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The evolution of multimedia sound

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Abstract

Multimedia sound is both durable and resistant to interference and forgetting. Yet sound alone is insufficient to learn from multimedia, hence the need for purposeful advice on how to enhance learning from technology with sound. The advice ranges from descriptions of the playback system to balancing the input to structuring the function of a sound. This paper describes five functions and three structures for multimedia sound that when combined can help students to focus their attention on important visual events in a multimedia learning environment.

Keywords: Multimedia; Sound; Modality; Attention; Reading; Listening; Media; Audio; SSF model

1. Introduction

In practical terms sound can be used either within a design framework or as a job aid for the teacher or student, media professional or researcher, software or instructional designer. The end product can be a scripted procedure or a heuristic for helping end-users to control their attention during multimedia learning. *Heuristic* is taken here in its functional sense, rather than the computer modeling sense (Bregman, 1989). The value in giving a sound a structure and purpose in multimedia resides in the potential contributions to research and development in cognitive psychology, instructional technology and user-interface design. This paper begins with a rationale for including sound in models and theories of instructional design and is followed by an overview of the search for design guidelines. In Section 4 the two dimensions in the original SSF model are introduced. Section 5 describes changes to the original model and the factors affecting those changes. This account is followed in Section 6 by an explanation of the revised SSF model.

2. The problem

A persistent problem in learning from multimedia is that students ignore or forget to read important instructions and feedback presented in text or other visual displays (Ragsdale, 1988), the way illustrations and pictures are ignored, regardless of their intended function, and unless they were instructed to do so

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(Pettersson, 1990; Reinking, 1986, 1987). "Many learners do not notice the option to read directions or will try to save time by skipping them" (Alessi & Trollip, 1991, p. 22). Feedback following an error is more interesting than feedback following a correct response (Ragsdale, 1988). "Although aesthetically pleasing, feedback provided in text will go unnoticed by the student" (Alessi & Trollip, 1991, p. 72). Student enjoyment of multimedia has been either uncorrelated or negatively correlated to learning outcome (Clark, 2001; Clark & Feldon, 2005). Unlike entertainment multimedia, educational multimedia required reading and listening to instructions and feedback presented in the program or website.

Although there are well-documented methods of designing visual instruction to control attention (e.g., Carney & Levin, 2002; Rieber, 1994; Zahn, Barquero, & Schwan, 2004), this paper is only concerned with instructional design solutions that require sound. Sound can provide a context for learning from multimedia, especially for poor and beginning readers. Whereas good readers can use their context-free word recognition skills, poor and beginning readers use repetitive sentence context. Poor readers gain more from context than good readers, consistent with Stanovitch's hypothesis (Goldsmith-Phillips, 1989; Nickerson, 1991; Swantes, 1991; Yeu & Goetz, 1994).

3. The rationale for sound

A strong rationale for using sound in the design of multimedia is that "memory for material presented in sound is more durable and resistant to interference from other modalities than visually-presented material, and more resilient to forgetting than visual traces" (Broadbent, Vines, & Broadbent, 1978 in Baddeley, 1986, p. 42). Neurological evidence shows that sound stimulation can evoke responses in visual areas of the brain, even in very young children (Goswami, 2004). O'Leary and Rhodes (1984) reported that when babies listened to an audio recording of one woman from a speaker located halfway between two videos of different women speaking simultaneously, the babies preferred to watch the face that belonged with the voice they were hearing. The babies shifted their attention until they associated the sound with the visual event. Young children will also use sound to monitor television programs for critical or comprehensive content to which they will then attend visually (Seels, Fullerton, Berry, & Horn, 2004).

Likewise multimedia learning experiments with adults (mostly undergraduate psychology majors and preservice teachers) showed that they learned better from illustrations when the accompanying verbal information was heard, rather than read because the instructional material did not require them to split their attention between multiple sources of mutually referring information (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1999; Mayer & Moreno, 1998; Moreno & Mayer, 2000). When post-secondary students watched an animation, they learned more when verbal information was narrated rather than left as on-screen text (Mousavi, Low, & Sweller, 1995). Mayer and Moreno (1998) reported that college students learned better when information with animation was presented as speech rather than on-screen text both for concurrent and sequential presentations. These students generated 50% more creative solutions on problem-solving questions from animation with narration, than those with animations and text. Mann (1997a) also found that university students learned better from some text with speech and diagrams, than from either speech and diagrams, or text and diagrams. In protocol analysis research, Mann (1995a, 1995b) determined that university students working with speech and diagrams made more evaluative-level verbalizations than those with text and diagrams.

Reports like these about the durability of sound and its resistance to interference and forgetting provide support for including sound in multimedia. However, sound *per se* is not sufficient to consistently effect learning from multimedia. Multimedia learning is more than synaptic responses to sensory stimulation. Designers must decide if audio should replace or enhance the on-screen text (Barron & Kysilka, 1993). "A systemic model for designing sound is required, "designer sound for computer systems" (Buxton, 1989, p. 1), purposeful advice on the design of instruction for multimedia learning based on learning theory (Koroghlanian & Klein, 2004; Mayer, 2001). Hence the need for design guidelines.

4. Design guidelines and definitions of multimedia learning

A researcher's opinion about how a student learns from multimedia can influence their choice of design guideline. Likewise the choice of design guideline can be seen to be a reflection of their working definition