

## How cuttlefish see objects

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Are the principles of visual perception governed by evolutionary contingency and the particularities of the human – or vertebrate – brain, or do they represent a general solution to the problem of interpreting natural images by advanced organisms? Cephalopod molluscs offer a remarkable opportunity to answer these questions. Their brains are of similar size to those of mammals, and they can change their appearance with great flexibility for camouflage and communication, which allows us to investigate with their vision. The European cuttlefish (*Sepia officinalis*) regulates the expression of about 40 distinct local pattern features such as spots or lines known as behavioural ‘components’ [1]. The expression of these components is coordinated to produce a suitable body pattern for a given context, much as we coordinate the action of many muscles to produce a facial expression. Although the full capabilities of the pattern generating system remain unclear, they must be matched by the animals’ vision. When the camouflage themselves on natural seafloor substrates the cuttlefish seem to make decision about whether the substrate is a continuous patterned surface – when they tend to express a so-called Mottle pattern, or made of discrete objects such as pebbles, when they emphasise a Disruptive pattern, which comprises relatively well defined visual features. The cuttlefish use multiple low level cues to make this distinction including the presence of edges, visual depth, and even modal completion [2-4]. More recently [5] we have investigated how cuttlefish use pictorial depth in 2-D images. We found that when they express the disruptive pattern cuttlefish are able to shade asymmetrically a white square component to give a subtle but effective artificial depth cue to the viewer. This shading is related to the presence of shaded objects in the environment, and seems also to be sensitive to the direction of illumination.

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