

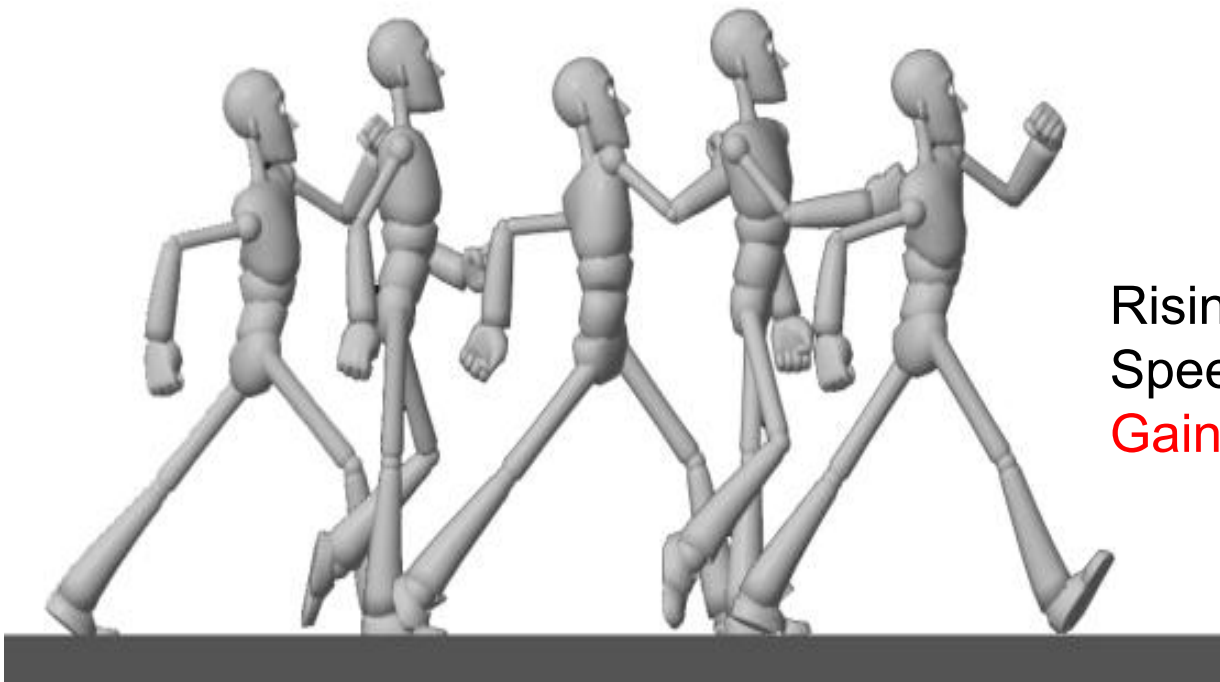
# Weight Shift & Walks Part 2



National Science Foundation  
WHERE DISCOVERIES BEGIN

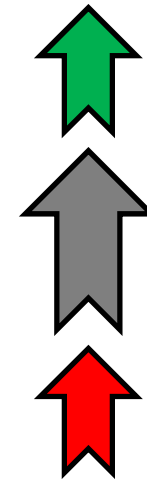
# Weight Shift in Walks

Up and down motion in a walk causes weight changes for the character.



