Affective video and problem solving within a Web-environment

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Abstract

Currently there is a growing interest in Web-based multimedia learning environments, particularly those making use of asynchronous streaming video. This interest motivates renewed attention to properties of video for educational purposes. A typical property of video is its emotion-evoking potential. Research by Isen, Daubman, and Nowicki (1987), Kaufmann and Vosburg (1997) and by Vosburg (1998) on video-evoked positive or negative mood states inspired a research project on the didactical functionality of emotion-evoking video materials in relationship to (educational) problem solving tasks within a Web-based environment. The results show that the video materials that were used in the experiment induced the expected positive or negative mood. Differential effects of positive or negative mood for problem solving tasks, however, were not observed. This outcome is discussed in the context of the findings of the above-mentioned authors.

Introduction

Vosburg (1998) reviewed research studies by Isen, Daubman, and Nowicki (1987) and Kaufmann and Vosburg (1997, Study 2) that show that video segments that are used to evoke affective responses can influence the performance on a problem solving task that follows the video segment. These studies pertain to positive and negative mood states that may be related to the way a creative problem-solving task is carried out. In all cases, the content of the video segments was not related to the task. The results of these studies seem in a first instance to lead to contradictory conclusions. Isen, Daubman, and Nowicki found that positive mood had a facilitative effect on creative problem solving, while Kaufmann and Vosburg found that positive mood could significantly inhibit creative problem solving. Vosburg (1998) proposes a model that may help to get a better understanding of the underlying phenomena and thus provide an explanation for the earlier results. It is a satisficing/optimizing model that describes differential effects of mood states (positive versus negative) on problem solving tasks as a result of given task requirements or conditions. Kaufmann and Vosburg (1997) suggest that optimizing and satisficing strategies may be important moderators of this mood influence. The purpose of the current study is to explore whether the satisficing/optimizing model could be verified as a first step towards the development of didactical functions of emotion-evoking video materials. The two types of task requirements or conditions are described as follows (adapted from Vosburg, 1998, p166-167):

Under satisficing conditions the requirements for the solution of the problem-solving task are open. When a participant is satisfied with his or her answer according to self-selected subjective criteria the task is finished. An example of a task with a typical satisficing requirement is a divergent thinking problem. In this kind of task participants are asked to generate “as much solutions as possible for a presented problem that they can think of and not to think of the quality of their responses".

Under optimizing conditions participants are asked to present the best solution for a given problem that fits the strict solution requirements. Insight problems exemplify problem solving under optimizing conditions, because strict solution requirements exist and there is (often) only one acceptable solution. An example of such a task is Duncker’s candle task (Duncker, 1945). On this task, subjects get a candle, a box with tacks, and a book of matches. Their task is to mount the candle against a wall so that it can burn without dripping. How to do that with the help of the given items, is the problem to solve.

The satisficing/optimizing model proposes that positive mood tends to lower and negative mood to raise subjective criteria for acceptable solutions. Positive moods are expected to facilitate and negative moods to inhibit task performance under satisficing conditions (for instance a divergent thinking task). Negative moods are expected to facilitate and positive moods to inhibit task performance under optimizing conditions (for instance an insight task).

In the present study both video, as mood induction technique, and two creative problem-solving tasks (a divergent and an insight task) are embedded within a Web-based environment as opposed to more traditional settings in the comparable studies. If the model can be verified, this mood-facilitating approach to problem solving could also be relevant for realistic problem solving tasks in Web-based E-learning environments.

(The preliminary question whether the affect-evoking potential of video presented in a Web-environment is comparable with video presented in a more traditional context, has been answered earlier by Verleur and Verhagen, 2001, who conducted an experiment that demonstrated that Web-based affective video can be an effective mood-induction technique.).

The purpose of the current study is operationalised in the following research question:
<u>When both the mood-evoking video materials and the problem solving tasks are embedded in a Web-based environment, can the "satisficing-optimizing model" (Vosburg, 1998) be verified?</u>

This question is answered by testing the following hypotheses (see also Table 1) in a Web-based environment:

1) Compared to a negative video clip, a positive video clip will result in:
   A better performance on the divergent thinking task that follows the clip;
   a worse performance on the insight task that follows the clip.
2) Compared to a positive video clip, a negative video clip will result in:
   A better performance on the insight task that follows the clip;
   a worse performance on the divergent thinking task that follows the clip.

