p = .58 (r = .07), two-tailed. In addition, the mean number of goals selected by participants did not correlate with autobiographical memory performance in either group (ps > .05). Goal selection also remained relatively constant during the one-week delay, with only one participant in the control group deciding that they were no longer pursuing a previously endorsed goal[3].

Goal ratings

Each goal that participants selected was rated for its degree of self-concordance (i.e. the extent to which the goal was pursued for intrinsic, rather than external, reasons) on a questionnaire that focused on participants' motivations for pursuing the goals. The three goals that scored highest on this scale (max = +16, min = -16) were analysed as the self-concordant goals, and the three goals that scored lowest were analysed as the non-self-concordant goals. A 2 (group: ASD vs. control) x 2 (goal type: self-concordant vs. non-self-concordant) mixed analysis of variance (ANOVA) revealed

that, as expected, the self-concordant goals (mean = 11.90, SD = 3.30) were rated as being pursued for more intrinsically motivating reasons than the non-self-concordant goals (mean = -2.14, SD = 4.04), F (1, 54) = 425.79, $p < .01$ ($\eta_p^2 = .89$). In addition, the ASD group rated their self-concordant (mean = 10.87, SD = 3.35) and non-self-concordant (mean = -2.95, SD = 3.36) goals significantly lower on the self-concordance scale than the control group (self-concordant goals: mean = 12.94, SD = 2.95; non-self-concordant goals: mean = -1.32, SD = 4.53), F (1, 54) = 7.40, $p < .01$ ($\eta_p^2 = .12$). There was also a non-significant interaction effect, F (1, 54) = 0.10, $p = .75$ ($\eta_p^2 = .01$), suggesting that the main effect of goal type was consistent across both groups.

Participants were also asked to rate each goal on the basis of commitment, difficulty, self-efficacy and thought frequency (see Table 2 for mean scores). As found by Moberly & MacLeod (2006), participants reported being more committed to their self-concordant goals, F (1, 54) = 39.07, $p < .01$ ($\eta_p^2 = .42$), and felt they had more of the necessary skills and resources to achieve these goals, F (1, 54) = 28.46, $p < .01$ ($\eta_p^2 = .35$). They also rated their non-self-concordant goals as being more difficult to achieve, F (1, 54) = 12.42, $p < .01$ ($\eta_p^2 = .19$). However, whilst Moberly & MacLeod (2006) found no effect of goal self-concordance on ratings of thought frequency, in the current study, participants reported thinking about their non-self-concordant goals more often than their self-concordant goals, F (1, 54) = 8.33, $p < .01$ ($\eta_p^2 = .13$).

Regarding differences between the goal ratings of the ASD and control groups, results demonstrated that although both groups were equally committed to their self-concordant and non-self-concordant goals, F (1, 54) = 0.37, $p = .55$ ($\eta_p^2 = .01$), the

ASD group reported finding both types of goal harder to achieve, F (1, 54) = 9.74, p < .01 (η_p^2 = .15), and believed that they had less of the necessary skills and resources to achieve their goals than the control group, F (1, 54) = 9.87, p < .01 (η_p^2 = .16). The ASD group also tended to report thinking about all of their goals more often than the control group, F (1, 54) = 4.74, p < .01 (η_p^2 = .08). There were no significant group by goal-type interaction effects (*ps* > .05).

(Table 2 about here)

General event knowledge task:

Figure 1 illustrates the mean latencies (in milliseconds) to the accessibility of general event knowledge as a function of goal type. A 2 (group) x 3 (goal type) mixed ANOVA revealed that the ASD group (mean = 2521, SD = 670) took significantly longer than the control group (mean = 1806, SD = 622) to access general event knowledge, F (1, 54) = 17.06, p < .01 (η_p^2 = .24). There was also a significant main effect of goal type, F (2, 108) = 23.14, p < .01 (η_p^2 = .30), with knowledge relating to self-concordant goals (mean = 1727, SD = 821) being accessed faster than knowledge relating to non-self-concordant goals (mean = 2308, SD = 957), t (55) = -4.83, p < .001 (r = .54), one-tailed. In addition, goal items (mean = 2018, SD = 771), were accessed significantly faster than non-goal items (mean = 2456, SD = 863), t (55) = 4.79, p < .001 (r = .54), one-tailed. Importantly, there was no significant interaction effect, F (2, 108) = 1.58, p = .21 (η_p^2 = .03), suggesting that adults with ASD use information about the self to facilitate the accessibility of general event knowledge to the same extent as control participants.

(Figure 1 about here)

To summarise, the results of the previous analysis found that although the ASD group can use the self to facilitate the accessibility of general event knowledge, they still take significantly longer than control participants to access knowledge at the general event level. This delay may be due to either (a) slower reaction times in the ASD group (as found in previous research, e.g., Schmitz, Daly, & Murphy, 2007), or (b) because the ASD group experienced fewer of the goal-related items than control participants (as instances in which participants reported that they had not experienced the goal item were assigned a maximum latency of 4000*ms*). Consistent with this latter suggestion, a 2 (group) x 3 (goal type) mixed design ANOVA examining the number of *yes* responses provided by the ASD and control groups (i.e. the number of times they reported experiencing the goal item) revealed that the ASD group (mean = 1.77, SD = .71) experienced fewer of the goal-related items than the control group (mean = 2.40, SD = .57), F (1, 54) = 13.49, $p < .001$ ($\eta_p^2 = .20$). In addition, there was a significant main effect of goal type, F (2, 108) = 15.81, $p < .001$ ($\eta_p^2 = .23$). Bonferroni corrected paired samples t-tests revealed that this was due to participants reporting that they experienced self-concordant goal items (mean = 2.52, SD = .74) more often non-self-concordant goals (mean = 2.00, SD = 1.01), t (55) = 3.71, $p < .001$ ($r = .45$), two-tailed. In addition, goal items (mean = 2.26, SD = .71) were experienced significantly more overall than non-goal items (mean = 1.75, SD = 1.01), t (55) = 4.29, $p < .001$ ($r = .24$), two-tailed. There was a non-significant interaction effect, F (2, 108) = .14, $p = .87$ ($\eta_p^2 = .003$), suggesting that this effect was consistent across groups.

