

MENTAL MODELS

Mental models, also called situation models, are mental representations of the state of affairs in a real or possible world. They serve as mental simulations of events. For reading, a mental model represents the situation described by the text rather than the text itself. The creation of a coherent mental model is the goal of comprehension.

Mental models are complex representations that contain many different types of information. This includes a spatial-temporal framework about the spatial context in which an event occurred and the time period in which the event transpired (i.e., where and when it occurred). They also contain tokens to represent entities, such as people, animals, objects, and ideas. These tokens might have properties associated with them, such as physical characteristics, emotions, or names. Within a framework there may be structural relations that define the event. This can include spatial relations (e.g., the umpire is behind home plate), ownership relations (e.g., the players are using the shortstop's ball), social relations (e.g., the two teams are bitter rivals), and so forth. Finally, because events are dynamic, several frameworks can be joined by linking relations that contain temporal order and causal information.

The Role of Experience

Mental model creation involves integrating prior knowledge with what has been given. This allows inferences to be drawn for information that has not been provided. Of course, the more knowledge a person has, the more likely it is that an adequate mental model will be constructed. For example, when watching a baseball game, a person with a lot of baseball knowledge will better understand the structure of the game, the causal and goal-related re-

lations among the players, and the sequence of events.

The structure of one's experience influences the creation of mental models. Suppose a person reads a text on a topic that the reader has a fair amount of knowledge of, such as going to a baseball game. In this case, there is a certain sequence in which the events occur (e.g., buying a ticket before finding one's seat). Even if two events are adjacent in the text, reading times increase as the distance between them in the standard sequence increases. So when building mental models, people consult their knowledge systematically. It is as if they are scanning sequentially through their knowledge to assess where the current events fit. The greater the distance, the longer the scanning process and the more that needs to be inferred.

Mental models are essentially an amalgam of the given information that can be acquired through a film, book, lecture, discussion, and so forth, along with prior knowledge that a person has in long-term memory. The use of mental models is found in a wide variety of circumstances, including language comprehension and memory.

Comprehension

Mental models are critical for understanding. When people comprehend language, they create three types of mental representations. The simplest is a verbatim representation of what was heard or read. This is forgotten very quickly unless there is something important about the exact wording, as with a joke. At a more abstract level is the propositional textbase. This is a representation of the idea units that were expressed. For example, the sentences "The ball was hit by the batter" and "The batter hit the ball" would correspond to the same propositional representation. This representation is forgotten less rapidly. Finally, at the most abstract and highest level is the mental model. This is a referential representation of the described events. The mental model is a representation of what the message is about. In contrast, the verbatim and textbase levels are representations of the message itself but may serve as scaffolding from which to build a mental model.

While the goal of comprehension is to construct a mental model, its organization and function can influence comprehension itself. During reading, people keep track of what is going on in the described situation. For example, readers may keep

track of the spatial location of a protagonist in a story. When that person moves from one location to another, knowledge about people or objects in the old location become less available. Switching from one spatial framework to another influences what information is readily available during comprehension. Moreover, the further the protagonist moves from the original location, the less available the information becomes. A similar thing occurs for temporal frameworks. Short time periods are more likely to be part of the same time frame, whereas long time periods are more likely to include a shift to a new time frame, and hence a new situation. Information that was relevant to the original situation is less available after a large time shift. Finally, people also monitor a protagonist's goals. Information that is relevant to current, unsatisfied goals is more available than information relating to goals that were successfully completed. The prior goal information is no longer maintained in the current mental model.

When the structure of the situation changes, reading times increase, as if readers are monitoring the described events. This includes changes in space, time, entities, causality, or the goals of the protagonist. When a major change in the described situation occurs, people update their mental models. In addition to monitoring event changes, people may also notice inconsistencies with what has been described before. Such inconsistencies result in increased reading times as the reader tries to resolve what they know of the situation with the current information.

One of the most important dimensions that people monitor is causality. Information varies in the degree of its causal importance. Information that plays an active role in the described situation is causally more important. Such information is typically read more quickly. Presumably, this is because it can be more easily integrated into the current mental model.

Memory

Mental models are also involved in memory. At very long periods of time, this is the representation that will dominate a person's recollections. Many of the influences during comprehension carry over into memory. For example, shifts in a situation during comprehension result in the memory being organized around those shifts. Also, causally important parts of an event are better remembered than less important parts. It should be noted that the ease

with which information is integrated into a mental model has an influence on the ability to identify that situation later. Continuous and consistent descriptions are remembered better than discontinuous, inconsistent descriptions.

Mental models include both given information and inferences a person generates. With the passage of time, it becomes difficult to disentangle these two. People often mistakenly identify information as having been encountered before if it is consistent with the previously described situation, even when that information is new.

How information refers to the world is important for how it is represented in mental models. This has important consequences for memory. When given a large set of related information, a person can integrate this information into one mental model if the information can be interpreted as being consistent with a single situation in the world. Otherwise, it may be stored in separate mental models. When a person needs to remember one piece of information, if there are related mental models containing related but irrelevant information, this will produce interference, causing the memory retrieval to be slower and more error prone. If, however, the information is integrated into a single model, there is no such cost to memory.

While these findings suggest that a mental model can influence memory retrieval, it is also possible to remove these influences to a certain degree. As mentioned earlier, people create multiple representations during comprehension, including verbatim, propositional, and mental model representations. The mental model will contain many inferences and will also capture the perspective of the comprehender. If the mental model is discredited in some way, such as asking a person to take a different perspective on the text that was read, then the person will rely less on the mental model and more on the propositional representation. For example, people reading a description of a baseball game might originally be told that the home team was going to make the playoffs. Then when the person is asked to recall the story, they could be told that the story was about a team that ended up in last place. This shift in perspective will cause a decrease in the number of inferences a person reports and also increase memory for those previously unremembered propositions that are consistent with the new perspective. Thus, the person has disregarded their mental model during memory retrieval.

Summary


Mental models are mental representations of specific states of affairs in the world. They are created using the knowledge a person has at hand, along with prior knowledge. The organization and extensiveness of this prior knowledge is of great importance. People use mental models during comprehension as the basis for their understanding. Changes in the described situations cause people to update their mental models, which has a tangible effect on the comprehension process itself. Finally, mental models appear to be the form of mental representation that is stored in memory for long periods of time. The ability of a person to remember information in part reflects the organization and structuring of information into mental models.

See also: LEARNING, *subentry on* KNOWLEDGE ACQUISITION, REPRESENTATION, AND ORGANIZATION; READING, *subentry on* COMPREHENSION.

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EDUCATION
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VOLUME

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Encyclopedia of Education, Second Edition
James W. Guthrie, Editor in Chief

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LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA

Encyclopedia of education / edited by James W. Guthrie.—2nd ed.
p. cm.
Includes bibliographical references and index.
ISBN 0-02-865594-X (hardcover : set : alk. paper)
1. Education—Encyclopedias. I. Guthrie, James W.
LB15 .E47 2003
370'.3—dc21

2002008205

ISBNs

Volume 1: 0-02-865595-8
Volume 2: 0-02-865596-6
Volume 3: 0-02-865597-4
Volume 4: 0-02-865598-2
Volume 5: 0-02-865599-0
Volume 6: 0-02-865600-8
Volume 7: 0-02-865601-6
Volume 8: 0-02-865602-4

Printed in the United States of America
10 9 8 7 6 5 4 3 2 1