

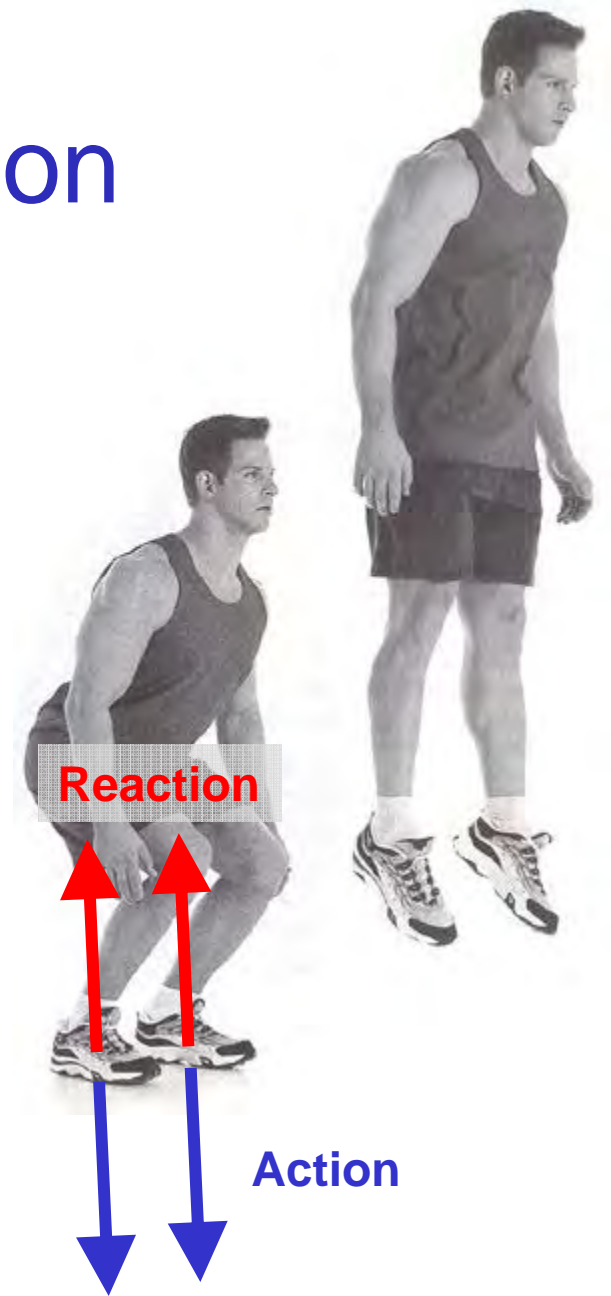
Character Interactions



National Science Foundation
WHERE DISCOVERIES BEGIN

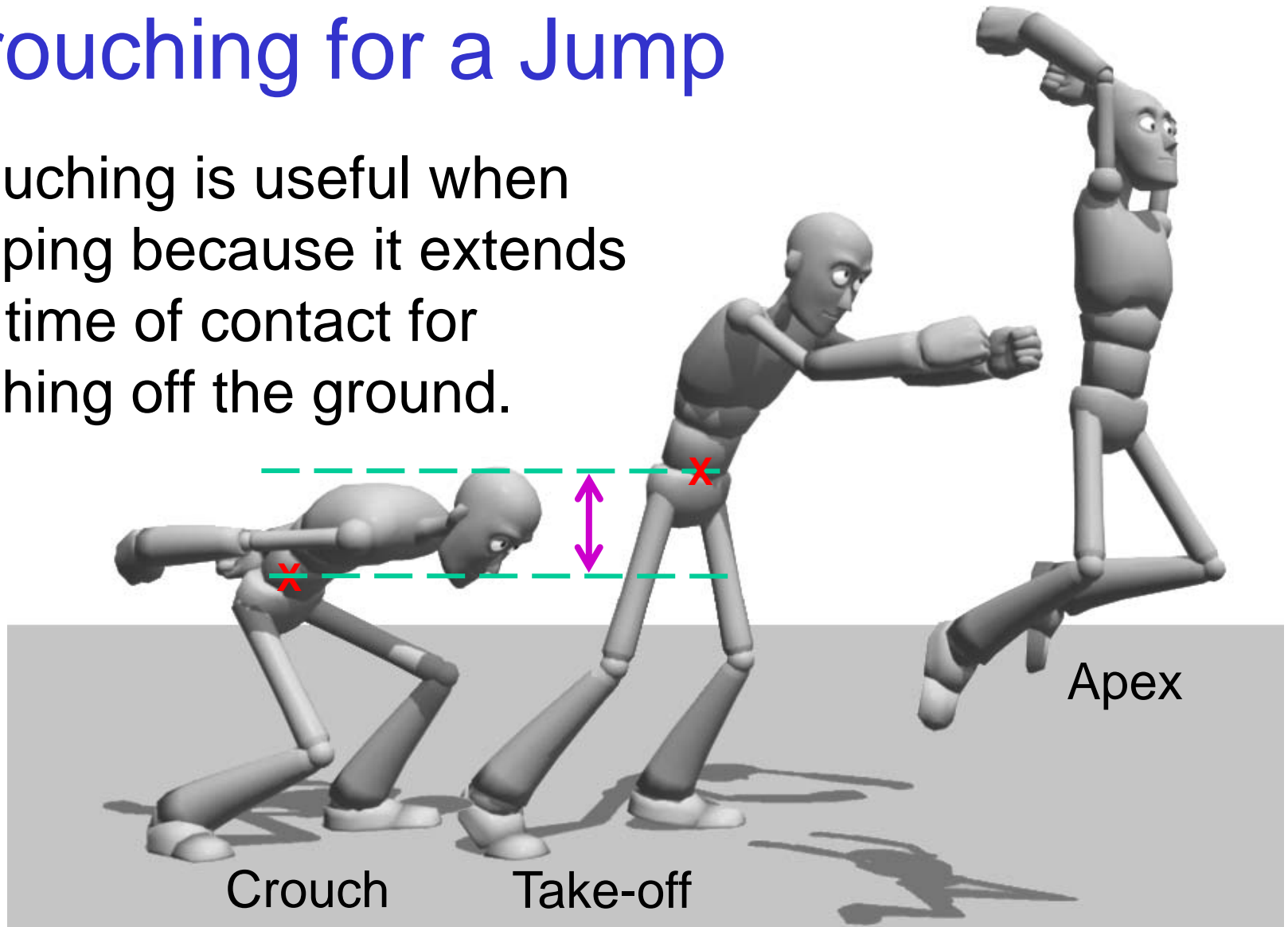
Jumping Action/Reaction

Jumping is done by pushing downward on the ground (action) so the ground pushes upward on you (reaction).



Crouching for a Jump

Crouching is useful when jumping because it extends the time of contact for pushing off the ground.

