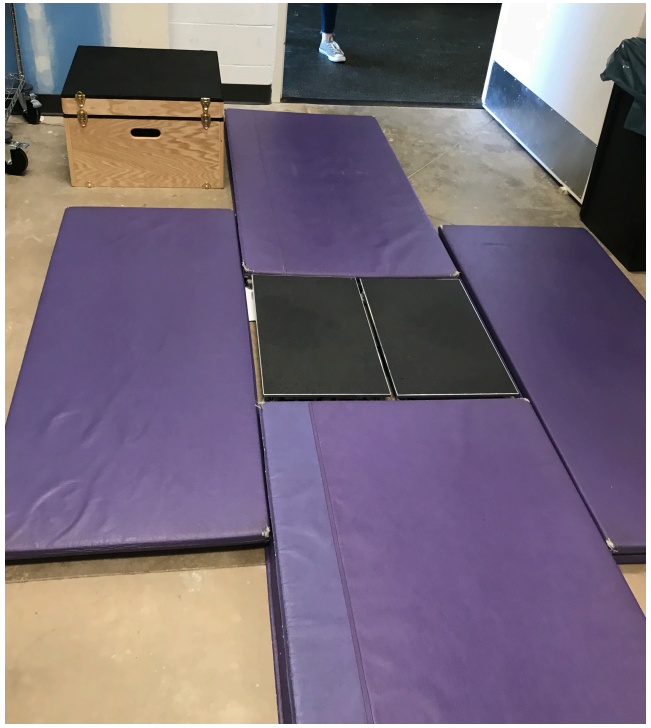
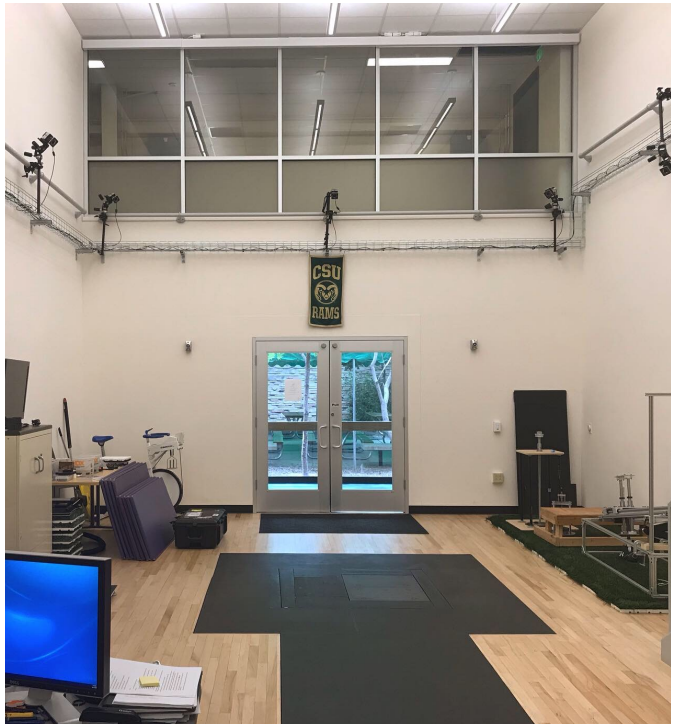
Finding the Best Injury Risk Assessment for the Lower Extremities



By Antonio Calderon

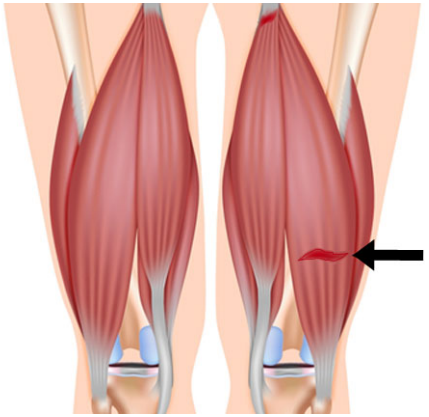
Dr. Raoul Reiser-Colorado State University

Dr. Emilie Gray-Colorado College



Sports Injuries: An Epidemic

- Huge cost and burden
- $1.8 billion/year in school-age children
- Single Big 10 Institution: 1317 injuries across 4 years



Limb Asymmetries

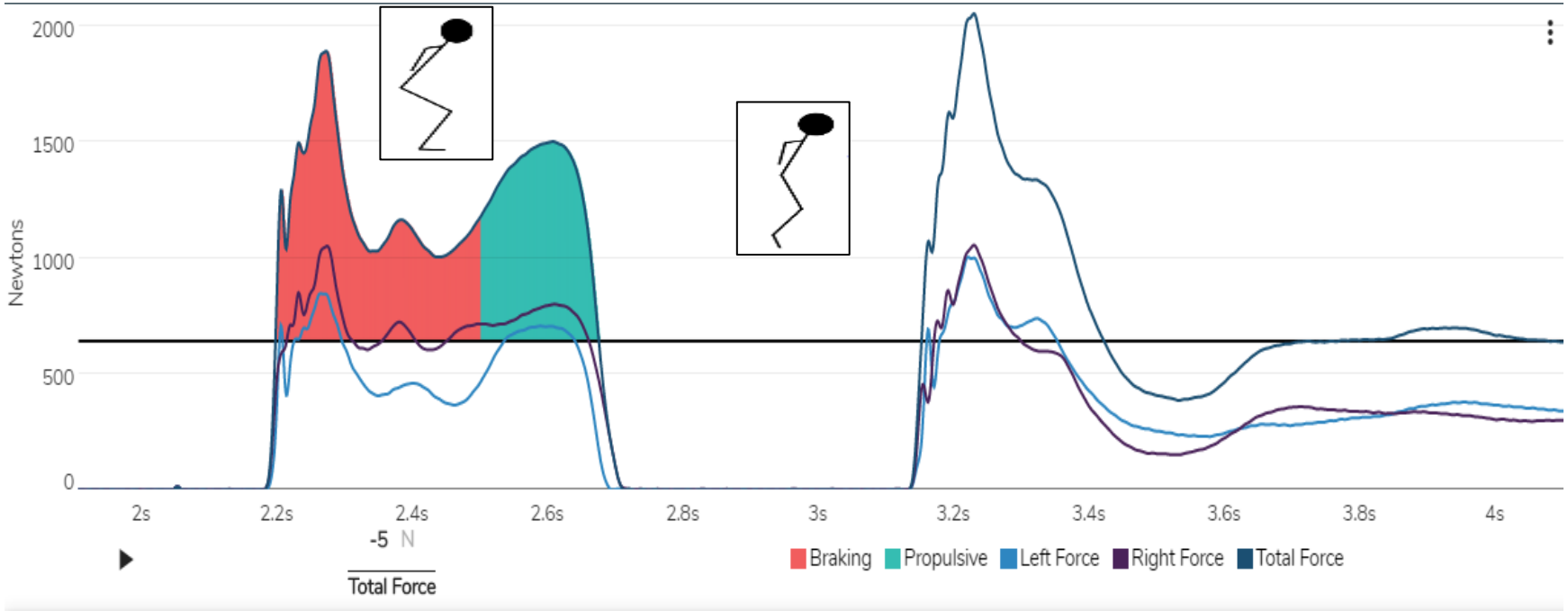
- Measurable difference in performance/function between L/R limbs
  - Hamstring strains
  - Lower back pain
  - ACL tears