In view of this, the general event knowledge data was reanalysed, assessing only the mean numbers of *yes* responses to the self-concordant, non-self-concordant and non-goal items (i.e. the number of trials on which participants indicated that they had generally experienced the goal-related events). In line with the results of the earlier analysis, a 2 (group) x 3 (goal type) mixed design ANOVA was used to assess mean latencies to experienced general event knowledge. As two participants in the control group, and nine participants in the ASD group, did not report any *yes* responses for at least one type of goal cue (self-concordant, non-self-concordant or non-goal), the data for these participants were removed from the following analysis, which left 19 participants in the ASD group and 26 in the control group. Analysis of the mean latencies to *yes* responses revealed that there was a significant main effect of group, as the ASD group (mean = 1592, SD = 301) were significantly slower than the control group (mean = 1289, SD = 278) at accessing experienced general event knowledge across all goal types, F (1, 43) = 13.84, $p < .01$ ($\eta_p^2 = .22$). In addition, there was a significant main effect of goal type, F (2, 86) = 3.32, $p < .05$ ($\eta_p^2 = .24$), which was due to experienced self-concordant goal-related knowledge (mean = 1317, SD = 512) being accessed significantly faster than experienced non-self-concordant goal-related knowledge (mean = 1486, SD = 448), t (48) = -1.78, $p < .01$ ($r = .25$), one-tailed. However, as found by Moberly & MacLeod (2006), latencies to the accessibility of experienced goal-related general event knowledge (mean = 1402, SD = 374) did not significantly differ from latencies to experienced non-goal-related general event knowledge (mean = 1448, SD = 392), t (44) = -.73, $p = .23$ ($r = .12$), one-tailed. In addition, there was no significant group by goal-type interaction effect, F (2, 86) = 1.37, $p = .26$ ($\eta_p^2 = .03$), suggesting that there was a similar pattern of results in the ASD and control groups[4].

Event-specific knowledge:

For the event-specific knowledge task, the mean number of specific memories retrieved by participants on this task was analysed first. As just three memories were retrieved to each goal type (self-concordant, non-self-concordant, non-goal), the overall number of specific memories retrieved across all goal types was analysed. An independent samples t-test revealed that, in line with predictions, the ASD group (mean = 7.07, SD = 1.80) generated significantly fewer specific memories overall than the control group (mean = 7.86, SD = 1.38), t (54) = -1.83, $p < .05$ ($r = .24$), one-tailed.

Figure 2 illustrates the mean latencies (in seconds) to the accessibility of event-specific knowledge in the ASD and control groups as a function of goal type. A 2 (group: ASD vs. control) x 3 (goal type: self-concordant vs. non-self-concordant vs. non-goal) mixed ANOVA revealed that, consistent with predictions, the ASD group (mean = 15.89*s*, SD = 8.38) took significantly longer than the control group (mean = 8.93*s*, SD = 6.14) to access event-specific knowledge, F (1, 54) = 12.56, $p < .01$ ($\eta_p^2 = .20$). Although there was no significant main effect of goal type, F (2, 108) = .99, $p = .37$ ($\eta_p^2 = .02$), nor a significant interaction effect, F (2, 108) = 1.47, $p = .23$ ($\eta_p^2 = .03$), a priori planned contrasts revealed significantly different patterns of performance on this task as a function of participant group. Specifically, Bonferroni corrected within-group ANOVAs revealed that whilst there was no significant main effect of goal type on response latencies in the ASD group, F (2, 54) = .27, $p = .77$ ($\eta_p^2 = .01$), this effect was significant in the control group, F (2, 54) = 3.99, $p < .025$ ($\eta_p^2 = .24$). A corrected paired t-test showed that this was due to goal cues (mean = 7.88, SD =

6.58) facilitating the speed of event-specific knowledge accessibility, relative to non-goal cues (mean = 11.04, SD = 8.59), t (27) = -1.99, $p < .01$ ($r = .36$), one-tailed. There was, however, no significant difference between latencies to self-concordant (mean = 6.85, SD = 5.62) and non-self-concordant (mean = 8.91, SD = 8.32) goal-related memories in this group, t (27) = 1.07, $p = .29$ ($r = .20$).

(Figure 2 about here)

Discussion

To summarise, the current study assessed general event knowledge and event-specific knowledge in adults with and without ASD. Regarding the general event knowledge task, the current study replicated the findings of Moberly & MacLeod (2006) in that goal-related general event knowledge appeared to be accessed significantly faster than non-goal-related general event knowledge. However, when analysing only the instances in which participants reported experiencing the goal items, the latency difference between self-concordant and non-self-concordant goals was maintained, whereas the difference between goal-related and non-goal-related cues was not (which Moberly & MacLeod attribute to participants' greater experience with goal-related items). Despite this, and consistent with predictions, goal self-concordance was found to play an important role, with self-concordant goal-related memories being accessed significantly faster than non-self-concordant goal-related memories. Interestingly, this pattern was observed in both the ASD and control groups.

For event-specific knowledge, the current study replicated Moberly & MacLeod's (2006) finding that, in typical adults, information relating to currently pursued goals (relative to information concerning non-goals) facilitated the speed at which associated event-specific knowledge was retrieved. Further, it confirmed that goal self-concordance (the extent to which goals are pursued for intrinsically motivating reasons) does not influence the accessibility of retrieved event-specific knowledge. Regarding the results of the ASD group, the current study confirmed previous reports of a deficit in specific autobiographical memory retrieval, as the adults with ASD recalled fewer specific memories than the control group, and also took significantly longer to do so. Moreover, the adults with ASD failed to use goal-related information to facilitate the accessibility of event-specific knowledge, despite both groups being equally committed to their goals. Therefore, the specific autobiographical memory difficulties in adults with ASD may be related to problems in using the self as an effective memory organisational system. It is also important to note that the goal items selected by the ASD group were rated consistently lower on the self-concordance scale than the goals selected by the control group, implying that adults with ASD may have a less motivationally integrated self-goal system than typical adults.

