



**LEHIGH**  
UNIVERSITY.



# Kingetics LLC Final Presentation

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# Kingetics, LLC: The Trident of Footwear

Kingetics LLC was founded by Dr. Steven King, a current podiatrist and past US army officer, after he broke his foot in 2007.

He designed and manufactured a rigid, levered spring orthosis-insert-midsole system made of advanced composites—a design superior to normal foam insoles.

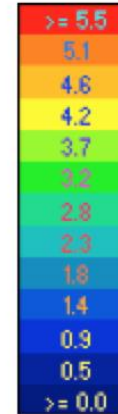


# Protection~Stability~Efficiency

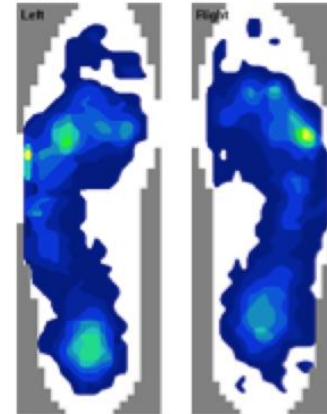
The Kingetics system has been proven to:



**Kg/cm<sup>2</sup>**



**Kingetics Insoles**



compared to a standard foam midsole layer.

# Competition: Nike Vapor Fly



## Nike Vapor Fly 4% Flyknit

- Intended to be used by world class marathon runners
- Claims to deliver breathable support, responsive foam with a full length carbon fiber plate that provides energy return
- Claims an aerodynamic heel design reduces drag

# Current Market/ Financials

- Sport/Court price before: \$350
- Military Boot price before: \$530
  - Reduce pricing through:
    - Injection molding cradle
    - Switch boot model
    - Switch Foam Topper manufacturer
- Sport/Court price after: \$225
- Military Boot price after: \$300
- Estimated current manufacturing costs:
  - Sport/Court Shoe: \$262.32
  - Military Boot: \$337.36
- Estimated reduced manufacturing costs:
  - Sport/Court shoe: \$143.12
  - Military Boot: \$189.16

# Verifying Further Claims: Shock Absorption

**Our Goal:** The Kingetics, LLC mechanical orthosis-insert-midsole system is a new innovation to the market which has contracted our TE Capstone Team to test and verify claims of improved impact reduction over current foam based footwear systems.



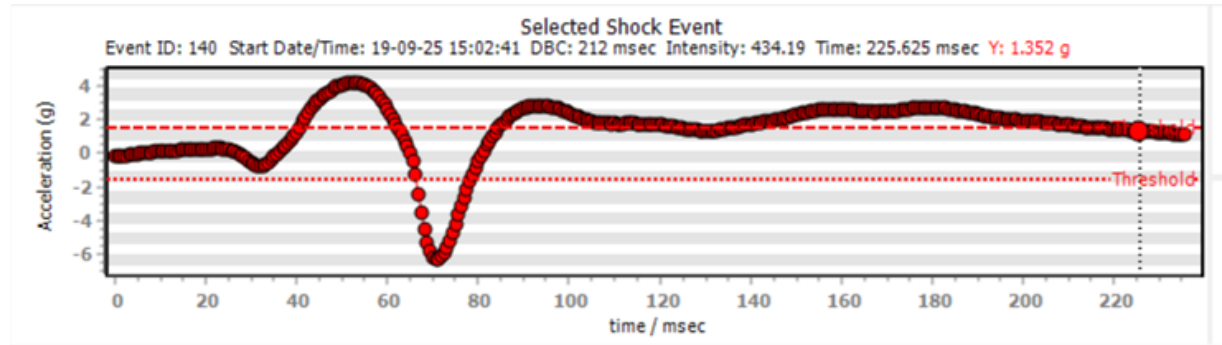
# The Importance of Reducing Shock

The Kingetics system has the ability to reduce injury from running and walking by diminishing the shock felt by the musculoskeletal system. It does so by absorbing more shock upon ground contact compared to normal foam insoles.



# Measuring Shock Absorption via Accelerometer

Shock absorption will be tested with an accelerometer. An accelerometer is an electromechanical device used to measure acceleration values.





