Encyclopedia of Human Development

Categorization

In cognitive psychology, categorization focuses on how knowledge is organized. Objects in the same category are likely to share certain attributes, and category membership allows inferences to be drawn. The term *category* refers to a set of things (objects, ideas, events) that are grouped together. The term *concept* often refers to the mental representation of such knowledge.

Categorization has obvious functions for learning, organizing, and storing information. From an evolutionary standpoint, it benefits an individual to be able to amass as large an amount of information with the least amount of effort or time. By grouping known items together, one can better identify novel items as well as predict some of their likely attributes.

Neuroscientific studies support an underlying categorical organization for semantic knowledge in the human brain; subjects with neurological damage can lose the ability to retrieve categorically selective information. For example, a person may be able to name tools or utensils, but not animals or fruits. These specific deficits point to a key organizational role for categorization in cognitive processing.

Categorization is a process that occurs crossculturally as well. But while some objects tend to be universally grouped together, such as shapes and colors, others may be grouped differently as a function of cultural background. Consider a classification task for the items *shovel, hoe, dirt*, and *hammer*. Someone from an industrialized background with formal education might use a taxonomic grouping and thus omit *dirt* because it is not a tool. Someone from an agrarian background without formal education might use a thematic grouping and thus omit *hammer* because the other items are used together.

Levels of Categorization

Many items can be categorized hierarchically, and the following scheme is often used in describing this organization:

"*Superordinate*—The superordinate level is a broad, inclusive level in the hierarchical scale of categories (e.g., animal, vehicle). Often the superordinate level will consist of several basic-level categories.""*Basic*—The basic-level category (e.g., cat, boat) is often used when one labels an object. Items within a basiclevel category share many features in common and are distinct from items in other basic-level categories. Researcher Eleanor Rosch argued for the primacy of basic-level categorization in early development.""*Subordinate*—Subordinate-level categories offer a more specific breakdown within a basic level category (e.g., tabby [for cat], canoe [for boat])."
Theories of Categorization

Researchers continue to debate various theoretical approaches for describing categorization processes. Most theories can be classified as either similarity based or explanation based.

Similarity-Based Categorization

The classical defining-attribute theory identifies members of a category based on certain traits that all items have in common. The set of common attributes is both

essential and sufficient for an item to be included in the category. All squares have four equal sides and four 90-degree corners. A shape that does not meet all the standards is not a square. This all-or-none explanation implies that no item within a given category is more representative of that category than another item. This theory has been disputed on the basis that most categories are not clearly marked but rather have fuzzy boundaries. Philosopher Ludwig Wittgenstein used the example of games, pointing out that among all possible games (those with boards, balls, cards, sticks, etc.) no set of features is necessary or sufficient for a particular game's inclusion or exclusion.

The prototype theory states that because there are no absolute boundaries, some items of a category are indeed more representative than others. The theory explains that a set of characteristic attributes, not defining attributes, is what identifies objects as belonging to a category. A prototype is created by averaging features together to create a typical or central example. Rosch cited one example as the category *birds*, stating that *robin* is far more "typical" than *penguin* and thus closer to the prototype, because it contains more of the characteristic attributes. The research finding that people are quicker to judge a robin as a bird than a penguin as a bird has been used to support this theory.

The exemplar theory states that we categorize items based on examples, rather than on a prototype that becomes abstracted over time. In other words, people are capable of drawing on multiple instances when locating or placing an object into a particular category. The mental representation of the category is presumed to contain information from various specific exemplars.

This theory is consistent with the finding that understanding variability and typicality of instances within a category plays a role in predicting category membership.

Explanation-Based Categorization

Instead of emphasizing similar features, explanation-based approaches define categories based on theory-driven inferences. For example, categories may be based on nonobvious features, such as the presumed internal characteristics that differentiate animate from inanimate objects. Also, ad hoc categories that ignore perceptual similarity can be created, such as the category *things at a yard sale*. These categories cannot be explained using a similarity-based view, but instead require fundamental theoretical knowledge.

