The Influence of the Serial Order of Visual and Verbal Presentation on the Verbal Overshadowing Effect of Dynamic Scenes

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Abstract

This article investigates the influence of verbalization processes on the visual recognition performance of dynamic scenes. In the recognition phase different distractor items were used: event model incompatible and event model compatible. It was hypothesized that source confusion, which is said to be responsible for inducing the verbal overshadowing effect, is reduced with event model incompatibility. In two experiments people viewed a dynamic scene and read a verbal summary related with the scene. The first experiment showed a verbal overshadowing effect when the verbal summary was presented after the film. In the second experiment – the verbal summary was shown before the film – recognition performance improved with event model incompatibility. Source confusion could be eliminated by changing the order of visual and verbal presentation.

Verbal Overshadowing

The question whether verbally describing a visual stimulus fosters or hinders its subsequent recognition has got a long tradition in cognitive psychology. Read (1979) showed that face recognition performance was improved using verbalization. More recently *verbal overshadowing* has come in the focus of research. Schooler and Engstler-Schooler (1990) examined the role of verbalization processes. In the *verbal overshadowing* paradigm, subjects first see a visual stimulus (e.g. a face) and then have to describe this stimulus verbally. Typically, in a subsequent recognition test, their recognition accuracy is lower (Schooler, 2002). In a meta analysis Meissner and Brigham (2001) analyzed 29 studies examining the verbal overshadowing phenomenon and found a negative effect of verbalization processes on the recognition performance. While active verbalization induces a *transfer inappropriate processing shift*, that dampens individuals' ability to apply certain non-verbal operations, Dodson, Johnson, and Schooler (1997) evinced that a verbal overshadowing effect (VOE) even appears if participants read a verbal description passively. As recognition performance did not show a VOE when participants were asked to ignore their verbal representation, *source confusion* about the validity of which mental representation should be the basis for the recognition was made accountable to this kind of VOE.

Although verbal overshadowing is a robust effect it could be shown that it disappeared under certain circumstances. Kitagami, Sato, and Yoshikawa (2002) found a VOE when distractor items were designed highly similar to the target items, while no verbal overshadowing effect appeared at low similarity. In a former study Bartlett, Till, and Levy (1980) found, using realistic photos as stimulus material, that verbalization led to higher recognition performance, when it enabled the participants to distinguish between target and distractor items. These findings are in accordance with the assumption that viewers develop a kind of *model* which specifies the characteristic and relevant features of the visual stimulus. This model enables the viewers to distinguish between target and distractor items in a recognition paradigm. On the one hand, model incompatible distractor items are easier to identify and on the other hand, model compatible distractor items are less likely identified. Additionally, it can be assumed that models directly derived from the visual stimulus contain more detailed information than models derived from the verbal description of the visual stimulus.

Research questions

The considerations above suggest that VOE is not a general effect, but appears only under certain conditions. In order to specify these conditions more precisely, two experiments were conducted, which were based on the following research questions. So far, VOE research has addressed the verbalization of static entities like the appearance of a face. In everyday life such entities are seldom verbally described and therefore little practiced. Unlike dynamic scenes, in sporting reports it is quite common to describe spatial relationships verbally. Hence, the first question focused on the domain: Is there a VOE within the domain of dynamic scenes, which are commonly accompanied by verbalizations (e.g. sports events)? Second, does the VOE influence recognition performance not only in quantitative, but also in qualitative terms? Regarding the spatial properties, it was shown that recognition of dynamic scenes is viewpoint dependent (Garsoffky, Schwan, & Hesse, 2002). A verbal summary which contains no spatial information (e.g. *left* or *right*) could lead to a less viewpoint dependent visual recognition performance, thereby indicating a qualitative influence of VOE. Third, it was assumed that *event model compatibility* had an impact on the VOE. While distractor items being designed *in line* with the verbal description (event model compatibility) should be difficult to identify, distractor items which *violate* the verbal

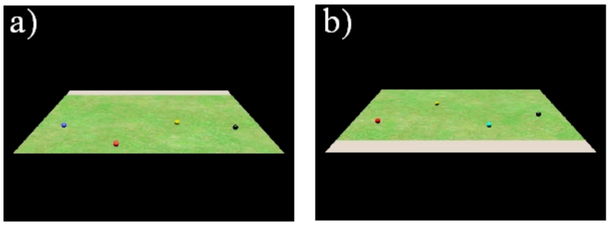

Figure 1: Stimulus material. a) is showing balls moving away from the observer, b) is showing balls moving towards the observer

