this spoken word, one of the two objects moved vertically up and down for approximately 60 ms, and observers discriminated the location of the moving object. Of critical importance, the spoken word referred to the eventual target object (the congruent condition), the eventual distractor object (the incongruent condition), or to an object not on the screen (the control condition), an equal number of times. Consequently, there was no incentive to attend to the referent of the spoken word, and observers were instructed to ignore the word. In addition, it is also important to note that the spoken words (object nouns) were orthogonal to the spatial discrimination task. Despite these contingencies, discrimination RTs were significantly faster in the congruent condition than in the control condition, suggesting that attention was drawn first to the target object. Likewise, discrimination RTs were also significantly slower in the incongruent condition than in the control condition, suggesting that attention was drawn first to the distractor object and then had to be re-oriented to the target object. Altogether, these findings are important because they suggest that attention can be controlled in an involuntary fashion by objects that are the referents of spoken words. Consequently, these findings provide further evidence that the non-visual properties of objects can control the allocation of visual attention.—B.S.G.

TEMPORAL ORDER PERCEPTION

Which came first, the tuna or the egg?

Holcombe, A. O., Linares, D., & Vaziri-Pashkam, M. (2011). Perceiving Spatial Relations via Attentional Tracking and Shifting. *Current Biology*, *21*(13), 1135–1139.

If one had to sum up the last two decades of research on visual attention with a single phrase, a good candidate might be “things which seem easy are really hard”. For example, say you’re seated in a Japanese restaurant watching the sushi boats go past. Was that pink salmon, then red tuna, and then yellow egg? Or did the egg come between the salmon and the tuna? Apprehending relative positions among objects like this seems like a trivial perceptual task. However, Alex Holcombe, Daniel Linares, and Maryam Vaziri-Pashkam, present a clever demonstration that selective attention is required to correctly achieve this feat. They take advantage of the fact that there is a speed limit on attention. Their displays consisted of circular arrays of colored disks, rather than sushi boats, but let’s stick to my tastier analogy.

Their method was to measure the speed at which various tasks could be accomplished. As we increase the speed at which the boats go by, there comes a point at which the relative positions of the nigiri cannot be determined. Of course, if the boats go by fast enough, it’s all a blur and we can’t see anything. So first Holcombe et al. measured the upper speed limit at which observers could perceive what the colors were; there’s definitely salmon, tuna, and egg, but not necessarily in the correct order. This turned out to be at least 3 revolutions per second (rps); the maximum speed that could be generated with their displays. Next, imagine two parallel rows of sushi boats. Are they aligned, so that the salmon in the outer row lines up with the salmon in the inner row and so on? This task could be done at around 2.5 rps. Note that in this task, observers did not have to report the order of the colors.

Identifying colors and detecting whether or not disks of the same color are aligned can be done at high speeds. Attentional tracking, however, has a much lower speed limit. Imagine a train of empty sushi boats. The experimenter points to one, otherwise identical boat and asks you to track it as it moves by. This speed was substantially lower, around 1.5 rps.

Finally, Holcombe measured the ability to report the relative spatial relationships among the colored disks, i.e. the order. Salmon->tuna->egg? Salmon->egg->tuna? Tuna->egg->salmon? There were two versions of this experiment, one in which they had to report the order within a single ring, and one where they had to report two colors that were aligned across rings. In both cases, the speed limit was around 1.5 rps. These experiments demonstrate that the speed limit for apprehending spatial relationships between objects is the same as the speed limit for tracking them. Holcombe et al. reasonably infer from this that attention is required to correctly report relative spatial relationships among objects.—T.S.H

ANIMAL SENSES

Dealing with clutter—if you are a bat

Bates, M. E., Simmons, J. A., & Zorikov, T. V. (2011). Bats use echo harmonic structure to distinguish their targets from background clutter. *Science, 333*(6042), 627–630.

Simon, R., Holderied, M. W., Koch, C. U., & von Helversen, O. (2011). Floral acoustics: conspicuous echoes of a dish-shaped leaf attract bat pollinators. *Science, 333* (6042), 631–633.

As humans, we have only a modest ability to use echoes as sensory signals. We might be able to tell the difference between indoor and outdoor spaces, based on the echoes of environmental sounds. However, our limited abilities make it hard to imagine how bats can