Chapter 8: Concepts

Overview

It is worth considering why we have concepts at all. Why are human beings so quick to group things? One answer is that concepts are evolved cognitive faculties that allow for adaptive behaviour. The real value in categorization is the ability to make inferences. Let's say you encounter a brand-new "living thing," for example, an animal that you have never seen or heard of before. Using the "living thing" concept, you already know a fair bit about it: it probably moves around, eats, procreates, and so on. That's a lot to know from the very beginning and so concepts help us deal with new objects quickly.

There is a tendency to assume that concepts (and concept formation) are more neat-and-tidy than they actually are. Bruner's experiments are interesting demonstrations of strategy use but they have been rightly criticized as artificial. As illustrated by attempts to carefully define a real-world concept, it is incredibly difficult to generate a satisfactory set of criteria, which points to a weakness in the classical approach to concepts.

The philosopher Wittgenstein made this point talking about games. We tend to assume that defining "game" (or anything else) should be a matter of coming up with a list of defining characteristics. Spend some time thinking about that but here's the spoiler: a list of characteristics just doesn't work as a definition. You might say "a game is something that you do for pleasure." But what about professional athletes who are doing it to make a living? It's still a game. As well, seemingly distinctive characteristics will often apply to things that are clearly not games. For example, you might say "a game involves competition and rules." Writing an exam involves competition (or it can, anyway—among classmates) and it involves rules, but it is not a game. There is no such thing as a list of characteristics that defines what a game is (or what a dog is, or anything else). What's remarkable, though, is that we *know* what a game is. We may not be able to explain how we know, but we do, and we can recognize one immediately and effortlessly.

One clue to how we know lies in prototypes. Prototypes are the items that are likely to be listed if someone reports the first examples of a concept to come to mind. When participants are asked to give examples of different categories (for example, "fruit") their responses tend to match lists of items that are rated as high in prototypicality. Apples, oranges, and bananas are rated as highly **prototypical** and tend to be the first ones that are generated. "Tomato" is very unlikely to be given as an example and it has a very low prototypicality rating. Prototypical items also tend to show large effects of priming: if you show people the word "sport" and then the word "baseball," they will be faster to read baseball than if you showed them "vegetable" and then "baseball." It is also a very common finding that people show greater priming effects when the second word is a prototype of the first than if it is not. That is, reaction time following the word "sport" will be faster for "baseball" than for "bowling." Prototypes are treated as special conceptually.

We have already discussed connectionist networks in other contexts; they are very relevant to concepts as well. A network model is an organized set of concepts with many inter-connections. Each concept can be referred to as a node, and activation spreads between nodes. Discussion of connectionist networks leads to an introduction of the parallel distributed processing approach to categorization. As the name implies, this approach proposes that information is processed in paral-

lel, meaning that it doesn't progress from one stage to the next; inter-related processes occur simultaneously.

As an example to get students thinking about parallel processing as it applies to object categorization, present the following statements, or clues:

- "It can be chopped down."
- "It grows in the ground."
- "It is used to make paper."
- "It is purple."
- "It has leaves."

The object in question is, of course, a tree. Ask students to consider their reactions to these statements. One way of thinking about it is that these statements activate components of a network and the pattern of activation leads to coming up with the response "tree." In generating the response, we don't first think of all the things that can be chopped down and then search for things that grow in the ground, and so on. Instead, we conduct a parallel search; we can perform a search based on various pieces of information all at once. We are also able to deal with inconsistent information—"tree" is generated as an answer even with the sentence "It is purple." The inconsistent sentence doesn't eliminate the activation that leads to "tree."

Learning Objectives

In this chapter students will:

- Review and evaluate classical approaches to the study of concept attainment.
- Review experiments used to study complex rules.
- Describe vertical and horizontal dimensions of concept organization.
- Outline how cognition is embodied.
- Examine and provide evidence for the theory of idealized cognitive models.
- Consider how folk biology relates to concept attainment.

