

Indexing Space and Time in Film Understanding

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SUMMARY

We investigated the extent to which understanders monitor shifts in time and space during film comprehension. Participants viewed a feature-length film and identified those points in the film in which they perceived a change in situation. We performed an *a priori* analysis of the films to identify the shifts in time, the movement of characters, and region. The relationship between the theoretical analysis of the films and the participants judgements of situational change was assessed. The results provide support for the Event Indexing Model and suggest that situation models for filmed events are indexed along multiple dimensions of situational continuity. Furthermore, the pattern of results was similar for narrative film as they are for narrative text. This finding suggest that there are general mechanisms for event understanding that operate independently of medium or mode of experience. Copyright © 2001 John Wiley & Sons, Ltd.

It has long been assumed that stories conveyed through discourse represent much more than what is explicitly provided in a text. Rather, they convey a complex set of events that bear some resemblance to real-world events. In particular, narrative events occur within a particular time, place, and are causally connected. Situation models can capture the people, spatial and temporal settings, the goal plans and actions, and event sequences that are depicted in a story. In the present study, we tested a particular model of discourse understanding, namely the Event Indexing (EI) Model (Zwaan *et al.*, 1995a; Zwaan and Radvansky, 1998), in a non-text domain, specifically film understanding. Narrative films may more closely resemble everyday experiences than do narrative texts, given the perceptual and analogue nature of filmed events. As such, the present study may provide a test of the extent to which the EI model can account for event understanding in general.

Theories of situation model construction assume that coherent models are indexed along multiple dimensions of situational continuity (Gernsbacher, 1990; Magliano *et al.*, 1998; Zwaan *et al.*, 1995a; Zwaan and Radvansky, 1998). The EI model (Zwaan *et al.*, 1995a; Zwaan and Radvansky, 1998) assumes that the online monitoring of situational continuity is a central process in model construction. As each story event and action is comprehended, understanders monitor changes in continuity in entities, time, space, causality, and intentionality. This indexing provides a basis for monitoring coherence because it enables an understander to determine how incoming information is related to the prior context. To the extent that a current event shares an index on a particular dimension with an event that is currently in working memory, a link will be formed between them, via the index. If no link can be established, a new index will be formed on that dimension.

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Broadly speaking, the EI model tries to capture how people understand *events*. As such, this model should capture important aspects of event understanding that are independent from mode of experience, that is, text events, filmed events, our real-world events. In most of the research that is relevant to the EI model, researchers have looked at text processing (see Zwaan and Radvansky, 1998), although there is related research on autobiographical memory (e.g. Thompson *et al.*, 1996; Wagenaar, 1986). A strong test of the EI would be to examine whether its predictions hold for situation-model construction for other types of events. To address this question, we investigated event indexing in the context of film comprehension. In particular, we assessed the impact of shifts in time and space on the perception that a situation has changed in a narrative film. As Zwaan and Radvansky (1998) argued, time and space are the most basic dimensions of events. Every event has an obligatory spatial and temporal index, that is, it always occurs at a certain time and in a certain location.

There has been relatively little research on situation model construction during film viewing (see Magliano *et al.*, 1996, van den Broek *et al.*, 1996), and therefore it is not as well understood as narrative text comprehension. Although there are surely similarities between text and film, there may be differences regarding the prominence of various indices in a situation model. For example, during reading with a goal to understand, temporal continuity between events is a prominent dimension in a situation model, whereas spatial continuity is not (e.g. Zwaan and van Oostendorp, 1993; Zwaan *et al.*, 1995b, 1998), except when comprehenders have detailed prior knowledge of the spatial context in which the story is set (e.g. Zwaan *et al.*, 1998). One reason for this may be that it is difficult to construct a three-dimensional spatial model from a text. This difficulty does not exist in film, as changes in spatial location are readily apparent. Given the visual-spatial nature of film, space may be more prominent in that medium than in text.