However, one weakness with the current design concerns how the event-specific and general event knowledge tasks were presented in the same testing session. As the control group accessed a greater amount of general event knowledge than participants with ASD (as evidenced by the greater number of *yes* responses on the general event knowledge task), this may have primed relevant event-specific knowledge in the subsequent specific memory task. It is, however, important to note that the two tasks

were separated by a 90-minute delay, in which a series of unrelated tasks were presented, which would potentially reduce the impact of priming effects. Further, if priming effects did occur, one would expect that despite a reduction in the overall amount of specific memories retrieved (and increased latencies to memory retrieval) by the ASD group, the pattern of responses as a function of goal type would be similar, since both the ASD and control groups reported experiencing a greater number of self-concordant items than non-self-concordant items, which were also experienced more than non-goal items. Nonetheless, it is of interest for future studies to investigate the role of priming from general event knowledge to event-specific knowledge in ASD.

It therefore appears that adults with ASD can use goals of the self to organise general event, but not event-specific, knowledge. However, there are several important differences between the event-specific and general event knowledge tasks presented in Study 1. Firstly, it is important to take into account the roles of task difficulty and complexity; whilst the general event knowledge task simply required participants to read short phrases and make yes/no judgements about whether or not they had generally experienced the events, the event-specific knowledge task was significantly more cognitively demanding, requiring participants to generate memories at speed whilst adhering to task demands and inhibiting inappropriate responses. As such, the task also relied more heavily on executive resources, which have been shown to be impaired in ASD (see Hill, 2004, for a review). Second, the nature of the cues used must be taken into account; whilst the event-specific knowledge task used single words (e.g., *'romance'*) to cue memories, the cues in the general event knowledge task comprised short phrases (e.g., *'romantic encounters'*), which were much richer in

nature. As a result of this, the event-specific knowledge task involved participants constructing a description of the cue item before the memory retrieval search began, further increasing the difficulty of the task. Finally, the tasks also differ regarding the type of knowledge they are accessing; whilst the event-specific knowledge task assesses autobiographical memories, the general event knowledge task indexes semantic knowledge about the self, which may be significantly easier to access. The results of Study 1 could therefore reflect a selective event-specific knowledge deficit in adults with ASD (with general event knowledge being genuinely intact) or could be due to the event-specific knowledge task being too cognitively demanding for the ASD group.

In order to test which of these two hypotheses were correct, a follow-up study was conducted in which the demands of the general event knowledge task were increased to correspond with those of the event-specific knowledge task. The decision was made to increase the demands of the general event knowledge task, rather than to reduce the demands of the event-specific knowledge task, as specific memories, by nature, require executive processes during retrieval (Dalgleish et al., 2007). It was therefore reasoned that if the ASD group were still able to use the self to facilitate general event knowledge retrieval, even with increased task demands, this would imply a selective event-specific knowledge deficit. In contrast, if the relationship between personal goals and general event knowledge was not observed in the high-demand general event knowledge task, it would suggest that the autobiographical memory cueing task may just be too executively demanding for the ASD group.

Study 2

The aim of Study 2 was to replicate and extend the results of Study 1 by examining general event knowledge using a task equivalent in difficulty and complexity to the cueing task used to assess event-specific knowledge in Study 1. Specifically, a revised version of the autobiographical memory cueing task, in which participants were instructed to retrieve general, opposed to specific, autobiographical memories (cf. Dalgleish et al., 2007), was administered to a group of adults with and without ASD. In this task, as in Study 1, memory cues comprised either goal-related (self-concordant or non-self-concordant) or non-goal-related items. For the typical adults, it was predicted that goal-related cues, relative to non-goal-related cues, would facilitate the speed at which general event knowledge was retrieved. It was also predicted that self-concordant goal-related general event knowledge would be retrieved significantly faster than knowledge relating to non-self-concordant goals in this group. Regarding the adults with ASD, there were two possible outcomes on this task. Firstly, if the adults with ASD were able to use information relating to personal goals to facilitate the accessibility of general event knowledge on this high-demand task, it would appear that general event knowledge is genuinely intact in this group and that this aspect of memory is organised around the self. If, however, this pattern were not found, it would imply that the autobiographical memory cueing task (both with specific and general instructions) is too cognitively demanding for adults with ASD and that it is the executive nature of these tasks that is hindering the performance of the ASD group.

Method

Participants

The ASD group comprised 20 adults (10 males, 10 females), each with a formal diagnosis of ASD (see Study 1 for details of inclusion criteria for participants with ASD). Eighteen of these participants had received a diagnosis of Asperger syndrome, and the other two were diagnosed with high functioning autism. The ASD group (mean = 36.70, SD = 5.31) also scored significantly higher than the control group (mean = 13.05, SD = 7.92) on the AQ (Baron-Cohen et al., 2001), t (38) = 11.09, $p <$ .01 (r = .87), one-tailed. On this measure, all but one participant in the ASD group (5%) scored above the suggested cut-off of 26 (Woodbury-Smith et al., 2005), whilst none of the control group did. The ASD participants were recruited from the National Autistic Society (UK), as well as local social groups and web pages for adults with ASD. The control adults (n = 20; 10 males, 10 females) were recruited from various Further/Higher Education colleges, and local social groups. Control participants were group-matched to the participants with ASD on the basis of verbal, performance and full-scale IQ (as assessed on the WASI, Wechsler, 1999a), and were individually-matched for age and gender (see Table 3). None of the participants who took part in Study 2 participated in Study 1.

(Table 3 about here)

Materials

General event knowledge task: A revised version of the autobiographical memory cueing task (adapted from Dalgleish et al., 2007) was used to provide an index of general event knowledge under conditions of high task demands. As in Study 1, participants were asked to complete a goal selection form one week before the testing

session, on which they indicated each goal that they were currently pursuing. However, to reduce the total testing time, the current study used a shortened goal selection form, which comprised 25, rather than the original 50, cues (see Appendix 1 for a full list of goals used in Study 2). During the testing session, each of the goal items that participants selected, as well as three randomly selected non-goals, were used as cues in the memory cueing task.