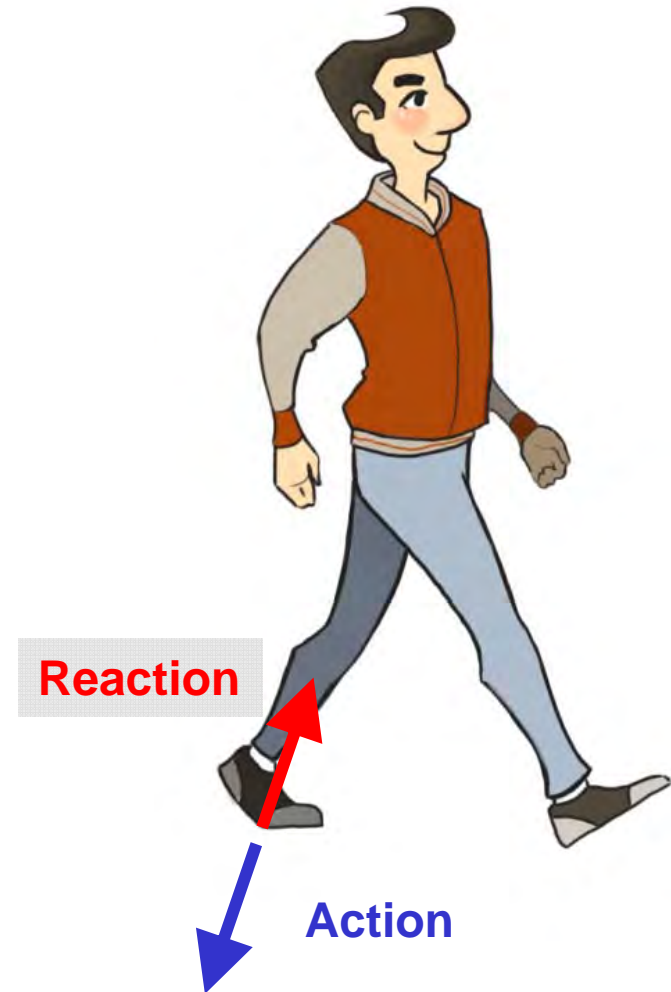


$$\text{Change in momentum} = (\text{Force}) \times (\text{Time})$$

Walking Action/Reaction

In walking a character exerts an action force on the floor, which results in a reaction force on the character.

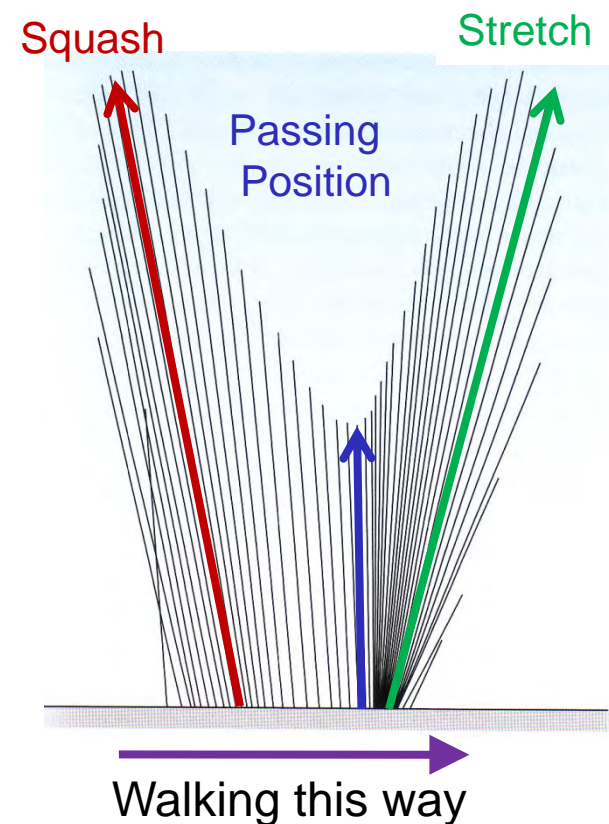
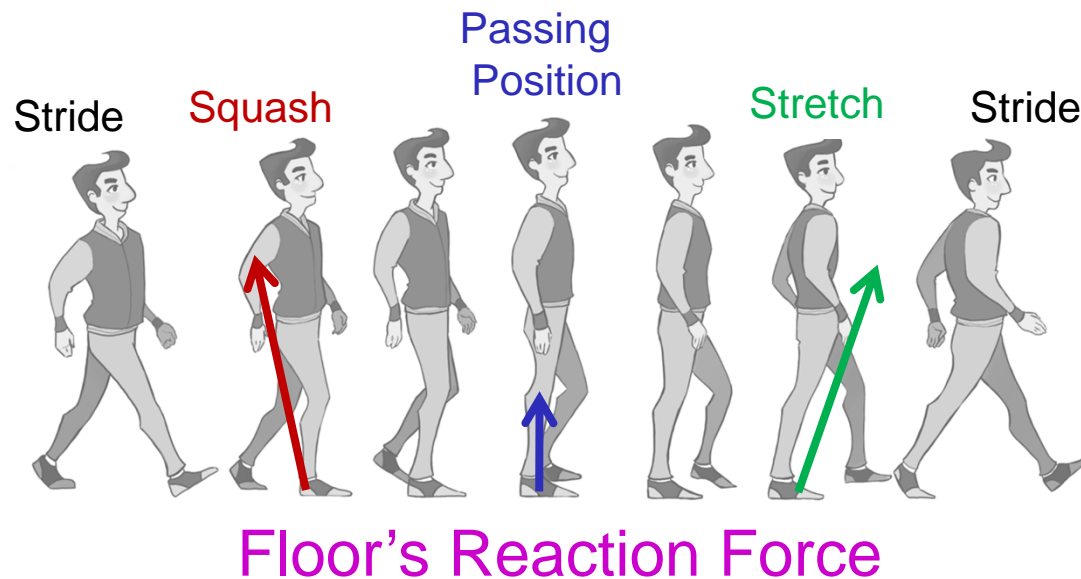
If the character is unable to exert a forward action force (e.g., slippery ice) then the character cannot walk.