We adopted an approach derived from Zwaan *et al.* (1995b) who developed a discourse analysis to identify shifts in space, time, and causality that occur in a text. Each clause in a narrative was analysed to determine if it was temporally, spatially, and causally contiguous with the prior clause. The covariation between the shifts that occurred was then examined within narratives and behavioural data, such as reading time. It was found that during the initial reading, reading times increased when there was a temporal or causal discontinuity, but not when there was a spatial discontinuity. Upon rereading a narrative, however, readers were sensitive to spatial discontinuities. It was concluded that time and causality are critical indices in the situation models of narrative text, whereas the spatial index is closely monitored when readers have a specific goal and/or have adequate working memory resources to do so.

In the present study, we developed a discourse analysis of film that enabled us to identify breaks in continuity along the temporal and spatial dimensions. We then adapted a methodology first proposed by Newton (1973) that enabled an assessment of the extent to which viewers index a narrative film along multiple dimensions of situational continuity and to determine which dimensions are most prominent in film understanding.

TEMPORAL AND SPATIAL CONTINUITIES IN FILM

Central to our approach is a discourse analysis that can *a priori* identify shifts in situational continuities. A number of such analyses have been proposed for narrative text (e.g. Trabasso *et al.*, 1989; Zwaan *et al.*, 1995b). These analyses typically use a clause or

statement node as the unit of analysis. The unit of film that most closely corresponds to a clause is a shot. A shot is a continuous piece of film without breaks. The correspondence between clause and shot is certainly not isomorphic. For example, whereas a clause typically conveys only one or two states, events, goals, or actions, this is not necessarily true for a shot.

We chose the shot as our unit of discourse analysis. This decision was based in part on work done by Bordwell (1985); (Bordwell and Thompson, 1993), who suggested that one salient feature of narrative film is continuity editing. In order to convey a coherent story, film makers adopt a set of editing conventions to create the illusion that a sequence of shots conveys temporally, spatially, and causally contiguous events and actions. There are also conventions for conveying discontinuities. These conventions operate almost exclusively to create continuity or discontinuity *between* a series of shots. For example, if film makers want to indicate that there is a jump in time, they could adopt the conventions of fading or dissolving out from one shot and into the next. The second shot of this hypothetical sequence should be interpreted as a jump in narrative time. By adopting the shot as a unit of analysis, we were able to identify if a given shot conveys events or actions that are contiguous or not with the immediately prior shot along the dimensions of time and space.

Creating understandable temporal relationships between shots is a critical component of film editing (Bordwell, 1985; Bordwell and Thompson, 1993). We considered a shot to be temporally continuous with the previous one if it depicts events or actions which immediately follow or are concurrent with those of the previous shot. Discontinuity in narrative time occurs when there is temporal ellipsis, that is, when a discrete and salient chunk of time is missing from the story world between two shots. A temporally discontinuity was identified when there was judged to be a salient ellipsis between the previous shot and the current shot.

We distinguished between two aspects of narrative space. The first refers to *spatial regions of interaction*. Spatial regions of interaction can be rooms, scenarios, or regions that have distinctive features that can be discriminated from alternative spatial settings in a story (Zwaan *et al.*, 1995b). For example, in the opening scene of *Moonraker*, the initial shots establish that a 747 airplane is carrying a space shuttle. As the scene progresses, the film alternates between activities taking place in the cockpit of the shuttle and the cockpit of the airplane. Both cockpits represent distinct and separate regions of interaction. Often, regions of interaction have clear boundaries, such as the walls of a room. However, in open space, a region of interaction could be as far as the eye can see. For example, in *Jeremiah Johnson*, the actions take place primarily in the Rocky Mountains. In many of the scenes, the main character moves to different locations in the mountains. These different locations are only minimally distinct from one another and as such were judged by the researchers to be all part of the same larger region, namely the Rocky Mountains.

