Foreword: The Next Phase in Multimedia Learning

Multimedia learning refers to learning from words and pictures. The words can be spoken or printed and the pictures can be illustrations, photos, animation, or video. Examples of multimedia learning include paper-based environments such as text and illustrations, computer-based environments such as animation and narration, and live environments such as a narrated PowerPoint presentation. If you want to create effective learning environments for students or effective training environments for trainees, you need to understand how to use words and pictures to promote learning.

As summarized in the table, there have been three major phases in research on multimedia learning. First, in work dating back to the 1980s and earlier, the major focus was on determining whether adding pictures to text would improve student learning. Research on this topic included studies of the role of illustrations in text, placing graphic advance organizers before lessons, and using scientific visualizations to help explain scientific concepts. As showcased in *Multimedia Learning* (Mayer, 2001), my colleagues and I have found strong and consistent evidence for what I call the *multimedia effect*: People learn better from words and pictures than from words alone. Thus, the first major accomplishment of research on multimedia learning was the creation of a research base supporting the multimedia effect. You can think of this phase as Multimedia Learning 1.0, in which the main goal has been to test for whether there is a multimedia effect.

Phase	Focus	Initial Period	Research Question	Example
Multimedia Learning 1.0	Search for an effect	Pre-1990s	Do pictures help?	Multimedia effect
Multimedia Learning 2.0	Search for design principles	1990s	Which features of multimedia help?	Spatial contiguity principle
Multimedia Learning 3.0	Search for boundary conditions	2000s	Under what conditions do features of multimedia help?	Expertise reversal effect

Early work culminating in persistent evidence for the multimedia effect was encouraging because it suggested that instructional designers could improve student learning by incorporating graphics into their lessons. However, it was clear that all forms of multimedia instructional messages were not equally effective, so the next step in multimedia learning research was to determine which features of multimedia instructional messages improved student learning. As shown in the second line of the table, in work largely underway in the 1990s, the major focus was broadened to include research on determining the features of effective multimedia. This work lead to the creation of principles for multimedia design, many of which are highlighted in *The Cambridge Handbook of Multimedia Learning* (Mayer, 2005). Exemplary principles include the *spatial contiguity principle* (People learn better when printed words are placed near rather than far from corresponding pictures on the screen or page), *coherence principle* (People learn when better when extraneous material is excluded rather than included), *modality principle* (People learn better when words are spoken rather than printed), and *personalization principle* (People learn better when words are in conversational style rather than formal style). You can think of this phase as Multimedia Learning 2.0, in which the main goal has been to test research-based principles of multimedia design.

We are now entering a third phase in research on multimedia learning in which the goal is to identify the boundary conditions under which the multimedia design principles apply. As shown in the third line of the table, in work largely underway in the 2000s, the focus has broadened once again to include research on determining when and for whom the principles apply. An important example of this phase is reflected in the *expertise reversal effect* (Kalyuga, 2005)—the finding that multimedia design principles that improve learning for low-experience learners may be ineffective or even harmful for high-experience learners. For example, an important boundary condition for the spatial contiguity principle is that the effect of spatial contiguity is strong for learners with low domain knowledge but not for learners with high domain knowledge (Mayer, 2001). Importantly, the boundary conditions can be used to test—and if necessary modify—theories of multimedia learning. You can think of this phase as Multimedia Learning 3.0, in which the main goal has been to establish the boundary conditions for multimedia design principles.

The book you are reading represents an important product of this emerging third phase of research on multimedia learning. In particular, Slava Kalyuga expands the field of multimedia learning by focusing on the role of learner's prior knowledge. He shows how learning is improved when multimedia principles are adapted to the knowledge level of the learner. His thesis is that instructional designers need to know what the learner knows (through embedded assessments) and to modify the lesson accordingly (through adaptation of instruction). In short, different instructional methods should be used for low-knowledge learners and high-knowledge

learners, or as an individual learner progresses from low- to high-knowledge in a domain. The challenge facing instructional designers is how to encourage learners to engage in productive cognitive processing during learning without creating cognitive overload. Slava Kalyuga shows how this goal can be achieved by being sensitive to the knowledge level of learners.

In short, the book you are holding is a prime example of Multimedia Learning 3.0—the newest phase in multimedia learning research. A commendable hallmark of the book is that the author takes an *evidence-based approach*—by basing the book on scientific research findings, and a *theory-based approach*—by basing the book on research-tested theories of how people learn from words and pictures. If you are interested in the latest trends in multimedia learning, then *Managing Cognitive Load in Adaptive Multimedia Learning* belongs on your bookshelf.

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REFERENCES

Kalyuga, S. (2005). The prior knowledge principle. In Mayer, R. E. (Ed.). *The Cambridge handbook of multimedia learning* (pp. 325-338). New York: Cambridge University Press.

Mayer, R. E. (2001). *Multimedia learning.* New York: Cambridge University Press.

Mayer, R. E. (Ed.). (2005). *The Cambridge handbook of multimedia learning.* New York: Cambridge University Press.

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