THE UNIVERSITY of TENNESSEE CHATTANOOGA

Prioritization of cognitive and motor components during dual-task activities

2024 GATP Research Day

Bartlett LR, Pfaff EA, Hogg JA, Acocello SN

Conflict of Interest Statement

The authors have no conflicts of interest or other disclosures to report.

Introduction

- Both cognitive and motor components influence lower extremity injury in reactive sports[1]
- Poor biomechanics (i.e., motor) increases injury risk[2]
- The addition of a cognitive task worsens cutting,[3] squatting,[4] and gait[5]

- **Does the addition of a cognitive task make motor tasks worse because athletes prioritize one over the other?**

Background

- Cognitive dual-task cost decreases as task complexity increased[4,6,7,8,9]
- People have preferences when completing dual task activities[7]
- The evidence is inconclusive regarding under what conditions people consistently prioritize the cognitive or motor component of a dual task[8,9]
- During activities more closely associated with sport, it is possible to acutely instruct/change prioritization in ACL injured participants[10]

Purpose Statement & Hypothesis

- We aim to determine whether ROTC cadets prioritize motor or cognitive components during tandem gait and balance dual-tasks

- We hypothesize that ROTC cadets will prioritize the cognitive components and sacrifice the motor components during a cognitive-motor dual-task

Participants

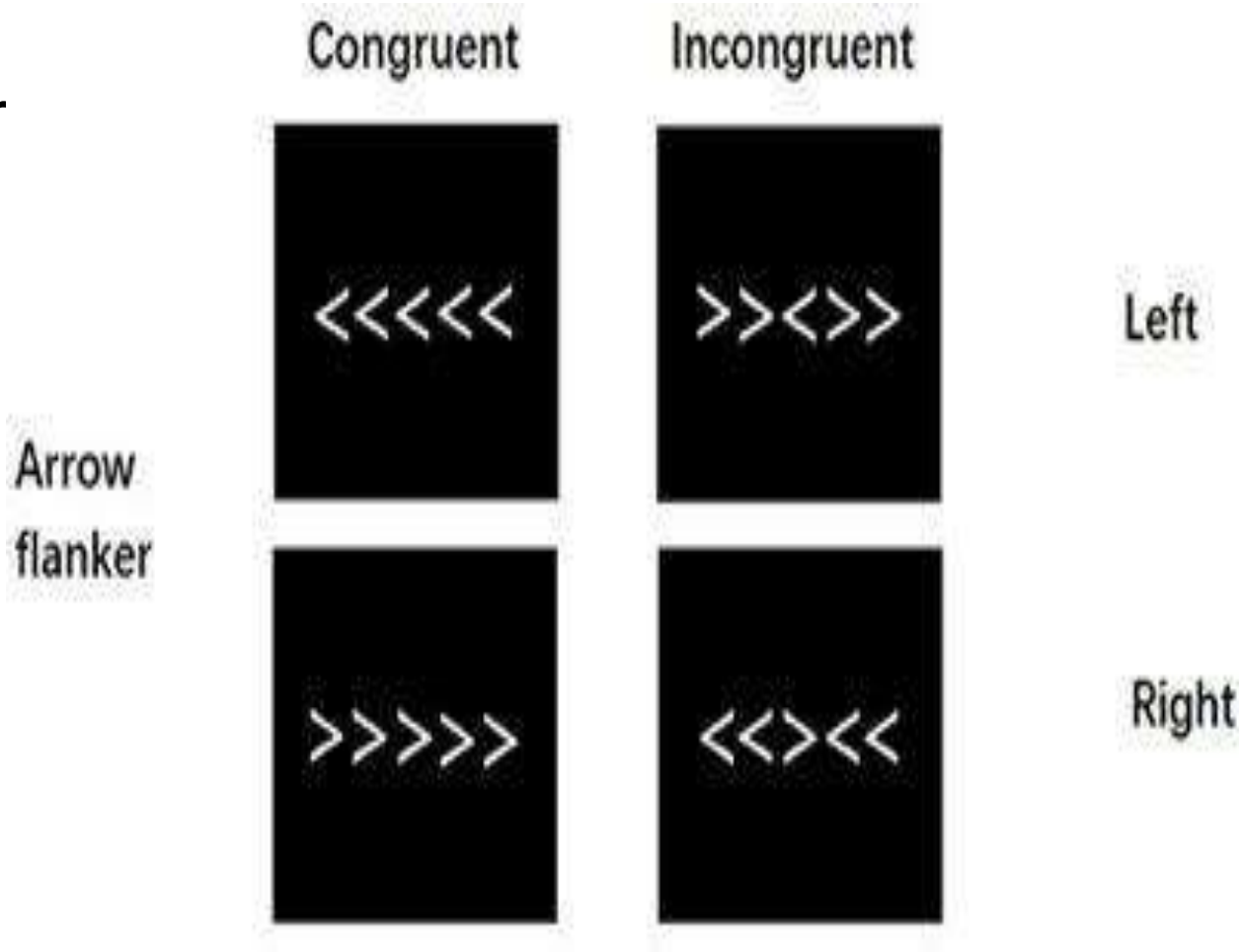
- We had a cohort of 36 UTC ROTC cadets (11 females, 25 males)
  - Age: 21.99 ± 3.73 years
  - Height: 68.93 ± 3.71 in
  - Weight: 169.55 ± 30.82 lbs
- Dominant kicking leg
  - R: 33
  - L: 3
- No exclusion criteria were used.
- IRB #23-052

Methods

- Tasks were completed in the following order in a well-lit, open room:
  - Single task Flanker
  - Single task tandem gait
  - Dual task- Flanker & tandem gait
  - Single task balance
  - Dual task- Flanker & balance

Methods - Single Task Flanker

- Participants were given a practice trial with the Flanker app before the single task Flanker was recorded
- Instructed to focus on center arrow and tilt phone in the same direction as the center arrow
- 20 repetitions for each trial were recorded



