A Multimedia Program in Associative Learning

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In this article, I describe a multimedia program in associative learning, resident on CD–ROM, available for Macintosh computers. The program uses HyperCard (1993) and consists of 70 minilectures grouped into 9 chapters. Each minilecture consists of an audio track, bullet charts, quotes, graphs, pictures, animations, and photographs; most contain one or more video clips. The text for each minilecture is available on an adjacent card. Student performance on objective tests suggests that the software is useful.

As class sizes increase and demands on faculty rise accordingly, it is imperative to develop alternative methods for covering academic material. A textbook has been the traditional vehicle for presenting information. The advent of computer-based multimedia provides an alternative to the traditional textbook. I describe a multimedia program developed to cover the basic concepts in the area of associative learning.

Research on memory suggests that people better remember material when they encode it both verbally and visually (Paivio, 1971). Furthermore, Bower, Karlin, and Dueck (1975) demonstrated that people can remember visually-presented material better, especially when they can create a meaningful context for the material. Multimedia provides the instructor with a dynamic presentation medium for teaching complex concepts.

Computer-based multimedia is a recent development. Thus, there are few, if any, production standards, and authors have to learn what promotes student learning by user-testing. The two most important decisions I made were to use HyperCard (1993) and to present the program in an essentially linear fashion. I based these decisions on the need for the program to be as responsive as possible and to constrain the user's ability to branch. The program meets both of these objectives; it is fast, and the speed enables users to move quickly from one module to another.

I began the project by writing outlines for nine chapters, which appear in Table 1. Furthermore, each chapter consists of a number of minilectures. There are important differences between these minilectures and a normal lecture. First, the minilectures range in duration from 30 sec to 5 min. Essentially, the minilectures present one concept and use a variety of supporting material to get that concept across. Second, minilectures are perfect every time; the professor makes no errors in the verbal presentations. Third, minilectures present supporting material at exactly the right moment. Fourth, because each minilecture is a self-contained video clip, the user can fast forward, rewind, single-frame forward or backward, or freeze the film.

Most of the minilectures follow the same format. For example, a minilecture describing Groves and Thompson's (1970) dual-process theory of habituation begins with an unfolding bullet chart describing the S–R pathway and the state system that together determine an animal's response to a stimulus. Next, the lecture presents Davis's (1974) test of the theory using the startle response in rats. Given that most undergraduate students do not know what the startle response is, a brief video clip shows a rat jumping and then freezing when it hears a loud noise. Finally, students see animated charts of the putative changes in the S–R pathway and the state system and the observed startle response. The first animation shows what happens when a loud tone occurs against a quiet background (i.e., habituation). The second illustrates the changes that occur when the same tone sounds against a noisy background (i.e., sensitization). These demonstrations include the appropriate sound effects.

The minilecture on tolerance as an associative phenomenon begins by noting that a drug is an unconditioned stimulus that elicits a number of unconditioned responses (e.g., morphine elicits hyperalgesia, as indexed by the paw-lick latency response in the rat). To provide students with context, they see a rat on a hot plate after being injected with saline and a second clip illustrating the increase in paw-lick latency following an injection of morphine. Students can measure the clear difference in reaction time using a stopwatch. Tolerance is then defined in the context of the change in paw-lick latency following repeated injections of morphine. An animated chart illustrates the outcomes of Siegel's (1975) Experiment 1. Siegel's explanation of tolerance in terms of a conditioned compensatory response follows. Finally, the outcome of Experiment 2 (Siegel, 1975), which directly tests the theory, is illustrated.

As a final example, discrimination training is introduced in the chapter on Generalization and Discrimination. The minilecture begins with a description of discrimination training in Pavlovian conditioning, in which a picture of a woman follows a cat's meow, and a blank screen follows a dog's bark. To avoid accusations of sexism, pictures of men follow a cow's moo, and a blank screen follows a ringing bell. To illustrate discrimination training in operant conditioning, a video clip follows of a bird (blue tit) pulling out red match sticks from a board. The release of a peanut occasionally follows the removal of the red match sticks. In contrast, the blue tit ignores blue match sticks, the removal of which have no consequence. Finally, Walker and Bitterman's (1989) demonstration of the ability of bees to detect and use magnetic fields as discriminative stimuli illustrates the power of discrimination training as an investigative tool.