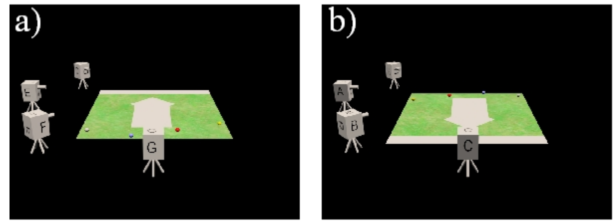

Figure 2: Stimulus material with cameras indicating the viewpoints from which the recognition items were recorded.

summary (event model incompatibility) should be easily identified. Event model incompatibility should reduce source confusion and consequently the VOE. The VOE after reading the description of a previously *seen* visual stimulus can be explained by *source confusion* which is induced by two competing representations. First, a very detailed one, derived from the visual input, second a less detailed one, derived via visualization processes (Intraub & Hoffman, 1992) from the verbal description. Therefore as a fourth research question, it was supposed that the serial order of visual and verbal presentation had an impact to the VOE. If the serial order of the stimulus presentation is switched (first the verbal and then the visual presentation) the participants will first visualize a raw sketch which can be enriched with details while watching the visual presentation. A VOE was expected in the classical condition (visual before verbal) and it was expected to disappear if the serial order was inverted (verbal before visual).

Experiment 1

The first experiment, in which the order of the presentation was the same like in the classical VOE studies, was conducted to examine the research questions 1, 2 and 3.

Method

Participants Subjects were 18 students (11 female, 7 male) of the University of Tübingen, Germany. Average age was 23 years. They were paid for their participation.

Apparatus The experimental procedures were controlled by a Microsoft computer and programmed using MediaLab and directRT. Video clips and video stills were presented on a black background in the middle of a 17" CRT-Monitor.

Stimulus material and design As stimulus material a kind of race[1] consisting of four balls moving on parallel laps toward a white line were created using *3ds max 6*. Every ball had a different starting position and a different movement characteristic (constant velocity, accelerating or decelerating). Each race lasted 8 seconds and was rendered either in that way, that the balls were moving away from the observer or that the balls were moving toward the observer (see figure 1).

The first independent variable was the *verbalization*, realized as a blocked within-design. In the *film only* condition the participants received no additional verbal information. In the *film + verbal* condition, the participants received a short verbal summary after watching the film. And in the *verbal only* condition they received solely the verbal summary. The verbal summary described the behavior of one ball, containing its starting position, its passings (in relation to the other balls) and its finishing position, for example: "The red ball starts behind all other balls, passes every other ball and finally wins." The verbal summary was supposed to establish an *event model*. It was supposed that the event model derived from the verbal summary contained very abstract information about the dynamic scene.

The second independent variable was the *event model compatibility*. It was realized by using the distractor items in the recognition test. Two types of distractor items were created: event model compatible items and event model incompatible items. The event model incompatible items violated the event model. In the example above, a possible event model incompatible distractor item could be created in moving the blue ball toward the finishing line, in that case it became impossible for the red ball to win this race. In contrast, the event model compatible items did not violate the event model. In the example, the yellow ball was moved. This modification is in line with the event model, that the red ball starts in the rearest position, passes all the other balls and finally wins the race. As third independent variable the *deviation between the viewpoint in the learning and the testing phase* of the video stills in the recognition phase was varied. The deviation was 0°, 45 °, 90° and 135° (see figure 2). And finally as fourth independent variable the recognition items were recorded at 4 different *points of time* during the scene (3.0, 4.5, 6.0 and 7.5 *s.*). This variable was introduced to measure several points over the length of time of the dynamic scene on the one hand, and also to collect enough datapoints for analysis.

Procedure All participants were tested individually and received the instruction via computer monitor. They got a description of the kind of dynamic scenes used, the verbalization conditions and the subsequent recognition test. After that they passed a training phase in which every condition was presented. These data were excluded from the analysis. The following experimental

[1]Examples of the stimulus materials are available at http://www.iwm-kmrc.de/cybermedia/cs06-voe/

phase consisted of three blocks: one block for every verbalization condition (film only vs. verbal only vs. film + verbal). These blocks were presented in a balanced manner. Between the blocks a rest period of 5 minutes was established to avoid exhaustion and possible carry-over effects.