Methods - Single Task Balance & Tandem Gait

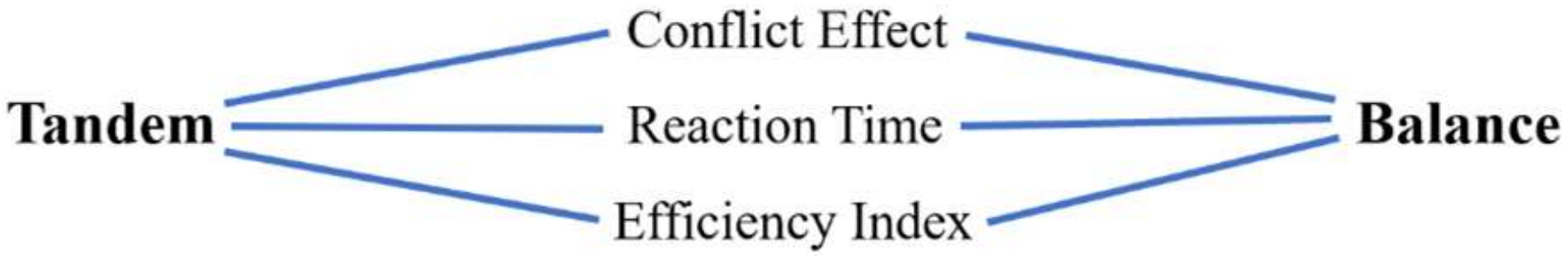
- Tandem Gait
  - 3 meters down & back as fast as possible, heel to toe with hands on hips
  - Timing gates were used for measurement (to the nearest hundredth of a second)
- Balance
  - Trials lasted 20 seconds
  - “Stand on your dominant kicking leg with your hands on your hips and eyes on the dot in front of you. Stay as still as possible.”

Methods - Dual Tasks

- Tandem Gait + Flanker
- Balance + Flanker

- “Now you’re going to complete both tasks at the same time. It’s important that you perform both tasks to the best of your ability with equal effort.”

Variables



UNITS

- Tandem Gait (seconds)
- Balance Center Of Pressure (m/s)
- Conflict Effect (ms)
- Reaction Time (ms)
- Efficiency Index (ms)

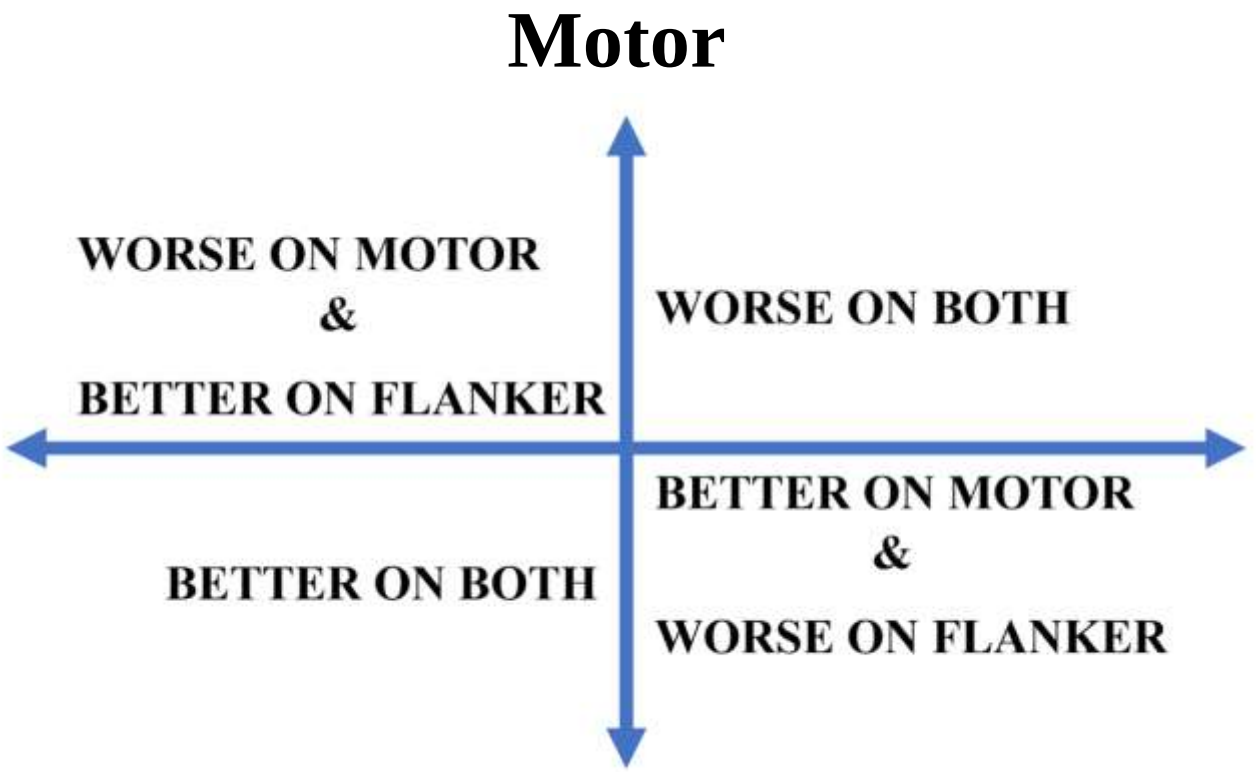
DUAL-TASK COST EQUATION

$$\frac{DT - ST}{ST} \text{ x100}$$

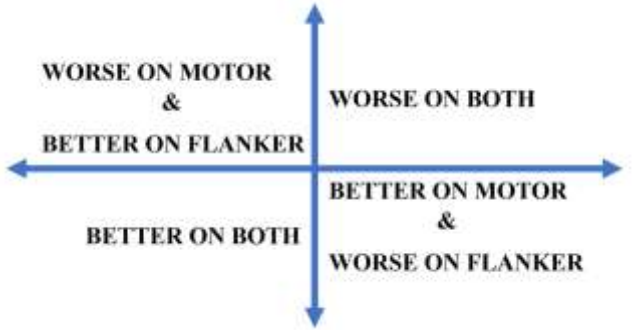
- If cost was positive: they got worse
- If cost was negative: they got

