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How birds direct impulse to minimize the energetic cost of foraging flight DIANA CHIN, DAVID LENTINK, Stanford University — Foraging arboreal birds frequently hop and fly between branches by extending long-jumps with a few wingbeats. Their legs transfer impulse to the branch during takeoff and landing, and their wings transfer impulse to the air to support their bodyweight during flight. To determine the mechanical energy tradeoffs of this bimodal locomotion, we studied how Pacific parrotlets transfer impulse during voluntary perch-to-perch flights. We tested five foraging flight variations by varying the inclination and distance between instrumented perches inside a novel aerodynamic force platform. This setup enables direct, time-resolved *in vivo* measurements of both leg and wing forces, which we combined with high-speed kinematics to develop a new bimodal long-jump and flight model. The model demonstrates how parrotlets direct their leg impulse to minimize the mechanical energy needed for each flight, and further shows how even a single proto-wingbeat would have significantly lengthened the long-jump of foraging arboreal dinosaurs. By directing jumps and flapping their wings, both extant and ancestral birds could thus improve foraging effectiveness. Similarly, bimodal robots could also employ these locomotion strategies to traverse cluttered environments more effectively.

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