EFFECTS OF FIXED AND VARIABLE DAMPING ENVIRONMENTS ON ANKLE AGILITY AND STABILITY

HARRISON HANZLICK

DR. HYUNGLAE LEE

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Importance of the Ankle

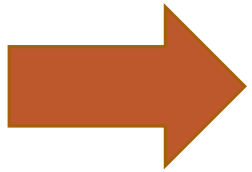
- Ankle is the primary joint responsible for transferring energy between the lower extremity (leg) and the environment.
  - Postural maintenance (standing).
  - Locomotion (walking).
  - Reacting to sudden changes in environment (balance).
- Proper control of ankle is vital to maintaining stability of the lower extremity.

Postural maintenance

Locomotion

Overview

Use robotic systems to characterize the natural properties of the human ankle.



Use robotic systems to augment and enhance the natural properties of the human ankle.

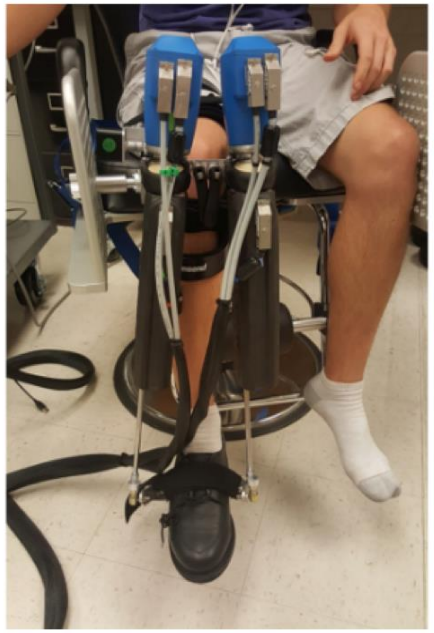
This Study:

- Quantified ankle agility/stability trade off across a range of damping-defined environmental conditions.

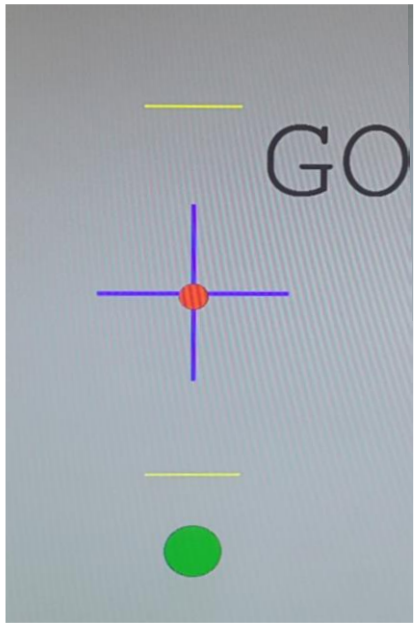
Experimental Setup

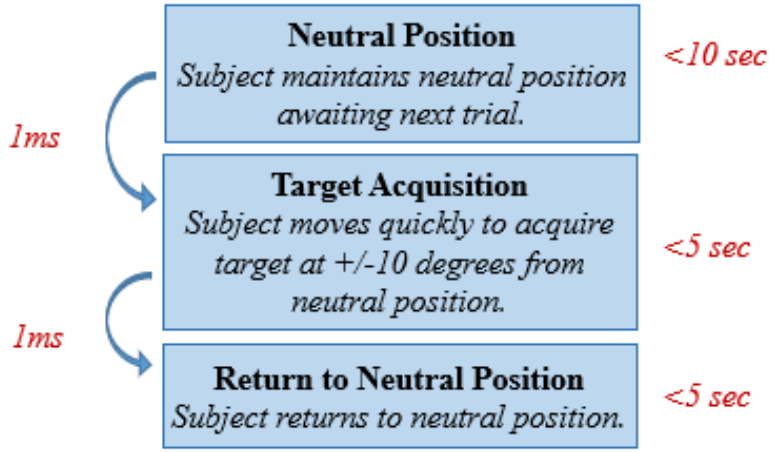
- Damping = [-1.0, 0.0, +1.0] Nm*sec/rad

