How The Visual System Constructs Moving Objects: One by One

August 11, 2011

Although our eyes record the word as millions of pixels, “the visual system is fantastic at giving us a world that looks like objects, not pixels,” says Northwestern University psychologist Steven L. Franconeri. It does this by grouping areas of the world with similar characteristics, such as color, shape, or motion.

The process is so seamless that we feel we’re taking it all in simultaneously. But this, says a new study by Franconeri and his colleague Brian R. Levinthal, is “an illusion.” Instead, they say, that for some types of grouping, the visual system is limited by its ability to perceive only one group at a time. The findings were just published in *Psychological Science*, a journal of the Association for Psychological Science.

How does this grouping work? Say you’re looking at a crowded street, with cars going every which way. Your view of each individual car is partially blocked, so that you actually see multiple “pieces” of each. Yet because those pieces move with the same direction of motion, grouping by “common fate” helps you perceive whole cars. You might feel that this grouping is happening for all the cars at once—but Levinthal and Franconeri suggest otherwise.

To demonstrate this point, the authors performed two experiments, simplifying the “car pieces” into pairs of moving dots. In the first experiment, participants had to find the pairs that were vertically arranged among pairs that were horizontally arranged. In the second, instead of finding a group with a specific shape, they were asked to find a group among non-groups—like whole cars among scattered pieces. The researchers conjectured that if it’s possible to perceive all groups at once, then finding one with a specific shape should be easy. If the visual system can construct only one group at a time, then this task should become progressively harder as more groups are added to the screen.

In both tasks, “people were surprisingly slow,” says Franconeri. As participants were asked to make decisions involving more groups, they took more and more time. They were limited by their one-at-a-time visual systems, which, he says, “needed to flip through the groups, at a rate of about 10 per second.”

The research, says Franconeri, offers practical information for people creating effective complex graphic systems such as charts and graphs, and even more complex visualizations, such as genomic sequences.

It also enhances science’s understanding of ordinary vision. “The visual system fools us into thinking that we process everything in rich detail, when in many cases we are processing only the most relevant pieces of the world,” says Franconeri. The new study adds another insight: “You think you’re seeing all these moving groups. But in fact you’re seeing only the group you are ‘looking at’ with your mind’s eye”—one by one by one.