

Dissecting a scientific paper about evolutionary biology II

Now that you've had a guided tour of one scientific paper, it's time to attack another one with a little less assistance. The sections below raise some important questions that you'll need to answer in order to understand this paper about sexual selection.

Article

Head, M. L., Hunt, J., Jennions, M. D., and Brooks, R. (2005). The indirect benefits of mating with attractive males outweigh the direct costs. *PLoS Biology*. 3: e33.
<http://www.plosbiology.org/article/metrics/info%3Adoi%2F10.1371%2Fjournal.pbio.0030033;jsessionid=FA17EA1487D67E3137C3D3B328E75862>

Title

The title usually summarizes the main point of the paper. Based on the title, what is the main point of this article? Does the title suggest that mating with an attractive male is mainly good or mainly bad? What do you imagine are some of the benefits and costs of mating with an attractive male?

Authors

Knowing something about the authors can illuminate the topic of the paper. Where does Robert Brooks work, and what does he usually research?

Abstract

Spend some time on the abstract. Read the abstract to get a thumbnail sketch of where the authors are going. Try translating the abstract line by line into plain English. This might mean you have to look up some vocabulary words. Don't worry if you get hung up on a sentence. Just try to understand each one as best you can. We've provided some questions below to help you.

- “The fitness consequences of mate choice are a source of ongoing debate in evolutionary biology.” Whose fitness do you think the authors are discussing, the chooser or the chosen?
- “Recent theory predicts that indirect benefits of female choice due to offspring inheriting superior genes are likely to be negated when there are direct costs associated with choice, including any costs of mating with attractive males.” This sentence discusses two components of female fitness that are affected by mate choice. What are they? What sorts of things do you think the authors mean by the “direct costs associated with choice?”
- “To estimate the fitness consequences of mating with males of varying attractiveness, we housed female house crickets, *Acheta domesticus*, with either attractive or unattractive males and measured a variety of direct and indirect fitness components.” What sorts of things do you think the authors mean by “indirect fitness components?” What did the researchers assume would happen if they “housed” male and female crickets together?
- “These fitness components were combined to give relative estimates of the number of grandchildren produced and the intrinsic rate of increase (relative net fitness).” What

do you think the authors might mean by “intrinsic rate of increase”? Did they actually measure intrinsic rate of increase and number of grandchildren produced?

- “We found that females mated to attractive males incur a substantial survival cost. However, these costs are cancelled out and may be outweighed by the benefits of having offspring with elevated fitness.” What does this say about the balance between the direct costs and indirect benefits associated with choosing an attractive mate?
- “This benefit is due predominantly, but not exclusively, to the effect of an increase in sons’ attractiveness.” To what benefit are the authors’ referring?
- “Our results suggest that the direct costs that females experience when mating with attractive males can be outweighed by indirect benefits.” What direct cost to females was reported in the abstract? What indirect benefits were reported in the abstract?
- “They also reveal the value of estimating the net fitness consequences of a mating strategy by including measures of offspring quality in estimates of fitness.” To what “measure of offspring quality” do you think the authors are referring? Do you think other investigations of this sort usually include this measure?

Introduction

The introduction provides background information and describes the importance of the paper to the field of biology. Try to restate the main point of each paragraph in plain English, but if a paragraph is just impossible to understand, press on ahead! Don’t let one confusing paragraph stop you. You may be able to figure out what it means later or may not end up needing it at all.

The first paragraph of this introduction is tricky. The authors introduce two big ideas that you might not be familiar with. First big idea is direct and indirect selection. The abstract discussed direct and indirect components of fitness. Hopefully, you gathered that direct components of fitness are survival/reproductive benefits and costs experienced by the individual of interest and that indirect components of fitness are survival/reproductive benefits and costs experienced by the individual’s offspring (or relatives). Direct selection is just selection acting to increase direct components of fitness (e.g., favoring traits in the mother that allow her to produce more eggs), and indirect selection is selection acting to increase indirect components of fitness (e.g., favoring traits in the mother that allow her to produce fecund offspring). The second big idea is that of theoretical models of evolution. In this context, these are mathematical models that simulate when a trait like “preferring to mate with louder-calling males” will evolve (and be maintained) and when it will be lost. Obviously, in the real world, choosy traits (like preferring louder-calling males) *have* evolved. When scientists’ models of this process match their real-world observations, they have more confidence that they really understand the process.

