Leser fokussieren ihre Aufmerksamkeit dabei auf das "Hier und Jetzt" der Hauptperson. Die hier vorgestellten Experimente zeigen, daß Leser diejenigen Objekte schneller aus dem Gedächtnis abrufen können, die sich nahe am Fokus der Aufmerksamkeit befinden ("räumliches Priming", "Distanzefekt"). Dieses Priming ist umso schwächer, je weiter das Objekt vom momentanen Aufmerksamkeitsfokus entfernt ist und je länger sein letzter Aufenthalt im Fokus zurückliegt. Das Priming tritt auch auf bei Objekten, die sich entlang eines implizierten Weges der Hauptperson befinden, und bei Objekten, an die die Hauptperson nur denkt. Das Priming zeigt sich in verkürzten Reaktionszeiten auf Fragen nach der Lokation der Objekte, aber auch in kürzeren Leseeinheiten von Sätzen, die referentielle Verweise auf die Objekte enthalten.


Schlüsselwörter: Textverstehen, mentale Modelle, Priming

Cognitive psychology is advancing on a number of fronts, one of which is in understanding text comprehension and discourse. The consensus view is that several different processes go on in parallel as people read a text or listen to someone telling them about events. According to many theories of text comprehension, readers build multi-level representations during the comprehension process (e.g., Gernsbacher, 1990; Johnson-Laird, 1983; Kintsch, 1988; van Dijk & Kintsch, 1983; Zwaan, Langston, & Graesser, 1995). First readers take in the surface structure of what's on the page, second, they extract a propositional text base which contains the logical relations between the concepts and the predicates and the arguments being made. Third, they construct a referential representation, a mental model or a situational model, which is what the text is about.

A mental model is constructed by connecting the concepts that are in the text to the real world or imaginary world referents. For instance, readers may create imaginary characters like Robin Hood or cowboy western heroes when they read about them in novels. As another example, when a newspaper article mentions Gerhard Schröder, readers will know that the article is referring to the man himself. The referential model can be used for integrating information about co-refering expressions. Thus, if the news article goes on to describe actions of the new chancellor of the German republic, readers understand that the expressions "new chancellor of the German republic" and "Gerhard Schröder" are referring to the same person. In addition, the mental model sets the parameters of space and time that are going to pervade the activities during the whole story. The model is used for deriving inferences, for interpreting the text, for filling out what the whole text is
describing, for evaluating statements, as well as for updating the story. The mental model of a text is also largely what people remember about it. They remember not what the author wrote or said, but what he or she talked about - the gist of the story.

A narrative text has three main components: First is the physical situation in which the story takes place. Second is the cast of characters. Third is a series of episodes in which those characters are performing actions. The characters have a set of goals and problems that are associated with their occupations or their roles in the story. These goals motivate a series of actions that constitute the episodes which are the main part of a story. As readers read and understand a story, they extract from it the actions, plans, and goals of the main characters. Readers then explain the actions by constructing a causal network of story parts reflecting how one action enabled another action or some action was carried out in order to produce a particular outcome. The causal network is important in determining people's judgements about what is important in a story, what is salient, what will be remembered, how the story should be summarized, and so on. The causal network of a text also determines the gist of the text that a person will extract. Considerable research has investigated causal networks and their role in narrative memory; for an overview see van den Broek (1994).

In this talk we will concentrate on mental models of the physical situation in which a story takes place. This model includes the spatial layout of objects described in the story. I will talk about how people use their spatial situational model. Situational models can be studied in several ways. One approach studies how people construct a model online as they read or hear it line by line. Another approach examines what readers do with the model once they have constructed it. This is the approach we followed in the experiments to be described.

In these experiments, people first memorized a map of a building before they read some stories about events taking place within that building. We were interested primarily in what is called the updating process, wherein readers modify the characters' location information as they read about them moving about. We were especially interested in the consequences of having the reader focus attention on specific characters and places within the mental model. One focus of attention is the main character or protagonist of the story. Narrators tell a story from the perspective of the main character. The protagonist's goals are given priority, readers view events from the protagonist's perspective, and they focus on the protagonist and his or her physical location. We think of this process of focusing in situation models as analogous to that of a spotlight shining into a doll house. The model might be thought of as an inner stage or a doll house that readers construct in their head. Thus, the reader's focus of attention is like a spotlight that he or she shines onto a character or a place in that doll house. This focus idea is similar to linguists' notions of foregrounding. The experiments described here were carried out to investigate some of the psychological consequences of this focus.

