COMMENTARIES

The Possible Impact of Observer Bias on Some Avian Research

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Observer-expectancy bias is systematic error produced in observational data by an observer's expectations or wishes. The error is strongly associated with observations made on variables that require subjective assessment (Rosenthal 1969). Such assessments are common in some avian research, and an expectancy is usually inherent in hypothesis testing, an important tool of predictive science (Romesburg 1981).

Researchers in some disciplines that are sensitive to the problem commonly employ techniques such as blind experiments, film records, and interobserver reliability checks to reduce or monitor the bias. Ornithologists, unfortunately, usually do not employ such techniques (Balph and Balph 1983). We probed the impact on avian research of this form of bias in two ways. First, we reviewed the results of some experiments designed to measure the bias in recording the activity of animals, and second, we applied the error found in these studies to some recent investigations to demonstrate how bias might affect the results.

Rosenthal (1969: 207) reviewed nine experiments designed to measure the amount of observer-expectancy bias obtained when observers were recording the behavior of animals after being given an expectancy. All experiments showed significant bias in the direction of the expectancy, and the standard normal deviate averaged 2.9 and ranged from 5.38 to 1.5. We retested the hypothesis that the expectancy of observers did not influence the data they collected with what we considered a more appropriate technique of combining probabilities (Sokal and Rohlf 1969: 776). We rejected the hypothesis ($P = 2.2 \times 10^{-10}$), as did Rosenthal (1969). To the extent that these studies are representative of bias in avian observational data, we also reject the notion that observations on birds are free of expectancy bias.

Our second approach was to illustrate changes in the results of some avian studies if the results were adjusted for the observer-expectancy bias found in the studies reviewed by Rosenthal (1969). To do this, we judgmentally selected six papers from recent issues of *The Auk* that (1) applied statistical inference to (2) observational data on (3) a parameter that required some subjective assessment (e.g. distance estimated rather than measured) in (4) a test that had an implied or stated expectancy (Table 1). The six studies all reported results that were statistically significant in the direction of their expectancies. We made the reported P-values equalities by the conservative method of increasing their significance one standard value (e.g. $P < 0.05$ became $P = 0.01$). We then converted these P-values to standard normal deviates to match the procedures presented by Rosenthal (1969). We reduced these by 1.5, the smallest presumed bias given in the nine studies reported by Rosenthal (1969), to get an adjusted standard normal deviate. We computed a new P-value from these values that was adjusted for bias (Table 1: column 5).

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Table 1. A demonstration of what happens to the results of six published studies if the results are adjusted to account for the amount of observer-expectancy bias found to be present in nine observational studies on animals.

		Before adjusting for bias			After adjusting for bias	
Study	Test	Reported P-value	Adjusted P-value	Standard normal deviate (z)	Adjusted standard normal deviate ($z - 1.5$)	Adjusted P-value
1	Chi-square	<0.001	0.0001	3.72	2.22	0.013
2	*t*-test[a]	<0.05	0.01	2.58	1.08	0.28[b]
3	Chi-square	<0.005	0.001	3.09	1.59	0.056[b]
4	Chi-square	<0.005	0.001	3.09	1.59	0.056[b]
5	Sign test[a]	<0.0001	0.00001	4.42	2.92	0.004
6	G-test	<0.001	0.0001	3.72	2.22	0.013

[a] Two-tailed test.
[b] Studies that "lost" statistical significance at 0.05 level.

The result was that only three of the six avian studies retained their statistical significance at the $P \leq 0.05$ level.

There is no way to assess directly the impact of observer-expectancy bias on published papers. Nor is it possible to determine whether the error found in the nine investigations of bias was representative of avian observational data. Perhaps the best one can do is to assess qualitatively the degree to which observers in the studies of bias relied on subjective assessment in documenting the behavior they expected to observe and compare this with avian studies with which one is familiar. One added problem, however, is that the observers in the studies of expectancy bias had no personal interest in the results, something that often is not the case in avian research.

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Mass or Weight: What Is Measured and What Should Be Reported?

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The terms mass and weight often are used interchangeably in the avian literature despite the fact that they are very different properties. When workers "weigh" whole animals, animal parts, or animal products they are usually interested in obtaining a measure of the amount of matter in the object. This quantity is called "mass" and is measured in grams. There are several methods of determining mass, although many are inappropriate for use in the field either because they are destructive or require sophisticated equipment, or both. The simplest and least destructive method involves the use of a balance to measure the force applied to the mass by the Earth's gravitational field. This method relies on the principle that the force required to accelerate an object is proportional to its mass. The force of gravity on a mass is termed "weight" and is measured in Newtons (N). One Newton is the force required to accelerate a mass of 1 kg at the rate of 1 m/s^2. Acceleration due to gravity is 9.8 m/s^2 and thus, a bird with a mass of 1 kg exerts a downward force due to gravity, or weight, of 9.8 N. Although balances measure weight, they usually are rescaled so that mass in grams rather than force in Newtons can be read directly.

A potential problem with this method of determining mass is that gravitational force decreases with altitude. Over the maximum altitudinal range encountered on Earth (about 8,800 m), however, the error in the measurement of mass by this method (about 0.3%, J. Black pers. comm.) is much smaller than the precision of many balances currently in use and thus can be disregarded.

Biologists usually require measurements of mass and obtain these indirectly by the determination of weight. For consistency, and to avoid potential confusion (e.g. C. J. Pennycuick 1986, Proc. Intern. Conf. Comp. Physiol. in press), I suggest that the term mass be used in preference to weight, when this type of data is reported.

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Why Hummingbirds Hover: A Commmentary

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A model developed by Pyke (1981) suggested small hummingbirds should hover while larger species, such as many sunbirds and honeyeaters, should perch. The model predictions are based on the rate of net energy gain maximization from feeding. Energy costs for hovering increase with body size more rapidly than do costs for perching. Although it always costs more to hover, the net rate of energy gain can be higher for a small bird if it can forage more quickly by hovering than by perching. Perching is predicted

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