

Preflexes or Reflexes? Mechanisms for maintaining stability on uneven terrain during rapid running

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Numerous investigators have suggested that reflex feedback plays less of a role in stabilizing rapid running in comparison with slower movements. Stability in rapid running has been assumed to rely more on reflexes than preflexes. However, evidence on this issue from animal models outside of insects is slim. Previous work on guinea fowl encountering an unexpected drop in terrain during rapid running resulted in the hypothesis that the distal joints may adjust their mechanical function using sensory feedback. However, more proximal joints were hypothesized to be controlled in a feedforward manner. We tested this hypothesis of a proximo-distal gradient of control by assessing the function of individual joints using inverse dynamics and measuring electromyographic activity of 12 muscles. Runs were recorded with and without an unexpected drop in terrain height. Based on inverse dynamics, we predicted that reflex changes in muscle activity might be required at both proximal and distal joints. These predictions were supported by our EMG recordings, which showed increased EMG amplitude in 9 of the surveyed muscles, including three that were activated within the 27 ms period between expected contact and actual contact with the lowered surface. Two of these rapidly activated muscles operate at the ankle and foot joints and one is a hip flexor. Our data do not support the hypothesis of a proximo-distal gradient in control and instead suggest that these fast bipedal runners show coordinated reflex control throughout the limb.