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Reading 7: AS A CATEGORY, IT'S A NATURAL

Rosch, Eleanor H. (1973). Natural categories. *Cognitive Psychology, 4,* 328–350.

In the 1934 Shirley Temple movie, *Stand Up and Cheer,* the great film actor and dancer who went by the name of "Stepin Fetchit," sat on the porch steps of an old house examining one of his old, beat-up pieces of footwear, and lamented philosophically, "Why's a shoe called a shoe?" His character often wondered why things were called what they were called, and in various ways psychologists have wondered the same thing. The behavioral scientists who focus on these sorts of questions study human *cognition* (thinking) and *perception* (humans' interpretation of the world around them).

One of the basic building blocks of these areas of research is the idea of *concepts.* Concepts are mental representations of your experience of the world that allow you to classify objects (furniture, vegetables, animals, professions, shoes, etc.) according to the characteristics they have in common. Concepts are extremely useful because they allow you to group objects into categories for efficient processing of information. For example, you know that a certain piece of furniture is a chair because it fits your "concept" of a chair. Therefore, it is not necessary for you to learn that a specific chair is called a chair each time you see an unfamiliar style so long as it fits into your category for chairs.

Because it has come up in our conversation here, you are now thinking of a chair (right?). What features comprise your "chair concept"? You probably think of a chair as having legs, a seat, and a back to lean against. Even though some chairs violate your rules (recliners and rocking chairs don't really have legs), they still fit into your chair category well enough. However, if you were to encounter a bean bag "chair" without knowing what is was, you probably would not call it a chair. In fact you might not be sure what to call it.

The question that has most interested cognitive psychologists is as follows: Where do you get your categories for objects? The traditional or "classical" view that was widely accepted prior to 1970 held that categories are a function of the language we speak. In other words, categories exist because we have words for them. For example, we have a category for animals that lay eggs, fly, have feathers, and chirp; the category is "bird." This traditional view maintained that if we did not have a word for bird, the category or concept for bird would not exist.

Therefore, concepts and categories should vary from culture to culture due to variations in language. And there is evidence of this. A frequently cited example is that the Inuit who live in far northern latitudes have 12 words in their native language for "snow," whereas in English there are only one or two. Obviously, the Inuit need greater flexibility in communicating about snow due to the climate in which they live, and this is reflected in their language. South Pacific Islanders have no word at all in their language for snow; therefore, scientists have assumed that such a concept would not exist for them.

For many years, this theory of the origin of concepts was taken for granted by scientists throughout the social sciences in psychology, anthropology, linguistics, and sociology. During the early 1970s, Eleanor Rosch, at the University of California at Berkeley, published a series of studies that challenged the classical view and turned the field of cognitive psychology upside down. She is considered to have revolutionized the study of categorization. She proposed that categories do not necessarily arise from the language, but exist naturally on their own, in relation to humans' biological abilities of perception.

Her landmark study presented here involved two separate experiments and some rather technical procedures. For the sake of clarity and space limitations, a summary of the first experiment reported in the article previously cited will be detailed here.

THEORETICAL PROPOSITIONS

Rosch theorized that if the prevailing theory were correct, all objects belonging to a certain category would have approximately equal status in that category—that is, they would fit into it equally well. She observed, however, that this is not the case. Instead, some "members" of a category are perceived by people to be better examples of the category than others (she called these *prototypes*). As an example of this, consider again the category of "bird." Now, quickly, picture a bird in your mind. You probably pictured something like a robin, blue jay, wren, or sparrow (maybe a crow or an eagle). It is quite unlikely that you thought immediately of a goose, a chicken, an ostrich, or a penguin. According to Rosch this is because a robin fits your *prototype* (or "ideal example") of a bird better than a chicken. In other words, a robin exhibits all or most of the features that describe your category of bird and you, therefore, judged it higher in "birdiness." Conversely, an ostrich has few of these features—it doesn't fly, doesn't chirp, is too big, etc.—and, consequently, an ostrich does not fit most people's prototype for a bird very well at all.

What Rosch argued was that most categories do not have clear boundaries as to what fits and what does not, but rather, our mental category borders are "fuzzy." We decide if an object fits into a category by comparing it to our category *prototypes*. She also believed that categories can exist and are psychologically real even when there are *no words* in a person's language with which to name them.