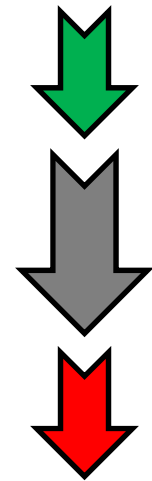
With gravity

Rising &  
Slowing Down:  
Lose Weight



Rising &  
Speeding Up:  
Gain Weight

Falling &  
Speeding Up:  
Lose Weight

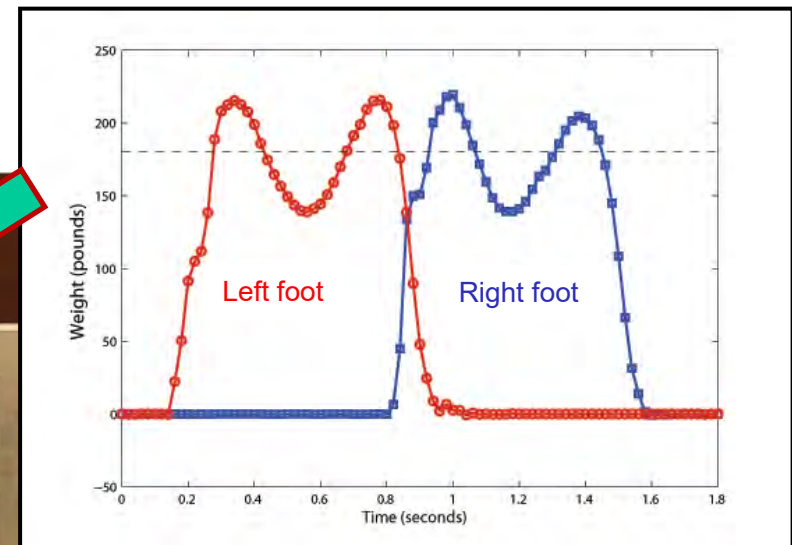
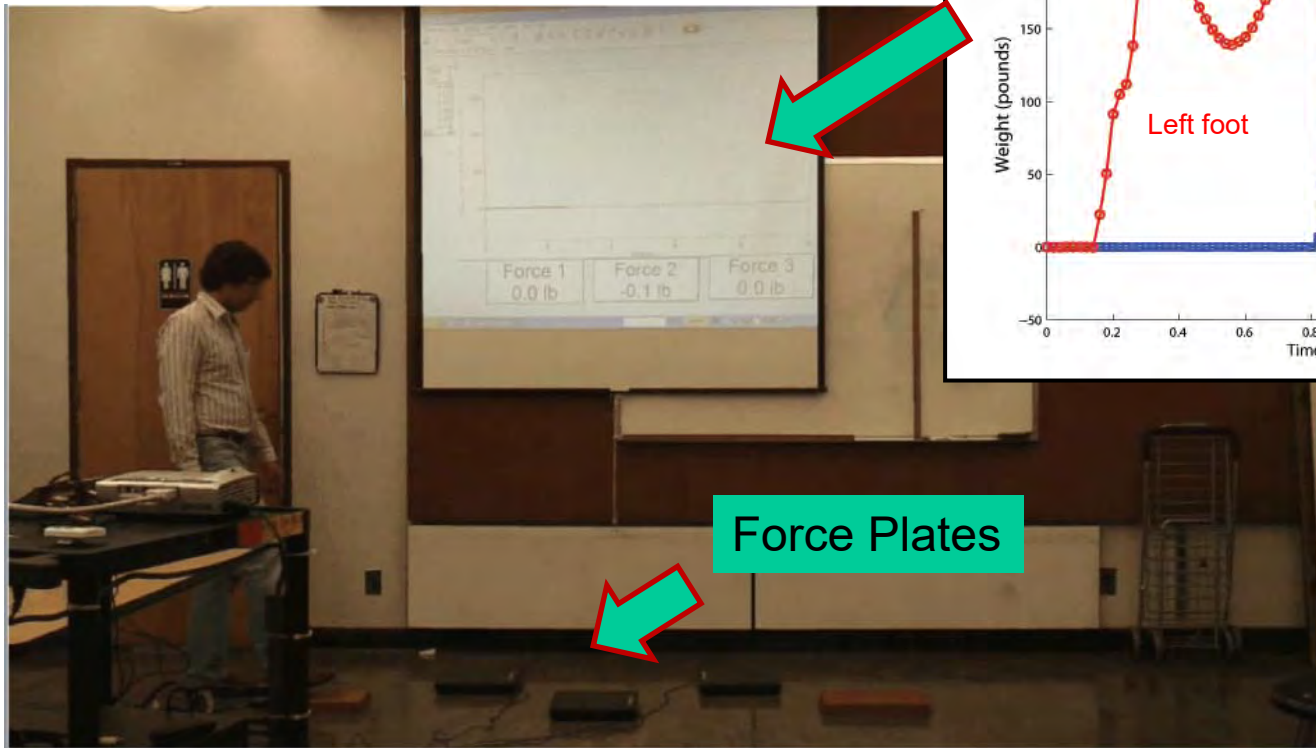


