Topic Summary: An Investigation on the Dynamic Processes of Mimicry in the Mimic Octopus (*Thaumoctopus mimicus*)

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ZOOL 567: Animal Behaviour

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December 2, 2021

Crypsis, or camouflage, is a well-documented defense mechanism used within Cephalopods for protection against visually oriented predators (Hanlon, 1999; Hanlon et al., 2008; Krajewski et al., 2009). The imitation of a model's behaviour and appearance, or mimicry, has also been frequently observed amongst Cephalopods (Hanlon et al., 2008; Norma et al., 2001). Papillae, textural bumps on the skin, and shifts in colouration result from the neuronally controlled expansion or contraction of skin muscles and chromatophores (colour cells) (Ikeda, 2021). Beyond these typical mechanisms, one Indo-Malayan octopus has incorporated advanced behavioural modifications and constructed an entire repertoire of mimics (Gómez-Moreno, 2019).

The effectivity of their deception and rapidity of their mimic changes, meant the mimic octopus, *Thaumoctopus mimicus*, was best observed in the wild through continuous filming (Norman et al., 2001). From the collected footage, researchers captured freeze frames to establish visual and behavioural criteria expressed for each mimic. Visual criteria included factors such as brightness, colour, patterning, and shape (Hanlon et al., 1999), while behavioural incorporated elements such as swimming-style and posture (Hanlon et al., 2008). Additional factors included the context, duration, and frequency of an individual performance (Hanlon et al., 2008).

The complexity of this behaviour has caused many researchers to question its modality. Some conjectured that it was Batesian mimicry, whereby a non-toxic species permanently mimics a single noxious model to appear unpalatable to predators (Hanlon et al., 1999; Maran, 2017). Given that the mimic octopus' repertoire contains several models, toxic and non-toxic, this seems unlikely (Hanlon et al., 1999). 'Dynamic mimicry', the variable and discontinuous performance of multiple mimics, seems a more appropriate term in this instance (Norman et al., 1999 as cited in Norman et al., 2001, p. 1757). By assessing their surroundings through camera-like eyes, they can moderate the individual expression of each mimic given its appropriateness for the current situation (Ikeda, 2021). Confirmation on the toxicity of the mimic octopus though, would indicate whether there is any incorporation of Batesian mimicry into this anti-predator strategy (Hanlon et al., 2008).

In exploring the origin of dynamic mimicry as a predator evasion strategy in octopuses, Krajewski et al. (2009) investigated social mimicry as a possible factor. Despite displaying conspicuous colouration, they observed that *Octopus insularis* was rendered inconspicuous by opting to swim at the centre of a *Cephalopholis fulva* school. A shared diet with these fish meant this octopus was already in frequent association with them. This arose question of whether this similarity served as an original proponent in the octopus leveraging these schooling practises to promote personal protection (Krajewski et al., 2009). Huffard et al. (2010) suggested that, following the adaptation of dorsoventrally compressed (DVC) swimming as a primary anti-predator defense mechanism, the dynamic mimicry of flatfish emerged secondarily as an exaptation. By constructing Octopod phylogenetic relationships through genome sequencing and trait distribution patterns, Huffard et al. (2010) deduced that the related behavioural and morphological traits behind mimicry evolved concurrently. As such, Cephalopod mimicry is inherent, rather than learned. Further support was provided on this as a hand-reared octopus produced a flatfish mimic without ever having seen one (Huffard et al., 2010).

Habitat was regarded as a promoting factor of dynamic mimicry across the literature. Octopods that use crypsis and inconspicuous mimicry typically reside in areas where they can seek shelter (Hanlon et al., 1999). In contrast, the sand plains that are home to the mimic octopus offer little landscape diversity and so, conspicuously mimicking others provides an alternate means of protection whilst foraging (Hanlon et al., 2009).

Some skepticism remains over whether the deception these octopuses employ is intentional (Maran, 2017). Predetermined outcome and recipient-interpretation of deceit has long been viewed a feature unique to primates (Gómez-Moreno, 2014). Recognition has been made however, that the intentional and situationally dependent choice of model indicates the same level of understanding within the mimic octopus (Norman et al., 2001). This finding shifts the understanding of zoosemiotics, animal communication using signs and signals, and highlights how much remains to be explored around Cephalopod cognition (Gómez-Moreno, 2014; Maran, 2017). Begging the question, how much insight does dynamic mimicry, and the intent behind its use, provide on the intelligence, awareness, and overall sentiency of these invertebrates (Gómez-Moreno, 2019)?

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