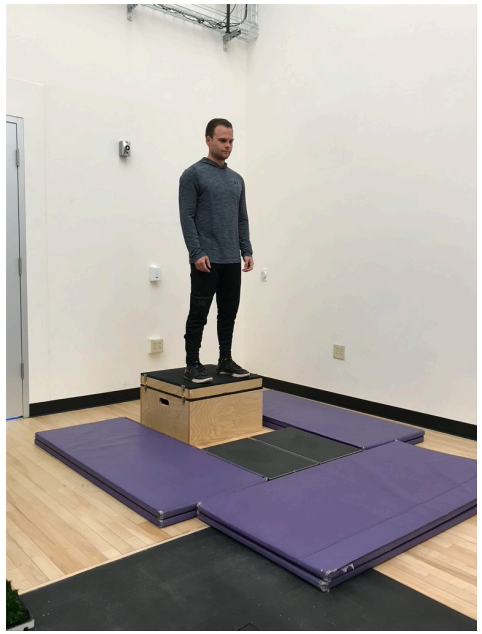
Functional Movement Assessments

- Simple, repeatable movements that may reveal risky biomechanics
  - Kinetic Chain Theory, Force Platforms

3 categories of FMAs:

1. Drop Jump (DJ)





1 →

2 →

3 →

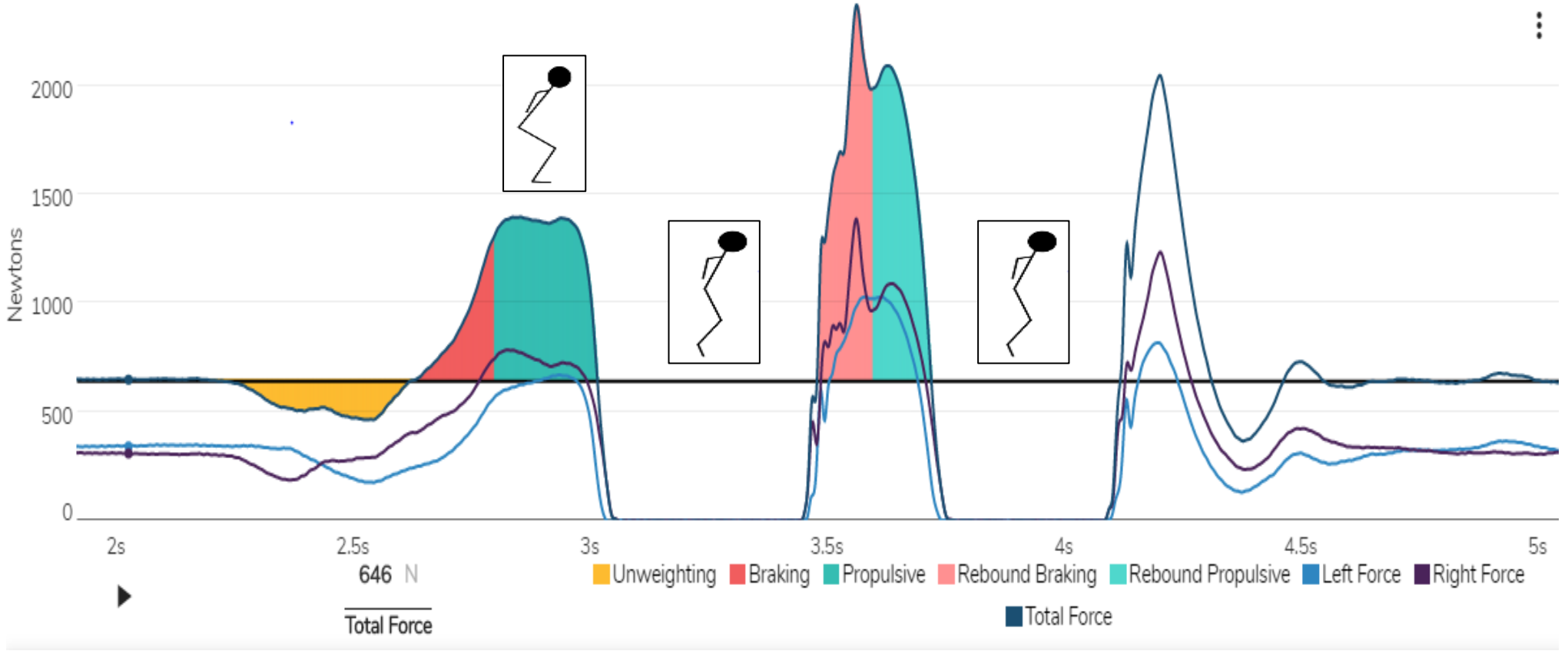
4 ↓

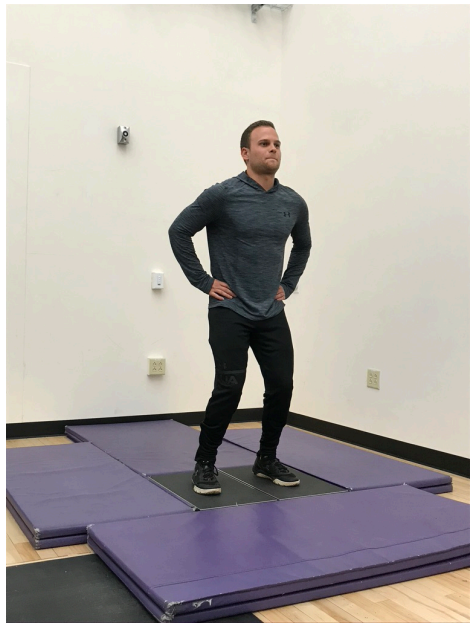