Read through the first three paragraphs, and try to answer these questions:

- What is the big question that the authors want to answer with this study?
- Have other studies tried to address this question?
- What do the authors see as the main problem with these other studies?

Read the fourth and fifth paragraphs, and try to answer these questions:

- In your own words, what is the difference between rate-sensitive estimates of fitness and rate-insensitive ones?

- What experiment did the authors perform to try to assess whether an attractive mate is worth the cost? Note that the Materials and Methods section appears at the end of this paper. If you have any questions about the experiment, just skip ahead and review that section.

References

References are extensively cited in the introduction and can be a handy way to learn about an area of research. Is there anything in the introduction that you don't understand and that has a reference associated with it? Reference 6 introduces the “sexy son hypothesis” and would be useful background reading for this paper.

Results

In the Results section of a scientific paper, the authors present their analysis of the data. In this article, the authors rely on tables and a figure to present most of the results, but the text highlights some of the most important findings. Read this section through twice. The first time, just try to get the overall message. The second time, compare the text to the tables and figures and try to understand which results the authors are discussing and why they discuss some results presented in the tables but not others. Answer these questions:

- What do rate-sensitive and rate-insensitive estimates of fitness indicate about the fitness consequences of choosing an attractive mate?
- What aspects or consequences of mating with an attractive male matter most in increasing a female's fitness?
- What aspects or consequences of mating with an attractive male matter most in decreasing a female's fitness?
- After reading the introduction and the results, do you have any questions or confusions about the experimental set-up? If so, skip ahead and read the Materials and Methods section.

Tables

In this article, tables are particularly important and convey the most important results. Compare Tables 1 and 2 to the text of the results section. Answer these questions:

- Which table addresses rate-sensitive estimates of fitness and which addresses rate-insensitive estimates of fitness?
- According to Table 1, does mating with an attractive or unattractive male significantly affect any aspects of fitness? If so, which ones and how?
- In Table 2, what are r_{est} , r_a , and r_u ?
- Table 2 presents the results of a modeling analysis. Explain this analysis in general terms. It may help to review the *Statistical analysis* section of the Materials and Methods section.
- The Results section says, “Treatment differences in other fitness components, although individually not significant, still influenced our estimates of the overall fitness consequences of mating with attractive males. In particular the combined

effect of sons' attractiveness and daughters' fecundity had a significant effect on our model." What data from Table 2 support this interpretation?

Figures

Figures present key information graphically to help readers visualize patterns in the data. Study Figure 1 and read the caption. What aspect of the figure conveys the idea that mating with attractive males is detrimental to females?

Discussion

In the discussion, the authors explain their interpretation of their data and how it reflects on their hypothesis or informs their research question. They also compare and contrast their findings with those of other researchers, discuss implications of the work, and highlight future directions for research. Read the discussion, and answer the following questions:

- What are the most important findings of this study?
- Why are these finding important to the study of evolution in general (i.e., outside the context of this particular study)?
- The study's findings are consistent with the idea that females differentially allocate resources to the offspring of attractive and unattractive males. What are two possible evolutionary explanations for this differential allocation?
- In the discussion, the authors mention two features of their experimental design that they think make their results more informative about the underlying evolutionary phenomena. Describe these features.
- List some aspects of the experimental design that do not match the situation in the natural world. How might each of these factors affect the study's outcome?

Materials and Methods

This section provides details on sample, analytical tools, study design, equipment, potential sources of error, and methods of statistical analysis. This section is necessary for other experts to evaluate the validity of a particular study, but since this section appears at the end of this paper, you've probably already gleaned a lot of information about the researchers' experiment.

Read the Materials and Methods section, and answer the following questions:

- What questions about the experimental set-up arose while reading the rest of the paper?
- How was male "attractiveness" assessed?
- How was the survival and reproduction of sons and daughters assessed?

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Reference section

These are the published papers that the authors directly cite in their study. In the course of reading this article, did you need to look up any other papers? If so, which ones and why?