CHAPTER 2

Situation models and themes*

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According to current theories of language comprehension, text comprehension can be viewed as the construction of a mental representation of the events described in the text (Kintsch, 1998; van Dijk and Kintsch, 1983; Zwaan and Radvansky, 1998). Although this view seems capable of explaining a great number of processes that go on in narrative comprehension, such as anaphoric resolution and knowledge activation, it is unclear at this point whether a situational analysis can account for thematic interpretation. For example, is it sufficient for a comprehender to mentally represent the sequence of events and their relations as larger episodes as described in the *Illiad*, *Madame Bovary*, or *One hundred years of solitude* in order for a thematic representation to be created? Or is it the case that a different level of representation and a different set of processing mechanisms is needed? If more is needed, then the question is, "what exactly is needed?"

Our goal in this chapter is to begin to address these questions. In doing this, we will first provide a discussion of situation models within the framework of the Event-Indexing Model (Zwaan, 1999; Zwaan, Langston, and Graesser, 1995; Zwaan and Radvansky, 1998; Zwaan, Radvansky, Hilliard, and Curiel, 1998). Specifically, we will focus on what processes in language comprehension this theoretical perspective can explain and provide insight into. In the second part of the chapter, we will provide a discussion of cognitive psychological research on thematic interpretations from a broad number of perspectives. Finally, in the third part, we will examine whether situation models are necessary and/or sufficient for thematic interpretations.

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Situation models

When readers comprehend a narrative, they form a mental representation of the events described in that narrative. In psychological research on language comprehension, this mental representation of what the text is about is called the situation model. According to the Event-Indexing Model, mental representations of individual events form the building blocks of situation models which may span several collections of events, which are referred to here as episodes. In general, events are conveyed linguistically by clauses. The Event-Indexing Model (EIM) assumes that readers track the relations between events on five dimensions: time, space, causation, motivation, and protagonist. They do this by indexing events on each of the five dimensions. This indexing process is regulated by the information in working memory. In psychology research, the idea of a working memory is widely regarded as a theoretical construct that corresponds to information that is in a very high state of availability (often either in or on the threshold of consciousness) and can be manipulated by mental processes. To the extent that an incoming event shares an index on a particular dimension with an event that is currently in working memory, a link will be formed between the two events, via the index. If no link can be established, a new index will be formed for that dimension.

This general idea leads to two global hypotheses: the *processing-load* and the *memory-organization* hypothesis. According to the processing-load hypothesis, processing load should increase when an event index needs to be updated. There is a great deal of evidence for this hypothesis, which is reviewed in Zwaan and Radvansky (1998). A stronger version of the hypothesis claims that the amount of increase should be a function of the number of indices that need to be updated. Consistent with the latter hypothesis, there is evidence that reading times increase as a function of the number of dimensions that require updating (Zwaan *et al.*, 1998).

According to the memory-organization hypothesis, the strength of the association between two events is greater when they share an index than when they do not. Zwaan and Radvansky (1998) discuss a large number of experimental studies using cued-recall and primed-recognition tasks that have yielded evidence consistent with this hypothesis. A stronger version of the hypothesis claims that the association between two events is a function of the number of dimensions on which they share indices. There is evidence for this hypothesis as well (Zwaan, Langston, and Graesser, 1995).

In order to provide a more detailed account of situation-model construction according to EIM, Zwaan and Radvansky (1998) distinguish between:

- the *current model*, the model currently under construction, i.e., the model at t_n
- the *integrated model* of the situations at times $t_1$through t_{n-1}
- the *complete model* of the situations at times t_1 through t_x

The *current model* is constructed at time t_n while a person reads a particular clause or sentence, called c_n. The *integrated model* is the global model that was constructed by integrating, one at a time, the models that were constructed at times t_1 to t_{n-1} while the person reads clauses c_1 to c_{n-1}. Finally, the *complete model* is the model that is stored in long-term memory after all the textual input has been processed; thus, at that stage, it is identical to the integrated model. Zwaan and Radvansky termed the process of incorporating the current model into the integrated model *updating*.

The processing-load hypothesis concerns the updating process. The more situational indices that are shared between the current model and the integrated model, the easier updating will be. The memory-organization hypothesis pertains to the structure of the integrated model and its final form, the complete model, in long-term memory.

