Developmental Review 34 (2014) 305–326

Contents lists available at ScienceDirect

Developmental Review

journal homepage: www.elsevier.com/locate/dr

The development of prospective memory in children: An executive framework

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ARTICLE INFO

Article history:
Received 4 March 2013
Revised 31 July 2014
Available online 22 August 2014

Keywords:
Prospective memory development
Executive function
Model
Intention
Delay
Ongoing task

ABSTRACT

Prospective memory (PM), the ability to remember to carry out one's intentions in the future, is critical for children's daily functioning and their ability to become independent from caregivers. This review assesses the current state of research on children's prospective memory. Using an executive functioning framework the literature can be organized into studies examining four factors that influence PM. We discuss studies that have manipulated the nature of the intention, the content or length of the retention interval, the nature of the ongoing task, and the nature of the PM cue. Further, we propose a model that attempts to account for the development of PM across childhood based on advances in executive control. Finally, we suggest promising future directions for research.

Orientation toward the future is thought to be a uniquely human characteristic. Our ability to think about, anticipate, and plan for the future sets us apart from our recent primate ancestors (Atance & O'Neill, 2001; Donald, 1991). Orientation to the future is critical in daily life in situations ranging from academic performance (e.g., studying for an exam instead of attending a party) to financial planning (e.g., saving up for a home) to social functioning (e.g., remembering to meet a friend after work). One central aspect of future orientation is prospective memory (PM) defined as memory for activities to be performed in the future (Einstein & McDaniel, 1990). In order to lead a productive life independent from others, one must develop the ability to remember to carry out planned intentions at a later time. Further, these intentions must be accomplished despite the presence of other ongoing

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http://dx.doi.org/10.1016/j.dr.2014.08.001
0273-2297/

activities that may capture attention and so interfere with realizing these delayed intentions. In the review that follows we review evidence for the role of executive processes in four key components of a PM task, describe a developmental model of PM that is driven by executive processes, and suggest fruitful directions for future work.

Prospective memory and its measurement

PM is distinct from retrospective memory (RM), defined as memory for information or events from the past. Whereas externally prompted retrieval is typically a critical feature of retrospective memory, prospective memory is more often characterized by self-initiated retrieval processes (Craik, 1983) and preparatory processes such as monitoring (e.g., Smith, 2003). Of course, RM processes are important in PM, as individuals must remember *what* they must do as well as *when* they must do it. Indeed, many researchers have suggested that successful PM combines memory processes (remembering the content of the intention; a retrospective component) with executive processes (executing the action at the appropriate time; a prospective component; e.g., Ellis, 1996; Kliegel, Brandenberger, & Aberle, 2010; Kliegel, Martin, McDaniel, & Einstein, 2002; McDaniel, Glisky, Guynn, & Routhieaux, 1999; Smith, Bayen, & Martin, 2010; Zöllig et al., 2007).

An important conceptual distinction is that between *time-based* and *event-based* PM (e.g., Einstein & McDaniel, 1990). Time-based PM requires the completion of an action at a certain time or after a specific amount of time has passed (e.g., pass a message to a colleague in two hours or at 4:15 pm), whereas event-based PM requires an action to be carried out after a certain event occurs (e.g., pass a message on when you see a colleague).

To mimic the demands of ongoing activities in daily life, a typical experimental PM paradigm has two main parts: a PM task and an ongoing task (OT; Einstein & McDaniel, 1990). The PM intention is usually an action the participant is asked to carry out when a particular stimulus is present or after a certain amount of time has passed. The OT provides a context for the PM action and fills the intervals between the appearances of the prospective target events. For example, an individual may be asked to complete a lexical decision task as an OT but they might also be told to press a particular button when an animal word appears. After instructions are given regarding the OT and the prospective action, there is typically a period of delay in which the prospective stimulus does not appear. Often, this period is filled with another task that is not related to the OT or the prospective action (i.e., an unrelated, filler task) in order to provide time for some forgetting to occur (e.g., Brandimonte & Passolunghi, 1994; Hicks, Marsh, & Russell, 2000). Once this retention or delay interval is over, the OT begins and the PM cues appear within it.

Why is it important to study prospective memory and its development?

There are many reasons to study PM and its early development. First, a majority of adults' daily memory errors appear to be prospective (e.g., forgetting to put out the garbage on pickup day) rather than retrospective (e.g., forgetting the name of a new colleague; Smith, Della Sala, Logie, & Maylor, 2000). According to a diary study, Terry (1988) found that 70% of memory errors made by university students are prospective in nature. The majority of forgetting had to do with neglecting to perform an action, to bring something to an event, or absentmindedness rather than forgetting facts, names, or other information known in the past. Naturalistic studies such as these have not been conducted with children but laboratory studies indicate high rates of forgetting in both experimental and quasi-naturalistic PM tasks (e.g., Guajardo & Best, 2000; Mahy & Moses, 2011; Somerville, Wellman, & Cultice, 1983).

Second, the ability to independently carry out a future intention reliably seems largely beyond the abilities of infants and toddlers (see Kliegel & Jäger, 2007). Instead, PM in this period is heavily scaffolded by parents and other caregivers who often give helpful reminders that aid children's PM. By the time children reach school age, however, they are expected to be able to remember to carry out *some* of their self-formed intentions as well as future tasks assigned to them by others: For example, remembering to bring a permission slip for a field trip home for a parent to sign or remembering to bring an assignment back to school on its due date. If a child fails to complete tasks such as these, their