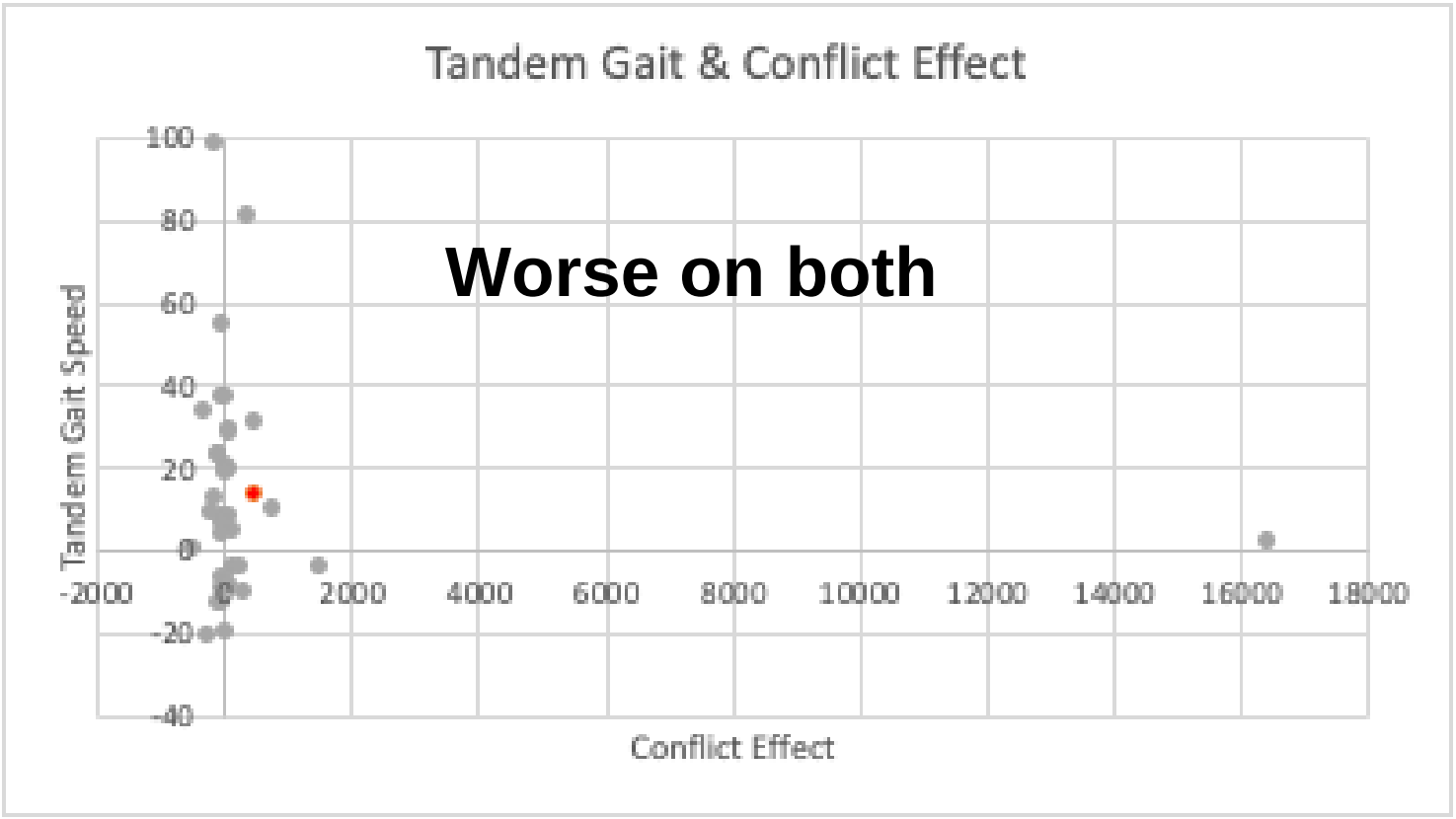
Statistical Analysis

- 6 paired samples T-test
- Inspected Cohen's *d*
  - 0.2: small effect
  - 0.5: medium effect
  - 0.8: large effect
- JASP version 0.18.3