A further specification of the Event-Indexing Model made by Zwaan and Radvansky (1998) is that they have adopted Ericsson and Kintsch's (1995) concept of long-term working memory. According to this view, skilled performers are able to use part of their long-term memory as working memory, thereby circumventing the traditional limitations of working memory. That is, long-term information in working memory is highly accessible, like that of information in working memory. However, its accessibility is less than that of information that is being actively processed in working memory. Metaphorically, the distinction between working memory, long-term working memory, and long-term memory can be thought of as the location of a paper on some topic one is interested in reading about. Working memory would correspond to the current paper one is reading, and perhaps to one or two other on the top of the desk. Long-term working memory would be papers in the filing cabinet (and maybe some of those under that box of donuts). Finally, long-term memory would be those papers that you have to go to the library to get.

Applied to the domain of text comprehension, which is a skilled activity for most literate individuals, the view holds that comprehenders are able to maintain retrieval cues to relevant previously constructed information available in long-term working memory. This allows them to form connections between events that were mentioned in disparate parts of a text. Zwaan and Radvansky proposed that comprehenders might maintain retrieval cues for each of the five dimensions in order to be able to efficiently update situational indices. However, as yet there is no empirical evidence that speaks to this proposal.

The five situational dimensions. A distinction can be made between event and episode information (this was described in the context of framework, content and relational information by Zwaan and Radvansky, 1998). Event information is that knowledge that is bound within a specific spatial-temporal framework. In fairy tales, for example, the stereotypical first sentence "Once upon a time in a far away

land . . ." fixes the narrated situation in time and space. This spatial-temporal framework information is obligatory for establishing a situation model when referring to specific events. An event always occurs at a given location and time, however ill-specified these may be.

In addition to the spatial-temporal framework, each representation of an event is thought to contain entities that are functionally involved in the situation. These include things such as people, objects and ideas. One or more entities are also obligatory elements of a situation model, although other less central entities may not be encoded into the situation model. Finally, there is structural relational information that conveys how the entities are related to one another within that framework, for example, the relative locations of objects in a room. Typically, these sorts of relations are thought to be left out of the model unless they are critical for understanding the structure of the situation. As such, this relational information is often optional. Thus, with regard to the representation of events, those aspects of a situation model having to do with space and time as well as the central entities involved in that situation are most likely to have an influence on processing.

Episode information involves linking relationships between events. These are relations that serve to organize collections of events into coherent wholes. There are three primary types of linking relations that are of importance here. These are temporal, causal and intentional relations. These sorts of relations provide a person with a means of structuring large amounts of information about a situation that is stretched across many different places and times. We also take the position that these linking relations are rooted in the entities that are involved in the events. As such, the entities can serve as a unifying source across many different events. Thus, with regard to the representation of events, those aspects of a situation model having to do with temporal, causal and intentional relations, as well as the central entities that are affected by these relations, are most likely to be involved in processing.

These aspects of situation model construction closely resemble the five dimensions outlined by the original version of EIM. Furthermore, this theoretical framework provides us with a means of understanding how these different dimensions might interact with one another and how changes along one or more of these dimensions may have an influence on thinking. In this theory, the number of shared indices may vary between zero and five. Thus, there can be various gradations of change from one situation to the next.

The number of shared indices has been shown to predict reading times (Zwaan *et al.*, 1998) as well as memory organization (Zwaan and Brown, 1996; Zwaan, Langston, and Graesser, 1995). Specifically, sentence and clause reading times increase as a function of the number of dimensional breaks while relatedness judgments for pairs of events increase with the number of shared indices. Because these effects are discussed in detail in the cited publications, we will not discuss them here.

Table 1 provides an informal illustration of how the Event-Indexing Model constructs a situation model from a simple narrative based upon one of Aesop's fables, which was used by Zwaan, Radvansky, Hilliard, and Curiel (1998).

On the *temporal* dimension, the events in clauses 1–6 are contiguous and so should be strongly connected on this dimension. However, in clause 7, a time shift occurs ("Back at the farm the next day"), which should lead to an increase in processing load. Given that there are no subsequent temporal discontinuities, clauses 7–15 are connected on the temporal dimension. They describe one continuous flow of events. Clause 16 presents another time shift because it describes the man returning whereas the previous sentence described him picking up the headband. This time shift is obviously smaller than the previous one, but Zwaan (1996) has shown that the size of the time shift is not a major factor.

