Evolution
in Action

Warning Signals Workshop

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The goal of the game is to demonstrate how warning colours and camouflage function in the wild. The game starts with the short introduction to animal coloration and how it can be studied. The goal of the introduction is to briefly describe how different types of protective colouration strategies function and how predators that use vision in foraging influence the evolution of prey coloration. Alternatively, the game can be started immediately by telling participants they will participate in an experiment where we test how predators choose different type of prey items and then go through the theory afterwards with the help of powerpoint slides, highlighting what actually happened. It would be good if the participants are naïve in terms of warning signal function before the game. However, for younger children giving the background before the game does not seem to change their behavior. Participants should be 5 years or older. There is no upper age limit.

Equipment needed for the game:

For a 10 person group

- 3-4 Black plastic bags to form a multidimensional background.
- 60 black plastic containers (for example camera film boxes), half marked with yellow spots
- 30 sweets / small fruits
- 3 bags / buckets marked 1-3

Additional equipment for looking at results:

- 6 clear plastic tubes large enough to hold the prey containers

To set up the game:

Prey items are black plastic containers (camera film boxes). Aposematic prey are marked with the yellow spots and camouflaged prey are plain black boxes. Inside the camouflaged (black) boxes put a candy or piece of fruit as camouflaged prey are often profitable and palatable prey. Aposematic prey boxes are empty as warning colours signal the unprofitability (here no food reward) prey. Prey boxes are deposited on the background with equal numbers of both prey types. The maximum number of each prey type should be the number of participants x 3. For example, if there are 10 participants there should be 30 prey items of each colour type.

During the game each participant can go to forage on the prey patch 3 times on 3 different rounds. On each round he / she can choose one prey item, open it, 'eat' the inside of the prey and then returns the empty box for the researchers. Empty prey boxes are collected on separate bags/buckets in each round which is important when the results of the game are analysed (explained below). We normally ask participants to open the boxes secretively and not to tell the other participants which kind of prey they choose and what it contained.

At the end of the three rounds compare the number of camouflaged (black) and aposematic (yellow spots) that were eaten in each round. How did the numbers change? Which prey type had more survivors still on the background at the end?

For younger children we advise also handing out candies to those who have failed to receive any rewarded 'prey' during the game.

Hypothesis / expectations to be tested:
In the first round participants are likely to attack on the aposematic prey (black boxes with yellow marks) as they are more conspicuous and easier to detect. However, during the second and third round participants normally learn that it is better to choose black prey boxes since they are more rewarding than aposematic empty boxes. That is also what happens in nature where naïve bird chicks that leave their nest tend to attack more on the conspicuous aposematic prey until they learn to avoid them.

Statistics:
Participants can participate for the analyzing the results. We have used clear plastic tubes (Fig), where you can fit 10 / 20 film boxes. Thus, for one game you will need 6 tubes: 1 / prey type / round. For example, 6 of the participants will divide boxes from each round into different tubes and then compare in real life how the frequencies of the different prey types change in each round. Normally the trend is something like this.

Evolution:
In the end of the game participants can calculate the number of each prey type that 'survived' it is then possible to e.g. calculate the frequencies of the different prey types in the next generation if all the remaining individuals would produce 2 offspring who would inherit the appearance of their parent.

Modifications of the game:

Social learning

Humans use lots of social information and social learning. It is possible to demonstrate this by dividing participants into 2 groups. In the first group participants are not to allowed to tell other ones what they've found out during the game and they are told to choose and open the prey secretively (there can be e.g. some kind of barrier surrounding the prey batch). In the social information group, participants can be allowed to see what the other ones have found and what's inside the prey, or participants are allowed to advice each other. In practice this group usually shows faster learning to predate black camouflaged prey boxes.

Cheating

Again participants can be divided in two groups for two separate prey patches. In the first patch the set up is normal so aposematic prey boxes are empty and camouflaged prey boxes are filled with candies/snacks. In the cheater's patch half of the aposematic prey boxes are filled with candies mimicking the situation of Batesian mimicry in the wild where palatable prey individuals (e.g. hoverflies) mimic the color pattern and appearance of defended prey (e.g. wasp). In this case you should see slower learning rates as the feedback from the aposematic prey is confusing.