Falling &  
Slowing Down:  
Gain Weight

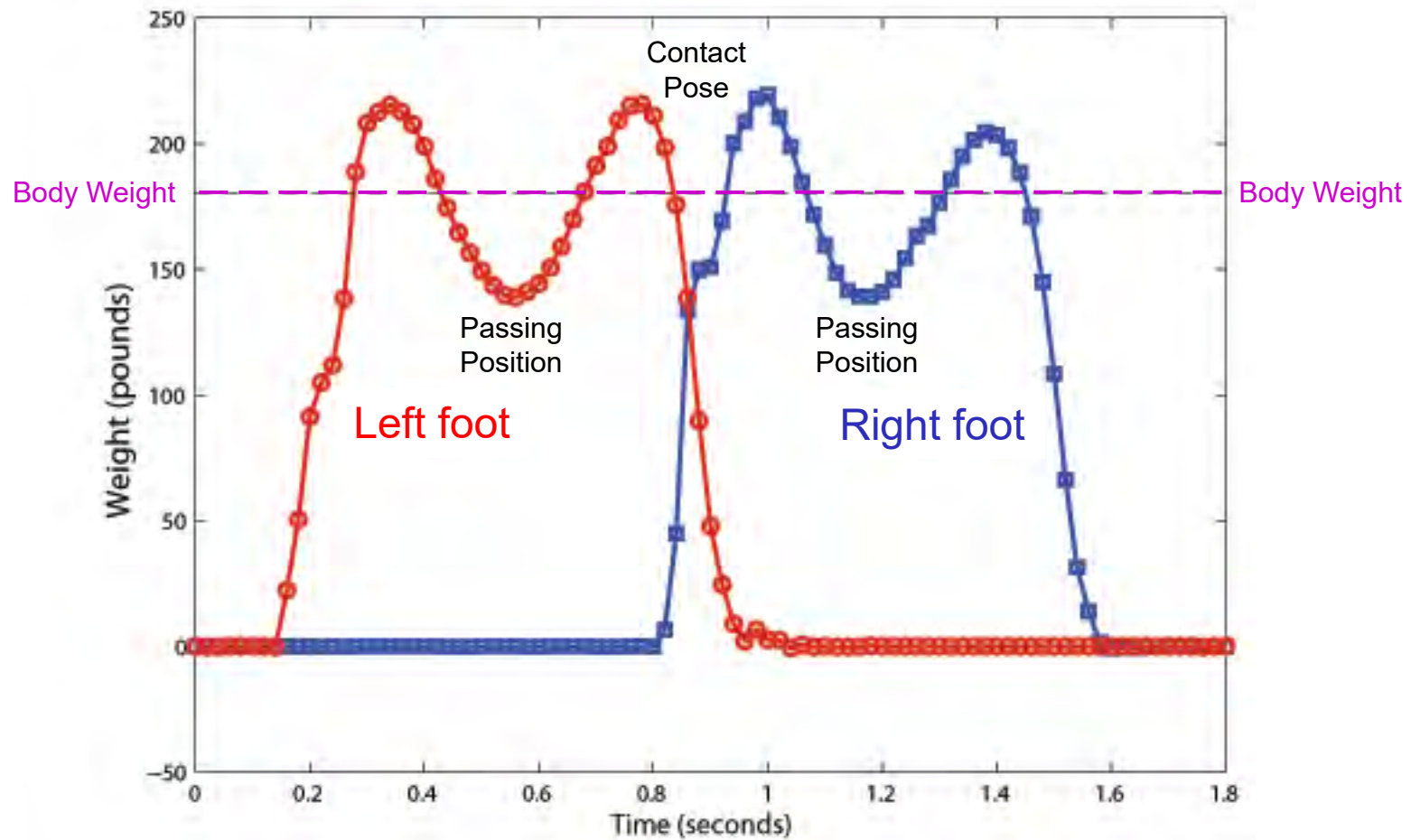
Against gravity

# Force Plate Measurements

Force plates measure and record the weight on each foot during a walk.



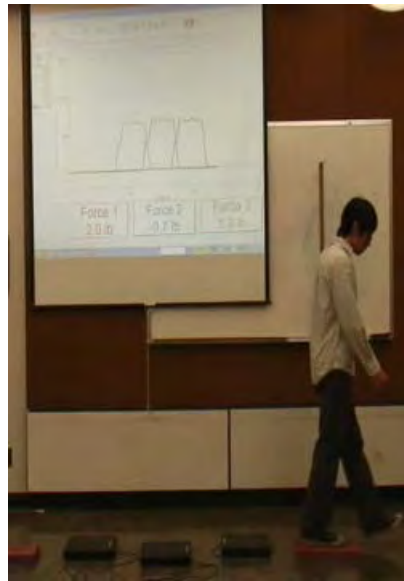
# Force Plate Measurements



# Normal, Slow, and Fast Walks



Normal walk



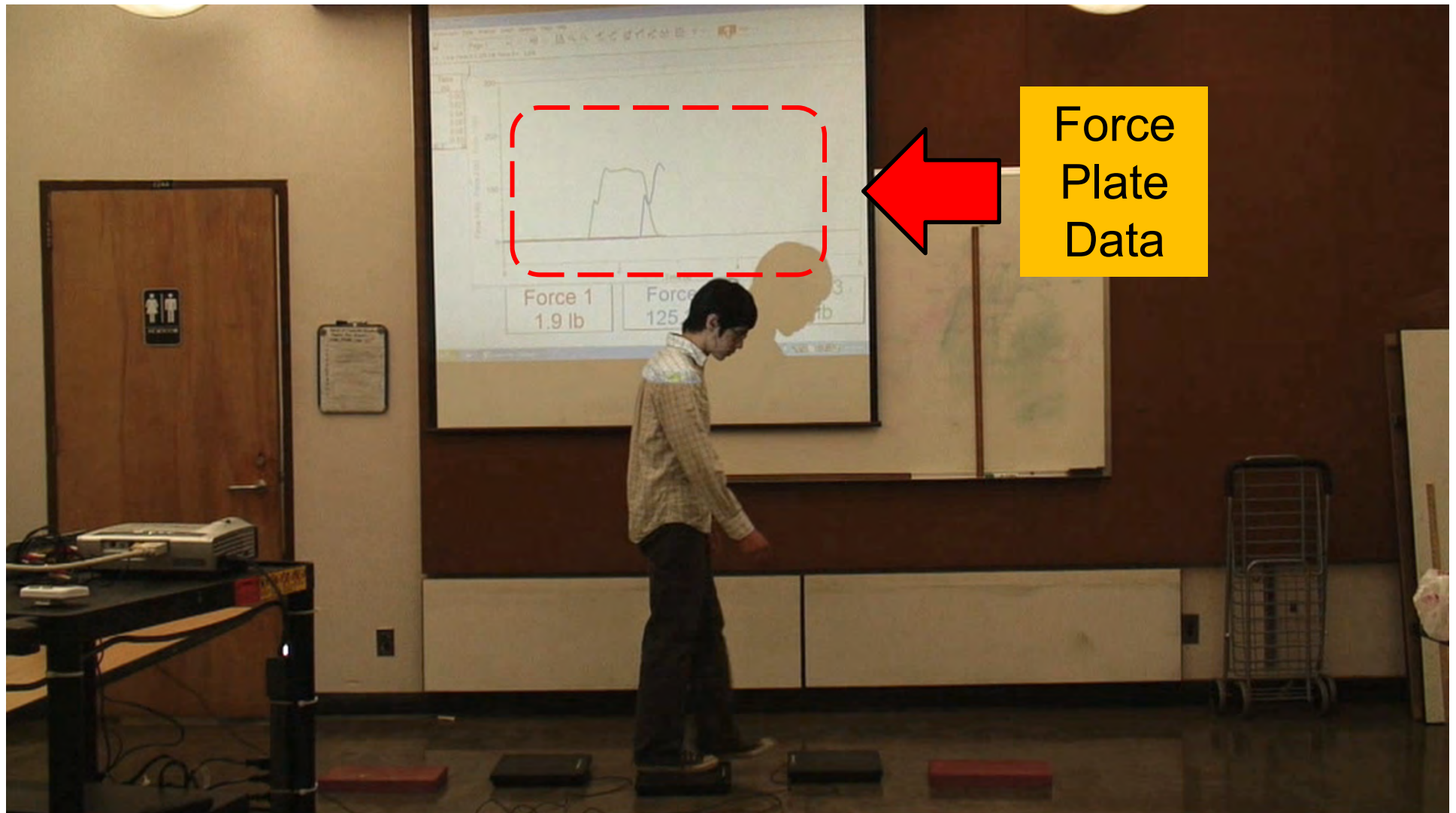
Slow walk has less variation in the weight shift