In the *film only* condition the participants were shown a dynamic scene twice. After the film the participants were shown a progress bar for the duration of 10 seconds. In the *film + verbal* condition the participants were shown a film twice before they read a verbal summary of the dynamic scene, which appeared for 10 seconds on the monitor. Instead of the film, in the *verbal only* condition the participants viewed a progress bar for 17 seconds. Afterwards a verbal summary of the dynamic scene appeared for 10 seconds.

In all conditions, before the recognition test, a video still, depicting the previously seen scene was shown to indicate the beginning of the recognition test, which included 48 video stills: 16 target items showing the original scene from 4 different viewpoints at 4 different points in time. 16 event model incompatible distractor items, showing a distractor scene (also 4 different viewpoints and 4 different points in time) and 16 event model compatible distractor items (4 different viewpoint deviations and 4 different points in time as well).

Taken together a 3 (verbalization) x 2 (event model compatibility) x 4 (viewpoint deviation) x 4 (point of time) design was realized.

Results

To compute the sensitivity measure A' (Pollack & Norman, 1964), the mean hit rate (yes-answers to target items) and the mean false-alarm rate (yes-answers to distractor items) for the event model incompatible and the event model compatible distractor items for every condition were calculated.

Across all conditions and participants a mean of .697 for A' was calculated. An ANOVA with repeated measurement was calculated including the independent variables *verbalization* (film vs. verbal vs. film + verbal), *event model* (incompatible vs. compatible), *viewpoint deviation* (0° vs. 45° vs. 90° vs. 135°) and *point of time* (3.0 vs. 4.5 vs. 6.0 vs. 7.5 s. after the beginning of the scene). A significant main effect for *verbalization* was found ($F(2, 34) = 13.588$, $MSE = 0.313$, $p < .001$, $\eta_p^2 = .444$[2]). In the *film only* condition an A' measure of .782 was observed. In the *film + verbal* condition A' was .700 and in the *verbal only* condition it was .601. Single comparisons according to Scheffé revealed significant differences between all of the three conditions ($p < .01$). A significant main effect for *event model* was found ($F(1, 17) = 28.973$, $MSE = 0.403$, $p < .001$, $\eta_p^2 = .630$). Event model incompatibility led to higher recognition performance ($A' = .779$) than event model compatibility ($A' = .615$). There was no main effect for

[2]In the reported experiments the partial η^2 (η_p^2) as effect size measure is reported, because it is more appropriate to the the design with more than one independent variable (Tabachnick & Fidell, 1989).

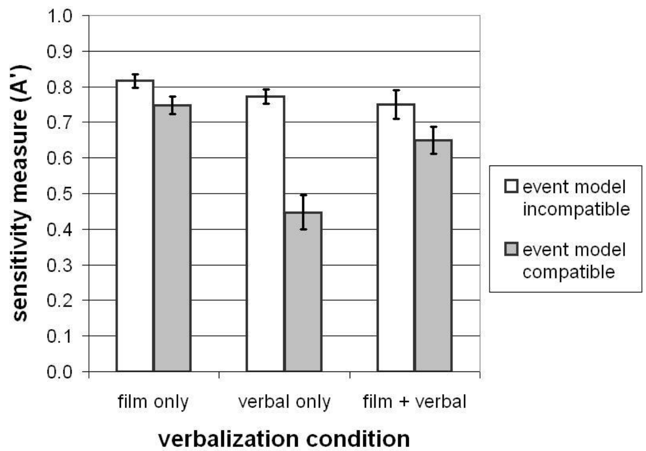

Figure 3: The interaction of verbalization and event model. Error bars indicating the standard error of the mean.

viewpoint deviation($F < 1$). The main effect for *point of time* was significant (A' for 1: .636, 2: .678, 3: .733, 4: .743; $F(3, 51) = 14.506$, $MSE = 0.07412$, $p < .001$, $\eta_p^2 = .460$). For this effect there was a significant linear trend indicating a recency effect ($F(1, 17) = 27.975$, $MSE = 0.109$, $p < .001$, $\eta_p^2 = .622$).