On the *spatial* dimension, events 1–6 take place in one location ('the field'). Event 7 takes place in a different location ('the farm'). The eagle spots the man and so is not in exactly the same spatial region. But then the eagle flies toward the man and the two are within the same spatial region. Events 14 and 15 occur at a new spatial location, away from the wall. Finally, events 16–18 occur back at the wall. This means that events 16–18 are connected with events 8–12 on the spatial dimension.

Table 1. Story used by Zwaan *et al.*(1998), Experiment 1

	THE FARMER AND THE EAGLE
1.	One day out in the field, a farm laborer happened upon an eagle
2.	that was struggling to free its wings
3.	which were caught in a barbed wire fence.
4.	The farm laborer was struck with the beauty of the bird.
5.	So he decided to let it go free.
6.	He took out his knife and cut the bird loose.
7.	Back at the farm the next day, the eagle spotted the farm laborer
8.	who was resting in the shade of an old wall
9.	that was crumbling.
10.	The eagle flew up
11.	and snatched in its talons the headband that he was wearing.
12.	The man jumped up
13.	and pursued it.
14.	The eagle then dropped the band
15.	and the man picked it up.
16.	On returning he found how wonderfully the bird had repaid his kindness.
17.	The wall had collapsed
18.	just where he had been sitting.

On the *causality* dimension the relations happen to be psychological rather than physical. Events 2 and 3 are connected as effect and cause (BECAUSE the eagle was caught in a barbed wire fence, he was struggling to free its wings), while clauses 4 and 5 are connected as cause and effect (BECAUSE the farmer was struck with the beauty of the bird, he decided to let it go free). Similarly, 9 and 10 are a cause and effect pair (BECAUSE the wall was crumbling, the eagle flew up, as it wanted to return the favor and save the man from the impending collapse of the wall), although many readers are not aware of this initially, as are 11 and 12 (BECAUSE it snatched in its talons the headband that he was wearing, the man jumped up).

On the *intentionality* dimension, clauses 2 and 5 state new goals ("struggling its wings" and "deciding to let it go free") and so should lead to an increase in processing load. The action described in clause 6 is part of the goal to set the bird free and so should be easily integratable and not lead to an increase in processing load. Event 10 is prompted by a new goal on the part of the eagle, preventing the man from being crushed by the wall, which is left implicit (and which not all readers who have participated in our experiments inferred). This goal motivates events 11 (snatching the headband) and 14 (dropping the band). Meanwhile, the reader has to infer a goal for the farmer, to retrieve the headband, which most readers readily do. his goal motivates events 12 (the man jumping up), 13 (the man pursuing the headband), and 15 (the man picking up the headband).

On the *entity* dimension, clauses 1 (laborer), 2 (eagle), and 9 (wall) should lead to increases in reading times on this dimension because they introduce new agents.

This analysis produces a network of events connected on 0–5 dimensions, which represents the situation model in the reader's long-term memory. These links are formed during comprehension. In theory, the reader's default assumption is that each incoming event is connected on all five dimensions to the events that are currently in (long-term) working memory. To the extent that this is not the case, reading times for the event (all other things being equal) will increase. The assumption is that this increase reflects the establishment of one or more indices for the new event. Another way of putting it would be to say that the increase in reading times reflects the relative difficulty of integrating the incoming event into the evolving situation model.

Thus far, it is fair to say that the EIM has been more a model of the relations among events than a model of the contents of the events themselves. As such, the present analysis clearly underspecifies what is going on during situation-model construction. However, it is precisely this which has allowed the model to be tested empirically. With the current empirical foundation, our goal is now to specify the nature of situation models and their construction in greater detail.

Returning to the example story, we remind the reader that it was based on a fable. The moral of this fable is something like "One good turn deserves another."

This could be regarded the theme of the story. In the next section, we will review what cognitive psychologists have learned about people's ability to extract themes from linguistic input.

Cognitive psychological research on themes

WordNet®, the lexical database maintained by the Cognitive Science Laboratory at Princeton University, distinguishes five senses of the word "theme." Two of these are relevant to our present discussion. The first sense is: "subject, topic, theme — (the subject matter of a conversation or discussion; "he didn't want to discuss that subject"; "it was a very sensitive topic"; "his letters were always on the theme of love")." The second sense is: "motif — (a unifying idea that is a recurrent element in a literary or artistic work; "it was the usual 'boy gets girl' theme")." The important distinction between these two senses of "theme" is that the first refers to a *concept*, whereas the second refers to a state of affairs, a *situation*, more specifically, an abstract situation, one that is not bound by time or space. The moral of "The farmer and the eagle" (One good turn deserves another), which we discussed earlier, is an example of this second sense.