To test this theory, in the late 1960s, Rosch traveled to New Guinea where a society of people live called the "Dani" (see the discussion of the study by Ekman in Reading 22 for other research within this country's cultures). The Dani, until recently, existed, in essence, as a Stone Age culture and communicated in a language that did not include certain concepts that now exist in all modern cultures. Rosch's early studies, including the one discussed here, focused on categories relating to color. English speakers use 11 major color categories: red, yellow, green, blue, black, gray, white, purple, orange, pink, and brown. Research has determined that speakers of English are able to agree on certain "focal colors": those that are the best examples (or *color prototypes*) of each color category. For example, English speakers know "fire engine red" is the "focal color" for the category of red (you could say it is the "most" redlike) and it is identified as red much more quickly and easily than other "reddish" or off-red colors. More on this in a moment. . . .

The Dani, however, only possess two color categories: "mili," which describes dark, cool colors and "mola," used for light, warm colors. Rosch theorized that if the original, "classical" view of categorization was correct—that language determines concepts—the Dani should possess only two color concepts. However, Rosch contended that *all* humans possess from birth—that is, have "preprogrammed" into our brains through evolution—many more than two color categories.

To test this, she decided to teach the Dani new words for either eight focal (prototype) colors or eight nonfocal colors. She hypothesized that many more than two focal color categories were "psychologically" real for the Dani culture, even though names for them had never existed in their language. If this were true, focal colors (i.e., color prototypes) should be able to be learned by the Dani faster and easier than nonfocal colors.

METHOD

Participants

The participants for her study were young Dani males who were all pretested to be sure no one was color blind. They were also tested to confirm that their knowledge of color terms was restricted to "mili" (dark) and "mola" (light). Interestingly, the Dani do not measure age, so based on size and general physical maturity the researchers judged all the participants to be at approximately 12 to 15 years of age. The participants volunteered to join in the study and were paid for their participation.

After they had completed the color-learning part of the procedure, they were divided into several groups of 12 participants each. The two most important experimental groups will be discussed here.

Color Stimuli

Glossy color chips, similar to those you might obtain from the paint store when you are repainting your house, were used as the stimuli for the colors to be learned.

These chips, however, were developed scientifically to represent specific colors of exacting wave lengths. The color categories used were pink, red, yellow, orange, brown, green, blue, and purple. For one group of participants, the colors were the focal, prototype hue for each color (such as fire-engine red). These were the colors that Rosch theorized to be *universally* represented by natural categories and, therefore, easily identifiable, regardless of culture or language.

For the other group, the hues of the eight color chips fell in between focal colors so that an English-speaker might call them "red-brown" or "yellow-green." These were called ambiguous or "nonfocal colors."

PROCEDURE

The first challenge Rosch and her associates faced was to assign names in the Dani language for the various colors. This was not as easy as it might sound because the names needed to be words that were all equally frequent, familiar, and meaningful to the participants, so as to avoid built-in bias. Rosch discovered that the Dani use many names for what they call "sibs." A *sib* was described by Rosch as a family group similar to a clan. (The English language uses the same word, which is a shortened version of *siblings*.) These names met her requirements for stand-ins for colors and so were used to represent the different color categories to be learned by the participants. To avoid a preference or bias, a participant's own sib name was not used as a color category.

Each participant was told that the task involved learning a new language that the experimenter would teach to him. At the beginning of the first day the colors were presented to the participant and the name assigned to each color was spoken by the researcher and repeated by the participant. Then the colors were shuffled and presented again. Each time the participant named the color correctly he was praised or, if he was incorrect, he was told the correct name. Over a period of five to twelve days, the participants were tested on their learning of the color categories and their progress was recorded until all the participants were able to name all the colors without error.

Upon completion of the learning period, an additional task was performed by all participants to determine if this new ability was truly understood as a general concept and would transfer to new situations or was limited only to the specific colors learned.

To test for this, each participant was shown a group of many colors and asked to identify eight of them that had *not* been part of the training categories. The success rate of this "transfer" task (determining if the learning would transfer to a different setting) was calculated for the participants in both groups.

RESULTS

If humans possess inborn, preprogrammed abilities to perceive certain categories of colors (as Rosch hypothesized), then the results of the Dani's learning task should demonstrate faster learning for the focal color categories than for the nonfocal colors, because focal colors are better prototypes of the color concept. Figure 7-1 summarizes the learning progress of the two groups over the testing period.

