A deep neural network that can maximize or minimize coloring to blend into or stand out against a background

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The effectiveness of the tigers colouring in the dichromat context is striking. Image of a tiger from the point of view of a dichromat receiver (a) and Q6 trichromat receiver (b). (Online version in colour.). Credit: *Journal of The Royal Society Interface* (2019). DOI: 10.1098/rsif.2019.0183

A team of researchers at the University of Bristol has developed a deep learning neural network that can identify the best way to minimize or maximize coloring to allow for blending into a background or standing out. In their paper published in *Journal of the Royal Society Interface*, the team describes their network and possible uses for it.

In nature, coloring is very important. In some instances, it can play a role

in attracting a mate—in others, it can be used to hide from predators. And in some other cases, it can also help predators hide while they hunt—tigers are one such example. The tiger is interesting because its bright orange and black coloring would seem to make it easy for prey to spot among the green of the jungle backdrop. But its prey, different types of deer, are all colorblind—to them, tigers look green and black.

In this new effort, the researchers sought to build a system that could reveal which colors best blend into which backgrounds, or conversely, which stand out the most. To achieve this goal, the researchers turned to a deep learning neural network. By programming it to understand what was desired and then to analyze photographs of many background scenes and animals, the system determined the best colors for an organism to avoid being seen by certain other creatures depending on their visual abilities—or to best stand out.

The network correctly chose orange as the right color for tigers. They note that mammals are not able to grow green fur; thus, tigers are orange because it works just as well. They have no explanation regarding why deer have not evolved the ability to see orange. Also, during testing with humans, they found that observers with dichromatic vision (color blindness) took longer to spot strongly colored animals. Those with trichromatic (normal) vision, on the other hand, were very good at breaking camouflage. They suggest their network could be a useful tool for better understanding the role color plays with animals living in the natural world.

More information: J. G. Fennell et al. Optimizing colour for camouflage and visibility using deep learning: the effects of the environment and the observer's visual system, *Journal of The Royal Society Interface* (2019). DOI: 10.1098/rsif.2019.0183