# Born as a Physicist

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## Abstract

This paper conducts a comprehensive review of key research within the domain of intuitive physics. While the existence of a human "physics engine" remains unproven, we explore the tantalizing possibility of its presence in the human mind. Our analysis primarily revolves around two core features of such an engine: its generality and its potential reliance on probabilistic reasoning. At last, we present our perspective on the merits of integrating a physics engine within artificial intelligence agents. This discussion advocates for further investigation into the potential advantages of incorporating such engines into AI systems, notwithstanding the ongoing debate surrounding the existence of a human-like physics engine.

## 1 Introduction

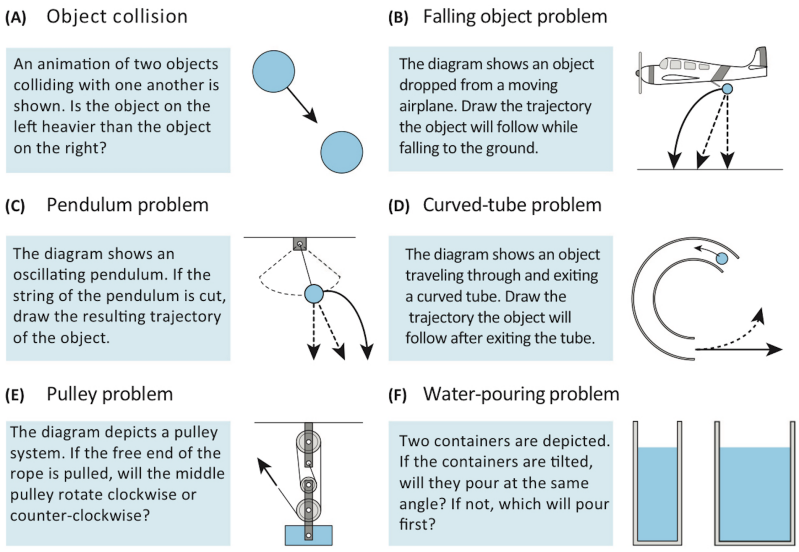


Figure 1: ( James R Kubricht [3]) Demonstrating several settings of intuitive physics

The past years have borne witness to a proliferation of research endeavors, as evidenced by numerous studies [5, 3], dedicated to the domain of intuitive physics. Within this field, a multitude of investigations have unveiled the remarkable perceptual and predictive abilities exhibited by human beings concerning the physical world. However, concomitantly, it is imperative to acknowledge the existence of misconceptions regarding human intuitive physics capabilities. This is exemplified by the scenarios depicted in Figure 1, where not all individuals consistently arrive at correct conclusions. Particularly, those lacking a solid grounding in the field of physics tend to formulate conclusions that deviate from the tenets of Newtonian physics when relying solely on their intuition [2].

Another significant avenue of research emanates from the realm of artificial intelligence (AI) and is centered on endeavors to model human intuitive physics through computational methodologies. Prominent among these methods is the Noisy Newton Model [1], which introduces stochastic perturbations to fundamental physical laws. This approach seeks to align with uncertainties arising from sensory information and to narrow the disparity between human judgments and the rigor of physical laws. Additionally, the field incorporates Probabilistic Simulation Approaches [1], which harness Bayesian techniques to emulate human cognitive processes in the context of physical scenarios. The exploration of intuitive physics assumes a position of paramount significance within AI research, driven by its aspiration to infuse artificial intelligence agents with a foundational understanding of the physical world and intuitive reasoning. This endeavor is deemed indispensable in the pursuit of developing artificial general intelligence (AGI).

While remarkable progress and compelling conclusions have been achieved within the domain of intuitive physics, the fundamental question of whether humans possess an innate "physics engine" remains a subject of ongoing inquiry. Substantial evidence, including studies based on fMRI data that highlight the robust engagement of parietal and frontal brain regions in the process of intuitive physics reasoning, supports the notion that there may indeed be a dedicated mechanism within the human brain for such reasoning [4]. Moreover, research involving infants has demonstrated that even at a very young age, there exist some rudimentary physical beliefs [5].

Nonetheless, the definitive existence of a "physics engine" in the human mind lacks direct empirical evidence, leaving this question an open and compelling problem within the realm of AI research. The central query arises: should we endeavor to construct a dedicated physics engine within our artificial intelligence agents, mirroring the potential capabilities inferred from human cognitive processes? This issue represents a challenging and consequential avenue for future exploration in the field of AI research. In this paper, we are not going to draw a conclusion on whether the physics engine exists, but to provide several insights on the topic and show the importance of it for artificial intelligence.

## 2 Features of Physical Engines

### 2.1 The General Nature

As illustrated by the scenarios depicted in Figure 1, the application of Newtonian Physics empowers us to readily deduce the trajectories of objects. This proficiency necessitates a profound understanding of the underlying physical laws and a robust foundation in the associated principles. Remarkably, when presented with a static image portraying a physical process, individuals spanning a spectrum of cognitive capacities display a proclivity for mentally extrapolating potential trajectories. Furthermore, we exhibit an aptitude for foreseeing the consequences of actions in entirely novel and unencountered scenarios, thus underscoring the intrinsic generality of our intuitive physics faculties. Consequently, when accept the existence of physical engines, it follows that their generative potential is a fundamental characteristic.

### 2.2 A Probability-Based Engine

Exemplified within the research of James R Kubricht [3], it becomes apparent that human beings are susceptible to misperceptions in specific instances of intuitive physics. In such cases, individuals may formulate conclusions that initially appear accurate but are subsequently found to be inconsistent with the rigor of Newtonian laws upon closer examination. Furthermore, the Noisy Newton Model and Probabilistic Simulation Approaches, as discussed in Sec. 1, have achieved notable success by incorporating elements of noise and probability into their frameworks. These observations offer compelling empirical evidence suggesting that if a human "physics engine" does indeed exist, it may not be characterized by precision or adherence to strict Newtonian principles, but rather be inherently probability-based in nature.

## 3 The Significance of a Physical Engine in AI

While the existence of a physics engine in the human brain remains a matter of ongoing inquiry, it is essential to acknowledge that the certainty of its presence eludes us. However, as highlighted in the seminal textbook by Stuart Russell [6], the pursuit of "artificial flight" achieved success when pioneers

like the Wright brothers ceased imitating birds and instead delved into wind tunnels and the principles of aerodynamics. Although the field of artificial intelligence differs from aviation, and the existence of a human-like physics engine remains partially substantiated, there is a compelling argument for incorporating such an engine into AI agents. It has been demonstrated that the integration of a physics engine can yield substantial benefits in AI systems, particularly in tasks related to the perception of object properties and more [7]. Thus, while the existence of a human-like physics engine remains a subject of ongoing investigation, its potential as a valuable component in AI agents cannot be understated.

## 4 Conclusion

In this paper, we have explored the possibility of the existence of a physics engine within the human mind, and we have discussed the potential characteristics of such an engine if it exists. Additionally, we have delved into the significance of integrating a physics engine into artificial intelligence agents. The presence of a human-like physics engine is a subject of ongoing inquiry, and our discussion underscores the potential implications of such an engine, should it be present, in the realm of artificial intelligence.

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