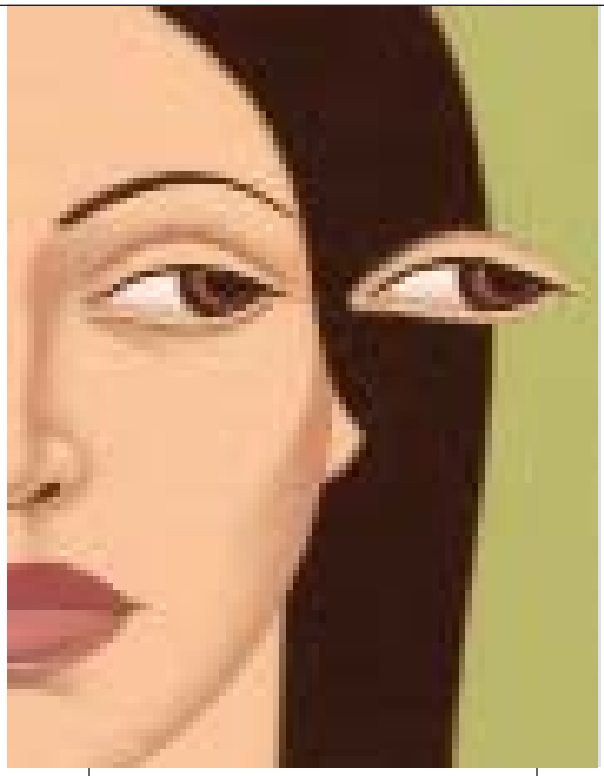
Looks Can Deceive

When you are facing a tricky task, your view of the world may not be as accurate as you think

BY CHRISTOF KOCH



ALL OF US, EVEN POSTMODern philosophers, are naive realists at heart. We assume that the external world maps perfectly onto our internal view of it—an expectation that is reinforced by daily experience. I see a coffee mug on the table, reach for a sip and, lo and behold, the vessel's handle is soon in my grasp as I gingerly imbibe the hot liquid. Or I see a chartreuse-yellow tennis ball on the lawn, pick it up and throw it. Reassuringly, my dog appears to share my veridical view of reality: she chases the ball and triumphantly catches it between her jaws.

That there should be a match between perception and reality is not surprising, because evolution ruthlessly eliminates the unfit. If you routinely misperceive or even hallucinate and act on those misapprehensions, you won't survive long in a world filled with dangers whose avoidance requires accurate distance and speed assessments and rapid reactions. Whether you are diving into rocky waters or driving on a narrow, two-lane road with cars whizzing by in the opposite direction, small mistakes can be lethal.

You probably believe that your eyes register high-fidelity information about the absolute size, speed and distance of visible objects and that you respond based on these impartial data. But although we build robots in this manner—equipping them with sensors and computers to plumb the metric properties of their environments—evolution has taken a more complex route.

As psychologists and neuroscientists have discovered over the past several decades, our consciousness provides a stable interface to a dizzyingly rich sensory world. Underneath this interface lurk two vision systems that work in parallel. Both are fed by the same two sensors, the eyeballs, yet they serve different functions. One system is responsible for visual perception and is necessary for identifying objects—such as approaching cars and potential mates—independent of their apparent size or location in our visual field. The other is responsible for action: it transforms visual input into the movements of our eyes, hands and legs. We consciously experience only the former, but we depend for our survival on both.

When driving in the mountains, have you ever noticed a discrepancy between the slope described on the yellow road sign and your sense that the incline is actually much steeper? Psychologist Dennis R. Proffitt of the University of Virginia and his then graduate student Jessica Witt did. Being scientists and not philosophers, they designed an experiment to find out why. Proffitt and Witt stood at the base of hills on campus and asked passing students to estimate their steepness in two ways. Subjects had to align the diameter line on a flat disk to the slant of the hill. They also were asked to place the palm of one hand on a movable board that was mounted on a tripod and then, without looking at that hand, to adjust the board's slant until they felt it matched that of the hill [*see photographs on opposite page*].

