Why is time so powerful?

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Why is time so powerful?

McMillan & Roberts (2012)
Noise in Timing

- S = 15, 30, 60 or 120 s
- C = 90, 180 or 360 s

Roberts (1981)

Kirkpatrick & Church (2000)
The interface of timing and other cognitive systems

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Neurobiology of time

Time collating system
Motor timing
Interval timing $> 2$ s

Time counting system
Time comparing system

Morillon, Kell & Giraud (2009)
“Three stages and four neural systems in time estimation”
The interface of timing and other sensory, motor, and cognitive systems

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Timing emerges at the onset of associative learning

Kirkpatrick & Church (2000)

Temporal tracking

Kirkpatrick & Church (2003)
The dominance of timing

**Fixed Number Schedule**

- 20 flashes

**Fixed Interval Schedule**

- 20 s

**Timing Test Trial**

- Switch at 10 s

**Counting Test Trial**

- Switch at 10 s

Roberts, Coughlin & Roberts (2000)
So, why is time so powerful?

- Psychological Arrow
  - We experience time as moving forward
  - We remember the past rather than the future
- The Thermodynamic Arrow
  - Time flows in the direction in which disorder increases
- The Cosmological Arrow
  - The universe is expanding and increasing in disorder
- The three arrows all point in the same direction
- “…the reason why we observe this thermodynamic arrow to agree with the cosmological arrow is that intelligent beings can exist only in the expanding phase”
- In other words, the universe must be expanding because intelligent beings exist, and intelligent beings exist because of the arrow of time
Acknowledgments

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