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PROCESS PAPER

Intraspecific Signaling as an Adaptive Force in the Evolution of Blue-Green Eggs in Robins: A Review of Recent Work

The familiar color "robin's egg blue" represented a mystery to me since I first considered it in a practical, evolutionary context. When so many birds protect their young by laying eggs that blend in with their surroundings—and when natural selection promotes traits contributing to offspring survival before nearly everything else—how could robins and other thrushes have evolved to lay brilliant blue eggs that seem to advertise their location to predators?

In order to rule out the obvious explanation—that blue eggshells, counterintuitively, provide good camouflage—I used the Web of Science database to seek out studies on the relationship between egg color and nest predation rates. I came across a number of studies in different species that had tested this by swapping out clutches of real or painted eggs of varying shades in the same nests. The general agreement was clear—not one of the studies found a lower predation rate for nests with bluer eggs.

After reading these findings, I tried to imagine every possible driving force for egg blueness based on other reading: distinguishing genuine robin eggs from those of nest parasites; protection from solar radiation; additional eggshell strength; or, least plausibly, a false warning of foul taste. Trying to find a consensus in the research for these hypotheses proved difficult—each had been examined at different times, in different species, and with varying methods that

made the results hard to compare. I began looking through the background references cited in these papers in hopes of finding an authoritative review. Although most references were previous studies easy to access on Web of Science or through the OBIS system, I was unable to find the text of one often-cited review at all.

To my surprise, after submitting an interlibrary loan request (ILLiad) for that reference, which I thought was an obscure review paper, I received a scanned version of an entire chapter from a 440-page book. Because the expectation for writing reviews is to survey original research from scientific literature, I had not considered that published books, although not primary sources themselves, could contain useful and comprehensive summaries. In my case, the chapter proved invaluable in showing a lack of support for each of my previous hypotheses that would have been difficult for me to assemble. However, the section on blue eggs concluded that, at the time of its publishing in 2002, the adaptive origin of the coloration was still a mystery.

The most exciting part of writing this paper was using Web of Science database searches to delve into the flood of recent research that began just one year after the chapter was published. Although I had seen the hypothesis earlier, the elimination of other explanations cast a new and plausible light on a 2003 letter to the journal Ecology which posited that egg blueness might serve as a signal of clutch quality to the male, thereby prompting better parenting. After eight years of investigation and a number of findings supportive of the hypothesis, a 2011 study looking specifically at robins found that manipulated nests with brighter blue eggs did receive more paternal care than their paler counterparts. However, with each study, new questions were raised about the mechanics and biological honesty of the proposed signaling pathway.

Writing about current research gave me an unusual sense of the process of scientific advancement. While this hither-to-unknown corner of the field of ornithology was still being plumbed, evidence to support (or debase) theories or doubts came in incrementally, prompting new assessments and reevaluations every few years. The introductions to each study often provided the most useful snapshot of thought on the matter, as no formal reviews of the signaling hypothesis have yet been published. Web of Science's tool for linking to studies that cited—and those cited by—a given paper allowed me to follow these connections in thought from one study to the next, each assuming questions that its precursors had left unanswered. After connecting nearly 40 journal articles, letters, reviews, and segments of books—a far greater breadth of sources than I had anticipated—this project allowed me a view of both the progress in and the process of answering the question I had started with.