5

Drop Jump (DJ)

Functional Movement Assessments cont.

2. Countermovement Jump w/ Rebound (CMJR)





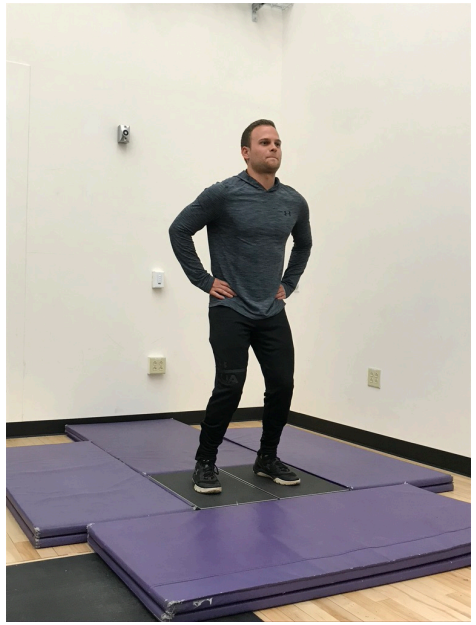
1

2

3

4

5



6

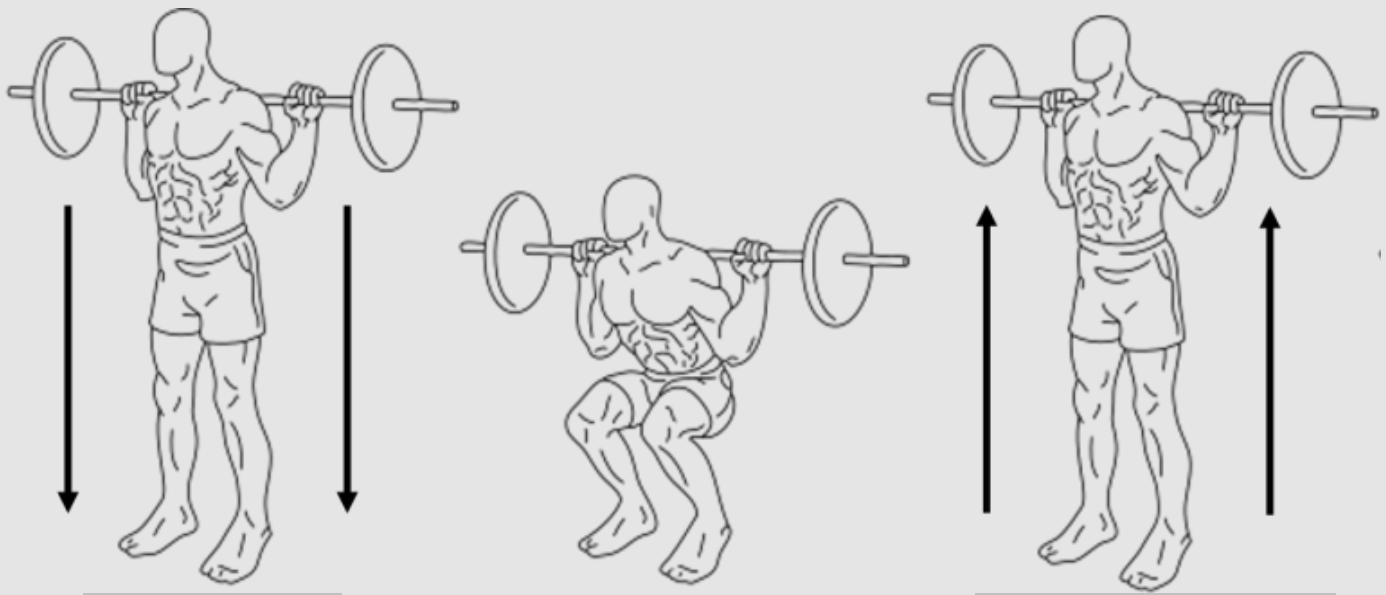
Countermovement Jump with Rebound Jump (CMJR)

Functional Movement Assessments cont.

