

Dynamic Balance



National Science Foundation
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Dynamic Balance

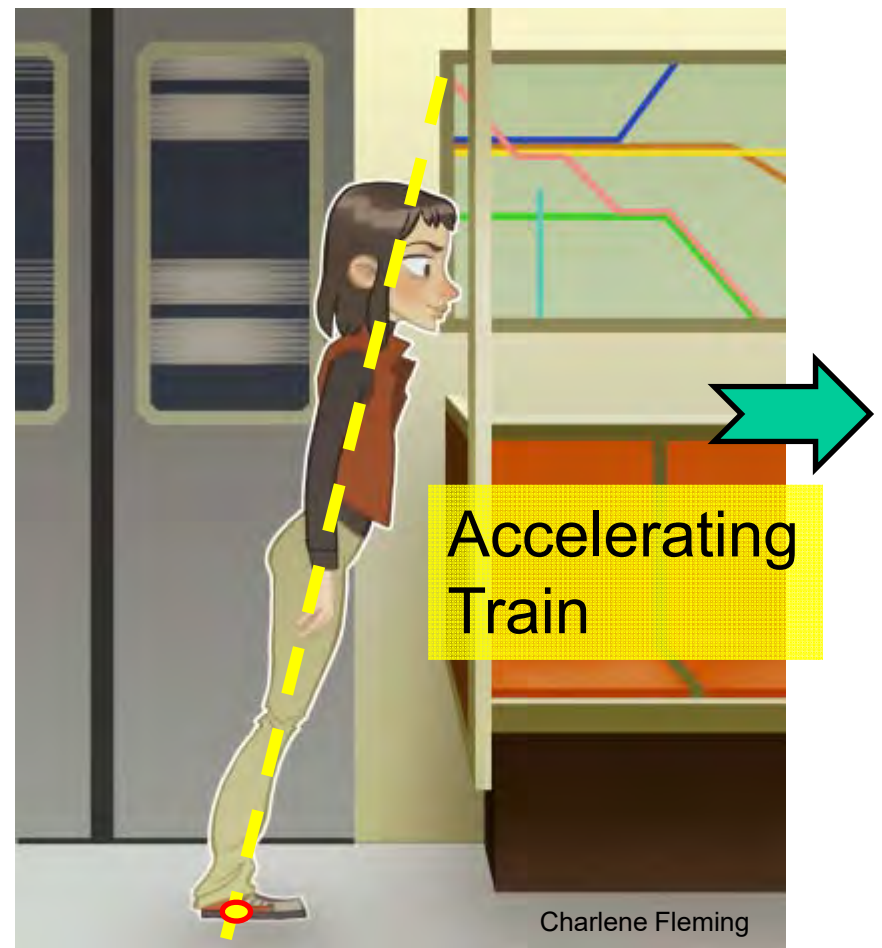
A pose that's out of balance for a stationary character may be in dynamic balance if the character is moving.