The first experiments by Dan Morrow (1985) were concerned with a process called anaphor resolution. Foregrounding of concepts brings them into working memory, so they are easily available when one has to understand what a pronoun refers to. Focus in language is used to resolve the referent of pronominal forms as occur in "John broke the window. It cut him." We know that the him refers to John, and the it to the broken glass of the window - because these elements are in the foreground. The operation effect of focus can more clearly be seen in ambiguous expressions such as "John walked past the car up the road into the house." The windows were dirty." What windows are being talked about? Morrow (1985) carried out a number of experiments in which people invariably used a principle of proximity to the protagonist to resolve what object is being referred to. Thus, if the protagonist is now at the house and we say "The windows were dirty," readers take that to be the windows of the house. If the text instead said something like "John was walking past the car towards the house. The windows were dirty," the windows would be those of the car. People use this principle of proximity to resolve ambiguous referring expressions by saying "What's nearer to the current focus of attention" which in this case is near to where the protagonist is at the moment.

The proximity principle predicts easier memory access to things that are near the focus of attention. We have tested this prediction in several experiments in which we examined access to information about things that are varying distances from a focus point. The earlier experiments were conducted in collaboration with Daniel Morrow (Morrow, Bower, & Greenspan, 1989; Morrow, Greenspan, & Bower, 1991). The procedure involved teaching participants a spatial layout of a building and then having them read a story about somebody moving around in that space. Supposedly, while reading the story, readers would focus on the main character as he or she moves around. We predicted that as the protagonist moved from one location into another, objects at that new location would be in the focus, would become more available in memory, so that questions about these objects could be answered quickly. We expected a spatial gradient or distance effect in this availability, i.e., the closer an object is to the focus of attention, the more available it should be. We also predicted a temporal delay effect, i.e., recently activated objects and places should retain some activation but a dwindling amount of time passes and the focus moves on to other places and entities.

As indicated, to investigate these effects, we taught people the layouts of two buildings, namely, a warehouse and a research center. Figure 1 shows the layout of the research center used in Experiment 1 of Morrow et al. (1987). Each building had four rooms with four objects in each room. After memorizing the layout of the two buildings, participants read stories line by line from a computer screen describing characters moving around through these buildings. The setting for half the stories was the research center and for the other half was the warehouse. Our focus hypothesis leads us to be particularly interested in cognitive processes surrounding sentences describing motions such as "Wilbur walked from the library into the reception room." These are the sentences that allegedly move the focus from one room to another (see Figure 1). After reading a motion sentence like this one, the availability of different objects and concepts in the situation model was assessed by interrupting the reading task and asking participants whether two objects were located in the same room. Half the time the two objects were in the same room (yielding a "Yes" answer) and half the time they were not. On some trials we varied
the distance from the focus to the two objects in the probe. The two objects could be in the room into which the protagonist just moved (e.g., the lamp and the rug in the reception room in Figure 1), in the room he just left (e.g., the shelves and the couch in the library), some other room in this building (e.g., the projector and the clock in the conference room), or in a room in another building which was not being talked about in this story (e.g., the bench and the bed in the warehouse). The focus hypothesis predicts that people should be very quick answering questions about objects in the room where the focus is (the "location room"), a little slower about objects in the room from which the protagonist started his movement a few seconds ago (the "source room"), slower still for objects in other rooms of the curr-
One question is whether people activate intermediate points along a path as their focus goes from a starting point to the ending point of a movement. To answer this, we had subjects memorize this large building and then read sentences which implied movements of the protagonist along a path, from a starting room through an intermediate "[path]" room into an ending "[goal]" room. The sentence did not actually mention the path room, only the start and goal room. After reading the motion sentence, accessibility was tested for objects in the starting room, the path room, the goal room, or some other room in the building.

What results might we expect here? If activation of places depends solely on explicit mentioning of their names, the source room and the location room should be highly activated, but the path room should not. If, on the other hand, readers represent in imagination the protagonist's motion from the source room through the path room into the location room, then the path room should be activated to an intermediate degree. If activation depends on spatial distance more than on explicit mentioning, the path room should receive higher activation than the source room. The reaction times revealed a spatial gradient of accessibility: retrieval of location room objects was faster than retrieval of path room objects which in turn were faster than retrieval of source room objects. So it appears as if readers imag-
cates that focus moves to what the main character is thinking about; this is, readers are in some sense simulating his or her thoughts.

One could object to this class of experiments because they all involve interrupting participants as they read a story and asking them about the current locations of the protagonist and various objects. Such tasks might make readers concentrate unduly on the locations of things. So we devised a technique that is unobtrusive and consists solely of having participants read the text at their own rate. With this technique, we have people first learn a spatial layout, and then read narratives containing motion sentences such as "Then Carl walked from the library into the storage room" (see Figure 2). At that point, we insert a "think about" sentence in the text, such as: "He thought about all the things he had to clean up for the directors. He thought he would clean up the closet in the storage room." We measure the time to read the final phrase that refers to a critical object, the closet. This object could be located either in the location room, the path room, the source room, or in some other room of the building.

Surprisingly, we have repeatedly found a robust spatial gradient in such reading times: reading is faster if the sentence refers to an object in the location room, next fastest for an object in the path room, next fastest for an object in the source room, and slowest for referring to an object in some other room in the building (Rinck & Bower, 1995; Rinck, Bower, & Wolf, 1998; Rinck, Hähnel, Bower, & Glowalla, 1997; Rinck et al., 1996).

