A contentious issue in de Winter and Oxnard's paper\(^6\) is the degree to which the primate line is unique in reflecting 'an increase in voluntary over more stereotyped control of behaviour'. de Winter and Oxnard\(^6\) could be misconstrued as supporting a model of 'lower organisms' being simple reflex automata. Alternatively, Menzel and Giurfa\(^5\) have suggested that insects (like most other organisms) have evolved flexible information-processing capacities (e.g. central integrators connecting domain-specific modules) to adapt to their particular environment. It is unlikely that de Winter and Oxnard would disagree with the idea of evolved mechanisms mediating flexibility across several lineages, because they endorse that, rather than a single evolutionary progression in 'general intelligence', different 'intelligences' most probably evolved independently in different ethological contexts. Indeed, de Winter and Oxnard (pers. commun.) do not support the lower organism or 'reflex automaton' viewpoint of animal cognition. Studies, such as that by de Winter and Oxnard, contribute towards a future resolution of the debate between Darwin\(^1\) and Wallace\(^2\) over the degree to which human and nonhuman cognitive capacities have been shaped by natural selection.

**Acknowledgements**

I thank Natasha Crewdson, Chris Moore and Charles E. Oxnard for helpful comments on this article. This work was supported by the Natural Sciences and Engineering Research Council of Canada and an Isaak Walton Killam Memorial Postgraduate Scholarship.

**References**


William M. Brown

Dept of Psychology, Life Sciences Centre, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4J 1.

E-mail: wmbrown@is2.dal.ca

---

**For your eyes only? The role of UV in mate choice**

Alexander N. Banks

A proliferation of experiments emphasizing the importance of the near-ultraviolet (UV) in avian mate choice has led to the proposal that this might be used exclusively by birds to signal to each other without alerting UV-insensitive mammalian predators. However, a new study suggests that information offered in the UV is no more ‘special’ than that offered in other wavebands.

Most avian species tested to date have revealed visual sensitivity to wavelengths of 315–400 nm, which is the near-ultraviolet (UV, specifically UV-A) part of the spectrum. Explanations for this sensory ability have ranged from the potential use of UV in orientation and foraging to a role in social and sexual signalling\(^1\). It is the role of UV in sexual signalling, and in mate choice in particular, that has been most intensively scrutinized. Strong evidence for the use of UV during avian mate assessment has led to the speculation that the evolution of UV vision in birds could have been driven by the need for a class-specific communication channel\(^2\). However, a new report from Sarah Hunt et al.\(^3\) suggests that we should not get too carried away with this idea.

Studies of the role of the UV waveband in mate choice have continued since the early experiments of Bennett et al.\(^4\), which showed that female zebra finches Taeniopygia guttata directed their behaviour towards males under full UV illumination (UV+) in preference to males behind UV-eliminating filters. Furthermore, this attraction to UV+ partners was probably an aspect of mate selection rather than of simple species recognition. Female zebra finches preferred symmetrical leg bands\(^5\), and, by varying the appearance of male bands, the authors showed that the females found symmetrical males more desirable. As the bands could only be distinguished on the basis of their visibility in UV, this wavelength was clearly instrumental in impressing the females.

This experimental paradigm has proved fruitful in subsequent studies underlying the hidden role that UV plays in the evaluation of prospective mates in other avian species, including starlings Sturnus vulgaris\(^6\) and blue tits Parus caeruleus\(^7\). Additionally, Sheldon et al.\(^8\) found that female blue tits mated with males with highly colour-saturated crests tended to produce more male offspring, whereas low colour-saturated males tended to father more females. Also, the highly colour-saturated males were significantly more likely to survive the following winter. The component of the signal used to indicate male quality lay within the UV band.

References

1. Altringham, J.D. (1996) Microhabitat selection by blue tits Sturnus vulgaris in the evaluation of prospective mates in the following winter. The component of the signal used to indicate male quality lay within the UV band.