Key Concepts with Illustrative Examples

category-specific deficits (see page 256)

Brain damage can cause knowledge deficits for certain categories only. For example, a patient may be able to identify inanimate, but not animate, objects.

correlated attributes (see page 248)

There are some combinations of attributes that we tend to associate with each other, as they tend to occur more frequently than other combinations. For example, when we are told an animal has feathers, we also think that the animal likely has wings and a beak. This is because feathers, wings, and a beak are correlated attributes of a bird.

criterial attribute (see page 242)

A criterial attribute is a one that is necessary for concept membership. One might decide that walking on four legs is a critical attribute of a dog. But what if a dog is taught to walk on its two hind legs? Does it cease to be a dog? Critical attributes can be illusory.

embodied cognition (see page 253)

Embodied cognition is the suggestion that cognition facilitates our successful interactions with the environment. This allows us to vary the meaning of concept to fit our needs in a particular instance. For example, imagine you are moving into a new apartment and have many boxes to carry through a locked security door. Although you could struggle to open the door each time you wanted to bring a box in, it might be easier for you to keep the door open until after all the boxes have been moved inside. You look around and you see a brick outside the door. Although a doorstop is typically a wedged object that is stuck under a door, because it is heavy and will keep the door open, the brick is a positive instance of the concept *doorstop*.

family resemblance (see page 247)

Attributes of family resemblance are those that numerous examples of the concept tend to have in common. There may be no single attribute that all examples of a concept share but there are some attributes that are more common than others. For example, not all birds fly but that is a very common attribute, one that contributes to family resemblance.

goal-derived (ad hoc) category (see page 253)

There are some categories that we form where the members of the category have no shared attributes. These are called goal-derived or ad hoc categories. You may have heard about people who have made a *bucket list*—a list of things they would like to accomplish before the end of their life. Every person's bucket list will be different and the things on the list, such as sky diving and going to Iceland, may not have anything in common with each other.

graded structure (see page 251)

Concepts have a graded structure in that some members are thought to be better members of the category than others. The boundaries between categories may also be unclear. Baseball might be considered to be highly representative of the concept "game" (there is competition involved, it is engaged in for pleasure, etc.). Hopscotch is not as prototypical and may be considered by some to be outside of the boundaries of the game category.

perceptual symbols (see page 255)

Perceptual symbols are aspects of perceptual memories that stand for events in the world and enter into all forms of symbolic activity. The object you imagine changes as its description changes. For example it you were to imagine your car, you might imagine the shape and colour of your car. Now, if I asked you to imagine the inside of your car, the perceptual symbol would change and you might imagine the motor, wires, the battery, etc.

prototypical (see page 247)

A prototypical member of a category is a member that is representative of the pattern seen in the members of the category. Some members are more prototypical than others. For example, a robin would be more prototypical of the category "birds" than a penguin would be because a robin has more characteristics that we would ordinarily associate with birds (i.e., wings, beak, flies).

subordinate, basic, and superordinate conceptual levels (see page 249)

Concepts may be at one of three levels of inclusiveness. A basic level concept name is how you are likely to describe an object. For example, if asked what you're drinking, you're likely to say "coffee." You are unlikely to say "liquid" (the superordinate category) or "non-fat, soy latte" (the subordinate category).

Discussion and Debate Ideas

1. Have the class attempt to define a concept. The text includes an excerpt of Wittgenstein's thoughts on the elusiveness of determining a set of defining characteristics of a "game" (see page 247). Have students try to list features of a dog, for example. It sounds simple but the list must be broad enough to include both German shepherds and poodles but specific enough to eliminate foxes and wolves.

2. Ask students to consider how difficult it is to compose lists of items that are *not* goal-derived. Have a student attempt to compose a *completely random* list of items. What may happen is that the student will start listing objects in the classroom or objects in their backpack which, of course, is not a random list at all. Discuss the strong tendency of human beings to think in terms of meaningful categories.

3. Have students consider whether double-function words are the exception or the rule. We tend to think of each word as having a relatively narrow meaning but a surprisingly large percentage of words in the English language may be used in more than one (and sometimes many) disparate ways. The text refers to the example of "warm" and "cold." Consider "book" (an object composed of pages with words; the act of reserving a hotel room) or "stand" (the act of being upright; holding an opinion, as in "taking a stand"). Challenge students to come up with truly single-function words. What do those single-function words have in common?

4. Have students discuss *why* we use concepts. Having concepts that we use every day without truly having to think about them makes it hard to imagine *not* having them. In fact, there are plenty of things for which we do not have concepts. For example, we do not have concepts for "things that emit a high-pitched sound," or "things that are brightly-coloured." We do have a concept

for "things that can be safely ingested" (edible). Conceptualization of high pitches or bright colours does not confer an evolutionary advantage; edible does. Our concepts, then, reflect (among other things) what is evolutionarily relevant.

It is also worth pointing out that we humans all have pretty much the same set of concepts. That is no coincidence; we all tend to have the useful concepts, the ones that help us get by in the world.

