The Coherence Principle:

An Analysis of Multimedia Learning Principles

Thomas Robb

Boise State University
Clark & Mayer, (2008) state that according to the coherence principle, when designing multimedia instruction “you should avoid adding any material that does not support the instructional goal.” More specifically, to expand this short version, would be the avoidance of extraneous audio, graphics, and words that are not directly related to learning. In all three cases, research has shown that learners have performed much worse on transfer assessments when adding more than what relates to the instructional goal.

Understanding the coherence principle is more fully understood when one examines the idea of cognitive theory of multimedia learning. Mayer (1999) defines this as the “the idea that humans have separate visual and verbal information processing systems.” Further, these two systems are highly limited. Lastly, meaningful learning involves active processing (cognitively) where learners must take information stored in short term memory and find relevance with existing prior knowledge by making “connections between visual and verbal representations”.

Again, the coherence principle is one in multimedia learning that states that extraneous audio, graphic, and text should be removed when they are not directly related to the goal of the multimedia lesson. In the case of audio, background music and sounds can overload working memory and are considered dangerous when a learner “may experience heavy cognitive load.” Overload can happen when a learner is considered a low performer or when the learner does not have much, if any, existing prior knowledge about the subject. For learners that may have existing prior knowledge, this simply becomes extraneous information to process; thereby putting a higher load on their working memory and leaving less for additional processing. In the case of graphics, one can easily add extraneous information with vast supply of graphics and video on the web. Some may argue that the addition of these graphics can support learners
coming into a lesson with existing prior knowledge; otherwise the risk is that these learners will be less aroused (bored). The coherence principle does not say that extraneous graphics are harmful; however, as is the case with extraneous audio, Clark & Mayer, (2008) assert that they are disruptive of the learning process. In fact many math and science books do just that. They decorate the page, but have little if anything to do to support the instructional goal. In other words, cognitive theory of multimedia learning states that “the learner is actively seeking to make sense of the presented material.” When a learner cannot make sense of extraneous pictures, while potentially enjoyable, learning is distracted and/or disrupted for unnecessary reasons. Lastly, in the case of extraneous words, the coherence principle recommends avoidance of extra text on a screen. Sometimes, extra words are added for interest, to expand on key ideas, or for technical depth. Studies have shown that, if the extra words are for any of these three purposes, then they should be avoided as studies demonstrate these actually are harmful to learning.

Moreno and Mayer (2000) conducted a study of seventy-five college students where students were given background music or environmental sounds in addition to multimedia presentation. The question was whether or not the background music supported or distracted from learning. In the case of environmental sounds (talking or general noise), learners had no difference in transfer tests, where students that had actual music performed far less on transfer tests than students that did not. This study seems to open more questions about whether learners can hold and process new information when there is extraneous sound. The question seems to be whether the extraneous sound is intentional, such as the case with music and points out a possible limitation with the coherence principle. What does seem consistent with Clark & Mayer, (2008) is that “Students learn better when extraneous material is excluded rather than
included in multimedia explanations.” A good example would include the addition of screeching 
brakes in the background of a lesson on how to replace brake pads. Many in the field of 
education may feel that the screeching brakes could support (or arouse) the interest of certain 
learners, it has little to do with how to replace brakes.

What seems consistent with the coherence principle when compared with other 
multimedia learning principles asserted by Clark & Mayer, (2008) is that less is more. On 
exception to this rule would be the multimedia principle. The multimedia principle states that 
learners perform better when presented with words and graphics rather than words alone. The 
contiguity principle takes this one step further in stating that words should be placed strategically 
close to corresponding graphics rather than far below, above, or in another location than the 
graphic itself. The modality principle states that one should narrate words rather than post all 
text on the screen. The redundancy principle states that visuals should be explained with words 
as either audio OR text rather than both. In other words, the preferred and researched based way 
to present information is to narrate it with audio; however do not couple the audio with on screen 
text.

The common theme between all of these principles is that they all support the idea of 
prevention of cognitive overload. In other words, the essence of designing multimedia 
presentations are in the way that the visual and auditory channels “capture” incoming 
information in order to make sense of the it, connect it to existing knowledge and storing it in 
long term memory. In the case of the contiguity principle, learners should spend less 
“extraneous processing” and can do so when text and graphics are in close proximity to each 
other rather than separated. When the modality principle is applied, this takes extra words off of
The page by placing that information in the auditory channel rather than completely relying upon visual to process both graphics and what could be channeled to a different processing area. The redundancy principle safeguards cognitive overload by preventing the same information being delivered to the same auditory or visual channel. The coherence principle is similar to the contiguity and modality principles in lessening information that could potentially overload or provide for extra processing time by removing what is separate from the instructional goal altogether from the multimedia presentation.

A limitation with the coherence principle can be seen where little evidence exists about the application of this principle to learners with higher existing knowledge about the subject. Clark & Mayer, (2008) state that “we do not know much about how individual characteristics of learners are related to the effectiveness of the coherence principle.” Sometimes, instructional design that works for beginners may not work for more advanced learners as has been seen with studies in 2005. One other limitation of this principle can be seen when designers are attempting to motivate their learners to be interested in a specific subject. Sometimes, audio, graphics, and certain text can actually gain a learner’s interest in a subject that may be particularly boring. The challenge here is in a balance between avoiding extraneous materials that would be detrimental to learning with potentially arousing materials that could gain interest or potentially further learning. Clark and Mayer contend that more research is needed at gaining interest while being sensitive to cognitive processing limitations.

I have attended many workshops over the years where many principles, including the coherence principle is violated. We had a math instructor that used Powerpoint animation to aid in the understanding of certain principles of math. One particular example I remember is how
she represented the idea of the base-10 numbering systems by having a blue rectangle consisting of 5 rows and 2 columns. As she explained ways to foster true understanding of the “tenness of 10” would be to have students think of ten as a rectangle of 5 rows and 2 columns or 10 rows and 1 column. While the visual helped understand how 10 of these blocks equaled one hundred, she added extra sounds (which were different each time) when one of these blue rectangles flew onto the screen. They were both distracting and unnecessary in learning. Also, she often violated the contiguity principle when she placed text at the bottom of the screen rather next to each colored rectangle (a legend of sorts) where I found myself looking all over the screen.

In all, I personally believe in the idea of adding only relevant information that supports the way learners learn. The rule of thumb that “less is more” is something I will use when I develop an upcoming workshop I intend to title “Multimedia Principles for Online Instructors”. I train our distance education faculty on ways to design their multimedia to support their students learning. I intend to overview these principles and provide visual elements where they apply using language directly quoted by Clark and Mayer (2008). While there are some pitfalls with what is not supported in research, each of these principles are easily tied to controlled studies. I like that I can reference studies specifically within the *E-Learning and the Science of Instruction* textbook when instructors question the assertions I make when guiding them towards developing a multimedia using principles that prevent cognitive overload. Often times, when talking one-on-one with instructors, I find that they have added certain elements to their presentation because someone showed them how to do it. This was the case with animations, sounds, and certain graphics. In other words, they learned the procedure for adding animation, but never gave much thought into how that would affect the learner’s ability to process the information. When
explaining that designers intentionally place graphics or text in a certain way, I usually do not see much in terms of disagreeing that the extraneous information could be removed.
References