Reaction Force on the Foot

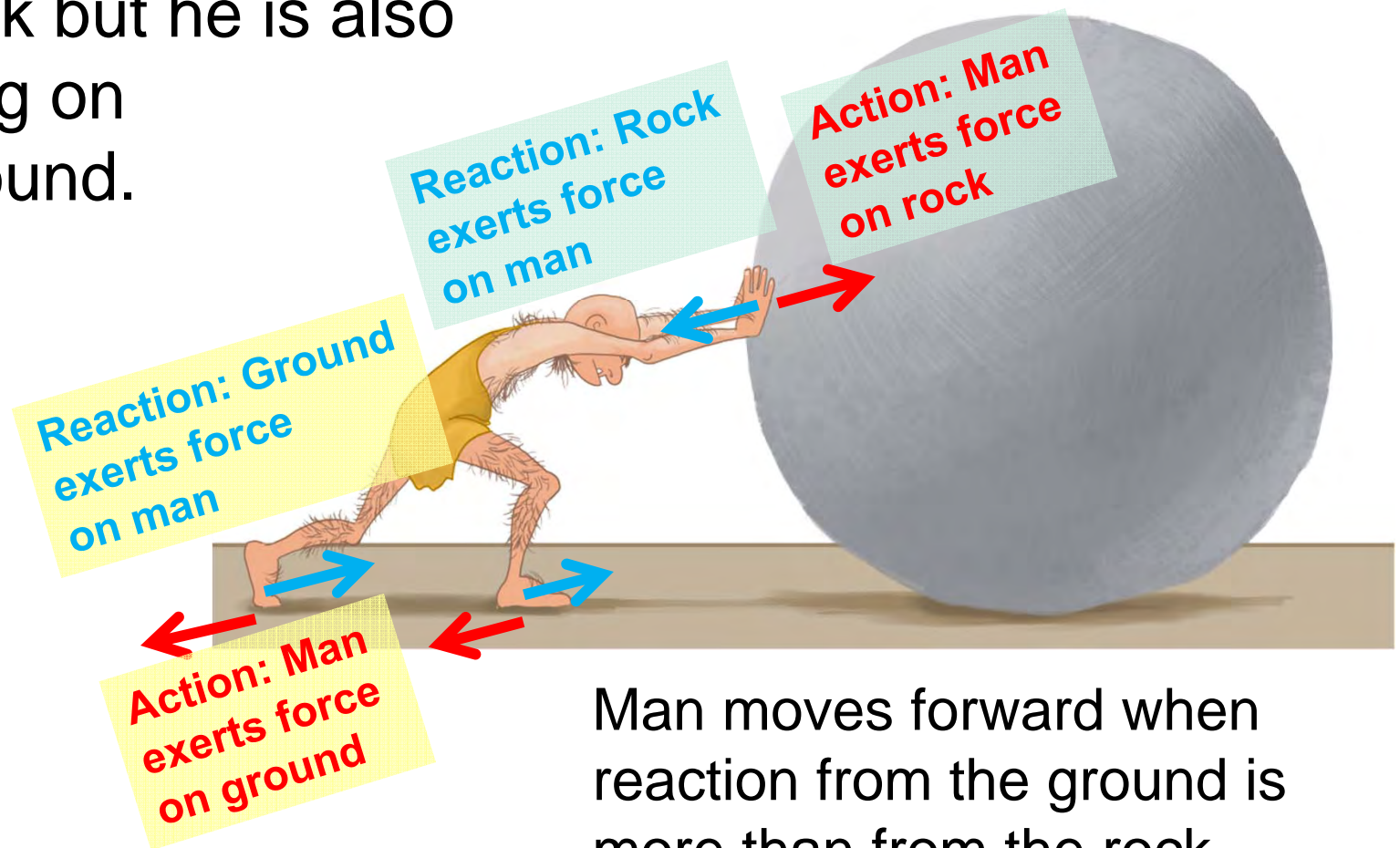
The floor exerts a reaction force that either slows us down (from squash to passing position) or speeds us up (from passing position to stretch).