3. Single-leg Countermovement Jump (SL CMJ)

1 → 2 → 3 → 4

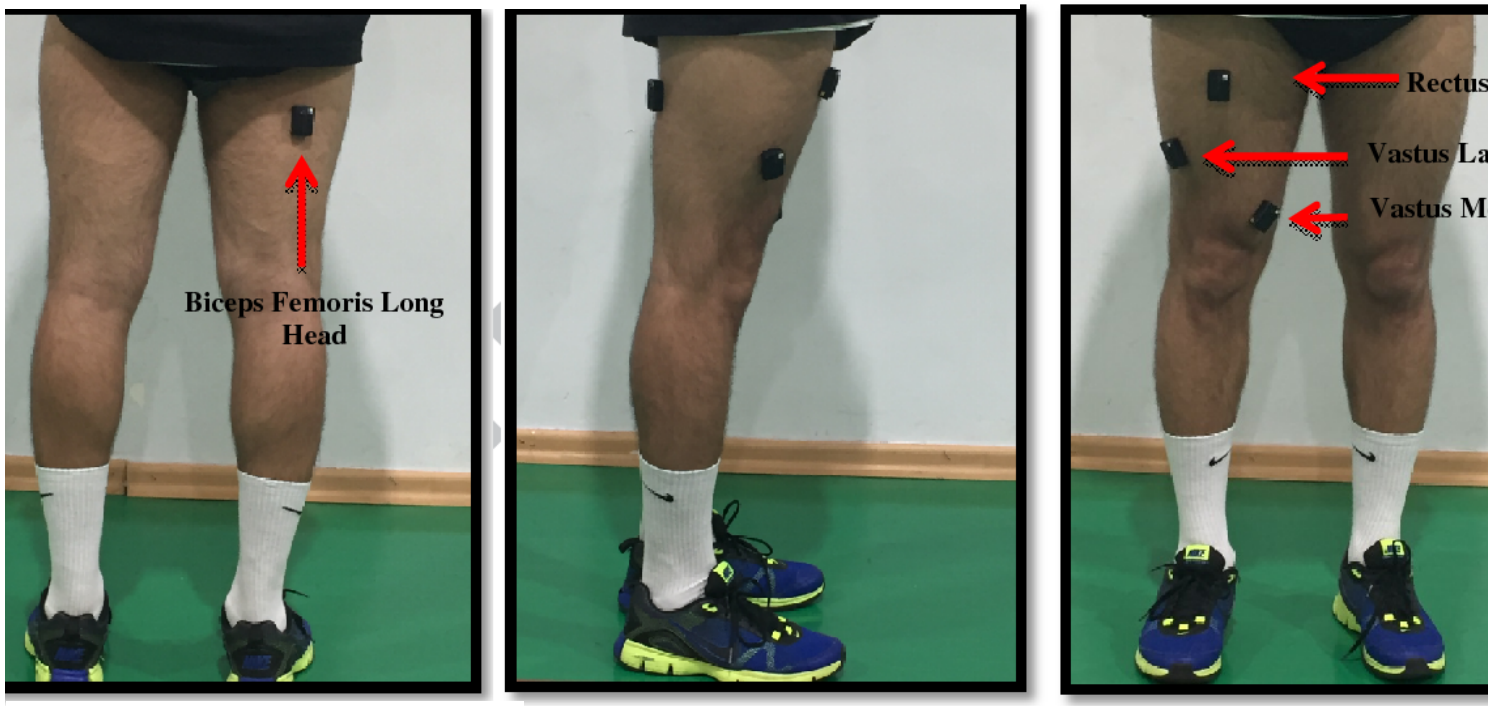
Braking vs. Propulsive Movements



Braking

Propulsive

- Braking: muscle lengthening under load (“resisting”)
- Propulsive: muscle shortening under load (“contracting”)
- Measuring asymmetry in both phases of movements → more info about injury risk



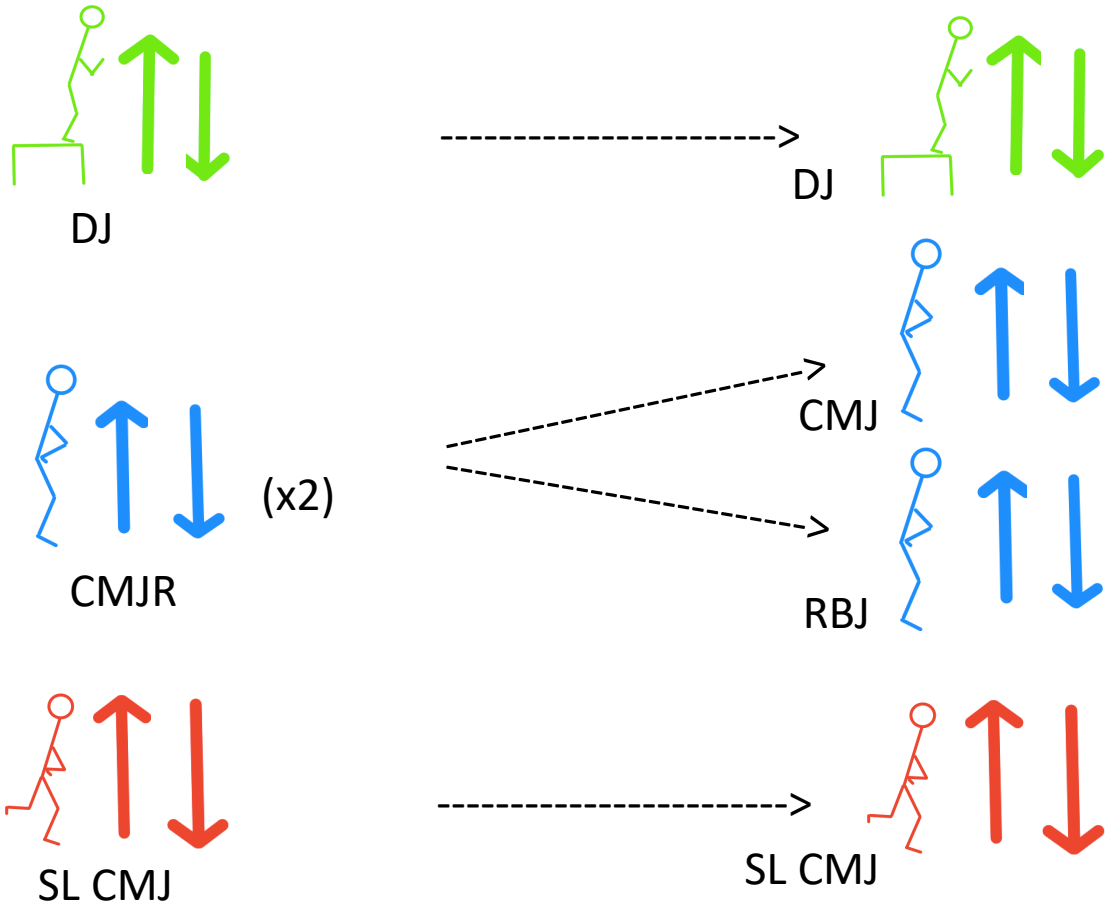
Electrode placement during muscle activation analysis (Sismek, 2017)