In this task, in line with the instructions used by Dalgleish et al. (2007), participants were asked to report a category of events that happened to them, at speed, in response to each cue word. For example, in response to the word *"exercise"*, an appropriate response on this task would be *"when I go to the gym"*. In contrast, an inappropriate (specific) memory would be *"I went to the gym last Saturday"*. Inter-rater reliability for this coding scheme (with one rater blind to group membership) was satisfactory (Cohen's Kappa = .85). Examples of appropriate general, and inappropriate specific, memories were provided to participants and at least two practice words were administered, ensuring that all participants understood the task instructions. In addition, at the end of the testing session, participants were asked to repeat the task instructions to the experimenter (cf. Dalgleish et al., 2007), which all participants were able to do. The mean latency to general memory retrieval was analysed as the dependent variable.

As in Study 1, at the end of the testing session, participants completed a goal rating form to determine which cues were to be analysed as the self-concordant and non-self-concordant goals. Participants also rated each selected goal for commitment, difficulty, self-efficacy and thought frequency at this time (see method section, Study

1, for full details on goal ratings). In addition, just one participant in the control group reported that they were no longer pursuing a previously endorsed goal.

Procedure

The goal selection form and AQ were administered one week before the testing session. Study 2 was conducted as part of a larger study into autobiographical memory in adults with and without ASD. In this study, participants were tested individually, in a quiet room, either at Goldsmiths, University of London, or in participants' own homes. The WASI was administered first, followed by the general event knowledge task and a memory task unrelated to the current study. At the end of the testing session, goal ratings forms assessing self-concordance, as well as commitment, difficulty, self-efficacy and thought frequency, were completed by participants for each goal that they had previously endorsed on the goal selection form.

Results

Goal selection

Participants each selected a series of goals that they were currently pursuing from a list of 25 goals (in Appendix 1). An independent samples t-tests revealed that there was no significant difference between the mean number of goals selected by the ASD (mean = 8.89, SD = 2.73) and control (mean = 8.20, SD = 2.67) groups, t (38) = .80, p = .43 (r = .13), two-tailed. In addition, as in Study 1, the number of goals selected by participants did not correlate with performance on the autobiographical memory task in either the ASD or control groups (ps > .05).

Goal ratings

Firstly, the self-concordance ratings (max = +16, min = -16) of the goals selected as self-concordant or non-self-concordant were analysed using a 2 (group: ASD vs. control) x 2 (goal type: self-concordant vs. non-self-concordant) mixed ANOVA. As predicted, self-concordant goals (mean = 9.86, SD = 3.54) were rated as being pursued for more autonomous reasons than the non-self-concordant goals (mean = -0.32, SD = 4.55), F (1, 38) = 175.39, $p < .01$ ($\eta_p^2 = .83$). In addition, consistent with the results of Study 1, the ASD group rated their self-concordant goals (mean = 8.36, SD = 3.77) and non-self-concordant goals (mean = -1.81, SD = 3.61) lower on the self-concordance scale than the control group (self-concordant goals mean = 11.28, SD = 2.69; non-self-concordant goals mean = 1.10, SD = 4.98), F (1, 38) = 9.09, $p < .01$ ($\eta_p^2 = .20$). Importantly, there was no significant interaction effect, F (1, 38) = .001, $p = .99$ ($\eta_p^2 < .01$), suggesting that the difference between the ratings of the self-concordant and non-self-concordant goals was consistent across both groups.

Participants were also asked to rate each goal on the basis of commitment, difficulty, self-efficacy and thought frequency (see Table 4). Regarding ratings of self-concordant vs. non-self-concordant goals, and consistent with the findings of Moberly & MacLeod (2006), participants reported being significantly more committed to their self-concordant goals, F (1, 38) = 12.38, $p < .01$ ($\eta_p^2 = .25$), and there was a trend towards participants feeling they had more of the necessary skills and resources to achieve their self-concordant goals, F (1, 38) = 4.04, $p = .052$ ($\eta_p^2 = .10$). Participants did, however, report that their non-self-concordant goals were more difficult to achieve than their self-concordant goals, F (1, 38) = 6.34, $p < .01$ ($\eta_p^2 = .15$). There

was also no difference between self-concordant and non-self-concordant goals in terms of thought frequency, F (1, 38) = 1.06, p = .31 (η_p^2 = .03).

Regarding group differences, as before, there was no significant group difference with respect to self-report ratings of commitment, F (1, 38) = 1.06, p = .31 (η_p^2 = .03). However, contrary to the results of Study 1, there were no significant differences between the ASD and control groups with respect to self-report ratings of difficulty, F (1, 38) = 1.38, p = .25 (η_p^2 = .04), or thought frequency, F (1, 38) = 0.04, p = .85 (η_p^2 = .04), although mean scores were in a similar direction. There was also a trend towards the control group reporting that they have more of the necessary skills and resources to achieve their goals, F (1, 38) = 3.79, p = .059 (η_p^2 = .09).

(Table 4 about here)

General event knowledge task

Firstly, the total number of general memories retrieved on this task was analysed. As just three general memories were retrieved for each goal type (self-concordant, non-self-concordant or non-goal), the number of memories retrieved overall was assessed. An independent samples t-test revealed there to be no significant difference between the overall number of general memories retrieved by the ASD (mean = 8.84, SD = .50) and control (mean = 8.85, SD = .67) groups, t (38) = -.04, p = .97 (r < .01), two-tailed.

