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Brief Report

Diminished false memory in adults with autism spectrum disorder: Evidence of identify-to-reject mechanism impairment

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A R T I C L E I N F O

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A B S T R A C T

Background: Research has demonstrated that memory in individuals with autism spectrum disorder (ASD) is not aided by conceptual relations among words. To explore that, we used a Deese-Roediger–McDermott (DRM) false-memory paradigm, known to rely on associative relations between words. We therefore expected people with ASD in our study to be less susceptible to produce false memories. The novelty of this study was to use *the externalized free-recall* procedure to further explore the dynamics of correct and error responses in ASD.
Method: Adults with ASD and age- and IQ-matched adults in a comparison group were tested on a DRM task where 12 lists of strongly associated words were presented auditorily. At test, an *externalized free-recall* procedure was used, requesting participants to report presented words, and also any extra words that came to their mind (generated words).
Results: As expected, the clinical group produced fewer false memories than the comparison group, potentially due to abnormal *relational processing*. Moreover, unlike comparison participants, individuals with ASD tended to accept the critical words as belonging to the list rather than as generated, which demonstrates abnormalities in the monitoring capacity underlying an *identify-to-reject* process. Furthermore, analysis of questionnaires revealed that adults with ASD are less likely than typical adults to use memory strategies at both encoding and retrieval.
Conclusions: These findings are discussed in relation to the operation of *error-inflating* and *error-editing* mechanisms, both of which seem to be compromised in autism.

1. Introduction

A growing literature into cognitive abilities in autism spectrum disorders (ASD) demonstrates specific episodic memory difficulties and intact performance on semantic memory tasks (Boucher & Bowler, 2008; Lind & Bowler, 2009; Bowler, Gardiner, & Gaigg, 2007). Problems in encoding and retrieval of information pertaining to spatial, temporal or semantic context of events have led researchers to suggest the existence of diminished *recollection* in ASD (e.g., Bowler, Gardiner, & Grice, 2000; Gaigg, Bowler, Ecker,

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Calvo-Merino, & Murphy, 2015; Ring, Gaigg, & Bowler, 2015). While it appears that people with autism can remember semantic details specific to the studied items, they show difficulties in tasks that involve *relational processing,* which relies on using the semantic information that arises from the meaningful relationships between items (e.g., Gaigg, Gardiner, & Bowler, 2008). Indeed, empirical studies demonstrate that people with autism have problems in grouping exemplars into categories (Gaigg et al., 2015), noticing meaning-related clusters (Bowler, Gaigg, & Gardiner, 2009; Gaigg et al., 2008; Smith et al., 2007), or binding multidimensional features (Bowler, Gaigg, & Gardiner, 2014). Furthermore, some studies show problems in source-monitoring tasks where individuals with ASD fail to recall contextual details such as *who* performed an action during an event, (e.g., *self vs. other,* see the review by Lind, 2010), *where* the event occurred (*location A vs. location B*, Ring et al., 2015) and *how* it occurred (*perceived vs. imagined,* Cooper, Plaisted-Grant, Baron-Cohen, & Simons, 2016).

This study examines recollection difficulties in ASD using the Deese-Roediger and McDermott (DRM) false memory paradigm (Roediger & McDermott, 1995). The novelty is to apply an *externalized free-recall* procedure (Unsworth, Brewer, & Spillers, 2010) to investigate the dynamics of correct and error responses in recall tests. In a DRM task, participants study a list of words (e.g., *bed, dream,* etc.) related to a non-presented critical word (CW) (e.g., *sleep*). The common finding is that, at test, the CW is highly likely to be falsely recalled/recognized as if it had been presented at study. Four studies exploring false memory using DRM in autism have produced mixed results. Beversdorf et al. (2000) found lesser susceptibility in people with autism to produce false memories. This was replicated by Hillier, Campbell, Keillor, Philips, and Beversdorf (2007) in a visual, but not verbal, paradigm. Bowler et al. (2000) found false memories to be comparable to typical adultś true memories, while Gaigg and Bowler (2009) found typical levels of distortion in orthographically related CWs, and even higher false memory rates in ASD for emotionally charged CWs. Although mixed outcomes may be related to the heterogeneity of materials and clinical samples (Hillier et al., 2007), another way to understand these inconclusive findings is to measure the specific contribution of the relevant processes involved in false memories.

False memories result from two independent processes: *error-inflating* and *error-editing* process (Arndt & Gould, 2006; Carneiro, Fernandez, & Dias, 2009). At the *error-inflating* stage, the presentation of the list of associates can evoke in the learners' mind a strongly related but non-presented CW, either through automatic spreading activation (Roediger, Balota, & Watson, 2001) or through concurrent encoding of the list gist (Brainerd & Reyna, 2005). However, the false memory can only occur if the internal source of the representation is erroneously identified as external (Johnson, Hashtroudi, & Lindsay, 1993). Therefore, a successful rejection of the CW (*error-editing* process) takes place if learners monitor their memory and attribute the source of false memory to, for example, an internal generation process by applying the so-called *identify-to-reject* strategy (Gallo, 2006). The novelty of our study is to use an *externalized free-recall* method to help to tease apart these processes.

In an *externalized free-recall* procedure, participants are told to recall the presented words plus any other related words that come to their mind, marking the ones that they think were actually presented for study. This procedure allows for a separation between the initial generation stage and the final editing stage in recall. Under these conditions, young adults produce CWs, but they are also effective in identifying and rejecting some of them (Carneiro & Fernandez, 2013). Because people with ASD show difficulties in using *relational processing* when memorizing words, it is expected that the *error-inflating* component of false memories will have a minimal impact, and a lower generation rate of CWs is expected in autism than in comparison participants. Furthermore, because they have impoverished source monitoring abilities, they might be less efficient in applying the *identify-to-reject* strategy and, thus, more likely to accept the CWs as presented rather than generated words. To better characterize those tendencies, we also used questionnaires to explore if people with ASD possessed declarative knowledge about different memory strategies at encoding (Questionnaire a-Qa) or during the rejection of false memories (Questionnaire b-Qb).

2. Method

2.1. Participants

Nineteen typical and 19 intellectually able adults with autism took part in the study (see Table 1). Comparison participants were University of Salamanca students and community-recruited individuals. People with ASD were recruited from a Social Skills Summer Course, and through InFoAutismo-University of Salamanca Diagnosis Centre. The diagnoses of all our participants with ASD were established by qualified clinicians according to diagnostic criteria from DSM-IV-TR/DSM-5 (American Psychiatric Association, 2000,

Table 1
Participants characteristics: Mean (Standard deviation), range and *t*-test differences on age and IQ measures.

	Group		t-test and mean differences effect sizes		
	ASD (n = 19)	Comparison Group (n = 19)			
	Mean (SD) [range]	Mean (SD) [range]	*t*	*p*	*d* [95% CI]
Age	25.90 (7.52) [16–46]	25.33 (7.27) [18–42]	−0.23	0.8	−0.08 [−0.73, 0.58]
FIQ	106 (16.96) [76–132]	110.21 (9.59) [94–129]	0.95	0.3	0.31 [−0.35, 0.97]
Verbal subtest	58.37 (14.15) [32–81]	57.32 (8.06) [42–70]	−0.28	0.8	−0.09 [−0.75, 0.57]
Performance subtest	48.16 (12.44) [24–65]	54.42 (7.77) [39–65]	1.9	0.07	0.06 [−0.07, 1.29]

FIQ-Full Intelligence Quotient.