Muscle Activation Patterns

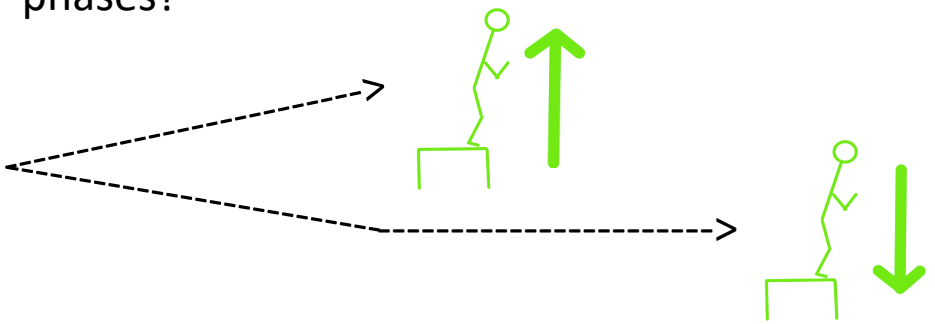
- Past research in muscle activation/neurological control
- Each phase/movement type should be categorized!
  - Braking Phase vs. Propulsive Phase
  - Unilateral vs. Bilateral

Research Questions

1. Are 4 functional movement assessments interchangeable? (DJ, CMJ (countermovement jump), RBJ (rebound jump), SL CMJ)



2. Do we get any additional information by dividing these movements into braking and propulsive phases?

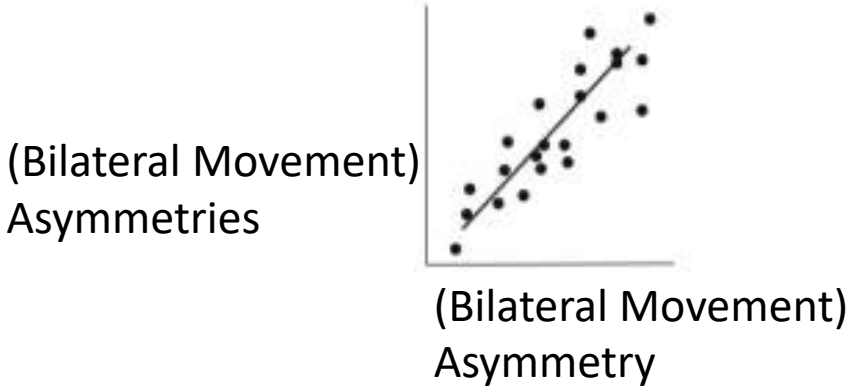


Etc.

Hypotheses

- 3 Bilateral Movements will correlate strongly
- Unilateral Movements (SL CMJ) will correlate weakly with Bilateral movements (DJ, CMJ, RBJ)
- Braking Force will correlate weakly with Propulsive Force

