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Recollection in adolescents with Autism Spectrum Disorder

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ABSTRACT

Introduction: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder primarily affecting social interaction and communication. Recently, there has been interest in whether people with ASD also show memory deficits as a result of abnormal brain development. However, at least in adolescents with ASD, the recollection component of episodic memory has rarely been explored. This paper is an evaluation of recollection in three different experiments in adolescents with ASD, using both objective (source discrimination) and subjective methods (Remember–Know judgments).

Methods: Three experiments were designed to measure different aspects of contextual information: sensory/perceptual information (Experiment 1), temporal information (Experiment 2) and spatial information (Experiment 3). To measure objective and subjective recollection, for all three experiments, all participants were presented with information to learn in a specific context. At the recognition stage, they were asked whether they remembered the information or just knew the information was there (R/K response, subjective method). To assess the quality of these subjective judgments, participants justified their Remember responses using the contextual information. After the recognition task, to assess source memory (objective measure), all items presented at encoding were represented and participants have to recall the source for all these items.

Results: All three experiments showed that adolescents with ASD could correctly recall source information. However, in the first experiment adolescents with ASD gave significantly fewer Remember responses than controls.

Conclusions: These findings point to a specific and subtle recollection impairment in adolescents with ASD, at least when subjective methods are used. We discuss how these might relate to differences in the self and to the brain abnormalities in ASD.

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1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder primarily affecting social interaction and communication. Recently, there has been interest in whether people with ASD also show memory deficits as a result of abnormal brain development. Studies investigating memory in ASD have compared two main systems: the episodic memory system and the semantic memory system (Tulving, 1985). Episodic and semantic memory differ in the subjective state or conscious awareness associated with retrieval (Tulving, 1985; Wheeler et al., 1997; for a neuroscience perspective see Habib et al., 2003). Episodic retrieval is associated with *autonoetic* awareness and includes the source of the memory, an awareness of its origin, and a conscious evaluation of itself. Episodic retrieval is thus characterized by a recollective experience and a feeling of the self in the past (Tulving, 1985). Semantic retrieval is associated with *noetic* awareness and reflects conceptual knowledge. Studies in ASD have revealed impairments in episodic memory (Boucher and Bowler, 2008) but intact performance on semantic memory tasks (Bowler et al., 2007; Lind and Bowler, 2009; Salmond et al., 2005). To explain this dissociation, it has been suggested that episodic memory deficits in ASD could be due to a lack of recollection (Boucher et al., 2008; Lind and Bowler, 2008). However, at least in children and adolescents with ASD, recollection has rarely been explored. The novelty of this paper is therefore an evaluation of recollection in three different experiments in adolescents with ASD, using both objective (source discrimination) and subjective methods (Remember–Know judgments). Furthermore, research with high functioning adults with ASD has suggested that the mixed findings reported on episodic memory tasks could be due to compensatory mechanisms developed by some individuals (see Boucher and Bowler, 2008). Thus, in the current study, episodic memory and in particular recollection were assessed on adolescents with ASD.

Neuropathological findings in ASD support the prediction that recollection might be impaired. Indeed, in ASD, atypicalities in brain regions known to be involved in memory functioning have been found (see Palmen et al., 2004, for review). For example, abnormalities of the hippocampus are very well documented (see Nicolson et al., 2006) and it is now well-established that the medial-temporal lobes and in particular the hippocampus are critical for recollective experience (see Eichenbaum et al., 2007; Yonelinas, 2002). For instance, patient studies have revealed that damage to the hippocampus is linked to a lack of recollection (e.g., Bowles et al., 2007; Schacter et al., 1996, 1997; Verfaellie and Treadwell, 1993). On the other hand, parahippocampal areas, known to be involved in familiarity processes and also in encoding of the contextual information (Eichenbaum et al., 2007) seem to be less affected in ASD (Bauman and Kemper, 1985). The role played by the hippocampus in episodic recollection has also been confirmed in an emergent literature exploring the developmental differences in brain regions associated with recollection. For example, Ghetti et al. (2010) using Functional Magnetic Resonance Imaging (FMRI) data collected in Typically Developing (TD) children and adults showed that the hippocampus was selectively activated for subsequent recollection only in adults and adolescents (from 14 years old). This was not the case for younger children, suggesting that developmental changes in the hippocampus were related to the developmental changes observed in recollection. In view of the brain abnormalities observed in ASD, and in particular the abnormalities found in the hippocampus, and the role played by this neural region in recollection, it is thus reasonable to assume that people with ASD may experience difficulties in recollection tasks (see Gaigg and Bowler, 2008, for a similar argument).

Recollection can be indexed either by objective information such as the source of the item, or subjective reports about the quality of retrieval as for example with the Remember–Know paradigm introduced by Tulving (1985). We will now in turn review the studies in ASD that have used objective and subjective measures to assess recollection in ASD. Source memory is assessed by asking participants to retrieve contextual information linked to the target, such as sensory/perceptual information, spatial and temporal information, semantic detail and affect (Johnson et al., 1993). Few studies have explored memory for sensory/perceptual, temporal or spatial contextual information associated with a specific event in people with ASD. In fact, studies exploring whether people with ASD can recall contextual information have only explored one contextual dimension (temporal source) and have revealed contradictory findings (Bennetto et al., 1996; Gras-Vincendon et al., 2007). Most studies of children with ASD have examined *reality monitoring* skills by asking participants to discriminate between self versus other as the source of information. TD children from age six perform well on reality monitoring tasks (Foley et al., 1993). The results of studies with children and adolescents with ASD reveal contradictory findings with some finding no impairment (Farrant et al., 1998; Hill and Russell, 2002; Russell and Hill, 2001; Williams and Happe, 2009a, 2009b) while others show clear monitoring difficulties (Hala et al., 2005; Lind and Bowler, 2009; Millward et al., 2000; Russell and Jarrold, 1999). Children with ASD also have an impairments on internal source monitoring tasks (Johnson et al., 1993) when, for example, asked to discriminate between *heard* versus *seen* words (Bowler et al., 2004) or *thought* versus *said* words (Hala et al., 2005). Thus, to date no studies have investigated systematically whether or not people with ASD can retrieve sensory/perceptual, temporal or spatial contextual information. In an exploratory way, three experiments will measure different aspects of contextual information: sensory/perceptual information (Experiment 1), temporal information (Experiment 2) and spatial information (Experiment 3), with the aim of examining which if any aspects of source retrieval are impaired in adolescents with ASD.

As opposed to the objective measure of recollection of contextual detail recorded by source judgments, when recollection is assessed by subjective states participants are asked to report whether or not information is familiar or remembered. With the Remember–Know paradigm originally proposed by Tulving (1985), participants are asked to learn a list of words and then during a recognition task are required to classify their responses, either as *Remember* responses or