Table 1. Overview of the expected influence of affect-inducing video clips on task performance in a Web-based environment

	Insight task	**Divergent-thinking task**
Positive video clip	-	+
Negative video clip	+	-

Note:
+ = Facilitates performance
- = Inhibits performance

Method

To study the hypotheses, an experiment was carried out that is specified below.

Participants

101 first-year university students in communication studies (70 women and 31 men, mean age = 18.67 years) participated in the experiment that was part of a course that introduces the field of media communication and media research. The results of the experiment and the experience of the students as subjects for the experiment were discussed in class a month after the experiment.

Materials

For the selection of affect-evoking video materials, video segments of about two or three minutes were used. In the experimental setting the positive video segment was taken from the comedy movie ‘When Harry met Sally’ (2’45”); the negative video segment was a news-item about ‘Hunger in Ethiopia’ (2’04”). To establish a comparable starting position for all subjects a 'neutral' video segment was added as a first video clip for all participants. This segment was a part of a documentary about birds (‘1’53”). All three clips were also used in the experiment reported by Verleur and Verhagen (2001).

Two types of tasks are used to test the satisficing-optimizing model: A divergent thinking task as a typical example of a task with a strict satisficing requirement and an insight task as a typical example of a task with a strict optimizing requirement. Task selection started from a replication perspective with considering the creative problem solving tasks from the studies of Isen, Daubman, and Nowicki (1987), Kaufmann and Vosburg (1997) and Vosburg (1998). Although the Duncker Candle task that was used in the study of Isen, Daubman, and Nowicki (1987) has attractive properties to be used for the insight task, it was not selected because the original task with realia cannot easily be embedded in a Web-environment. The chosen insight task is the "Two String Problem" from Maier (1970).

This task was the best performing insight task in the study of Kaufmann and Vosburg (1997). The chosen divergent thinking task is the "Real-life divergent-thinking task" that was described in the study of Vosburg (1998). This task is referred to as the "Class problem" (how to handle being distracted during a lecture class) adapted from Mraz and Runco (1994).

In the Two String problem the task is to tie together two strings hanging down from the ceiling. The two strings are too far apart to be reached by hands alone. The participants have to solve this problem by using tools that they select from a set of items. The available items are a pair of pliers, a screwdriver and a box of tacks. The correct solution is to tie one or each string to one of the tools (i.e. the pair of pliers or the screwdriver), push one or both into a pendulum movement and to grab the string(s) when they are close enough. Following Martinsen's version of the task (1993) two points were given for this 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 these tasks could be 2, 1, or 0. Conform the study of Kaufmann and Vosburg (1997) the task was presented in writing with an illustration of the situation and the tools available.

The Class problem is a verbal description of a realistic problem situated in a classroom and is written from the perspective of the problem solver. Following Vosburg 's version of the task (1998) the description presented was 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 accompanying instruction asked the subjects to think of different solutions to solve this problem: "What are you going to do? How are you going to solve this problem?". In a pre-test with a task comparable to the Class Problem it appeared, however, that subjects tended to generate a step-wise procedure for one solution in stead of generating different solutions. This made it necessary to reformulate the instruction into "Think of different solutions to solve this problem"; to make sure that students would generate 'different solutions'. The instruction specified what was mend by the word 'different'.

Design and procedure An experiment was designed with two conditions: A 'Positive Affect' and a 'Negative Affect' condition. In each condition the participants encountered both the insight and the divergent thinking task. To balance for order effects the task order was randomized within each condition. Table 2 presents an overview of the experimental conditions and the resulting four versions of the experimental arrangement that were embedded in the Web-environment. To improve the precision for analyzing affective state effects, the study was balanced by keeping the number of subjects in each of the two conditions equal. Furthermore the subjects were blocked by gender.

Table 2. Overview of the experimental conditions

Condition	**Task order (two versions for each condition)**
Positive Affect	Insight task - Divergent thinking task
	Divergent thinking task - Insight task
Negative Affect	Insight task - Divergent thinking task
	Divergent thinking task - Insight task

Note: Insight task = Two String Problem; Divergent thinking task = Class problem

After viewing the 'neutral' video clip a questionnaire was presented to pre-test the initial affective state of the participant. Then an example problem-solving task was presented to familiarize the participant with this type of task. (The data of the example problem are no part of the analyses.) Next the experimental part of the session started by showing the positive or negative affective video clip followed by the same questionnaire that was used after the neutral video clip to measure the video-induced affective state. This was followed by both problem tasks that were presented in random order: half of the participants first encountered the insight task followed by the divergent thinking task, for the other half this was the other way around. For each task a maximum of 5 minutes was available to work on the solution.

