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Can mood-inducing videos affect problem-solving activities in a web-based environment?

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Abstract
The purpose of this study was to examine whether a video-induced positive and negative mood has a differential effect on subsequent problem-solving activities in a web-based environment. The study also examined whether task conditions (task demands) moderated the mood effect. As in traditional experimental mood-effect studies, the affective video materials were not related to the tasks. The results show that affective video clips did impact performance on an insight task but not on a divergent-thinking task. This provides evidence that in some cases affective video has an effect on the performance of unrelated tasks in a web-based environment.

Introduction

A strength of video lies in its realism. Videos have the potential to show scenarios and people in real-world situations as well as dramatised reconstructions. Reeves and Nass (1996) have demonstrated that viewers respond to situations depicted in videos in a similar way as they do with real experiences. This means that video has a strong affective potential, which might be pedagogically exploited when affective learning goals are at stake (eg, Koumi, 1994; Wetzel, Radke & Stern, 1994). Affective video materials may also have educational potential when used as a *context* for activities. Experimental research on creative problem solving shows that affective video segments can influence performance on a subsequent problem-solving task (eg, Isen, Daubman & Nowicki, 1987, Study 2; Kaufmann & Vosburg 1997, Study 2). The content of the video

segments used in this type of experimental studies is typically not related to the task. Its purpose is to implicitly induce a positive or negative mood state in the subjects. Usually these studies are conducted in traditional settings using video monitors or projection screens to present the mood-inducing videos. These videos are followed by paper-and-pencil tasks or tasks with realia.

The notion that video materials can evoke affective responses and induce mood states is related to the way in which learners freely browse in web-based environments. Typically, people routinely browse by alternating between 'serious work' and other activities (Nielsen, 2000). Consequently, while browsing learners may encounter a wide range of materials. Learners may encounter video materials that are unrelated to their study tasks. Similar to the effects described in previously mentioned studies, these materials may evoke affective responses that unconsciously support or hinder learner performance. It is not clear whether these effects occur in a web-based environment. Studies have indicated that different media settings may be perceived and experienced differently by participants (eg, Nielsen, 1997). The purpose of this study is to examine whether the effects of a video-induced mood can be replicated in a web-based environment.

Our study is based upon previously cited experiments on mood effects on problem solving and aims to answer the following research question:

- Do mood-inducing video clips affect subsequent unrelated problem-solving activities, when both are presented in a web-based environment?

Research suggests that the valence of one's mood might affect cognitive processing and task performance. Martin and Clore (2001) argue that 'individuals in negative moods typically process more systematically than individuals in positive moods, whereas individuals in positive moods typically process with more flexibility and creativity than individuals in negative moods' (p. 2). They also discuss inconsistencies in different studies, suggesting that there might be moderating or interacting variables at work (eg, Hirt, Melton, McDonald & Harackiewicz, 1996).

Kaufmann and Vosburg propose that task description or conditions of problem-solving tasks have this kind of moderating role (Kaufmann & Vosburg, 1997, 2002; Vosburg, 1998; Vosburg & Kaufmann, 1999). Divergent-thinking and insight tasks require different solution requirements. In a divergent-thinking task, participants are asked to generate as many solutions as possible for a given problem. Performance of this type of problem-solving task is controlled by the participants themselves according to self-selected subjective criteria. When a participant is satisfied with his or her answer, the task is finished (*satisficing condition*). In a typical insight task, participants are asked to propose an optimal solution to an insight problem; insight problems often have only one solution (*optimising condition*). This idea of distinguishing solutions in terms of satisficing and optimising requirements was originally proposed by Simon (1956).

Table 1: Overview of hypotheses for the experiment

Affective video content	*Insight task (optimising condition)*	*Divergent-thinking task (satisficing condition)*
Positive	–	+
Negative	+	–

+, facilitates performance; –, inhibits performance.

Vosburg (1998) proposes that a positive mood is assumed to lower and a negative mood is assumed to raise criteria for acceptable solutions. This suggests that a positive mood facilitates divergent-thinking task performance and inhibits insight-task performance, while a negative mood facilitates insight-task performance and inhibits divergent-thinking task performance.

Therefore, this study is based on the following hypotheses:

- Hypothesis 1: Performance on an insight task (optimising condition) is better after watching a negative affective clip than after watching a positive affective clip.
- Hypothesis 2: Performance on a divergent-thinking task (satisficing condition) is better after watching a positive affective clip than after watching a negative affective clip.

Table 1 outlines the expected effects. In the next section, the design of an experiment to test the hypotheses will be described.

