

DISCOVER[®]

M A G A Z I N E



[Subscribe Today »](#)

- [Renew](#)
- [Give a Gift](#)
- [Archives](#)
- [Customer Service](#)

- [Facebook](#)
- [Twitter](#)
- [Newsletter](#)

SEARCH



- [Health & Medicine](#)
- [Mind & Brain](#)
- [Technology](#)
- [Space](#)
- [Human Origins](#)
- [Living World](#)
- [Environment](#)
- [Physics & Math](#)
- [Video](#)
- [Photos](#)
- [Podcast](#)
- [RSS](#)



Not Exactly Rocket Science

« [Aging termites put on suicide backpacks full of chemical weapons I've got your missing links right here \(28th July 2012\)](#) »

How the rhino beetle got its horn (and why it cannot lie)



The male [Japanese rhino beetle](#) wields a huge forked horn on his head. It looks like a jousting weapon, and the male uses it to pry and flip other males off a branch. But it's also a billboard, a prominent and completely honest advertisement for the male's quality.

The horns are extremely variable. Small males have pathetic nubbins on their heads, while big ones have unfeasibly large prongs that can grow to two-thirds of their body length. [Doug Emlen](#) from the University of Montana has found that the growth of the horns is intimately tied into molecules that reflect how well-nourished the beetles are. Not only that, but the horn is more sensitive to these molecules than any other body part. Well-fed beetles may have larger wings and bodies than poorly-fed ones, but they have *much* larger horns.

This ornament can't be faked. It is impossible for a weak beetle to feign rude health by growing a larger horn, so females can rely on the size of the horns to judge a potential partner's health. And with a body part that conspicuous, they don't have to look very

hard.

The growth of the horns depends on insulin and related molecules called insulin-like growth factors ([IGFs](#)). Most people know insulin as the substance that some diabetics have to take, but it and the IGFs are also major players in animal development. Their levels change depending on nutrition, stress and infections, and they control how fast different tissues can grow. They fine-tune the size of an animals' body so that it's appropriately sized for the environmental challenges it will face. If there's plenty of food around, a bigger body will do well, and insulin and IGFs ensure that one is produced.

If every body part was equally responsive to insulin and IGFs, then every bit of an animal would grow at the same size. A big individual would just be a scaled-up version of a small one. But this doesn't always happen. Some body parts ignore the signals and are much the same size in every individual – the genitals of many insects are a good example. Others, like the rhino beetle's horns, are hypersensitive and grow huge, out of all proportion to the rest of their bearer's anatomy.

Emlen studied the beetles' horns by [interfering with](#) their insulin receptors, the molecules that insulin docks with. Without these receptors, insulin becomes a message without a listener – it has no influence. Emlen silenced the receptors when the beetles were finishing up their larval careers, and ready to transform into adults. At this point, their body size is roughly set, but their adult body parts, like horns, wings and genitals, were still getting bigger.

The loss of insulin signals didn't affect the beetles' genitals – they were the same size as those of normal insects. It did, however, make their wings around 2 percent smaller.

And it made their horns a whopping 16 percent smaller. This means that the horns are 8 times more sensitive to insulin than wings (which are representative of most other body parts).

Insulin and IGF help to set the size of many other exaggerated animal ornaments, including the antlers of red and fallow deer, the horns of dung beetles, and the giant claws of some crustaceans. You can understand why. These hormones have been coupling the growth of animals to environmental conditions for half a billion years. They form a widespread system, and an easy one to tweak. If a body part becomes subtly more sensitive to these signals, then – Bam! – it’s free to outpace the rest of the body in size.

Here’s the important thing: a change like that would *necessarily* produce body parts that honestly indicate their owner’s quality. Weak, starving individuals can’t produce big ornaments, because the size of those ornaments is tied to their insulin levels and their insulin levels are tied to their nutritional state. They can’t fake their way to showiness.

This is a subtly different explanation to the one that’s often put forward to explain the evolution of flashy animal ornaments – the [handicap principle](#). It states that low-quality individuals can’t bear the cost of, say, a long tail or a magnificent set of antlers. They would be too conspicuous or heavy. They need strength and health to pull off. Cheats couldn’t bear the burden.

You can understand how the handicap principle would work for a signal that’s *already* exaggerated, but obviously, those signals didn’t start off that way. They would have had much humbler and smaller origins, when the costs of bearing them would have been low. So, at this early stage of evolution, why didn’t weak individuals cheat by producing larger ornaments?

Emlen’s rhino beetles provide an answer. The signals can’t be faked not because they’re a drain, but because they’re intimately tied into an individual’s physical condition. It’s not that cheaters can’t carry the burden of big ornaments. It’s that cheaters can’t exist.

Reference: Emlen, Warren, Johns, Dworkin & Lavine. 2012. A Mechanism of Extreme Growth and Reliable Signaling in Sexually Selected Ornaments and Weapons. Science <http://dx.doi.org/10.1126/science.1224286>

More on extreme body parts:

[From 250 million years of repression, a wonderland of hats](#)

[Giant squid, what big eyes you have. All the better to spot sperm whales with, my dear.](#)



July 26th, 2012 by [Ed Yong](#) in [Anatomy](#), [Animal behaviour](#), [Animal communication](#), [Animals](#), [Evolution](#), [Sexual conflict](#) | 6 comments | [RSS feed](#) | [Trackback >](#)

6 Responses to “How the rhino beetle got its horn (and why it cannot lie)”

1. 1. [Steve S](#) Says:
[July 26th, 2012 at 4:39 pm](#)

There will now be a market to sell to these beetles IGF (male enhancement) drugs. I can envision the adverts now...