The experiment was conducted parallel in two computer rooms during scheduled computer lab hours with all four versions of the Web-environment in both rooms present. Each room contained 20 individual workplaces. The number of participants required three rounds to lead all participants through the experiment. Each round took place in a time slot of one hour and 15 minutes. All participants were able to complete their tasks within that period without further time pressure than the timed answers to the problems. All rounds were administered on the afternoon of the same day.

Each individual workplace consisted of a computer configuration with a 17-inch monitor and a headset. Separation screens prevented distractions by eye contact or viewing other monitors. The experimental Web-environment was available as a click able icon on the desktop. The experimental procedure, instruments and introductions to the steps in the experiment were all embedded in the Web-environment.

Randomizing in advance each order of four versions predetermined the order of the Web-version assignment. In order to spread the male participants equally over the versions, in each round the male group had to enter the room first and was then randomly distributed over all versions. After a brief introduction to the experiment the participants were asked to click on the icon on the desktop that would launch the experimental Web-environment. The experimental procedure, instruments and introductions to the steps in the experiment were all shown, explained, and practiced in an introductory part of the Web-environment before the experimental part of the study started.

Scoring

***Instruments*.** To measure the affective responses the paper-and-pencil version of the Self-Assessment Manikin (SAM) devised by Peter Lang (Bradley & Lang, 1995) was adapted into a Web-version. The original SAM measures three emotional dimensions: Valance (ranging from pleasant to unpleasant), arousal (ranging from calm to excited) and Dominance (ranging from controlled to in-control) with a 9-points rating scale for each dimension. The Valence dimension of the SAM-scale was used in the present study as a measure for the 'Affective State'. Figure 1 shows the Web-version of this scale. In addition a small number of bipolar items on a semantic differential (also using a 9-point scale) were added to assess cognitive and mood responses to the video materials. These questions were not part of the experiment but were used to mask the purpose of the study

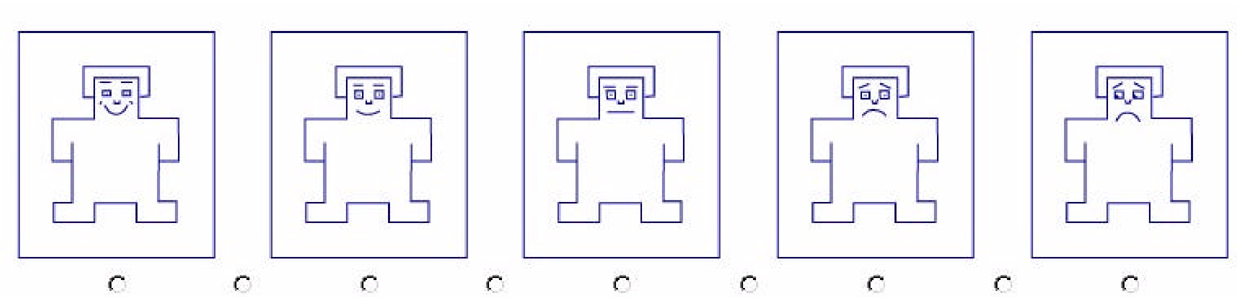

FIGURE 1. Web-version for the Valence dimension of the Self-Assessment Manikin (SAM)

Results

Homogeneity and manipulation check for affective state

***Initial affective state*.** During the practice part of the session the initial affective state was measured just after the presentation of the 'neutral' video clip on the 9-points SAM scale (1= unpleasant, 9= pleasant). Overall the neutral clip resulted in a 'light positive' affect state (N=101, M=6.41, SD=1.23). When the two experimental conditions were compared, a t test showed no significant differences between the positive (n=50, M=6.46, SD=) and the negative (n=51, M=6.35, SD=) condition (t[99]=-0.437, p=.663, two-tailed). The two conditions can be considered homogeneous on initial affective state.

***Affective state changes*.** The affective state after viewing the first 'neutral' clip was compared with the affective state after viewing the second 'affective' clip (being positive or negative depending on the condition). In the negative condition the affective state changed into a more negative state (ΔM=3.06, SD=1.62; $\Delta M = M_{neutral} - M_{negative}$). A paired-T-test showed that this mean change was significant (t[50]=13.51, p<0.001, two-tailed). In the positive condition the affective state changed into a more positive state (ΔM=-1.58, SD=1.39; $\Delta M = M_{neutral} - M_{positive}$). Although the mean change was less than in the negative condition a paired-T-test showed that this change was also significant (t[49]=-8.06, p<0.001, two-tailed). The 'light positive' nature of the neutral clip might have been of influence on the magnitude of these changes. The manipulation check data confirmed the expected positive and negative affective states in the two conditions as result of the affective video inductions.

