# Real-world human locomotion as a platform for cumulative and societally impactful computational cognitive science

Gustav Markkula[1,2], Aravinda Srinivasan[1], Yi-Shin Lin[1], Yueyang Wang[1], Jac Billington[2], Matteo Leonetti[3]

[1] Institute for Transport Studies, University of Leeds, [2] School of Psychology, University of Leeds, [3] Department of Informatics, King's College London

## Background

- Recurring calls for **cumulative theory-building** in psychological/cognitive sciences
- One suggested approach: model **real-world human behaviour** → requires **integration of theory**
- Most applied human behaviour modelling is **ad hoc engineering models** or **black box machine-learning**

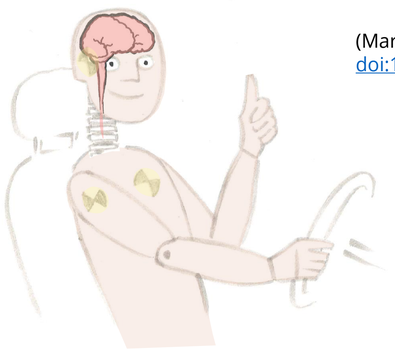
→ Here: **Integration of computational cognitive theory to model human driving/walking**

## Routine and near-crash driver behaviour

Closed-loop ⟷ Open-loop

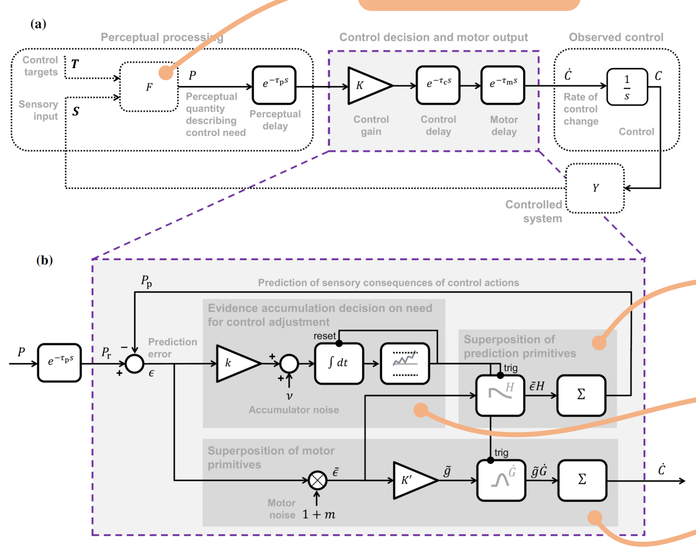
Short delays ⟷ Long, random delays

Well-adjusted control ⟷ Under- and overreactions



(Markkula, 2014, HFES Annual Meeting)
doi:10.1177/1541931214581185

Perceptual-motor heuristics



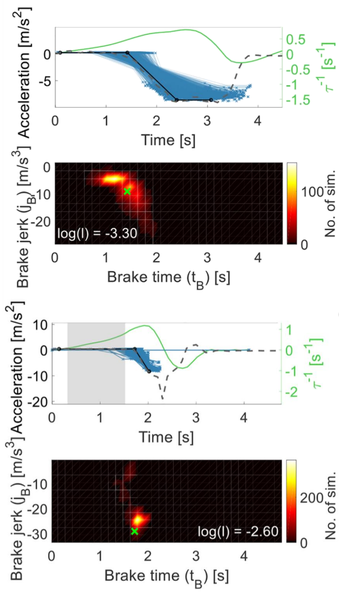

(Markkula et al., 2018, Biological Cybernetics)
doi:10.1007/s00422-017-0743-9

Sensory predictions (corollary discharge)

Evidence accumulation

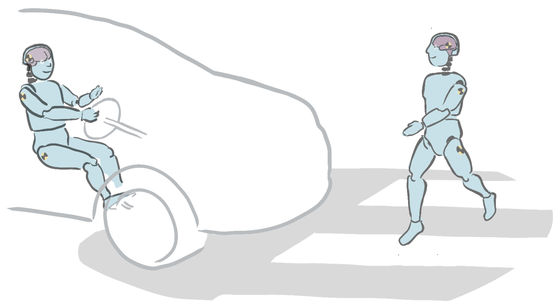
Motor primitives

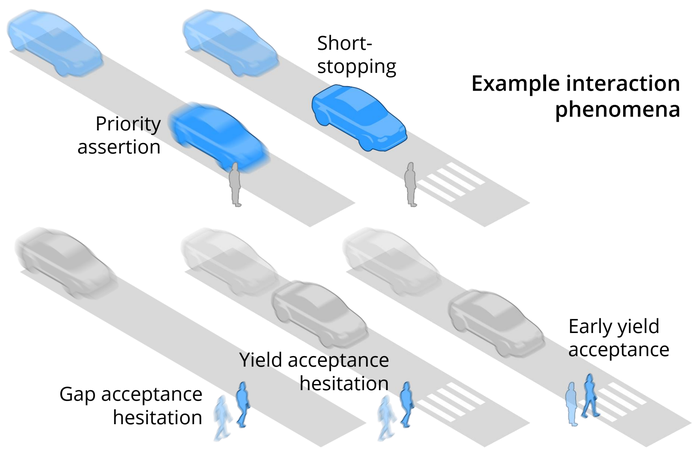
### Modelling braking in real near-crashes and crashes




