ANGULAR MOMENTUM CONSERVATION AND THE CAT TWIST

Simple Explanation

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CAT TWIST — SIMPLE EXPLANATION

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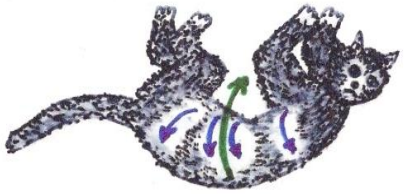
- Swing single dumbbell weight from right hand to left hand behind back, then from left hand to right hand in front. This will assist a hula hoop-like swing of the hips.
- Entire upper body, legs, and platform will twist in opposite direction.
- All motion stops and starts together. Angular momentum remains zero at all times. (Zero net torque.)

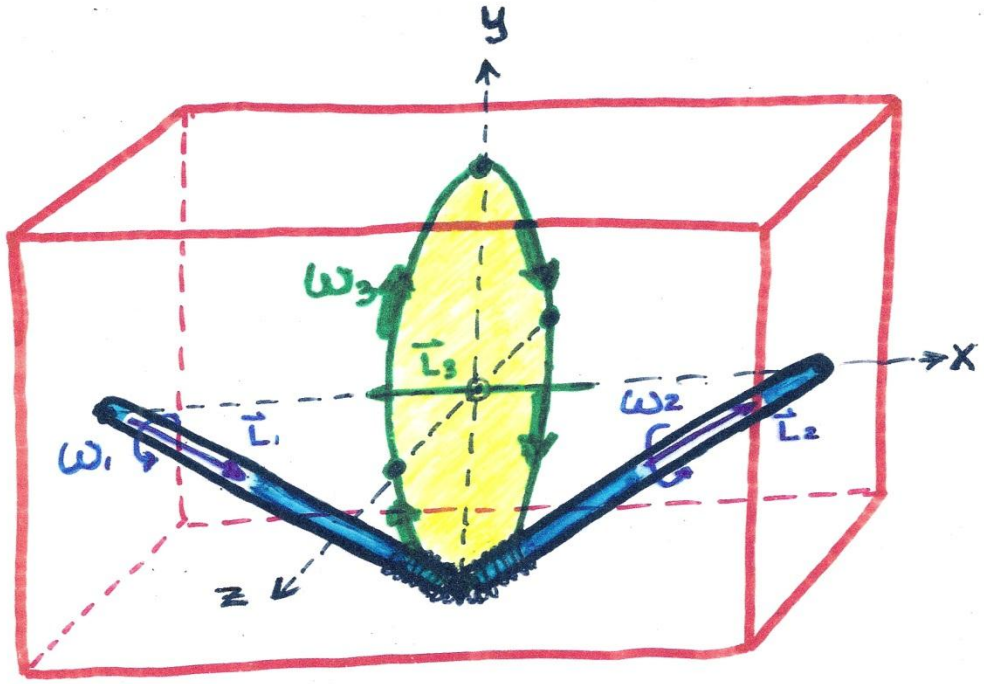


- Body and weight end up in original configuration, but now facing a different direction. (Possibly 180-degree twist.)
- Cat does similar maneuver about horizontal axis, but bends its spine and swings it around to twist in the opposite direction. (From feet up to feet down.)

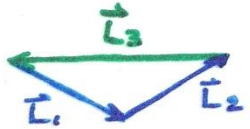
Note: The two "ends" need not move together and, in fact, sometimes twist at different rates.

Original detailed analysis of torque-free twist:
John Ronald Galli, "Angular Momentum Conservation and the Cat Twist," *The Physics Teacher,* **33**(9), 404-407 (1995).

CAT TWIST - ADVANCED EXPLANATION



ω_1 and ω_2
out and down



ω_3
out and up

The NET torque is zero,
thus the TOTAL angular momentum
remains zero

THE FALLING TWISTING CAT

To view a video of a mechanical twisting cat (Gallicat) and over 150 other short movies of physics demonstrations, go to www.physics.weber.edu/galli

SUMMARY and CONCLUSIONS

- ANGULAR MOMENTUM IS CONSERVED.
- “LEGS IN/LEGS OUT” IS NOT SUFFICIENT.
- “BENT SPINE” HAS PROVEN NECESSARY AND SUFFICIENT.
- “ORBIT” AND “SPIN” ARE BOTH REQUIRED.
- HUMANS CAN PERFORM THE MANEUVER ABOUT A VERTICAL AXIS WHILE ON A TURNTABLE.
- THE MECANICAL “GALLICAT” DEMONSTRATES HOW THE REAL CAT FLIPS OVER TO LAND ON ITS FEET.

REFERENCES

- John Ronald Galli, "Angular Momentum Conservation and the Cat Twist," *Phys. Teach.* **33** (9), 404 (1995).
- Richard D. Kaufman, "The electric cat: Rotation without net overall spin," *Am. J. Phys.* **81** (2), 147 (2013).
- Mark Levi, *Why Cats Land on Their Feet (*Princeton University Press, 2012), pp.142-144.
- *Gallicat Video-www.*physics.weber.edu/galli (go to "Cat-Twist")
- *Gallicat Purchase*-www.teachersource.com (go to "Physics" then "Laws of Physics"