The Speed of Thought: Investigating Instantaneity Across Minds, Machines, and Matter

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Abstract

This paper explores the concept of 'instantaneous thought' through a multi-disciplinary lens. It examines human cognitive processing speed, the neurobiological and quantum-mechanical definitions of time and instantaneity, and compares these to artificial intelligence response times and token-based reasoning. Building from philosophical, physical, and computational theories, it addresses the illusion of immediacy, neural latency, and machine latency, proposing that what is perceived as instantaneous is often a collapsed duration mediated by time, attention, and inference. The paper argues for a new cognitive framework to understand how various agents—organic or artificial—experience and enact 'thought speed.'

Introduction

The idea of an “instant” thought has persisted for centuries, often perceived as the hallmark of both genius and artificial superintelligence. But what is a thought? And can any thought truly be instantaneous?

This paper seeks to map the terrain between perception and processing, between what we call immediate and what merely appears so. Human brains, artificial intelligences, and photons are all part of this inquiry—not as metaphors, but as clocks.

1. Historical and Linguistic Foundations of the Instant

1.1 The Origins of “Instantaneity”

Latin: instans — "pressing, urgent"

Greek distinctions: chronos (sequential time) vs. kairos (opportune moment)

1.2 Language as Temporal Encoding

Cultures encode time differently: Hopi verbs, Chinese aspect markers, English tenses

Reflexive grammar shapes perception of presentness

2. Defining 'Instantaneous': Physics and Perception

2.1 Physics: Planck Time and the Illusion of Now

Planck time ≈ 5.39×10^{-44} s — the smallest unit of time

Relativity: simultaneity is observer-dependent

Light takes time to travel—but from a photon's POV, it experiences no time

2.2 Perception: Lag in the Human Brain

Visual stimuli lag ~100–300 ms behind reality

Libet experiments: consciousness lags decisions by ~200 ms

The brain predicts, then interpolates—perception is reconstruction

3. The Neuroscience of Thought Speed
3.1 Neural Transmission Speeds
Axonal conduction: ~1–120 m/s (based on myelination)

Dendritic integration adds microdelays

Synaptic delay ≈ 1 ms per connection

3.2 Brainwaves and Temporal Bandwidth
Alpha (~8–12 Hz): relaxed focus

Beta (~13–30 Hz): active thought

Gamma (>30 Hz): binding across brain regions

Time is chunked rhythmically

4. Computational Instantaneity in AI
4.1 Tokens, Inference Time, and Latency
Tokens = atomic language units (~0.75 words/token)

Vectorization and transformer architecture introduce pipeline delay

Latency sources: GPU processing, API calls, interface response

4.2 Perceived AI Thought Speed
<200 ms feels instant to most users

True inference often takes 100–1000 ms depending on model/hardware

UI feedback (e.g., “...” while typing) creates illusion of thought

5. Cognitive Time Dilation
5.1 Time Under Pressure
Adrenaline can slow perceived time during crises

Near-death experiences often report “life review” in compressed moments

5.2 Consciousness and Time Compression

Meditation: subjects report timeless states

Psychedelics: time perception becomes non-linear, nested, or infinite

6. Comparative Table of Thought Speeds

System	Latency / Delay	Notes
Human Reflex	~30–50 ms	Spinal response; bypasses cortex
Human Thought	~200–700 ms	Varies by task complexity
AI Inference	~20–500 ms	Depends on model, tokens, hardware
Photon	~0 (its own frame)	Time doesn't pass for light itself

Conclusion
What we call “instantaneous” is deeply subjective, contextually bound, and processor-dependent.

For a photon, thought is timeless—it moves through space without experiencing time.

For a human, thought is predictive reconstruction—a fast yet staggered cascade of neurons and rhythms.

For an AI, "instant" is a carefully masked delay—filled with tokens, weighted sums, and a polite pause.

The illusion of the instant is the most convincing lag of all.
And yet, it is this very illusion—this shared delay—that creates the possibility of understanding across agents and timelines.

Thought, like light, is never truly still. But it might appear so—if only briefly, if only beautifully.