# Our Test Method: Human Subject Testing



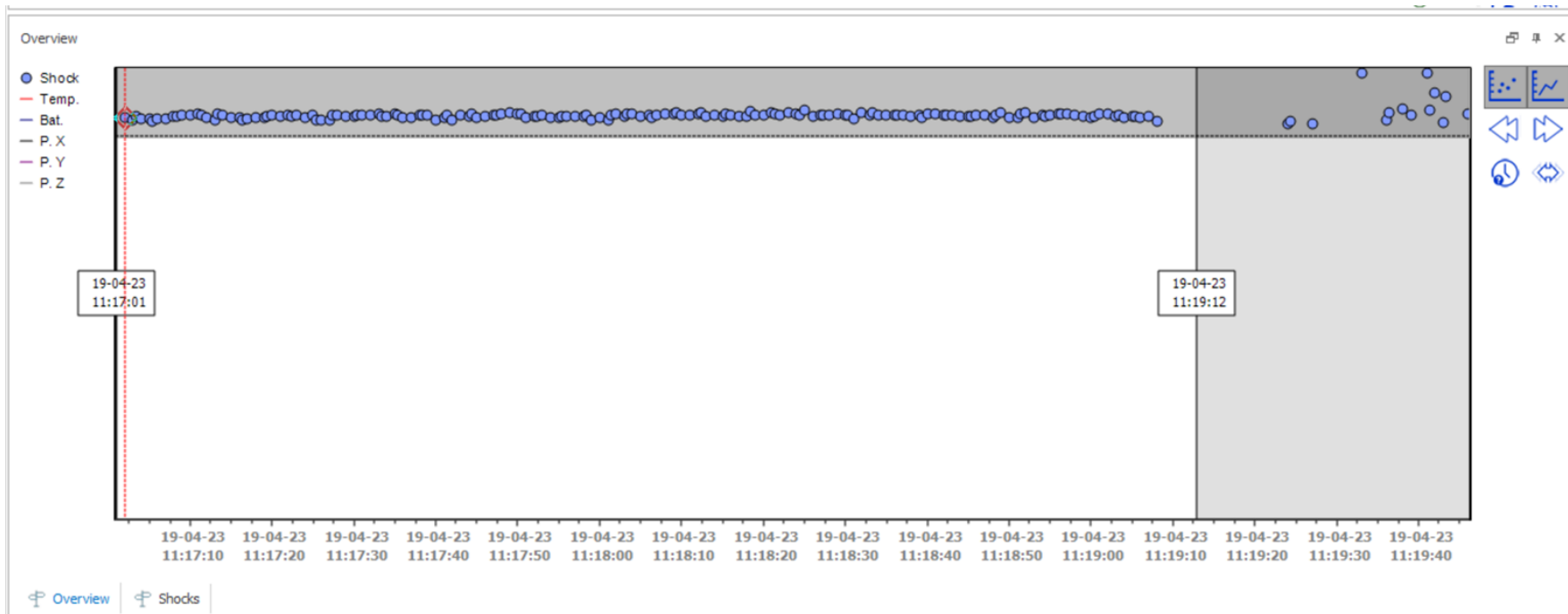
Walking, 0% Incline,  
2 mph

Running, 0% Incline,  
5 mph

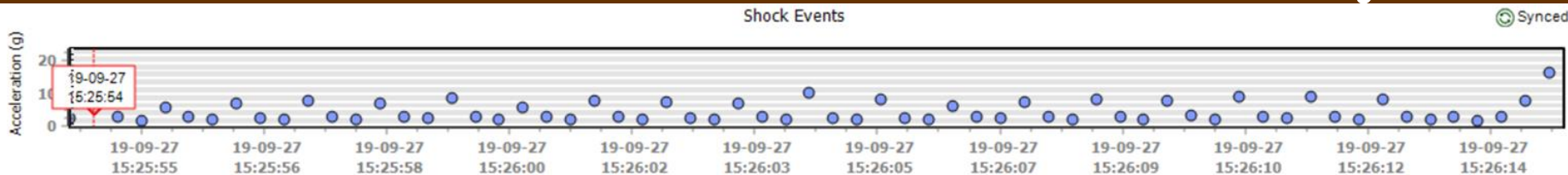
Walking, 3% Incline,  
2 mph

Running, 3% Incline,  
5 mph

# From Data Collection to Data Analysis

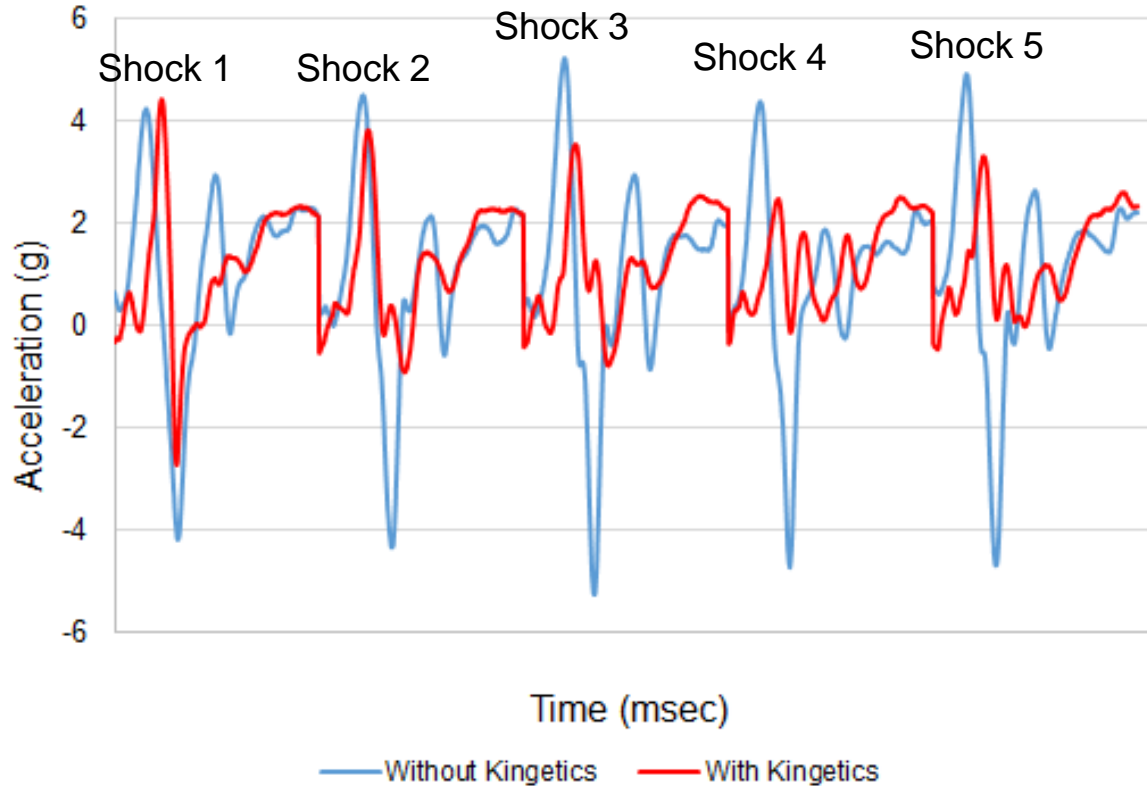


# From Data Collection to Data Analysis



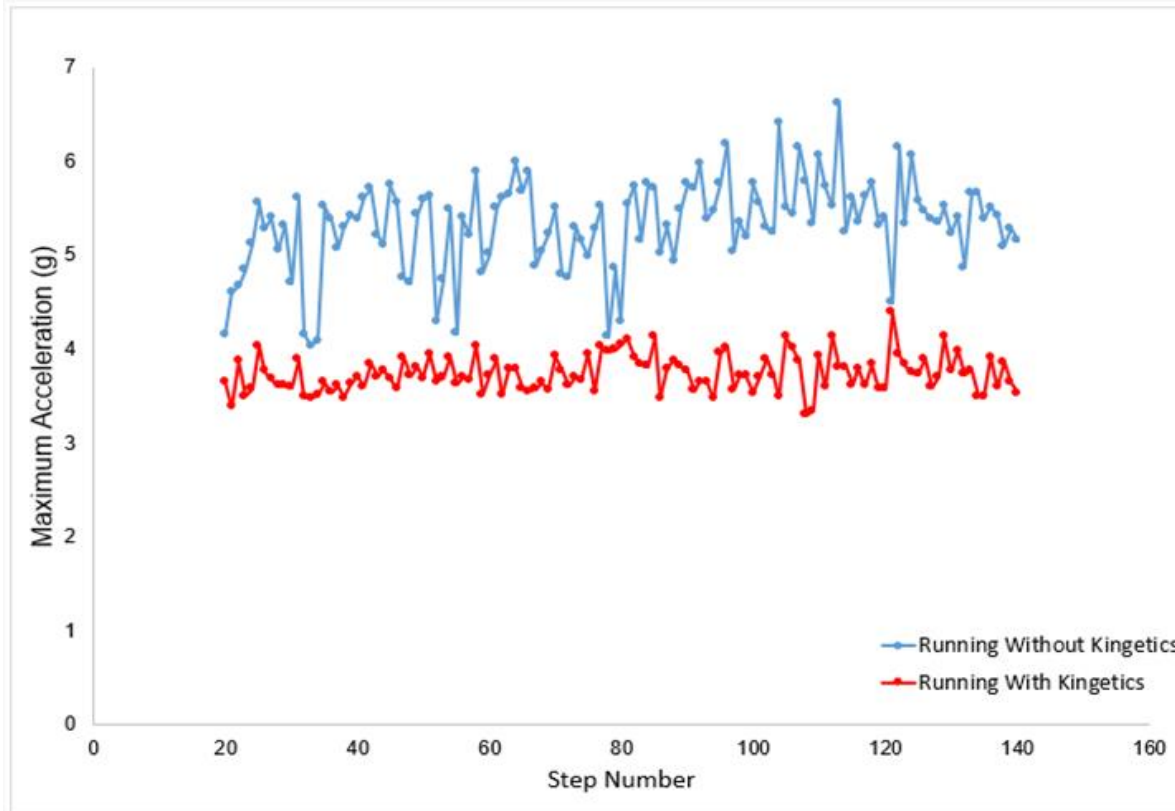
ID	Date/Time	imum Accelerz	Intensity	DBC	Temperature	Battery	Position X	Position Y	Position Z