There are several areas in cognitive psychology where people have done research that is relevant to the study of themes in both of the definitions given above. We will focus on four areas: list memory, autobiographical memory, discourse comprehension, and analogical reasoning.

List memory. Consider the following list of words: DOOR, GLASS, PANE, SHADE, LEDGE, SILL, HOUSE, OPEN, CURTAIN, FRAME, VIEW, BREEZE, SASH, SCREEN, SHUTTER. People who are asked to memorize lists such as this one often (i.e., about 40 per cent of the time) falsely recall having studied a word such as WINDOW (Roediger and McDermott, 1995; see Deese, 1959 for the original study). As the reader may have noticed, WINDOW is a close associate of all of the words on the list. In fact, the list was constructed by taking the 12 closest associates of WINDOW from a set of association norms.

It may not be too much of a stretch to say WINDOW is the theme-topic of the list. Unfortunately, there is currently not a great deal memory researchers know about the mechanisms underlying the false recall of topic words. However, current evidence suggests that the intrusion of WINDOW occurs while people are memorizing the list (McDermott, 1997). One possibility is that the theme-word intrusion occurs as a by-product of other activities, such as mnemonic elaboration strategies. Because the lists are presented at a rate of 1.5 or 2.0 sec per word, there would be sufficient time for elaboration. However, it cannot be ruled out completely that the theme-word intrusion occurs at least in part as a result of spread-

ing activation. After the presentation of each word, the theme word, being a close associate of each of the words on the list, will accrue more activation, until, perhaps, its activation level matches that of the presented words, such that its retrieval likelihood is comparable to actually presented words (Roediger and McDermott, 1995; McDermott, 1997). However, this does not mean that the theme word is equivalent to the presented words. When the theme word is actually included on the list, its recall likelihood by far exceeds that of the other words (McDermott, 1997).

Autobiographical memory. The notion of a theme is also present in theories of autobiographical memory. Many of the themes are of the abstracted situation type mentioned earlier. Of most relevance here is Conway's (1996) theory of autobiographical memory. In this theory, autobiographical memories are thought to be organized at three primary levels. At the lowest level are memories for specific events that a person experienced. An example of this would be a person's memory for the first time they met their college roommate. At the middle level are representations of general events. This is knowledge that is not situation-specific, but which captures general characteristics of a set of specific events. For example, knowledge of "fights with my roommate" would be classified as general event knowledge. Of particular interest here is the highest level of representation, that of the lifetime periods. These are long stretches of time that serve to unify a variety of general events. For example, "my time in college" would be a lifetime period.

This is particularly noteworthy because an autobiographical memory corresponds to the events that a person experienced. There is no external "author" who is choosing what information should be included and which should be excluded, thereby having some control over the theme that a person may abstract. The generation of themes for different aspects of life is a subjective process done (although most likely not consciously) entirely by the person owning the autobiographical memories. Moreover, mental representations of what a text is about, such as situation models, can be thought of as being vicarious autobiographical memories (see also Taylor and Tversky, 1997). That is, when a person reads narrative text, and the text is well written, the person will feel as if they are embedded in the situations described, perhaps from the perspective of one or more of the characters. As a result, the reader will have memories that are similar to (although often clearly distinguishable from) memories for actually having experienced the event.

The lowest level in this theory of autobiographical memories is event-specific level. This corresponds to event information in our situation model theory. As before, information at this level is organized around a specific spatial-temporal framework. In the experience of real life events, information that is represented in

this form provides the raw materials for higher levels of processing. Thematic processing that occurs at this level would primarily involve the identification of events as being consistent with themes in life that have already been identified. For example, when the neighbors have a loud argument after having had several in the past, a person may identify that specific event as being consistent with the theme of the neighbors' dysfunctional marriage.

The intermediate level in Conway's autobiographical memory theory is the general event level. This roughly corresponds to the representation of episodes in our situation model theory because both involve information from across a collection of event-specific memories. In situation model theory, the information at this level is thought to represent a single course-of-events situation composed of events that are united into a coherent whole via a set of linking relations. As such, each episode that is represented is more or less unique. Similarly, in autobiographical memory, these representations capture a number of individual events.