Charlene Fleming

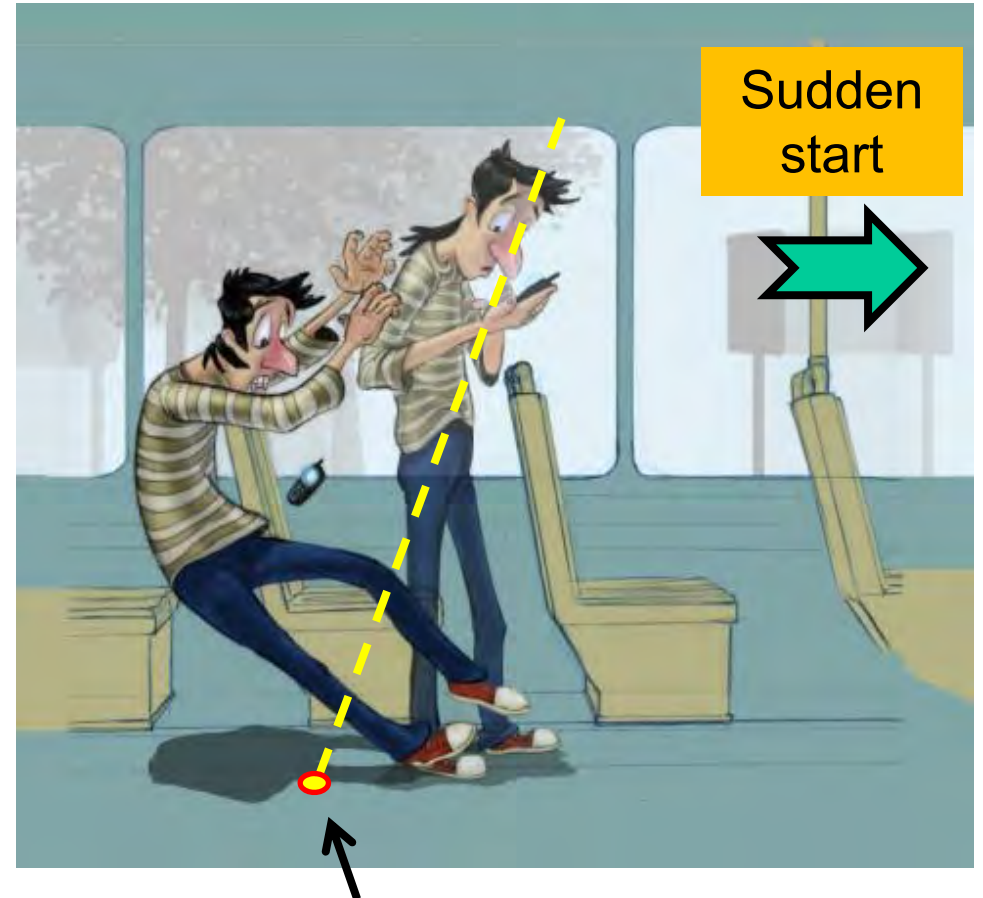
Tilting the Line of Gravity

Acceleration tilts the line of gravity.



Balance in a Sudden Start

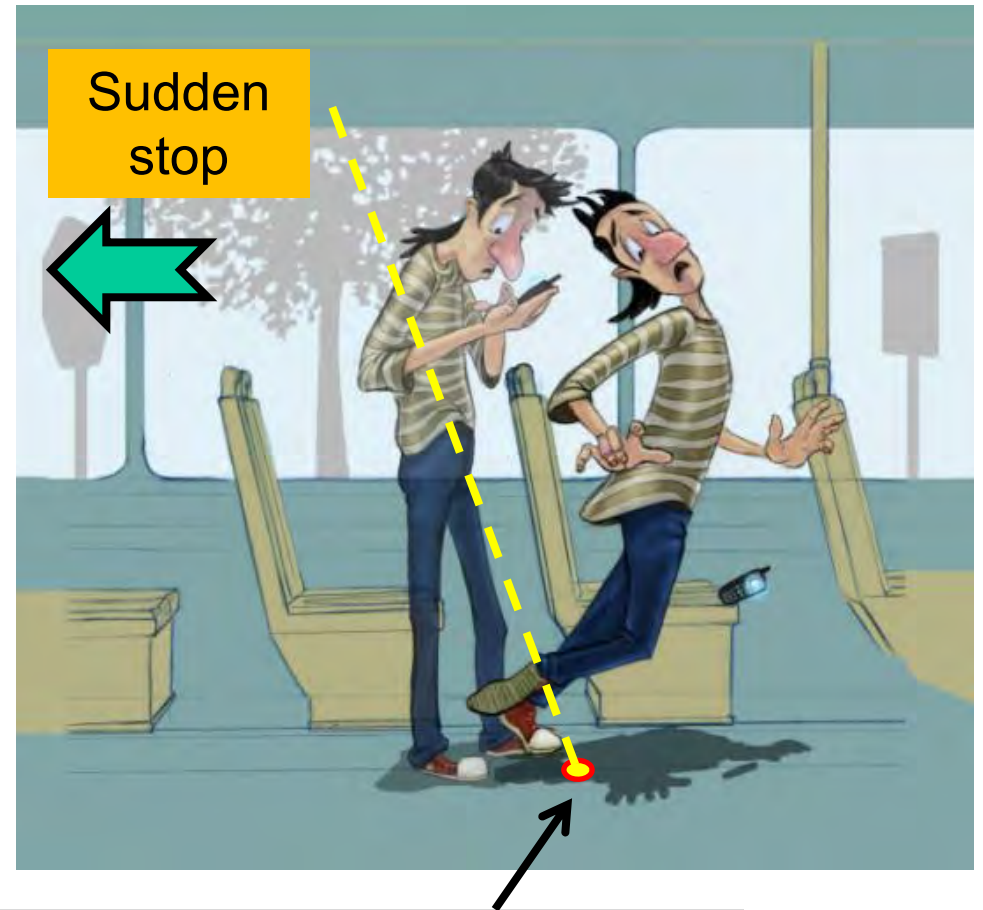
You can lose balance on a sudden start, say standing on a bus that starts moving, since acceleration tilts the line of gravity.



