Multimedia Learning

Second Edition

For hundreds of years verbal messages such as lectures and printed lessons have been the primary means of explaining ideas to learners. Although verbal learning offers a powerful tool, this book explores ways of going beyond the purely verbal. Recent advances in graphics technology have prompted new efforts to understand the potential of multimedia and multimedia learning as a means of promoting human understanding. In *Multimedia Learning, Second Edition*, Richard E. Mayer asks whether people learn more deeply when ideas are expressed in words and pictures rather than in words alone. He reviews twelve principles of instructional design that are based on experimental research studies and grounded in a theory of how people learn from words and pictures. The result is what Mayer calls the cognitive theory of multimedia learning, a theory introduced in the first edition of *Multimedia Learning* and further developed in *The Cambridge Handbook of Multimedia Learning*.

Richard E. Mayer is Professor of Psychology at the University of California, Santa Barbara, where he has served since 1975. He is the author of *Multimedia Learning* (Cambridge University Press, 2001) and editor of *The Cambridge Handbook of Multimedia Learning* (Cambridge University Press, 2005). In 2008 he received the American Psychological Association's Distinguished Contributions of Applications of Psychology to Education and Training Award.

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Dedicated to Beverly

Contents

Preface

Multimedia instruction refers to presentations involving words and pictures that are intended to foster learning. How can we design effective multimedia instruction? In this book I review twelve principles of instructional design that are based on experimental research studies carried out by my colleagues and me and that are grounded in a theory of how people learn from words and pictures, which I call the cognitive theory of multimedia learning. In short, the premise underlying this book is that the design of multimedia instruction should be based on research and grounded in theory. If you are interested in an evidenced-based and theory-grounded approach to multimedia design, then this book is for you.

For hundreds of years, verbal messages – such as lectures and printed lessons – have been the primary means of explaining ideas to learners. Although verbal learning offers a powerful tool for humans, this book explores ways of going beyond the purely verbal. An alternative to purely verbal presentations is to use multimedia presentations in which people learn from both words and pictures – a situation that I call *multimedia learning*. Recent advances in graphics technology have prompted new efforts to understand the potential of multimedia as a means of promoting human understanding – a potential that I call *the promise of multimedia learning*. In particular, my focus in this book is on whether people learn more deeply when ideas are expressed in words and pictures rather than in words alone.

Multimedia encyclopedias have become the latest addition to students' reference tools, and the Internet is full of messages that combine words and pictures. Educational games, interactive simulations, and online pedagogical agents are touted as the wave of the future in education and training. Do these multimedia forms of presentation help learners? How do people learn from words and pictures? What is the best way to design multimedia messages?

These are the kind of questions prompted by advances in information graphics technology. My premise in this book is that the answers to these questions require a program of careful, systematic research. To understand how to design multimedia messages, it is useful to understand how people learn from words and pictures.

During the past twenty years, my colleagues at Santa Barbara and I have been conducting research studies on multimedia learning. This book provides a systematic summary of what we have found. The outcome is a set of twelve principles for the design of multimedia messages and a cognitive theory of multimedia learning. In short, this book summarizes research aimed at realizing the promise of multimedia learning – that is, the potential of using words and pictures together to promote human understanding.

People learn better from words and pictures than from words alone. This is the thesis I investigate in the book you are holding. This straightforward statement is what got me started doing research on multimedia learning in the first place, and it has sustained my interest over two decades and nearly 100 experimental comparisons. In short, I began with curiosity about whether people learn more deeply from a verbal lesson when graphics are added. This curiosity prompted questions about whether value is added when we incorporate graphics into a verbal lesson, under what conditions graphics improve learning, and how graphics help people learn. If these questions also pique your interest – and you want some research-based answers – then this book is for you.

