

The Application of Sound and Auditory Responses in E-Learning

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INTRODUCTION

Prior to computer technology, several studies have concluded that multiple senses engage the learner to the extent that a person remembers 20% of what they see, 40% of that they see and hear, and 70% of what they see, hear and do. In general, the participant engages what is seen and what is heard. With this implication, instructional designer or developers try to use design guidelines to identify the main uses of sound in e-learning as multimedia agents to enhance and reinforce concepts and training from e-learning solutions. Even with such understanding, instructional designers often make little use of auditory information in developing effective multimedia agents for e-learning solutions and applications. Thus, in order to provide the learner with a realistic context for learning, the designer must strive to incorporate the use of sound for instructional transactions. By sharing knowledge on this issue, designer can create a more realistic vision of how sound technology can be used in e-learning to enhance instruction for quality teaching and participant learning.

BACKGROUND

Prior to computer technology, many studies concluded that multiple senses engage the learner to the extent that a person remembers 20% of what they see, 40% of that they see and hear, and 70% of what they see, hear and do. "Human beings are programmed to use multiple senses for assimilating information" (Ives, 1992). Even with such understanding, instructional designers often make little use of auditory information in developing e-learning. "This neglect of the auditory sense appears to be less a matter of choice and more a matter of just not knowing how to 'sonify' instructional designers to enhance learning" (Bishop & Cates, 2001). The major obstacle in this development is that there is not a significant amount of quantitative study on the

why, when, and where audio should or should not be used (Beccue & Vila, 2001).

In general, interface design guidelines identify three main uses of sound in multimedia agents in e-learning: (a) to alert learners to errors; (b) to provide stand-alone examples; or (c) to narrate text on the screen (Bishop & Cates, 2001). Review of research on sound in multimedia applied to effective e-learning solutions reveals a focus on the third use cited above. Barron and Atkins's (1994) research found that there were few guidelines to follow when deciding whether audio should replace, enhance, or mirror the text-based version of a lesson. The results of her study showed equal achievement effectiveness with or without the addition of the audio channel. Perceptions were positive among all three groups. Shih and Alessi's (1996) study investigated the relative effects of voice vs. text on learning spatial and temporal information and learners' preferences. This study found no significant difference on learning. The findings of Beccue and Vila's (2001) research supported these previous findings. Recent technological advances now make it possible for full integration of sound in multimedia agents to be employed in e-learning solutions. Sounds may enhance learning in multimedia agents, but without a strong theoretical cognitive foundation, the particular sounds used may not only fail to enhance learning, but they may actually detract from it (Bishop, 2001).

The three audio elements in multimedia production are speech (narration, dialogue, and direct address), sound effects (contextual or narrative function), and music (establishing locale or time; all of these identify characters and events, act as transition elements between contrasting scenes, and set the mood and pace of presentation (Kerr, 1999). Silence can be used to set a mood or to provide a moment for reflection.

Mayer and his associates (Moreno & Mayer, 2000a, 2000b; Mayer 2003) have conducted a number of experiments with older learners, demonstrating the superiority of audio/visual instructions. These studies have shown

that, in many situations, visual textual explanations may be replaced by equivalent auditory explanations, and thus enhance learning. These beneficial effects of using audio/visual presentations only occur when two or more components of a visual presentation are incomprehensible in isolation and must be mentally integrated before they can be understood.

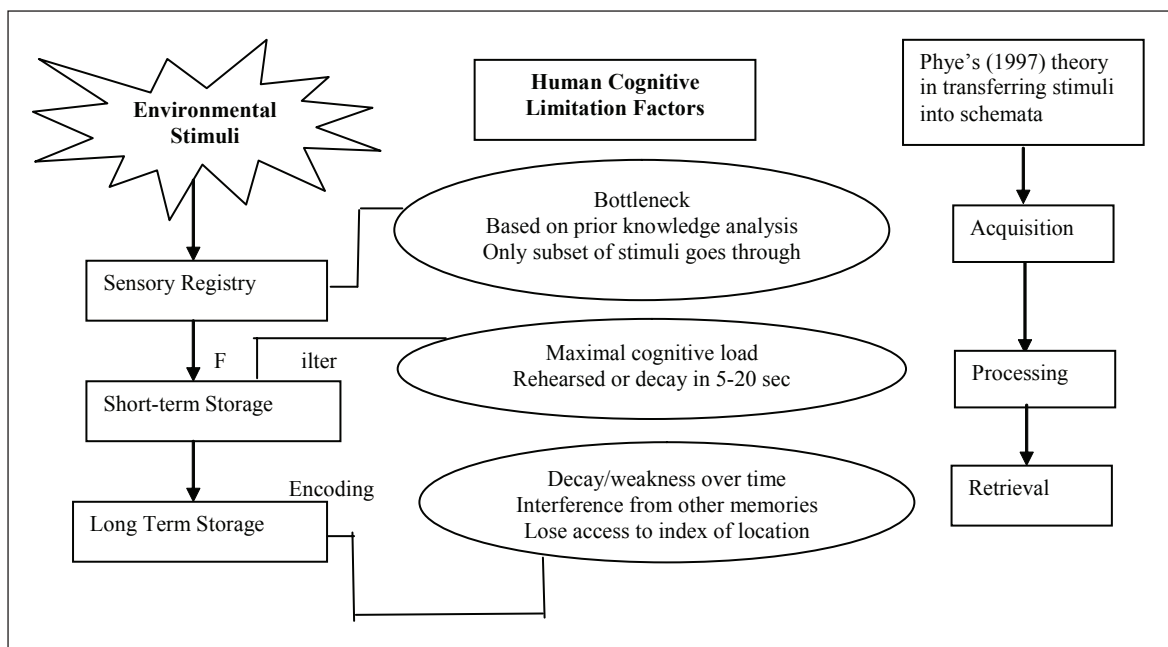
Because some studies suggest that the use of multiple channels, when cues are highly related, is far superior to one channel, the more extensive use of sound may lead to more effective computer-based learning materials. In order to have design guidelines in using sound in e-learning, instructional designers must understand the cognitive components of sound's use and the ways sound contribute to appropriate levels of redundancy and information in instructional messages. Bishop and Cates suggested that research should first explore the cognitive foundation. "Such theoretical foundation should address information-processing theory because it supplies a model for understanding how instructional messages are processed by learners; and communication theory because it supplies a model for structuring effective instructional messages."

MAIN DISCUSSION: THEORETICAL FOUNDATIONS FOR THE USE OF SOUND IN INSTRUCTION SOFTWARE

Bishop and Cates proposed a theoretical foundation for sound's use in multimedia instruction to enhance learning. They studied the Atkinson-Shiffrin information processing model, which addresses the transformation from environment stimuli to human schemata and their limitation factors due to human cognitive constraints. They adopted Phye's categorization of this process to three main operations: acquisition, processing, and retrieval. Table 1 summarizes the Atkinson-Shiffrin information processing model and its limitations. "Information-processing theory addressed human cognition.

Communication theory, on the other hand, addressed human interaction" (Bishop & Cates, 2001). Bishop and Cates also investigated the Shannon-Weaver Communication model and its limitations. They also adopted Berio's suggestion that learning models in terms of communication generally begin with and focus on

Table 1. The Atkinson-Shiffrin information processing theory model and illustrations



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