35	19-09-27 15:25:05.433	7.032	255.9267	137.5	29.3	3.893555	-0.224	1.048	-0.216
36	19-09-27 15:25:05.769	2.792	207.6237	203.75	29.3	3.893555	-0.224	1.048	-0.216
37	19-09-27 15:25:06.105	2.72	206.6595	158.125	29.3	3.893555	-0.224	1.048	-0.216
38	19-09-27 15:25:06.441	6.384	376.6039	190.625	29.3	3.893555	-0.224	1.048	-0.216
39	19-09-27 15:25:06.778	2.336	187.7373	164.375	29.3	3.893555	-0.224	1.048	-0.216
40	19-09-27 15:25:07.114	2.192	176.8532	158.75	29.3	3.893555	-0.224	1.048	-0.216
41	19-09-27 15:25:07.450	9.08	345.9621	148.75	29.3	3.893555	-0.224	1.048	-0.216
42	19-09-27 15:25:07.786	3	200.9827	159.375	29.3	3.893555	-0.224	1.048	-0.216
43	19-09-27 15:25:08.123	2.664	229.5104	157.5	29.3	3.893555	-0.224	1.048	-0.216
44	19-09-27 15:25:08.459	7.584	375.1024	186.875	29.3	3.893555	-0.224	1.048	-0.216
45	19-09-27 15:25:08.795	2.816	206.8697	171.875	29.3	3.893555	-0.224	1.048	-0.216

# Analyzed Data: Consecutive Shock Events



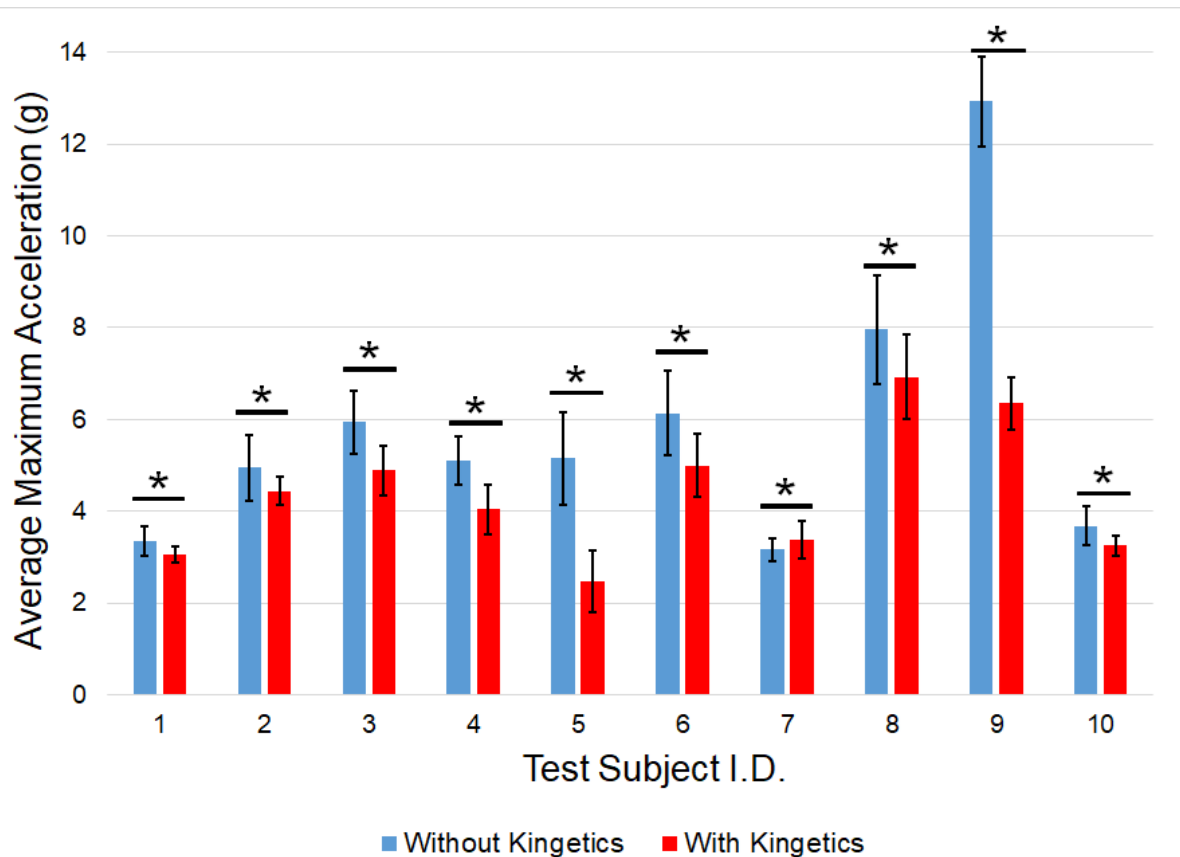
**Five consecutive shock events running with the Kingetics system and running without the Kingetics system on a flat surface.**