In our discourse analysis, continuity in spatial region of interaction was assumed to occur when a shot depicts a location that is within the same spatial region as the previous shot. Discontinuity occurs when a shot depicts (1) a new spatial region that has not been shown in any previous shot or (2) a location in a spatial region that has been shown before, but was not the same spatial region depicted in the previous shot.

The second aspect of narrative space refers to the *spatial movement of characters*. Narratives convey characters moving between salient spatial regions. An accurate situation model requires that understanders keep track of these movements. If a character is located at a particular salient region of interaction and is subsequently shown at a new

one, people must update their models to accommodate that change. With respect to our analysis, a shot was continuous on the spatial movement if all the salient characters depicted in it were located in the same region as the shot in which they were last seen. A shot was discontinuous if it depicted any salient character that was in a different region from the last shot in which he or she was seen.

Although spatial regions and spatial movements are related, it is important to understand that these are independent dimensions. A film maker can shift the viewer from region to region within the story world, but the characters may not change location. Conversely, film makers can stay in the same region, but have characters enter and leave that location.

ASSESSING EVENT INDEXING IN FILM

We adapted a methodology used by Newton (1973). With his approach, participants viewed video tapes of people engaged in various activities (e.g. a man repairing a motorcycle). The participants' task was to identify natural breakpoints in the ongoing activities. Participants pushed a button at those perceived breakpoints and Newton temporally coordinated those decisions with the activities on the video tape. This approach allowed him to identify the perceptually discrete actions that comprised the activities and to infer the hierarchical structure of those actions that was imposed by an understander. In the present study, participants viewed a feature-length narrative film in its entirety. They made *situation-change judgements* in which they were instructed to identify points in the film that contained a change in the situation or circumstances that the characters were facing. Participants were not given any instructions as to what factors may constitute a change in situation. Thus, in terms of the EI model, this task assessed how comprehenders parse a continuous stream of visual input into situations and to what extent they used temporal and spatial cues in the film to do this. The camera shots in which the situation-change judgements were made were identified. An *a priori* analysis of was conducted to identify the camera shots that depicted shifts in continuity along the dimensions of time, spatial regions, and spatial movement based on the criteria outlined above. An analysis of variance was then conducted to assess the relationship between theoretical analysis of shifts in continuity and the empirical judgements of changes in situation.

PREDICTIONS

This approach allowed us to address a number of important issues of situation model construction in the context of film understanding. At the most general level, testing predictions generated by the EI model in the domain of film processing would be a significant step towards a generalization of the model. A central assumption of the EI model is that the situational dimensions have *unique* impacts on situation model construction (Zwaan, 1999 called this the 'independence hypothesis'). There is evidence for this claim in text comprehension (Magliano *et al.*, 1998; Zwaan *et al.*, 1995b, 1998). According to an *independence hypothesis*, shifts in time, movement, and region should each have significant, unique impacts on the situational-change judgements.

A second prediction involves the impact of concurrent shifts in dimensions of situational continuity. Even if the variables have independent effects, it does not

necessarily mean that their effects would not be additive. Specifically, it is reasonable to expect that the more shifts that occur at a particular point in a narrative, the higher the likelihood that understanders would conclude that the prior situation has been completed and a new situation has begun (Gernsbacher, 1990; Zwaan *et al.*, 1998). An *additivity hypothesis* states that the more shifts that occur, the greater the impact on the situation-change judgements.