A

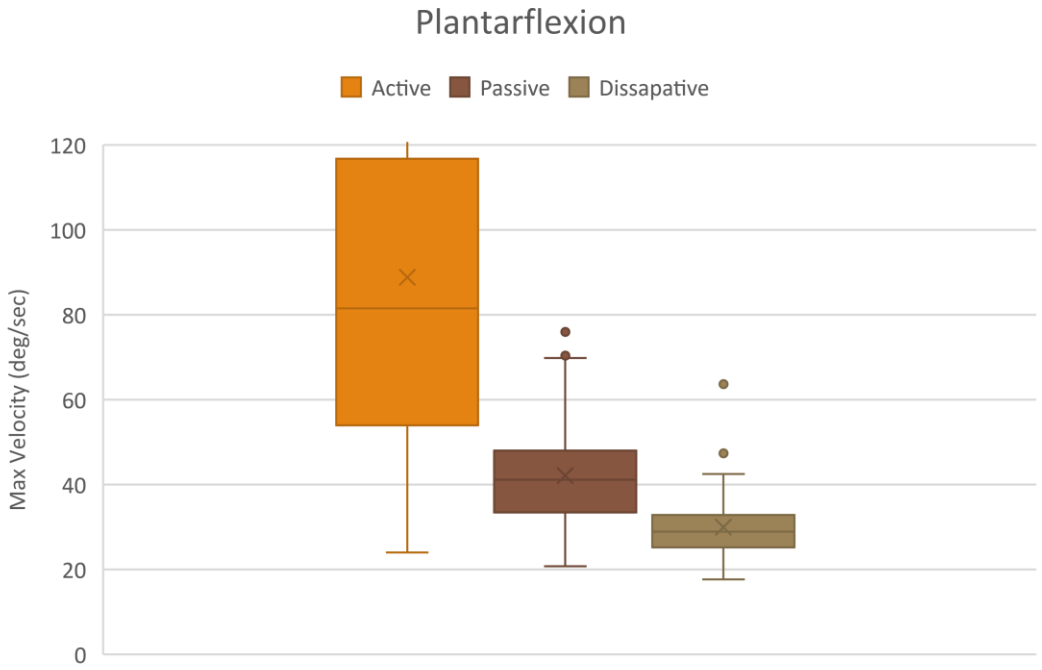


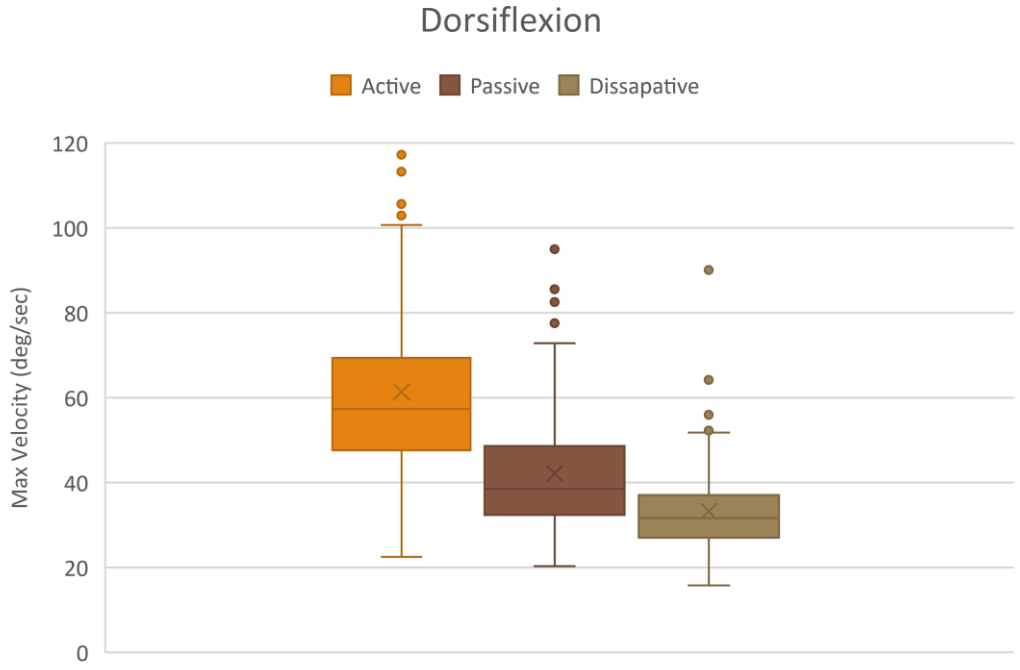
B



