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A Virtual Week study of prospective memory function in autism spectrum disorders



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ABSTRACT

Prospective memory (PM) refers to the implementation of delayed intentions, a cognitive ability that plays a critical role in daily life because of its involvement in goal-directed behavior and consequently the development and maintenance of independence. Emerging evidence indicates that PM may be disrupted in autism spectrum disorders (ASDs), potentially contributing to the functional difficulties that characterize this group. However, the degree, nature, and specificity of ASD-related impairment remains poorly understood. In the current study, children between 8 and 12 years of age who were diagnosed with ASDs ($n = 30$) were compared with typically developing children ($n = 30$) on a child-appropriate version of the Virtual Week board game. This measure provides an opportunity to investigate the different sorts of PM failures that occur. The ASD group showed significant PM impairment on measures of time-based (but not event-based) prospective remembering. However, only a subtle difference emerged between regular and irregular PM tasks, and group differences were consistent across these tasks. Because regular and irregular tasks differentially load retrospective memory, these data imply that the PM difficulties seen in ASDs may primarily reflect a monitoring deficit

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and not an encoding and memory storage deficit. PM performance was poorer under conditions of high ongoing task absorption, but the magnitude of this effect did not vary as a function of group. In both groups, time-based (but not event-based) PM difficulties were associated with functional outcomes in daily life, but only an inconsistent association with executive control emerged.

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Introduction

Prospective memory (PM) describes the cognitive process of remembering to execute previously formed intentions such as attending an appointment and taking medication. In the developmental literature, attention has predominantly focused on how and why PM is affected during late adulthood. Laboratory studies indicate that there are moderate age-related declines in PM function, with older adults being significantly impaired relative to their younger counterparts (Henry, MacLeod, Phillips, & Crawford, 2004). However, during recent years there has been an increased focus on improving our understanding of how PM develops during early childhood (Rendell, Vella, Kliegel, & Terrett, 2009). Available evidence indicates that rudimentary PM skills emerge during the preschool years (Mackinlay, Kliegel, & Mäntylä, 2009; Rendell et al., 2009; Wang, Kliegel, Liu, & Yang, 2008), with children as young as 3 years able to succeed at certain tasks under certain conditions (Kvavilashvili, Kyle, & Messer, 2008). Developmental research has argued that independence and autonomy in children may be heavily dependent on PM functioning (see Kvavilashvili et al., 2008, for an influential review) and that these skills in turn have important implications for academic functioning and peer relations (Mahy & Moses, 2011). Therefore, it is surprising that, to date, there has been only limited empirical assessment of whether PM is disrupted in circumstances where normal development is known not to occur and, if so, how this relates to important functional outcomes.

Autism spectrum disorders (ASDs) represent the most common of the developmental disorders, with a recent epidemiological study reporting that approximately 1 in 88 children of school age is affected (Baio, 2012). Therefore, ASD is no longer considered a rare condition and, given its effects on functional independence, is now recognized as being of major societal concern (Roth & Rezaie, 2011). ASDs are characterized by restricted and repetitive behavior patterns as well as deficits in communication skills and social interaction (American Psychiatric Association, 2000). Symptom severity and intellectual ability vary considerably, but in all cases the capacity to cope effectively with the demands of daily life is negatively affected. Children with ASDs, for example, experience difficulties in organizing time, planning, and completing tasks such as school homework (Humphrey & Symes, 2011). This profile of difficulties implies that problems with PM might also be expected to be a key underlying feature and one that potentially contributes to poor functional outcomes in this group.

To date, only six studies have compared PM performance in individuals with ASDs with typically developing controls (Altgassen, Koban, & Kliegel, 2012; Altgassen, Schmitz-Hübsch, & Kliegel, 2010; Altgassen, Williams, Bölte, & Kliegel, 2009; Brandimonte, Filippello, Coluccia, Altgassen, & Kliegel, 2011; Jones et al., 2011; Williams, Boucher, Lind, & Jarrold, 2013). Each of these studies assessed time-based and/or event-based prospective remembering. Whereas the former requires the participant to perform a specified behavior at a particular time, for the latter the required behavior is prompted by an external cue. Of the two types, therefore, time-based PM is believed to be the most reliant on internal control mechanisms (e.g., monitoring the elapsing time) because, assuming that no external mnemonic aid is used, it imposes greater demands on self-initiated mental activities. Indeed, evidence from the early developmental literature indicates that whereas the ability to complete event-based tasks emerges during the preschool years (Kliegel & Jäger, 2007), the successful completion of time-based PM tasks does not appear until much later during childhood, between 7 and 12 years of age (Nigro, Senese, Natullo, & Sergi, 2002). Such findings have been attributed to the fact

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