Fall towards the new Center of Pressure.

Balance in a Sudden Stop

In the same way you can lose balance on a sudden stop since the deceleration also tilts the line of gravity, but in the opposite way.



Fall towards the new Center of Pressure.

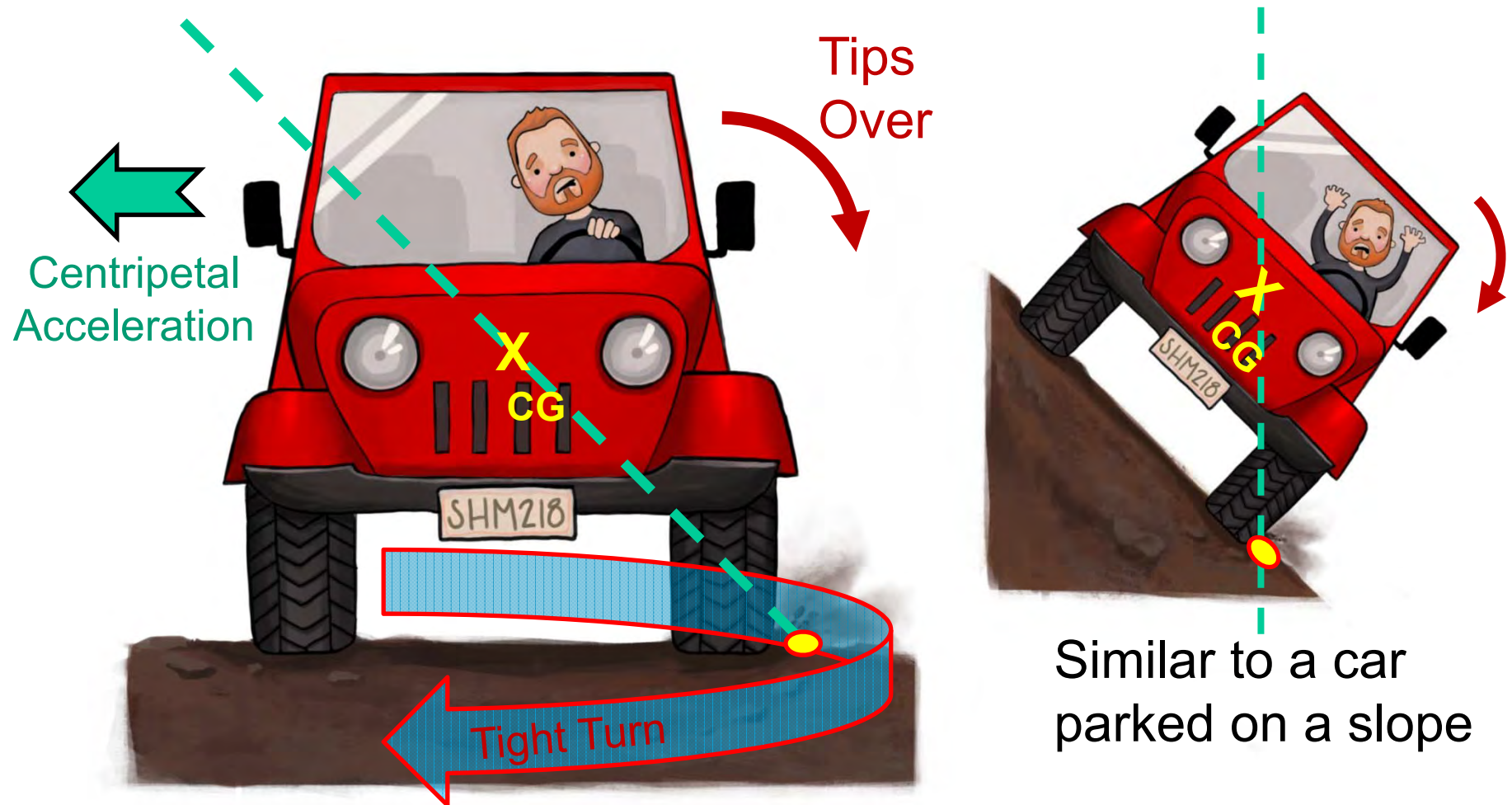
Leaning into a Turn

Centripetal acceleration tilts the line of gravity to the inside of the turn.