The inclusion of various events into a general representation is not a simple-minded process. That is, events that are included are not simply those that are temporally contiguous, but are those events that share some common thread, such as dating a certain person or working at a certain job. One thing to note about these general autobiographical memories is that they can serve to represent a collection of events that are very similar in their basic structure. For example, a memory for "Junior year chemistry class" would represent a large set of events that all had the same basic structure (e.g., "That was the class where the professor gave pop quizzes almost every day and I had to write frantically to keep up with my notes").

As will be discussed in the next section, the abstraction of thematic information at this level does not occur often in narrative text comprehension. However, in autobiographical memory, this sort of abstraction process is very much automatic. In fact, people often treat this level of autobiographical memory as the basic level of processing when thinking and talking about events in their lives, not the more basic event-specific level. Part of the reason for this difference may lie in the simple fact that people are often much more involved and engaged in events the highly detailed information present in their own lives than in the events that are conveyed with considerably less detail in a text. As such, thematic extraction would require more effort.

Finally, at the highest level in Conway's hierarchy are lifetime periods. These have no clear counter-part in situation model theory as it has been developed to date. Lifetime periods are clearly thematic motifs. One example would be a relationship theme in a person's life that would include periods such as "first boy/girlfriend," "living with X," "married to Y." People obviously have no problem generating these sort of motifs, and appear to do so spontaneously.

Discourse comprehension

Researchers in discourse comprehension have addressed both types of themes, although the main focus has been on theme as topic. For example, Guindon and Kintsch (1984) have found evidence that topic statements, which they call macropropositions (i.e., propositions that summarize a set of other propositions) have a special status in the reader's memory representation. Specifically, in a primed-recognition task they found significantly greater priming between words from the same macroproposition than between words from the same micro-proposition. Moreover, they observed this effect whether or not the college students in their experiment were instructed to summarize the text. This suggests that readers spontaneously assign a special status to macropropositions.

Lorch, Lorch, and Mathews (1985) found that sentence-reading times increased after a major topic shift compared to after a minor shift. This suggests that readers form a macrostructure during on-line comprehension. Glanzer, Fischer, and Dorfman (1984) interrupted subjects who were reading texts and then presented them with a cue, either the last sentence the subjects read or a topic sentence before the next sentence of the text was shown. Reading times for the next sentence were significantly faster when the last sentence was used as a cue compared to when the topic sentence was presented. This suggests that the last sentence was a better cue than the topic sentence, which casts some doubt on the special status of topic sentences. However, Lorch (1993) noted there were some problems with the Glanzer *et al.* study. For example, they used a recall task that required memory for factual information, which presumably de-emphasizes thematic processing relative to normal reading. Lorch (1993) conducted an experiment using the same interruption paradigm as Glanzer *et al.* but eliminating the problems with their design. Lorch found that topic cues were as effective as the last sentence, which is more consistent with the idea that topic sentence have a special status in the reader's working memory.

There is very little research on theme as motif. Seifert, McKoon, Abelson, and Ratcliff (1986) showed that a narrative being read does not automatically activate a thematically similar story that was read previously. Only when subjects were asked to evaluate stories for similarity were there significant differences between stories with the same or different theme found in a sentence verification task. This study demonstrates that readers can process the thematic elements of a text, but that recognizing thematic similarities is a strategic, rather than automatic process. This finding dovetails nicely with the literature on analogical reasoning to which we turn next.

Analogical reasoning. Research on analogical reasoning is concerned with themes as motifs. In a classic study, Gick and Holyoak (1980) presented college students with the tumor problem shown in Table 2. This is a very difficult problem

for people; only 10 per cent of Gick and Holyoak's students were able to solve it. However, about 75 per cent of the students were able to solve the problem after they had read the Fortress Story (also in Table 1) AND were told to make use of it when solving the tumor problem.

This finding has two important implications for research on theme abstraction. The first implication is that people, college students at least, are able to map a situation model from one domain onto another domain that is completely different in its surface characteristics. After all, the story is about a military situation and the problem about a medical one. Thus, the mapping occurs at a deeper level. For example, the fortress will be mapped onto the tumor, the army

Table 2. Reasoning Problem used by Gick and Holyoak (1980)

The tumor problem

Suppose you are a doctor with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed, the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately, at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either. What type of procedure might be used to destroy the tumor with the rays and at the same time avoid destroying the healthy tissue?