2. 2. [Michael Cook](#) Says:
[July 26th, 2012 at 7:40 pm](#)

While not knowing just how much the quantity of food allows horn growth (independent of the insulin-like growth factors) I did wonder as female beetles are selecting for horn size, there must be a chance this elegant system breaks down when via random mutation a beetle is born whose horn grows large irregardless of diet. It would be interesting to find a sub population of beetles like this as it would be further proof of evolution for those who need it 😊

3. 3. [Jeff Bell](#) Says:
[July 27th, 2012 at 5:06 pm](#)

Actually, these beetles are cheating, they are exaggerating their health signal by increasing the sensitivity of the horns to IGFs. If the growth of the horns mirrored that of the wings, then it would be an honest signal. However, they aren't lying, they are just stretching the truth a little bit, like most fishermen and hunters.

4. 4. [Steve O'Brien](#) Says:
[July 27th, 2012 at 5:48 pm](#)

So I was just wondering... What do you think would happen if there was a mutation that caused the rhino's horns to be 10x as sensitive to insulin/IGF as its wings? Wouldn't it then be a “cheater”? Its horns would grow faster than other beetles getting the same nutrition. It would appear to be a more sexy mate. Wouldn't it?

5. 5. [Lou Jost](#) Says:
[July 27th, 2012 at 7:47 pm](#)

Do the females really choose males in these beetles? I thought these males find and mate with females more or less at will, in the dark, and if that is true, the horn would not advertise a male's quality to the female, but simply serve to defeat male rivals. Do the authors of the article provide any evidence that female choice is involved?

6. [Lou Jost](#) Says:
[July 27th, 2012 at 8:01 pm](#)

I did some internet checking and it appears that at least in some species of rhinoceros beetles, females do not choose males. In fact in some rhinoceros beetles, there are two kinds of males, a big-bodied horned male which defends a burrow containing a female, and a small-bodied hornless male that is more agile and sneaks into females' burrows to mate with her. The evolution of this hornless morph suggests that the female does not reject hornless males. The horn is not a signal to the female about the male's quality. The horn's evolution appears to have been driven primarily by the need to defeat rival males.

Leave a Reply

Name (required)

Mail (will not be published) (required)

Website



• About Not Exactly Rocket Science



Ed Yong is an [award-winning](#) British science writer. His work has appeared in New Scientist, the Times, WIRED, the Guardian, Nature and more. Not Exactly Rocket Science is his attempt to talk about the awe-inspiring, beautiful and quirky world of science to as many people as possible.

[My personal website with biography, other writing, speaking engagements, and more](#)

[Some interviews with me](#)

[Some awards that I've won](#)

Who my readers are: [2008](#), [2009](#) and [2010 editions](#)

[A complete list of posts from this blog](#)

Follow me on [Twitter](#) or [Google+](#)

Contact me on edyong209[at]gmail[dot]com

-
-

DISCOVER blogs



• Support



• What others say

"One of the best sites for in-depth analysis of interesting scientific papers" - The Times

"One of the smartest science bloggers I read... a prime practitioner among the new generation of scientifically authoritative bloggers" - David Rowan, editor of Wired UK

"Engaging and jargon-free multimedia storytelling about science and the digital age" - National Academy of Sciences

"A consistently illuminating home for long, thoughtful, and thorough explorations of science news" - National Association of Science Writers

"Head and shoulders above many broadsheet hacks" - Ben Goldacre

"Ed Yong... is made of pure unobtainium and rides TWO Toruks." - Frank Swain

"Ed Yong is better than chocolate, fairy lights, and kittens chasing yarn. That is all." - Christine Ottery

• Do you want to be a science writer?

Read [origin stories and advice](#) from over 130 science writers from around the world.

• Not Exactly Rocket Science content

[Recent Posts](#) [Categories](#) [Archives](#)

- [Why did people start mummifying their dead in the driest place on Earth?](#)
- [Weapons made from shark teeth are completely badass, and hint at lost shark diversity](#)
- [Not Exactly Rocket Science turns six today](#)
- [A world of genetic diversity within a single tree](#)

- o [I've got your missing links right here \(11 August 2012\)](#)
- o [Sandpipers forgo sleep for days because there's too much sex to be had](#)
- o [Prisoners do science, help to save endangered butterfly](#)
- o [Beetle walks and sticks underwater by creating dryness with every footstep](#)

Twitter

• My wife, who makes it all possible



[NetworkedBlogs](#)

Blog:
[Not Exactly Rocket Science](#)

Topics:
[science](#), [biology](#),
[news](#)

[Follow my blog](#)



Copyright © 2012, Kalmbach Publishing Co.

[Privacy](#) - [Terms](#) - [Reader Services](#) - [Subscribe Today](#) - [Advertise](#) - [About Us](#)