Method

One hundred and one 1st-year university students in communication studies (70 female and 31 male, mean age = 18.67 years) participated in an experiment for which they earned course credits. In a between-subjects design, two affective video conditions were used: a positive and a negative condition. In each condition, the participants first encountered a neutral affective video clip. This was done to create a pretest measure for mood. This was followed by a practice section to get accustomed to the experimental procedures. Then a positive mood-inducing video clip was shown in one condition and a negative mood-inducing video clip in the other condition. In each condition, the video clip was followed by two randomly ordered problem tasks: an insight task and a divergent-thinking task. The affective video clips were not related to the tasks. The video clips and problem-solving tasks are specified in further discussion. The study was balanced by keeping the number of subjects in each of the two conditions equal, and subjects were blocked by gender.

Video clips

Mood-inducing video clips of about 2 to 3 minutes were used. The positive video clip was taken from the comedy movie *When Harry Met Sally* (2 minutes and 45 seconds). This scene is a part of a validated library of affective video segments (Gross & Levenson,

1995). The negative video clip was a news item about hunger in Ethiopia (2 minutes and 4 seconds), which was broadcasted by a national TV news programme. Both video clips had been shown in a previous study to induce mood-changes within a Web environment (Verleur, Verhagen & Heuvelman, 2006). A neutral video segment from a documentary about birds (1 minute and 53 seconds) enabled a pretest measure for mood. This segment had also been shown to be effective in a previous study (ibid.).

Problem-solving tasks

Two tasks were selected to illustrate optimising and satisficing solution requirements. A divergent-thinking task was used to exemplify a satisficing requirement, and an insight task was used to illustrate an optimising requirement. The insight task was adapted from Kaufmann and Vosburg (1997). The divergent-thinking task was based on Vosburg (1998). Both tasks were originally paper-and-pencil tasks and were subsequently adapted for Web use through a web-based form.

The selected insight task is the 'two-string problem' from Maier (1970). In the two-string problem, the task was to tie together two strings hanging down from the ceiling. The strings were too far apart to be reached without using tools. Participants had to solve this problem by using tools selected from a set of available items: a screwdriver, a box of tacks and pliers. The correct solution was to tie one or each string to one of the tools (ie, the pliers or the screwdriver), push one or both into a pendulum movement and to grab the string(s) when they are close together. The task was presented in writing with an illustration of the situation and the tools available, similar to the Kaufmann and Vosburg (1997) study.

The selected divergent-thinking task was a real-life task, referred to as the 'class problem' (Mraz & Runco, 1994). This was a verbal description of a realistic problem that may be encountered in a classroom, written from the perspective of the problem solver. Vosburg's (1998) description of the task was used as follows: 'Rolf, a friend of yours sits next to you in the classroom. Rolf likes to talk to you and often interrupts you when you are taking notes. Sometimes he distracts you so that you are missing important parts of the lecture'. The task instruction asked the subjects to think of solutions to this problem.

Web-based environment

An experimental web-based environment was designed to embed the video clips and problem tasks. It guided the participants through the experiment comparable to structured online learning settings. This was done to stay close to realistic learning situations. Figure 1 provides an impression of the look and feel of the web-based environment. The left side of the figure shows an example of a video window on top of a web page. This was used for playback of the mood-inducing videos. The right side of the figure shows a web page with a task (two-string problem) and the form for submitting the solution.

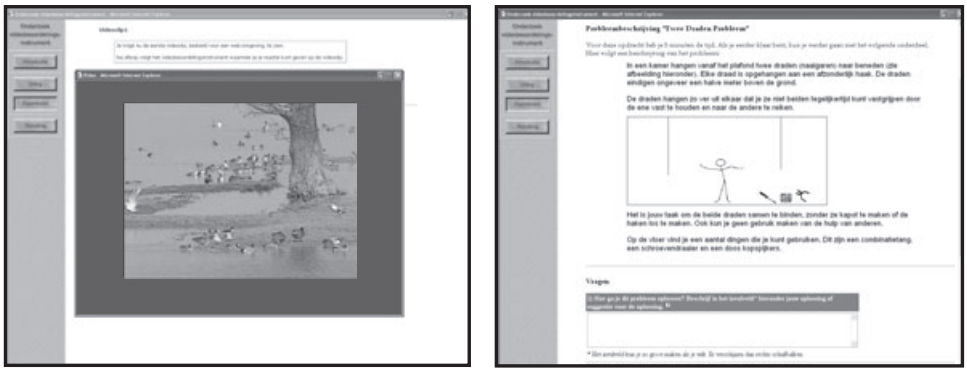

Figure 1: The Web interface for the experiment; left: video window; right: task frame with the two-string problem

Instruments

Video-induced mood assessment

A 12-item questionnaire was presented. A 9-point semantic differential scale was used to ascertain whether the affect manipulation was successful ('describe your current mood' ranging from very positive to very negative). Another item was included to check whether the video clips affected the subject at similar arousal levels. This was done to ensure that arousal level was not confounding the study. Other items were included to disguise the purpose of the questionnaire.

