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Bird-Brained Illusionists
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PSYCHOLOGY

Bird-Brained Illusionists

The bowers constructed by great bowerbirds to attract mates create optical size and distance illusions.

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Our perceptual experience is constructed from the cues extracted about the content of the world by our senses. In vision, any source of image variation that is predictive of a property about the world is a potential cue. But which cues are actually used, and how do they affect our experience and behavior? If we understand what cues are used to make inferences about the world, then we should be able to manipulate our perceptual experience by manipulating the cue, even if—and most impressively when—this manipulation gives rise to experiences that appear to differ from physical reality (*1*). On page 335 of this issue, Kelley and Endler (*2*) show that humans may not be alone in this perceptual manipulation game. In terms of concrete rewards, we may even be trumped by the architectural craftsmanship of male great bowerbirds.

The males of avenue-species bowerbirds—including great bowerbirds—construct elaborate bowers composed of two stick walls (see the figure, panel A). The bowers are aligned to run from north to south, and the ends are filled with "gesso" (a collection of gray to white shells, stones, and bones), upon which colored objects are placed and thrown. These elaborate bowers have only one purpose: to lure female mates. Females enter bowers from their south end and watch the male at the north end carry on a display that includes vocalizations, movements, and the tossing of colored objects in front of the gesso. Many males never succeed in attracting females to their bowers, and only a select few do most of the mating after females visit and inspect their bower. The reproductive stakes are therefore high, and the quality of the bower plays a key role in separating the successful from the unsuccessful male. Kelley and Endler now show that one of the measures of bower quality is literally in the eye of the beholder—specifically, the female's view of the gesso from within the bower (see the figure, panel B).

In a previous report, Endler *et al*. (*3*) discovered that the arrangement of the gesso is not random: Smaller objects are arranged near the opening of the display court, and larger ones more distant from the opening.

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How to attract a mate. The bachelor bower (**A**) of a male great bowerbird serves to attract females to mate. Kelley and Endler show that the males arrange the gradients in the rocks such that from the vantage point of the female in the bower, larger objects are placed farther away, making the projected texture appear more uniform (**B**). This arrangement results in an optical illusion, but it remains to be shown whether the birds construct these illusions intentionally.

When the researchers reversed the gradient, the bowerbirds rapidly restored it to its initial distribution (but not the individual objects, just the gradient). This study showed that male bowerbirds, for whatever reason, care about the gradient. The interesting observation was that the bower creates a condition conducive to creating experiences of "forced perspective," a term used to describe size and/or distance illusions in photography, filmmaking, and vision science laboratories.

Kelley and Endler provide insight into why the males care so much about the gradient. They report that the males most adept at crafting forced-perspective illusions are most likely to achieve mating success. In other words, not only the males care about the distribution of gesso; the females also care, and appear to make mating decisions based on perceived properties of the gesso. The projected gradients, as seen from within the bower, are more predictive of mating success than the actual physical gradients.

These intriguing results suggest that male bowerbirds manipulate the perceptual experience of prospective mates, which appear to create illusions of forced perspective. But do these results actually demonstrate that bowerbirds use illusions to promote mating success? Have male bowerbirds mastered the laws of perspective and learned to manipulate them to achieve lascivious ends?

Although this possibility is intriguing, the current data are not yet sufficiently rich to sustain this remarkable hypothesis. The data provide compelling evidence that the quality of the gradient, from the vantage point of the female, predicts mating success, but the visual fact of the more uniform texture, not an illusion, may be the only factor determining her preference. Indeed, it has been previously reported that males with more symmetrical bower avenues have a higher mating success rate (*4*). Constructing a bower that appears as orderly as possible from the female viewpoint is in itself a remarkable feat, but it does not entail the construction of illusions.

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The authors list seven possible consequences of their findings, most of which involve speculations about the role that visual illusions might play in shaping females' mating choices. Although intriguing, there are currently no data to support these speculations, as the authors appropriately note. Indeed, some of the proposed effects may be perceptually nonexistent or even in the opposite direction to that proposed by the authors.

For example, the authors suggest that the manipulated gradients might cause male bowerbirds or their display objects to appear larger. But if bowerbirds experience the same illusion as humans, then the positive texture gradients in the bower should cause more distant objects to appear closer in depth than they truly are, which should, in turn, cause them, or objects placed or displayed in front of these regions, to appear smaller. There is also no evidence that bowerbirds use texture gradients as a cue to depth, or if they do, how strongly they weight this cue in comparison to others. Any attempt to ascribe bowerbird mating success to their capacity to construct visual illusions requires a much more extensive assessment of their visual sensitivities than currently available.