Results

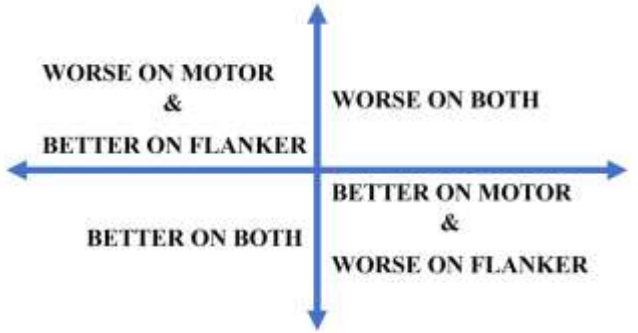


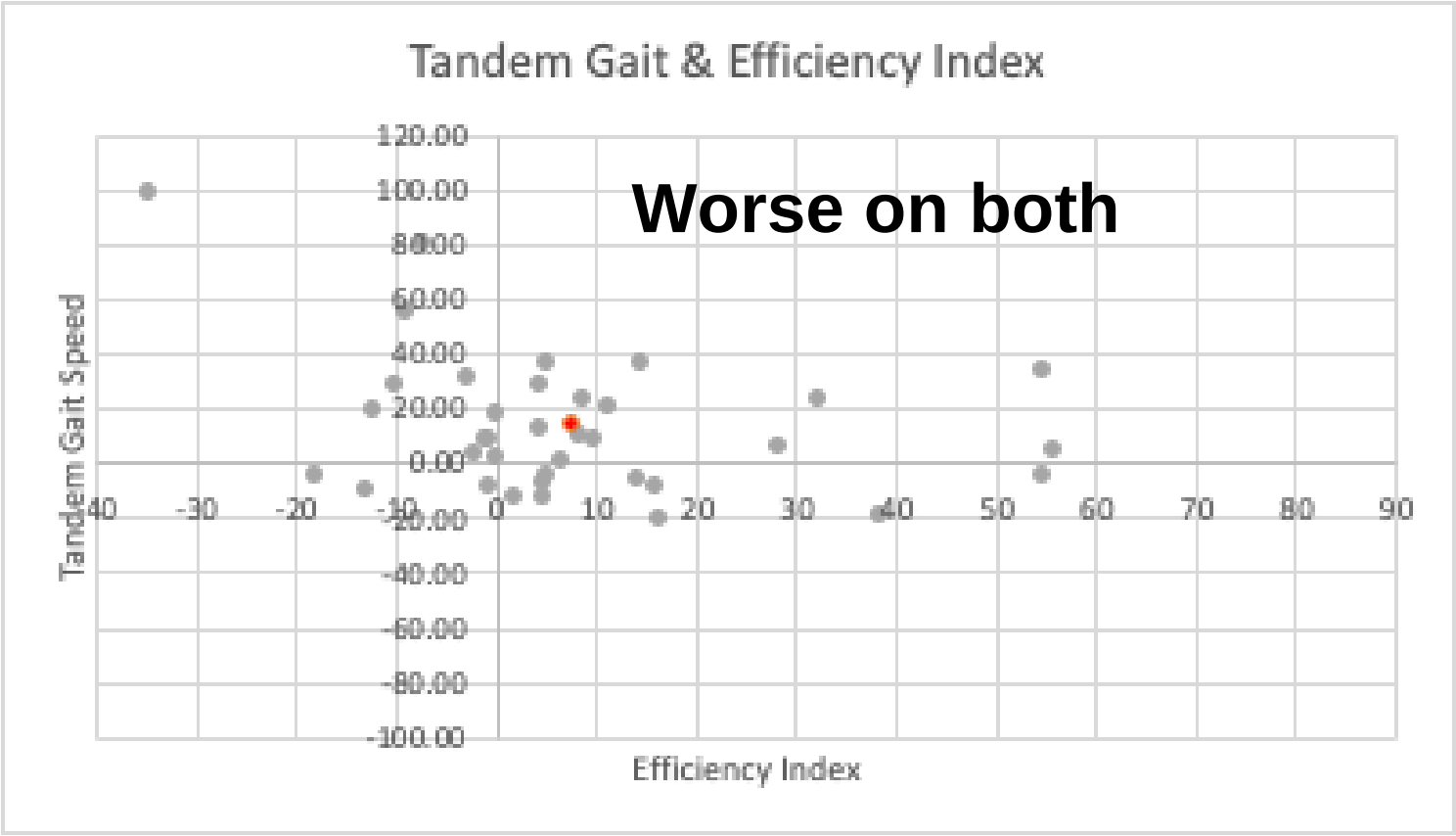


Dual-task Costs	Mean ± SD
Tandem Gait	13.63 ± 25.89
Conflict Effect	520.66 ± 2741.69

T_{df}	p	Cohen's *d*
-1.11_{35}	0.28	-0.19

Results

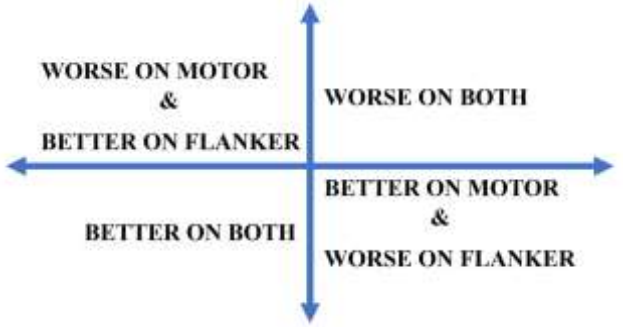




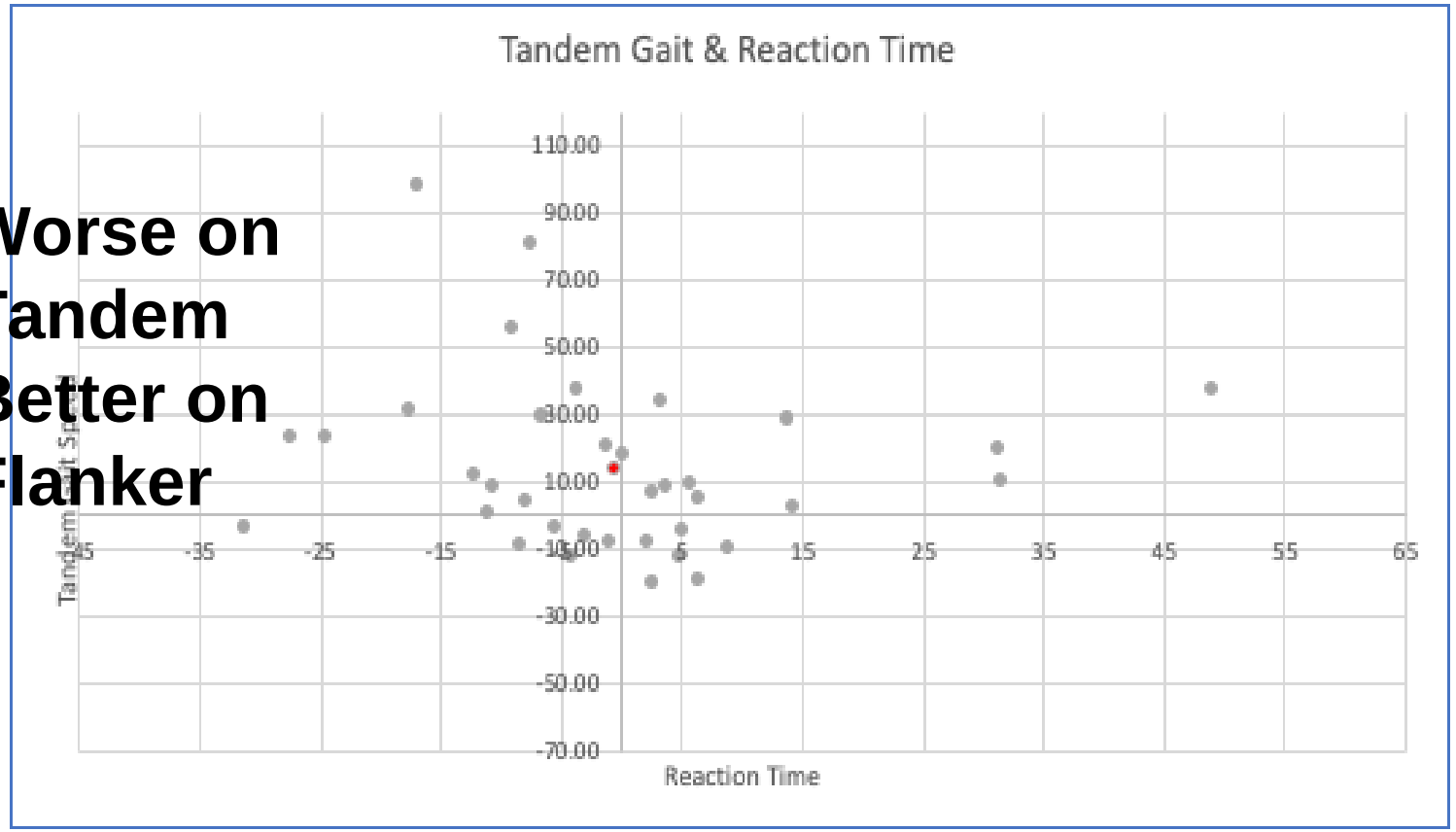
Dual-task Costs	Mean ± SD
Tandem Gait	13.63 ± 25.89
Efficiency Index	7.93 ± 19.76