A third set of predictions involves the relative importance of time, movement, and region in event understanding in narrative film. In the context of narrative text comprehension, time is a more prominent dimension of a situation model than space (Magliano *et al.*, 1998; Zwaan *et al.*, 1995b, 1998; Zwaan and Radvansky, 1998). One potential reason for this dominance is that language is more heavily indexed with temporal information than spatial information (e.g. Miller and Johnson-Laird, 1976) and therefore time is a salient feature of narration in text. It is possible that the relative importance of time and space is different in narrative film understanding from narrative text understanding. It is quite possible that changes in spatial movement and regions each may have a greater impact on processing than time because space is a more salient feature of narration in film. On the other hand, it is possible that time is a central feature of narrative understanding independent of medium and as such, it would more dominant than space during film understanding just as is the case in text comprehension. One reason for making this assumption is that temporal order puts strong constraints on the interpretation of causality, whereas space places relatively weak constraints. A *medium-dependent hypothesis* predicts that shifts in movement and/or region will have greater impacts on situational-change judgements than shifts in time. A *medium-independent hypothesis* predicts that shifts in temporal continuity will have a greater impact on situational-change judgements than shifts in movement or region. Testing between these two hypothesis will involve comparing the present results to those obtained in the context of reading. If we find evidence for the medium-independent hypothesis, then this would suggest that there are elements of event understanding that are independent of medium or mode of experience.

METHOD

Participants

Sixty undergraduates at Northern Illinois University participated for course credit.

Materials

Participants viewed one of three films. *Moonraker* (Broccoli and Gilbert, 1979) is a James Bond movie and could be classified as in the action adventure genre. *Star Trek II: The Wrath of Khan* (Sallice and Meyer, 1982) is the second of the *Star Trek* film series and could be classified as in the science fiction genre. *Jeremiah Johnson* (Coonan *et al.*, 1972) could be classified in the western drama genre. Approximately one hour of film was sampled from each film for the discourse and data analyses. Specifically, 1:01:45 was sampled from *Moonraker*, 1:03:33 was sampled from *Star Trek II: The Wrath of Khan*, and 0:59:03 was sampled from *Jeremiah Johnson*. These hour segments were composed of three approximately 20-minute segments that were sampled at the beginning, middle, and end of each film. These segments began and ended at the first shot of a given scene.

In order to conduct the situational continuity analysis of the film segments, the individual shots that comprised segments were identified. A shot was defined as a continuous piece of film from one camera angle without breaks in the continuity of action. There were a total of 2457 individual shots across the sampled film segments. There were 938, 617, and 886 shots in the segments for *Moonraker*, *Star Trek II: The Wrath of Khan*, and *Jeremiah Johnson*, respectively. The average lengths of the shots were 3.95, 6.18, and 4.00 seconds for *Moonraker*, *Star Trek II: The Wrath of Khan*, and *Jeremiah Johnson*, respectively.

Situational continuity analysis of the films

An analysis of situational continuities was used that was based on the analyses developed by Zwaan *et al.* (1995b). The unit of analysis was the shot. Each of the shots was analysed to determine whether there was a break in continuity in time, movement, and/or region. The criteria for each dimension is discussed below.

Time

The time dimension captured shifts in time within the story world. Temporal continuity occurs when the prior shot depicts events that immediately proceed or are concurrent with those in current shot. Temporally discontinuity occurred when there was a temporal ellipsis in the story world. The presence of a dissolve or fade was extremely helpful in identifying long ellipses. A shot was assigned a one if there was an ellipsis between it and the immediate prior shot, and a zero if the events were judged to be contiguous or concurrent with the prior shot. The first and second authors made these judgements and interrater reliability was high (Kappa = 0.88).

Spatial regions

Spatial regions of interaction that captured changes in the spatial regions that are created in the narrative story world. There were two levels to this variable. When a shot introduces a new region that the viewer has never seen before or when a shot reintroduces a spatial location that the viewer has seen before but is not the same region depicted in the previous shot, then it was assigned a one. Shots that depict events that are in the same region as the immediately prior shot were assigned a zero. Interrater reliability for judgements of continuity in spatial region was also high (Kappa = 0.89).

Spatial movement

Spatial movement captures changes in the location of characters within the story world. There two levels to this variable. If a shot establishes any prominent character in a different location (i.e. region of interaction) from where he or she was last seen, then that shot was assigned a one. If a shot depicts all prominent characters in the same location as last seen, then that shot was assigned a zero. Interrater reliability for judgements of continuity and discontinuity in the spatial movement of characters was high (Kappa = 0.86).

