Finding 5: Ideomotor Pendulum Variability

Statement

The nervous system oscillates between ideomotor and proprioceptive dominance during fatigue and stress, with oscillation variability indicating nervous system state.

Mechanism

Within the Control Loop Framework, ideomotor control relies on mental imagery and forward models. Proprioceptive control relies on real-time sensory feedback. Under fatigue, proprioceptive feedback degrades and the nervous system shifts toward ideomotor control. As cognitive resources deplete, the nervous system attempts to re-engage proprioceptive control. This cycle repeats.

The frequency and amplitude of this oscillation reflect the balance between proprioceptive degradation and cognitive resource depletion. High variability indicates the nervous system is struggling. Stable oscillation indicates the nervous system has found a rhythm. No oscillation indicates either fresh resources or complete exhaustion.

Key Implications

- **Performance variability under fatigue is predictable**: Not random, but follows a specific oscillation pattern
- **Oscillation stability can be trained**: Athletes can learn to maintain stable oscillation under fatigue
- **Oscillation pattern is a biomarker of nervous system state**: Observable indicator of fatigue and stress

Practical Applications

1. Identify the athlete's natural oscillation pattern under fatigue
2. Train to stabilize oscillation through proprioceptive resilience and cognitive efficiency
3. Monitor oscillation patterns during training and competition
4. Use oscillation variability to assess readiness and recovery

Competitive Context

Elite athletes maintain stable oscillation even under high fatigue. Their performance remains consistent because their control mode switching is smooth and predictable. Athletes with high oscillation variability show erratic performance as fatigue increases.

Study 001 — Control Loop Framework Research
The Unfinished Athlete — Scott Felluss, PhD