Intuitive mechanics guides reasoning about complex scenes and unknown forces

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Intuitive physics
People's ability to reason about scenes' physical properties and dynamics from sensory data and background knowledge.
Our judgments are rapid, systematic, and subtle, but varied in quantitative precision. And, we often require little or no training.

How do we know what might happen in these scenes?

3-9 month-old children are sensitive to these principles (Baillargeon, Spelke).
"High-school" physics uses simple situations and coarse approximations -- Real-world judgments require something different.

Model
1. Perception
   Infer 3D arrangement of objects.

2. Physical reasoning
   Predict future states under approximate physical mechanics, with unknown forces.

3. Decision
   Judge what will happen.

Experiment 1: Which color is more likely to fall off?
10 participants
24 example trials
584 experiment trials
126 scenes, 3 reps/scene
Feedback every 100th trial (random force bump)

Experiment 2
10 participants
18 example trials
360 experiment trials
12 scene x 5 tables x 2 reps
Force arrows: Nore + 2 (blue arrows)

Results
- Model's force magnitude best fit range: 45-160N.
- For force arrow trials, force angle best fit range: 150 degrees.
- Model v human corr 0.85
- Best heuristic (avg. distance) corr 0.57

Conclusions
- People can incorporate the effects of extrinsic forces into their intuitive physical reasoning.
- They can predict dynamics in complex scenes, and are sensitive to information about the impending forces.
- Supports the hypothesis that people's intuitive physics is driven by a simulation-based theory of mechanics.