

The representation of structure: Elements and relations

The environment we live in has an organized structure: features are not distributed randomly, but they tend to co-occur (e.g., creatures that have feathers are also likely to lay eggs). Structure could be defined as a set of relations among elements of the environment. Science strives to discover the structure of a particular domain and mathematics strives to describe the structure using appropriate formalisms. As a result, mathematics and science also have a structure or a set of relations among entities. In short, there is structure in the world as well as in formal conceptions about the world (i.e., in science) and the formal language of mathematics. This project addresses three sets of questions. First, how do people extract informational structure, and in what manner do they mentally represent entities and relations among these entities? Second, do their representations exhibit general tendencies that cut across knowledge-rich and knowledge-lean domains, such as mathematics, science, logic, or spatial arrangements of objects? And third, how do these representations change in the course of development and learning? Current experiments point to several regularities. First, across knowledge domains, people are more likely to represent elements than they are to represent relations. For example, in an equation $3 + 5 + 7 = 5 + 7 + 3$ they are more likely to attend to particular numbers than they are to attend to commutativity. Participants are more likely to attend to elements (i.e. shapes and colors) than they are to attend to spatial positions of these objects. Second, the ability to attend to relations increases with expertise: regardless of age, experts in mathematics and logic are more likely to attend to these classes of relations than novices. Third, attention to relations is often hindered by the necessity to inhibit information about elements. And finally, learning de-emphasizing the importance of elements improves attention to and representation of relations. In future experiments, we plan to (1) further specify conditions that facilitate representation of relations and (2) establish what accounts for a difficulty gradient of relations across knowledge domains.