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Metacognitive Judgments and Control of Study

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Abstract

Recent evidence indicates that people's judgments of their own learning are causally related to their study behavior and not epiphenomenal. I argue here that people use these metacognitions in an effort to selectively study material in their own region of proximal learning. First they attempt to eliminate materials that are already well learned. Then they progress successively from studying easier to more difficult materials. Successful implementation of this metacognitively guided strategy enhances learning. The necessary components are, first, that the metacognitions be accurate, and second, that the appropriate choices are implemented for study. With these parts in place, the individual is in position to effectively take control of his or her own learning.

Keywords

metacognition; judgments of learning; study-time allocation; discrepancy-reduction model; region of proximal learning; self-regulation of study

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The study of people's metacognition—their knowledge of their own knowledge—is motivated by the assumption that if metacognition were accurate, people could take effective control of their own learning. Because of this assumed link to control of learning, much attention has been given to the question of whether metacognitive monitoring is or is not accurate. In a recent article, Dunlosky and Lipko (2007) showed that, although under many circumstances people's metacomprehension judgments are biased, there are some circumstances under which they make excellent judgments. The same is true of learning situations, the focus of the present article. While some methods of eliciting people's judgments produce biases that make these judgments undiagnostic about the difficulty of learning the materials, when people make cue-only delayed judgments of learning, their judgments are highly diagnostic of their future performance (Dunlosky & Nelson, 1992). This procedure involves waiting some time after the original study of the to-be-learned materials before eliciting participants' judgments of learning for each item, and then presenting the cues (questions) alone, without the targets (answers). Thus, although there are ways to evoke metacognitive errors (see Bjork, 1994), it is now well established that this method is effective in overcoming them. To be a fully self-regulating learner, however, an individual must not only make accurate judgments of their own learning but must also know how to convert those judgments into strategies for study that will pay off in the best learning gains for the situation at hand. This article, then, is concerned with questions of metacognitively guided control: Do people use their metaknowledge to control their learning? If so, how are the metacognitions used? And, finally, is their use effective?

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Is there a Causal Relation Between Judgments of Learning and Study Behavior?

The first issue that must be addressed is the possibility that metacognitions are epiphenomenal—feelings, perhaps even compelling feelings, but feelings that may not have an impact on behavior. The assumption among researchers that this is not so stems largely from the finding of a negative correlation between people's judgments of learning and the amount of time they allocate for study. People preferentially study items that they believe that they have not learned well. For instance, Son and Metcalfe (2000) found 47 published experiments in which either judgments of learning had been assessed or item difficulty had been varied. Among those taking metacognitive judgments, 13 showed a negative correlation between judgments of learning and study time, while the other 3 showed null results. Among those in which no metacognition was assessed, 23 showed that people allocated more time to the difficult items and 8 showed null results. Such results invited the interpretation that people were studying strategically, based on their metacognitions.

However, there are other interpretations. Difficult items may simply afford longer study, for instance. Bargh and Williams (2006) demonstrated that people behave automatically in many situations, and they illustrated many cases in which external stimuli or events controlled people's behavior without their knowledge or awareness of the causes (and presumably without the intervention of metacognition). The fact that the negative correlation between study-time allocation and item difficulty occurred whether metacognitive judgments were made or not might indicate that the judgments were made covertly and controlled their study. But it might equally indicate that the judgments were not made at all, that they are irrelevant, or that the behavior was automatic.

Furthermore, several more recent experiments have shown that, even when people appear to be behaving strategically, a negative correlation between judgments of learning and study time may not occur. The negative correlation disappears when people are under time pressure (Metcalfe, 2002; Son & Metcalfe, 2000; Thiede & Dunlosky, 1999) and when the well-learned items are eliminated from the pool of to-be-learned materials (Kornell & Metcalfe, 2006). Given that the negative correlation between study time and judgments of learning can no longer be taken as prima facie evidence for a causal connection, the question arises as to whether people's metacognitive judgments do influence study behavior.

Three papers have addressed this question head on. Thiede, Anderson, and Therriault (2003) showed that when more accurate judgments of text comprehension were induced, people restudied more strategically and performed better. The study had three conditions, only one of which increased people's metacomprehension accuracy. Only the condition that improved metacomprehension accuracy affected people's choices. Participants in this condition chose to restudy texts on which they had performed poorly, whereas people in the other conditions chose randomly. After rereading what they had chosen, people in the condition that enhanced metacomprehension accuracy performed better on a final test than did people in the other two groups.

Finn and I (Metcalfe & Finn, 2008) also demonstrated that metacognitions had a causal effect on study choice. We used a metacognitive illusion we had found in an earlier paper, in which some to-be-learned pairs were presented five times and some only once during a first trial in which items were studied then tested. On the second trial, the pairs that had been studied five times on the first trial were studied once (5-1), and those studied only once were studied five times (1-5), such that when people were asked for recall, the proportion correct was the same in the 1-5 condition as it was in the 5-1 condition. However, people's judgments of learning after studying on the second trial were higher for the 5-1 pairs than for the 1-5 pairs. This difference in people's metacognitions, even though not based on a difference in learning, produced differences in their study choices: When people thought they knew the items better, they declined study relative to when they thought they knew them less well. We also used Koriat and Bjork's (2005) finding that with associatively asymmetrical pairs, recall is also higher in one direction (e.g., producing “cat” when given *kitten*) than in the other (producing “kitten” given *cat*). But people are metacognitively blind to the difference. Here too, study choice was affected by people's metacognitions, not by their actual recall.