The fortress story

A small country fell under the iron rule of a dictator. The dictator ruled the country from a strong fortress. The fortress was situated in the middle of the country, surrounded by farms and villages. Many roads radiated outward from the fortress like spokes on a wheel. A great general arose who raised a large army at the border and vowed to capture the fortress and free the country of the dictator. The general knew that his entire army could attack the fortress at once it could be captures, His troops were poised at the head of one of the roads leading to the fortress, ready to attack. However, a spy brought the general a disturbing report. The ruthless dictator had planted mines on each of the roads, The mines were set so that small bodies of men could pass over them safely, since the dictator needed to be able to move troops and workers to and from the fortress, However, any large force would detonate the mines. Not only would this blow up the road and render it impassable, but the dictator would destroy many villages in retaliation. A full-scale direct attack on the fortress therefore appeared impossible.

The general, however, was undaunted. He divided his army up into small groups and dispatched each group to the head of a different road. When all was ready he gave the signal, and each group charged down a different road. All of the small groups passed safely over the mines, and the army then attacked the fortress in full strength. In this way, the general was able to capture the fortress and overthrow the dictator.

onto the rays, and the general onto the doctor. This mapping is based not on shared surface features, but on role equivalence. That is, the fortress and the tumor are the target, the army and the rays are the means, and the doctor and the general are the main agent deploying the means.

The second important implication from the Gick and Holyoak findings is that people had to be instructed to use the story to solve the problem. They rarely did so spontaneously. This suggests that people do not spontaneously generate structural analogies. The Gick and Holyoak research has been followed up by a host of other studies. By and large, these studies converge on the conclusion that people can use analogies but that they rarely do so spontaneously. However, more recently, Wharton *et al.* (1994) found evidence that people can spontaneously generate structural remindings. Specifically, spontaneous structural reminding is more likely to occur when there are several alternative targets for reminding in memory, compared to when there is only one target, as in the Gick and Holyoak (1980) and Seifert *et al.* (1986) studies.

Conclusions. Both theme-topic and theme-motif have been studied in cognitive psychology. The list-memory literature suggests theme-topic can be generated spontaneously, that is, without the specific goal to generate a thematic inference. In discourse comprehension, topical statements appear to have higher activation levels in the reader's working memory relative to other statements. Moreover, readers appear to spontaneously assign this privileged status to topical statements. The story appears to be different for theme-motif. Most studies in analogical reasoning and discourse comprehension suggest that people can generate thematic representations but do not do so spontaneously. However, the story is different for autobiographical memories, where spontaneous thematic abstraction seems to be the rule. Furthermore, Wharton *et al.* have shown that when there are competing targets for analogical reminding, there is evidence that people spontaneously use theme-motif representations.

Situation models and themes

Are situation models necessary for thematic inferences? There is a great deal of evidence that comprehension involves the construction of situation models and that comprehenders spontaneously construct situation models. The question that interests us here is whether it is necessary to construct a situation model if one wants to construct a thematic interpretation. The best way to start answering this question is by restating it as a counterfactual. Thus: "If comprehenders do not construct a situation model, can they construct a thematic interpretation?" We will attempt to answer this question, using the distinction between theme-topic and theme-motif.

It would seem that theme-topics can be generated without the prior construction of a situation model. For example, it is unlikely that subjects in list-memory experiments are actively constructing situation models and that the intrusion of the target is the result of this. First, it is not easy to construct situation models based on single words (mostly nouns), because single words do not describe events, but people or objects. As we have argued before, events form the building blocks of situation models. Second, theme-topics can be generated as the result of repeated automatic activation.

Obviously, this does not explain the finding that people spontaneously assign more weight to topical statements than to other statements when comprehending a text. However, we argue that even in this case it is not necessary to invoke situation models as an explanatory construct. There is a range of linguistic conventions to indicate topicality. For example, the topic of a text is typically stated in the title (especially in expository prose). Topic sentences are typically the first sentence of a paragraph. In textbooks, topics are often highlighted (e.g., boldfaced). Topics are also indicated by illustrations. And of course, the topic can be explicitly stated. The point is that in each of these cases the topic can be inferred based on textual markers, rather than on a situation model.