To measure the arousal levels after watching the video, a paper-and-pencil version of the self-assessment manikin (SAM) devised by Peter Lang (Bradley & Lang, 1995) was adapted into a Web version. This measure uses drawings of a manikin showing emotional states. The measure was chosen because it appears to correlate highly with physiological measures of arousal by skin conductance (eg, Lang, Bolls, Potter & Kawahara, 1999). Similar to the SAM-instrument procedure, all three dimensions of the SAM scale (ie, valence, arousal and dominance) were embedded in the questionnaire. However, only the arousal item, ranging from calm to excited on a 9-point rating scale, was relevant to the present study.

Problem-solving performance

Both the two-string and class problems used an open-answer format (fill-in fields in a Web form). As in Martinsen's (1993) version of the two-string task, two points were given for the correct solution, one point for a good try (for instance, when the tacks were used to stitch one or both strings to the wall to get them closer to each other) and no points for a wrong or no solution. Hence, the score for this task could be 2, 1 or 0. For scoring the class problem, Vosburg's (1998) fluency criterion was used, ie, generated solutions were counted.

Procedure

The experiment was conducted simultaneously in two computer rooms. Each room comprised 20 individual separated computer workstations with 17-inch monitors.

Each session lasted approximately 1 hour and 15 minutes. After a brief introduction to the experiment, participants were asked to click on the icon on the monitor desktop to launch the experimental Web environment. This initiated an introduction providing information on the purpose of the experiment as well as the types of questions used in the questionnaires. A subsequent practice section served two purposes. First, it supported participants in becoming acquainted with the experimental procedure. Second, it served as a pretest measure. The practice section started with presenting the neutral affective video clip followed by a questionnaire to measure the participants' initial mood. The practice section was concluded by an example problem-solving task.

The experimental section was initiated by showing the positive or negative affective video clip. This was followed by a questionnaire to measure the video-induced mood. Then the two problem tasks were presented in random order: half the participants first encountered the insight task followed by the divergent-thinking task, while the other half received the tasks in reverse order. For each task, a maximum of 5 minutes was available to find a solution. The experiment was concluded online by thanking the participants for their participation.

Results

During the practice session, the initial mood (1 = very negative, 9 = very positive) was measured immediately after exposure to the neutral video clip. Overall, the neutral clip resulted in a light-positive mood ($n = 101$, $M = 6.32$, $SD = 1.44$). When the two experimental conditions were compared, a Mann–Whitney test was used to indicate the difference between the two conditions. The difference was not significant on initial mood, $Z = -0.36$, *ns*. The two conditions can be considered to be homogeneous.

Video-induced mood

Tests were conducted to measure whether the two affective video clips were effective in inducing different moods (positive vs. negative) and similar arousal levels. The mean score for the positive clip ($M = 7.34$, $SD = 1.19$) was higher (more positive) than the mean score for the negative clip ($M = 3.53$, $SD = 1.47$). A Mann–Whitney test confirmed that the between-subjects difference was significant, $Z = -8.19$, $p < 0.001$. There was also clear evidence of change in a subjects' mood when comparing the measurements recorded after exposure to the neutral and the affective video clips. A Wilcoxon signed ranks test revealed that this mood change was significant both in the positive-video condition, $Z = -4.45$, $p < 0.001$, and in the negative video condition, $Z = -6.13$, $p < 0.001$. A Mann–Whitney test was used to compare the arousal levels (measured by the SAM-arousal item) for the two types of affective video clips. This showed no significant differences, $Z = -0.64$, *ns*. In both conditions the arousal level approached the midpoint of the scale. These results confirm earlier findings with respect to the same clips (Verleur *et al*, 2006).

Insight-task performance

In Hypothesis 1 we predicted improved performance on the insight task (optimising condition) when the task was presented after the negative affective clip compared with

Table 2: Frequencies for solutions to the two-string problem

Affective video condition	*Solution category*			
	No/wrong solution	*Good try*	*Best solution*	*Total*
Positive	15	27	8	50
Negative	8	31	12	51
Total	23	58	20	101

the positive affective clip. Overall, only 20 (19.8%) subjects found the best solution to the two-string problem. In the negative video condition, 12 of the 51 subjects found the optimal solution to the problem, 31 subjects had a 'good try' score and 8 subjects failed to solve the problem. In the positive-video condition 8 of the 50 subjects solved the problem, 27 subjects had a 'good try' score and 15 subjects failed to solve the problem. Solutions categorised under 'good try' ($f = 58$) were 'extending string or arm with tools' ($f = 25$), 'stitching strings to the wall or ceiling' ($f = 23$) and 'pushing strings into a pendulum movement without using (sufficient) weight' ($f = 10$). Table 2 summarises these results. The Mann–Whitney test indicated that the differences between the two conditions were significant, $Z = -1.68$, $p < 0.05$, one-tailed. These results confirm Hypothesis 1.