T_{df}	p	Cohen's *d*
0.915_{35}	0.37	0.15

Results



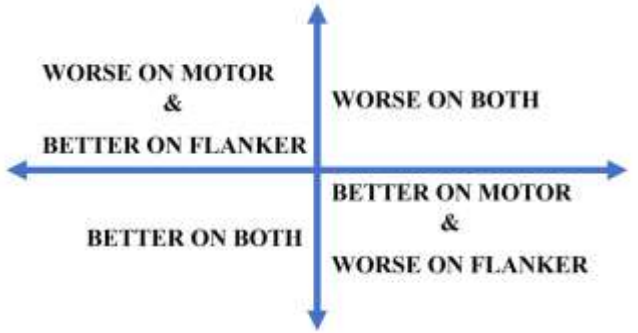
Worse on Tandem Better on Flanker

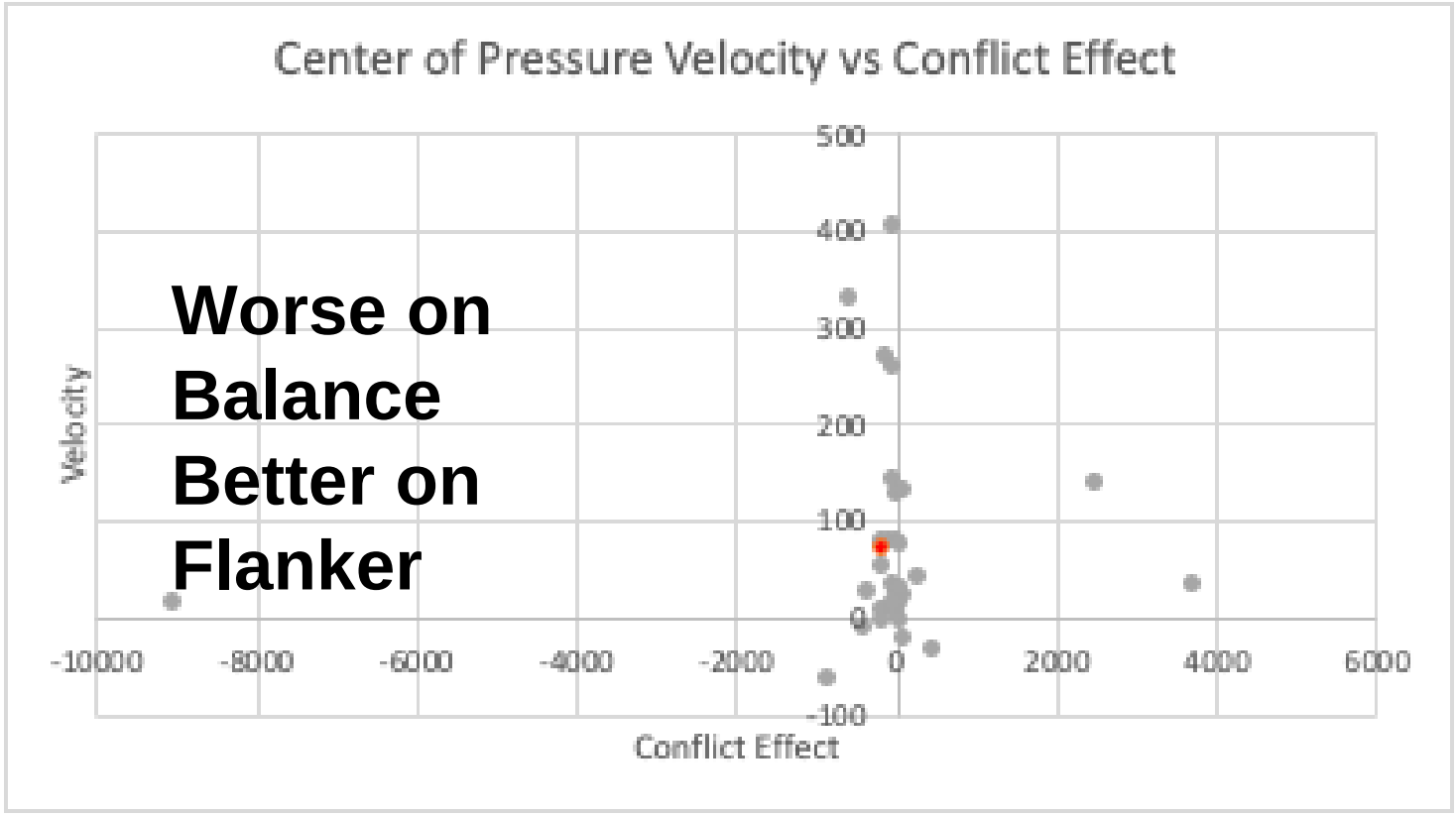


Dual-task Costs	Mean ± SD
Tandem Gait	13.63 ± 25.89
Reaction Time	-0.54 ± 15.79

