When Warbler's Attack

Behavior Plasticity within Reed Warblers as the Population of Avian Parasites Decline

Paper Citation

Thorogood, Rose, and Nicholas Davies. "Reed Warbler Hosts Fine-Tune Their Defenses to Track Three Decades of Cuckoo Decline." *Evolution* 67.12 (2013): 3545-555.*Wiley Online Library*. John Wiley & Sons, Inc, 8 Aug. 2013. Web. 5 Mar. 2014. http://onlinelibrary.wiley.com/doi/10.1111/evo.12213/full

Summary of the Paper

The paper we chose for our independent project follows the populations of cuckoos and reed warblers in England. The study was specifically conducted in Wicken Fen, where the population of cuckoos has declined significantly in the past three decades. Cuckoos lay their eggs in the nests of reed warblers. The warblers have defense mechanisms against these parasites by mobbing adult cuckoos that approach their nests and rejecting non-mimetic cuckoo eggs. These defenses have a high cost for the warblers. The study presented in the paper found that as the risk for local parasitism declined, the proportion of warblers that showed these defense mechanisms also declined. The experiment was performed by assessing the responses of warblers to cuckoo mounts and model eggs. Although it is unsure why the population of cuckoos in this particular location has declined, there are no other changes in the environment to explain the change in behavior by the reed warblers. Analysis favored phenotypic flexibility as the most likely cause of the decline in host defenses.

3 Concepts from class

1) Phenotypic plasticity (and behavioral plasticity): Phenotypic plasticity is the behavioral modification in an organism in response to different environments. Phenotypic plasticity could is demonstrated through the change in organism's behaviors, not through the change in genetic composition. This concept shows that organism's are capable of modifying their behaviors when the environmental stimuli change and not having to be influenced by the change in genotype. There are two types of phenotypic plasticity: reversible and irreversible. Reversible plasticity is the change in the organism could be reversed back within its life time. This modification could be in behavior, physiology, or in morphology. An example is the morphological plasticity in Peacock Pansy's camouflage during wet and dry season; there is a clear distinction between the two variations of camouflage and the butterflies were able to switch back-and-forth between seasons. In irreversible plasticity, the features expressed as a change cannot be reversed even when the environmental stimulus disappears. For instance, when plants are stimulated by the environmental factors to flower, they cannot reverse that flowering action.

2) Red Queen Theory: The Red Queen Theory explains that between two interacting species, there are constant changes in two species that respond to the interaction with each other. In the case of a prey and a predator, they will try to evolve adaptations to outcompete each other; this is also known as the evolutionary arms race. This arms race could also be between the constantly changing environment and the organism. For instance, in Darwin's finches, we saw that the climate (amount of rainfall per year) could influence the beak size of the finches. The finches attempted to evolve in a way that would enable them to survive (obtain food in this case) under the climate's selective pressure. During two species' interactions, the two populations co-evolve with each other and eventually show a change in the genetic composition in individuals, where certain variations are favored over others. In conclusion, changes in one species triggers change in the other.

3) Behavioral plasticity vs. genetic change: The paper hypothesizes that because the defenses are costly, selection favors behavioral plasticity. When nesting pairs of warblers mob adult cuckoos that approach their nests the chances of parasitism is reduced but this is a risky attack because cuckoos resemble hawks (Thorogood and Davies 2013). Egg rejection reduces the warbler's reproductive investment in the cuckoo young, however it runs the risk of a warbler rejecting its own egg because cuckoo eggs mimic that of a reed warbler. These flexible defenses means that host populations are tracking the long-term changes in parasitism (Thorogood and Davies 2013). Behavioral plasticity is favored over genetic changes in this situation because of the fluctuation in the population of cuckoo birds, hence the need to increase and decrease the attacking behaviors over time. A genetic change in the situation would not be favored because the risk of parasitism is not constant. For example, if the warblers have attacking behaviors even in the absence of cuckoo birds, it would be a costly adaptation for them to expend extra energy that they could invest in somewhere else.

<u>Linking theory and paper</u>

The Red Queen hypothesis indicates an evolutionary arms race between organisms and the environment. In the paper, it is presented as a race between the host and parasite populations. For instance, at times when the cuckoo population increases, the warblers would try to prevent parasitism by modifying their behaviors (increase defensive behaviors). Also, the warblers' eggs would evolve to have a more specialized pattern so that mimicry is harder for the cuckoos to achieve (Thorogood and Davies 2013). The environment is always changing and thus requires behavioral adaptation from the inhabitants in particular habitats. In the paper, as the environment around the warblers changed (the amount of parasitism declined over the past three decades) their behavior also changed (their response to mounted cuckoos and model eggs)—but not permanently. Theory says that selection will favor phenotypic (behavioral) plasticity when defenses are costly. Also, plasticity has an advantage under changing environmental conditions because it allows flexibility in behavior unlike a

change in genes that is permanent. In reed warblers' case, they are able to decrease the defensive behaviors against the cuckoos as the parasitism subsides. The evolution of plasticity in reed warbler defenses can be explained by the fluctuation in parasitism risk.

Movie!

In our motion pictures, we will start off by demonstrating the two defense mechanisms of the reed warblers have against the cuckoo birds, which are the mobbing actions and egg rejection. We would have two actors playing the Reed Warbler and the Common Cuckoo in the above scenario along with a narrator describing the situation. We will model behavior plasticity of the reed warbler by showing the decline in defense as the population of cuckoo's decline. Following that, we would then explain the concepts found in the paper that we have talked about in class. We would do this through live-action and narration. In the end of the video, we would extend the theme of behavioral plasticity and show that as the population of cuckoos decreases, the reed warblers would engage in defense mechanisms less frequently. For our video we will utilize the library's resources offered to us by the university.

