How do Cuttlefish Use Camouflage to Trick Predators?

**Key Terms**

**Cephalopod:** A group of marine invertebrates that include octopus, cuttlefish, and squids; Can camouflage themselves against virtually any background

**Invertebrate:** Animals that do not have a backbone/spine

**Camouflage:** The ability to blend into their surroundings; Often used to hide from predators

**Chromatophore:** Cells that contain pigment (color) and can reflect light.

**Motor neuron:** A brain cell that helps control muscle movement

**Uniform (pattern):** Not a lot of variation

**Mottle (pattern):** Light and dark patches; some pattern repetition

**Disruptive (pattern):** Different shaped light and dark patches; high contrast

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**ABSTRACT**

Do you think that chameleons are the masters of camouflage? Well, think again. **Cephalopods**, a group of marine **invertebrates** that include octopus, cuttlefish, and squids, can camouflage themselves against virtually any background. This ability to camouflage is possible because of complex visual systems that allow Cephalopods to quickly assess their environment and produce the correct motor response that leads to camouflage.

In this study, researchers categorized camouflage patterns into three broad categories after years of study using Cephalopods. They used European cuttlefish, a good model organism, to test their hypothesis that all camouflage patterns in animals would fall into these three categories. After multiple experiments using their own virtual backgrounds, the researchers found evidence for their hypothesis, showing how a complex trick like camouflage can come from three simple patterns.

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**Figure 1:** A diagram showing the external features of a cuttlefish including the fin, mantle, head, and tentacles.
WHAT MAKES CEPHALOPODS DIFFERENT?
- Cephalopods have good vision and special skin with a nervous system that allows for quick change and adaptation.
- They don’t need to depend on timing, right lighting, or hormones like other animals with camouflage abilities such as the more common chameleons.

THE CAMOUFLAGE TECHNIQUE
There are three features of cephalopod camouflage:
- the background doesn’t have to match completely
- they change quickly
- camouflage is possible from both visual and physical features of the cephalopods.

Quick visual change is possible because of special structures called chromatophores which cephalopods control with their brain. These are sacs of pigment (color) with muscles attached around the side. Each muscle has a motor neuron connected to it, and when the neuron gets excited, the muscle contracts and the color in the sacs spreads farther across the skin (Figure 2). Cephalopods also have structures on their skin that are activated by visual signals.

THREE TYPES OF PATTERNS
Scientists have gathered about 5000 pictures of animals of different species and divided camouflage patterns into three categories:
- **Uniform**: Not a lot of variation in the pattern of the skin; smooth appearance
- **Mottle**: Light and dark patches; some pattern repetition on skin surface
- **Disruptive**: Different shaped light and dark patches; high contrast among patches
Majority of tests done in relation to camouflage in cuttlefish focused on disruptive patterns.

Cuttlefish use their mantle size (white spot on their back that's actually a muscle) as a frame to match their surroundings.

Cuttlefish use disruptive camouflaging when checks in a checkered pattern were 40-120% their mantle size (similar enough to their size). 

If the checkered patterns were a lot larger or smaller than their mantle, they used mottle or uniform patterns.
DISCUSSION

- Cuttlefish use neurons that stretch all the way to their skin, to change their pattern and camouflage with their surroundings instantly!!

- Cephalopods have three basic pattern classes for camouflage: uniform, mottle, and disruptive.

- The camouflaging tricks include differences in edges, shadows, outlines, and patterns which is also used in art and photography!

- Based on the results from this study, we can study more about predator and prey interactions both on land and water!

WHAT'S NEXT?

- Future studies on related marine species will push the need for new technology that can be used underwater like miniature computers!!

- We can further investigate the relationship between the cephalopods' environment and the features of the patterns that are used to achieve camouflage.

- Since we know how camouflage works in the water, how does it work on land? What are other ways that animals protect themselves from predators?

Figure 4. The *Octopus vulgaris* is an example of a cephalopod that is able to camouflage to its surroundings in less than a second.

Adapted by Deena Haque, Dhara Salazar, and Natalia Santos from *Cephalopod Dynamic Camouflage* by Roger Hanlon, Current Biology, 2020.