T_{df}	p	Cohen's *d*
2.677_{35}	0.01	0.45

Results

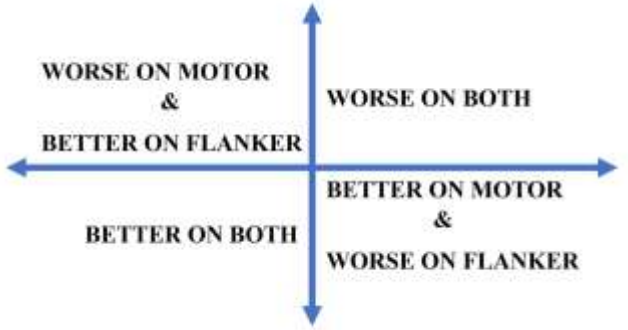


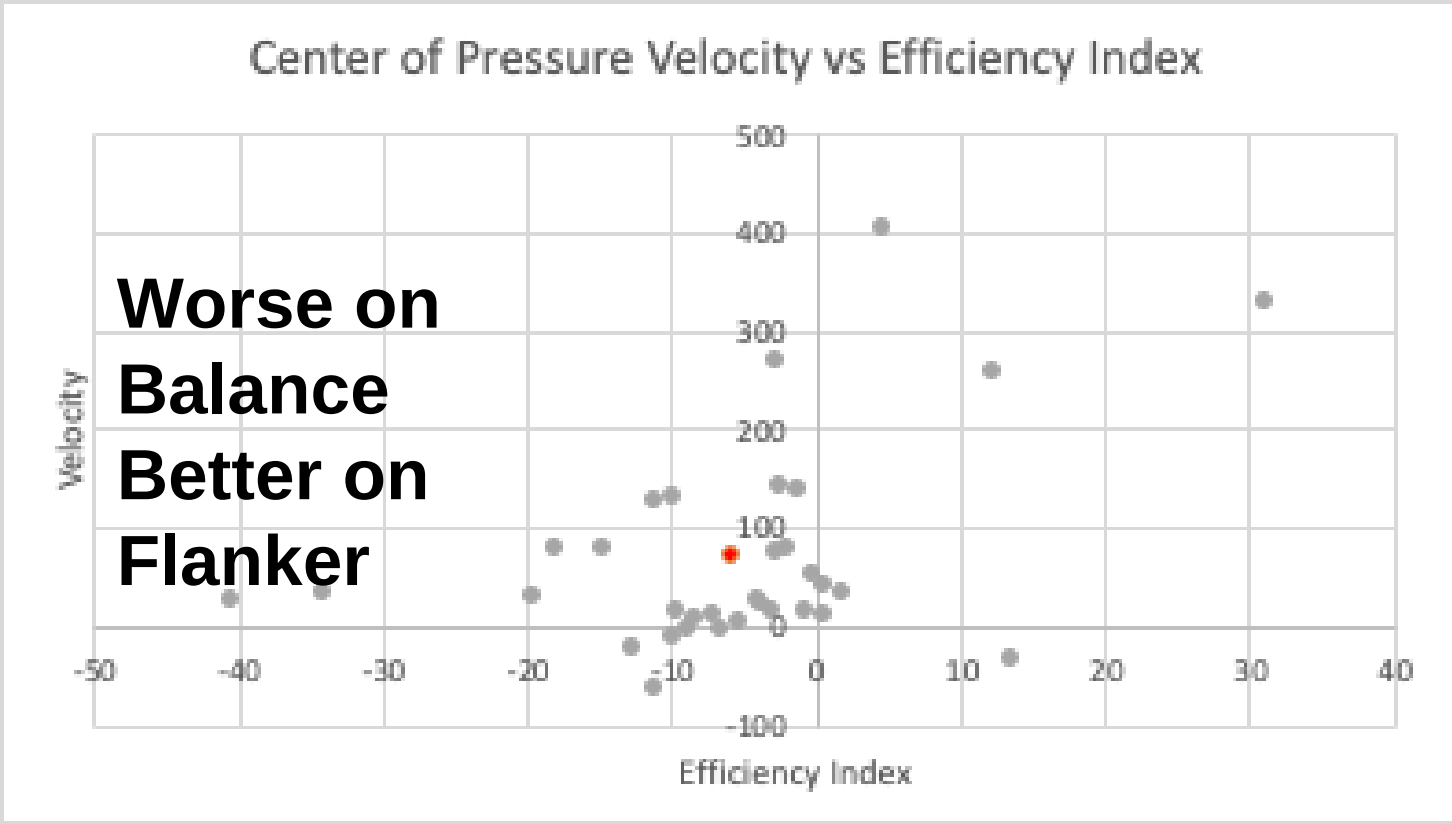


Dual-task Costs	Mean ± SD
COP Velocity	71.67 ± 102.31
Conflict Effect	-152.2 ± 1796.36