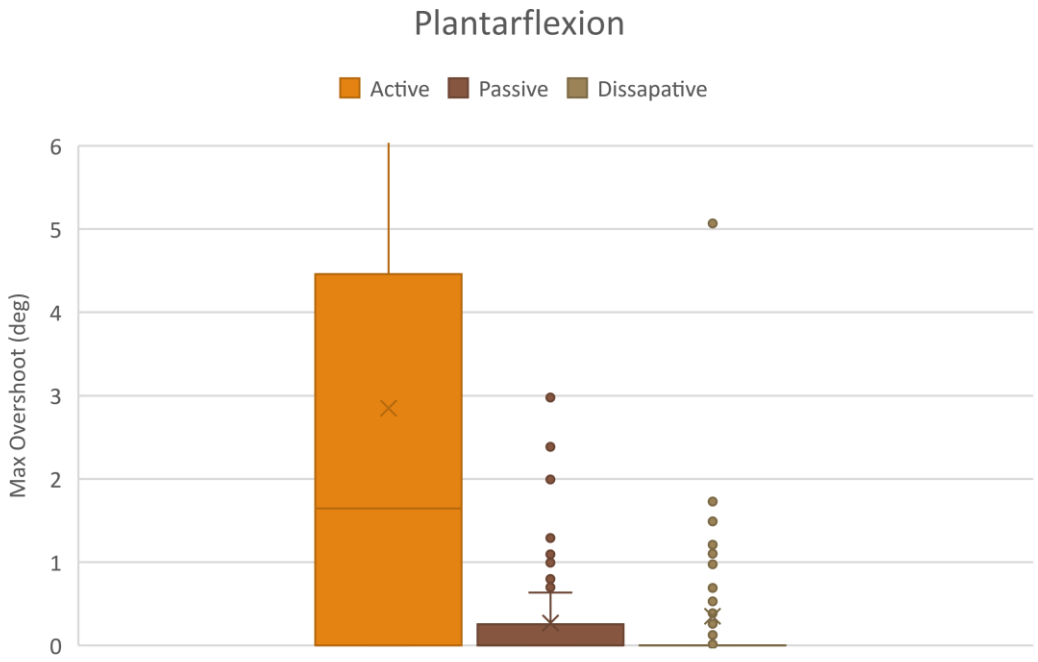


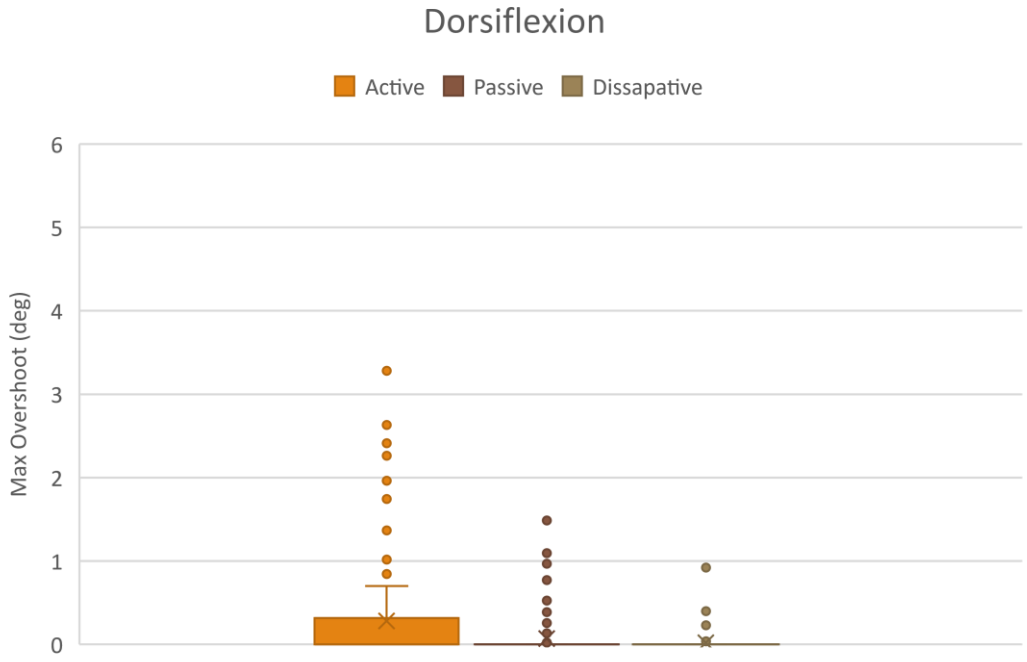
Agility Aggregate Results





Stability Aggregate Results