“Butterfly diagram” of force vectors.



Pushing an Object

The man pushes on the rock but he is also pushing on the ground.

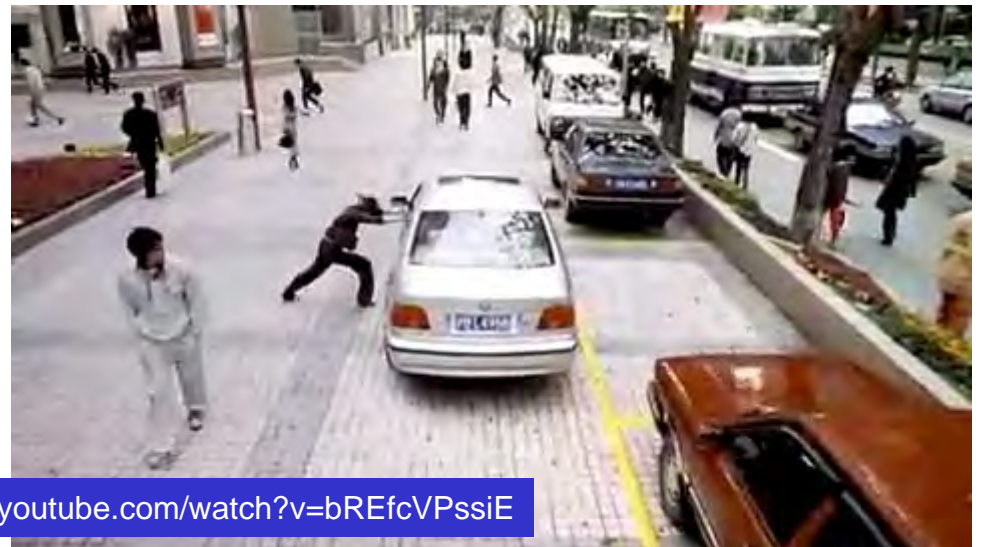


Man moves forward when reaction from the ground is more than from the rock.

Pushing an Object

If the woman is very strong then she could push the car with her hands.

But what about the force exerted by her feet?