Figure 3 illustrates the mean latencies (in seconds) to the accessibility of general event knowledge as a function of goal type in the current study. As predicted, a 2

(group: ASD vs. control) x 3 (goal condition: self-concordant vs. non-self-concordant vs. non-goal) mixed ANOVA revealed a significant main effect of goal type, F (2, 76) = 4.93, $p > .01$ ($\eta_p^2 = .12$). Corrected paired samples t-tests revealed this to be due to goal cues (mean = 4.52, SD = 4.41) facilitating the speed of general events knowledge accessibility, relative to non-goal cues (mean = 6.47, SD = 6.12), t (38) = 2.95, $p <$ .01 ($r = .43$), one-tailed. However, there was no effect of goal self-concordance (self-concordant mean = 4.57, SD = 5.11; non-self-concordant mean = 4.46, SD = 4.66), t (38) = .16, $p = .87$ ($r = .02$), one-tailed. In addition, contrary to the results of Study 1, there was no difference between the response latencies of the ASD (mean = 5.66, SD = 1.08) and control (mean = 4.71, SD = 1.05) groups, F (1, 38) = 26.39, $p = .53$ ($\eta_p^2 =$ .01). There was also a non-significant interaction effect, F (2, 76) = 0.60, $p = .55$ ($\eta_p^2 = .02$), suggesting that the effect of goal type was consistent across both groups.

(Figure 3 about here)

Discussion

To summarise, the results of Study 2 demonstrated that, in line with the results of Study 1, adults with ASD could use information about the self to facilitate the accessibility of general event knowledge. This finding lends support to the poor performance of the ASD group on the event-specific knowledge task in Study 1 being due to a genuine difficulty in accessing specific autobiographical memories, rather than being due to problems with task demands. This therefore suggests that there is a dissociation between event-specific and general event knowledge in ASD; whilst

event-specific knowledge is impaired in this group, general event knowledge appears intact.

These results do, however, contrast from Study 1 in that they failed to demonstrate a role for goal self-concordance in the accessibility of general event knowledge. One possible explanation for this regards differences in the goal cues used in Studies 1 & 2 (as a reduced set of goal items were offered in Study 2). However, since ratings of goal self-concordance were equivalent between the two studies (and ratings of commitment, difficulty, self-efficacy and thought frequency were also similar), this explanation appears unlikely. It is also possible that this difference is a function of the general event knowledge task in Study 1 indexing semantic self-knowledge, whereas the general event knowledge task in Study 2 assesses general autobiographical memories. It is therefore important for future studies to compare semantic self-knowledge with general autobiographical memories in this group more systematically. One final reason for this difference concerns how the cueing task used in Study 2 may not be as sensitive as the rapid response task used in Study 1 to detect the very subtle effect of goal self-concordance. Although Moberly & MacLeod (2006) did assess the role of self-concordance on an autobiographical fluency task (cf. Dritschel, Williams, Baddeley, & Nimmo-Smith, 1992), in which several memories were retrieved to each goal item (opposed to the one retrieved in the current studies), it is still possible that verbal methodologies (e.g., the cueing task and fluency task), which assess response latencies via a stopwatch and rely on the verbal abilities of the participant, are less able to detect the effect of goal self-concordance, which may be rather implicit in nature.

General discussion

To summarise, the current series of studies explored the role of goal pursuit on the accessibility of event-specific and general event knowledge in adults with and without ASD. Results demonstrated a selective event-specific knowledge deficit in the ASD group, whilst general event knowledge appeared relatively intact. Moreover, whilst the control group were able to use information pertaining to currently pursued goals to facilitate the accessibility of both event-specific and general event knowledge, a corresponding pattern only emerged for general event knowledge in the ASD group. Taken together, these results suggest that one factor underlying the specific autobiographical memory difficulties in adults with ASD may be a failure in using the self as an effective memory organisational system.

The results of Study 1, which found adults with ASD to generate significantly fewer specific autobiographical memories, and to take longer to do so, than a matched control group, are consistent with a growing body of research demonstrating impairments in memories for specific personally experienced events in this group (e.g., Crane & Goddard, 2008; Goddard et al., 2007). In addition, although previous studies have reported the preservation of some aspects of autobiographical knowledge in ASD, including personality traits (Klein, Chan, & Loftus, 1999) and biographical information (Crane & Goddard, 2008), this study is the first to demonstrate that memories of general autobiographical events also appear intact.

General event knowledge is thought to be more closely connected to the self than event-specific knowledge (e.g., Brunot & Sanitioso, 2004; Moberly & MacLeod,

2006), as general event knowledge is more representative of a person's typical behaviours, whereas event-specific knowledge reflects more unique or exceptional events (Klein, Loftus, & Sherman, 1993). Consistent with this suggestion, the adults with ASD were able to use information pertaining to personal goals to facilitate the accessibility of general event, but not event-specific, autobiographical knowledge. However, this explanation fails to explain why the current studies (and the results of Moberly & MacLeod, 2006) found goal-related information to facilitate the accessibility of both general event *and* event-specific knowledge in typical adults.

Moberly & MacLeod (2006) suggest that event-specific knowledge relating to personal goals is more accessible than event-specific knowledge relating to non-goals because goal-related events are experienced more overall. Indeed, analysis of the number of instances in which participants responded that they had generally experienced the goal items (in Study 1) revealed that self-concordant goal-related events were experienced more often than non-self-concordant goal-related events, which were, in turn, experienced more often than non-goal-related events. Further, the adults with ASD reported that they had generally experienced fewer of the goal-related items than the control group. Therefore, it does appear that a lack of experience with the goal-related items may be one factor affecting the event-specific knowledge difficulties of the adults with ASD. However, this explanation does not account for why general event, but not event-specific, knowledge was intact in ASD when the same goal cues were used (in Study 1). Clearly, experience cannot be the only factor influencing the accessibility of autobiographical knowledge.

One suggestion concerns the retrieval mechanisms used by the ASD group to access autobiographical knowledge. Conway & Pleydell-Pearce (2000) suggest that personal goals are used dynamically, iteratively shaping memory retrieval cues. If, as the current data suggest, adults with ASD preferentially retrieve autobiographical knowledge at the general event level, this may account for why this group are able to use personal goals to facilitate the accessibility of general event knowledge. However, iterative sampling of event-specific knowledge relies heavily on executive resources, which have been shown to be impaired in ASD (Hill, 2004). This may make it especially difficult for this group to access event-specific knowledge.

