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Invited Commentary

When seeing is deceiving: a comment on Kelley and Kelley

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It seems sensible that our senses should provide us with an accurate perception of the world around us. But this is seldom, if ever, true for 2 reasons: they are limited by basic constraints on perceptual systems, and even in the absence of constraints, an unerring account of the world may not be good for our genes. Perceptual accuracy is limited by our senses in numerous ways. For example, there is an inverse correlation between spatial and temporal resolution, on the one hand, and visual sensitivity on the other. Thus, animals operating in low-light environments will have a less accurate view of the world than those in high-light environments (Rosenthal 2007). In this case and in many others, we assume that perceptual accuracy would promote fitness: discriminating predator sounds from background noise, identifying close relatives, and knowing when it is about to rain can all contribute to Darwinian success. In other cases, as Trivers (2011) argues, self-deception can be advantageous; for example, allowing the weak to bluff resource holding potential without revealing the tell-tale signs of a liar or allowing some of us to view the glass as half full, whereas other see it as half empty. Thus, sometimes, we do not see the world as it is because we lack the necessary perceptual machinery and other times because selection favors a deceptive view of the world.

Numerous studies have shown how constraints on sensory end organs (eyes, ears, and noses) influence a receiver's response to signals and how these receiver biases, in turn, shape the evolution of signal design (reviewed in Ryan and Cummings 2013). But these end organs are where perception begins, not where it ends, as biases in perception pile up at all levels in the brain. Sometimes, these biases are so extreme we call them illusions. As Guilford and Dawkins (1991) pointed out in a paper of monumental importance to this field, "Even in perception of lightness and colour, the brain distorts incoming sensory data to construct its own illusory version of the world outside" (see also Rosenthal 2007). This is the focus of the review by Kelley and Kelley (2014): what visual illusions do the brain create, how do these illusions influence receiver responses to signals, and how do senders evolve signals to exploit these illusions?

The authors make it clear that we know much more about the psychology of illusions as it applies to signals directed at predators than as it applies to social signals. Disruptive coloration, threatening eye spots, startle signals, and memorable colors of prey all tweak the predator's psychology to enhance the prey's survivorship. This wealth of knowledge contrasts greatly with the sparsity of such studies of social and especially sexual interactions. True, Endler, and his colleagues (Endler et al. 2010) argue that male greater bowerbirds arrange their bower decorations to elicit the illusion of forced perspective from females viewing the court from the bower. But much of the current work on visual biases in mate preferences has not advanced much since Endler (1978) drew our attention to the importance of visual signals from the receiver's point of view and proscribed a method for quantifying this phenomenon in the context of signal colors and contrast (Endler 1990). These studies advanced the field by integrating photoreceptor sensitivity with putative color opponency systems to understand how signals evolve to enhance contrast (reviewed in Ryan and Cummings 2013). But the majority of these studies stop at the periphery; they do not show that the visual contrast models predict receiver responses in the target species nor do they conduct the behavioral experiments necessary to reveal how the signals are perceived by the brain and what, if any, illusions they instantiate.

The review by Kelley and Kelley (2014) combined with the insightful review of visual signaling by Rosenthal (2007), hopefully, will mark a new chapter in studies of visual ecology by reminding us that all visual tracts lead to the brain and that the biases in percepts generated by the brain, whether illusory or not, contribute to the psychological landscapes that shape the evolution of signal design.

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