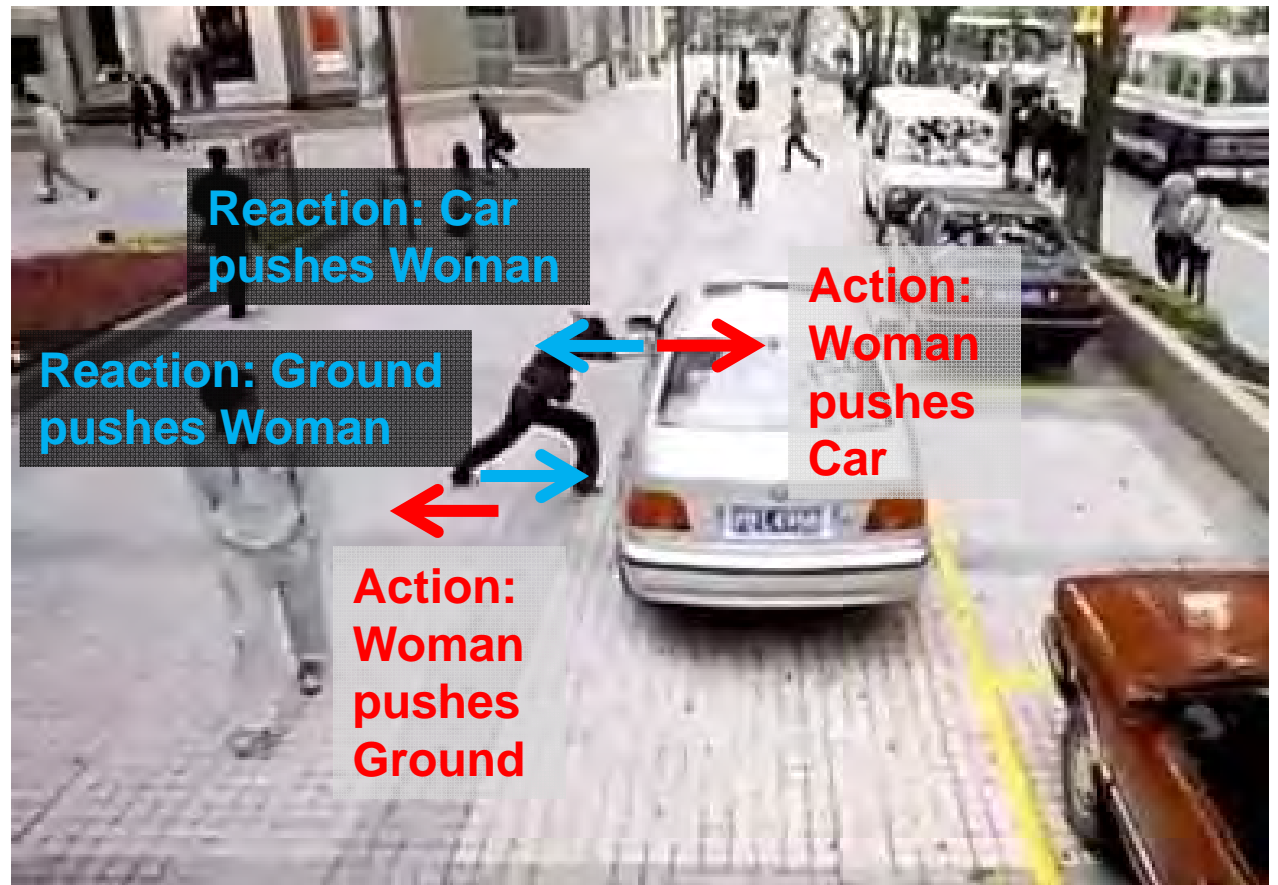


<http://www.youtube.com/watch?v=bREfcVPssiE>

Pushing an Object

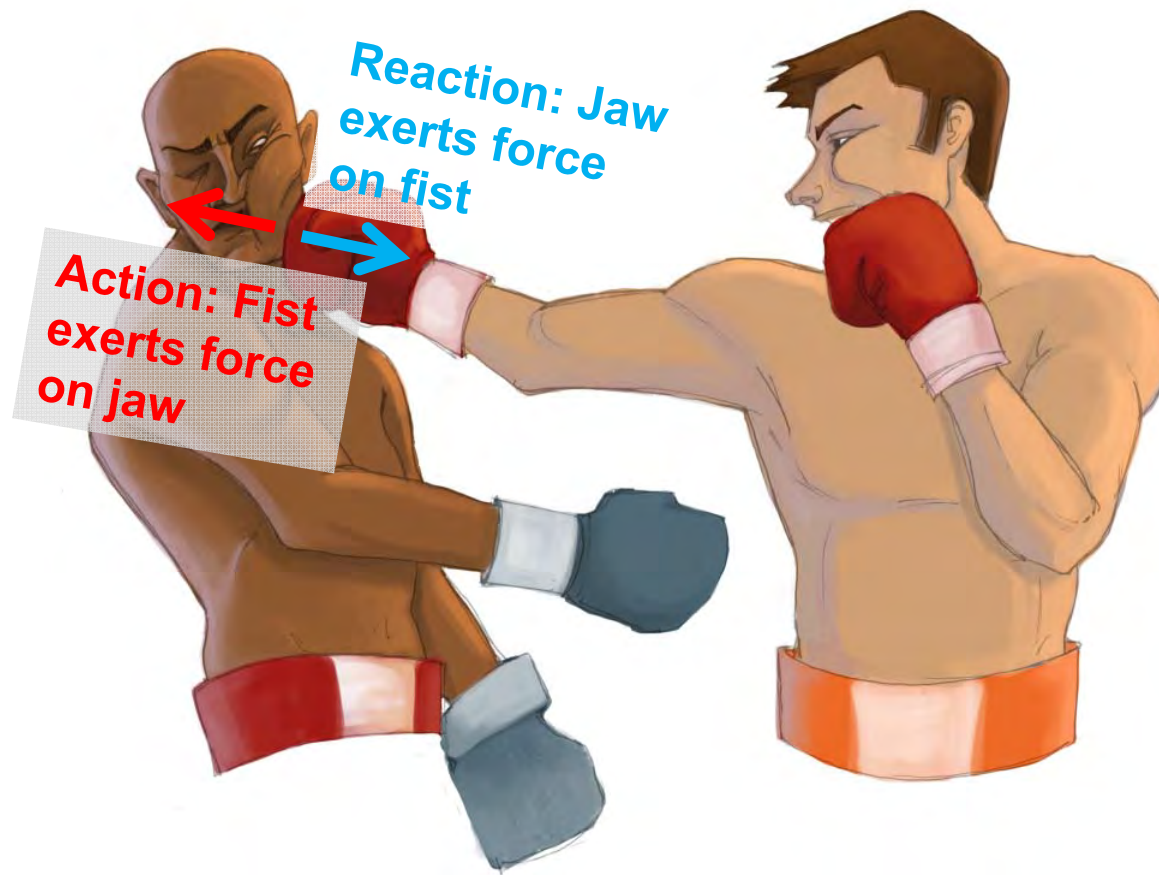
She must push back with her feet with the same force as she pushes with her hands.

Woman doesn't move so the two reaction forces balance. This means that the two action forces must be equal.