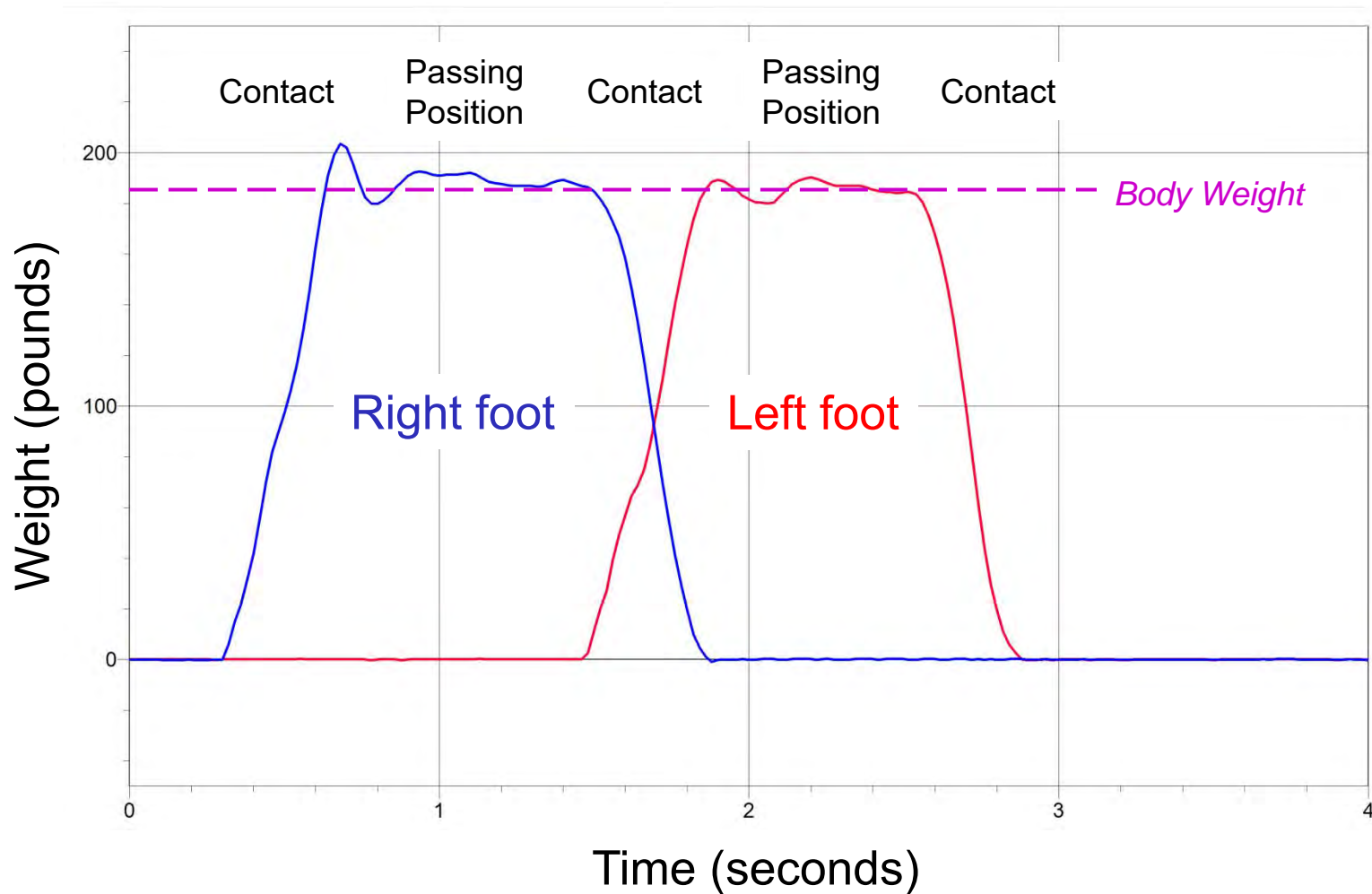
Fast walk has more variation in the weight shift



