

# Perceptual motor styles during locomotion at high altitude in a Virtual Reality environment

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Human perceptual-motor style captures the individual variations in posture and movement during sensorimotor tasks, emphasizing the adaptability and variability of human behavior. This concept reflects the complex interaction between perception, cognition, and motor control, which can be heavily influenced by environmental factors. Among these, height exposure poses a unique challenge, evoking responses that range from mild discomfort to severe anxiety. These reactions can be categorized into physiological height imbalance, visual height intolerance, and acrophobia, all of which significantly impact motor performance. Observable effects include altered postural control, reduced oculomotor and head movements, and changes in gait.

Our prior research examined how perceptual-motor styles adapt during locomotion at height using virtual reality (VR). We observed considerable variability among participants in static markers (head, trunk, and limb stability) and dynamic markers (jerk, entropy, sample entropy, and adherence to the Two-Thirds Power Law). Importantly, 61% of participants displayed lasting changes in dynamic locomotion control on the ground after height exposure.

In the present study, we extended this work by investigating neuromuscular adaptations to height exposure. We recruited 22 participants without prior height-related fears and used the VR game *Richie's Plank* to simulate locomotion at a 30th-floor height. This environment induced anxiety while enabling the analysis of muscle activity through electromyography (EMG).

Our findings revealed significant alterations in EMG patterns between ground-level and height conditions, with upper body muscles exhibiting the most pronounced changes. Remarkably, 61% of EMG features remained altered even after returning to ground level, suggesting persistent neuromuscular adaptations. These results align with earlier kinematic data, offering deeper insights into how height-induced challenges shape motor control.

In conclusion, this research underscores the complexity of perceptual-motor adaptations and highlights the need for continued exploration of individual responses to environmental challenges. Such insights are pivotal for designing tailored interventions in fields like rehabilitation, sports science, and fall prevention.