# Analyzed Data: Maximum Acceleration



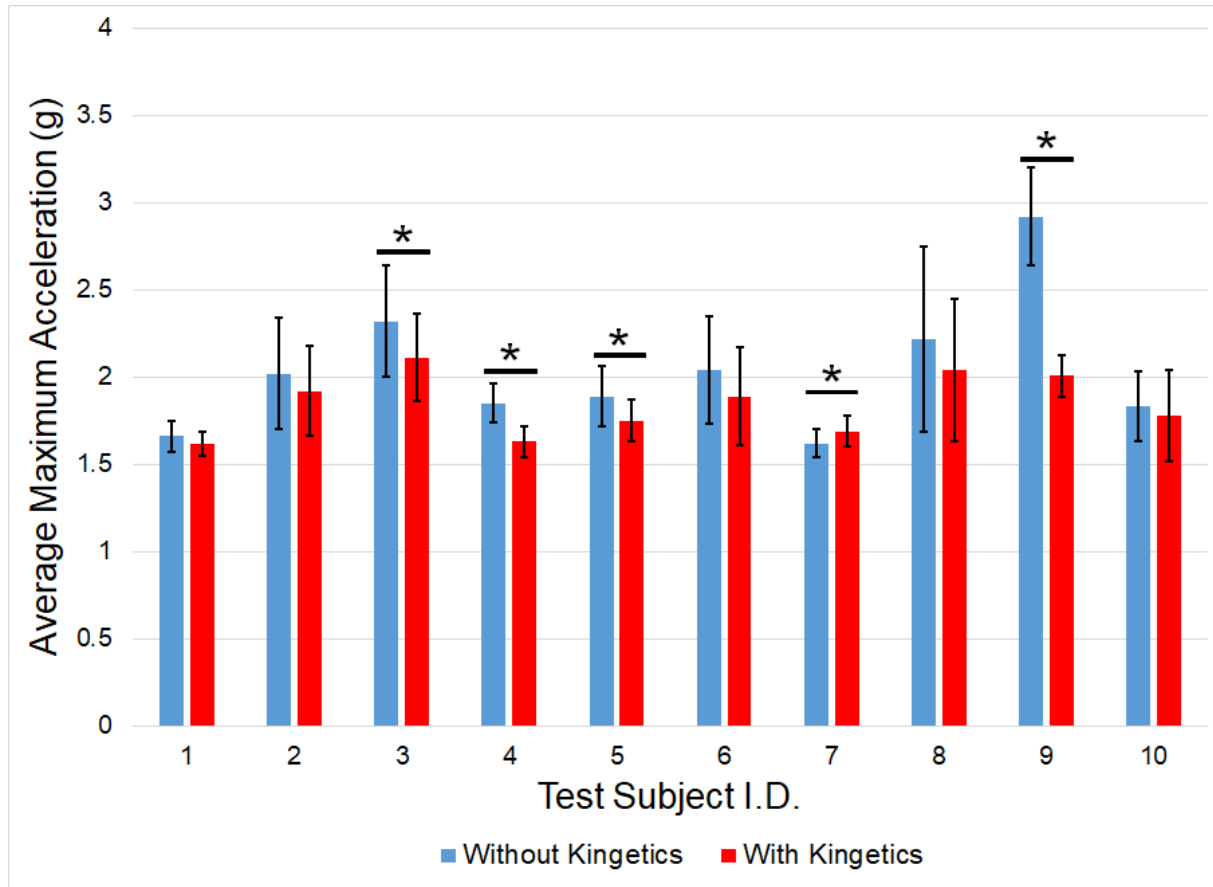
**Maximum  
acceleration of shock  
events running with  
and without the  
Kinetics system on  
a flat surface.**