It is also crucial to note that despite general event knowledge being viewed as more closely connected to the self than specific memories (Brunot & Sanitioso, 2004; Moberly & MacLeod, 2006), event-specific knowledge can also significantly shape a person's self concept. Self-defining memories, for example, refer to highly significant life events that reveal important information about one's identity (cf. Singer & Moffitt, 1991-1992). They have also been linked to goal pursuit (Sutin & Robins, 2008) and are thought to play an important role in the development and consolidation of the self (Conway, 2005). Likewise, Wagenaar (1992) suggested that specific memories can serve a self-enhancement function, providing useful exemplars of when a person is not characterised by a particular (usually negative) attribute. Therefore, whether adults with ASD can access self-defining memories, or can use specific memories for self-enhancement purposes, are fruitful avenues for future research.

A further interesting finding in the current study concerns the unimpaired performance of the ASD group on the high-demand general event knowledge task

(Study 2). Several researchers have noted that the autobiographical memory cueing task relies heavily on executive resources (e.g., Dalgleish et al., 2007). Further, executive dysfunction has been widely reported in individuals with ASD (see Hill, 2004, for a review). This therefore raises the question of why the performance of the ASD group was equivalent to that of control participants on the general event knowledge task (in Study 2). One explanation is that the executive processes required for the general memory cueing task (Study 2) are not as demanding as those necessary for the standard specific version (Study 1) (cf. Dalgleish et al., 2007). In support of this, autobiographical memory is thought to be organised hierarchically, with memory cues activating general descriptions first, followed by more specific exemplars (Conway & Pleydell-Pearce, 2000). Therefore, to access a general memory on the cueing task (as in Study 2), participants would only need to inhibit a small subset of specific memories that are directly accessed by bypassing the general memory stage (cf. Conway & Pleydell-Pearce, 2000). In contrast, when retrieving specific memories to cue words (as in Study 1), participants need to inhibit each inappropriate general memory that they encounter during the retrieval search (Dalgleish et al., 2007). Executive difficulties may therefore be a further contributing factor to the specific autobiographical memory deficits experienced by adults with ASD and this issue warrants further, more systematic, investigation.

Finally, it is also important to highlight the methodological limitations of the current series of studies. Firstly, each study used personal goals as an index of cue self-relevance. Although the ASD group were able to select personally important goals, and could differentiate between goals that were high and low in terms of self-concordance, they did report finding their goals harder to achieve than control

participants, and felt they had less of the necessary skills and resources to achieve their goals. Consistent with this, they reported experiencing fewer of their goals overall than the control group. It would therefore be useful for future research to investigate the relationship between goal success and goal failure on autobiographical memory retrieval in ASD.

A further issue with the goal-cueing paradigm regards the strategies that participants use to select their goals. Presumably, goal selection would rely on participants accessing related general or specific autobiographical memories to determine whether or not they class a particular item as a goal. It is therefore possible that participants with and without ASD use different strategies when selecting their goals, with the ASD group relying less on event-specific knowledge to aid goal selection. This could potentially impact on the type of memories retrieved on the cueing tasks. Although priming effects in the current series of studies are unlikely, given the one week delay between goal selection and memory retrieval, it is nonetheless important for future studies to employ alternative methodologies, which do not concern personal goals, to further assess the relationship between the self and autobiographical memory in this group.

One final issue with the methodologies used in the current series of studies concerns the nature of the cueing paradigms used to assess general event and event-specific knowledge. These tasks, although widely used in autobiographical memory research, have been criticised for not necessarily indexing memories that are most integral to one's sense of self (Jansari & Parkin, 1996). Indeed, the cueing task has also been shown to bias the retrieval of recent life events, rather than those that are most

personally important (Rabbitt & Winthorpe, 1988). Investigation of the quantity and quality of self-defining memories retrieved by participants with ASD could overcome this issue by exploring extremely important and highly self-relevant memories in this group. This would also serve to expand our knowledge of the relationship between the self and memory in adults with ASD.

To conclude, this series of studies have demonstrated that although event-specific knowledge is impaired in adults with ASD, general event knowledge appears intact. Moreover, although control participants could structure both event-specific and general event knowledge around goals of the self, a corresponding relationship was only observed for general event knowledge in the ASD group. Therefore, one factor underlying the specific memory deficits in ASD could be a failure in using the self as an effective memory organisational system. Future research is necessary to assess the relationship between the self and autobiographical memory in greater depth, using a wider variety of methodologies. Importantly, this may help to elucidate the complex memory profile found in ASD, and could lead to important advances in our understanding of the relationship between autobiographical memory and the self.

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Table 1: Participant demographics (Study 1)

	ASD group	**Control group**	**Group differences**		
			t	*p*	*r*
Age	41.57 (16.49)	40.53 (17.20)	.23	.82	.03
Verbal IQ	115.39 (12.10)	110.68 (13.35)	1.38	.17	.18
Performance IQ	114.96 (15.55)	116.64 (11.45)	-.46	.65	.06
Full scale IQ	117.18 (13.47)	115.11 (11.67)	.61	.54	.08

Table 2: Mean commitment, difficulty, self-efficacy and thought frequency ratings for self-concordant and non-self-concordant goals in the ASD and control groups (Study 1)

		Self-concordant goals		**Non-self-concordant goals**	
		Mean	*SD*	*Mean*	*SD*
Commitment	*ASD*	7.21	0.97	5.95	1.42
	Control	7.21	1.29	6.31	1.34
Difficulty	*ASD*	5.26	1.93	6.27	1.72
	Control	4.01	1.72	5.11	1.95
Self-efficacy	*ASD*	6.49	1.28	5.47	1.79
	Control	7.48	1.15	6.70	1.54
Thought	*ASD*	3.75	0.78	3.42	0.75
frequency	*Control*	3.30	0.64	3.12	0.74

Table 3: Participant demographics (Study 2)

	ASD group	**Control group**	**Group differences**		
			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

Table 4: Mean commitment, difficulty, self-efficacy and thought frequency ratings for self-concordant and non-self-concordant goals in the ASD and control groups (Study 2)

