Journal of Experimental Child Psychology 132 (2015) 140–154

Contents lists available at ScienceDirect

Journal of Experimental Child Psychology

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

Developmental changes and the effect of self-generated feedback in metacognitive controlled spacing strategies in 7-year-olds, 10-year-olds, and adults

Nike Tsalas *, Markus Paulus, Beate Sodian

Section of Developmental Psychology, Ludwig Maximilians Universität, 80802 Munich, Germany

ARTICLE INFO

Article history:
Received 3 July 2014
Revised 20 January 2015
Available online 20 February 2015

Keywords:
Metacognition
Monitoring
Control
Development
Spacing
Memory

ABSTRACT

The current study investigated the development of metacognitive monitoring-based control of spacing choices in children and adults. Moreover, we assessed whether metacognitive learning decisions are influenced by the effects of previous metacognitive decisions. We tested groups of 7-year-olds, 10-year-olds, and adults in a task with two learning blocks in which they needed to monitor their learning through judgments of learning (JoL) and in which they then needed to decide whether to space their study, mass it, or terminate it. Extending previous findings, our study provides the first evidence that already by 7 years of age children can make metacognitive controlled scheduling decisions. The results also revealed that adults had more clearly differentiated strategies related to their JoL. Furthermore, our study provides evidence that participants of all age groups improved their relative monitoring accuracy in the second learning block and adjusted their JoL. However, only adults changed their strategy choices.

Introduction

A fundamental aspect of successful studying is when people take an active role in their learning. Metacognitive self-regulation, which is the ability to monitor and control one's own learning behavior,

* Corresponding author.
E-mail address: nike.tsalas@psy.lmu.de (N. Tsalas).

http://dx.doi.org/10.1016/j.jecp.2015.01.008
0022-0965/

can substantially improve learning outcomes (e.g., Thiede, Anderson, & Therriault, 2003; Wang, Haertel, & Walberg, 1990). Consequently, improving people's metacognitive abilities is—or should be—a highly valued goal for education (Metcalfe & Finn, 2013; Nelson & Narens, 1990). A better understanding of how these abilities develop across childhood and adolescence, when people undergo one of the most intense periods of learning in school, is paramount for the creation and/or improvement of intervention programs for different age groups.

Developmental research on metacognition and the interplay between monitoring and control in study decisions suggests that even though children can be fairly accurate in the monitoring of their own learning progress, they have problems in translating their monitoring into appropriate behavioral strategies (control). This implementation deficit has been most prominently illustrated in paradigms on study time allocation (Dufresne & Kobasigawa, 1989; Lockl & Schneider, 2003) and more recently in paradigms investigating metacognitive controlled scheduling and spacing decisions (Son, 2005, 2010). These developmental findings suggest that children at 6 or 7 years of age do not use the outcome of their metacognitive monitoring to then guide their control decisions. However, there are reasons to believe that children's abilities might be underestimated. First, a recent study that investigated metacognitive monitoring and control in 5- to 7-year-olds showed that already 6-year-olds allocate their study time based on their metacognitions (Destan, Hembacher, Ghetti, & Roebers, 2014), that is, children who were younger than in previously reported studies. Moreover, as we argue in the following paragraphs, the findings on metacognitive-based scheduling decisions, which are also often cited to illustrate that children do not use their monitoring to guide their control decisions (Koriat, 2012; Metcalfe & Jacobs, 2010; Schneider & Pressley, 1997), are too ambiguous to allow settling on the conclusion that children fail to make monitoring-based control decisions.

The spacing effect is the robust phenomenon that repeated, temporally interrupted studying leads to better memory performance than does studying that takes place in a massed manner, that is, crammed into short periods of time (for a review, see Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Ebbinghaus, 1885/1964). A wealth of research has investigated the processes that might explain the spacing effect and its magnitude as a function of varying interstimulus intervals (the length of the interval between spaced studying sessions) and retention intervals (the time lag between learning and recall). Overall, this research indicates that the spacing effect holds true across timescales (see Cepeda et al., 2006, for an extensive meta-analysis), namely seconds (e.g., Russo, Mammarella, & Avons, 2002), weeks (Sobel, Cepeda, & Kapler, 2011), and years (e.g., Bahrick, Bahrick, Bahrick, & Bahrick, 1993). In addition, the spacing effect has been found across the lifespan from infancy to older adulthood (Galluccio & Rovee-Collier, 2006; Kornell, Castel, Eich, & Bjork, 2010; Vlach & Sandhofer, 2012).

Despite the robustness of the spacing effect in memory, very few studies have investigated it in a metacognitive context where people can make the scheduling decisions themselves (i.e., to mass or space study). The few studies that have explored this question asked for the basis of people's spacing decisions. Do people hold explicit beliefs about the merits of massing or spacing and apply these theories accordingly? Or, do people rely on their metacognitions, driven by experiential mnemonic cues (i.e., cues that derive from the very experience of learning [Koriat, Nussinson, Bless, & Shaked, 2008]), to guide their spacing decisions? The latter would imply that people distribute their learning depending on how they assess their current state of knowledge while engaged in a learning task. More specifically, if an item is thought to be well learned, then it might not be necessary to continue studying it immediately and, in line with the spacing effect, waiting a while before studying it again would be a better strategy (spacing). However, if an item has not been learned yet, then continuing to study this item straight away (massing) would be more beneficial (Metcalfe, 2009; Son, 2004). Indeed, empirical research has shown that adults do not merely apply one strategy to learning material of varying difficulty (which would be the prediction of the idea that they hold an explicit belief about the merits of a specific strategy). Instead, they use their metacognitions to guide their spacing choices and choose to space items that have been sufficiently encoded and to mass items when encoding has been insufficient (Benjamin & Bird, 2006; Son, 2004; Toppino, Cohen, Davis, & Moors, 2009). These findings suggest that adults make spacing decisions based on their metacognitive monitoring.

Developmental findings, however, seem to contrast with findings from the adult literature. In particular, one study found that first graders not only tended to choose the strategy considered to