Effects of Pictures and Sounds in Learning from Explanative Narration

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Abstract. The purpose of the study was to investigate the effects of sounds and pictures accompanying learning from an explanative narration. Although the benefits of adding pictures to a narration are well established (Mayer, 2009), the effects of nonverbal sounds have received less attention and were usually examined only in conjunction with pictures (Moreno & Mayer, 2000). In the present experiment, sounds and pictures were varied independently, and their effects on retention and transfer performance were investigated. We used a 2x2-Design with presence or absence of pictures and presence or absence of sounds as experimental factors. The participants were university students who were randomly assigned to the experimental groups. First results showed that students remembered more main ideas when pictures had been presented than when no pictures had been presented. In contrast, students showed better transfer performance when sounds had been presented than when no sounds had been presented. Theoretical and practical implications will be discussed.

Keywords: Multimedia Learning; Sounds; Pictures; Narration

Theoretical Background

Most of the research in multimedia learning has been directed to exploring effects of presenting material in verbal and pictorial formats. The benefits of adding pictures to printed or spoken text are generally attributed to pictures helping students to construct a representation based on dual codes (Mayer, 2009). However, there are other than verbal and pictorial presentation modes that may guide learning processes. A feature of multimedia learning situations that has received little attention is the acoustic information beyond language. Do nonverbal sounds, for example, contribute to learning? A study conducted by Moreno and Mayer (2000) showed that adding background music to a combination of spoken text and animation (about the formation of lightning) decreased learning performance while adding environmental sounds did not affect performance. These results suggest that background music and environmental sounds affect learning processes by different mechanisms. For example, students may encounter difficulties in relating background music to the learning content in a meaningful way. In contrast, environmental sounds can be intrinsically related to the learning content when they correspond to events in the process described in the text. In the formation of lightning, for example, the sound of a thunder represents a specific phase in the process of lightning formation. Thus, hearing the sound of thunder while hearing the word ‘thunder’ may support the learner in creating a representation of this process. One reason why sounds did not increase comprehension in the Moreno and Mayer study may be that the sounds were presented in addition to an animation, thereby eventually imposing too high levels of cognitive load on the learner (Sweller, 2005). The purpose of the present experiment was to take a closer look at how environmental sounds may affect learning performance by carefully implementing and coordinating sounds in a textual scientific

explanation. Our second aim was to differentiate effects of pictures and environmental sounds on learning performance by treating the presence of sounds and pictures as independent factors.

Method

The participants heart a scientific explanation of lightning formation in a 2x2-factorial design with the first factor being presence or absence of explanative pictures and the second factor being presence or absence of environmental sounds. The participants were university students in teacher training courses at the University of Muenster. Learning and testing materials consisted of (a) two tests for assessing verbal and spatial ability, (b) a questionnaire for assessing prior knowledge on meteorology, (c) four computer-based versions of a program presenting the text, the pictures, and the sounds according to the experimental design, (d) a questionnaire on cognitive load, (e) a retention test, and (f) a transfer test. The environmental sounds represented the events that were described in the narration. They were presented during the narration when the particular event was explained (for example the sound of a gentle wind representing warm air rising from the ground).

The procedure was as follows. First, students filled in the prior-knowledge questionnaire (5 min.) and the verbal ability (7 min.) test. Second, they listened to the computer-based explanation on the process of lightning formation (8 min.), filled in the spatial ability test (3 min.) as well as the cognitive load questionnaire (5 min.). Finally, the participants completed the retention test (8 min.) and the transfer test (20 min.).

Results and Discussion

As data collection and analysis have not yet been completed, the results are preliminary. With regard to verbal ability, and prior knowledge no differences between the experimental groups were found. However the experimental groups differed in spatial ability, $F(3,58) = 3.24$, $p = .029$. Therefore spatial ability was used as a covariate. With regard to the retention test, results indicated a main effect for explanative pictures with the picture groups remembering significantly more main idea units than the other groups, $F(1,57) = 7.20$, $p = .010$. Adding environmental sounds to a scientific explanation did not significantly affect the retention test scores, $F(1,57) = 1.30$, $p = .259$. However, the reversed pattern was observed for transfer performance. The groups that received a textual explanation with environmental sounds generated significantly more solutions for transfer problems than the groups without sounds, $F(1,57) = 8.63$, $p = .005$. Adding pictures to the narration did not significantly affect the transfer test scores, $F(1,57) = 2.04$, $p = .159$. These results support the idea that adding environmental sounds to a scientific explanation does help students in developing deeper understanding of the learning content. Thereby, the effectiveness of nonverbal sounds may depend on whether the learner is able to relate these sounds to the events described in the explanation. This would explain why adding music, which is not intrinsically related to the content, negatively affected learning performance in the Moreno and Mayer study. However, in contrast to our results environmental sounds did not improve learning performance in Moreno and Mayer's study. One explanation is that adding sounds to an animated explanation may impose too high levels of cognitive load on the learner, which is not the case when static pictures are presented. This, in turn, would imply that sounds and animation draw on same working memory resources.

References

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