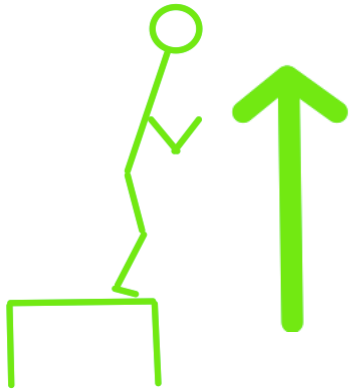
Example Graphs

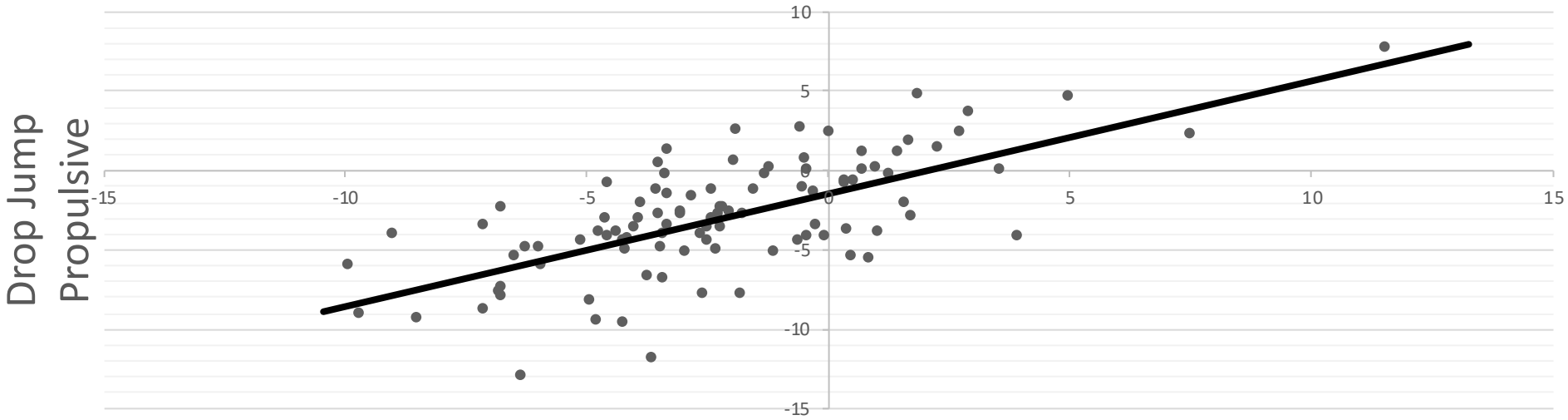


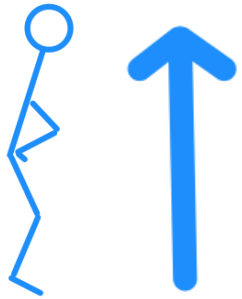
Methods

- N=104, 3 jump types (DJ, CMJR, SL CMJ), 3 trials each
- 4 movements analyzed: DJ, CMJ, RJ, SL CMJ
- Pearson's Correlations
  - R>0.5 = Strong
  - 0.3<R<0.5 = Moderate
  - R<0.3 = Weak

Results: Bilateral vs. Bilateral Propulsive







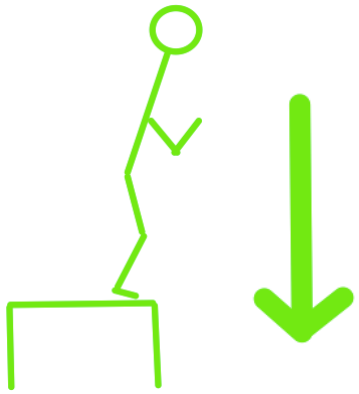
R = 0.679 (CMJ – DJ)

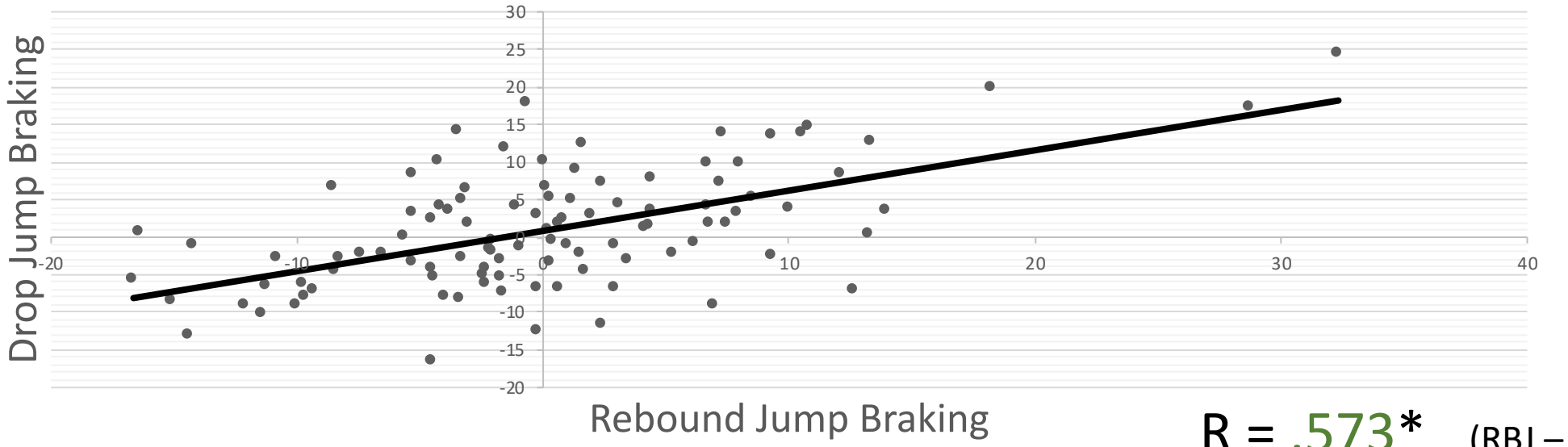
0.660 (RBJ – DJ)

0.708 (CMJ – RBJ)

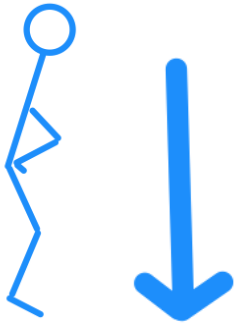
ALL STRONG CORRELATIONS

Results: Bilateral vs. Bilateral Braking





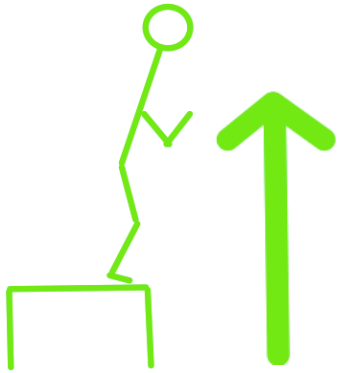
R = .573* (RBJ – DJ)