The average number of *errors* over the entire learning period was 8.54 for the prototype color group compared to 18.96 for the ambiguous

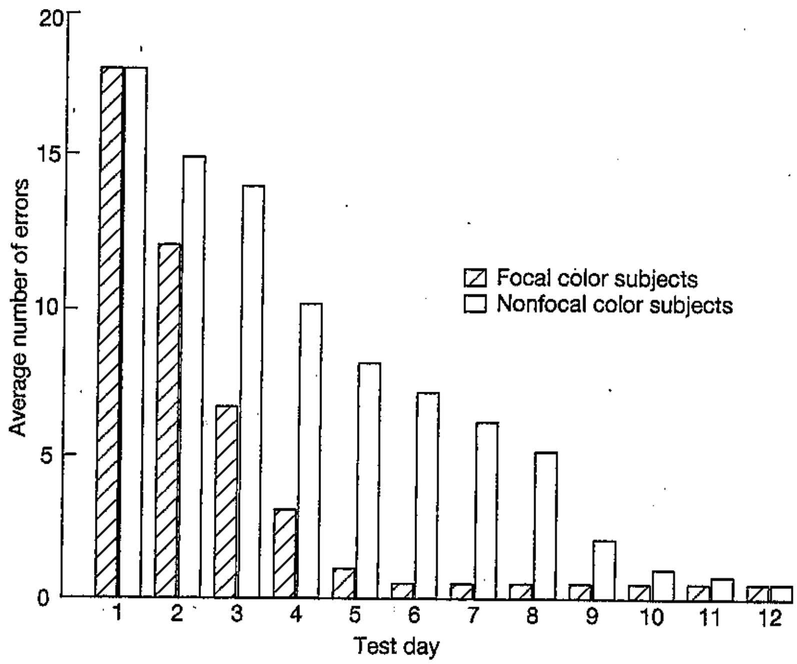

FIGURE 7-1 Average rate of color category learning for the focal color and nonfocal color participants. (Based on data from p. 338.)

color group. This difference was highly statistically significant. If you consult Figure 7-1, you can see that the group presented with the colors that most members of Western cultures consider central to a particular color category, were able to learn the names of the colors in only five days compared to eleven days for the group trying to learn the nonfocal color categories.

Rosch felt that it was important to demonstrate that the skill of recognizing color categories had been acquired in such a way that it would transfer to new situations—that it was not only a result of the study, but had become a "usable" concept. On the task in which participants were asked to identify colors that were not part of the learning, correct responses would be expected only about 12% of the time (the percentage correct due to chance alone) if the concept did not transfer. The participants in Rosch's study correctly identified the colors *not* used with 90% accuracy.

One additional informal finding reported by Rosch was that four of the participants in the nonfocal color group became very frustrated during the learning period and wanted to quit before learning all the color names. It took a great deal of persuasion to convince them to continue until they completed the task. This problem was not encountered with the focal color group who generally seemed to enjoy the experimental process.

All this may seem like a long way to go for rather simple findings, but, as mentioned at the beginning of this chapter, the results from this and additional studies by Rosch and others had a profound effect on our knowledge of how the brain works. First, Rosch's discussion of her findings will be summarized followed by a brief glimpse of the huge amount of subsequent, related research.

DISCUSSION

Rosch had found a way to test a theory that, on the surface, would seem nearly impossible to test. Can you think of a concept or category of objects that does not exist for speakers of English (or any other language) in the way color categories are missing from the Dani language? There may be some, but they are difficult to find and even more difficult to test. The notion to locate and study a culture that does not acknowledge color categories was ingenious in itself. But the weight of her contributions lies more in what she discovered.

The main finding was that people from a culture that did not possess concepts for colors could learn colors that comprised hypothesized prototypes faster than nonprototype colors. This finding indicated that certain concepts exist in the brains of *all* humans regardless of the language they speak or whether they have ever used the concepts. This was a major discovery. Because these concepts appear to be part of the biological structure of humans, Rosch called them "natural categories" (the title of her article). The reason this study had such an impact on psychological research was that suddenly the nearly universally accepted idea that language produces concepts had been changed to the radically opposing view that linguistic concepts stem from and form around these naturally occurring categories.

Rosch concludes her article by suggesting further implications of her findings:

> In short, the evidence which has been presented regarding the structure and learning of color categories may have implications beyond the domain of color: (a) there may be other domains which are organized into natural categories and (b) even in nonperceptual categories, artificial prototypes (the best examples of nonperceptual categories) once developed, may affect learning and processing of categories in that domain in a manner similar to the effects of natural prototypes. (p. 349)

What this means, is that most of what you perceive is analyzed and categorized by your brain according to how well or poorly it matches an appropriate prototype (natural or not), rather than how well it meets the criteria of a formal linguistic definition.

