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Updating in working memory: A comparison of good and poor comprehenders

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Abstract

In this research, we examined the relation between reading comprehension and success in a working memory updating task. We tested the hypotheses that poor comprehenders' deficiencies are associated with a specific difficulty in the working memory updating process, particularly in controlling for information that is no longer relevant. In the first experiment, groups of poor and good comprehenders, ages 8–11 years, were administered a working memory updating task. In the second experiment a year later, a subgroup of participants involved in the first experiment was tested with a different updating task. In both experiments, poor comprehenders had less accurate recall performance and made more intrusion errors than did good comprehenders. Moreover, distinguishing intrusion errors on the basis of their permanence in memory, we found that poor comprehenders were more likely to intrude items that were maintained longer in memory than were good comprehenders. This type of error predicted reading comprehension abilities better than did working memory recall. This suggests that the relation between reading comprehension and working memory is mediated by the ability to control for irrelevant information.

Keywords: Reading comprehension; Working memory updating; Inhibition

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Introduction

Memory updating is the act of modifying the content of memory to accommodate new input (Morris & Jones, 1990). The updating function goes beyond the simple maintenance of task-relevant information by requiring a dynamic manipulation of the content of working memory, and it is broadly considered an executive function (Lehto, 1996; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Morris & Jones, 1990). Furthermore, updating represents the most typical way by which working memory is involved in psychological functioning. In fact, the importance of working memory is related to the temporary maintenance and elaboration of memory contents that are continuously changed to meet the online requests; it is improbable that this change happens in the form of simple substitution of old information with new information. Very often, this change seems to also include an updating of old information based on its comparison with the new information. Despite its importance, the process of updating information in working memory has been studied only rarely, whether directly or in relation to other cognitive processes. Furthermore, until now, no well-established and completely satisfactory procedures for testing updating have been proposed.

In particular, although working memory seems critical in reading comprehension (for a review, see Daneman & Merikle, 1996; Oakhill, Cain, & Bryant, 2003), and this relation is probably mediated by an updating function (Gernsbacher, Varner, & Faust, 1990), only a few studies have directly examined the relation among updating, reading comprehension, and working memory. Furthermore, the results of the studies that have been carried out are not entirely consistent. A study by Palladino, Cornoldi, De Beni, and Pazzaglia (2001) found a relation between reading comprehension and updating in working memory. But from a different perspective, Radvansky and Copeland (2001) showed that measures of working memory, such as the reading span test (Daneman & Carpenter, 1980), operation span test (Turner & Engle, 1989), and spatial span test (Shah & Miyake, 1996), are not good predictors of success in updating situation models during reading comprehension. In the reading comprehension task used by Radvansky and Copeland (2001), each passage mentioned a critical object that was either spatially associated with the protagonist or spatially dissociated from the protagonist. The construction of a coherent mental model was tested by asking participants to solve an anaphor. The results of the study showed that the measures of success in the updating process during the reading comprehension task were weakly related to working memory measures but were strongly related to a general measure of situation model processing (a situation model identification test). Radvansky and Copeland did not exclude the existence of a relation among reading comprehension, updating, and working memory, highlighting that their results could suggest only a lack of relation with a capacity measure of working memory. They hypothesized that some other aspects of working memory related to attentional control and information manipulation could reveal the role of working memory in reading comprehension. This could be the case for a working memory task devoted specifically to examining its updating component.