5. Phantoms in the Brain – V. S. Ramachandran
Part 1 (beginning at 6:04) https://www.youtube.com/watch?v=wlFi6IV42Ag
Part 2. https://www.youtube.com/watch?v=DDbzaEO0shs&ebc=ANyPxKpvUudliVAIU-QSej7bUbqNJmb_hN0tqaLfdb7jXmOL7btu9EIBM36vxJMAgCJJSG5FQ4jODv_qlHYPEM8JI1Vl6Ad9rQ

Neurologist V. S. Ramachandran introduces us to a patient, Phillip, who suffers from category-specific deficit for living things. After watching the film, have students discuss how such a deficit would affect Phillip's life. Which would be worse—a deficit for living things or non-living things?

6. Recreate Rosch's prototypicality experiment by giving students a list of "birds" and have them rate how typical each member would be of the category. Discuss some of the factors that might influence prototypicality effect. Some suggestions would be level of expertise, and culture. Also, will prototypicality effects change over time? For example, penguins have been receiving a lot of media coverage – would this make the penguin a more typical member of the bird category than before?

7. Are perceptual symbols and imagery the same thing? While some would argue they are, it is possible to have perceptual symbols without imagery (e.g., hunger) and it is possible to have imagery without having had a perceptual experience.

8. Select a category (e.g., animals, monsters, games) and have each student produce a list of examples of members of the category. Have them expand each member to include the three levels (superordinate, basic, and subordinate) of the hierarchical organization. Have students think about how the categorical hierarchy might differ for an expert vs. a novice.

Further Reading, Media Suggestions, and Teaching Aids

1. **Biletzki, A., & Matar, A. 2011. Ludwig Wittgenstein. In N. Edward (Ed.). *Stanford Encyclopedia of Philosophy*. Stanford University.**
http://plato.stanford.edu/entries/wittgenstein.

This encyclopedia article provides a useful summary of Ludwig Wittgenstein's writings, which are quite relevant to many areas of cognitive psychology. This accessible review of Wittgenstein's ideas helps to demonstrate the connection between philosophy and psychology.

2. **Rosch-Heider, E., and Oliver, D.C. 1972. "The structure of the color space in naming and memory for two languages." *Cognitive Psychology, 3,* 337–354.**

Aspects of this paper are described in Chapter 9 of the text but it is of great relevance to the discussion of concepts as well. Despite the fact that the Dani language has only two colour terms, the Dani seem to categorize colour mentally in ways that are similar to the speakers of other languages.

3. **Capitani, E., Laiacona, M., Mahon, B., & Caramazza, A. 2003. What are the facts of semantic category-specific deficits? A critical review of the clinical evidence. *Cognitive Neuropsychology*, 20, 213-261.**

   This article is a review of 79 case studies on patients exhibiting semantic category-specific deficits. It examines exactly which categories are included in these deficits and the interaction between the type of impaired knowledge and the specific category that is impaired.

4. **Shanks, D. R. 2005. Implicit Learning. *Handbook of Cognition*, Sage Publishing, 202-220.**
   http://www.homepage.psy.utexas.edu/HomePage/Class/Psy394U/Gilden/shanks-il.pdf

   This book chapter offers a comprehensive review of implicit learning including the research of Reber (1960), as well as the research of other key experts in this area.

5. **Barsalou, L. W. 1999. Perceptual symbols systems. *Behavioral and Brain Sciences*, 22, 577-660. http://www.cogsci.ucsd.edu/~coulson/203/barsalou.pdf**

   This is the original paper by Barsalou introducing his perceptual symbols theory.

6. **Brenda Milner, Neuropsychologist. https://www.youtube.com/watch?v=JliczINA_Y**

   This video interviews Brenda Milner, a Canadian neuropsychologist whose career included working with the famous patient H.M. Aside from the memory aspect of this video, at about the 5:45 point she discusses H.M. and implicit learning of the mirror task.

Homework or Study Questions

1. **Describe Bruner's concept formation strategies.**

   All of Bruner's strategies are aimed at determining which attributes are relevant to a concept. Instances are selected for comparison to a positive case in order to test hypotheses. Conservative focusing involves focusing on one attribute at a time to test, one by one, which attributes are relevant. Focus gambling involves comparing instances that vary on more than one attribute. In some cases, this will lead to useful information quickly. Using simultaneous scanning, all possibilities are kept in mind in order to eliminate as many as possible with each selection. Successive scanning involves formulating a single hypothesis and testing it until arriving at a correct hypothesis.