Resulting mean affective state scores for the two conditions. The resulting mean affective state score was in the negative condition clearly lower (M=3.29, SD=1.43) than in the positive condition (M=8.04, SD=1.12). A t test showed that the difference between the two conditions was significant (t[99]=-4.75, p<0.001, two-tailed).

Two String Problem (Insight Task)

Only 20 (19.8%) of all subjects found the best solution for the problem. In the negative condition 12 of the 51 subjects found the optimal solution to the problem, 31 subjects had a 'good try' score and eight subjects did not solve the problem. In the positive condition 8 of the 50 subjects solved the problem, 27 subjects had a 'good try' score and 15 subjects did not solve the problem at all. A Mann-Whitney test indicated that the differences between the two conditions were not significant (Z=-1.68, p=0.92, two-tailed). Solutions that were categorized under 'good try' (f=58) were: 'extending string or arm with tools' (f=25), 'stitching strings to the wall or ceiling' (f=23), 'pushing strings into a pendulum movement without using (sufficient) weight' (f=10). Table 3 summarizes the results.

Table 3. Frequencies per solution type for the Two String Problem

Condition	**No/wrong solution**	Good try	Best solution
Negative Affect (n=51)	8	31	12
Positive Affect (n=50)	15	27	8
Total (N=101)	23	58	20

Class Problem (Divergent Thinking Task)

Based on the solutions given by the subjects a category list was developed to make a clear distinction between the different solutions/answers. The data showed that some subjects combined two solutions in one solution, where others presented them as two separate solutions. For example two solutions might have been 'telling Rolf to stop talking' and 'agree to meet Rolf during the break'. Some subjects combined these two solutions into one sentence. In both cases two solutions were counted. (Although this procedure was used because it seemed the most fair one, analysis of the uncorrected scores showed that there was no clear need for it. The overall scorings pattern remained the same but with slightly lower mean scores.) To solve the problem subjects in the Negative Affect condition generated a mean number of 4.24 (SD=1.63) solutions and subject in the Positive Affect condition a mean number of 4.32 (SD=1.97) solutions. A t test indicated no significant differences between the two conditions (t[99]=-0.24, p=0.815, two-tailed).

Discussion

The purpose of the current study was to explore whether the satisficing/optimizing model of Vosburg (1998) could be verified when both video, as mood induction technique, and two creative problem-solving tasks (a divergent thinking and an insight task) were embedded within a Web-based environment. Table 1 presented an overview of the expected effects. The results show that the two affective video clips were effective in inducing a positive and a negative affective state in the subjects. This finding replicated the results of a preliminary experiment (Verleur and Verhagen, 2001). The data, however, do not confirm the satisficing/optimizing model nor did they replicate findings from comparable studies that were conducted in more traditional settings.

A first question that occurs is whether the adaptation to the Web environment or the changes in the methodology may have prevented the replication of the earlier results. Vosburg (1998) and Kaufmann and Vosburg (1997) used paper-and-pencil tests to administer their experiments. It cannot be guaranteed that filling in Web forms gives the participants equal mental room for playing with their thoughts during the different tasks. Kaufmann and Vosburg also used more tasks. Vosburg (1998) used four divergent thinking problems and Kaufmann and Vosburg

(1997, Study 2) used two insight tasks. They based their conclusions on combined scores of all tasks in each of their experiments. Vosburg was able to find significant effects in line with the satisficing/optimizing model. Kaufmann and Vosburg, however, did not find a differential effect for mood on task performance, which is in line with our results. As Vosburg (1998) and Kaufmann and Vosburg (1997) only reported the combined scores of the tasks, no data are available to analyze whether for instance the use of the class problem in the Web environment did or did not equally well as in their case. Also it is not known how the Class problem itself performed in comparison to the other divergent thinking tasks used by Vosburg.