Some students may not wish to listen to a sound track. I have provided two alternatives for such users. First, the entire script is on the CD–ROM in text format. Thus, a user can

Table 1. The Chapter Headings and Their Contents

Chapter	Contents
The Beginnings (1)	René Descartes
	Thomas Hobbes
	John Locke
	David Hume
	Herbert Spencer
	Ivan Pavlov
	John Watson
	B. F. Skinner
Habituation and Sentzation (2)	Habituation
	Dishabituation
	Stimulus intensity and sensitization
	Sokolov's comparator model
	Groves and Thompson's dual-process theory
Pavlovian Conditioning	Unconditioned stimulus and unconditioned response
Basic Principles (3)	Conditioned stimulus and conditioned response
	Acquisition and extinction
	Temporal relationships between the CS and the US
	Extinction and inhibition
	Latent inhibition
	Higher-order conditioning
	Overshadowing
	Sensory preconditioning
	Blocking
Pavlovian Conditioning	Long-delay learning
Theories and applications (4)	Contingency theory
	The Rescorla–Wagner model
	Tolerance as an associative phenomenon
	Conditioning and the acquisition of phobias
	Counter-conditioning and the removal of phobias
	Aversive counter-conditioning
Operant Conditioning: Reinforcement (5)	Techniques for studying operant behavior
	Definition of reinforcement
	Shaping
	Schedules of reinforcement
	Fixed ratio reinforcement
	Variable ratio reinforcement
	Fixed interval reinforcement
	Variable interval reinforcement
	Magnitude of reinforcement
	Extinction
	Negative reinforcement
Theories of reinforcement (6)	Learning—mechanistic or cognitive?
	Insight—Köhler's chimpanzees
	Actions and habits
	What is a reinforcer?
	A behavioral regulation theory of reinforcement
	The matching law
Operant conditioning: Punishment (7)	Positive and negative punishment
	Response-contingent versus response-independent
	Delay of punishment
	Intensity of punishment
	Generalization of punishment
	Providing an alternative unpunished response
	Theories of punishment
Generalization and discrimination (8)	Discrimination
	Stimulus generalization
	Sharpening stimulus generalization
	Inhibitory versus excitatory stimulus generalization
	Is a signal for non-reinforcement aversive?
	Errorless discrimination learning
	Project "Sea Hunt"
Biological influences on learning (9)	Biological constraints on learning
	Applications of taste aversion learning
	Conditioning and cancer chemotherapy
	Autoshaping and misbehaving animals
	Preparedness and phobias
References	
Acknowledgements	
Credits	

print the script and sit in front of the computer, working with all of the audiovisuals but without the soundtrack. Second, if the user wishes to consult this information on an irregular basis, the text for each of the movie cards is placed in an adjacent card. Controls are available to allow the user to toggle between the text card and the movie card.

To measure the success of the CD–ROM in achieving the objectives that I had in mind, I compared the performance of two cohorts of students on three multiple-choice tests. The 1995 group ($n = 60$) sat through normal lectures, whereas the 1997 group ($n = 95$) covered the material using the CD–ROM. The live lectures were associated with higher scores on the early tests, but this difference disappeared on later tests (Test 1, 68.5 vs. 60.2; Test 2, 65.2 vs. 59.9; Test 3, 71.6 vs. 69.9). A mixed model ANOVA, with repeated measures on Test, yielded significant effects of Group, $F(1, 153) = 7.97$, $MSE = 359.42$, $p < .01$; Test, $F(2, 306) = 23.10$, $MSE = 359.42$, $p < .01$; and a Group × Test interaction, $F(2, 306) = 4.25$, $MSE = 96.29$, $p < .05$. Three points are important. First, because most of the students in the 1997 group did not have Macintosh computers at home, the only time they could work with the CD–ROM was during scheduled class times, and the 1997 group spent less time using the CD–ROM than the 1995 group spent listening to the live lectures. Second, as indicated by the Group × Test interaction, the differences between the groups became smaller across the three tests. Indeed, by the third test, the differences were nonsignificant ($t < 1$). One might expect these outcomes, given that this was the 1997 groups' first experience of using a CD–ROM as an educational vehicle. The minilectures provided a learning experience that was different from anything the students had experienced before, and the students took time to adapt to the minilectures. Third, the subject was an elective for the 1995 cohort, whereas it was compulsory for the 1997 cohort. In sum, I believe that the CD–ROM achieved its educational objectives.

Faculty and students can use the CD–ROM in a number of ways. Some lecturers may wish to use it and a textbook as the basis for an entire course. Some lecturers may wish to lecture as they do now but employ the many graphics provided in their lectures. Others may provide access to the CD–ROM in much the same way that they refer students to a textbook. All would be appropriate uses.

References

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Notes

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2. Thanks to Dr. Charles Hart for producing the first version of the HyperCard stack and for his enthusiasm and knowledge of all things Macintosh. Thanks also to all those who provided film and other material.

3. Interested parties can obtain evaluation copies of the CD–ROM for personal use, free of charge, by writing to the author. A Power Macintosh or 68040, with 8 (preferably 16) megabytes of memory, HyperCard 2.2 or greater (complete or runtime version), and QuickTime 2.0 or greater, are required to run the CD–ROM.
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