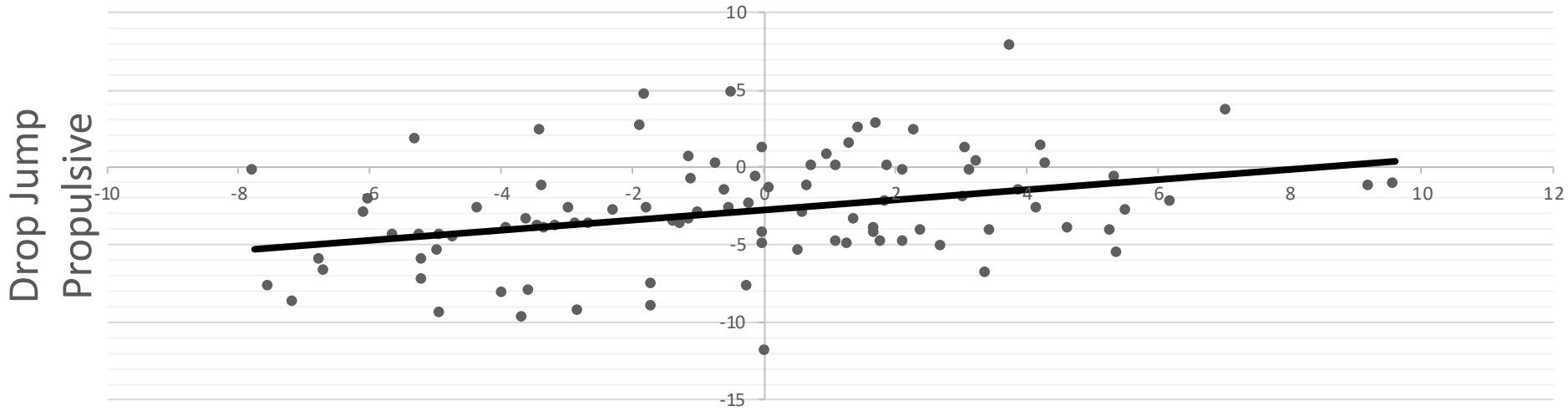


ALL STRONG CORRELATIONS

*only correlation we were able to make in this category

Results: Unilateral (SL CMJ) vs bilateral propulsive



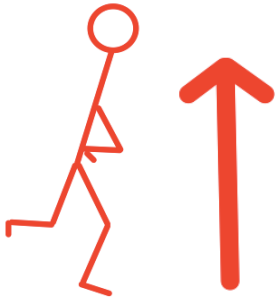


Single Leg Countermovement Jump Propulsive

R = .350 (SLCMJ – DJ)

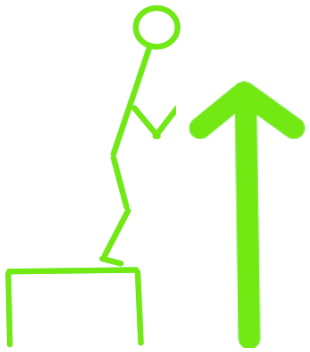
.321 (SLCMJ - CMJ)

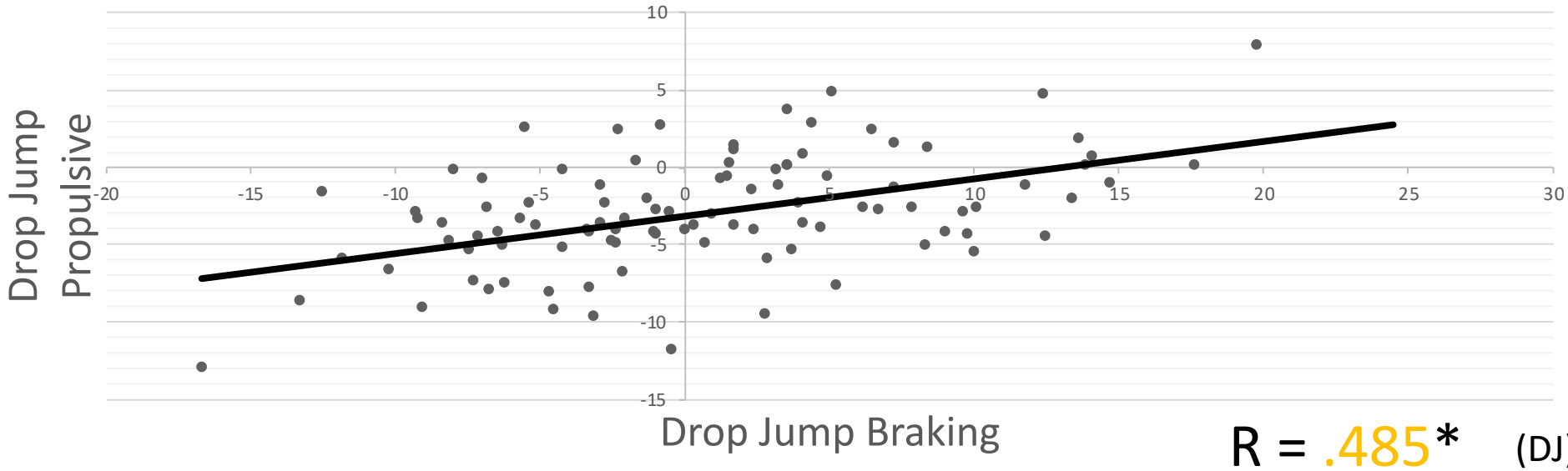
.278 (SLCMJ – RBJ)



ALL MODERATE/WEAK CORRELATIONS

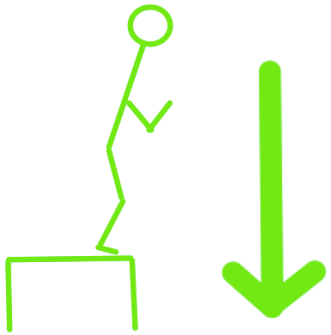
Results: Propulsive vs. Braking





R = .485* (DJ)

.440* (RBJ)



ALL MODERATE CORRELATIONS

*-only were able to make two correlations in this category

Conclusions

Research Question	Conclusion(s)
1. Are any functional movement assessments interchangeable?	• - Bilateral movements correlate strongly → potentially interchangeable • - Bilateral vs. Unilateral correlate weakly → not interchangeable
2. Any additional info from dividing into braking and propulsive?	• - Yes. Braking vs. Propulsive moderately correlated → not interchangeable