Procedure

Participants individually viewed a video tape of a one of the films, which were randomly assigned. Before viewing the film, they were instructed that the researchers were interested

in assessing how people understand the situations that arise in a film. They were told to identify those points in the film in which the circumstances or situation changed. Participants were asked to consider the events that were occurring at any point in time when making these decisions, but they were not given specific instructions regarding what would constitute a change in situation or circumstances. The instructions were intentionally vague because we did not want to bias the participants' intuitive understanding of what constitutes a change in situation in narrative. People were given a remote control for the video tape player and instructed to keep their finger on the pause button throughout the film. They were told to pause the film whenever they thought that the situation or circumstance in a given scene had changed. A video tape for each film was created such that the bottom of the video screen showed a running-time counter which was accurate up to a 10th of a second. After they paused the film, participants wrote down the time that was at the bottom of the screen. After this was done, they continued the video tape.

RESULTS

In this study, we took advantage of naturally occurring shifts in time, movement and region that occur in actual films. As one would expect, these dimensions of situational continuity are related. The bivariate correlations between time and movement ($r = 0.57$), time and region ($r = 0.42$), and movement and region ($r = 0.41$) were all significant. Table 1 contains the frequency of shots containing the various combinations of changes in time, movement, and region of interaction. As depicted, the frequency of shots containing shifts in these dimensions is relatively low. This makes sense when one considers that scenes in a film can be defined as a sequence of events taking place in a particular time and place (or limited set of places). Furthermore, there is most likely a limit in the number of shifts that can occur along these dimensions and still maintain a sense of continuity. A chi-square test of independence performed on the frequencies in this table was highly significant (Chi-square (8) = 1412.65, $p < 0.01$). This further indicates that changes in these variables are related with one another. Interestingly, the frequency at which the dimensions occurred in isolation was less than expected in all three cases. However, the frequency of shifts in region was considerably higher than that for time or movement. Conversely, frequency at which the shifts occurred in clusters was almost always greater than expected, with the exception that shots containing movement of characters to a different region (i.e. contain both a shift in the movement and region dimensions) in isolation of temporal shifts.

Participants made an average of 85.05 (SE = 8.89), 99.25 (SE = 9.07), and 77.25 (SE = 7.50) change in situation judgements for *Moonraker*, *Star Trek II: The Wrath of Khan*, and *Jeremiah Johnson*, respectively. To what extent do changes in time, movement,

Table 1. Frequency of shots containing shifts in time, movement, and region

Movement	Region	Time	
		No shift	Shift
No movement	No shift	1988	17
No movement	Shift	185	38
Movement	No shift	61	33
Movement	Shift	54	71

and region have an effect on the change in situation judgements? To address this question, we calculated a situation-change score for each of eight cells depicted in Table 1 for each subject. Situation-change scores were calculated by dividing the number of times a participant indicated that there was a change in situation in the shots that comprised a given cell by the total number of shots in that cell. For example, in *Moonraker*, there were 28 shots that depicted shifts in all three dimensions. If a participant indicated that there was a change in situation in 20 of these shots, the subjects change score for this cell would be 0.71. Table 2 shows the average change scores for each of the eight cells. A Time ×

Table 2. Change scores as a function of shifts in time, movement, and region

Movement	Region	Time	
		No shift	Shift
No movement	No shift	0.07	0.25
No movement	Shift	0.16	0.43
Movement	No shift	0.26	0.35
Movement	Shift	0.30	0.50