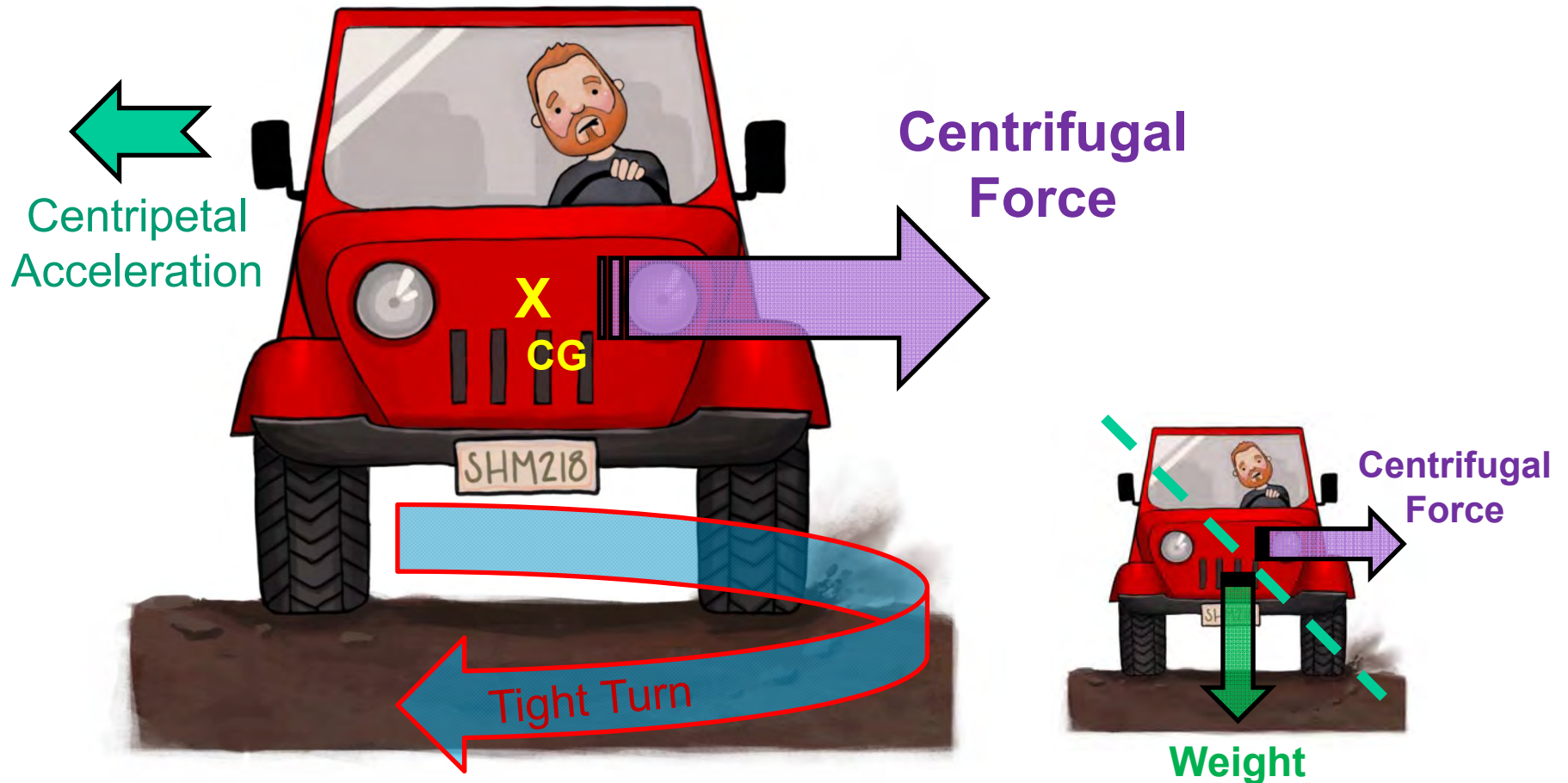
“Roll Over” Loss of Balance

Car making a tight turn may lose balance due to tilting of the line of gravity caused by centripetal acceleration.



Centrifugal Force

Can view roll-over loss of balance in terms of the centrifugal force pulling the CG outward.



Bullitt (1968)

Watch the cars as they take high-speed turns.

