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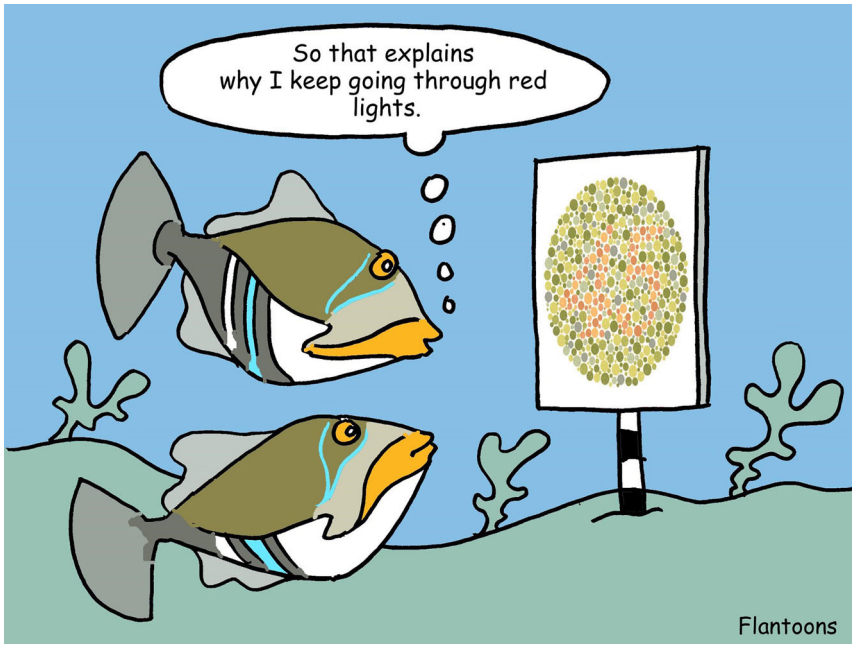
INSIDE JEB

Colour blindness test gets submerged



The colour of the kitchen in our home is a bone of contention. My husband is convinced that it's grey/blue, while I'm certain that it's teal; which is just as well, because he dislikes green. Whatever the shade, it's clear that we see the world in slightly different ways and it is extreme differences in colour perception, manifested as colour blindness, which the infamous blobby images designed by Shinobu Ishihara in 1917 test for. But testing colour discrimination in animals is considerably more challenging; Karen Cheney from The University of Queensland, Australia, explains that one of her colleagues, Connor Champ, spent 4 months training triggerfish to distinguish between colours. Realising that scientists needed a less-demanding method for determining how well fish discriminate colours, Justin Marshall (also from Queensland) and John Endler from Deakin University, Australia, decided to reinvent Ishihara's colour vision test cards from a piscine perspective.

Knowing that triggerfish, which have good colour vision, are capable of distinguishing spots that are more than 2 mm wide over a 30 cm distance, Cheney, Marshall, Endler, Daniel Osorio (from the University of Sussex, UK) and Misha Vorobyev (from The University of Auckland, New Zealand) designed a series of Ishihara-like cards highlighting one spot – the 'odd-one-out' – which was clearly a different colour from a background of spots that appeared grey to the fish. Laser printing each design onto a piece of paper, Naomi Green, also from Queensland, and Alexander Vibert, from Cardiff University, UK, immersed each sheet in the fish's tank and placed a tasty morsel of squid on top of the 'odd' spot to train the fish to peck at it. Once the fish had got the hang of picking out the different spot, they hid the squid reward beneath it and trained the fish to peck through the spot when they were certain that it was a different colour from the background. Impressively, the triggerfish picked up the new skill within a couple of weeks.

After completing the fish's training, Green and Vibert tested whether the animals were able to discriminate different shades of blue, green, teal, brown and pink from the grey spot backgrounds, starting from shades that were virtually indistinguishable from grey, to shades that were clearly distinct. Having analysed the triggerfish's responses, the team discovered that the animals are particularly well tuned to teal, picking out shades that were only a few tones removed from grey, while the pink shades had to be extremely distinct before the fish could pick them out. The team also recorded how many blunders the fish made, in addition to the length of time they took to make a decision, as an indication of how clearly the spot stood out. 'If the colour is very obvious, the fish will not make any errors', says Cheney. And she is optimistic that these reinvented Ishihara plates could revolutionise our understanding of colour perception in the animal kingdom, allowing scientists to test the vision of species both above and below the water line.

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Cheney, K. L., Green, N. F., Vibert, A. P., Vorobyev, M., Marshall, N. J., Osorio, D. C. and Endler, J. A. (2019). An Ishihara-style test of animal colour vision. *J. Exp. Biol.* **222**, jeb189787.

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