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Decorative pictures and emotional design in multimedia learning

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ABSTRACT

Recent studies have shown that the positive emotional design of learning environments might foster learning performance. In contrast, the seductive detail effect postulates that additional, learning irrelevant details inhibit learning. This research focusses on the implementation of decorative pictures as a prime for emotions and context-relatedness. This study examines four groups of decorative pictures which might be conducive for learning. Eighty-two students were randomly assigned to one cell of a 2 (emotionally positive vs. emotionally negative pictures) × 2 (school context vs. leisure context pictures) between-subjects, factorial design. The dimensions of pleasure, arousal, and dominance are examined as possible mediators. Results show that either positively valenced pictures or learning pictures foster retention and transfer performance. Pleasure is identified as mediator of the effect between valence of pictures and learning performance. A further analysis shows differences for arousal and dominance for both factors. These results are interpreted with concepts like motivated attention and other arousal theories.

1. Introduction

Research on multimedia learning has dramatically changed over the last few years as its theoretical focus shifted from “cold” into “hot” cognition. Whereas cold cognition theorists are convinced that learning takes place when enough selective attention and reasoning is available (e.g. Kane et al., 2004), hot cognition approaches claim that other factors like emotional conditions enlarge or diminish working memory capacities and learning results (Klein & Boals, 2001). Following this new approach within the field of multimedia learning, affective support has been shown to promote learning in combination with cognitive support (Huk & Ludwigs, 2009). For this, not only elaborated theories like the Cognitive Load Theory (CLT; Sweller, 1994; 2011), but also several design principles have to be reconsidered, as pictures, videos, animations and other forms of interactive media might evoke different states of emotion (Lindström & Bohlin, 2011). For example, the seductive detail effect (Harp & Mayer, 1998) is concerned with the question how irrelevant but interesting information affects learning outcomes. Seductive detail effect studies show that additional pictures can be helpful as long as they are not irrelevant (Butcher, 2014), however, illustrations used in the most of these experiments are not controlled by their affective impact. This study provides a first insight into the possibilities of affective pictures within the field of multimedia learning. For this, current trends of the implementation of an emotional design are presented and the role of seductive details within this field is highlighted. Moreover, a first differentiation of decorative pictures based on the current literature is created in order underline possible effects of affective influences within decorative pictures.

2. Multimedia and affect

Within multimedia learning arrangements, affect states have not only been shown to influence learning outcomes but also cognitive processes.

The *emotional design hypothesis* postulates that designing features with the goal to impact learners' emotions will influence learning performance (Park, Knörzer, Plass, & Brünken, 2015). If elements will appear as visually appealing, cognitive processes are enhanced and lead to better learning scores (Mayer & Estrella, 2014; Plass, Homer, & Hayward, 2009). There is a number of different studies following this hypothesis.

Um, Plass, Hayward, and Homer (2012), for example, tested if an emotional design versus a neutral design is able to foster learning. Results showed that the emotional design evokes positive

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emotions, which in turn fostered cognitive processes and learning performance. In a study by Plass, Heidig, Hayward, Homer, and Um (2014), students had to learn how viruses attack cells. Results indicate that an emotional design, again, fosters comprehension, although transfer scores were not affected. Mayer and Estrella (2014) examined students studying an animation (5 min) on how viruses cause a cold with either emotional design (colors, faces) or neutral design (black/white, no faces). The emotional design group scored best on learning tasks, with medium effect sizes ($d = 0.69$, $d = 0.65$). Three hundred and thirty four students of a study by Heidig, Müller, and Reichelt (2015) had to learn different learning materials altering in its design (classical vs. expressive) and usability (high vs. low). Results show that aesthetics and usability affected emotional states and positive states led to better learning outcomes and a higher intrinsic motivation. With the help of eye-tracking, Park et al. (2015) experimentally observed induced emotions (positive vs. neutral) while the learning material was changed in its design (with vs. without anthropomorphisms). Students with an induced positive emotional state had better comprehension and transfer scores and showed longer fixations on verbal information. However, just a few design features have been tested to function as emotional design features.

3. The role of decorative pictures in emotional design

Experiments have shown that learners learn better with verbal and pictorial representations instead of only verbal information (Mayer, 2010). According to Carney and Levin (2002), pictures serve five different functions. Four of these functions are supposed to support learning directly: representation, organization, interpretation, and transformation. A fifth function – decoration – does not have any relationship to the content of the learning text. Although decorative pictures lack on information concerning the learning tasks, they are examined to have only less to detrimental effects on learning in literature (Rey, 2012, 2014; Sung & Mayer, 2012).