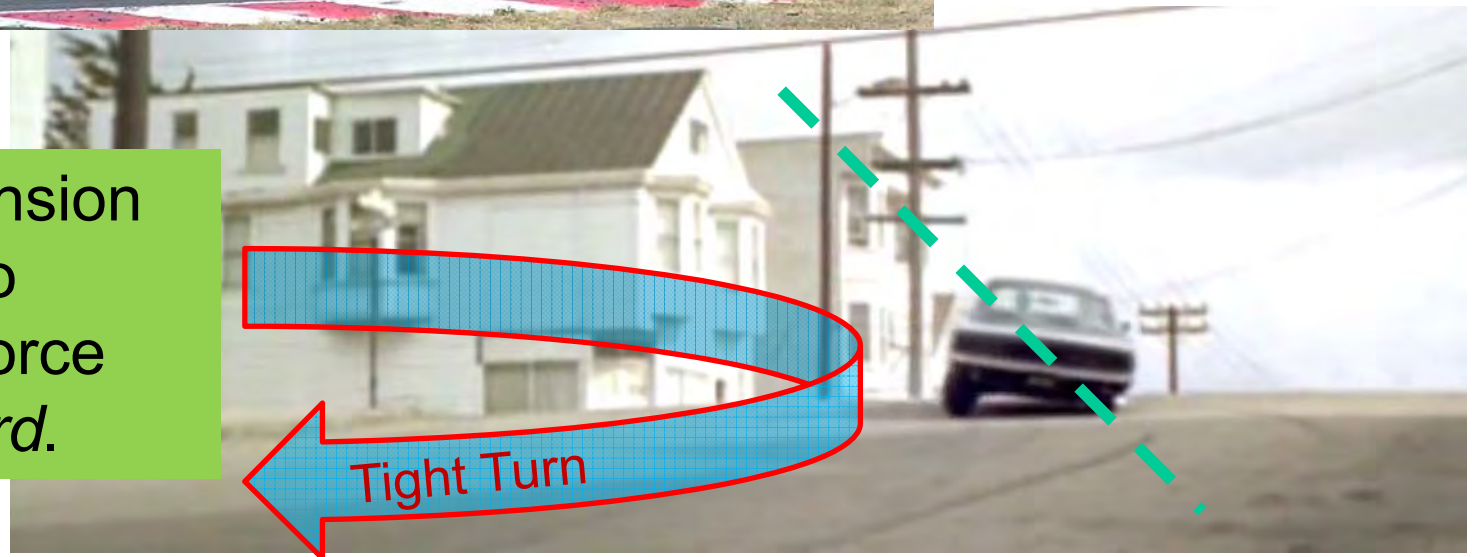


Leaning In vs. Tilting Outward



Motorcycle riders actively *lean into* the turn to maintain