# Analyzed Data: Running on a Flat Surface



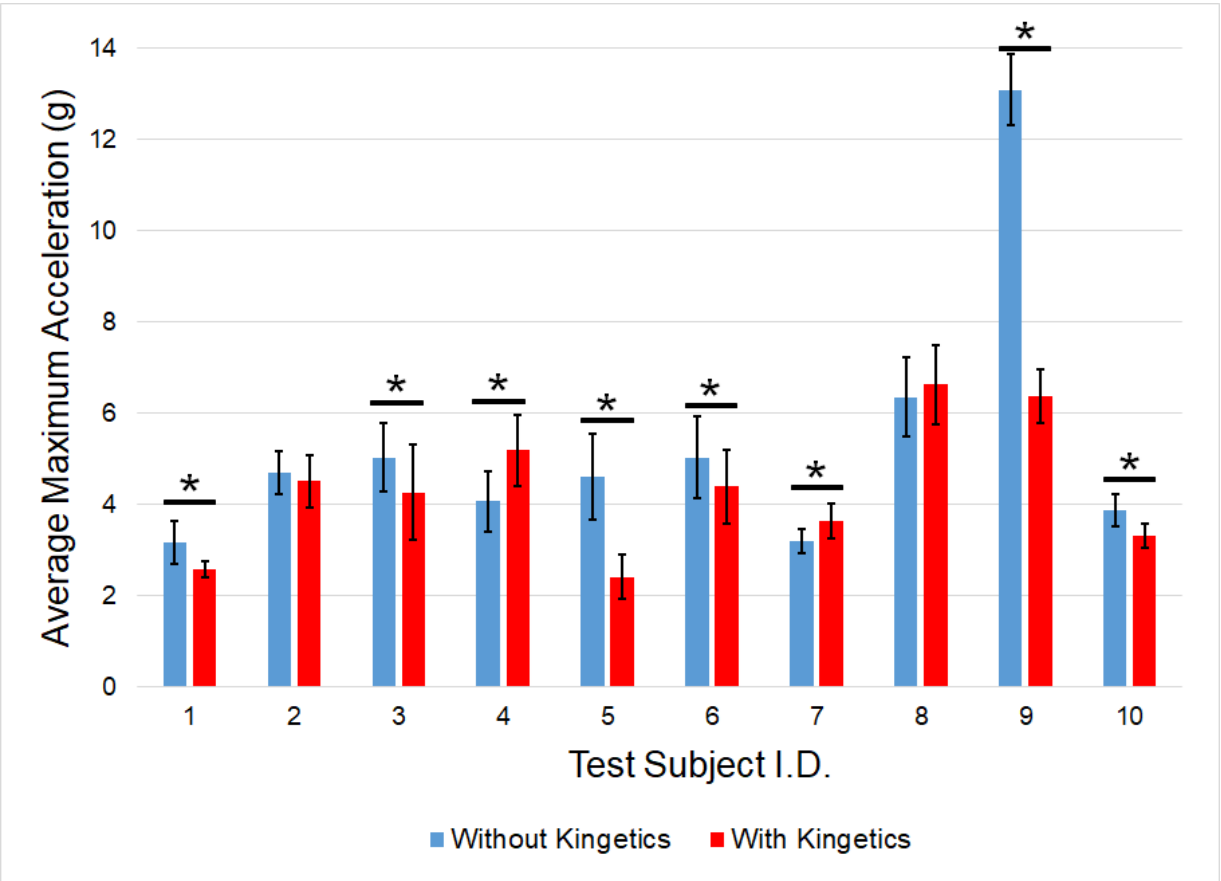
“\*” represents statistical significance using a t-test ( $p < 0.05$ ).

# Analyzed Data: Walking on a Flat Surface



“\*” represents statistical significance using a t-test (p<0.05).