One might ask how "distance" is to be measured in this effect. Is it metric, Euclidean distance as a crow-flies, or is it categorical distance based on the number of rooms? For a given distance, is an object's accessibility determined more by the size of the rooms or by the number of divisions of a given distance into discrete rooms between an object and the focus of attention? The earlier experiments always confined categorical and metric distance. But maps can be constructed in which these types of distance are unconfounded (Rinck et al., 1997). These maps contained paths leading through single path rooms that were either short or long, and paths through two path rooms that were either short or long. In this way, Euclidean distance (size of the path rooms) and categorical distance (number of path rooms) of different paths were varied orthogonally in the map. As before, after memorizing the map, participants read stories containing motion sentences implying that the protagonist walked through a path room (or rooms) of one of these four kinds.

A first surprising finding was that reading time for a motion sentence was longer when the implied path led through two rooms compared to one room. The size of the intermediate room (or rooms), i.e., Euclidean distance traveled by the protagonist, had no effect on reading times at all.

After each motion sentence, people read an anaphoric sentence that referred to an object in the part of the path room that was near or far from the protagonist. As noted, categorical distance between the protagonist and the object referred to was either one or two rooms, and the Euclidean distance was either short or long. Reading times of these anaphoric sentences yielded another surprising finding: Metric distance between the object referred to and the protagonist had no effect whatsoever on anaphor reading times. Rather, reading times varied solely with categorical distance: References to an object that was one room away from the protagonist were understood more readily than references to an object that was two rooms away regardless of the Euclidean distances involved. Thus, reading and anaphor look-up times are determined by categorical segments of space (i.e., rooms), not Euclidean metric distance. Paradoxically, in this situation people have in memory all the knowledge about metric information necessary to draw (after the experiment) a correctly scaled map of the building. However, they seem not to use this metric knowledge during reading.

Another objection that is often raised regarding these experiments is that the results may be due to the rather artificial map learning procedure. People usually learn about spatial environments by experiencing them directly rather than by memorizing a map. The objection is unjustified, however. We have observed the same distance effects after people learned about the relevant spatial information from studying a text describing the building (Rinck et al., 1996). These distance effects also arose when the texts and questions referred to a well-known spatial environment that people did not have to memorize at all. In an unpublished study by Saskia Traill and Gordon Bower, participants read stories about salesmen who traveled to various cities around the United States of America. For instance, a sentence in one story described how the main character drove his car from Miami to New York City. Following such motion sentences participants read anaphoric sentences designed to measure the accessibility (via reading time) of the source city (Miami), the location city (New York), or an unmentioned intermediate path city (Baltimore). As before, a spatial gradient of accessibility occurred in reading times, indicating that the location city was more available than the path city which in turn was more available than the source city.

Finally, we may ask why these spatial priming results arise at all. Our current hypothesis is that spatial distance effects are at least partially related to priming by inferred or stated goals of the protagonist. When the main character moves near objects, why should those become more accessible than distant objects? Our suggestion is people go to locations in order to do something that will satisfy some goal, often by using objects located there. For example, you go to the laundry room to do the laundry, you go to the bathroom to use the toilet, or you go to the kitchen to get some food. In these locations, typical objects will be used to satisfy the goals, e.g., the washer, the toilet, and the refrigerator, respectively. In short, people do not wander around aimlessly, they go places to satisfy goals using objects. This is as true for characters in stories as it is for real people.

To gather some supporting evidence, we conducted an experiment in collaboration with Erin Graves (described in Bower & Rinck, in press), in which the goal relevance in the story of probed objects was varied independently of their spatial proximity to the protagonist of the text. After a motion sentence, the critical object probed was either in the source room or in the location room, and it was either relevant or irrelevant to the protagonist's temporary goal. When accessibility of these objects was probed, we found that both goal relevance and spatial distance...
affected accessibility additively: relevant objects close to the focus were most accessible, whereas irrelevant objects far from the focus were least accessible.

To summarize, this paper has described how we have investigated the consequences of shifting the focus of attention in mental models. Readers use the proximity principle to resolve ambiguous referential expressions; access to information about objects close to the focus is particularly fast; this spatial priming effect follows a distance gradient; intermediate priming occurs on objects and places along the path of the protagonist; the focus moves to where the protagonist's thoughts are, not where he or she is located at the moment; objects that are physically carried along with the protagonist - like a flower in the buttonhole - are in the focus of attention; distance effects are categorical rather than Euclidean; distance effects occur in anaphor resolution time as well as in probe reaction time; distance effects can be observed after learning of fictitious environments from texts as well as maps, and as well with familiar natural environments; and finally, the accessibility of objects is affected both by their spatial proximity and their goal relevance. We believe, we have made a substantial beginning in our efforts to investigate consequences for memory retrieval of readers shifting their focus of attention.

References


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