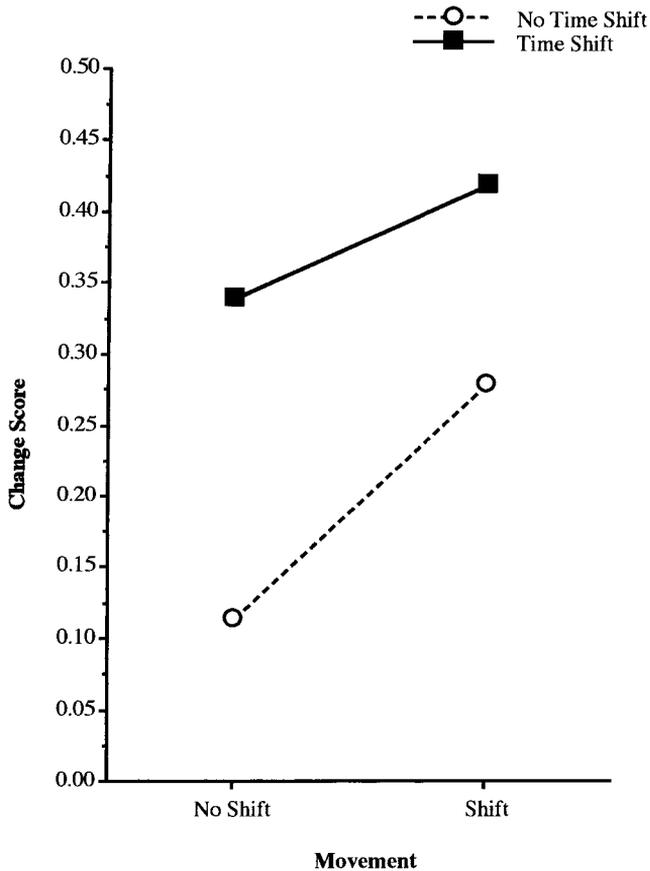


Figure 1. The interaction between time and movement

Movement \times Region repeated-measures ANOVA conducted on these change scores showed a main effect of Time ($F(1, 59) = 72.86$, $MSe = 0.06$, $p < 0.01$) with a mean change score of 0.19 when there was no shift and 0.38 when there was a shift. There was a main effect of Movement ($F(1, 59) = 53.25$, $MSe = 0.03$, $p < 0.01$) with a mean change score of 0.23 when there was no and 0.35 when there was a shift. There was also a main effect of Region ($F(1, 59) = 42.01$, $MSe = 0.04$, $p < 0.01$) with a mean change score of 0.23 when there was no shift and 0.35 when there was a shift.

There was a significant interaction between time and movement ($F(1, 59) = 7.14$, $MSe = 0.03$, $p < 0.05$), which is depicted in Figure 1. *Post hoc* tests (LSD) revealed that the situation-change scores were higher for both shots containing shifts in time and movement alone than for shots containing neither of these changes. These differences indicate that shifts in time and movement had unique effects on situation-change. Furthermore, shots containing a shift in both time and movement had higher change scores than those containing a shift in movement alone, whereas shots containing changes in both dimensions did not have a higher change score than shots containing temporal ellipsis alone. There was also an interaction between time and region ($F(1, 59) = 10.59$, $MSe = 0.03$, $p < 0.01$), which is depicted in Figure 2. *Post hoc* tests (LSD) revealed that change scores for shots shifts in time alone were greater than those containing no shifts