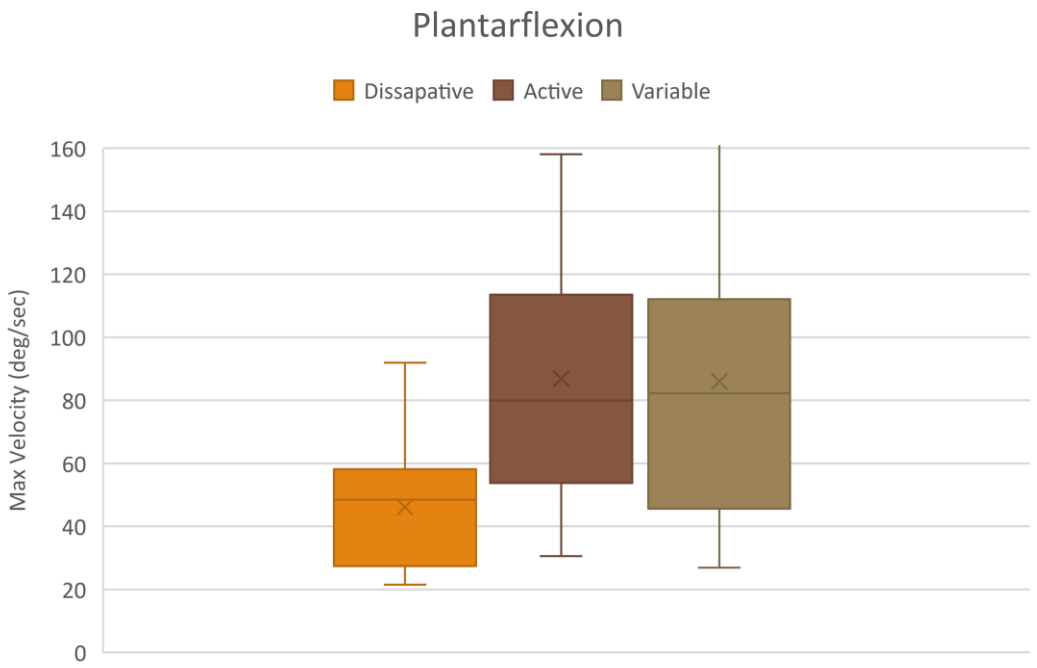


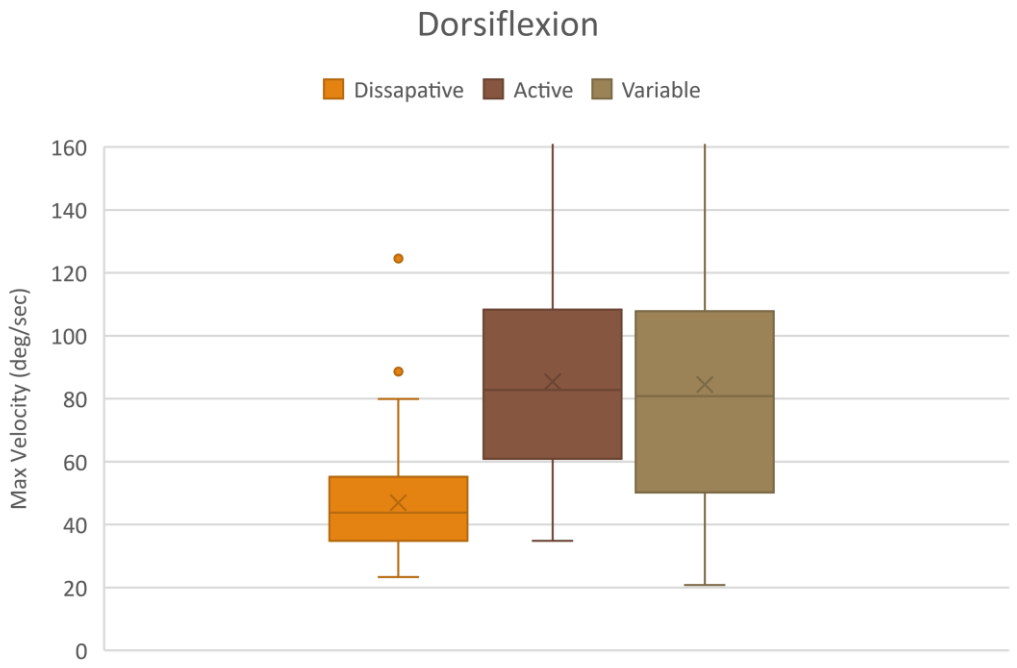


Takeaway?

