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Event- and time-triggered remembering: The impact of attention deficit hyperactivity disorder on prospective memory performance in children

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ABSTRACT

The current study examined prospective memory (PM, both time-based and event-based) and time estimation (TR, a time reproduction task) in children with and without attention deficit hyperactivity disorder (ADHD). This study also investigated the influence of task performance and TR on time-based PM in children with ADHD relative to controls. A sample of 69 children, aged 8 to 13 years, completed the CyberCruiser-II time-based PM task, a TR task, and the Super Little Fisherman event-based PM task. PM performance was compared with children's TR abilities, parental reports of daily prospective memory disturbances (Prospective and Retrospective Memory Questionnaire for Children, PRMQC), and ADHD symptomatology (Conner's rating scales). Children with ADHD scored more poorly on event-based PM, time-based PM, and TR; interestingly, TR did not appear related to performance on time-based PM. In addition, it was found that PRMQC scores and ADHD symptom severity were related to performance on the time-based PM task but not to performance on the event-based PM task. These results provide some limited support for theories that propose a distinction between event-based PM and time-based PM.

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Introduction

Prospective memory (PM) refers to one's ability to remember to do something in the future. In essence, it is the realization of delayed intentions and their associated actions (Ellis, 1996; Kliegel, McDaniel, & Einstein, 2008). PM forms an integral part of everyday living for young and old alike. For children, PM is required for remembering to turn in completed homework or to pass on a note to a parent. For adults, successful prospective remembering is needed to ensure that medications are being taken or that bills are paid on time. In fact, it has been found that 50% to 80% of all everyday memory failures, at least in part, are prospective rather than retrospective in nature (Terry, 1988). That being said, it stands to reason that the successful development of PM during childhood is necessary for independent living later in life and therefore, is an important and relevant topic of interest for psychologists interested in memory (Kliegel & Martin, 2003; Wang, Kliegel, Liu, & Yang, 2008).

The importance of PM is seldom recognized until the cognitive mechanisms underlying the ability, generally considered to be the frontal cortices of the brain, have been impaired in some way. For example, PM deficits are seen regularly in the aging population where age-related declines in cognition are common (Einstein & McDaniel, 1990; Einstein, McDaniel, Manzi, Cochran, & Baker, 2000; Einstein, Smith, McDaniel, & Shaw, 1997) and can also be commonly seen in individuals following traumatic brain injury (Cockburn, 1996). Likewise, PM deficits have been demonstrated in children with attention deficit hyperactivity disorder (ADHD), where deficits in abilities considered dependent on the frontal lobes are common (Kerns & Price, 2001; Zinke et al., 2010).

Conceptually, PM can be subdivided into different types. Most commonly investigated are time-based PM and event-based PM, which differ in relation to the context associated with task retrieval (Einstein & McDaniel, 1996). Event-based PM is a memory for action that is triggered when a cue is provided (Ellis, 1996) such as when a child arrives to class and sees an empty homework basket (cue) on the teacher's desk and remembers to take out last night's homework and put it in the basket (action). Time-based PM is a memory for an intended action that is triggered by a specific time or time period or after a specific time has elapsed (Wang et al., 2008). Remembering to call the doctor's office at 1 pm and to pay a bill in the afternoon are examples of this. Einstein and McDaniel (1996) theorized a distinction between these two subtypes because they believed that the constructs differ fundamentally in the way that the memory for action is triggered, namely either in response to an external cue (the homework basket) or in response to a specific period of time (this afternoon or at 1 pm). They believed that because of this difference in retrieval context, time-based PM tasks would require more self-initiated monitoring or retrieval processes than event-based PM and thus, would be more difficult to successfully complete and would rely more on brain systems involved in self-monitoring. Based on these differences, the researchers believed the two constructs to be distinct. The current study included both an event-based PM task and a time-based PM task to further evaluate this distinction (see also Martin, Kliegel, & McDaniel, 2003; Yang, Chan, & Shum, 2011).

PM in children

Although interest in PM in day-to-day functioning has increased dramatically during the last decade, there is still much to be learned about the development of these abilities as well as the associated impact of typical versus atypical cognitive development in children. Of the research currently available, it seems that PM follows a clear developmental trajectory; performance on PM tasks is consistently shown to improve with age, with older children tending to carry out intended actions correctly more frequently than younger children (Kerns, 2000; Kerns & Price, 2001; Mackinlay, Kliegel, & Mäntylä, 2009; Rendell, Vella, Kliegel, & Terrett, 2009; Shum, Cross, Ford, & Ownsworth, 2008; Wang et al., 2008; Zinke et al., 2010). For example, it has been found that preschool-aged children are limitedly capable of performing PM tasks (Aberle & Kliegel, 2010; Kvavilashvili, Messer, & Ebdon, 2001; Rendell et al., 2009), whereas typically developing 13-year-olds have been found to be capable of successfully performing PM tasks without difficulty (Kerns, 2000; Kliegel, Mackinlay, & Jäger, 2008). Taken together, it would seem that PM abilities "come online" early in cognitive development and develop rapidly to reach adult capacity by middle childhood, where they will be

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