dynamic balance.

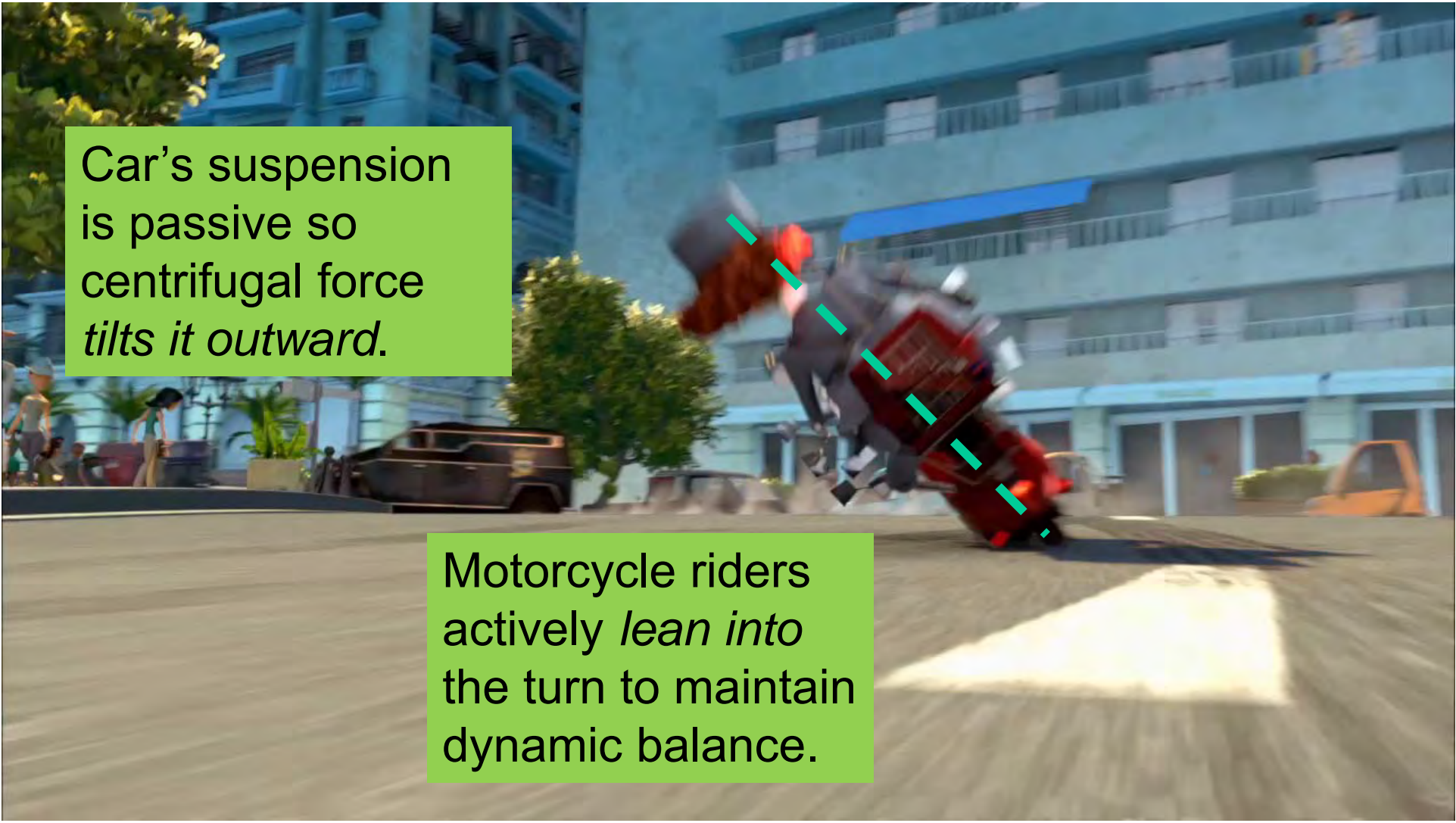
Car's suspension is passive so centrifugal force *tilts it outward*.