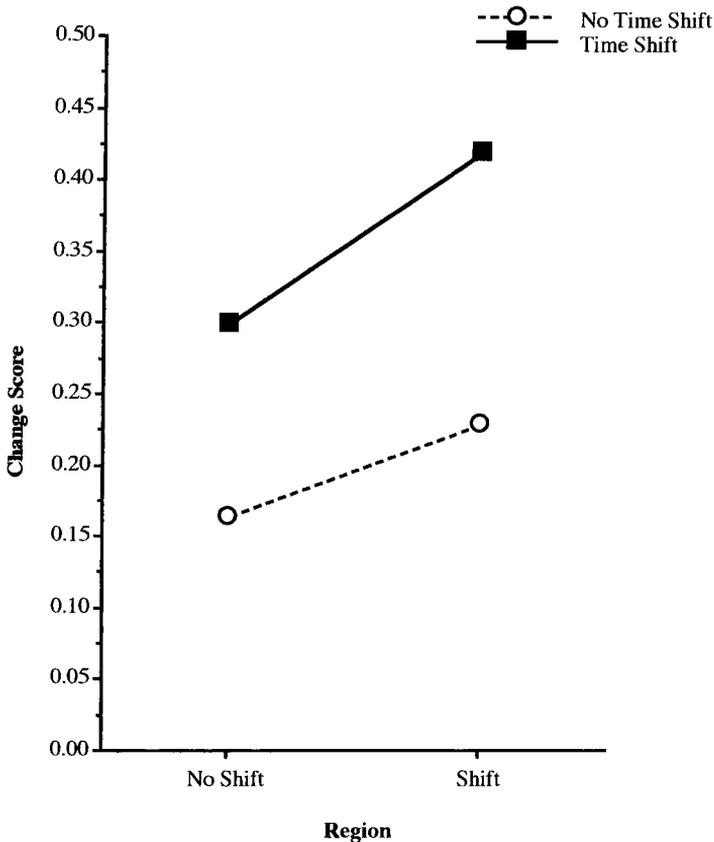


Figure 2. The interaction between time and region

in either dimension, whereas those shots containing a shift in regions alone were not significantly different from shots containing no shifts in either dimension. Furthermore, shots containing shifts in both dimensions had greater change scores than all other cells in the interaction.

A final analysis was conducted to assess whether the effects of changes in these dimensions on the perception of situational change are additive, and if so, what is the nature of that additivity. We calculated situation-change scores for shots containing a change on a single dimension, two dimensions, and all three dimensions, which were 0.22 (SE = 0.015), 0.36 (SE = 0.024), and 0.50 (SE = 0.037), respectively. A one-way ANOVA was significant ($F(2, 118) = 10.59$, $MSe = 0.01$, $p < 0.01$). *Post hoc* tests (LSD) indicated that shots containing changes in all three dimensions had higher situation-change scores than those containing changes in two dimensions, which were in turn greater than those containing a change in only one dimension. These differences suggest that the effects of multiple shifts are additive. An examination of the means supports this interpretation. When the discourse analysis identified no situational change, the average change scores was 0.07. Each successive situational change appears to have increased the change score by about 0.15.

DISCUSSION

Our results provide an important extension of the EI Model (Zwaan and Radvansky, 1998) to narrative film. Consistent with the EI Model, the present study demonstrated that viewers index the events that occur in narrative film along multiple dimensions of situation continuity when monitoring the situations that are part of the story. More specifically, there is evidence for the independence hypothesis that the dimensions made independent contributions to situation-model construction, but only for time and movement. Shifts in either of these dimensions were sufficient to create a change in situation in the mind of a viewer. However, shifts in region alone were not enough to create a new situation. Interestingly, this effect is consistent with that found in text comprehension (Zwaan *et al.*, 1995b). Shifts in region did, however have an impact on the perception that a situation has changed when they co-occurred with temporal ellipsis.

The finding that shifts in region alone are not sufficient to trigger a new situation may stem from one aspect of narration. Storytellers often describe two or more sequences of events that occur concurrently in the story world, but in different locations. Typically, in scenes that have such a structure, the events that occur in these different regions are part of the same causal-temporal sequence of events. For example, during the battle scenes in the film *Star Trek II: The Wrath of Khan*, the film maker shifts between the bridges of the two ships. The activities that take place on each of the bridges are all part of the ongoing battle. Therefore, a shift from one bridge to the next does not by itself indicate that the circumstances of the battle have changed.

There was also evidence for the additivity hypothesis that shifts in multiple dimensions of continuity have additive effects on situation-change judgements. Zwaan *et al.* (1998) found similar additive effects of situational continuity breaks on sentence-reading times. Understanders are sensitive to shifts along multiple dimensions because these instances have important implications for the construction of the mental representation for events. Specifically, shifts in multiple dimensions cue the understander that the prior situation has ended and a new one is beginning.