# Force Plate – Slow Walks



# Weight Shift in a Slow Walk



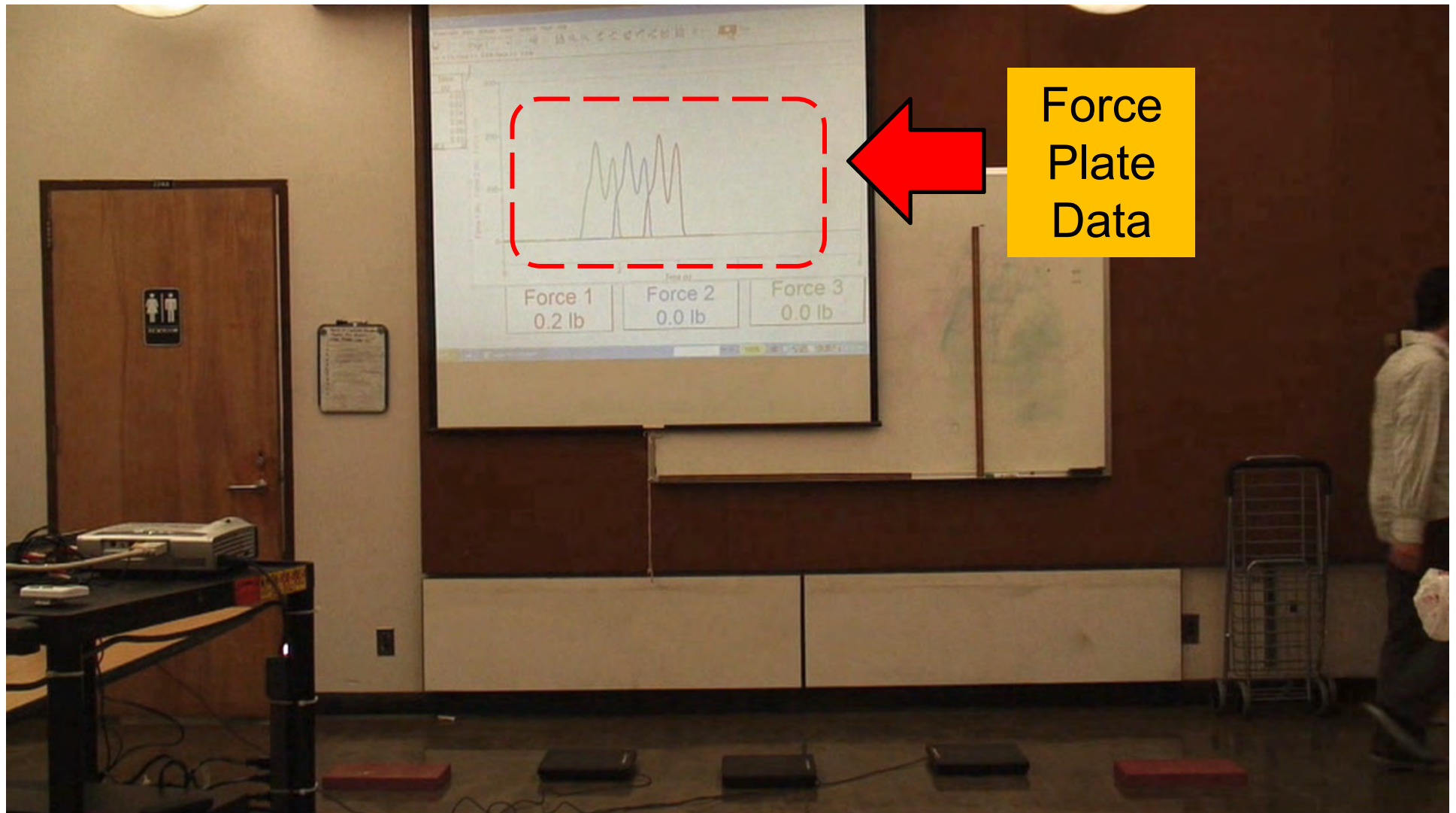
# Slow Motion vs. Walking Slow

Normal walking in slow motion differs from walking slowly, as seen in the difference in weight shift.

