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Cognitive and affective effects of seductive details in multimedia learning

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ABSTRACT

The present study integrates cognitive and affective aspects of media processing in order to make an argument for reexamining the current cold cognition perspective in multimedia research in favor of a more integrative perspective. The Cognitive-Affective-Theory-of-Learning-with-Media (CATLM) assumes that students need to become motivated to make full use of their cognitive resources. Therefore, and even though seductive details (sds) are additional interesting but unnecessary pieces of information that do not conform with the coherence principle, their possible motivational role should not be dismissed. Using a 2 × 3-experimental design, participants (N = 123) were asked to learn about biology with multimedia instruction that manipulated modality (text vs. narration) and presence of seductive details (no-sds vs. textual-sds vs. narrated-sds). Results of variance analyses show a modality effect. In addition, moderated mediation analyses with the moderator modality and mediator situational interest confirm the affective mediation assumption with the following two conditional effects. A direct detrimental effect of seductive details on learning performance under the text-condition and an indirect compensatory effect under the narration-condition were shown.

1. Introduction

In research on multimedia learning, the role of affective processes has not been the focus as much as has been cognitive processing and associated principles. Especially the multimedia principle has become prominent. Studies (Mayer, 2005) have shown that learners learn better with textual and pictorial representations instead of only textual information. Moreover, it is recommended by the coherence principle that only coherent information be presented and that additional unnecessary information, such as seductive details be excluded (Mayer, 2005). In contrast, the Cognitive-Affective Theory of Learning with Media (CATLM; Moreno, 2005, 2006; Park, Plass, & Brünken, 2014) suggests that affect and motivational factors mediate learning by increasing or decreasing the amount of cognitive resources that students invest in the learning task at hand. Students need to become motivated to learn or (in lieu of motivation) use their self-regulation to allocate sufficient cognitive resources to the task at hand (Moreno, 2006). Therefore, and even though seductive details do not conform with the coherence principle, their possible motivational role should not be dismissed in multimedia learning (Park, Moreno, Seufert, & Brünken, 2011).

Seductive details are instructional materials that meet at least the following two necessary conditions: (1) the materials are interesting and (2) the materials provide additional information that is not necessary to accomplish the learning objectives of a lesson (Lehman, Schraw, McCrudden, & Hartley, 2007). Seductive details therefore impose an extraneous cognitive load during learning by forcing students to spend their limited resources in processing materials that distract from or disrupt the construction of a coherent mental model in the learning process. In a study by Park et al. (2011) it was shown that inconsistent results in seductive details research, sometimes confirming the detrimental effect and sometimes presenting non-significant results, can be explained by an effect on cognitive load. The findings showed that students' learning performance was significantly higher when seductive details were presented under the low load condition (narration) as compared to all other conditions. This finding was interpreted as a motivational effect in the frame of the CATLM. However in this study, no aspects that reflect the assumed affective processes were measured. Thus, the present study looks at the impact of seductive details on learning performance through moderated mediation

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with the moderator modality (high load text vs. low load narration condition) and the mediators situational interest and positive emotions. This research question on how seductive details influence learning performance will be addressed using a regression-based approach to test this affective mediation assumption.

2. Theoretical framework

The present work uses the Cognitive Load Theory (CLT) and the CATLM as a theoretical framework to explain inconsistent results in seductive details research. Both theories are now described in order to present two different perspectives on multimedia learning.

2.1. Multimedia learning processes from a cold cognition perspective

CLT (Plass, Moreno, & Brünken, 2010; Sweller, Ayres, & Kalyuga, 2011) assumes that knowledge acquisition depends on the efficiency of the use of available (limited) cognitive resources. In addition, the extent of cognitive load is determined by three components. First, *intrinsic cognitive load* characterizes the part of cognitive load caused by complexity of the given task. This load type depends on the extent or number of interacting concepts (element-interactivity) that must be simultaneously processed in working memory to learn the material that is being taught. The greater the number of elements and/or the higher the interactivity of the material that needs to be learned, the greater is the intrinsic cognitive load. Second, *extraneous cognitive load* is caused by the unnecessary cognitive demands imposed by instructional design. The more optimal the learning material is presented, considering the cognitive architecture and empirically proved instructional design principles, the lower the extraneous cognitive load. Finally, *germane cognitive load* is the load that results from engaging in learning activities that foster schema acquisition. Whereas extraneous sources of load hinder learning, intrinsic sources of load reflect the complexity of the given learning task in relation to the learnerś level of expertise, and germane sources of load promote learning by helping students engage in the process of schema formation and automation. A basic assumption of CLT is that the total cognitive load experienced during learning is additively composed of these three load types, the so-called additivity hypothesis (Moreno & Park, 2010; Park, 2010). If total cognitive load is excessive, learning and problem solving will be inhibited. The triarchic model of CLT is shown in Fig. 1 that is adapted from a summary on the historical development of CLT by Moreno and Park (2010).