T_{df}	p	Cohen's *d*
0.72_{32}	0.48	0.13

Results

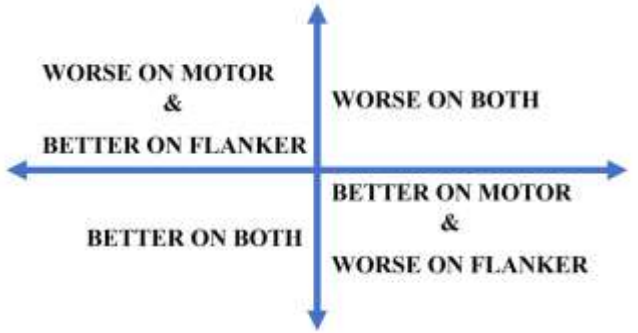


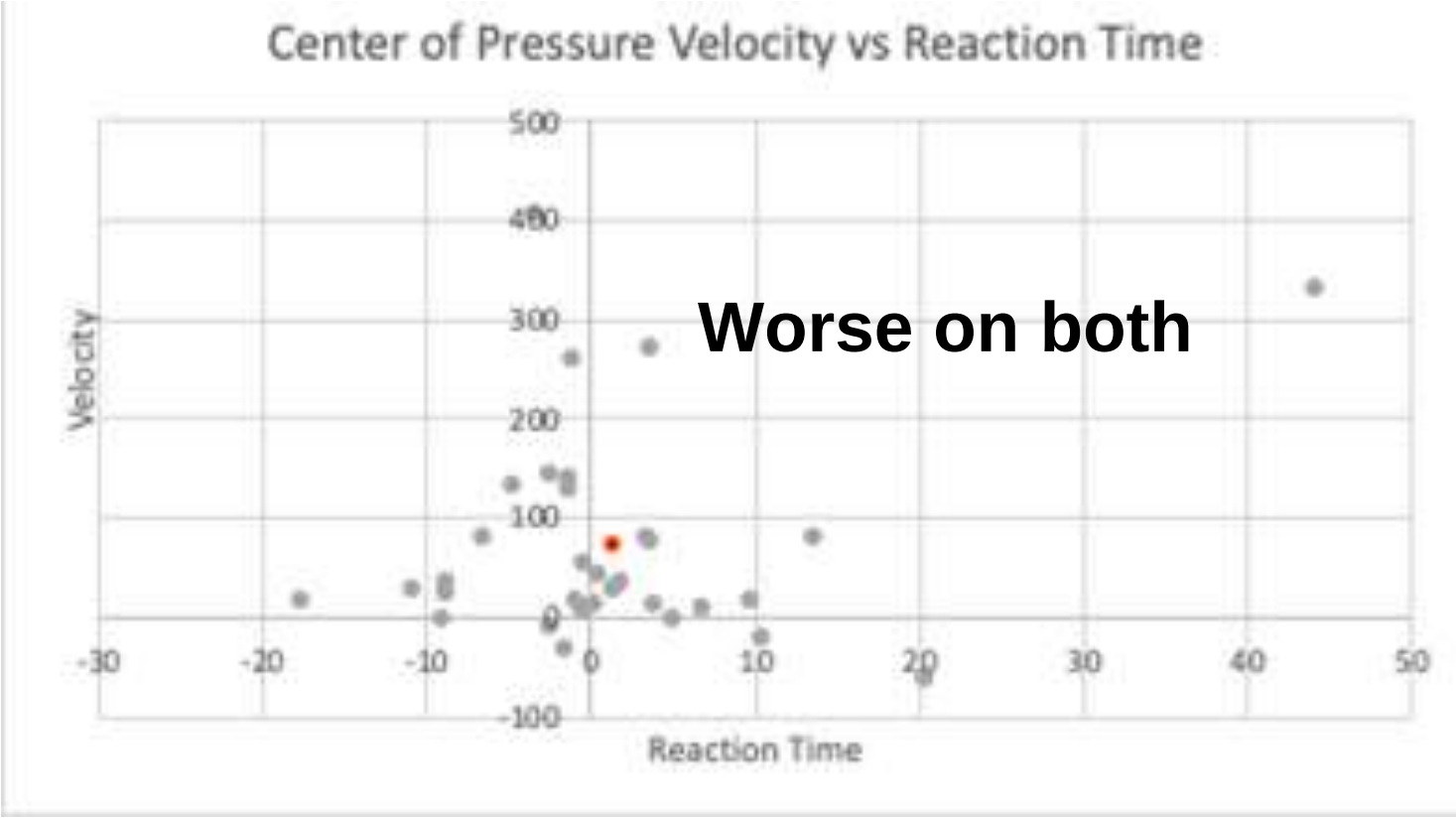


Dual-task Costs	Mean ± SD
COP Velocity	71.67 ± 102.31
Efficiency Index	-5.72 ± 12.59

