Why Animated but not Static? The Spatial-Temporal

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Background

Past research has shown that pictures in general enhance learning with text. Glenberg & Langston (1992) found that pictures compatible with text facilitate the learning of a procedural concept with concurrent steps. Glenberg & Kruley (1992) evinced that pictures assist anaphor resolution, thereby improving comprehension.

One of the major theoretical constructs adopted to account for such facilitatory effect is the dual-code theory by Paivio (1971), which suggests that information could be stored either verbally or visually, and that these codes together lead to better retention than either one alone.

Owing to the advancement in information technology, multimedia instructional materials, such as computer-generated animation, have become popular. Compared with static pictures, animation facilitates learning only under more specific conditions. Rieber (1991) showed that students with animated presentation outperformed those with static presentation, but only when frames were presented in chunks. Schnotz, *et al.* (1999) showed that animation better assists learning than static pictures for individual learning, but not cooperative one, which leads to cognitive overload. Mayer and Sims (1994) demonstrated that high-spatial ability students benefit more from contiguous animation than their counterparts. Large, *et al.*(1996) found that animation improves the comprehension of a procedural text more than a descriptive one.

Hypotheses

The aforementioned findings converge to suggest that animation learning demands additional cognitive processing that consumes extra cognitive resources, compared with static-picture learning. In the light of 1) the advantageous position of high-spatial ability students, 2) the facilitatory effect upon learning sequential concepts, and 3) the essential disparity between animated and static pictures, it is postulated that the animation-over-static-picture advantage, when it occurs, is attributable to better spatial-temporal coding in the former condition.

Methodology and Findings

The design was a modified version from the study by Moreno and Mayer (1999). The participants were forty-four undergraduates enrolling in Introduction to Psychology at the University of Hong Kong. Participants in the animation-narration condition viewed an animation of 190 seconds on lightning formation, while participants in the static-picture-narration condition viewed 11 static pictures that were snapshots representing critical steps of lightning formation extracted from the animation. After the learning section, participants were tested with three tasks: 1) matching verbal labels with to-be-circled objects, 2) verbal recall of narration and 3) sorting the sequence of 11 pictures, which were the pictures shown in the static condition. The last measure, which had not been adopted in previous studies, was developed to assess spatial-temporal coding.

One-tailed independent-samples t tests showed that the animation-narration group outperformed static-picture-narration group, on the matching task ($t(42) = 2.630$, $p = 0.006$), the verbal-retention task ($t(42) = 3.077$, $p = 0.02$) and the visual-spatial-retention task ($t(42) = 1.895$, $p = 0.0325$).

Discussion

Results showed that animation plus narration is a better combination than static pictures plus narration in facilitating learning. The former led to stronger verbal and visual representational connections, and closer referential connections between the two modules, all of which are beneficial to the learning of a sequential concept. In addition, animation was found to be superior to static graphics in assisting spatial-temporal coding. These findings are consistent with a modified version of Paivio's dual-code theory.

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