Individual Differences

Richard E. Mayer

Incorporating Individual Differences into the Science of Learning

Commentary on Sternberg et al. (2008)

Richard E. Mayer

University of California, Santa Barbara

Address correspondence to Richard E. Mayer, Department of Psychology, University of California, Santa Barbara, Santa Barbara, CA 93106; e-mail: mayer@psych.ucsb.edu.

ABSTRACT—Sternberg, Grigorenko, and Zhang (2008, this issue) make a valiant effort to reinvigorate the somewhat dormant field of cognitive style by showing the implications of cognitive style for instruction and assessment. In support of their call to differentiate instruction for different kinds of learners, they summarize evidence showing that people learn better from a broad instructional method that is sensitive to multiple cognitive styles than they do from a narrow instructional method that is mainly addressed to one cognitive style. In support of their call for using multiple measures of learning potential, they summarize evidence showing that learning outcomes are better predicted by multiple measures of learning potential than by a single measure. In this commentary, I briefly examine Sternberg et al.'s claim that cognitive styles matter for instruction and assessment.

Fifty years ago, Cronbach (1957) called attention to the role of individual differences in learning in his classic piece, *The Two Disciplines of Scientific Psychology*. In spite of Cronbach's eloquent appeal, the science of learning continues to focus mainly on explaining how learning works, without much regard for individual differences in how people learn. However, contemporary scholars remind us from time to time that any complete theory of learning must account for individual differences in how people learn. The latest reminder comes in Sternberg, Grigorenko, and Zhang's (2008, this issue) assertion that individual differences in how people learn are related to the design of instruction and the assessment of learning.

Sternberg et al. make a valiant effort to reinvigorate the somewhat dormant field of cognitive style by showing the implications of cognitive style for instruction and assessment. In support of their call to differentiate instruction for different kinds of learners, they summarize evidence showing that people learn better from a broad instructional method that is sensitive to multiple cognitive styles than they do from a narrow instructional method that is mainly addressed to one cognitive style. In support of their call for using multiple measures of learning potential, they summarize evidence showing that learning outcomes are better predicted by multiple measures of learning potential than by a single measure. In this commentary, I briefly examine Sternberg et al.'s claim that cognitive styles matter for instruction and assessment.

IMPLICATIONS FOR INSTRUCTION: A CALL FOR DIFFERENTIATED INSTRUCTION

Different kinds of learners should receive different methods of instruction. This straightforward proposal can be called the *differentiated instruction view*, and it is a major theme of Sternberg et al.'s article. In this section, I consider two questions concerning the nature of individual differences and the nature of the instructional methods in the differentiated instruction view.

First, how should we conceptualize and measure individual differences? Sternberg et al. make the case that individual differences in cognitive style should be a primary consideration. However, a major challenge is to develop consensus on a theory-based conceptualization of styles and a practical way of measuring styles—a challenge that has persisted for more than 30 years (Sternberg & Zhang, 2001).

Although, the authors focus on the role of individual differences in cognitive styles, the preponderance of existing research in the science of learning suggests that the single most important individual differences measure for learning is prior knowledge. If an instructor could know only one characteristic about a learner, the instructor would be best served by knowing the learner's level of domain knowledge. There is substantial evidence that instructional methods that are effective for low-knowledge learners may not be effective for high-knowledge learners (Mayer, 2001) or may even be detrimental for high-knowledge learners (Kalyuga, 2005). Kalyuga (2005) refers to this attribute-treatment interaction (ATI) involving learner knowledge as the *expertise reversal effect*.

Second, how do we differentiate instruction? A weak version of the differentiated instruction is that broader methods are better than narrow methods at promoting learning for all students. The rationale is that broader methods have features intended to promote

learning for multiple kinds of learning styles. As evidence for this version of the differentiated instruction view, the authors summarize research in which a broad method of instruction—which includes features intended for multiple kinds of learning styles—is more effective in producing learning than a narrow method of instruction—which uses a single approach for all learners. Although the broader-is-better findings are intriguing, they simply show that one instructional method is better for all learners.