The choice to limit the number of tasks to one insight task and one divergent thinking task was made in order to make the experiment manageable. This was considered to be feasible because it was expected that the difference between a well-chosen insight and a well-chosen divergent thinking task should be observed if the satisficing/optimizing model is valid. This expectation was supported by the fact that the present study used the described video-based mood induction technique (which appeared to change mood significantly) while the subjects in Vosburg's study were not brought into the different affective states by a mood induction technique, but that the actual affect state 'on arrival' was measured and taken as the independent variable. Still she found significant results to support her model. A critical question is whether the tasks were indeed 'well-chosen'. As there are no data about these tasks from the other authors and there was also no control condition, this is difficult to know.

One possibility is that the tasks were not so different after all. In the Method part of this paper it was explained that the task instruction for the Class problem was reformulated to make sure that students would generate 'different solutions' instead of a step-wise procedure. This might have triggered the participants to look more at the quality of their solutions to make sure that the solutions were different from each other, which could have changed the perception of the task in the direction of an optimizing task. However, when discussing this in a debriefing session with a group of students (where about 30% of the subjects was present), the students reported that they did realize afterwards that the task evoked a satisficing strategy in them. They had felt that they could end the task after they had generated 'enough solutions'. Other reasons for stopping to work on the task were that they 'run out of solutions' or 'they run out of time'. Although the instruction was not literally saying to 'generate as much solutions as possible', almost all students did understand that this was the objective for the task. In all it seems that the task instruction was perceived in the same way as in Vosburg's study.

A further uncertainty is that although the video clips were able to evoke the different affective states in the subjects, no evidence was collected that this evoked state was continued during the task performance and thus remained sufficiently effective.

The uncertainties about the applied methods make that conclusions about the validity of the satisficing/optimizing model cannot be drawn. There are, however, a few reasons why doubts raise about this validity.

In the study of Isen et al. (1987, Study 2) subjects were presented two types of tasks, one of them being an insight task (Duncker Candle task). In that study the subjects in the positive mood performed better than the subjects in the negative mood. Vosburg (1998) gives a possible explanation for this effect: The Candle task was performed using real attributes, so it was not a paper-and-pencil task. By physically working on the task the subjects would receive feedback on the correctness of their problem solving attempts. This type of feedback might have yielded direct information on how to proceed for finding the solution. This fact may explain why task performance differed from paper-and-pencil insight tasks. In the study by Isen et al. there were four conditions: A positive affect, a negative affect, a neutral affect and a control condition. A remarkable finding of their study was that the positive affect condition did best, than the negative affect condition, followed by the neutral affect condition. The control condition did worst. Kaufmann and Vosburg (1997) put forward that this could mean that there is a more general performance-facilitating factor at work as a function of mood manipulations prior to task performance. This might suggest that there is a main effect for mood manipulation. As the present study was carried out without a control condition, no data are available to analyze whether such a general effect occurred.

Kaufmann and Vosburg (1997, Study 2) used the Two String problem in combination with another insight problem (Hatrack problem) in a paper-and-pencil version. In their study the tools that were available to solve the Two String problem were a cup, a screwdriver and a box of pins. They scored the tasks according to a strict solved/unsolved criterion, where one point was given for a true solution, and 0 for no solution or quasi-solutions, not fulfilling all solution criteria. In the present study only one of the tasks was used and for which the scoring system of Martinsen (1993) was followed. The same visual representation of the problem (with adaptation for the tools) and instruction was used as in Kaufmann's and Vosburg's study. In general more subjects (45%) were able to solve the Two String problem in the Kaufmann and Vosburg study compared to our study (19.8%). This might have been related to the other tools used. For the combined insight tasks they did not found a significant effect of affective state on problem solving which is in line with the findings in the present study, but in contradiction with the satisficing/optimizing model.

A different issue is that that Kaufmann and Vosburg did find a significant effect of affective state on the time spend to solve the problem (latency rates) or 'solution ease'. A negative affect state produced the most superior performance (faster) and the positive affect state the most inferior performance (slower). 'Time' was not used as a dependent variable in this study, but may be used in further work.

In all, the experiment was not able to confirm the satisficing/optimizing model. Further work has to be done to get a better understanding of the relationship between video-induced affective states and problem solving. For subsequent research it is recommended that: (a) the research methods control for the main effect of mood induction by means of a no-treatment control condition; (b) possible decay of induced mood during the experiments is monitored (at least by post testing mood state after the task performance); (c) several (in stead of one) tasks are used for each factor (insight or divergent thinking) to middle out the noise that is caused by inevitable task imperfections; and (d) the tasks as well as the related instructions are extensively pre-tested to assure their validity and reliability.

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