In this study, illustrations in multimedia environments are split into two main dimensions: informative pictures and decorative pictures (see Fig. 1). Whereas informative pictures are directly concerned with the support of the learning process, decorative illustrations might foster or hinder learning (Magner, Schwonke, Aleven, Popescu, & Renkl, 2014). For this, decorative pictures are divided into two separate dimensions.

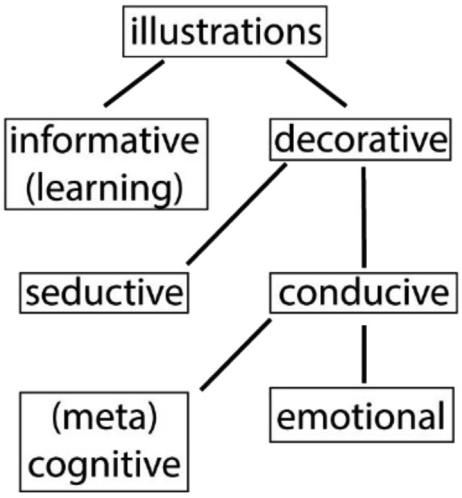

Fig. 1. Classification of illustrations within multimedia learning environments.

3.1. Seductive decorative pictures

There are, at least, some decorative pictures that might lead to an increase of cognitive load or distract students' attention (Harp & Mayer, 1998; Mayer, Griffith, Jurkowitz, & Rothman, 2008; Park, Moreno, Seufert, & Brünken, 2011; Schnotz, Fries, & Horz, 2009) and, therefore, decrease learning performance. These pictures are further called seductive (decorative) illustrations. Seductive illustrations and the accompanying seductive detail effect, which states that additional irrelevant but interesting learning materials impair learning performance, are examined with a large number of studies so far. In a meta-analysis by Rey (2012), results show that either retention performance ($d = 0.95$) or transfer performance ($d = 0.83$) is negatively affected by the insertion of seductive pictures. In four different experiments by Harp and Mayer (1998), six seductive illustrations were added to a text accompanied with learning pictures, which was about the process of lightning formation. All of these additional pictures contained consequences of lightning with frightening and gloomy moods (not tested). Results in each experiment showed that participants with seductive pictures did worse on retention and transfer scores. Bartsch and Cobern (2003) replicated this finding by inserting seductive illustrations on ten of thirty PowerPoint slides, whereas no pre-test on the emotional content of the pictures is reported. Seductive picture were also found to impair learning performance and distract attention in two experiments by Sanchez and Wiley (2006). Pictures were pre-tested for their emotional interest but not on their valence or arousal. It was further shown that seductive illustrations hindered learning success for students with low prior knowledge (Magner et al., 2014). Again, this study did not report any pre-test on emotional valence. In consequence, all the studies that have been described for seductive pictures suffer from methodological different issues: (1) None of the seductive details were checked on their emotional valence and arousal, (2) only few of the seductive details were intertwined logically with the learning environment, (3) none of the seductive details were designated as seductive for learners, and (4) no picture was checked on its metacognitive impact. These four issues might explain inhibiting learning effects of seductive illustrations and, if checked for, might lead to a creation of conducive decorative pictures. Two of these issues will be addressed in this study – the valence and metacognitive impact of decorative pictures, while the other two are controlled for.

3.2. Conducive decorative pictures

There might be decorative pictures that increase learning mediating factors like positive emotions or interest (Lenzner, Schnotz, & Müller, 2013; Sitzmann & Johnson, 2014) and, therefore, increase learning (Chang & Choi, 2014). These pictures are further called conducive (decorative) illustrations. Conducive illustrations can be distinguished between two or even more subcategories, a separation that is close to the cognitive interest and emotional interest theory from Kintsch (1986), which was also used by Park and Lim (2007).

The first subcategory is called *(meta-)cognitive (conducive decorative) illustrations* and is supposed to enhance learning mediating processes like cognition and metacognition, such as summary illustrations (Harp & Mayer, 1997), pictorial metaphors (McKay, 1999), or any pictures that enhance metacognitive processes (Ahmad, Ohsawa, & Nishihara, 2011). Other forms of pictures might support retrieval and function as retrieval cues (Unsworth, Spillers, & Brewer, 2010). In particular, metacognitive decorative pictures might activate retrieval processes within working memory so that these pictures are linked to verbal information (Khader, Burke, Bien, Ranganath, & Rösler, 2005). This link between