7. Additionally, Sheldon et al.\(^8\) found that female blue tits mated with males with highly colour-saturated crests tended to produce more male offspring, whereas low colour-saturated males tended to father more females. Also, the highly colour-saturated males were significantly more likely to survive the following winter. The component of the signal used to indicate male quality lay within the UV band.
For birds’ eyes only

Clearly, the realization that UV should be considered in mate choice experiments was too long in coming. That most mammals are blind to UV (Ref. 9) led Guilford and Harvey2 to speculate that this channel might be reserved exclusively for intra-avian signalling. Following the argument10 that the bright colouration of birds evolved as an honest indicator of unprofitability to mammalian predators, the authors suggested that male and female bluetits, for example, might seek to advertise their unattractiveness to mammals whilst secretly relaying social and sexual information to each other using UV.

To test whether the effects of blocking UV on mate choice were in any way unusual, Hunt et al. let each of eight female zebra finches choose between four different males3–7, each of which was seen through a different colour filter. Filters were chosen to correspond with the peak sensitivities of the four zebra finch retinal cone types. Each male was therefore seen to lack reflectance in either UV light (UV−), short-wave human visible light (SW−: perceived as violets and blues), medium-wave human visible light (MW−: perceived as greens) or long-wave human visible light (LW−: perceived as reds).

Interestingly, females spent most time in front of stimulus males that were seen as UV−. Rather than attending primarily to any UV signals, the test birds seemed least deterred by conspecifics lacking UV reflectance. Conversely, females displayed the least inclination towards MW− or LW− males. It seems, therefore, that these birds do not rate UV signals as being any more instructive than those transmitted in other wavebands. The primary sexual ornament of the zebra finch is thought to be the distinctive scarlet bill11,12 (although how this feature ranks alongside behavioural displays is unclear13). In keeping with the role of this strongly sexually selected character, it is the apparent absence of longer, red-reflecting wavelengths in this case that most affected the decisions of the females.

One interpretation of earlier findings implicating the significance of UV in mate choice is that, in the light of this experiment, males simply exhibit more complete information about quality when viewed under the entire bird visible spectrum. The study also further emphasizes the need to allow animals access to ecologically important information in experiments of this type, such as providing full colour space.

No ‘private’ channel for zebra finches

It seems as though, for zebra finches at least, that there is no ‘private’ communication channel for sexual signals. One reason for this might be that, as Guilford and Harvey note, small birds are as likely to be preyed upon by other birds as they are by mammals, and UV sensitivity has been discovered through behavioural experiments in some birds of prey14. So, just as lepidopterans were once falsely thought to communicate to each other using signals inaccessible to their avian predators15, there would seem to be nothing to stop avian predators picking up UV signals sent from avian prey for detection by potential mates. This, of course, assumes that raptors and small birds, such as passerines, are equally receptive to signals in this waveband.

However, this is surely not the end of the story. The zebra finch bill is far from being an ‘ultraviolet ornament’ and intriguing questions are raised in other bird species. It remains to be seen whether different results will be found in animals with highly UV-reflectant ornaments, such as the bluetit. These species possibly do make more use of signals in UV, but it seems that such information cannot be considered in any way more special than would be a signal sent in the red, green, blue or any other waveband. Additionally, there is still the possibility that signals sent in UV might be ‘special’ to receivers detecting information under different wave length backgrounds16. For example, crepuscular birds, which are most active at times when UV is more prominent than is longer wavelength light, might be more affected by the removal of UV than the diurnal zebra finches.

In the meantime, although we must be careful not to throw the baby out with the bathwater, we cannot ignore the contribution of UV to avian colour space – it seems for now that the role of this waveband might be less special than was first imagined2,15. Sexual signals seem to be broadcast across the entire visible spectrum and, for birds, this includes the UV, regardless of how it might have arisen.

Acknowledgements

I thank Tim Guilford, Ben Sheldon and Adrian Thomas for advice and encouragement.

References

3 Hunt, S. et al. (2001) Is the UV waveband a special communication channel in avian mate choice? J. Exp. Biol. 204 (14), 2499–2507

Alexander N. Banks
Animal Behaviour Research Group, Dept of Zoology, University of Oxford, South Parks Road, Oxford, UK OX1 3PS.
e-mail: alexander.banks@zoo.ox.ac.uk

Students!

Did you know that you can subscribe to Trends in Ecology and Evolution at a 50% discount?

Use the form bound in this issue to claim your discount