Title:

The Butterflies, *Bicyclus anynana*, Sexual Selection

Citation:

Westerman, Erica L. "MATE PREFERENCE FOR A PHENOTYPICALLY PLASTIC TRAIT IS LEARNED, AND MAY FACILITATE PREFERENCE-PHENOTYPE MATCHING." - *Westerman*. N.p., 15 Feb. 2014. Web. 02 Mar. 2014.

The Paper:

In this experiment, a group of researchers want to see in the species, *Bicyclus anynana*, if there is mate choice, and if so, what would be the preference. In the butterflies, it is not necessarily the polyphonic traits that would be focused on in mate preference. The researchers developed two hypotheses. The first hypothesis is the following: Fixed, genetically determined, mate preferences vary from the adults to the offspring. The fittest phenotype from the parents may be absent in the offspring. Then they will compare the above hypothesis to the following second hypothesis: Polyphenisms mate preferences are either based on traits or genetics. By doing this will determine whether or not there is a mate choice, and where the preference would be if there is any. The two different hypotheses are then tested. In the experiment, the butterfly *Bicyclus anynana* that is female-limited seasonal polyphenism in a sexually dimorphic trait is defined. Moreover, dorsal hindwing spot numbers (DHSN) are determined. Then, mate preference is tested by observing whether male and female have an inclination for the existing trait. Since the young and inexperienced butterflies, both male and female, showed no mating preference for DHSN, while the adult males but not females recognized DHSN, they concluded that mating preference in the butterfly *Bicyclus anynana* is learned. Furthermore, the learned mate preference plasticity may be sexually dimorphic because males noticed DHSN when females did not.

Explanation of the three concepts:
The three concepts we chose are the following:

- Maladaptation vs. Adaptation
- Phenotypic Plasticity
- Sexual Dimorphism

First off, Maladaptation vs. adaptation illustrates a trait of a species that may be more harmful or helpful. A maladaptation is a trait that is useless or harmful. It may occur within the lifetime of one individual or group. An adaptation is a trait that is maintained and evolved by means of natural selection. Adaptation alters the fitness and survival of a species. When the species face environmental challenges, over time, they develop and alter their traits in response to their circumstances. Second, phenotypic plasticity is what provides species with the capability to adapt to their surroundings by changing its phenotype in response to the way the environment changes around them. There are two types of plasticity, reversible and irreversible. Reversible plasticity occurs in a species lifetime when the environment changes, while irreversible plasticity tends to not change back in one's lifetime. Lastly, sexual dimorphism exists when males and

females of the same species express obvious differences. These differences could vary between phenotypic and behavioral differences.

The link between the two:

In the experiment, the three topics discussed above: Maladaptation vs. Adaptation, Phenotypic Plasticity, and Sexual Dimorphism are portrayed. You first see phenotypic plasticity in the article as the butterflies all depict different numbers of spots on their hind wings. The researchers abbreviate this as DHSN (dorsal hindwing spot numbers). The species of butterflies that they are studying is *Bicyclus anynana.* These butterflies all have various numbers of spots on their wings and some may be darker than others. This is phenotypic plasticity in the sense that these spots develop on their wings based on the way that the environment is changing around them. In the environment that this species lives in there are two seasons. One season being wet and one season dry. In the laboratory these two types of weather alone could change the number of spots that are developed on the wings. This trait is due to the way that the light reflects upon the butterflies. Especially in the front part of the dorsal wings the scales/spots are reflective. This brings me to my next point, maladaptation vs. adaptation. *Bicyclus anynana's* phenotypes, the DHSN, vary according to their changing environment. The parents' phenotypes often are absent in the offspring. Therefore, fixed and genetically determined mate preferences for the species are maladaptive because offsprings would have to search for mates with a phenotype that is different from their parents. One way *Bicyclus anynana* can adapt to this is learning mate preference and mating with a butterfly of a different number of spots. Finally, sexual dimorphism comes into play when the researchers conclude that males are the ones that notice the DHSN while the females do not. Even though both sexes choose their mate dependent on phenotypic differences, the males are picky when it comes to the spot number, while the female's main focus is a certain scent that the males give off. In the species *Bicyclus anynana* sexual dimorphism is based upon phenotypic differences and based upon those differences, in turn, allow for behavioral differences that are learned.