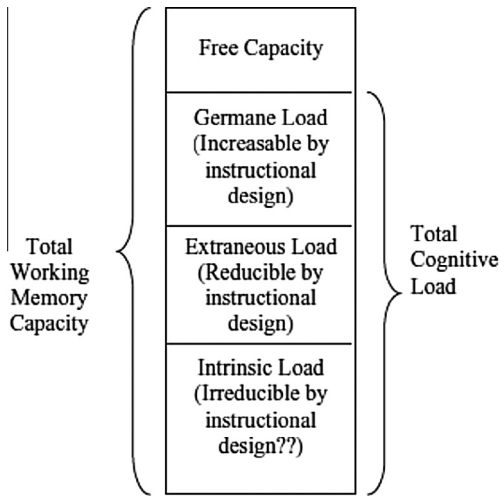

Fig. 1. Triarchic model of cognitive load theory (Moreno & Park, 2010, © Cambridge University Press, reprinted with permission).

Two characteristics of learning materials that are typically associated with extraneous load are the modality of the learning material and the presence of seductive details. Both characteristics can be varied by teachers as well as instructional designers and are often found in educational learning materials at schools or universities. How does the variation of these learning material characteristics influence learning?

2.1.1. Modality – A source of extraneous cognitive load

According to CLT, when visual representations (e.g., pictures, diagrams, animations) are combined with simultaneous text, they force students to split their visual attention during learning. Therefore a detrimental effect on learning performance is apparent. While the empirical base of the learning benefits caused by replacing text with narration (the modality effect), seems to be quite robust (e.g. Ginns, 2005), the theoretical explanation of this effect is still under discussion (Rummer, Schweppe, Fürstenberg, Seufert, & Brünken, 2010; Schnotz, 2011). The most recent theoretical explanation of the effect is based on auditory recency: When a picture is accompanied by narration, the most recent narrated elements (or even the whole narration, if it is only one sentence) can be represented with some durability in the sensory register. The representation enhances the maintenance of the corresponding verbal information in working memory. This is very helpful, even in case the narration is no longer presented and the learner still looks at the picture. However, when a picture is accompanied by visual text, the visual fixation of the picture immediately overwrites the verbal information in the sensory register (Rummer et al., 2010). In terms of CLT, this explanation shows that learners have more information available for an immediate integration within the learning process. Therefore, using narration instead of text creates a low load learning condition. In contrast, visual-only material causes a high load learning condition because of the multiple visual fixations that are needed for the integration of constantly overwritten visual information in the sensory register. Consequently, this process of re-loading against overwriting creates an extraneous source of cognitive load.

2.1.2. Seductive details – Another source of extraneous cognitive load

How do seductive details influence the learning process? The term "seductive details" was first introduced by Garner, Gillingham, and White (1989) to refer to the addition of interesting but unnecessary information to text which reduce the recall or learning of "non-seductive", relevant text ideas. Until now, research on the effect of seductive details has focused on seductive text passages or seductive illustrations in text comprehension studies. Several studies have shown a detrimental effect of seductive details (e.g. Garner et al., 1989; Harp & Mayer, 1998; Lehman et al., 2007), whereas others have shown non-significant results (e.g. Garner & Gillingham, 1991). All of these studies showing a detrimental effect used scientific texts that explained concepts such as detailed differences between insects or the lightning process step by step. In contrast, the studies that did not show the detrimental effect of seductive details were using non-scientific texts (e.g. biographies). These results may suggest that seductive details can only interfere with learning within a high load learning process that requires managing the available cognitive resources.

To date, three different explanations for the seductive details effect have been discussed and supported: (1) diversion, (2) disruption of the learning process, and (3) distraction from the relevant learning process (Harp & Mayer, 1998). First, the diversion hypothesis suggests that the seductive details effect is due to the activation of inappropriate prior knowledge functioning as an