In the first part of the test, which relied on visual cues alone, subjects badly overestimated, interpreting a 31-degree slant as a much steeper, 50-degree one. But when people's eyes were guiding their hands, subjects judged accurately, tilting the board an appropriate amount. Perhaps even more striking was the finding that people's tendency to overestimate on the strictly visual part of the test increased by more than a third when they had just run an exhausting race—but the hand estimates were unaffected. The same discrepancy occurred when subjects wore a heavy backpack, were elderly, or were in poor physical condition or declining health.

In another variant of the experiment, Proffitt had subjects stand on top of a hill on either a skateboard or a wooden box the same height as the skateboard. Participants were instructed to look down the hill and judge, both visually and manually, its grade. They were also asked how afraid they felt to descend the hill. Fearful participants standing on the skateboard judged the hill to be steeper than did the braver souls standing on the box. Yet the visually guided action measurement was unaffected by fear.

Proffitt argues that perception is not

CHRISTOF KOCH (*Koch*); IMAGES.COM/CORBIS (*illustration*)

Good kickers perceived the field goal as 10 percent wider. **Poor performers** saw it as 10 percent narrower.

fixed: it is flexible, reflecting a person's physiological state. Your conscious perception of slant depends on your current ability to walk up or down hills—hard work that should not be undertaken lightly. If you are tired, frail, scared or carrying a load, your assessment of the hill—the one that guides your actions—will differ from what you see. Not by choice, but by design. It is the way you are wired.

Participants in a 2007 study judged the steepness of a hill by sight alone (*left*), and using both sight and touch (*right*). The results differed, suggesting that we do not see the world uniformly. One vision system plans actions, and accommodates our physical abilities; the other recognizes objects, and is less variable.

The Witt-Proffitt team published another report on the observation, well known in sports lore, that baseball players perceive the ball to be larger when they are hitting well and smaller when they are on a losing streak. Since then, Witt, now a professor at Purdue University, along with her student Travis Dorsch, has pursued this intriguing link between how success (or lack of it) in a task affects one's perception of the world.

In their experiment, 23 volunteers had to kick an American football through the field goal from the 10-yard line. After a warm-up, participants were asked to judge the height and width of the goal by adjusting a hand-held, scaled-down model of the goal made out of PVC pipes. They then each performed 10 kicks. Immediately after the final kick, participants repeated the perceptual measurement.

The result was striking. Before kicking, both groups had the same perception of the size of the goal (incidentally, an inaccurate one: everybody underestimated its actual width-to-height ratio). But after 10 kicks, the poor performers (those who scored two or fewer successful kicks) saw the goal as about 10 percent narrower than they had before, whereas the good kickers (those who scored three or more) perceived the goal to be about 10 percent wider. How well you have performed over the past few minutes influences the way you see the world! Not just metaphorically, but on a physiological level—it changes your actual perceptions.

After more data mining, the two psychologists discovered that the people who missed the goal because they tended to kick the ball too short perceived the crossbar as being higher than did their more successful peers, whereas those who missed because they kicked wide judged the upright field posts to be narrower.

So by now you may be thinking: How convenient! The perceptual system offers us self-serving justifications for bad performance. But there is likely some value here, evolutionarily speaking: if people perceive the goal as higher or smaller than it actually is, they will aim more precisely the next time. What happens in football also holds for softball and golf, Witt and her colleagues have found—and, most likely, for life in general.

Our conscious perception of the world, though relatively stable, is not static. We are incapable of being fully objective, even in our most mundane observations and impressions. Our awareness of the objects around us is informed and fine-tuned by any number of transient factors—our strength and energy levels, our sense of confidence, our fears and desires. Being human means seeing the world through your own, constantly shifting, lens. M

CHRISTOF KOCH is Lois and Victor Troendle Professor of Cognitive and Behavioral Biology at the California Institute of Technology. He serves on *Scientific American Mind*'s board of advisers.

(Further Reading)

- **The Roles of Altitude and Fear in the Perception of Height.** J. K. Stefanucci and D. R. Proffitt in *Journal of Experimental Psychology: Human Perception and Performance,* Vol. 35, pages 424–439; 2009.
- **Perceived Slant: A Dissociation between Perception and Action.** J. K. Witt and D. R. Proffitt in *Perception,* Vol. 36, pages 249–257; 2007.
- **Kicking to Bigger Uprights: Field Goal Kicking Performance Influences Perceived Size.** J. K. Witt and T. E. Dorsch in *Perception,* Vol. 38, pages 1328–1340; 2009.