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When Language Can Hold the Answer

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Faced with pictures of odd clay creatures sporting prominent heads and pointy limbs, students at Carnegie Mellon were asked to identify which “aliens” were friendly and which were not.

The students were not told that the aliens fell naturally into two groups, although the differences were subtle and not easy to describe.

Some had somewhat lumpy, misshapen heads. Others had smoother domes. After students assigned each alien to a category, they were told whether they had guessed right or wrong, learning as they went that smooth heads were friendly and lumpy heads were not.

The experimenter, Dr. Gary Lupyan, who is now doing postdoctoral research at Cornell, added a little item of information to one test group. He told the group that previous subjects had found it helpful to label the aliens, calling the friendly ones “leebish” and the unfriendly ones “grecious,” or vice versa.

When the participants found out whether their choice was right or wrong, they were also shown the appropriate label. All the participants eventually learned the difference between the aliens, but the group using labels learned much faster. Naming, Dr. Lupyan concluded, helps to create mental categories.

The finding may not seem surprising, but it is fodder for one side in a traditional debate about language and perception, including the thinking that creates and names groups.

In stark form, the debate was: Does language shape what we perceive, a position associated with the late Benjamin Lee Whorf, or are our perceptions pure sensory impressions, immune to the arbitrary ways that language carves up the world?

The latest research changes the framework, perhaps the language of the debate, suggesting that language clearly affects some thinking as a special device added to an ancient mental skill set. Just as adding features to a cellphone or camera can backfire, language is not always helpful. For the most part, it enhances thinking. But it can trip us up, too.

The traditional subject of the tug of war over language and perception is color. Because languages divide the spectrum differently, researchers have asked whether language affected how people see color. English, for example, distinguishes blue from green. Most other languages do not make that distinction. Is it possible that only English speakers really see those colors as different?

Past investigations have had mixed results. Some experiments suggested that color terms influenced people in the moment of perception. Others suggested that the language effect kicked in only after some basic perception occurred.

The consensus was that different ways to label color probably did not affect the perception of color in any systematic way.

Last year, Lera Boroditsky and colleagues published a study in The Proceedings of the National Academy of Sciences showing that language could significantly affect how quickly perceptions of color are categorized. Russian and English speakers were asked look at three blocks of color and say which two were the same.

Russian speakers must distinguish between lighter blues, or goluboy, and darker blues, siniy, while English speakers do not have to, using only “blue” for any shade. If the Russians were shown three blue squares with two goluboy and one siniy, or the other way around, they picked the two matching colors faster than if all three squares were shades from one blue group. English makes no fundamental distinction between shades of blue, and English speakers fared the same no matter the mix of shades.

In two different tests, subjects were asked to perform a nonverbal task at the same time as the color-matching task. When the Russians simultaneously carried out a nonverbal task, they kept their color-matching advantage. But when they had to perform a verbal task at the same time as color-matching, their advantage began to disappear. The slowdown suggested that the speed of their reactions did not result just from a learned difference but that language was actively involved in identifying colors as the test was happening. Two other recent studies also demonstrated an effect of language on color perception and provided a clue as to why previous experimental results have been inconclusive. In The Proceedings of the National Academy of Sciences, Dr. Paul Kay of the International Computer Science Institute at Berkeley and colleagues hypothesized that if language is dominant on the left side of the brain, it should affect color perception in the right visual field. (The right visual field is connected to the left side of the brain, and vice versa.)

English-speaking subjects were shown a ring of 12 small squares that were all the same color except an odd one on the left or the right. If the odd square was shown to the right visual field and it was from a completely different color category in English, like a green square compared to the ring of blue squares, then subjects were quick to identify it as different. If the odd square shown to the right visual field was the same basic color as the ring of squares, perhaps just being a different shade of blue, subjects were not as fast to recognize the difference. If the odd square was shown to the left visual field, it didn’t matter if it was a different color or only a different shade.

The extent to which language affected color perception depended on the side of the brain being used.

Dr. Lupyan has also investigated how quickly the effects of language might come into play. In one experiment, he asked students to look at a computer screen that had “2” once and “5” many times in a circle. Over hundreds of trials where the positions of the numbers changed, the students were asked to “find the target” or “find the ‘two.’ ”

Whenever subjects heard the word “two,” they always found the numeral faster. They found the “2” even faster when instructed to “ignore the 5s,” as opposed to “ignore the distracters.” In these cases, Dr. Lupyan suggested, language is “greasing the wheels of perception.”