The story is quite different for theme-motif representations. It is very difficult to see how theme-motif representations can be constructed without situation models. In the autobiographical memory literature, it is clear that themes about different life periods are constructed out of the specific events that a person experiences. If these experiences are thought of as being represented by situation models, then the situation models would be needed for motif creation. As the analogical-reasoning literature shows, analogical remindings occur between texts that are very different at the surface level, and even at the theme-topic level. Rather, these remindings are based on abstract causal and goal-based representations. As we will argue in more detail below, these abstract representations are derived from situation models.

Are situation models sufficient for theme abstraction? With respect to theme-topic information, the answer to this question is a tentative "yes." The answer is tentative because we know of no empirical evidence directly pertaining to this issue. However, it is plausible to assume that the construction of a situation model would activate a great number of concepts associated with the theme, such that the topical inference would be generated as a by-product. For example, in a passage about the history of the Beatles, John, Paul, George, and Ringo, would be the main agents in most of the events being described. As a consequence, many event nodes would be connected to the node for 'Beatles' in memory representation. Therefore, this node would have a high level of activation.

With respect to theme-motif, situation-model construction is clearly not sufficient. This answer is prompted by both theoretical considerations and

onto the rays, and the general onto the doctor. This mapping is based not on shared surface features, but on role equivalence. That is, the fortress and the tumor are the target, the army and the rays are the means, and the doctor and the general are the main agent deploying the means.

The second important implication from the Gick and Holyoak findings is that people had to be instructed to use the story to solve the problem. They rarely did so spontaneously. This suggests that people do not spontaneously generate structural analogies. The Gick and Holyoak research has been followed up by a host of other studies. By and large, these studies converge on the conclusion that people can use analogies but that they rarely do so spontaneously. However, more recently, Wharton *et al.* (1994) found evidence that people can spontaneously generate structural remindings. Specifically, spontaneous structural reminding is more likely to occur when there are several alternative targets for reminding in memory, compared to when there is only one target, as in the Gick and Holyoak (1980) and Seifert *et al.* (1986) studies.

Conclusions. Both theme-topic and theme-motif have been studied in cognitive psychology. The list-memory literature suggests theme-topic can be generated spontaneously, that is, without the specific goal to generate a thematic inference. In discourse comprehension, topical statements appear to have higher activation levels in the reader's working memory relative to other statements. Moreover, readers appear to spontaneously assign this privileged status to topical statements. The story appears to be different for theme-motif. Most studies in analogical reasoning and discourse comprehension suggest that people can generate thematic representations but do not do so spontaneously. However, the story is different for autobiographical memories, where spontaneous thematic abstraction seems to be the rule. Furthermore, Wharton *et al.* have shown that when there are competing targets for analogical reminding, there is evidence that people spontaneously use theme-motif representations.

Situation models and themes

Are situation models necessary for thematic inferences? There is a great deal of evidence that comprehension involves the construction of situation models and that comprehenders spontaneously construct situation models. The question that interests us here is whether it is necessary to construct a situation model if one wants to construct a thematic interpretation. The best way to start answering this question is by restating it as a counterfactual. Thus: "If comprehenders do not construct a situation model, can they construct a thematic interpretation?" We will attempt to answer this question, using the distinction between theme-topic and theme-motif.

It would seem that theme-topics can be generated without the prior construction of a situation model. For example, it is unlikely that subjects in list-memory experiments are actively constructing situation models and that the intrusion of the target is the result of this. First, it is not easy to construct situation models based on single words (mostly nouns), because single words do not describe events, but people or objects. As we have argued before, events form the building blocks of situation models. Second, theme-topics can be generated as the result of repeated automatic activation.

Obviously, this does not explain the finding that people spontaneously assign more weight to topical statements than to other statements when comprehending a text. However, we argue that even in this case it is not necessary to invoke situation models as an explanatory construct. There is a range of linguistic conventions to indicate topicality. For example, the topic of a text is typically stated in the title (especially in expository prose). Topic sentences are typically the first sentence of a paragraph. In textbooks, topics are often highlighted (e.g., boldfaced). Topics are also indicated by illustrations. And of course, the topic can be explicitly stated. The point is that in each of these cases the topic can be inferred based on textual markers, rather than on a situation model.

The story is quite different for theme-motif representations. It is very difficult to see how theme-motif representations can be constructed without situation models. In the autobiographical memory literature, it is clear that themes about different life periods are constructed out of the specific events that a person experiences. If these experiences are thought of as being represented by situation models, then the situation models would be needed for motif creation. As the analogical-reasoning literature shows, analogical remindings occur between texts that are very different at the surface level, and even at the theme-topic level. Rather, these remindings are based on abstract causal and goal-based representations. As we will argue in more detail below, these abstract representations are derived from situation models.