Our results also speak of the relative importance of shifts in time, movement, and region in the monitoring of situational continuity during film understanding. They suggest that monitoring changes in time is more dominant in event understanding than monitoring changes in movement and region. The interactions depicted in Figures 1 and 2 provided the strongest support for this conclusion. The interaction between time and movement (Figure 1) indicated that shifts in both time and movement are sufficient to create an understanding that a situation has changed. However, the co-occurrence of these shifts enhanced this perception over and above changes in movement alone, but not time alone. Furthermore, the interaction between time and region (Figure 2) indicated that shifts in region create the sense that there is a new situation only to the extent that they co-occurred with shifts in time.

These results provided support for the medium-independence hypothesis in that they are consistent with those found in studies investigating event indexing in the context of narrative text comprehension (see Zwaan and Radvansky, 1998, for an extensive review). There is a growing body of evidence that monitoring shifts in time is an obligatory aspect of narrative text comprehension (Zwaan, 1995b, in press; Zwaan, 1996). Changes in the movement of characters appear to be monitored primarily when those changes are important for comprehension (de Vega, 1995). Finally, shifts in region appear to be monitored only when doing so is consistent with reader goals or when rereading a text (Zwaan *et al.*, 1995b). It appears that the relative importance of the dimensions of situation continuity in event indexing is by and large medium-independent. This finding bolsters the claim that the higher-level processes involved in situation understanding are generalizable across experiences, whether they occur in text, film, or in real life (Gernsbacher *et al.*, 1990). One important avenue for future research is to map out the similarities and differences in situation understanding across types of experiences. Such research would provide important extensions to theories and models of understanding to domains other than discourse.

The present study suggests that the surface form in which a narrative is conveyed is not trivial to situation model construction. A number of recent studies have demonstrated that the grammatical form of a sentence, such as tense and aspect, has an important impact on model construction during reading (Carreiras *et al.*, 1997; Gernsbacher and Jescheniak, 1995; Magliano and Schleich, in press; Zwaan, 1996). For example, Magliano and Schleich (2000) demonstrated that the aspectual class of a sentence has an impact on the perception that the event depicted in it is completed or ongoing and has an impact on the availability in working memory of that information while reading the subsequent context. Similarly, the present study demonstrated that the editing techniques of film makers (see Bordwell, 1995, for an extensive review) have an impact on the understanding of the unfolding situations that occur in film. Theories of situation-model construction must account for the impact of surface form on situational understanding.

It might also be argued that our method of having people identify situational breaks was unnaturalistic, given that the movie-going public is not required to do this in the theatre. In other words, How can we be sure that people spontaneously identify these breaks while watching a movie? We can offer no direct evidence that they do. However, we offer three strong sources of circumstantial evidence. First, the degree of overlap across subjects with which the breaks were identified in our experiment was high. If the subjects were merely responding in idiosyncratic ways, we would not have observed such a high degree of overlap. Second, as discussed above, our data are highly consistent with the reading-comprehension data collected in ours and other labs. Given that participants in these

experiments were not instructed to identify situational breaks, we can assume that they monitored these breaks spontaneously. It therefore seems plausible that the same would occur in naturalistic film viewing. Third, our results accord well with Bordwell's (1985) theoretical analyses of cinematic devices and with the EI Model, as well as with theories about the organization of autobiographical memory (e.g. Thompson *et al.*, 1996; Wagenaar, 1986). As such, we believe that the present methodology did provide results that can be generalized to more naturalistic viewing circumstances.

ACKNOWLEDGEMENTS

We would like to thank Tom Trabasso and Art Graesser for their helpful comments during the planning of this study and on the data analyses. We would also like to thank members of the Discourse and Technology group at Northern Illinois University, Gabe Radvansky, Kathy Pezdeck, and an anonymous reviewer for their comments on earlier drafts of this manuscript.

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