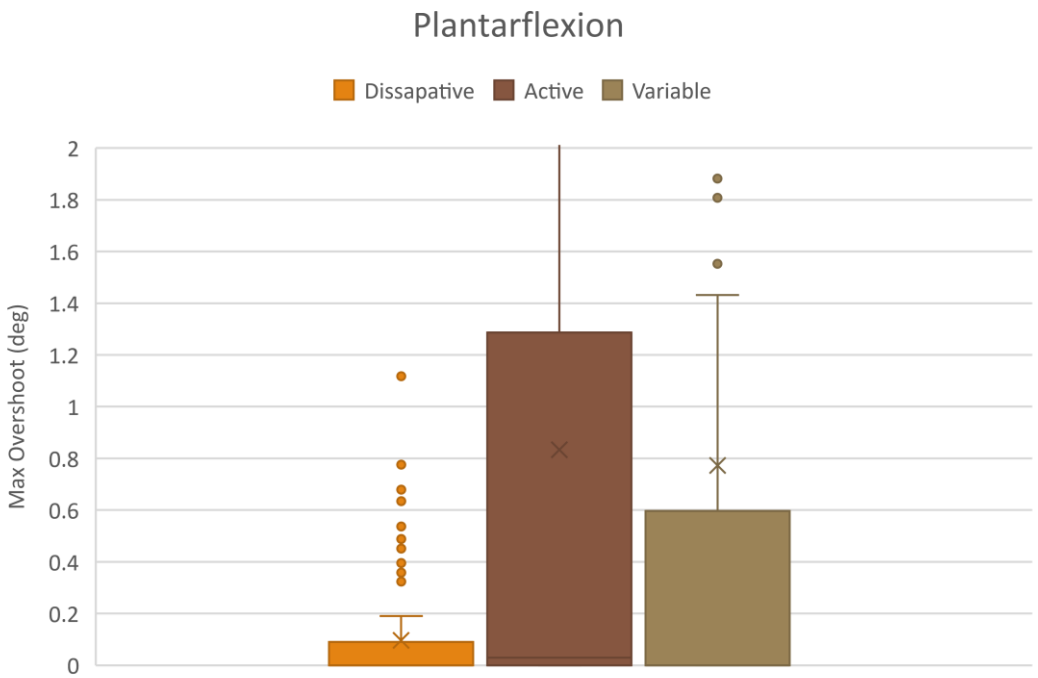
- Negative damping increases agility **but** decreases stability.
- Positive damping decreases agility **but** increases stability.
- There is a trade-off, but can we have the best of both?
  - Variable damping environments.

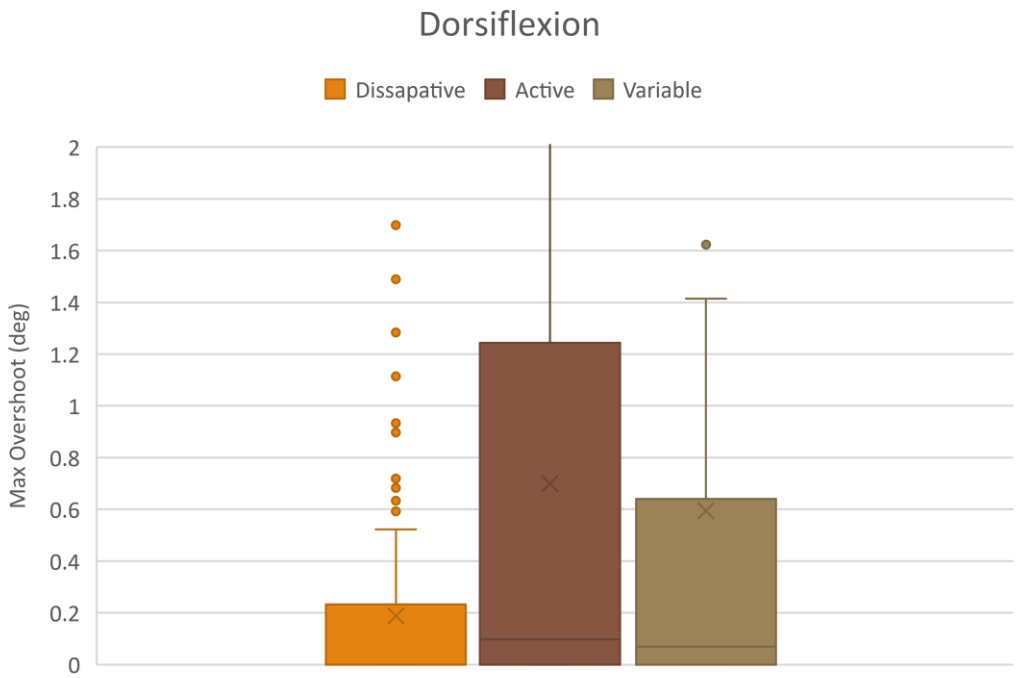
Agility Aggregate Results





Stability Aggregate Results





Conclusions

- Constant damping environments offer either enhanced agility or stability.
- Variable damping environment offers most of the agility boost of negative damping without as much instability.
- Variable damping shows potential as a control scheme for assistive devices—several factors must be tuned for each individual.

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Thank you