Language also has a significant role in seeing and remembering where objects are in space. Dr. Dedre Gentner at Northwestern and her colleagues conducted experiments on the spatial reasoning of hearing children and children who “home-sign.”

Home-signers have hearing parents, but they are congenitally deaf and have never been taught a sign language, according to Susan Goldin-Meadow, an expert in homesign. The gestural language they develop is invented solely by themselves. In the past, Dr. Gentner and her colleagues had observed that children who home-sign did not appear to invent gestures for locations spontaneously.

The children were shown two side-by-side boxes. Internally, each box was divided in three. In each space was a card.

During each trial, the experimenter took a card from the first box and showed the child that it had a special star on the back. Replacing it in the first box in the same space, the experimenter asked the child to find where the special card would be in the second box. Essentially, the children were asked to map the position of the target card in the first box to the same position in the second.

The researchers found that children without words for spatial relationships, whether young or home-signers, had much more trouble finding the special card in the second box than older hearing children who had learned the relevant words.

For young hearing children, exposure to spatial language in the experiment strongly influenced the success rate. If the experimenter used spatial terms when speaking to a child, saying, “I’m putting the card in the top” (or “middle” or “bottom”), as opposed to, “I’m putting the card here,” the children were much likelier to find the correct spot in the second box.

The effect lasted not just through the experiment, but until at least two days later, when the children were retested.

“By giving us a framework for marshaling our thoughts, language does a lot for us,” Professor Gentner said. “Because spatial language gives us symbols for spatial patterns, it helps us carve up the world in specific ways.”

There is other evidence that a lack of spatial language is not a handicap in solving spatial problems. In 2006, scientists published an experiment that investigated the ability of the Amazonian Munduruku tribe to understand and manipulate geometric relationships for which their language has no words. The Munduruku performed about the same as Americans whose language is rich with spatial terms.

This separation of language and thought is emphasized in a recent book by Steven Pinker, at Harvard University, a skeptic of “neo-whorfianism.” In “The Stuff of Thought: Language as a Window Into Human Nature,” Pinker explores the complicated ways that language and thought relate to each other. He cautions against confusing the “many ways in which language connects to thought.” “Language surely affects thought,” he writes, but he argues that there is little evidence for the claims that language can force people to have particular thoughts or make it impossible for them to think in certain ways. With numbers, the importance of language evidence is much clearer. It appears that the ability to count is necessary to deal with large, specific numbers. And the only way to count past a certain point is with language.

Elizabet Spaepen, a doctoral student at the University of Chicago, examined the ability of home-signing adults in Nicaragua to use numbers. Ms. Spaepen emphasized that although the subjects had never been taught a formal sign language, including counting, they were fully integrated in society. They have jobs and they are paid as much as hearing or signing adults.

Ms. Spaepen asked the home-signers to match an array of objects laid out before them. For example, she placed plastic discs on a table and encouraged the subjects to lay out the same number of discs. If the number was small, as in one, two or three, the home-signers got it right all the time.

If the number was larger, the home-signers got it right just approximately. If Ms. Spaepen laid out four discs, the subjects might lay out five or six. Although they were never quite right, they were never completely wrong. The home-signers would not lay out one or 15 discs in response to four.

Scientists have shown that the understanding of small, specific numbers is a trait with long evolutionary history. Monkeys and other animals can compute the exact number of a small set of objects at a glance without explicitly counting. The ability is called subitization.

Ms. Spaepen suggests that when home-signers correctly use small numbers, they are relying on this innate trait. The count list we learn with most languages (some languages do not have a count list or words for specific numbers greater than three) has enabled humans to build on this heritage, taking the specific and uniform gap between "one" and "two" and "two" and "three," and extending it out through four and higher, theoretically to infinity.

In another experiment, Dr. Lupyan showed subjects a series of chairs and tables using pictures from the Ikea catalog. Some subjects were asked to press a button indicating that the picture was of a table or a chair. Other subjects pressed a button to make a nonverbal judgment about the pictures, for example, to indicate whether they liked them or not. Dr. Lupyan found that the subjects who used words to label the objects had more trouble remembering whether they'd seen a specific chair before than subjects who had only pressed a button in a nonverbal task.

Language helps us learn novel categories, and it licenses our unusual ability to operate on an abstract plane, Dr. Lupyan said. The problem is that after a category has been learned, it can distort the memory of specific objects, getting between us and the rest of the nonabstract world.