Divergent-thinking task performance

In Hypothesis 2, we predicted improved performance on the divergent-thinking task (satisficing condition), when the task was presented after the positive affective clip compared with the negative affective clip. This was measured by the number of solutions generated for the class problem. Solutions given by the subjects were categorised in order to distinguish between the different solutions/answers. The data showed that some subjects combined two solutions in one, while others presented them as two separate solutions. For example, two solutions might have been 'asking Rolf to stop talking' and 'suggest talking with Rolf during the break'. When subjects combined these two solutions into one sentence both solutions were counted. To solve the problem, subjects in the negative affect condition generated a mean number of 4.24 solutions ($SD = 1.63$). Subjects in the positive affect condition generated a mean number of 4.32 solutions ($SD = 1.97$). A *t*-test indicated no significant differences between the two conditions, $t(99) = -0.24$, *ns*. Therefore, Hypothesis 2 was not confirmed during this study.

Discussion

This study illustrates that when both affective video clips and tasks are presented in a Web environment, mood-inducing video clips do affect subsequent unrelated problem-solving activities. In order to gain insight into the way a video-induced mood might affect task performance, the study also investigated whether task characteristics moderate the mood effect. Based on Kaufmann and Vosburg's studies, we devised two hypothesises. First, that problem-solving activities in an optimising task condition (ie,

the problem is solved when the solution matches the objective solution criteria) would be impacted by a negative mood. Second, that problem-solving activities in a satisficing task condition (ie, the problem is solved when the user is satisfied about the given solution[s]) would be impacted by a positive mood. Our findings confirmed Hypothesis 1: viewing a negative video clip improved performance while exposure to a positive video clip reduced performance on an insight problem (two-string problem). Hypothesis 2 was not confirmed because no significant differences were found: the positive video clip did not support performance on the divergent-thinking task (class problem).

Reasons why the satisficing condition did not have the expected impact might be explained through a closer examination of the results. In both the positive and the negative conditions the mean number of generated solutions for the class problem was only four. Therefore, this task might not have been sufficiently discriminating to test the predictions of the satisficing condition.

The distinction between satisficing and optimising task conditions might still be valid and applicable to learning task settings. This can be compared to the notion of 'stop rules' (Martin, Ward, Achee & Wyer, 1993). Stop rules are instructions for the participants as to when they can stop working on a task: for example, when they do not enjoy it any more (cf. satisficing condition) as opposed to when they feel they have gained sufficient information (cf. optimising condition). Hirt *et al* (1996) investigated the role of stop rules or processing goals. They found that participants in a positive mood spent more time on a task and generated more items than other participants in a satisficing condition (enjoyment-based stop rule) than in an optimising condition (performance-based stop rule). In addition, they found that regardless of the stop rules, participants in a positive mood showed greater interest in a task and were more creative. It is clear that mood affects learning and, as demonstrated in our study, depends upon task conditions.

Traditional experimental mood studies were used as a basis for our research. Pekrun (2005) questioned the external validity of these studies: 'It remains an open question to which extent the results of experimental mood research can be generalized to more intense emotions experienced in real-life academic situations outside the laboratory' (p. 501). The present study might be considered an attempt to bring traditional experimental mood studies closer to more realistic settings. Our findings support the claim that web-based environments might unintentionally become a mood-inducing context for learning and, as a result, affect task performance. It is essential that educational practitioners take into consideration the facilitating or inhibiting effects of mood. An instructional designer might consider restricting the openness of the web-based learning environment for certain tasks. Alternatively, it maybe useful to raise learners' awareness of the intrinsic effects that might impact their performance. How this affects learning in practice would be a challenging issue for further exploration in real online learning settings.

In purposefully designed web-based learning activities, video materials are related to or integrated with the task (eg, Collis & Peters, 2000; Verhagen, 1996). One well-known

use of task-related video is the use of an affective video clip for the presentation of a realistic situation or problem. The affective reactions to such a 'trigger video' or 'problem vignette' stimulate higher order learning during the subsequent problem solving process (Cyrs, 1997). It combines the affect-evoking potential of video with the presentation of a problem, as in the present study. Next to studying *task-unrelated* affective video materials, it would be useful to explore how *task-related* affective video materials might facilitate performance on subsequent activities in a web-based environment. Such studies could begin by investigating how trigger videos affect related learning activities in a web-based environment.

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