The interaction between *verbalization* and *event model compatibility* was significant ($F(2, 34) = 10.366$, $MSE = 0.272$, $p < .001$, $\eta_p^2 = .379$). Single comparisons according to Scheffé revealed the following significant differences ($p < .01$). At event model incompatibility there was a significant difference between the *film only* (.816) and the *film + verbal* condition (.750). For event model compatible distractor items significant differences were found between all conditions. Single comparisons regarding the event model compatibility within the verbalization conditions revealed, that in every verbalization condition, event model incompatibility led to higher recognition rates ($p < .01$). See figure 3. A planned comparison of the predicted difference between the *film only* and the *film + verbal* condition regarding *event model compatibility* revealed no difference; there was no significant interaction between *verbalization (film only vs. film + verbal)* and *event model compatibility* ($F < 1$).

The interaction between *event model compatibility* and *viewpoint deviation* was significant ($F(3, 51) = 3.086$, $MSE = 0.01584$, $p < .05$, $\eta_p^2 = .154$). Post hoc analysis (Scheffé) revealed that there were no differences between the different viewpoint deviations both within event model incompatibility and event model compatibility, $p < .01$ (see table 1).

The interaction between event model compatibility and point of time was significant ($F(3, 51) = 4.714$, $MSE = 0.032522$, $p < .01$, $\eta_p^2 = .217$). Post hoc analysis showed the following result pattern (see table 2). Event model incompatibility led to lower recognition performance at the first point of time than at the other points of time. There were no differences between point of time

Table 1: Interaction between viewpoint deviation and event model compatibility (sensitivity measure A').

		event model	
		incompatible	compatible
viewpoint	0°	.795	.611
deviation	45°	.772	.601
	90°	.770	.636
	135°	.781	.613

2, 3 and 4. Event model compatibility led to a significant difference between the first two and the last two points of time ($p < .01$).

There was also a significant interaction between verbalization condition and point of time ($F(6, 102) = 4.681$, $MSE = 0.06415$, $p < .001$, $\eta_p^2 = .216$, see table 2). While there were no differences in the *film + verbal* condition over the different points of time, there were several differences in the *verbal only* and the *film only* conditions: In the *film only* condition there were significant differences between point of time 1 and 3 and 4 as well as between point of time 2 and 3. In the *verbal only* condition there were significant differences between points of time 1 and 3 and 4 and between 2 and 4 ($p < .01$).

There was a significant interaction between verbalization condition, event model compatibility and point of time ($F(6, 102) = 11.104$, $MSE = 0.04167$, $p < .001$, $\eta_p^2 = .395$). Single comparisons according to Scheffé revealed the following result pattern. Event model incompatibility led to no significant differences across the different points of time solely in the *film + verbal* and the *film only* condition. In the *verbal only* condition there was lower recognition performance at point of time 1 than at all other points of time. Event model compatibility again led to no differences across the different points of time in the *film + verbal* condition. In the *film only* condition lower recognition performance was observed at point of time 1 than at point of time 3. In the *verbal only* condition there was lower performance at point of time 2 than on the fourth one ($p < .01$, see table 2).

Table 2: Interaction between verbalization condition, event model and point of time (sensitivity measure A').

		verbalization condition					
		film only		verbal only		film + verbal	
		event model compatibility					
		yes	no	yes	no	yes	no
point	1	.760	.614	.607	.474	.760	.599
of	2	.792	.748	.781	.347	.784	.615
time	3	.872	.869	.837	.416	.739	.663
	4	.840	.758	.863	.553	.717	.725

Discussion

One main focus of this experiment was the question whether the verbal overshadowing phenomenon also holds for dynamic scenes. Recognition performance was lower in the *film + verbal* condition than in the *film only* condition. In the control condition, in which the participants only read a verbal summary of the film, recognition performance was lowest. This finding suggests, that verbalization shows the same impacts on dynamic scenes, describing spatial relationships as on static material. Although former are more often accompanied by verbal descriptions.

Secondly, it was assumed, that a so called *event model* describing the similarity of the verbal summary and the distractor items, could help the participants to distinguish between target and distractor items (research questions 1 and 3). As expected, there was a significant interaction between the verbalization condition and the event model (research question 3). But the results do not show the expected absence of the VOE for event model incompatibility, although the event model enabled the participants in the *verbal only* condition to perform above chance level. A possible explanation could be that source confusion (Dodson et al., 1997) was not completely reduced by this manipulation and the participants still were not able to apply the appropriate representation during the recognition test. Unlike Kitagami et al. (2002), the similarity of distractor items with target items seemed not to be important for this kind of VOE.

There is no indication that VOE led to a change of the qualitative features of the recognition performance in this experiment (research question 2). Neither in the *film only* condition nor in the conditions containing the verbal summary a viewpoint deviation effect was observed. Therefore this effect is not part of the discussion in this paper.