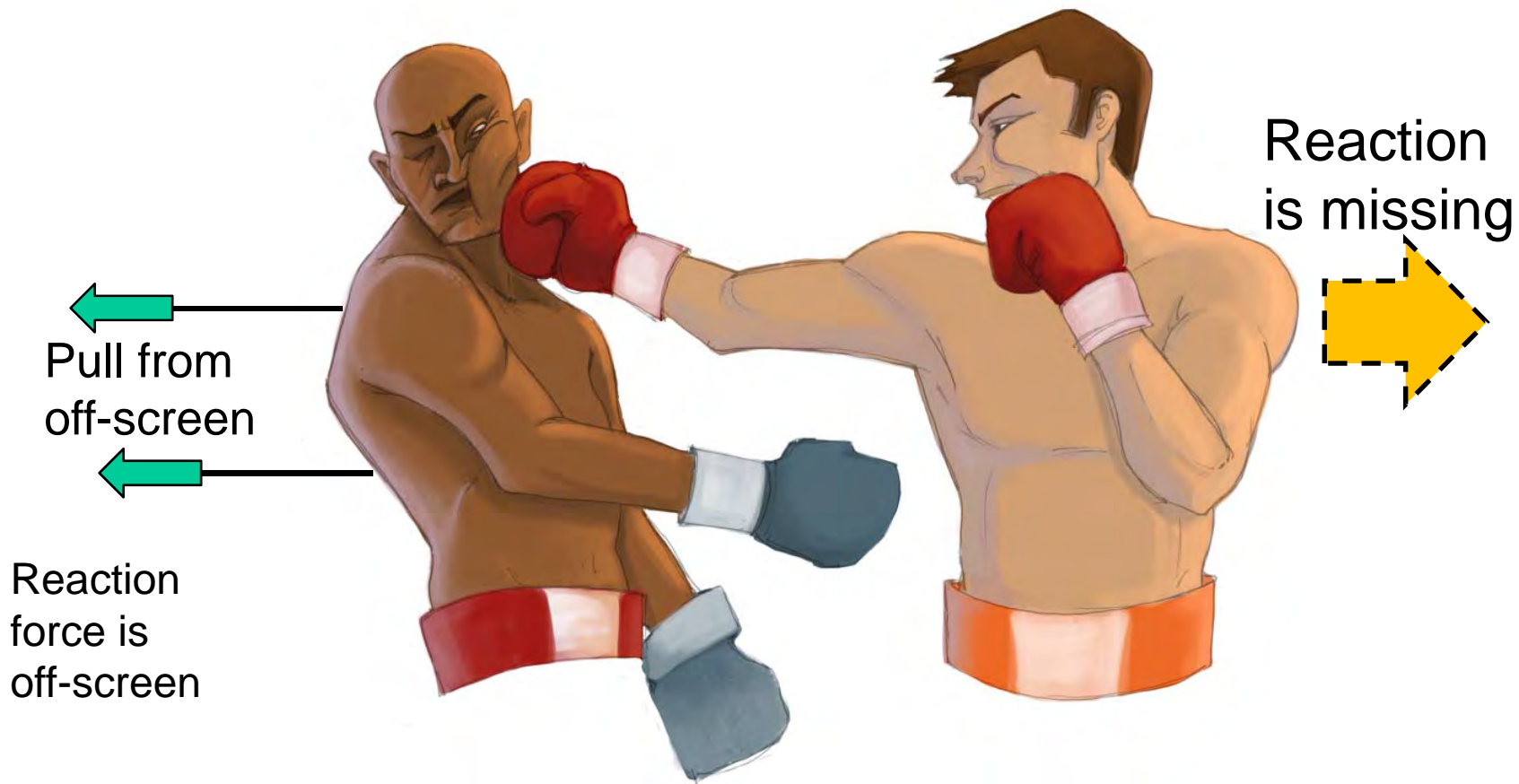
Fight Scenes

Fight scenes are realistic when the action forces in punches and kicks have believable reaction forces.



Fight Scenes with Wires

Sometimes wires are used in live-action (or in motion-capture) to create a dramatic impact force.



Spiderman 3 (2007)

Spiderman's kick looks fake since he shows no visible recoil due to the reaction force.



Kung fu Hustle (2004)

In a comedy it's best to make a fight scene less realistic, which makes it funny.



Manipulating Action-Reaction

Action/Reaction principle is often manipulated to give “weight” to a dramatic character or to make a comedic character “light.”



Action-Reaction in KFP



Watch for the reaction force each character as they strike the inanimate punching bag.

Phys-Dev (Physics Development)

KFP plays with Action-Reaction, but consistently. Strong characters have mass; the weak ones are light.



Weak



Strong

Summary

- Jumping and walking rely on reaction forces produced by the action forces of the character.
- When a character pushes an object forward they exert at least as much force with their feet as with their hands (if not then character slips).
- Realistic fight scenes have believable reaction forces matching the action forces.
- Using wires to pull a character gives an action force without an on-screen reaction.
- Action-Reaction can be used for Phys-Dev.