Leaning In vs. Tilting Outward



Leaning In vs. Tilting Outward

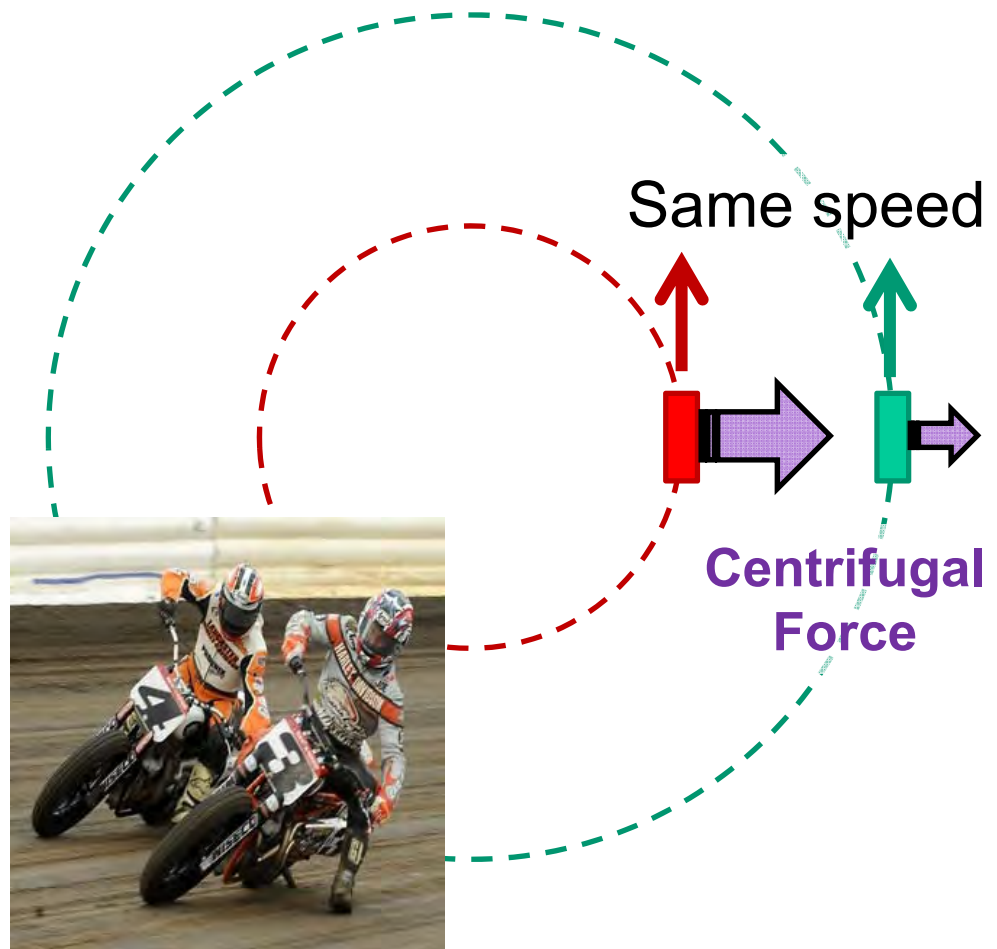


Car's suspension is passive so centrifugal force *tilts it outward*.