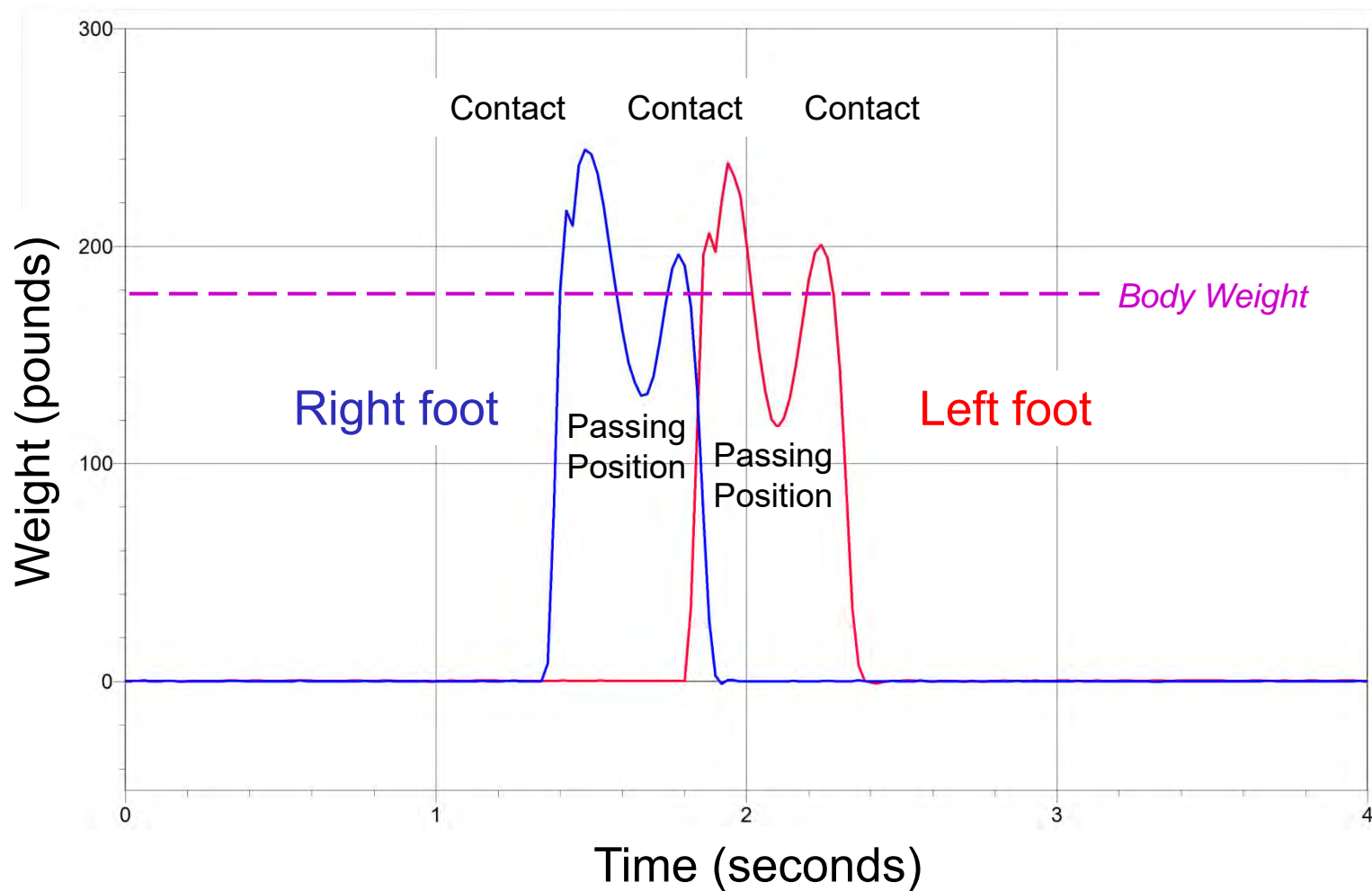




# Force Plate – Fast Walks



# Weight Shift in a Fast Walk



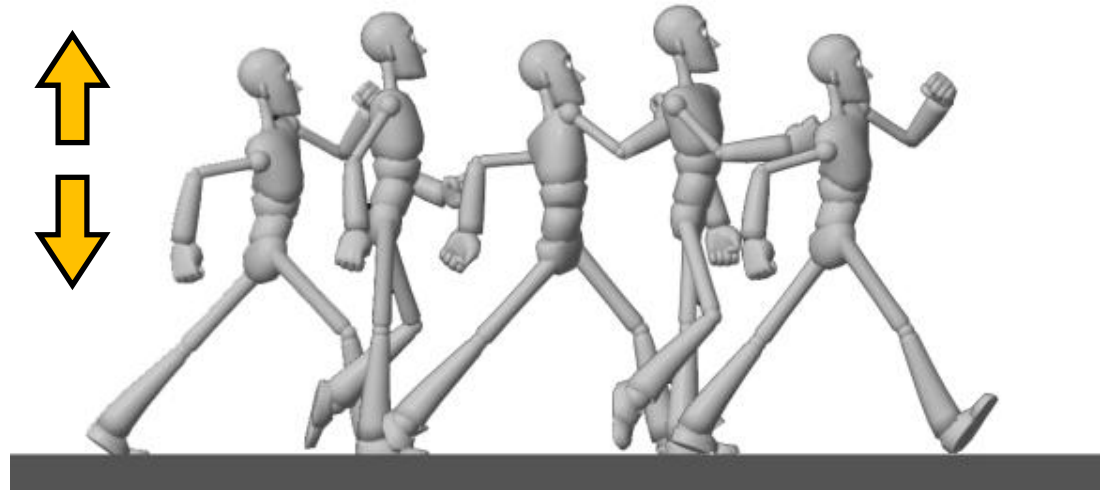
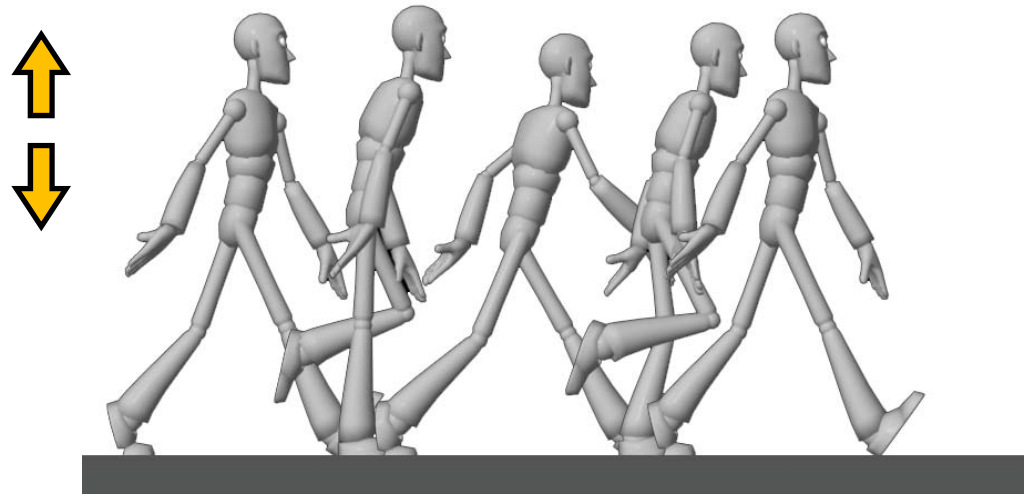
# Walking Slower or Faster

To walk faster you naturally increase *both* your stride length and stride rate (cadence).

Walk	Stride length	Stride rate	Speed
Slow walk	3 feet	$\frac{2}{3}$ stride per second	2 feet per sec. ( $1\frac{1}{3}$ m.p.h.)
Fast walk	4 feet	1 stride per second	4 feet per sec. ( $2\frac{2}{3}$ m.p.h.)