Are situation models sufficient for theme abstraction? With respect to theme-topic information, the answer to this question is a tentative "yes." The answer is tentative because we know of no empirical evidence directly pertaining to this issue. However, it is plausible to assume that the construction of a situation model would activate a great number of concepts associated with the theme, such that the topical inference would be generated as a by-product. For example, in a passage about the history of the Beatles, John, Paul, George, and Ringo, would be the main agents in most of the events being described. As a consequence, many event nodes would be connected to the node for 'Beatles' in memory representation. Therefore, this node would have a high level of activation.

With respect to theme-motif, situation-model construction is clearly not sufficient. This answer is prompted by both theoretical considerations and

we will infer that this action was part of Mike's plan. However, when Mike falls by himself, this is relevant to Mike's goal, but it is not part of his plan.

Thus, how does thematic abstraction proceed? On our analysis, readers first construct a situation model along the lines of EIM as described earlier. First-order information, such as temporal, spatial, and protagonist-based relations are used to build and reinforce a second-order causal-motivational representation. It should be noted that the construction of these dimensions is interactive, rather than sequential.

The situation forms the input to the thematic-abstraction process. We hypothesize that this process will proceed as follows. A thematic structure is constructed by:

- creating a copy of the causal and motivational structure. This copy is needed because the reader will have mental representations of both the situation described in the text and the abstract theme.
- deleting the temporal and spatial framework information.
- eliminating all the temporal, spatial, and protagonist information that is not directly connected to the causal-motivational structure.

So, for example, the fact that eggs are oval and white (or brown) is not relevant to the causal-motivational structure of "Don't count your chickens before they're hatched." Even the fact that fertilized eggs may contain living chicks is not relevant. Moreover, even the fact that not all chickens will hatch is in itself not relevant. However, it does have the relevant implication that counting eggs does not produce equivalent results to counting chickens. In other words, having fertilized eggs does not enable you to determine the number of chickens you will have. This can be abstracted to the idea that one cannot engage in an action before its enabling conditions are met. At this point, there is no trace left in the abstracted representation of the chickens and the eggs.

To return to our earlier example about the farmer and the eagle. The fact that one protagonist is a farmer and the other an eagle is irrelevant. Also, the fact that the eagle was caught in a snare is irrelevant. All that is relevant is that the fact that one protagonist helps another at one point in time, without expecting to receive any direct benefits himself, causes the other protagonist to return the favor when the opportunity presents itself. Thus, the lesson here is that if you help someone without expecting something in return, the favor might actually be returned when you least expect it.

Obviously, the process does not stop here. Once the thematic structure has been abstracted, it can be used in a top-down fashion to interpret other texts. In that case, the causal roles will be filled again. In this case, the theme functions as a kind of frame with slots. The process of theme abstraction and use has been addressed in the artificial intelligence literature (e.g., Dyer, 1983; Schank, 1990). Schank makes the general point that people use the same cues to retrieve stories from memory as they use to understand them: goals, plans, actions, and themes. Thus, when people tell us a story, we are spontaneously reminded of other stories with similar themes as a result of the mapping of thematic structures.

Conclusions

Our goal in this chapter was to answer the question whether situation models were necessary and/or sufficient to explain how readers extract themes from stories. Our quest for an answer involved a review of the cognitive literature on themes from the perspective of the Event-Indexing Model. We made a distinction between theme as topic and theme as motif. We found that situation models are not necessary for the generation of theme-topics, whereas they are for theme-motifs. Furthermore, we drew the tentative conclusion that situation models may be sufficient for the abstraction of theme-motifs. This conclusion is tentative, because we know of no direct evidence that addresses this question. However, it is entirely plausible, given what we know about semantic activation in general. Finally, we concluded that situation models are not sufficient for the abstraction of theme-motifs and sketched out a cognitive mechanism that could abstract motifs from situation models.

Thus, we would like to argue that the study of situation models provides a necessary starting point for cognitive theories of thematic abstraction. It is an important and interesting challenge for researchers to design experiments that test hypotheses about thematic-abstraction processes. Such research would increase our scientific understanding of language comprehension in general and of literary comprehension in particular.

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