Movie Script

Narrator - Mackenzie Dougherty; Bird watcher - Morgan Malone; Scientist – Victoria Cheng; Male Warbler – Mackenzie Dougherty; Cuckoo – Alex Johnson

Scene 1

(Displaying daily interactions between individuals of cuckoos and reed warblers)
Narrator: Here in Cambridgeshire, UK we see a Common Cuckoo bird approaching the nest of a reed warbler. Reed warblers nest on the reed fridges of waterways. When the pair of reed warblers are away from the nest foraging the nest is susceptible to the invasion of cuckoo birds. These parasitic birds remove a warble egg and replace with their own, which mimics the warble egg pattern.
Cuckoo: Laying its egg in the nest that already has three warbler eggs and and pushed one of the three out. Flies away. *Camera will zoom in to show similar egg patterns*
Bird watcher: *puts down binoculars and walks to face the camera* Narrates: However, the reed warblers have evolved defense mechanisms against the parasitic cuckoos and their eggs.
Warblers: Flying back to the nest, stare at the eggs for a while and push out the foreign egg correctly. [Bird watcher: Oh look! There is the cuckoo bird that laid the egg earlier and it is flying around near by. Watch out!] At this time, the warblers noticed cuckoo bird flying around and attacked (mobbed) them physically as they got close to each other.

[Concept explanation: Red Queen Hypothesis] *Background switches from the research site to a white board*
Bird watcher would explain the Red Queen hypothesis and co-evolution.
1. Evolution of egg pattern of cuckoo eggs
2. The behaviors of young cuckoos, ex: pushing eggs and "fighting" for food
3. Evolution of egg pattern of warbler eggs
4. The frequent attacking behaviors of warblers plus egg-pushing. Be sure to mention how the attacking behaviors decrease when the cuckoo population decreases.
Concluding statement: This theory is shown through the observations in a recent study on how the warblers attacking behaviors changed (declined) when there was fewer cuckoos present in the study area (Cambridgeshire, UK).

Scene 2

Narrator: We are back in Cambridgeshire, where we see a significant decline in the cuckoo population during the last three decades. A recent study by Rose Thorogood and Nicholas B. Davies of the Department of Zoology at the University of Cambridge. The study found that as the risk for local parasitism declined, the proportion of warblers that showed these defense

mechanisms also declined. This shows the ability of warbles to modify their behaviors based on the environmental changes. This is also known as behavioral plasticity.

Hold signs that show year of the experiment 1985
Portray the warblers' mobbing behaviors when many cuckoo birds were present in the area.

*Show the cuckoos (made out of cardboard) being taken out of the scene = decline in population.

2012
Bird watcher: Notice how the population of cuckoo bird is changing due to various factors… Now when a cuckoo bird approaches the nest, the reed warbler no longer show defense mechanisms. Phenotypic plasticity is the most likely cause of the decline in host defenses.

[Concept explanation: What is phenotypic plasticity & plasticity versus genetic changes]
Bird watcher:
1. Define phenotypic plasticity.
2. Elaborate/distinguish on behavioral plasticity and egg pattern changes.
3. Describe situations in which phenotypic plasticity is favored over genetic changes that stay permanently throughout one's life. Ex: defense mechanisms are costly in terms of energy; rejecting eggs is decreasing one's reproductive fitness, etc.
4. If the population of cuckoos increases in the future, we will most likely see the reed warblers showing defense mechanisms more frequently.

End scene: show pond.

FEEDBACK FROM INSTRUCTOR:

Hi Morgan & Victoria,

You did an excellent job on the **movie**. You included almost all the elements I asked for and satisfied most criteria indicated in the rubric. You earned 74 out of 75 points.

You made a really fun movie, the idea of acting it out was very creative and worked very well for the study. Good job!

A few things I noted:
You mentioned the red queen theory but didn't explain what it means (aside from giving an example), I'm not sure if someone who is not familiar with the term would have understood the concept. Unfortunately, there were extensive issues with the quality of the movie which made some of the things you showed very hard to see/read. That was a real shame! Maybe next time using the camera on your iphone/smartphone might be an alternative solution.

Overall very well done!

Here's what your peers said about your movie:

- *Amusing acting*
- *Funny, loved the dudes as birds*
- *Acting was very funny – looked like a lot of work*
- *Creative use of actors*
- *Creative and fun with a good explanation*
- *Creative and theatrical*
- *Bizarre and funny*
- *Oscar-winning acting*
- *I liked the "birds", the lecture style video was good too*

Overall, you did a fine job on the **final script**. You included most of the elements I asked for and satisfied most of the criteria indicated in the rubric. You earned 52 out of 75 points.

Here are some comments:

- Your section on **theory concepts** is actually the section on linking theory and paper, nowhere do you describe the theory concepts independently. Your section "linking theory and paper"

is redundant as you mostly repeat what you have already said in the previous section. Since there is almost nothing I can grade you on, you lost most points in this section. (-22 pts) **I'm offering you the opportunity to resubmit just this section** as I assume my directions weren't clear (although I clearly stated this in the rubric, see section theory concepts). Your **deadline for resubmission of this section is Monday, Apr 28th** before the final exam. *(NOTE: This version of the final script is the team's resubmission.)*

- Your movie description does not include everything you did, it seems like this is what you wrote in your draft also indicating what equipment you were planning on using. You did include your movie script which has all this information, I just wish you would have summarized it or altered the draft-movie description. (-1 pt)

Best,

D. Magdalena Sorger