2. **What is the major criticism of Bruner's concept research?**

Bruner focused on artificial concepts (e.g., shapes on cards). He chose artificial stimuli because they provide for much more experimental control. There is a cost, though, in terms of ecological validity: there may be a qualitative difference between how people conceptualize artificial versus real objects.

3. **Rosch (1978) formulated two principles that she believed underlie the way we use concepts. Describe the principles.**

The principle of cognitive economy: Two opposing tendencies must be balanced. One of the tendencies is to maximize information given to us by our categories. At the extreme, for maximum discrimination, we could create a separate category for every single event. This would, of course, defeat the purpose of categories altogether. The tendency toward simplification acts as a counterbalance. By ignoring differences between events and focusing on similarities, we can treat similar items as members of the same class.

The principle of perceived world structure: Some combinations of attributes tend to occur more frequently than other combinations. For example, "breathes," "moves around by itself," and "makes noises" tend to go together. This is in contrast to artificial concepts such as the Bruner cards, which do not have correlated attributes.

4. **How does the sensory-functional theory account for some cases of category-specific deficits?**

Patients who have sustained a specific type of brain damage may be able to correctly identify inanimate objects, but not living things. Cree & McRae (2003) have argued that living things tend to be understood in terms of their sensory features whereas inanimate objects tend to be understood in terms of their function. Damage to brain regions that analyze sensory information, then, may have the greatest impact on the identification of living things, not because they are living, per se, but because they are analyzed in a sensory way.

5. **What is the difference between a selection task and a reception task?**

In a selection task the participant selects instances from those presented by the experimenter. In a reception task the experimenter chooses which instances are presented to the participants.

6. **Describe Reber's (1989) cognitive unconscious hypothesis.**

Reber's cognitive unconscious hypothesis suggests that implicit learning represents an evolutionarily primitive form of unconscious cognition.

7. **Review the three levels of inclusiveness of a concept according to Rosch. Using a single concept, provide an example of each level.**

The three levels are superordinate, basic, and subordinate. For the concept "guitar" the superordinate level would be "musical instruments", "guitar" would be the basic level, and "classical guitar" would be the subordinate level.

8. **Explain the importance of embodied cognition to how we understand concepts.**

   With embodied cognition, an object that would typically be a negative instance of a concept can become a positive instance if its use changes. For example, a Coke bottle can become a positive instance of a *vase* if you fill it with water and put flowers in it. It demonstrates the flexibility of concepts.

9. **Shelley's mother runs into the room and says, "I have big news". Shelley understands that this means her mother has important news. How does she know this?**

   The phrase "big news" is a primary metaphor. In this case, the word "big" is a metaphor for important.

Suggestions for Research Paper Topics

1. Do experts differ from novices in their use of concepts? Choose an area of expertise and examine how experts think differently. Do their notions of prototypes differ from novices? Are they more likely to spot family resemblances?

2. Reber argues that the implicit cognitive system is very old evolutionarily and that the explicit cognitive system is newer. Why did human beings evolve explicit cognition? Why, specifically, was it adaptive?

3. How universal are prototypes? Does culture have an impact? For example, is hockey more prototypical of "sport" in Canada than in England? Do life circumstances have an impact? For example, does having a turtle as a pet cause a person to judge turtles as more prototypical of "pets"?

4. Explore the topic of essentialism, the view that for any given entity there is an "essence." The essence is not directly observable but we know it's there. The idea of essentialism dates back as far as Plato and Aristotle. What relevance does it have for researchers today?

5. What do category-specific deficits tell us about categorization and the brain? Does it differ for deficits for living things and non-living things?

6. The mirror task is an example of a task used to explore implicit learning. Research other tasks that provide support for our ability to learn without awareness.

7. In his embodied cognition view, Glenberg (2015) suggests that conceptual knowledge and thought are based upon sensorimotor representation. In an alternative perspective, Mahon (2015) suggests that thought is the basis cognition and, although it might evoke sensorimotor representations, it is independent of them. Review both sides of this debate, providing the arguments of both sides.

8. Some researchers have suggested that the basic level of categories is "special". Review the literature on this topic and provide evidence that either supports or contradicts this notion.

9. The cognitive unconscious hypothesis suggests that implicit learning represents an evolutionarily primitive form of unconscious cognition. Evolutionary psychology suggests that to be selected for, implicit learning must have an adaptive purpose. Review the literature on implicit learning from an evolutionary perspective and discuss how it might be adaptive.