Learning and Instruction 44 (2016) 31–40

Contents lists available at ScienceDirect

Learning and Instruction

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

Metacognitive judgments and disfluency – Does disfluency lead to more accurate judgments, better control, and better performance?

Elisabeth Pieger [a,*], Christoph Mengelkamp [b], Maria Bannert [a]

[a] Technical University of Munich, TUM School of Education, Teaching and Learning with Digital Media, Arcisstraße 21, 80333 Munich, Germany
[b] University of Wuerzburg, Institute of Human Computer Media, Instructional Media, Oswald-Külpe-Weg 82, 97074 Wuerzburg, Germany

ARTICLE INFO

Article history:
Received 19 March 2015
Received in revised form
17 December 2015
Accepted 29 January 2016
Available online 9 March 2016

Keywords:
Metacomprehension
Disfluency
Metacognitive judgments
Metacognitive monitoring
Metacognitive control

ABSTRACT

Theories of metacognition assume that better monitoring leads to better control and performance. Furthermore, monitoring accuracy is often low because students are overconfident (absolute accuracy) and unable to discriminate comprehension of different text-passages (relative accuracy). Fluency seems to be a cue for metacognitive judgments, and therefore, reducing fluency should lead to less automatic processing, lower judgments, and better absolute and relative accuracy. Because the accuracy of metacognitive judgments is the basis of the control of learning, disfluency should lead to more appropriate control and thus to better performance. To test these assumptions, students ($N = 83$) learned either with disfluent or with fluent text-passages. The results show that disfluency led to better absolute and relative accuracy but not for all types of judgments. Moreover, students hardly implemented monitoring in control, resulting in lack of improved performance. Further research is required to investigate why students did not base control on monitoring.

1. Introduction

Monitoring and control are important components of metacognition, and many theories of metacognition and self-regulated learning suppose that accurate monitoring is a prerequisite for adequate control and better performance (Nelson & Narens, 1990; see also Boekaerts, 1997; Winne & Hadwin, 1998; Zimmerman, 1990). This supposed link from monitoring to control and performance implies far-reaching repercussions for instructions in educational contexts. The assumption that monitoring affects control and performance leads to the conclusion that interventions that improve monitoring also improve performance. To justify this conclusion, evidence supporting that monitoring affects control and performance is required (Dunlosky & Rawson, 2012; Efklides, 2012).

However, there is little research on this causal link between monitoring, control, and performance (Thiede, Anderson, & Therriault, 2003). Moreover, this link seems to be more complex than supposed by previous theories (Schwartz & Efklides, 2012). For example, Koriat (2012; Koriat, Ma'ayan, & Nussinson, 2006) describes that students use their monitoring to control their learning (*monitoring-based control*) but also that control can affect monitoring (*control-based monitoring*). Furthermore, there are different types of monitoring *accuracies* that affect different aspects of control (Dunlosky & Rawson, 2012; see also De Bruin & van Gog, 2012; Koriat, 2012): *Absolute accuracy* of monitoring is based on the difference between students' judged and actual performance level (Dunlosky & Metcalfe, 2009) and affects the amount of time students invest for further learning (*termination of study*). *Relative accuracy* of monitoring refers to the extent to which students discriminate their performance of different texts correctly and affects which texts students select for rereading (*text selection*). Thus, to be able to develop instructions that improve performance, it is important to foster both types of monitoring accuracy and to test their impact on termination of study and text selection.

Moreover, to be able to apply findings from laboratory research into real-world settings, meaningful material should be investigated (Schwartz & Efklides, 2012). Previous research often focused on words and word-pairs when investigating metacognition (see Dunlosky & Metcalfe, 2009; for an overview). However, to master an exam, students have to learn from textbooks. Therefore, they have to monitor their comprehension (also called *metacomprehension*, see Maki & Berry, 1984) to decide which text-passages to reread and

* Corresponding author. Dipl.-Psych., Technical University of Munich, TUM School of Education, Teaching and Learning with Digital Media, Arcisstraße 21, 80333 Munich, Germany.
E-mail addresses: elisabeth.pieger@tum.de (E. Pieger), christoph.mengelkamp@uni-wuerzburg.de (C. Mengelkamp), maria.bannert@tum.de (M. Bannert).

http://dx.doi.org/10.1016/j.learninstruc.2016.01.012
0959-4752/

how much time to invest. However, metacomprehension accuracy has often been found to be low (see Glenberg & Epstein, 1987; Glenberg, Wilkinson, & Epstein, 1982; for *illusion of knowing*). Thus, there has been some research investigating how monitoring accuracy can be improved (see Dunlosky & Lipko, 2007; Maki & McGuire, 2002; for reviews). Most studies thereby focused on relative monitoring accuracy because students are not able to discriminate their knowledge of different text-passages (see Dunlosky & Lipko, 2007; Dunlosky & Metcalfe, 2009; for an overview). However, within the last few years, there has been increasing research on absolute accuracy (also known as *calibration*; see Alexander, 2013; for an overview) that found that students often predict higher performance compared with their actual performance in a test (*overconfidence*; e.g., Dunlosky, Hartwig, Rawson, & Lipko, 2011; Miesner & Maki, 2007). One way to reduce overconfidence and to foster relative monitoring accuracy at the same time is to use *disfluent* texts (text with reduced ease of processing), which will be described in the next section.