		Self-concordant goals		**Non-self-concordant goals**	
		Mean	*SD*	*Mean*	*SD*
Commitment	*ASD*	7.03	1.27	6.54	1.25
	Control	7.05	1.35	5.85	1.22
Difficulty	*ASD*	5.47	2.00	6.14	1.86
	Control	4.78	1.57	5.78	1.46
Self-efficacy	*ASD*	6.46	1.60	5.91	1.05
	Control	7.18	1.52	6.78	1.64
Thought	*ASD*	3.67	0.81	3.58	0.81
frequency	*Control*	3.75	0.73	3.58	0.64

Figure Captions:

Figure 1: Mean latencies (in milliseconds) to the accessibility of general event knowledge in the ASD and control groups, as a function of goal type (Study 1)

Figure 2: Mean latencies (in seconds) to the accessibility of event-specific knowledge in the ASD and control groups, as a function of goal type (Study 1)

Figure 3: Mean latencies (in seconds) to the accessibility of general event knowledge in the ASD and control groups, as a function of goal type (Study 2)

Figure 1

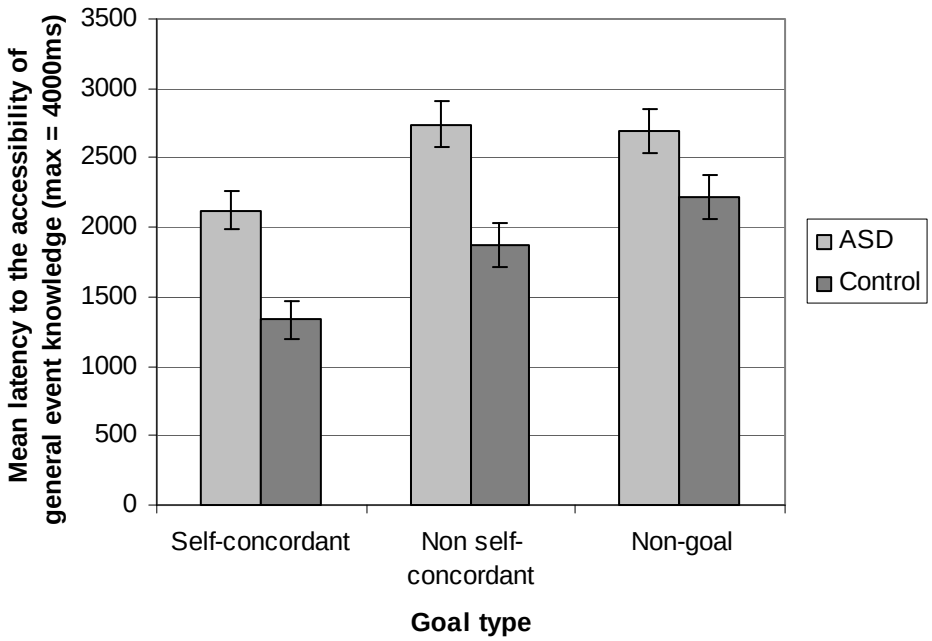

Mean latency to the accessibility of general event knowledge (max = 4000ms)
3500
3000
2500
2000
1500
1000
500
0
Self-concordant
Non self-concordant
Non-goal
Goal type
ASD
Control

Figure 2

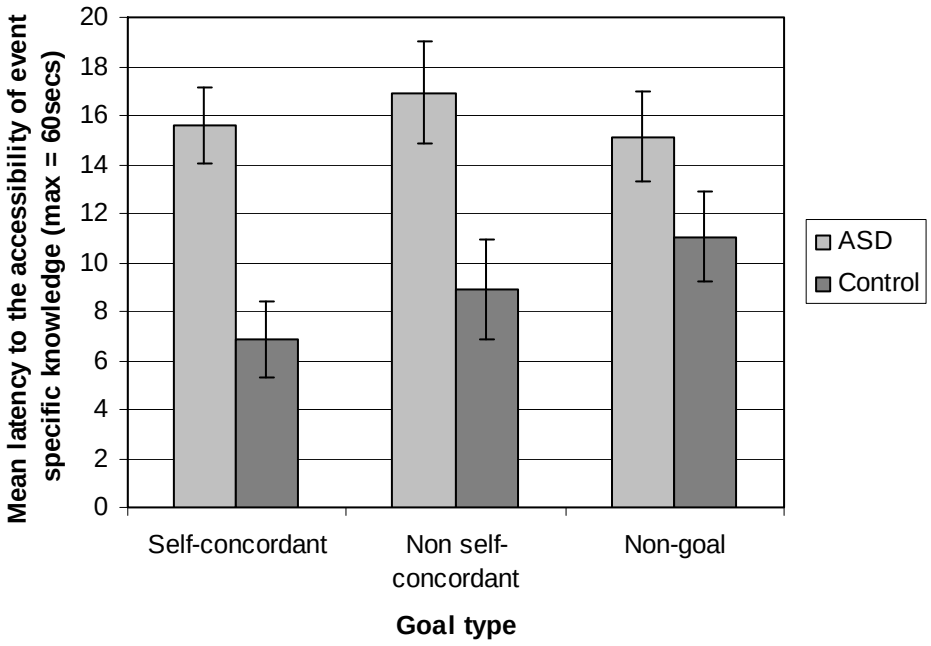
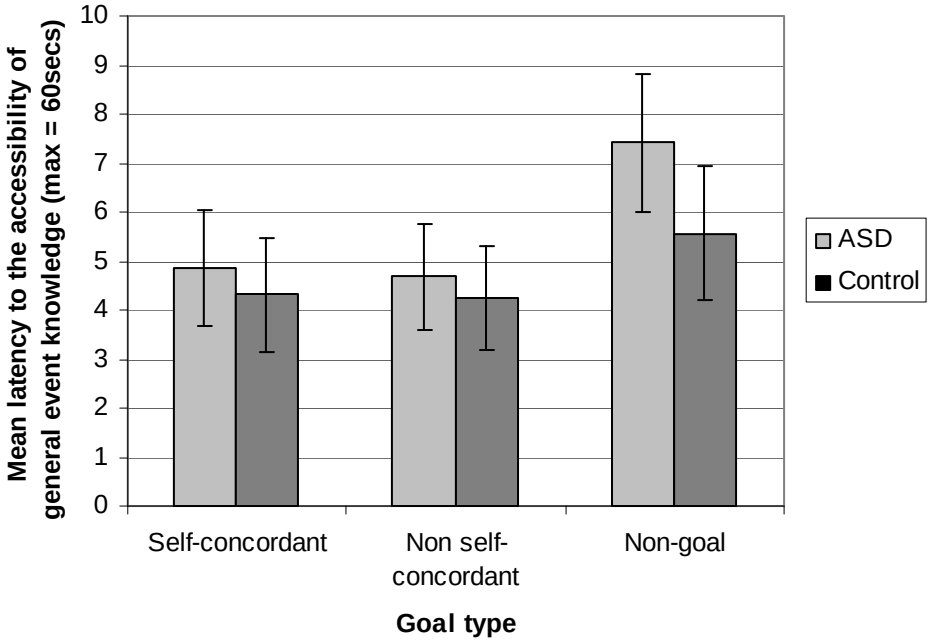

