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Predictors of time-based prospective memory in children

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ABSTRACT

This study identified age differences in time-based prospective memory performance in school-aged children and explored possible cognitive correlates of age-related performance. A total of 56 7- to 12-year-olds performed a prospective memory task in which prospective memory accuracy, ongoing task performance, and time monitoring were assessed. Additional tests of time estimation, working memory, task switching, and planning were performed. Results showed a robust relationship between age and prospective memory performance even after controlling for ongoing task performance. Developmental differences in time monitoring were also observed, with older children generally adopting a more strategic monitoring strategy than younger children. The majority of age-related variance in prospective memory task performance could be explained by cognitive resources, in particular planning and task switching. In contrast, no further independent contribution of time estimation was observed. Findings are in line with the development of strategic behavior, as well as executive functioning, in school-aged children.

Introduction

Being able to remember to do something in the future (e.g., remembering to take medication in time) is a vital skill for day-to-day functioning as autonomous individuals (Shallice & Burgess, 1991). This everyday memory task has been named *prospective memory* (PM) (Ellis, 1996). Specifically, the task of remembering to do something at some time point in the future is referred to as *time-based prospective memory* (TBPM) (Einstein & McDaniel, 1996). From a conceptual perspective, besides

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retrospective memory for the content of the delayed action, PM involves executive functions for the appropriate and self-initiated execution of the delayed action, for example, monitoring for the target time (Kliegel, Jäger, Altgassen, & Shum, 2008). A particular challenge for succeeding in this type of memory task is that the prospective task typically must be carried out in the midst of performing an attentionally demanding *ongoing task* (Ellis & Kvavilashvili, 2000).

Time-based prospective memory in children

From a developmental perspective, PM skills appear to emerge relatively early in childhood, with even preschoolers demonstrating the ability to remember to do something in the future under some conditions (Guajardo & Best, 2000; Kliegel & Jäger, 2007; Somerville, Wellman, & Cultice, 1983). It has been suggested that the early development of PM has a particular functional value for the development of goal-directed behaviors in general (Winograd, 1988). Moreover, TBPM skills are increasingly called on as children enter the school environment, where they are expected to complete nonroutine tasks such as being in a particular location at a particular time, for example, going to the school hall at 12 o'clock to collect a letter for their parents. Therefore, it is surprising that, despite its clear importance for everyday functioning, age-related TBPM performance in school-aged children has not received much research attention in the developmental domain. Thus, the current study aimed to examine possible age differences in TBPM performance across school-aged children and to explore cognitive resources potentially underlying age-related TBPM performance. In the few existing studies on this topic, TBPM performance has been evaluated in terms of task accuracy (whether the delayed intention is carried out on one's own initiative) and time monitoring behavior (how time is monitored to enable action at the appropriate point).

TBPM in children: Accuracy

Studies investigating the development of TBPM accuracy generally show an inconsistent pattern of results and are likely to have been hampered by ceiling effects, inadequate measuring/reporting of ongoing task performance, and a lack of testing retrospective memory for task instructions (Kvavilashvili, Kyle, & Messer, 2008). Ceci and Bronfenbrenner (1985) found that the majority of their 10- and 14-year-old participants could remember to remove cupcakes from the oven after a 30-min delay (TBPM task) during which they played a computer game (ongoing task). Children could monitor the time by checking a clock that was mounted on the wall behind them. Unfortunately, performance of this single prospective act was largely at ceiling, potentially masking any age-related differences in TBPM performance, and ongoing task performance was not reported.[1] A similar critique also holds for a study by Nigro, Senese, Natullo, and Sergi (2002), who reported superior performance of 7- to 11-year-olds on one PM task over another but did not report task performance in relation to age and retention of task instructions. In contrast, Kerns (2000) observed age effects in TBPM accuracy of 7- to 12-year-olds who performed a computer driving game (ongoing task) in which they were required to monitor the level of gas in the tank to select the right time to refuel (embedded TBPM task). Younger children ran out of gas more frequently than older children, and no ceiling effects were observed. However, because ongoing task performance was not measured, it is not clear whether the age effects reported resulted from true differences in TBPM itself or from differences in the requirements of the ongoing task. In addition, children were not assessed for recall of the TBPM task instruction at the end of the game. Mäntylä, Carelli, and Forman (2007) asked 8- to 12-year-olds and young adults to press a button every 5 min (TBPM task) while watching a video (ongoing task). Participants could monitor time by pressing a different button to make a clock appear on the screen. In the absence of ceiling effects, no age effects in TBPM performance were reported, with all participants achieving approximately 80% of correct responses. Although absorption in the ongoing task (video watching) could not be quantified, participants' understanding of, and memory for, task instructions was verified.

[1] To put this critique into perspective, it should be noted that the focus and major contribution of the work of Ceci and colleagues is on time monitoring in TBPM tasks, rather than on task accuracy per se.