# Analyzed Data: Running on an Inclined Surface

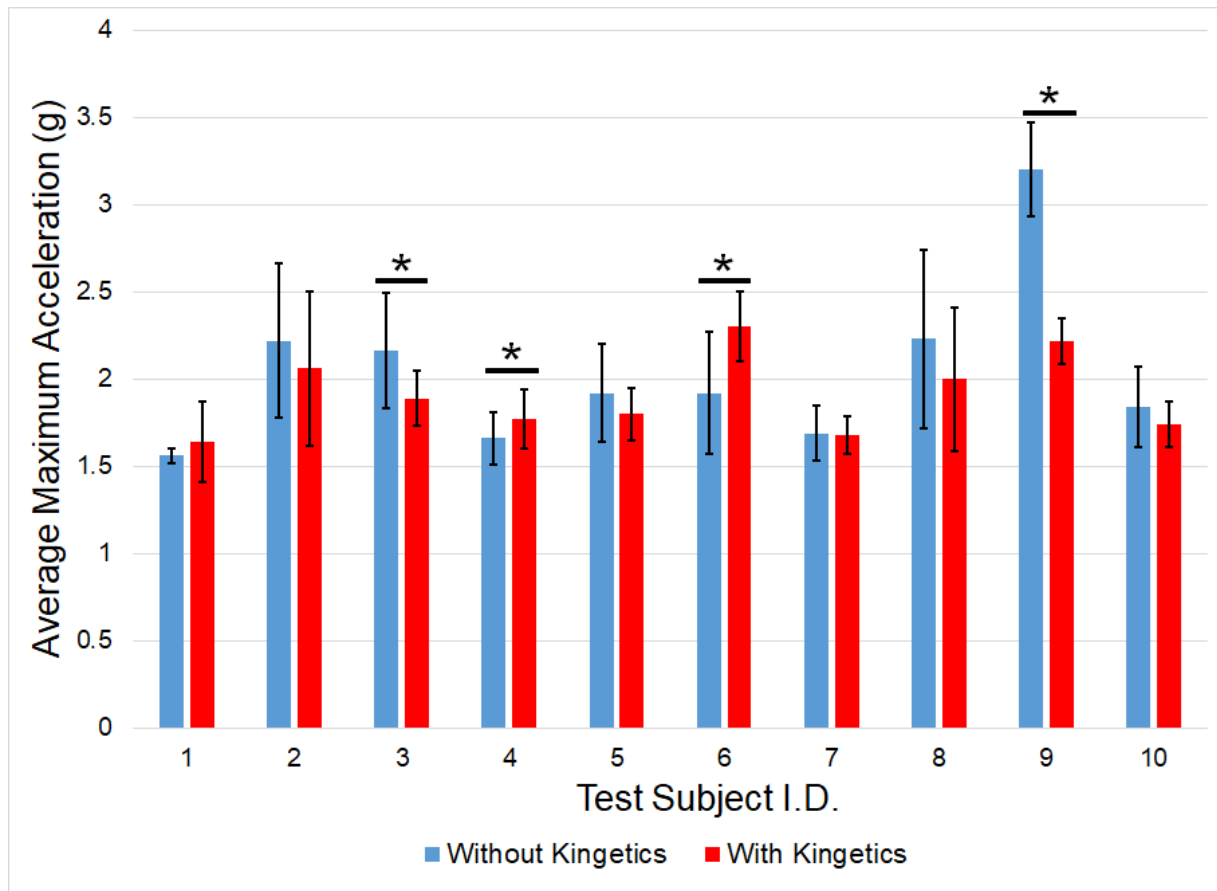


“\*” represents statistical significance using a t-test (p<0.05).





# Analyzed Data: Walking on an Inclined Surface



“\*” represents statistical significance using a t-test (p<0.05).

# Statistical Analysis: t-test

Subject	Running, Flat	Running, Incline	Walking, Flat	Walking, Incline
1	0.00058824	1.45308E-06	0.05841124	0.09355805
2	0.00252763	0.16356582	0.32856315	0.20704159
3	2.67065E-07	0.00022504	0.01391421	0.00066484
4	7.07776E-09	1.59439E-06	1.58197E-09	0.01750518
5	5.47388E-14	1.63988E-12	0.0013238	0.08707374
6	1.05322E-05	0.01031539	0.07439526	3.16887E-05
7	0.03325747	1.67708E-05	0.00333178	0.65000405
8	0.00112971	0.26888807	0.17243866	0.07938511
9	1.42752E-27	1.09351E-33	3.56642E-16	1.29519E-17
10	4.17829E-05	1.2824E-07	0.47207643	0.05395731