The assumption that visualization processes occur after reading the verbal summary is supported by the fact, that participants are able to perform above chance level in a visual recognition test in the *verbal only* condition (Intraub & Hoffman, 1992, reported similar effects).

In sum, results from the *film only* condition indicate, that participants did not need the verbal summary to develop an event model of a dynamic scene – in the *film only* condition, event model incompatible distractor items were more often identified than event model compatible items. The VOE in the *film + verbal* condition can be explained as follows: there were two competing representations, a detailed one, derived from the visual input and a second one, which was more abstract, derived from the verbal input. Source confusion now occurred because the latter could not be integrated into the former one. That is, because participants had already formed an *event model* from the visual input, which is not necessary congruent with the *event model* induced by the verbal summary. Therefore two representations existed, which led to source confusion and consequently to the observed VOE.

Experiment 2

In contrast to the first experiment, in experiment 2 the order of the visual presentation and the verbal summary was changed. The verbal summary was presented *before* the visual presentation. When the verbal summary was presented before the visual presentation it was expected that no source confusion occurred, because only *one mental representation* of the event was constructed by the participants: they first visualize a raw sketch including a kind of *event model*. This representation, containing no detailed information about the scene, can be enriched with more details while watching the film. It was hypothesized, that a verbal summary, presented before the video clip increased recognition performance, when it contained information which was relevant to identify event model incompatible distractor items. This is because the event model derived from the verbal summary should direct the *attention* of the participants to relevant parts of the scenes.

Method

Participants Subjects were 18 students (15 female, 3 male) of the University of Tübingen, Germany. Average age was 23 years. They were paid for their participation.

Apparatus, stimulus material and design The same setting, stimuli and design as in the first experiment were used.

Procedure The procedure was almost the same as in the first experiment, apart from the order of the video clip and verbal summary. The *film only* condition was adapted in that way, that after watching the film twice (17 seconds) the participants were asked to start the recognition test by pressing the space bar. In the *verbal only* condition the verbal summary was presented. After reading the text the participants had to press the space bar, then a progress bar appeared for 17 seconds. Again the recognition test started after pressing the space bar. In the *verbal + film* condition the participants first read a verbal summary of the film they were shown after pressing the space bar. Right after the film clips (which lasted 17 seconds) the participants were asked to start the recognition test by pressing the space bar.

Results

As in experiment 1, A' as dependent variable was calculated. Across all participants and conditions a mean sensitivity rate of $A' = .730$ was measured. An ANOVA with repeated measurement was conducted using the independent variables *verbalization* (film vs. verbal vs. verbal + film), *event model* (incompatible vs. compatible), *viewpoint deviation* (0° vs. 45° vs. 90° vs. 135°) and *point of time* (3.0 vs. 4.5 vs. 6.0 vs. 7.5 sec. after the beginning of the scene). There was a significant main effect for *verbalization* ($F(2, 34) = 7.605$, $MSE = 0.214$, $p < .05$, $\eta_p^2 = .309$). Signal comparisons with the Scheffé procedure revealed significant differences between all conditions. In the *verbal only* condition the sensitivity measure was .671, in the *film only* condition .744 and in the *verbal + film* condition .775. As in experiment 1 there was also a significant main effect for *event model compatibility* ($F(2, 34) = 75.260$, $MSE = 0.08879$, $p < .001$, $\eta_p^2 = .816$). Event model incompatibility lead to higher sensitivity measures (.792) than event model compatibility (.668). There was no main effect for viewpoint deviation ($F < 1$). The main effect for *point of time* was significant (A' for 1: .683, 2: .710, 3: .739, 4: .789; $F(3, 51) = 19.969$, $MSE = 0.05335$, $p < .001$, $\eta_p^2 = .495$). For this effect there was a significant linear trend indicating a recency effect ($F(1, 17) = 35.172$, $MSE = 0.07695$, $p < .001$, $\eta_p^2 = .665$).

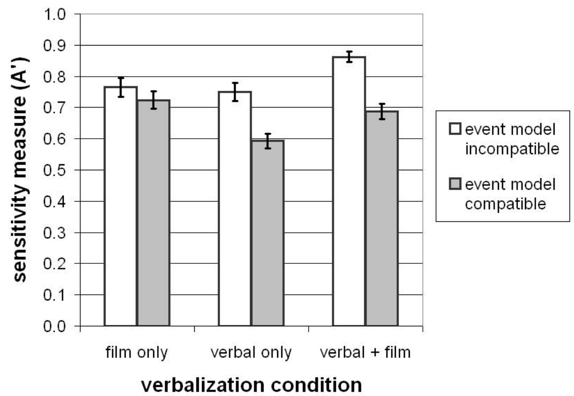

Figure 4: The interaction of verbalization and event model. Error bars indicating the standard error of the mean.