Another interpretation of the data is that there is some other behavior that is highly correlated with the males who produce the best forced-perspective displays, and that it is this other behavior that is responsible for the mating choices made by females.

So the question remains: Do male bowerbirds craft illusions to attract mates? The answer is currently unknown. Kelley and Endler's data suggest that male bowerbirds appear to consider the viewpoint of their potential mates when constructing their bower courtyards, and the ones who do this best are rewarded with a higher rate of mating success. Just what matters, and why it matters, remain open and intriguing questions.

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CANCER

Taking a Back Door to Target Myc

Gerard Evan

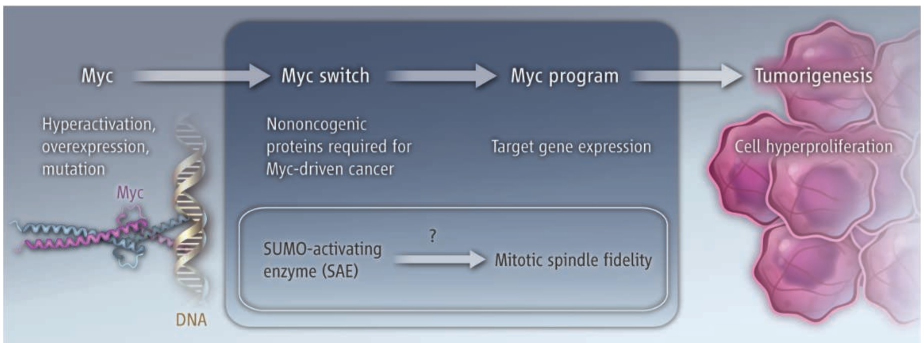
The oncogenic activity of the transcription factor Myc might be blocked by targeting nononcogenic proteins that Myc depends on to cause cancer.

The transcription factor Myc coordinates the expression of a vast and functionally diverse repertoire of thousands of genes that, together, are required for the orderly proliferation of somatic cells within the body. These include genes that govern processes within the cell, such as the cell division cycle, cell metabolism and biosynthesis, cell architecture, and cell survival, as well as the multitude of processes that proliferating cells need to engage in their surrounding microenvironment, such as the generation of blood vessels, tissue remodeling, and the recruitment of cells loaded with enzymes and growth factors needed to do this. Myc is functionally nonredundant and absolutely required for the efficient proliferation of normal and cancer cells. Its expression depends on growth signals in normal cells, ensuring that its growth-promoting activities are unleashed only in cells instructed to proliferate. Control of Myc expression in cancer cells is almost always compromised. Mutations that cause Myc to become hyperactived cause uncontrollable cell proliferation and tumor formation. However, Myc has proven to be an elusive target for drug development. On page 348 of this issue, Kessler *et al*. (*1*) provide insight into how Myc's oncogenic activity might be suppressed by targeting nononcogenic proteins whose functions help Myc to transform cells.

Myc is thought to act as a "driver" of cancer, but in many cancers, the *Myc* genes (there are three isofunctional genes) appear untainted. In these situations, Myc expression is deregulated due to its relentless induction by oncogenic mutations in upstream signaling molecules. Whether this occurs by direct or indirect mechanisms, the outcome locks cells into a continuously proliferating state.

Experiments in which a switchable transgenic form of oncogenic Myc is used to drive tumor formation in mice have shown that inactivation of transgenic Myc in such tumors triggers dramatic regression. This is mediated by a variety of mechanisms, but typically involves terminal differentiation, tumor cell death, and collapse of the tumor microenvironment (*2*–*5*). Further mouse studies have also demonstrated that inhibition of endogenous Myc function also elicits a therapeutic effect in diverse tumor types in which Myc is not itself mutated and where the oncogenic driver mutations lie in other signaling pathways (*6*, *7*). Moreover, indirect pharmacological inhibition of Myc triggers tumor regression (*8*). These studies have strengthened Myc's candidacy as a promising cancer drug target and also intimate that Myc inhibition might be therapeutic in many or most cancer types, irrespective of the driving oncogenic mechanism. Unfortunately, we have as yet no clue how to develop drugs that inhibit Myc function.

If Myc can't be targeted, what can be done? One intriguing idea is that the oncogenic mutations that drive cancers necessarily impose novel dependencies on other, collat-



Myc-driven cancer. Many genes implicated in Myc-driven cancer encode proteins that are not oncogenic and may affect a specific genetic program regulated by Myc that promote tumorigenesis.

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