*Correspondence should be addressed to s.mathot@cogsci.nl

A bit about birds looking sideways

Sebastiaan Mathôt[1,*]

[1]Aix-Marseille Université, CNRS, Laboratoire de Psychologie Cognitive

This afternoon I was eating a sub in the Plymouth harbor, finally enjoying a bit of sun, which we haven't seen much of this summer. I was joined by a seagull chick. It was presumably hoping to score a piece of my sub…

The fovea

As you probably know, we see only a small part of our surroundings with high resolution and in color (Betts et al., 2013). This is the part that falls onto our fovea, a small, extra dense part of the retina (see Figure 1). Foveal vision corresponds to about the size of a thumb at arm's length. Yet we feel as though we have a complete and full-color perception of our entire visual field. In large part, this is because our eyes are mobile: If we think about something, we immediately look at it (bring it into foveal vision) to get a crisp view of the object in question.

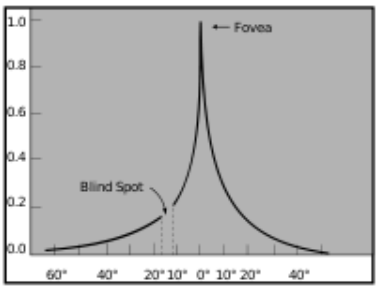

Figure 1. *Visual acuity drops of rapidly with distance from the fovea (source: Wikipedia)*

So what does this have to do with the gull chick? Well, for birds it's much the same, but with a

twist. Many birds don't have a single fovea (per eye), like we do, but two (Land & Nilsson, 2002). (The details differ between species, but I believe the following applies to many species except birds of prey.) They have a temporal fovea, which is like ours in the sense that it looks straight ahead and offers binocular vision (i.e. the temporal foveas of both eyes point in the same direction). But birds also have a central fovea, which points sideways and is, obviously, monocular (i.e., the central foveas of both eyes look in opposite directions).

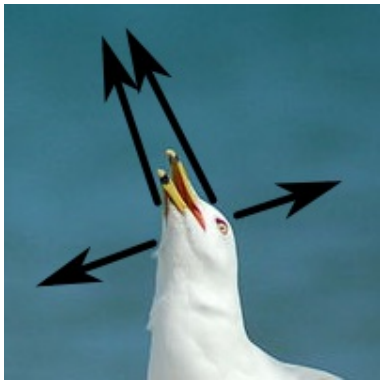

Figure 2. *Some birds can look in front of them and sideways (Adapted from Wikipedia)*

So when a bird wants to look at something it has a choice: It can look straight ahead with its temporal foveas, to the left with the central fovea of its left eye, or to the right with the central fovea of its right eye (see Figure 2). And this is not a hypothetical possibility: Birds actually do switch between foveas all the time (Dawkins, 2002)! This is why they tend to swing their heads erratically in turns of about 90°, as you can see in the video above. And this is also why, according to Michael F. Land (1999) "it is frustratingly difficult to tell what a bird is actually attending to." (This quote is actually taken a bit out of context, but it applies quite well anyway.)

Vision science

As a vision scientist, I find this intriguing, because it completely goes against our (totally anthropocentric) ideas about vision. Basically all theories about vision assume that there is a single fovea, used to look at one object at a time, and that consequently we attend to only a single object (more or less) at a time. But how well does this translate to birds? Do birds have a more distributed awareness of their environment, as a consequence of their having multiple foveas?

There is some research, notably by Robert Cook (2000), that suggests that perception and attention in birds is actually similar to that in humans, but, in general, I believe that this is an open (and interesting!) question.

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