Motorcycle riders actively *lean into* the turn to maintain dynamic balance.

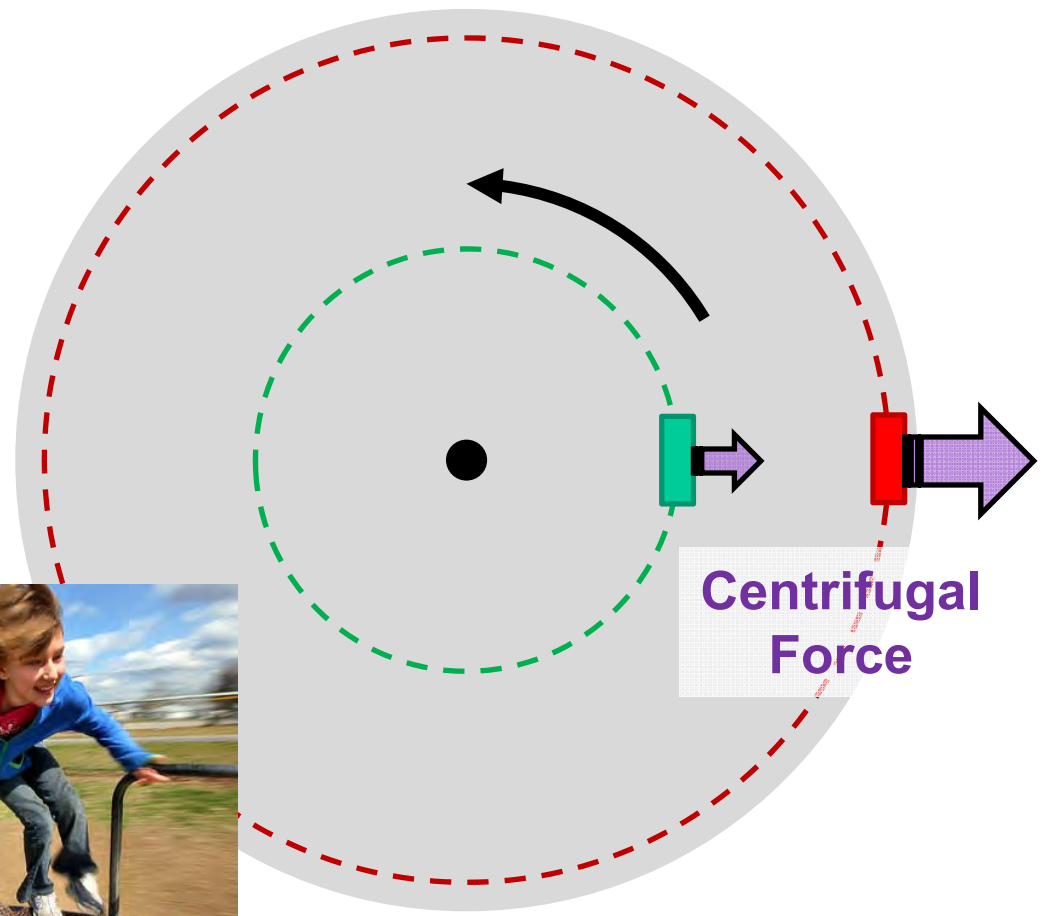
Radius of the Turn

Going the same speed, the tighter the turn the greater the centrifugal force.



Radius of the Rotation

With constant rotation (rpms), the farther from the center the greater the centrifugal force.



Summary

- When there's acceleration the line of gravity tilts in the direction of acceleration.
- In a turn, centripetal acceleration tilts the line of gravity toward the inside of the turn as the centrifugal force pulls outward.
- For a given speed, the tighter the turn the greater the centrifugal force.
- For a given rotation rate (rpms) the centrifugal force is greater on the outer rim.