Quantification of predator response in groups of fish

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Introduction

To understand brain evolution, we need to be able to assess the fitness costs and benefits associated with certain features of the brain. One major component of fitness is survival, which often requires an appropriate response to predators. By studying this predator response in detail we hope to understand in what aspects individuals differ, and to what extent these differences can be attributed to brain morphology.

Escape is the most obvious response to the presence of a predator. Some species, however, perform predator inspections, which is often classified as risk assessment. Here we investigate predator inspection behaviour in the Trinidadian guppy (Poecilia reticulata) towards a model predator, using a complementary approach of video tracking and manual behaviour classification. We used guppies that were artificially selected for large and small relative brain size, differing by 11% after four generations. Because guppies usually occur solitarily and in small groups, we subjected them to the predator model as singletons, pairs and shoals of four.

Methods

We applied continuous top-view recording during the 20 min trials and analysed these videos in two ways. First, by using computer vision software (Ctrax) to track the exact 2D locations of the fish. Second, by manually scoring classic predator inspection behaviour using JWatcher. The created data allows us to exactly quantify the predator response in each trial, e.g. the exact distance to the predator, the speed and direction. The same data can also be used to describe social behaviour, such as the distance between individuals, simultaneous inspections and coordination of movement. Given the nature of the data, for each of these parameters we know both the exact time and location. We can, for example, examine the average speed for each location in the tank. Using time stamps, the computer vision data can further be directly coupled to the manual observations so the location relative to the predator where behaviours were performed can be visualized.

Results and conclusion

Using these techniques we can give the most detailed description of predator inspection behaviour yet, illustrating the power of the complementary use of video tracking. We use this understanding to elucidate the effects of group size, sex and relative brain size on the inspection behaviour of guppies.

Ethical statement

Experiments were performed in accordance with Swedish regulations and approved by the appropriate authority (Stockholm's Norra Forsöksdjursnämnd).

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