T_{df}	p	Cohen's *d*
4.38_{32}	<.001	0.76

Results





Dual-task Costs	Mean ± SD
COP Velocity	71.67 ± 102.31
Reaction Time	1.47 ± 10.58

T_{df}	p	Cohen's *d*
3.86_{32}	<.001	0.67

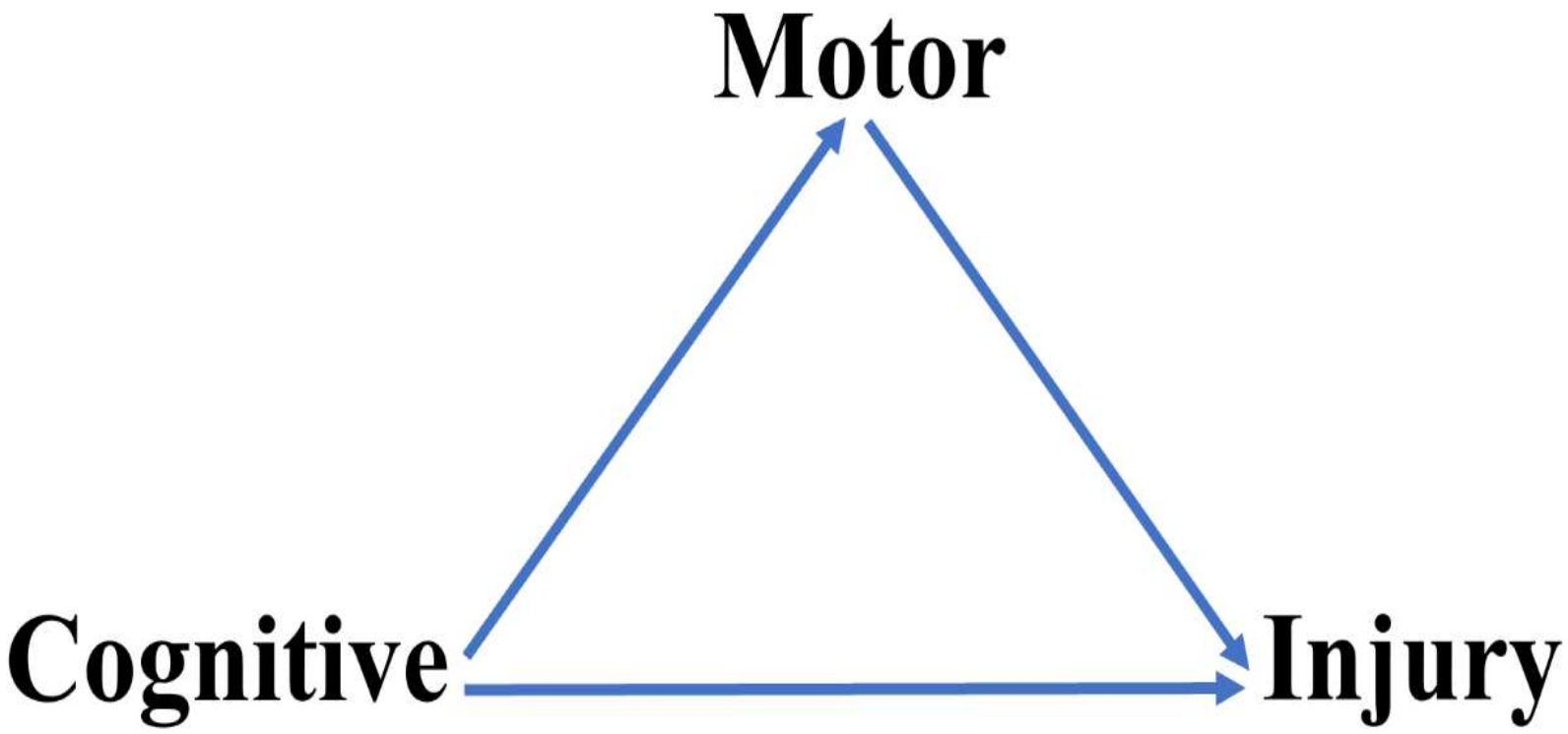
Discussion

- **Our hypothesis was supported in that we observed ROTC cadets sacrificed the motor and maintained performance in the cognitive component**
- We didn’t observe any apparent between-task effects

Discussion

- Dynamic cognitive and static motor
- Two tasks in our study were similar in complexity
- Prior work from this lab has demonstrated varying effects based on the complexity of the motor task[11]
- Synergistic components
- Improving dual task performance

Clinical Relevance



References

1. Swanik CB, Covassin T, Stearne DJ, Schatz P. The relationship between neurocognitive function and noncontact anterior cruciate ligament injuries. *Am J Sports Med*. 2007;35(6):943-8. doi:10.1177/0363546507299532
2. Hewett TE, Myer GD, et al. Biomechanical measures of neuromuscular control and valgus loading of the knee predict anterior cruciate ligament injury risk in female athletes: a prospective study. *Am J Sports Med.* 2005;33(4):492-501. doi:10.1177/0363546504269591
3. Monfort SM, Pradarelli JJ, et al. Visual-Spatial Memory Deficits Are Related to Increased Knee Valgus Angle During a Sport-Specific Sidestep Cut. *Am J Sports Med.* 2019;47(6):1488-1495. doi: 10.1177/0363546519834544.
4. Hogg JA, Avedesian JM, et al. Sex Moderates the Relationship between Perceptual-Motor Function and Single-Leg Squatting Mechanics. *J Sports Sci Med.* 2022;21(1):104-111. doi: 10.52082/jssm.2022.104.
5. Howell DR, Buckley TA, Lynall RC, Meehan WP. Worsening Dual-Task Gait Costs after Concussion and their Association with Subsequent Sport-Related Injury. *J Neurotrauma*. 2018;35(14):1630-1636. doi:10.1089/neu.2017.5570.

References

6. Bianchini E, Warmerdam E, Romkinders R, Hansen C, Pontiere FE, Maetzler W. Cognitive dual-task cost depends on the complexity of the cognitive task, but not on age and disease. *Front Neurol*. 2022;13:964207. doi:10.3389/fneur.2022.96420.
7. Jansen RJ, van Egmond R, de Ridder H. Task prioritization in dual-tasking: instructions versus preferences. *PLos One*. 2016;11(7):e0158511. doi:10.1371/journal.pone.0158511.
8. Patel P, Lamar M, Bhatt T. Effect of type of cognitive task and walking speed on cognitive-motor interference during dual-task walking. *Neuroscience*. 2014;260:140-149. doi:10.101/j.neuroscience.2013.12.016.
9. Small GH, Neptune RR. Task-prioritization and balance recovery strategies used by young healthy adults during dual-task walking. *Gait Posture*. 2022;95:115-120. doi:10.1016/j.gaitpost.2022.04.010.
10. Chan MS, Sigward S. Prioritizing limb loading improves symmetry during dual-tasking in individuals following anterior cruciate ligament reconstruction. *Front Sports Act Living.* 2023;5: 1090694. doi:10.3389/fspor.2023.1090694
11. .Hogg JA, Riehm CD, Wilkerson GB, Tan Le, et al. Changes in dual-task cognitive performance elicited by physical exertion vary with motor task. *Front Sports Act Living.* 2022;28:4:989799. doi:10.3389/fspor.2022.989799.