Finally, Finn (2008) asked people for judgments of whether they would remember or forget an answer. With “remember” framing, the participants were confident in their memory and tended to decline restudy. With the “forget” framing, they were less confident and chose to restudy. These three studies indicate that people's metacognitions are not epiphenomenal and underline the need for metacognitive judgments to be accurate. Fortunately, the cue-only delayed judgment of learning procedure—which produces extremely high accuracy—can be used to elicit such judgments.

How do People Use their Metacognitions to Control Study?

Given that people do use their metacognitions to control their study, the next question is how? There have been two theories of metacognitively guided study-time allocation: the discrepancy-reduction model and the region-of-proximal-learning framework. Both—at least under some circumstances—predict a negative correlation between judgments of learning and study time. The discrepancy-reduction model (Dunlosky & Hertzog, 1998) says that people study the most difficult items preferentially, devoting most of their time to reducing the largest discrepancies from their internal learning criterion. This emphasis on studying the most difficult items results, directly, in a negative correlation between judgments of learning and study time. The region-of-proximal-learning framework (Metcalfe & Kornell, 2005) says that the first thing people do is to eliminate items they believe they have mastered from the pool of potential restudy items. This elimination of high judgment-of-learning items usually results in a negative correlation between study time and judgments of learning.

Once these already-learned items have been eliminated, though, the region-of-proximal-learning framework says that people should choose to selectively study the easiest rather the most difficult items first, turning to more difficult items only once the easier items have been studied, as shown in Figure 1. These easy items are the ones most susceptible to learning efforts and constitute the person's region of proximal learning. This concept of a region in which the person's learning efforts are most likely to be productive draws on concepts such as Vygotsky's zone of proximal development, Piaget's notion of *décalage*, and Atkinson's transitional learning state.

An emphasis on studying the easiest items should be particularly salient when study time is short. Thiede and Dunlosky (1999; see also Son & Metcalfe, 2000) showed that people are sensitive to time pressure in just this way. With more time available, people should turn to more difficult items that will also take more time to master (see, Metcalfe, 2002, Metcalfe & Kornell, 2005). The region of proximal learning is specific to the individual: Experts are more likely than novices to have mastered the easy items in their own domains, so their regions of proximal learning should be more toward the difficult items. Metcalfe (2002) and Metcalfe and Kornell (2003) showed this expertise-based shift toward difficult items with bilingual as compared to monolingual speakers learning Spanish–English translations. Children should, and do (Metcalfe & Kornell, 2003), show a bias toward easier items as compared to adults. But they may be biased simply because they know less, not because they are children.

The region-of-proximal-learning framework predicts that when already-learned items are eliminated from the study choices, people should choose first the easiest remaining items rather than the most difficult remaining items. These easy but as-yet-unlearned items are likely to yield a near-certain payoff for the small investment of study time needed to propel them into a learned state. The discrepancy-reduction model, by contrast, predicts that even when the already-learned items are eliminated from the choice possibilities, people should still tend to choose the most difficult items. Kornell and Metcalfe (2006) found that when items that were correct on a test were eliminated, people chose for restudy items to which they had given high judgments of learning rather than low judgments of learning, consistent with the region-of-proximal-learning framework.

These two models speak to people's perseverance once an item is chosen for study, and both specify a stop rule. The discrepancy-reduction model says that the person will persevere until the item reaches an internal criterion of being (sufficiently) learned. A serious problem with this stop rule is that people could study a difficult item for an unreasonably—possibly even infinitely—long time. The region-of-proximal-learning framework says that people stop studying an item when their perceived rate of learning approaches zero, as shown in Figure 2. An easy item is learned quickly with no further perceived learning; the rate accordingly goes to zero quickly. More study time is predicted for medium-difficulty items if people perceive themselves to be making progress. However, people may stop quickly on extremely difficult items if they do not feel themselves to be making progress.

This stop rule has implications for whether people should choose to mass or space their learning. First, they should choose to not study at all items with extremely high judgments of learning (because these items are thought to be already mastered). They should defer study until a later time—choosing spaced practice—on items with high judgments of learning, because these easy items will very quickly produce no increases in perceived learning, and the stop rule will dictate that study should cease. They should mass practice on difficult (but not impossible) items, because when the perceived rate of learning has not yet gone to zero the stop rule will dictate that the person should simply persist in studying. In an experiment looking at the relation of judgments of learning to spacing choices, this is exactly what college students did (Son, 2004).

Son (2005) also investigated children's spacing choices. Unlike adults, children mostly chose to mass their practice—a strategy with limited benefit for long-term learning—and they did so indiscriminately over the range of their judgments of learning. Schneider and Lockl (2002) suggested that while young children may have accurate metacognitions, they may nevertheless fail to translate their metaknowledge into effective study strategies.