# Weight Shift in Fast Walks

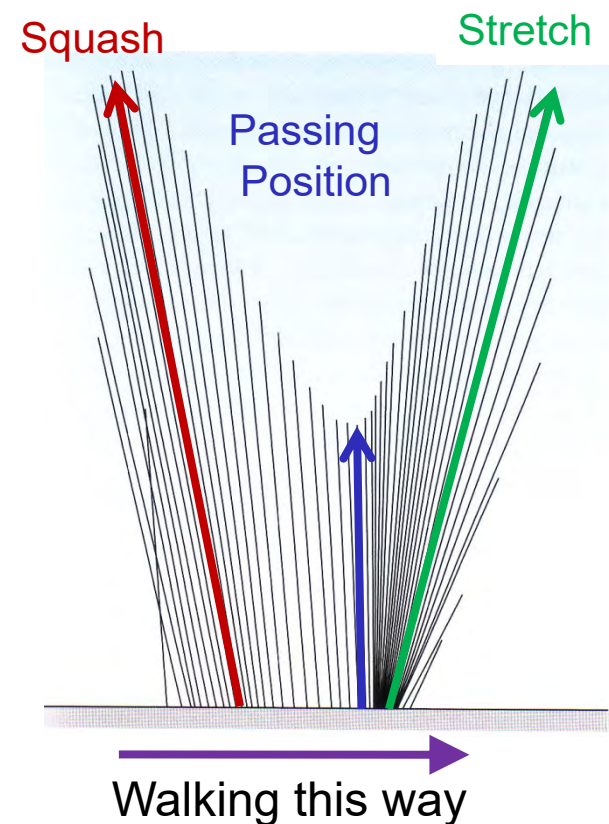
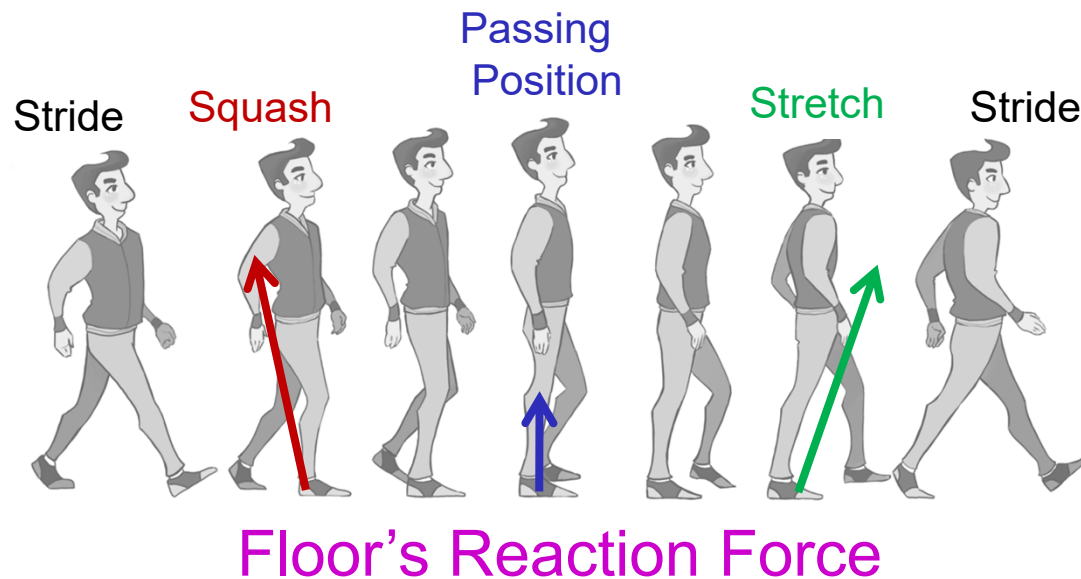
Due to the longer step length there is more up/down motion in a fast walk *and* it happens faster, causing large weight gain and loss.



# Reaction Force on the Foot

The floor exerts a reaction force that either slows us down (from squash to passing position) or speeds us up (from passing position to stretch).

“Butterfly diagram” of force vectors.