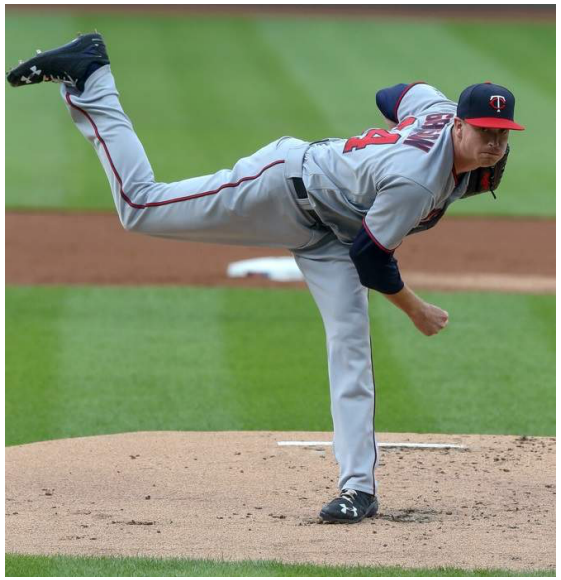
All movements and phases provide unique information → should be used together

Genetic Basis for Functional Asymmetry

- Early developmental signaling pathways → L/R body asymmetry → “handedness”
- Handedness could be associated with:
  - Asymmetry in muscular strength
  - Asymmetry in neuromuscular control

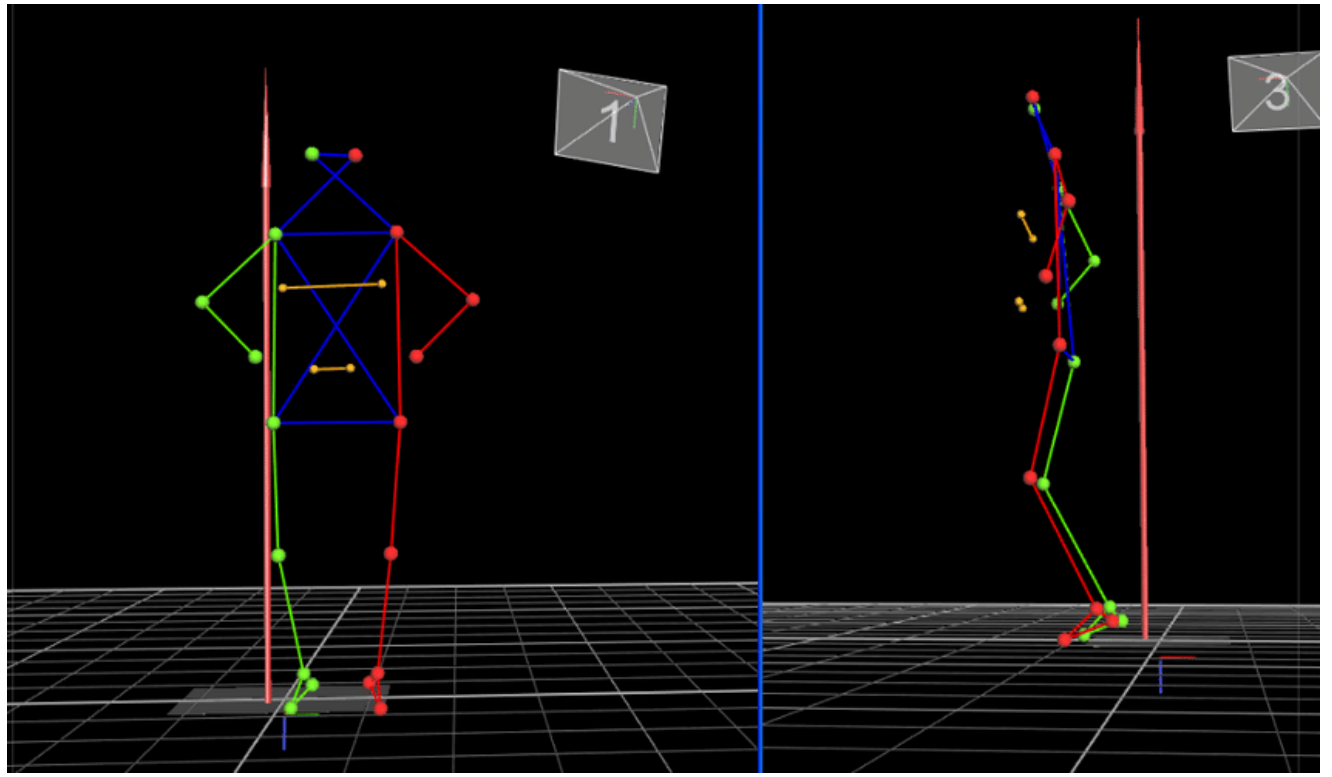
Other Important Factors to Consider

- Leg-Length Asymmetry
- Adaptive Asymmetries in certain sports
  - Baseball, Australian Football, Cricket Fast Bowlers



Future Directions

- Address limitations: control for prior activity, warmup type/duration, obtain medical records
- Larger sample size to perform inter-class correlations
  - Sex-Specific/Sport-Specific/Position-specific
  - Leg-length asymmetry classes
  - Measure limb strength and neurological control
- 3-D motion capture (Kinematic Variables)



(Cazzola, 2010)

Acknowledgements

- Dr. Raoul Reiser, Dept. of Health and Human Sciences, Colorado State University
- Dr. Emilie Gray, Dept. of Organismal Biology and Ecology, Colorado College
- Colorado State University Dept. of Athletics
- Colorado State University Dept. of Health and Human Science
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- Colorado College Dept. of Organismal Biology and Ecology

THANK YOU!

Any questions please let me know:

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Supplemental Equations, etc.

- Asymmetry Equation: (((Left limb force-Right Limb force)/((0.5)*(Right limb force+Left limb force)))*100=% asymmetry