Object Recognition and Categorization
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The environment in which we live and function is filled with elements that bombard our sensory system (specifically our visual system) with information. The basic challenge for the human brain, as for the nervous system of all living creatures, is to make efficient use of this sensory information to increase our chances of survival and improve our functioning. The brain's ability to process information allows us to distinguish between different objects and identify them in a meaningful way. It also allows us to generalize what we learn, based on relatively little experience, for latter use in less familiar situations and to act appropriately. Object recognition, categorization, and concept learning are the conventional terms for a series of information processing activities and computations that the human brain performs to interpret events in a meaningful way. At a simple perceptual level, theses processes allow us, for example, to identify an object such as a cat without mistaking it for a dog. Based on the conceptual knowledge we have acquired through previous experience with other cats, we develop reasonable expectations about the newly encountered cat. The study of these processes is a major concern in several fields of science—among them psychology, neurobiology, and artificial intelligence—and at centers for interdisciplinary research such as the Interdisciplinary Center for Neural Computation at the Hebrew University of Jerusalem.

Although identifying and categorizing objects may seem to be challenges that even young children can handle with ease, there is still a gap between the information available to us and our ability to make use of that information. The reason, apparently, lies in the brain's computational ability, which is restricted to finding partial—yet adequate—solutions. Despite its limited computational skills, however, the brain meets the challenge of identifying objects better than even the most powerful computers in use today. Why? Two reasons: The brain's computational ability gives it an enormous advantage over computers, and we researchers have yet to understand these computational processes well enough to be able to incorporate computer vision or artificial intelligence and integrate it in given information processing systems. Today, these two branches of research are intertwined. On one hand, knowledge gained about the way the human brain solves different problems has proven very useful in designing computerized systems that can solve similar problems. On the other hand, the successes and failures of various computational strategies employed by computers can indicate more feasible solutions that the brain has developed over the course of human evolution and our development as individuals. All in all, the research holds the key to the problem-solving process and helps us better understand the brain's functioning.

In a series of recent cognitive-behavioral studies in which participants were asked to compare few novel objects, we demonstrated the great benefit of providing human subjects simple cues implying that the given objects are of the same type or, conversely, of different types. By executing this sort of comparison, individuals learn a set of principles by which they can categorize other objects, not only on the basis of their global similarity. When we encounter a new object, we learn to identify specific features that are linked in some way to object features that have greater importance to us, and to ignore other features that, though more salient, perhaps, are unimportant in determining the nature of the object and predicting its behavior. We also showed that human beings are not always able to make use of the information available to them. Their manner of using the information is often determined by minor changes in the way it is presented. In addition, we found that cognitive development in the transition from early childhood to late childhood does not only involve the expansion of our conceptual knowledge; it also involves changes in our ability to acquire this knowledge. Along the course of development, we learn how to learn.