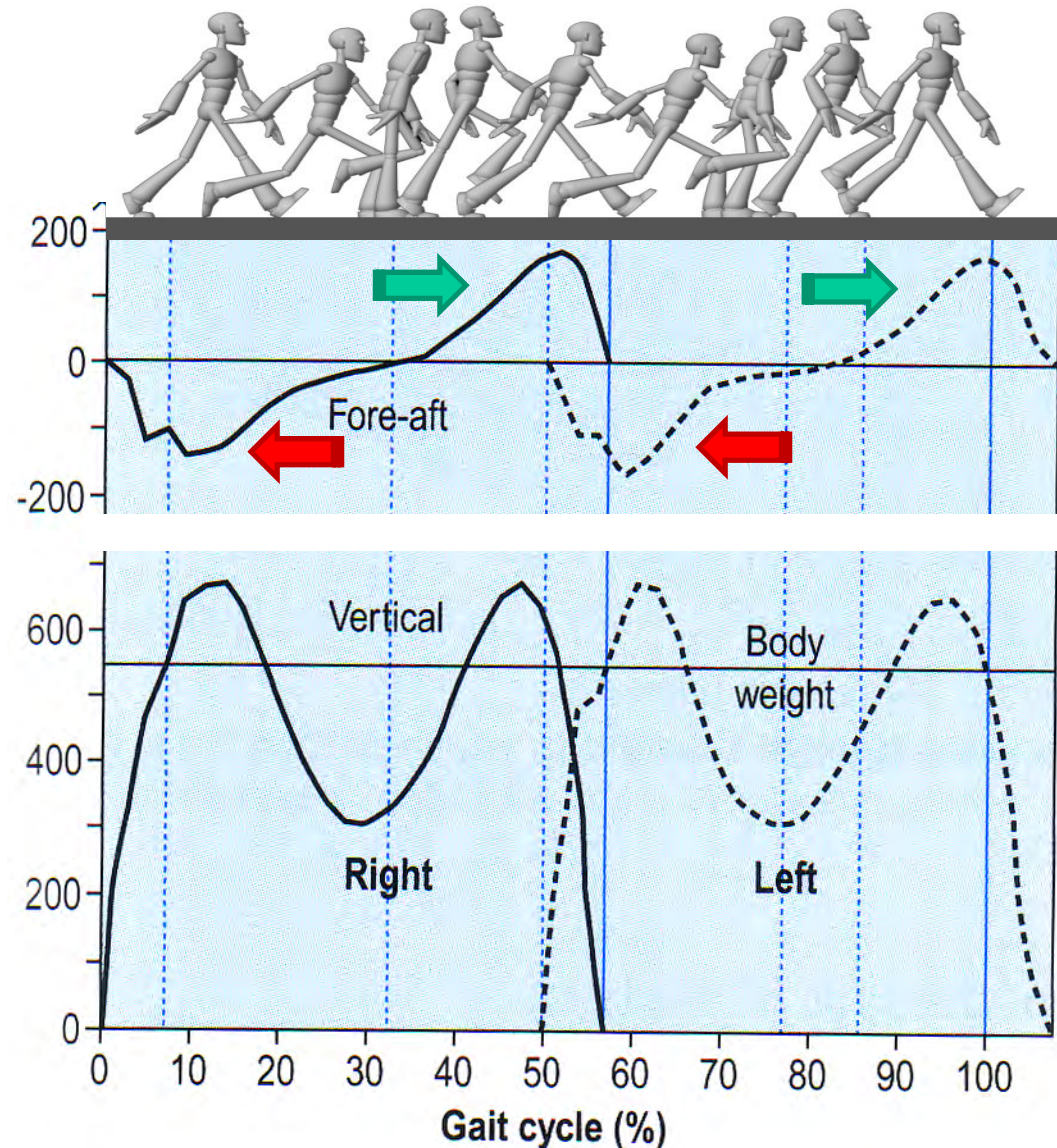


# Forward & Backward Forces

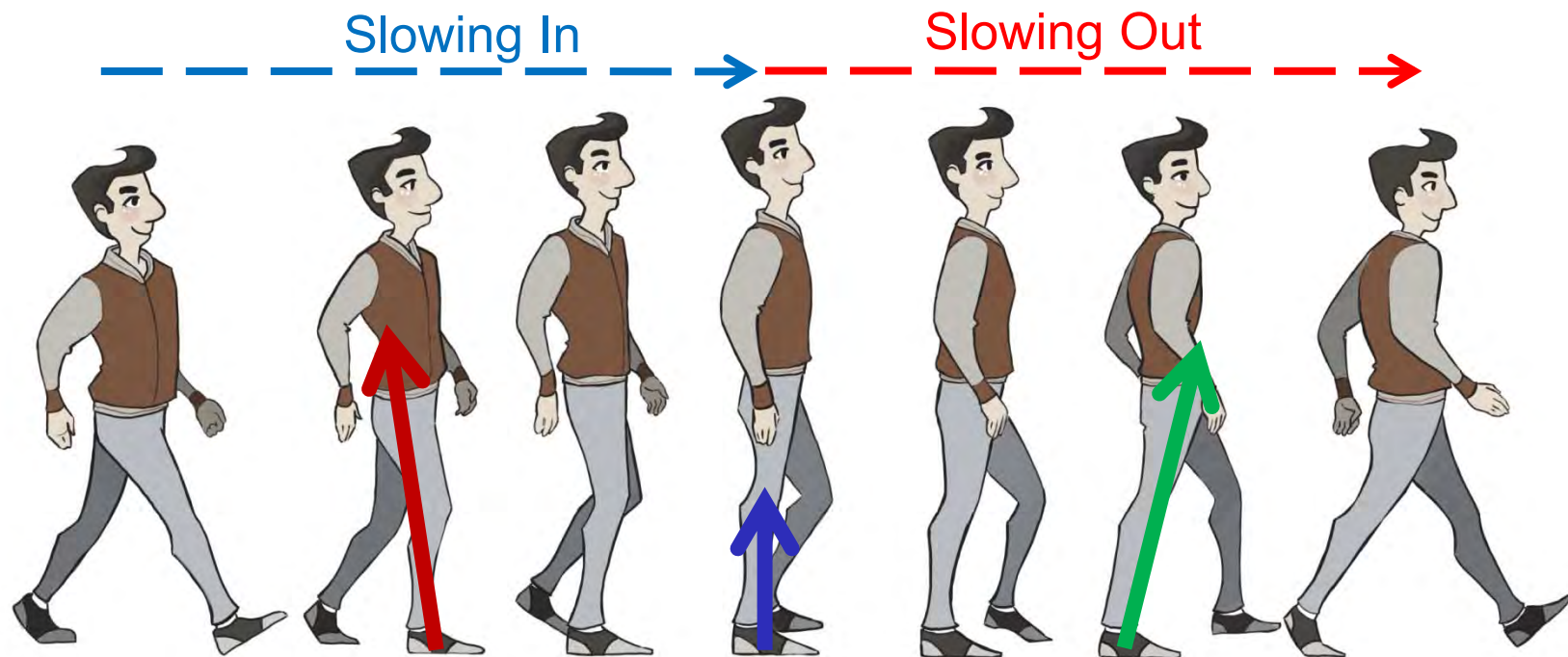
From passing position to contact the leg on the ground is pushing the body forward.

From contact to passing position it is pushing the body backward.

Walking at constant speed these forces average to zero.



# Timing of the Walk



Timing and spacing has some slowing in and out due to the backward and forward reaction forces.

# Summary

- Slow walks show very little weight variation as weight shifts from one foot to the other.
- Fast walks show significant weight variation due to both quicker timing and the greater up/down motion of the body.
- There is a backwards reaction force from heel strike of the contact pose to passing position.
- There is a forward reaction force from passing position to toe off of the contact pose.