The interaction between *verbalization* and *event model compatibility* was significant ($F(2, 34) = 5.673$, $MSE = 0.133$, $p < .01$, $\eta_p^2 = .250$). Single comparisons according to Scheffé showed following significant differences ($p < .01$). Event model incompatibility led to higher sensitivity measures in the *verbal + film* condition than in both the *film only* and *verbal only* conditions. However, no difference between the film and *verbal + film* conditions was observed during event model compatibility, just the *verbal only* condition there was lower performance than in the other two conditions (see figure 4).

Discussion

The goal of this experiment was to show that the same verbal summary, impairing visual recognition performance in experiment 1, will be able to improve recognition performance, if it is presented before the video clip. It was assumed that reading a verbal summary leads to a visualization process resulting in a raw sketch including a *model* of the event which is enriched with details while looking to the film. That is, only one mental representation of the event was constructed. Indeed, no VOE was observed. The significant interaction between the event model and the verbalization condition qualifies this main effect. It is important to stress, that the improvement in the *verbal + film* condition only occurred at event model incompatibility. That is, those distractor items violating the verbal summary were easier to identify than those distractor items which were in line with the verbal summary. In the *film only* condition there was no difference regarding the event model compatibility. The *verbal only* condition as control condition indicated that the improvement of the recognition performance in the *verbal + film* condition can not be reduced to the verbal summary, because the performance in the *verbal only* condition is lower than in the *verbal + film* condition.

General Discussion

There were five major points regarding the experiments reported in this paper. First, *verbal overshadowing* appears during the recognition process of dynamic scenes. Second, *source confusion* seems to be important for the classical verbal overshadowing effect (visual before verbal presentation) and cannot be reduced by the introduction of different distractor items (unlike Kitagami et al., 2002). It seems that watching a film leads to the establishment of an *event model*. If the verbal summary, also containing an event model, is presented after the film, source confusion (Dodson et al., 1997) will occur because the two competing event models cannot be integrated into one representation by the participants. Third, source confusion is no general effect of presenting visual and verbal information. It could be shown that VOE can be reduced by changing the serial order of verbal and visual presentation. It was assumed that visualization processes while reading the verbal summary (Intraub & Hoffman, 1992) are responsible for this effect. When participants first viewed a detailed dynamic scene and then read an abstract verbal summary, they visualized it and got confused. But when the abstract verbal summary was presented first, they visualized a raw sketch with the corresponding event model at first. This model now directed the attention of the participants to the relevant details of the dynamic scene during the visual presentation, which led to an enrichment of the raw sketch. Only one event model was generated by the participants, no source confusion appeared, hence no VOE was observed. Contrariwise, results showed that presenting a verbal summary prior to the film led to higher recognition performance when event model incompatible distractor items were used. Fourth, the different time lags between stimulus presentation in the learning phase and visual recognition in experiment 1 and 2 could be responsible for the following effects. (a) In experiment 1 recognition perfomance in the *film only* condition at *event model incompatibility* was higher than at *event model compatibility*; this effect did not occur in experiment 2. This could be because in experiment 1 the participants in the *film only* condition had enough time while watching the progress bar to develop an *event model* autonomous, unlike in experiment 2, where visual recognition followed the film immediately. This event model was made responsible for higher recognition performance in experiment 1. (b) In experiment 1 recognition performance in the *verbal only* condition at event model compatibility was at chance level ($A' = .5$) ($t(17) = -1.111$, $p = .282$) but not in experiment 2 ($t(17) = 3.921$, $p < .01$). One possible explanation for this finding could be that rehearsal processes while looking at the progress bar took place in experiment 2 which finally led to higher recognition performance. Fifth, recognition performance indicated no qualitative change regarding the viewpoint dependency.

Future research is needed to develop a framework in which the mentioned processes can be integrated. Therefore a next step should address the question whether the verbal overshadowing effect for dynamic scenes also holds for active verbalization processes.

Acknowledgments

This work was supported by grant from the DFG (Deutsche Forschungsgemeinschaft).

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