The Vision Centre

MEDIA RELEASE

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EDGE DETECTION CRUCIAL TO EYESIGHT

In a major advance in understanding how our eyesight works, Australian scientists have shown that birds' amazing flight and landing precision relies on their ability to detect edges.

The research suggests that edge detection is crucial in helping all animals, including humans, move around safely, and may be more important than our ability to see colour.

The study by the Vision Centre and University of Queensland found that budgerigars ignore colour and look for the edge of an object in order to ensure a smooth landing, and will be published in *PLoS ONE* on 7 October.

Although a lot is known about the visual cues that help birds navigate when flying over long distances, this is the first study to reveal how budgies navigate from moment to moment and choose where they land, said Partha Bhagavatula, who completed the research as part of his PhD.

"It makes sense that birds use contrasting edges to target their landing - the edge of an object normally presents a good place to get a strong grip and it can help birds to avoid over or undershooting," said Bhagavatula.

The findings have helped scientists understand how birds fly and land so accurately, particularly in dense spaces and low light, and also provide insight into human vision.

"Our results reflect studies on edge detection in bees and primates and suggest that edge detection is critical to helping all animals, including humans, move around. Colour vision is important when it comes to recognising objects, but these findings suggest you don't need it in order to do many day to day tasks," said Dr Mandyam Srinivasan, Bhagavatula's co-supervisor from the Queensland Brian Institute.

The findings also suggest that edge detection may be the key to creating unmanned aerial vehicles (UAVs) and flying robots that can dodge objects while travelling through cluttered environments, a feature that is in high demand, according to Dr Srinivasan.

In order to test the visual features that guide budgies landing, Bhagavatula and a team placed a feeder tray in the middle of a disc on a background of blue paper.

Even though the food was in the centre of the disc, the birds landed on the edge and then walked to the middle. “This showed that they were using the contrasting edge of the disc to guide a safe landing, instead of just setting down close to the food,” said Bhagavatula.

Different coloured discs were used under the same conditions, and although the budgies had the ability to differentiate between all of the colours and the background, there were certain shades that they appeared to be unable to find the edge of. When these discs were used, the budgies landed anywhere.

“Birds can see in all three of the human primary colours – red, blue and green – and also ultraviolet, but their edge detection skills appear to be colour-blind,” said Bhagavatula.

This suggests that the ability to detect edges may have evolved before colour vision in birds and may be more useful for navigating in their environment, he added.

“When birds are flying through dense foliage they may not be able to see much colour, as it is often in the low light of dawn or in the dark, but the contrast between edges is a fairly constant marker. It may be more practical for them to manoeuvre this way.”

The fact that animals that are so different, like birds, bees and humans, all use edge detection to help them navigate in cluttered environments shows just how crucial this aspect of vision is, according to Dr Charles Claudianos, a co-supervisor from the Queensland Brain Institute.

“It is great to take information we have learned from insect studies and applied it to studies of vertebrates. It is remarkable how the evolution of such different creatures leads to very similar mechanisms,” said Dr Michael Ibbotson, a co-supervisor from the Vision Centre at Australian National University.

The study in birds could also help scientists understand exactly how the human eye detects edges, he added.

“We are finding more and more that things we discover in bees and birds are also true in humans. We know a lot more about nerve cells in certain animals than we do in human ones, so we can work out how they detect edges and then apply it to humans.”

The findings will also help to build flying robots and UAVs that can fly quickly in dense environments, said Dr Srinivasan.

“Birds are very agile, especially when flying through cluttered environments, and edge detection plays an important role in their manoeuvring. We can use this knowledge to create UAVs capable of dodging skyscrapers and flying in busy CBDs, which is something people are particularly interested in at the moment.”

The paper, Edge Detection in Landing Budgerigars (*Melopsittacus undulatus*), by Partha Bhagavatula, Charles Claudianos, Michael Ibbotson and Mandyam Srinivasan will be published in *PLoS ONE* on Wednesday 7 October at 10am AEST. The article is freely available online at http://dx.plos.org/10.1371/journal.pone.0007301.

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More information:

Partha Bhagavatula, Queensland Brain Institute, University of Queensland,
ph +61 (0)437 399 481

Dr Mandyam Srinivasan, Queensland Brain Institute, University of Queensland,
ph +61 (0)434 603 082

Professor Trevor Lamb, The Vision Centre, ph +61 (0)2 61258929 or 0434022375

Professor Julian Cribb, The Vision Centre media contact, +61 (0)418 639 245

Jan King, University of Queensland media, ph +61 (0)7 3365 1120