# Experimental Conclusions

## Running vs Walking

- High vs low impact loading

## Flat Surface vs Incline

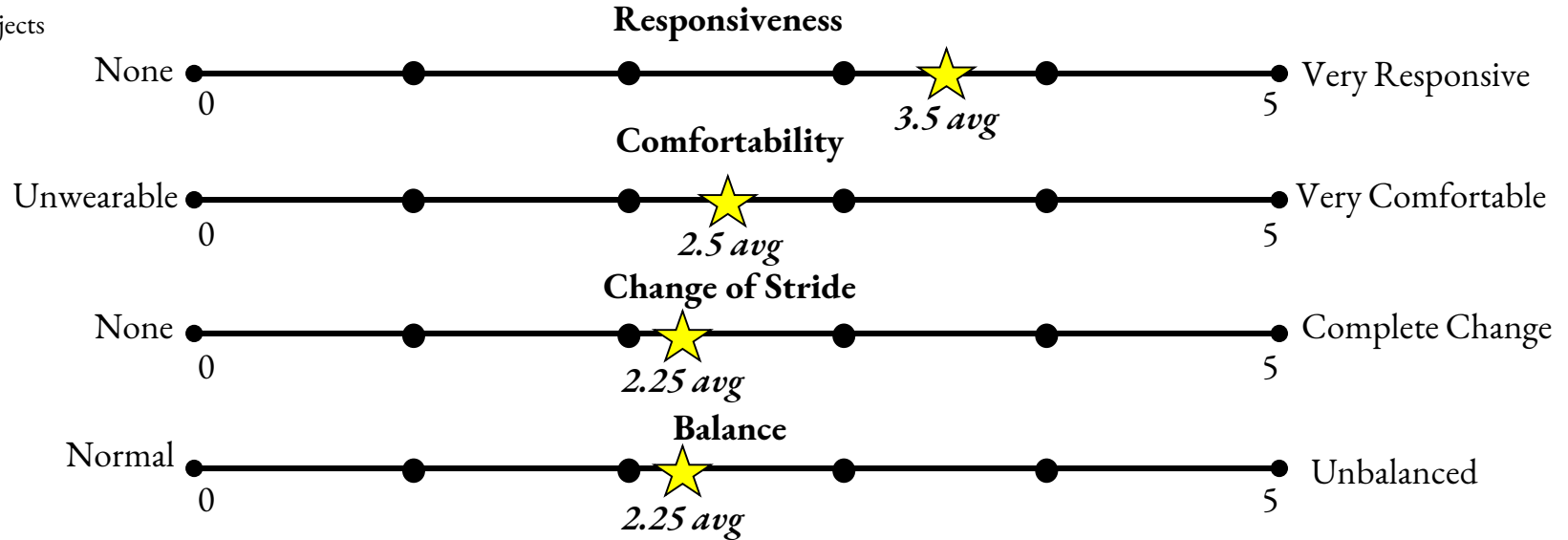
- Change in gait and stride

## Sources of Error

- Accelerometer

# Post-Experiment Survey

\*8 of 10 test subjects



Test subjects noted:

- Reduced ground impact
- Raised heel
- Increased support/ responsiveness
- Less pressure on heels
- More apparent while running
- Activated calves more

# Future Work

## Experimental Continuation

- Increase sample size
- Increase variability (age, weight, height, gender)
- Alter accelerometer placement
- Incorporate new activities

## Equipment Validation

- Confirm accelerometer placement is effective and is attached tightly enough
- Find new ways to attach the accelerometer to see if there are differences in data

## Additional Statistical Analysis

- Utilize the software JMP to create a DOE and assess relationships between variables in our continued experimentation

# Acknowledgements

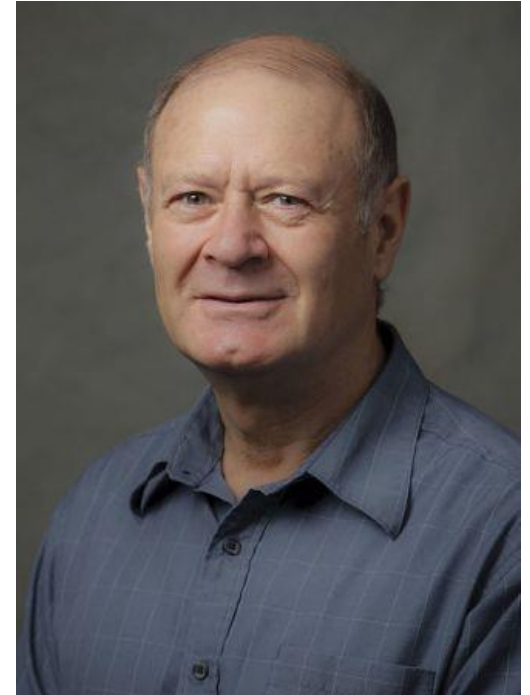
Dr. Steven King



Dr. Sabrina Jedlicka



Dr. Arkady Voloshin



Thank you for listening!

QUESTIONS?