Learning and Contest Behaviour in Hermit Crabs

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Aims

- To investigate whether hermit crabs are capable of associative learning.
- Determine whether individuals' learning can affect their contest behaviour and assessment strategy using classical conditioning.

Introduction:

Hermit crabs are a superfamily of decapod crustaceans found in rock pools and shores along the British coast. They carry a scavenged gastropod shell to protect their soft abdomen.

Hermit crabs compete in fights of shell rapping in which an attacking crab repeatedly brings its shell into contact with a defending crab's shell in a series of bouts. If the attacker is successful, the contest will result in a shell exchange, with the attacker removing the defender from its shell and claiming it for itself.

Figure 1. Hermit crab in a scavenged gastropod shell

Methods: Preparation and Conditioning Period

Before staged contests, attacking hermit crabs were conditioned by being exposed to both high and low quality shells with a colour associated with them.

Shells were prepared by being painted either white or black. A layer of sand was glued to the inside of shells to make them poor quality, whereas a glue layer only was set inside high quality shells.

Two groups of crabs were trained under different conditions. One group with a constant association of shell quality and colour (Group Consistent) and crabs with random pairings of colour and quality (Group Inconsistent). The subjects were exposed to these shells for 24 hours.

Figure 2. Hermit crab subjects collected by rock pooling on Cullercoats coast.

Methods: Staged contests

Conditioned hermit crabs were then paired for a contest against an opponent with a shell colour the subject had been previously exposed to (Figure 3). It could then be observed whether the conditioning period had affected the crabs' behaviour during contests through the learned association between shell quality and colour.

Table 1. Summary of the different conditions of hermit crab groups during the conditioning period and staged contests. (Con.= Consistent, Incon.= Inconsistent)

Group	Con.	Con.	Con.	Con.	Incon.	Incon.
Colour shells associated with high quality during conditioning	Black	Black	White	White	Mixed	Mixed
Shell colour of opponent during contest	Black	White	Black	White	Black	White
Quality associated with opponent's shell colour	High	Low	Low	High	No association	No association

Predictions

- If hermit crabs are capable of learning the association between the colour and quality of a shell through conditioning, it would be expected that their motivation during a fight would change accordingly based on its opponent's shell colour.
- Against an opponent with a shell colour the subject had associated with high quality, the subject would be expected to show more motivation to seize its opponent's shell (and less motivation when the association is with low quality).
- Motivation could be shown by more attempts to engage with the opponent or by more fights occurring and/or shell changes by crabs with the high quality association.

Figure 3. Staged contests between the conditioned hermit crabs and their opponents with a painted shell

Results

- There was no significant difference in the number of fights or shell changes between the groups of crabs with high, low or no quality associated with their opponent's shell colour.
- There were more attempts to engage in a fight from crabs whose opponent's shell colour was associated with high quality (mean=8.0) than crabs with the low quality association (mean=5.5) or no association (mean=4.9) (Figure 4). However, this result was not significant.
- There was a significant relationship between the attempts to engage with fight occurrence, showing more attempts leads to an increased probability of a fight (Figure 5).

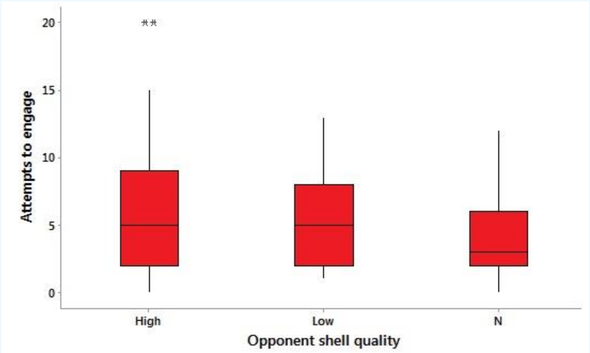

Figure 4. The number of attempts to engage in a fight with the opponent sorted by the association with the opponent's shell colour (N = no association – Group Inconsistent).

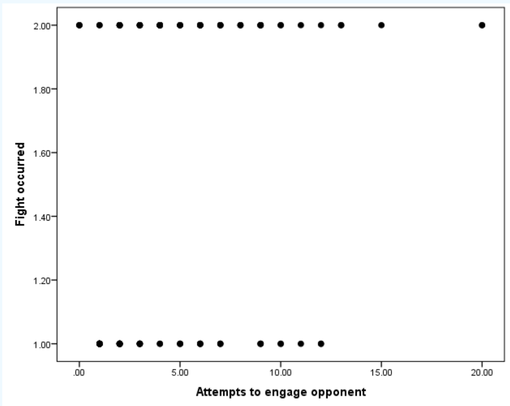

Figure 5. The number of attempts to engage with the opponent against fight occurrence, 1.00 being no fight occurring to 2.00 where a fight occurred.

Conclusions

- No significant differences in contest behaviour between groups with high, low or no quality associated with their opponent's shell colour suggests hermit crabs may be incapable of learning the association between the colour and quality of a shell.
- To investigate further, more shells per crab during conditioning may be necessary or a longer exposure time to learn the association.