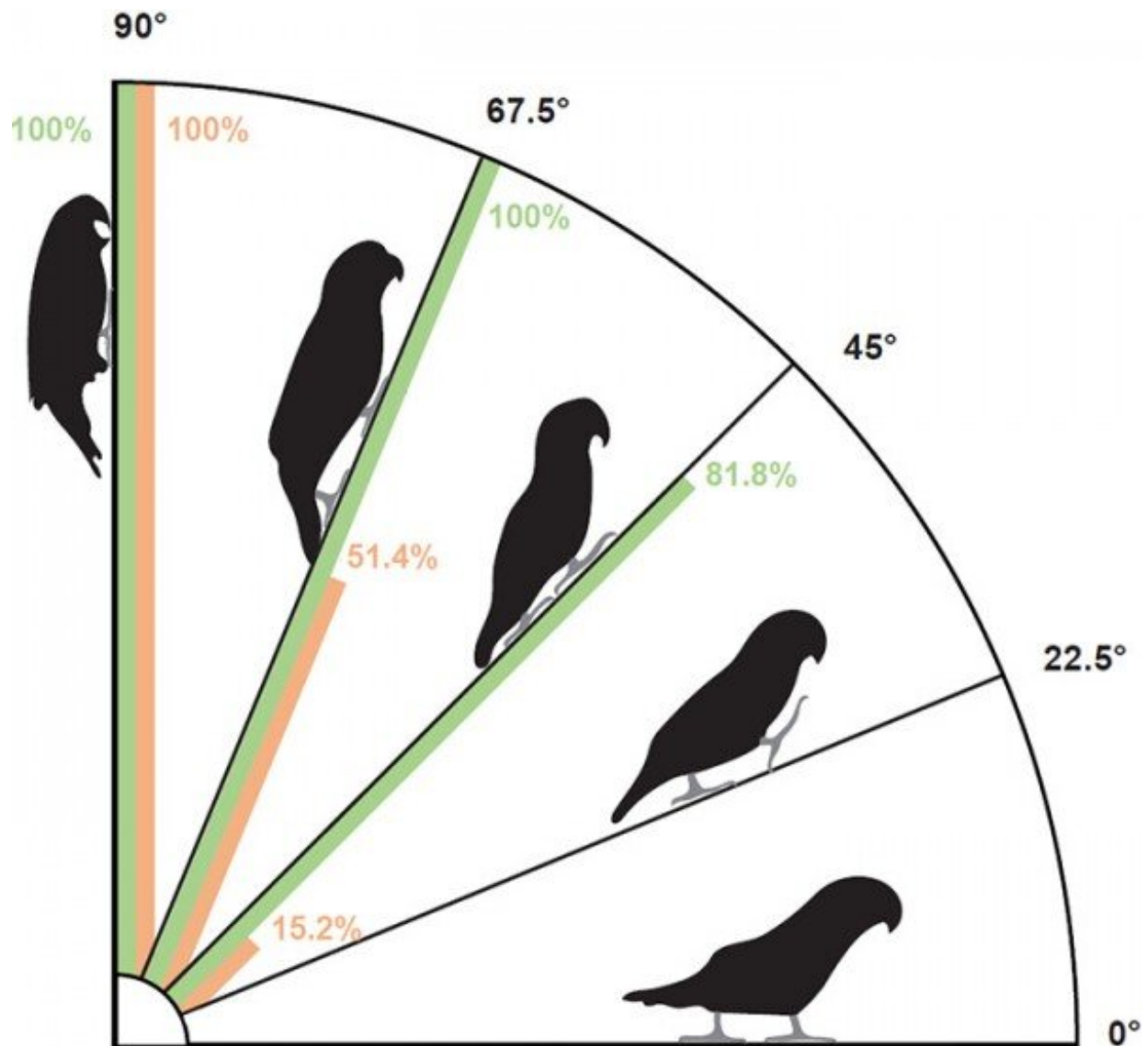


Study finds parrots use their heads as a 'third limb'

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The parrots' beaks first contacted the vertical runway when climbing at a

45-degree angle, and then consistently made contact while climbing at a 90-degree angle. Credit: New York Institute of Technology

No vertebrate (fish, mammal, bird, reptile, or amphibian) has ever had an odd number of limbs. Despite this "forbidden phenotype," some animals seem to use other body parts as a third or fifth "limb" to move from one place to another.

For example, while [parrots](#) are unable to use their wings for grasping, they climb by extending their heads and grasping branches or other surfaces with their beaks. However, it is unclear whether the [head](#) acts as a "third [limb](#)" that propels the bird, or if it is simply used for stabilization, with the beak hooking into surfaces for support. In addition, while many studies have highlighted parrots' incredible intelligence, research on their locomotor behavior is almost nonexistent.

Now, for the first time, research from New York Institute of Technology College of Osteopathic Medicine (NYITCOM) finds that parrots do, in fact, use their head as a propulsive third limb. A new study in the journal *Proceedings of the Royal Society B*, authored by medical student Melody Young and Michael Granatosky, Ph.D., assistant professor of anatomy, analyzed the climbing gaits of rosy-faced lovebirds (*Agapornis roseicollis*), a species of small parrot.

The researchers devised a series of experiments in which the parrots climbed a man-made vertical runway positioned at angles ranging from zero to 90 degrees. Two [high-speed cameras](#) captured their movement, while a small force plate mounted to the back of the runway measured the force generated by the beak, hindlimbs, and tail as each body part came into contact with the runway.

The parrots' beaks first contacted the runway when climbing at a 45-degree angle and, when climbing at a 90-degree angle, generated forces that were comparable to those produced by the hindlimbs. In fact, the forces generated by the parrots' beaks were of equal or greater magnitudes than the forces known to be produced by the limbs of humans or other large primates during climbing. In contrast, the birds' tails produced minimal forces, suggesting that the tail is used simply for support and not as an additional limb.

Young, who is enrolled in NYITCOM's Osteopathic Medicine, D.O./Medical & Biological Sciences, Ph.D. program, notes that the anatomy of parrots likely evolved over many years to support these resourceful climbing behaviors.

"Although many birds climb vertically, so far, parrots are the only birds known to engage the head as a third limb. This behavior seems to have necessitated neuromuscular changes over time, including neck flexors that generate additional [force](#) and modifications to spinal neural circuitry," she said.

Granatosky, an expert in the evolution of animal movement (locomotion), suggests that parrots' innovative climbing [behavior](#) may also distinguish them from other animals.

"While juvenile pandas are known to swing their heads laterally as they ascend vertical surfaces, appearing to use their head as a 'fifth limb,' it does not make contact with the surface. Utilizing the head as a propulsive limb represents an evolutionary novelty that, to our knowledge, has only ever existed in parrots," said Granatosky. "We hope our findings will enhance our understanding of how animals co-opt unusual anatomical structures to adopt entirely novel behaviors."

This [project](#) is the first step in a series of studies focused on the

locomotor behaviors of parrots. Parrots are an ancient arboreal (tree-dwelling) lineage, with many behavioral and anatomical parallels to living primates. Over the next few years, Granatosky and his lab will work to understand the anatomical and neuromuscular underpinnings of parrots' unusual locomotor behaviors to develop bio-inspired robotic systems that simulate this movement.

More information: Melody W. Young et al, Overcoming a 'forbidden phenotype': the parrot's head supports, propels and powers tripedal locomotion, *Proceedings of the Royal Society B: Biological Sciences* (2022). [DOI: 10.1098/rspb.2022.0245](https://doi.org/10.1098/rspb.2022.0245)

Provided by New York Institute of Technology

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