SUBSEQUENT RESEARCH

Various studies that followed Rosch's early research supported the existence of natural categories and the use of prototypes in concept formation. Rosch and her colleagues as well as others expanded on the early findings reported in this chapter to demonstrate its broader implications.

For example, she further demonstrated that concepts do not have the clear, distinct boundaries that might exist if we used a strict linguistic definition to categorize objects, but rather, as mentioned earlier in this chapter, concepts are indeed fuzzy and somewhat overlapping (see Rosch, 1975). If we return once again to our example of your concept of "bird," would you say a kiwi is a bird? How about a bat? You may have formal knowledge that a kiwi is a bird (even though it doesn't fly, or chirp, or sit in trees), but when you think of a *BIRD*, a kiwi rarely comes to mind (well, maybe *now* it will!).

On the other hand, you know that a bat is not a bird and yet it flies, makes a sort of a chirping sound, and some of them live in trees. So, some people may, on some level, conceive of bats as birds. As another example, consider your category for "fruit." What fruits are you thinking of? Apples, oranges, or bananas are usually the ones named first. What about a tomato? A tomato may be a fruit, but it is a poor example (compared to your prototype) of one because it is quite distant in resemblance to your prototypical fruit. Remember, psychologists are interested more in *how* you think than whether you are technically correct. (By the way, a kiwi is not only a bad example of a bird; it is also a bad example of a prototype of a fruit!)

RECENT APPLICATIONS

Various research techniques to reveal how people conceptualize the world around them have been developed since Rosch first demonstrated the existence of natural categories with the Dani in New Guinea (for a complete discussion see Rosch, 1978). One method simply asks participants (from any culture) to use a number scale (such as from one to ten) to rate how well an object fits into a certain category (meaning how well it matches your prototype for that category). For the category "dog" a German Sheppard might rate 10, but a French Bulldog might get a 3 (this has nothing to do with the quality of the breed, just how "doggy" people think they are). Another research technique uses reaction time to measure how well something fits into a mental category (e.g., Dovidio, 1986; Rosch & Mervis, 1975; Unyk, 1990).

One of the ways this is done is that you, as a participant, see or hear a statement, such as, "A turkey is a bird" and then press a button for true or false as fast as you can. Findings from this line of research demonstrate that the closer the category example matches your prototype of the category, the faster you will respond. "A turkey is a bird" will produce a significantly slower reaction time than, "A robin is a bird."

We all know that a French bulldog is a dog, but you would be unlikely to think of this particular breed when asked about dogs because it does not fit your prototype of a dog very well (unless you own one!). (Katsai Tetiana/Shutterstock)

A third method involves asking participants to produce examples of category members either by listing them or making line drawings. In a given amount of time, the participants will produce a far greater number of the more representative members of a category. For example, if you are asked to draw pieces of furniture, you will probably draw a chair, a couch, or a table, before you will draw a hutch or a bookcase. Or, if asked to list human emotions, *happiness* and *anger* might come to mind faster than, say, *confusion* or *rage* (e.g., Fehr & Russell, 1984).

Just as is true of many of the studies summarized in this book, Rosch's discoveries relating to natural categories and prototypes changed psychology's view of your use of concepts, but over the 40 years since her findings, other research has appeared that either expands or questions her results. For example, some research has suggested that, although Rosch's prototype theory appears to be valid, this does not mean researchers have abandoned our use of strict linguistic definitions. For example, one 2010 study, although acknowledging Rosch's study discussed here, reported that other studies, including one with participants from another Papua subculture, do not appear to base their color perception primarily on prototypes within categories, but rather on linguistic cues (Tylen et al., 2010).

The "truth" appears to be (if we can ever actually know the truth) that people will invoke linguistic definitions when that level of precision is necessary. Returning to the category of fruit provides an excellent example. If someone says to you, "Would you like a piece of fruit?" you do not think, "Fruit: The ripened seed-bearing structure of a plant." Instead you immediately access your prototype for "fruit," which is most likely something such as an apple, an orange, or a banana. You would be quite surprised if you answered, "Yes!" and someone tossed you a pine cone (which is, technically, a fruit from a pine tree)! However, sometimes a formal, linguistic definition of fruit might be useful, such as, say, when you are on a nature walk and come upon an unusual plant with strange objects growing on it. Even though the objects on this plant bear little resemblance to your fruit prototype, your formal, linguistic definition might allow you to say, "Look! This plant is bearing fruit."

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