Examining Contributions to Learners’ Metacomprehension Change During Science Text Learning

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Introduction

Effective monitoring is an important determinant of self-regulated learning. Self-regulated learners establish clear goals and standards for their learning, and monitor their performance dynamically across task completion (Winne, 2011). Monitoring is also critical during science text learning, with direct implications for strategy use and inferencing as processes that augment learners’ text comprehension (Best et al., 2005).

Metacomprehension is an established approach to examining learners’ ability to monitor and present their text understanding (Wiley et al., 2016). Alongside this approach, recent research (Little & McDaniel, 2015) has also found that practice testing – a generalizable learning technique (Dunlosky et al., 2013) – may facilitate learners monitoring of performance during text learning. Despite this work, little, if any, research has examined processes of change in learners monitoring during text learning.

In this research, we examined the effects of practice testing on learners’ metacomprehension change and monitoring of performance. Specifically, we examined:

- the effect of practice testing condition on learners’ improvement in metacomprehension
- the role of correctness feedback in augmenting metacomprehension change
- the role of practice-assessment alignment on the relations among learners’ monitoring judgments

To support the aims of the current research, the following research questions were posed:

1. Does the degree of metacomprehension change differ by practice testing condition?
2. Does metacomprehension accuracy mediate the relationship between practice testing condition and text comprehension?
3.a. Are the relations between metacomprehension accuracy and postdictive judgment accuracy mediated by participants’ item-level monitoring accuracy?
3.b. Are the indirect effects of metacomprehension accuracy on postdictive judgment accuracy, via participants’ item-level monitoring accuracy, moderated by practice testing condition?

To address these questions, we conducted conditional process analyses of learners monitoring of performance by condition.

Method

Participants (74.6% female; M GPA=3.28, SD=0.70) were college learners from undergraduate courses representing the social and natural sciences at a large, Mid-Atlantic research university. A total sample of 390 college learners was obtained. Participants were randomly assigned to one of four practice testing (PT)/control conditions:
- PT: Generation with recall (GWR)
- PT: Multiple-choice with feedback (MWF)
- PT: Multiple-choice without feedback (MNF)
- Control: Reflection on reading strategy use

Materials and Measures

Prior Knowledge. An established six-item measure of participants’ knowledge of the text content was administered.

Texts and Text Comprehension. A 1,049-word science text describing human digestion and major digestive stages and processes was used. The text contained one representation and was constructed to have strong easability (concreteness, syntactic simplicity, referential cohesion > 50% Sillé; Graesser et al., 2011).

An established 18-item measure of text comprehension was administered, assessing lower- and higher-level comprehension of the text. A one factor structure to the items, using CFA and MLR estimation, demonstrated adequate fit (composite α=0.93).

Metacognitive Judgments. To examine the role of practice testing in participants’ metacomprehension change, participants provided metacomprehension judgments before (MC1) and after (MC2) completing practice testing. Two measures of metacomprehension accuracy were calculated:
- Absolute accuracy: absolute difference between MC1 and MC2
- Bias: Signed difference between MC1 and MC2

Participants also provided local and global monitoring judgments across comprehension testing. We calculated measures of absolute accuracy and bias based on:

- Item-level confidence judgments during testing
- A global postdictive judgment after testing

Reading Strategy Use. The 30-item Metacognitive Awareness of Reading Strategies Inventory (Mohkhari & Reichard, 2002) was given to measure participants’ reading strategy use.

The following simplified conceptual models guided primary analyses:

Results

Figure 1. Diagram of the parallel mediation analysis conducted to address Research Question 2. Metacomprehension accuracy was hypothesized to mediate the relationship between practice testing condition and participants’ comprehension of the science text.

Figure 2. Diagram of the moderated mediation analysis conducted to address Research Question 2. Metacomprehension accuracy was hypothesized to mediate the relationship between practice testing condition and participants’ comprehension of the science text.

Discussion

Existing research suggests that learners leverage testing performance feedback to make meaningful and augmentative decisions during text learning (Roediger et al., 2011). This study provided additional evidence of the positive benefits of practice testing, extending a novel understanding of the role of the learning technique in improving the accuracy of learners’ metacomprehension and, by extension, supporting learners’ comprehension of science text.

Specifically, this work suggests:

- Improvement in metacomprehension accuracy may depend on alignment between the manner in which practice testing is conducted and the manner in which comprehension is assessed
- Feedback, when embedded in a practice testing paradigm, plays an important role in augmenting learners’ metacomprehension accuracy
- Learners’ monitoring judgments are linked over time and across the judgment timespan
- The relations among learners’ monitoring judgments across a learning task (i.e., before, during, and after assessment) may depend more on format alignment than on feedback received

Overall, this work suggests important avenues of future research that aim to better understand how to leverage principles of self-regulated learning (Follmer & Sperling, 2018; Zimmerman, 2008) to best facilitate effective comprehension of science text.

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Research Question 3a and 3b

- Participants’ item-level monitoring accuracy, as measured by bias, mediated the association between their metacomprehension accuracy and their postdictive judgment accuracy
- Conditional indirect effects were higher for those in the MWF and MNF conditions:
  - MWF: IMN=0.09, SE=0.04, 95% CI [0.01, 0.17]
  - MNF: IMN=0.10, SE=0.04, 95% CI [0.03, 0.18]
- The model explained 47% of the variance in participants’ postdictive judgment accuracy

- R²=0.47

- Participants’ item-level monitoring accuracy, as measured by absolute accuracy, did not mediate the association between their metacomprehension accuracy and their postdictive judgment accuracy

- path b: b=1.27, 95% CI [-1.45, 3.99]
- all 95% CIs for the IMN contained 0