In contrast, a strong version of the differentiated instruction view would be supported by attribute treatment interactions. As noted by Cronbach and Snow (1977) in their classic *Aptitudes and Instructional Methods*, the strongest evidence for the differentiated instruction view would be reflected in ATIs in which students with one kind of cognitive style learn best from one method of instruction and students with another kind of cognitive style learn best from another method. Evidence for ATIs involving cognitive styles is hard to find in the research that is highlighted in Sternberg et al.'s review. I also must confess, that my colleagues and I also were not able to find convincing evidence for ATIs in research in which we used pictorial or verbal instructional methods to teach electronics to learners with visual or verbal learning styles (Massa & Mayer, 2006).

In short, the call for differentiated instruction in which different kinds of students receive different kinds of instructional methods may be warranted for individual difference dimensions such as prior knowledge, but more convincing evidence is needed concerning cognitive styles. The current state of the field is that Sternberg et al. provide some compelling evidence for using broader methods of instruction that improve learning for all students.

IMPLICATIONS FOR ASSESSMENT: A CALL FOR MULTIPLE MEASURES

The best way to assess a person's learning potential is to use multiple measures rather than a single measure. This straightforward proposal can be called the *multiple measures view*, and it is a core theme in Sternberg et al.'s paper. For example, the SAT (which measures analytic skills, according to the authors) predicts college GPA, but the predictive power is nearly doubled by adding measures of other cognitive skills, such as creative and practical skills. The authors also report that although ethnicity is related to SAT scores, the differences based on ethnicity are greatly reduced by using a battery that includes the SAT along with the added cognitive tests. By broadening the assessment of learning potential, the impact of ethnicity was reduced and the predictive power was increased. The results reported by Sternberg et al. have important implications for the science of learning because they point to the need to broaden the conception of learning potential beyond conventional measures.

Although the case for multiple assessments is promising, continued work is needed on both theoretical and empirical grounds. The authors propose the theory of mental self-government, which offers a useful overarching metaphor, but more work is needed on creating a precise and testable theory of learning ability. They also focus on creative and practical skills as useful adjuncts to conventional measures such as the SAT, but research evidence is needed that examines whether adding other skills (such as spatial ability perhaps) would be as effective or more effective in a battery of tests that predict learning. The search for primary mental abilities has a long and confusing history in psychometrics dating back to the work of Thurstone and others (Carroll, 1993). Work is

needed to pinpoint which collection of mental abilities best predicts learning for which kinds of materials and which kinds of learners.

In summary, the authors are to be commended for their attempts to incorporate individual differences into the science of learning and, in particular, for their contributions to explaining how cognitive skills matter for instruction and assessment. However, the work is far from complete, particularly concerning whether different instructional methods should be used for learners with different cognitive styles and in determining which collection of cognitive skills best predicts school learning.

REFERENCES

- Carroll, J.B. (1993). *Human cognitive abilities*. New York: Cambridge University Press.
- Cronbach, L.J. (1957). The two disciplines of scientific psychology. *American Psychology*, 12, 671–684.
- Cronbach, L.J., & Snow, R.E. (1977). *Aptitudes and instructional methods*. New York: Wiley.
- Kalyuga, S. (2005). The individual differences principle in multimedia learning. In R.E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (pp. 325–338). New York: Cambridge University Press.
- Massa, L.J., & Mayer, R.E. (2006). Testing the ATI hypothesis: Should multimedia instruction accommodate verbalizer-visualizer cognitive style? *Learning and Individual Differences*, 16, 321–336.
- Mayer, R.E. (2001). *Multimedia learning*. New York: Cambridge University Press.

Sternberg, R.J., Grigorenko, E., & Zhang, L. (2008). Styles of learning and thinking matter in instruction and assessment. *Perspectives on Psychological Science*, 3, xxx–xxx.

Sternberg, R.J., & Zhang, L. (Eds.). (2001). *Perspectives on thinking, learning, and cognitive styles*. Mahwah, NJ: Erlbaum.