Multimedia Learning, Second Edition, is intended for anyone who is interested in the scientific underpinnings of multimedia learning. This book could be used in courses across the university, including courses in psychology, education, and computer science, as well as in specialties such as educational technology, instructional design, applied cognitive psychology, and human-computer interaction. I do not assume that the reader has any previous knowledge of psychology, education, or technology. I do assume that the reader is interested in the promise of multimedia learning – that is, in understanding how to tap the potential of multimedia messages for improving human understanding.

This book has both a theoretical and a practical orientation. On the one hand, it is aimed at those with interests in basic theory and research in the cognitive psychology of how people learn from words and pictures. On the other hand, it is aimed at those with practical interests in designing effective multimedia presentations. If you are interested in the theoretical or practical bases of multimedia learning (or a combination of the two), then this book is for you.

Writing this book has been my labor of love. I hope that you enjoy reading it as much as I have enjoyed writing it. If you have

any comments or suggestions, I would like to hear from you at <mayer@psych.ucsb.edu>.

WHAT'S NEW IN THE SECOND EDITION?

The first edition of this book, published in 2001, appeared when the field of multimedia learning was still in its childhood. Since then, the research base and theoretical base of multimedia learning have continued to grow, as is indicated by numerous special issues of journals highlighting multimedia learning and numerous edited books on multimedia learning. In 2005, I had the privilege of editing *The Cambridge Handbook of Multimedia Learning*, which contains thirty-five chapters by leading multimedia researchers around the world who were charged with highlighting empirical research on multimedia design principles. Portions of this second edition of *Multimedia Learning* are based on corresponding chapters in the first edition of *Multimedia Learning* and on my four chapters (2005a, 2005b, 2005c, 2005d) in *The Cambridge Handbook of Multimedia Learning*.

There are four major changes in the second edition – concerning the growth of the research base, the growth in the number of principles, the theoretical reorganization of the principles, and the boundary conditions of the principles. First, our research base has more than doubled: In the first edition, I reported on forty-five experimental comparisons involving transfer test performance carried out by my colleagues and me, whereas in this edition that number has increased to ninety-three experimental comparisons. Second, the number of principles has increased from seven to twelve. Six original principles are retained in the second edition: coherence, redundancy, spatial contiguity, temporal contiguity, modality, and multimedia principles. Six new principles are added: signaling, segmenting, pre-training, personalization, voice, and image principles. One of the original principles – the individual differences principle – is recast as a boundary condition (i.e., the individual differences condition is the idea that design principles that are effective for beginners may not be effective for more experienced learners).

Third, the underlying theory has been expanded to incorporate the triarchic model of cognitive load, which consists of extraneous, essential, and generative cognitive processing. Correspondingly, the twelve principles of multimedia instructional design have been reorganized into three sections – reducing extraneous processing, managing essential processing, and fostering generative processing. Although the main focus of the first edition was on reducing extraneous processing, the

second edition adds new foci on managing essential processing and fostering generative processing. Finally, an indication of the maturity of the field is that the second edition highlights *boundary conditions* for each principle – research-based constraints on when a principle is likely or unlikely to apply. The boundary conditions are interpreted in terms of the cognitive theory of multimedia learning, and help to both test and enrich theories of multimedia learning. A focus on boundary conditions is consistent with the idea that principles of multimedia design must be applied in light of an understanding of how people learn.

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I appreciate the excellent research environment in the Department of Psychology at the University of California, Santa Barbara, as well as the opportunity to interact with a talented group of students and professors. Throughout my thirty-three years at UCSB, I have always enjoyed the opportunity to pursue research issues that come my way. I fondly acknowledge the influence of my parents, James and Bernis Mayer, who instilled in me a love of learning and helped me appreciate the indispensable value of intellectual honesty, hard work, and boundless curiosity. Their memory is never far from my thoughts. I appreciate the interest of my children – Ken, Dave, and Sarah – who often asked, "How's the book doing?" They have brought much light into my life, as has our new grandson, Jacob. Finally, this book would not have been possible without the encouragement and support of my wife, Beverly. I am pleased to dedicate this book to her, with love.

Finally, I gratefully acknowledge the contributions of the staff at Cambridge University Press.

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