Summing up, the goal of our study is to investigate whether better monitoring leads to better control and better performance, thereby using disfluency to improve absolute and relative monitoring accuracy. This research question is both theoretically and practically relevant because understanding the interplay between monitoring, control, and performance is necessary to develop instructions that foster performance (De Bruin & van Gog, 2012). Because students often learn from textbooks, we will investigate metacomprehension. Next, we will describe our theoretical framework.

1.1. Connecting metacomprehension and fluency research

According to Schwartz and Efklides (2012; see also Efklides, 2009), judgments are often based on (metacognitive) experiences while reading a text, which is consistent with the assumption that control affects monitoring (control-based monitoring; Koriat, 2012; Koriat et al., 2006; see Fig. 1). The experience that a text is easy (*fluent*) or is difficult (*disfluent*) to process should therefore affect metacognitive judgments. Correspondingly, Koriat (1997) mentions ease of processing (also known as *fluency*) as a cue for judgments. Moreover, Alter, Oppenheimer, Epley, and Eyre (2007) have shown that ease of processing is a metacognitive cue that affects subsequent processing, which is consistent with the assumption that monitoring affects control (monitoring-based control; Koriat, 2012; Koriat et al., 2006; see Fig. 1).

The experience of disfluency in processing can be induced by different types of disfluency that can affect judgments (e.g., Schwarz, 2010). *Perceptual disfluency* affects the ease of identifying words (e.g., deciphering words; surface level of text processing) and thus affects processing on a lower level than *conceptual disfluency* (Schwarz, 2010). Conceptual disfluency affects the ease of identifying the meaning of words and their relations to knowledge structures (Schwarz, 2010), which is a prerequisite for text comprehension: When reading a text, students do not only have to decipher words (surface level), but they have to make sense within and between sentences (textbase level) and to integrate this information into memory (situation model; De Bruin & van Gog, 2012; Redford, Thiede, Wiley, & Griffin, 2012).

Both types of disfluency affect metacognitive experiences (see Schwarz, 2010), but only conceptual disfluency should affect performance. This is because conceptual processing is required for comprehension (see McDaniel & Butler, 2010; for an overview). To be able to investigate the causal chain from monitoring to control and performance, only monitoring, and not performance, should be improved in the first reading phase (see Fig. 1). In this case, better performance after rereading (see Fig. 1) can be attributed to more accurate monitoring (rather than to better performance in the first phase). Conversely, in educational contexts, it may be helpful to develop instructions that improve both accuracy of monitoring and performance in the first phase. Perceptual disfluency should improve monitoring accuracy (but not performance) and thus, enables us to test whether better monitoring leads to better control and finally to better performance.

Monitoring is accurate if students use cues for their judgments that are valid predictors of their performance (*cue diagnosticity*; Dunlosky & Thiede, 2013). However, students often use cues and

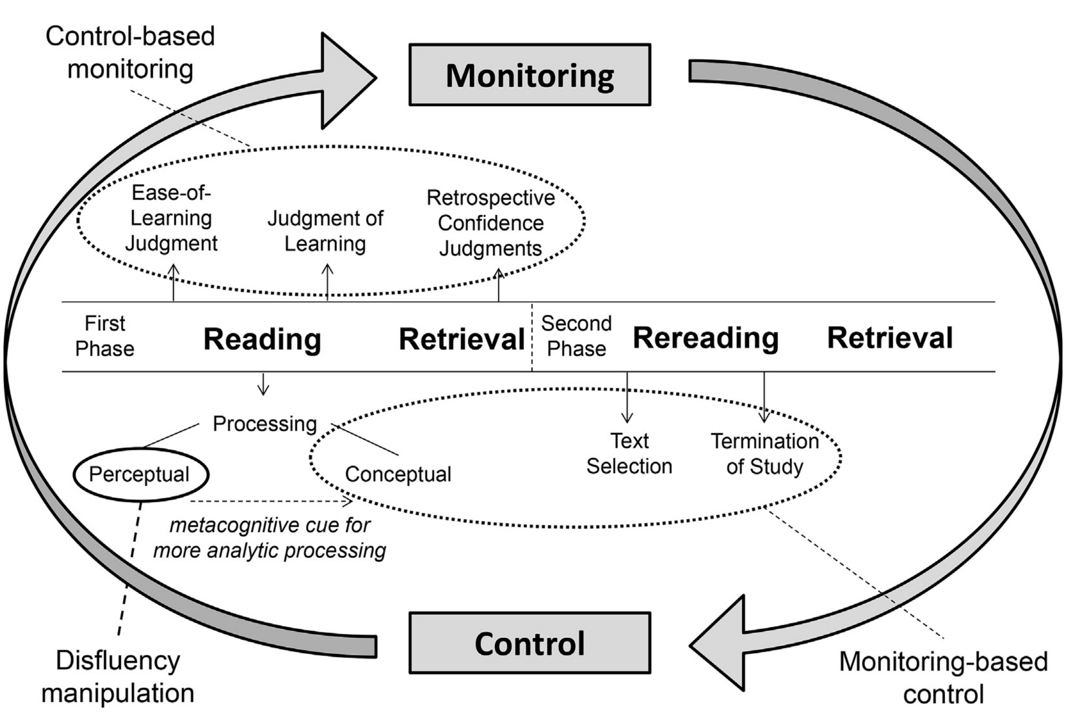

Fig. 1. Integrated model of monitoring, control, and performance.