In the movie:

In our movie we start out by explaining phenotypic plasticity. We do this by showing a male and female with the same number of spots mate in both a wet and dry season. Showing that the number of spots on the offspring differ greatly due to what season it was born in show that the environment affects the phenotype of the butterfly portraying phenotypic plasticity. Next, we show sexual dimorphism. We portray this by showing that when males are picking a mate their choice is dependent on the number of spots, and in any situation when given the choice of two females, the male would always pick the same butterfly with the same number of spots. Furthermore, when we show the same experiment with a female choosing a male mate, we notice that the female is not interested in the number of spots on the males. The females are not choosy, and when we give the females a choice of two males in any situation, each time the females choose a different mate regardless of their spot numbers. Finally, we show maladaptation vs. adaptation. In this concept we show a male butterfly that mates with a female that has two spots and they produce a female offspring with sixteen spots. In these butterflies the phenotypes are not normally passed down to the offspring. Therefore, now the male can't mate with a two-spotted female because they produced a sixteen-spotted female. The genetically determined mate

preference is maladaptive and now that the male will have to choose a female with a different number of spot we show that the male must learn mate preference which is an adaptive trait.

**FEEDBACK FFROM INSTRUCTOR:**

Hi [redacted] & [redacted],

You did a great job on the **movie**. You included most of the elements I asked for and satisfied most of the criteria indicated in the rubric. You earned 72 out of 75 points.

I really liked your creative take on this, using drawings. Even though you used a low-tech approach, it worked well! Good job!

A few things I noted:
Your movie would have benefited from a little more explanation. The voiceovers you had were very good but there were places where more explanation, either in the form of voiceovers or short text would have been beneficial. You didn't provide any background information on the study system. You mentioned theory concepts but didn't explain what they mean (aside from giving the example). I wonder if someone not familiar with the term phenotypic plasticity would have gathered what the theory behind the concept states. Also, you focused on results and didn't explain the methods.

But overall it was well done!

Here's what your peers said about your movie:

- *Stop-motion – great way to explain the study*
- *GREAT illustrations*
- *Killer background music, fun ways of doing animation*
- *The description of concepts was great*
- *Unique technique*
- *VERY CREATIVE!*
- *Really well-done narration*
- *Information presented clearly*

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 66 out of 75 points.

Here are some comments:

- Your title is not representative of the project, it reads like keywords, why didn't you use your movie title here? (-1 pt)
- You jump around between tenses in your summary which makes it hard to follow (should be all past tense). There are some phrases that are a bit confusing and places where there are words missing. For instance: *Polyphenisms mate preferences are…* Polyphenism is a noun, yet you are using it like an adjective on several occasions. Overall, your summary suffers from some grammatical inconsistencies and would have benefitted from more structure; also it was not very concise. (-2 pts)
- The descriptions of your theory concepts are short and not very clear. I had asked for 100-200 words PER theory concept, your whole section consists of 166 words. You also used some very confusing wording, for instance: *Maladaptation vs. adaptation illustrates a trait of a species that may be more harmful or helpful.* This sentence makes little sense since you should be describing

one term versus the other. OR *Adaptation alters the fitness and survival of a species.* When you say "alters" that is very ambiguous. In class we defined an adaptive trait as a trait that "increases the fitness of possessor (compared to some alternative traits)". (-4 pts)

- Your description of sexual dimorphism is incorrect. Sexual dimorphism means that males and females look differently (=their morphology differs). Your description seems to be the description of male/female choice. Please, see me before the final exam if this is not clear. (-2 pts)

Best,
D. Magdalena Sorger