Learning the Locomotion Behaviour of Lizards
Transfers Across Environments

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Abstract

Successful locomotion is essential for the survival of most animals and crucial for arboreal species. In this work, we analyze the locomotor behaviour of a species of lizard, Anolis carolinensis, from the perspective of transfer learning, by analyzing the limb movements of 14 individuals on 6 different surfaces (3 inclinations x 2 perch diameters). We show that the strategies employed to improve stability during locomotion on narrow perches can be transferred across environments with different inclines. This transfer of behaviour is analogous to phenotypic plasticity, which likely plays a key role in the rapid adaptive evolution characteristic of Anolis lizards. This novel result emphasizes the valuable contribution that modern machine learning perspectives can give to the study of comparative biomechanics.

Features that Transfer

Correlations of our input variables against the LDA hyperplanes revealed that the key features used in the best models to distinguish between perch diameters were ones associated with stability [1]. For example:

- Crouched posture on narrow perches to reduce shoulder/hip height via greater limb flexion
- Wrapping limbs around the sides of narrow perches via greater humerus/femur depression
- Greater proportion of strike in contact with the narrow perch

In models including data from both limbs, >75% of the variables that correlated strongly (>0.7) belonged to the hind limb.

Evolutionary Implications

The variables that transfer across inclinations are integral to known strategies for improving stability on narrow substrates. Further, the majority of the variables contributing to our best performing models relate to the hind limb, which has been suggested to take on a more stabilizing role on narrow surfaces in A. carolinensis [1].

The principles underlying TL and the results of our analysis connect to the rapid adaptive radiation, likely facilitated by plasticity [2,3,5], that has made Anolis lizards a model system in biology. If pre-existing behaviours that facilitate locomotion on narrow surfaces are useful on multiple types of inclines, then the locomotor plasticity manifested through the transfer of the traits that facilitate locomotion on those surfaces should give an adaptive advantage by improving stability of motion and indeed, survival in those new complex environments. Of particular interest will be to test how our models generalize to different species/ecosystems of Anoles, as well as to other genera of lizards as this could provide insight into the plasticity and adaptability of reptiles.

References