Is Self-Determined Study-Time Allocation Efficacious?

Given that people's metacognitions result in systematic study choices (at least for adults), we can ask the final question: Does such metacognitively guided study enhance learning? Thiede et al.'s (2003) metacomprehension study, described above, suggests the answer is yes. To further address this question, Kornell and Metcalfe (2006) developed the honor/dishonor paradigm, in which, after making judgments of learning, people are allowed to make their own study choices. These choices, though, may be either honored or dishonored in what the experimenter presents for restudy. The logic is that if people learn better when they are allowed to restudy the items that they chose rather than those they declined, then their choices were the right ones.[1] Experiments using this paradigm have consistently shown that honoring the person's choices resulted in superior learning. The learning superiority in the honor-choice condition occurred when no items were eliminated from the pool and people's choices tended to be low judgment-of-learning items. It also occurred when the items that were correct on an intervening test were eliminated from the choice pool and people's choices tended to be high judgment-of-learning items. These results indicate that adults, at least, make efficacious study choices.

Conclusions and Future Directions

These early results are encouraging. Even so, they invite further elaboration and scrutiny. The connections among metacognition, control strategies, and learning are only starting to be understood. Payoffs in a learning situation should affect study strategy, but these effects have not yet been explored nor implemented in any models to date. Individual differences, including not only gross deficits in metacognitive monitoring or the implementation of strategies but also differences in other cognitive capabilities such as working memory (e.g., Griffin, Wiley, & Thiede, 2008), attention, motivation, perseverance, and individual goals, are all likely to be crucial in both metacognition about learning and the attendant control processes this allows.

The further development of theory on what processes, concepts, and learning materials are in an individual's region of proximal learning may allow us to pinpoint inadequacies in learners' monitoring or choice strategies that lead to learning difficulties. The locus of impairments will have consequences for intervention, of course. Advances in the field of metacognition now allow us to elicit highly accurate judgments of learning from people as young as kindergarten-age children. But even with excellent metacognition, this knowledge may not be implemented appropriately to allow effective study strategies—suggesting an obvious point of intervention and remediation. Further research should be directed at isolating the conditions that produce optimal learning in people of different ages, the metacognitive and control processes they use, and whether or not these processes are effective. Such research will put psychologists in a better position to intervene, when necessary, but also, and ultimately, it will allow those interventions to foster individuals' own effective control over their learning.

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[1]This paradigm does not permit differentiation between a “choicefulness” benefit—that is, one that accrues because the person makes the choice himself or herself—from a benefit that results from study of the right items, unless the person chooses the wrong items.

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Recommended Reading

Nelson, TO.; Narens, L. Metamemory: A theoretical framework and new findings. In: Bower, GH., editor. The psychology of learning and motivation. Vol. 26. New York: Academic Press; 1990. p. 125-141.A classic paper that influenced all subsequent research on metacognition and on the connections between metacognition, control, and learning; discusses metatheoretical and philosophical implications of metacognition.

Kuhn D, Dean D Jr. Metacognition: A bridge between cognitive psychology and educational practice. Theory Into Practice. 2004; 43:268–273.A fascinating study on how the mechanisms of metacognition may be applied in education and provide a bridge between educational practitioners and academic researchers, resulting in a cross fertilization that may greatly foster the educational goal of critical thinking so valued in our society.

Dunlosky, J.; Metcalfe, J. Metacognition. San Francisco: Sage; 2008. A comprehensive textbook providing a thorough grounding in all aspects of human metacognition, both theoretical and applied.

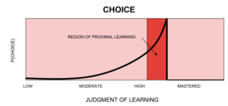

Fig. 1.

The relation between judgments of learning and study choice that are postulated by the region-of-proximal-learning framework. This framework says that people should decline study of the extremely high judgment-of-learning items, as shown on the far right of the graph, because these items have, almost certainly, already been mastered. If already-mastered items are eliminated from consideration, study choice should decrease as people's judgments of learning decrease, as shown. People should strongly prefer to choose items for study that are easy (have high but not extremely high judgments of learning), but are not perceived to be mastered. The region of proximal learning—where a small amount of time and effort should yield maximal learning gains—consists of items in the dark colored band, in which items are perceived to be close to being learned but are not yet thought to have been mastered.

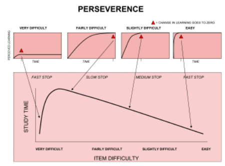

Fig. 2.
Study perseverance in the region-of-proximal-learning framework. In this framework, study of a given item stops when the perceived rate of learning approaches zero. The inset boxes show the functions, over time, of the person's perceived rates of learning for very difficult, fairly difficult, slightly difficult, and easy items. The triangles in each inset indicate the time at which the perceived learning function goes to zero and, hence, the time at which study will stop for that particular level of item difficulty. As is shown in the large bottom panel, the result is that the time to stop as a function of item difficulty varies, but not necessarily in a monotonic way. For extremely difficult (unlearnable) items the time to stop may be quite short, because the perceived rate of learning reaches zero quickly.