The Development of Categorization

Questions about the development of categorization help us characterize how infants and children understand their worlds and provide information about the building blocks of adults' cognitive skills.

Current research explores some critical questions about how categorization and conceptual processing develop. For example, do infants first recognize basic-level categories, followed by elaboration of the hierarchical organization of superordinate categories? Does development proceed from perceptually based categories to conceptually defined categories?

Psychologist Eleanor Gibson argued that laboratory studies of categorization often focus on static presentation of visual stimuli (e.g., pictures), whereas infants in the real

world use dynamic information from various modalities. She emphasized the benefit of a symbiotic connection between perception and action. Acting on an object provides more information about it, and its perceptual characteristics allow for plausible actions. She proposed that perception is not separate from meaning, and thus the distinction between perceptual and conceptual categorization may be unnecessary.

Categorization in Infants

Studying categorization in infants requires methods that do not rely on verbal explanation. In one popular method, infants are shown a series of objects from the same category (e.g., cats) and the time that they look at each item is measured. The subsequent test measures how long the infant looks at a novel member of that same category (cat) compared to how long they look at a novel member of a different category (e.g., rabbit). The inference is that a preference for the novel category demonstrates the infant's categorization of the initially presented category.

Using this method, researchers have demonstrated that infants as young as 3 months can discriminate categories such as shapes, colors, and animal types. Between 6 months and 1 year, infants attend to categories such as vehicles, tools, facial expressions, and gender.

Researchers propose that early conceptual understanding occurs for distinctions such as animate versus inanimate objects, and that infants begin to categorize based not only on perceptual appearance, but also on function. During the second year, infants can group toys with different attributes into different piles, actively demonstrating their categorization skills. As linguistic skills develop, children's abilities can be tested with verbal tasks.

Categorization in Childhood

Later in childhood, hierarchical classification skills emerge. Rosch found that preschool-aged children are more adept at sorting objects at the basic level than at the superordinate level. Children's language learning and adults' labeling of objects to children follow this same trend. Other researchers suggest an early appreciation of more global characteristics of object categories.

The development of explanation-based categorization has also been studied. For example, researcher Frank Keil tested children with stories about an animal (e.g., raccoon) that was physically transformed to look like a skunk. Preschoolers tended to be fooled by appearance, but second-graders were able to classify the animal using internal characteristics.

Categorization and Language Development

Another area of debate is the developmental connection between categorization and language. This debate reflects the classic distinction between theorists Lev Vygotsky and Jean Piaget on the connection between language and thought. That is, do children's linguistic processes (e.g., labeling) simply reflect their level of cognitive understanding of categories, or does the acquisition of language influence and facilitate developing processes of categorization?

Researchers have proposed that linguistic development is important in categorization

and conceptual development because the use of a common label (e.g., *vehicle*) across multiple things (e.g., boats, planes, cars) highlights common features of the category and allows for inferences about internal and functional properties. Many studies reveal young children's ability to link language and concepts. For example, children's sensitivity to linguistic distinctions has been revealed through the use of nonsense phrases such as "this is *a* nax" versus "this is *some* nax"; they correctly map the first label to the count noun (e.g., a whole object) and the second label to the substance of a mass noun (e.g., sand).

Summary

Categorization is a fundamental aspect of cognition, and there is growing interest in the organization and mental representation of categories. Perceptual categorization is evident early in infancy. Preschool-aged children categorize adeptly, use concepts for inductive reasoning, and notice linguistic cues for categorization. During middle childhood, theory-based reasoning continues to unfold and hierarchical classification is evident. The mental representation of categorical knowledge in children and adults continues to be debated, and each of the various theoretical approaches has advantages and disadvantages.

- categorization
- infants
- prototypes
- cats
- penguins
- birds
- children

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Further Readings and References
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