(Svärd et al., 2021, Accident Analysis & Prevention)
doi:10.1016/j.aap.2021.106433

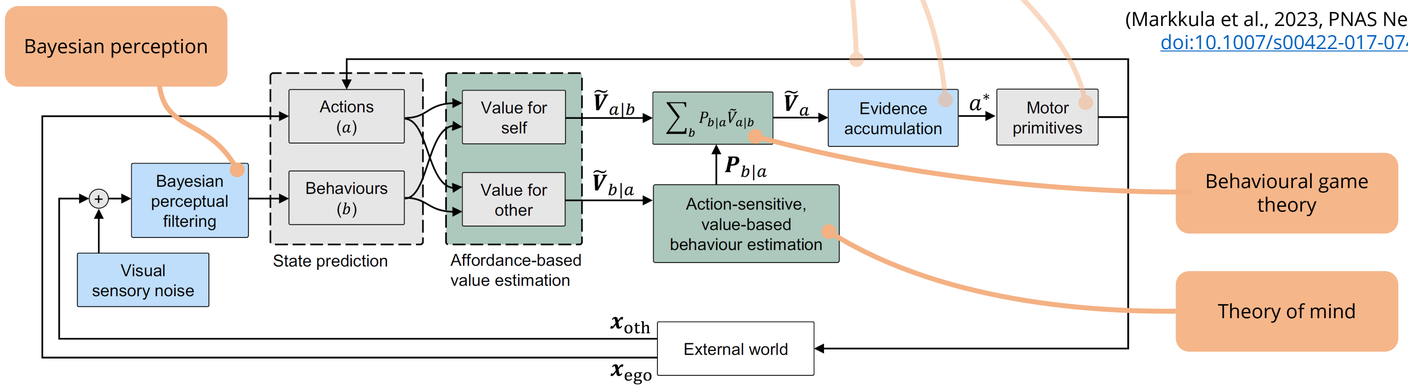
## Driver-pedestrian interaction






**Example interaction phenomena**

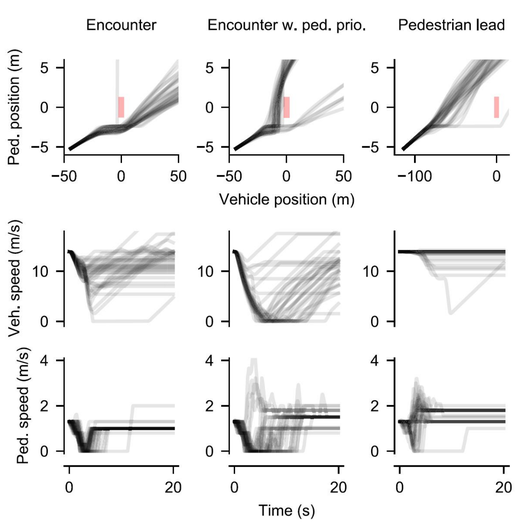
Bayesian perception



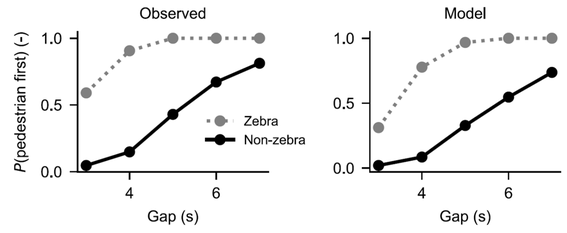

Behavioural game theory

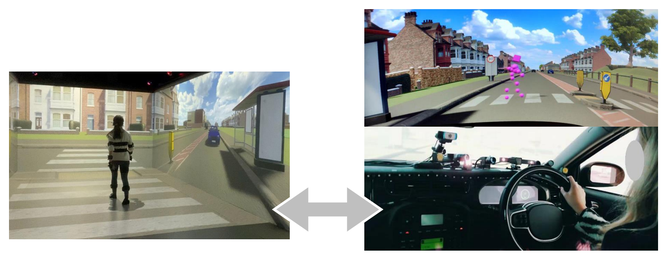
Theory of mind

### Two-agent model simulations




### Predicting outcomes in two-participant simulator study



(Kalantari et al., 2023, Accident Analysis & Prevention)
doi:10.1016/j.aap.2023.107050

## Outlook

- Real-world locomotion is a **microcosm of human cognition** → good platform for **integrating models**
- In general many **benefits** of developing **applied human behaviour models based on fundamental theory**

**Applied researchers** get models that can be:
- Explained and understood
- Used to guide interventions
- Extended as fundamental science progresses

**Fundamental researchers** get:
- Cumulative theory-building
- Real-world impact of their models
- Ideas/steer on research directions

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