Overview

The main tenet of this theory states that when a learner is presented with both verbal and pictorial information during multimedia instruction this will yield a positive learning result. As defined by Mayer (2005a), one of the pioneers of the theory, “multimedia learning occurs when people build mental representations from words…and pictures” (p. 2). This cognitive-based theory is guided by “three assumptions” which are “dual-channel”, “limited capacity” and “active processing” (Mayer, 2005b, pp. 32). The following is a brief description of these assumptions.

First, the dual-channel concept states that humans receive information during multimedia instruction on two separate but simultaneous tracks; auditory and visual. Second, the limited capacity assumption states that we have definable limits on the amount of information we can hold in short-term memory. Because of this limitation, instructional designers must be aware of the cognitive load of the product so as not to overwhelm the students by including extraneous information. Last, the active processing assumption posits that “humans are active processors who seek to make sense of multimedia presentations” with the cognitive end-goal of formulating a “coherent mental representation [model]” (Mayer, 2005b, p. 36). If learners cannot create an adequate mental model of the information, due to content disorganization, excessive cognitive load, and/or lack of continuity, then cognitive dissonance naturally occurs. This dissonance creates process confusion forcing the student to use additional psychic energy to just make sense of the content which reduces learning.
The rest of this paper will discuss two of the main contributors, five major principles, and an example of the application of multimedia learning theory (MLT).

Contributors

As mentioned, the leader in the field is Professor Richard E. Mayer from the University of California, Santa Barbara. Mayer has led much study and collaboration and has written voluminously about the subject. In fact, “during the past two decades he and his colleagues have conducted over 100 experimental tests leading to 12 research-based principles for how to design on-line learning environments and computer-based games” (UCSB, 2012a). Moreover, Mayer “is the author of more than 400 publications including 25 books” on the subject and continues to research, write, teach, and collaborate (UCSB, 2012b).

Another important contributor to the theory, and one who has worked with R. E. Mayer on many projects, is Ruth Colvin Clark. This contributor collaborated with Mayer on *E-learning and the Science of Instruction* (2008). This publication is in its third edition and been used in many classrooms as an instructional tool since its release. Presently, Dr. Clark owns a training agency in southern California and continues to research and write on the topic.

Major Principles

**Modality Principle.** This is the evolution of the split-attention effect theory which states that “students learned better when pictorial information was accompanied by verbal information presented in an auditory rather than a visual modality” (Mayer & Moreno, 1998, p. 318). The modality principle “states that people learn better from graphics and narration than from graphics and on-screen text” (Harskamp, Mayer, & Suhre, 2007, p. 465).

**Contiguity Principle.** This principle informs designers that it is important to “coordinate printed words and graphics” in multimedia presentations (Clark & Mayer, 2008, p. 93). There are
also two subcategories of this theory. The first one states that designers should always “place printed words near corresponding graphics” (p. 93). If this is not done then students may not associate the graphical information with the text and as a result not learn the material. The second contiguity principle informs designers to “synchronize spoken words with corresponding graphics” (p. 102). This is important because if the voice/sound is not aligned with the graphics/video then students will become disoriented. For example, have you ever watched a television show or movie where the voice track did not exactly match the film? If so, then you know that this causes confusion in the average human brain and we all turn the channel quickly in order to escape the disorientation. The same effect can occur in a multimedia presentation with weak contiguity, which undoubtedly has a negative effect on the transfer of learning.

**Coherence Principle.** This principle states that designers should “avoid adding any material that does not support the instructional goal” (Reiser & Dempsey, 2007, p. 151). Further, there are three subcategories of this principle which inform designers to “avoid e-lessons with extraneous audio”, “graphics”, and “words” (pp. 153-166). This is a straightforward concept to understand but in practice many designers make the mistake of adding too much content. The goal of the instruction should be to teach the learner the material in a parsimonious manner and not inundate them with excessive content. For example, the “paradox of rich media” states that nowadays designers have the capability to “deliver information to learners than learners have [the] psychological capacity to assimilate that information.” Given this prior point, designers should understand that content “only benefit learners to the extent that its capabilities are harnessed in ways that support human cognitive learning processes” (p. 312).

**Redundancy Principle.** The name of this theory actually describes what designers do not want to happen in a presentation which is “redundant on-screen” and “spoken text.” This is
considered a cardinal rule in e-learning as theorists found that “people learn better from concurrent graphics and audio than from concurrent graphics, audio, and on-screen text” (p. 133). In other words, when narrating a presentation do not read the text on the screen because when you do this you are using the visual and auditory tracks for delivering the same information.

**Application**

In a prior instructional technology class, one of the final projects was to construct a Web-based standalone tutorial, employing elements of MLT, and then administer to a small sample population which included an assessment. For analysis, the ADDIE model was used and included the need for instruction, a learner definition, the goals and objectives, a navigational chart, and 31 storyboards. This 12-minute tutorial presented company information to new hires that included the supplies, duties, and behaviors required.

The main goal of the design was to keep cognitive load at a low rate. This was done because cognitive load theory “assumes a limited working memory that stores about seven elements but operates on just two to four elements. It is able to deal with information for no more than a few seconds with almost all information lost after about 20” (van Merrienboer & Sweller, 2005, p. 148). Reducing cognitive load allows for effective encoding of the material and because of this the text, narration, video and graphical representations were of a basic design.

Admittedly, there was one mistake in the design phase as the voiceover, in many instances, read the text presented on the screen verbatim which contradicts both the *modality principle* and the *redundancy principle*. This was a valuable lesson learned and a mistake that will not occur again during design. Regardless of my own ineptitude, this type of methodology
was successful in this business context as the participants scored a high rate of recall, over 90%, after completing the 15 question posttest.
References