Mean latency to the accessibility of event specific knowledge (max = 60secs)
20
18
16
14
12
10
8
6
4
2
0
Self-concordant
Non self-concordant
Non-goal
Goal type
ASD
Control

Figure 3


Mean latency to the accessibility of general event knowledge (max = 60secs)
10
9
8
7
6
5
4
3
2
1
0
Self-concordant
Non self-concordant
Non-goal
Goal type
ASD
Control

Appendix 1: Goal phrases and their corresponding memory cues (Studies 1 & 2)

Goal	**Specific memories (Study 1) (** = Study 2)**	**General memories (Study 1)**
Being in love	Love **	Loving relationships
Getting an education	Education **	Educational achievements
Having friends I love, close companionship	Friend **	Loyal friendships
Eating more healthily	Healthy eating **	Healthy meals
Be more religious	Religion **	Religious experiences
Having romantic experiences	Romance	Romantic encounters
Having a successful career	Career **	Successful career
Being more charitable	Charity **	Charitable acts
Avoiding stress	Stress	Avoiding stress
Keeping up with fashion	Fashion **	Fashionable clothes
Feeling close to my family/loved ones	Family	Loving company
Being physically active, exercising regularly	Exercise **	Physical workouts
Keeping things in order (my desk, office, house etc).	Tidy	Tidy spaces
Devoting time to amusements, entertainment, hobbies	Hobby **	Enjoyable hobbies

Learning more about culture and the arts	Culture	Cultural activities
Earning more money	Money	High earnings
Paying my bills on time	Bills **	Bill payments
Going on holiday	Holiday	Pleasant holidays
Decorating or renovating my home	Decorating **	Decorating projects
Being more honest with people	Honest **	Honest discussions
Keeping a positive attitude	Positivity	Positive thoughts
Improving my conversational skills	Conversation	Witty conversations
Having as much fun as possible	Fun **	Fun pastimes
Spending more time reading	Reading **	Gripping reading
Following current affairs more closely	Current affairs	News reports
Saving more money	Savings	Financial savings
Recycling more	Recycling **	Recycling tasks
Going on a diet	Diet **	Strict diets
Making myself physically attractive	Attractive	Attractive faces
Being in the centre of things, being popular	Popularity **	Increasing popularity
Avoiding feelings of failure	Failure	Avoiding failures
Eating at restaurants more often	Restaurant **	Nice restaurants
Spend more time relaxing	Relaxation	Relaxing breaks
Spend more time playing sport	Sport **	Sporting events
Mend a personal relationship	Relationship	Repaired relationships

Learn a new language	Language	Foreign languages
Be more polite to those around me	Polite **	Polite actions
Getting back in touch with an old friend	Old friend	Friendly reunions
Getting a new job	Job **	Satisfying jobs
Being more tolerant	Tolerant	Tolerant behaviours
Be more assertive	Assertive	Assertive encounters
Achieving my aspirations	Aspirations	Achieving aspirations
Be more helpful to my relatives	Relatives	Helpful chores
Spend more time with my loved ones	Loved ones	Loving company
Helping others, cooperating, giving support	Helpful **	Helping others
Do as well as possible academically	Academic **	Academic achievements
Having stability in life, avoiding change	Stability	Stable lifestyles
Having original, novel ideas	Idea	Novel ideas
Keeping to myself, being private	Private **	Private people
Having intellectual experiences, conversations, discussing interesting topics	Intellectual	Intellectual experiences
--	--	Lottery jackpots *
--	--	Comfortable housing *
--	--	Creative ideas *

--	--	Miraculous escapes *
--	--	Psychic powers *
--	--	Ethical choices *
--	--	Lifesaving acts *
--	--	Determined efforts *
--	--	Entertaining films *
--	--	Cancelled debts *

* = General memory task filler item only

Footnotes

[1] Although ASD has a gender ratio of approximately 4:1 (males: females), with ratios of around 6:1 reported for higher functioning samples (Fombonne, 1999), the samples in the current series of studies comprised an equal number of males and females. As gender differences have previously been reported on autobiographical memory tasks (e.g., Goddard, Dritschel, & Burton, 1998; Pohl, Bender, & Lachmann, 2005), the current study investigated the role of gender on autobiographical memory retrieval in ASD. However, there were no significant effects of gender on any of the variables in Experiments 1, 2 and 3, in either the ASD or control groups (*p* values ranged between .20 and .81; η_p^2 values ranged between .009 and .05).

[2] As the original list of 38 goal items used by Moberly & MacLeod (2006; Studies 1 and 2) were designed for a student sample, the list of goal cues was adapted and extended for the current study, to incorporate a wider range of cues.

[3] When completing the goal rating forms, all participants were informed that each form that they were to complete represented a goal item that they previously selected on the goal selection form (one week prior). Participants were instructed to tick a box on the goal selection form if they were no longer pursuing that goal.

[4] This analysis was also repeated using the overall latencies to both *yes* and *no* responses on this task, and a similar pattern of results were obtained – whilst there was a significant effect of goal self-concordance (with self-concordant goal-related events being accessed faster than non-self-concordant goal-related events), the mean latencies between responses to goal and non-goal items was not significant.