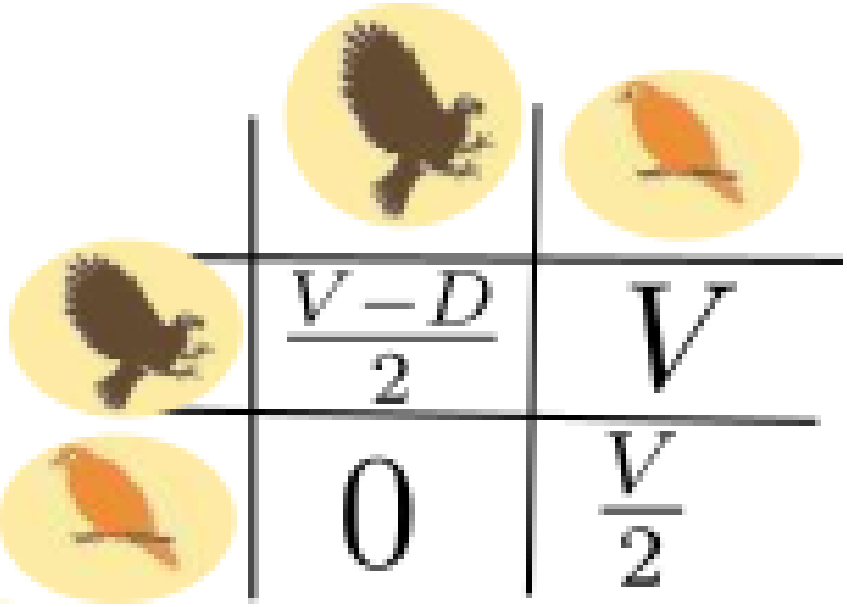
The evolution of badges of status with learners

Andrés Quiñones

The Hawk-Dove game

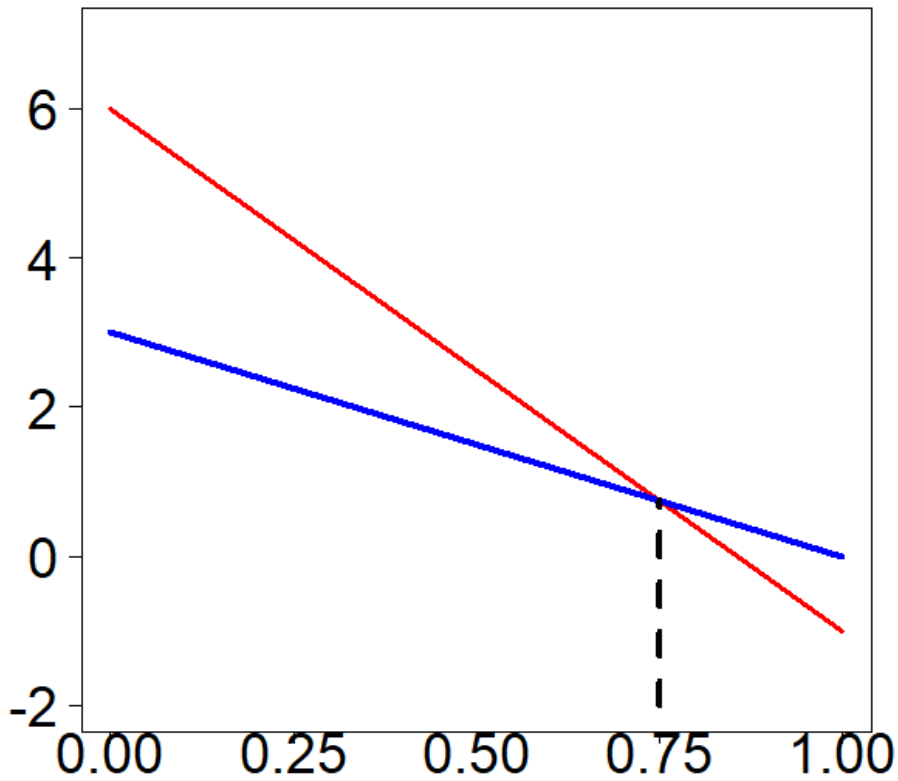
Individuals have one of two genetically determined phenotypic strategies. *Hawks* are willing to start a conflict over resources, while *doves* prefer to stand down in the hope to share the resource without an aggressive contest.



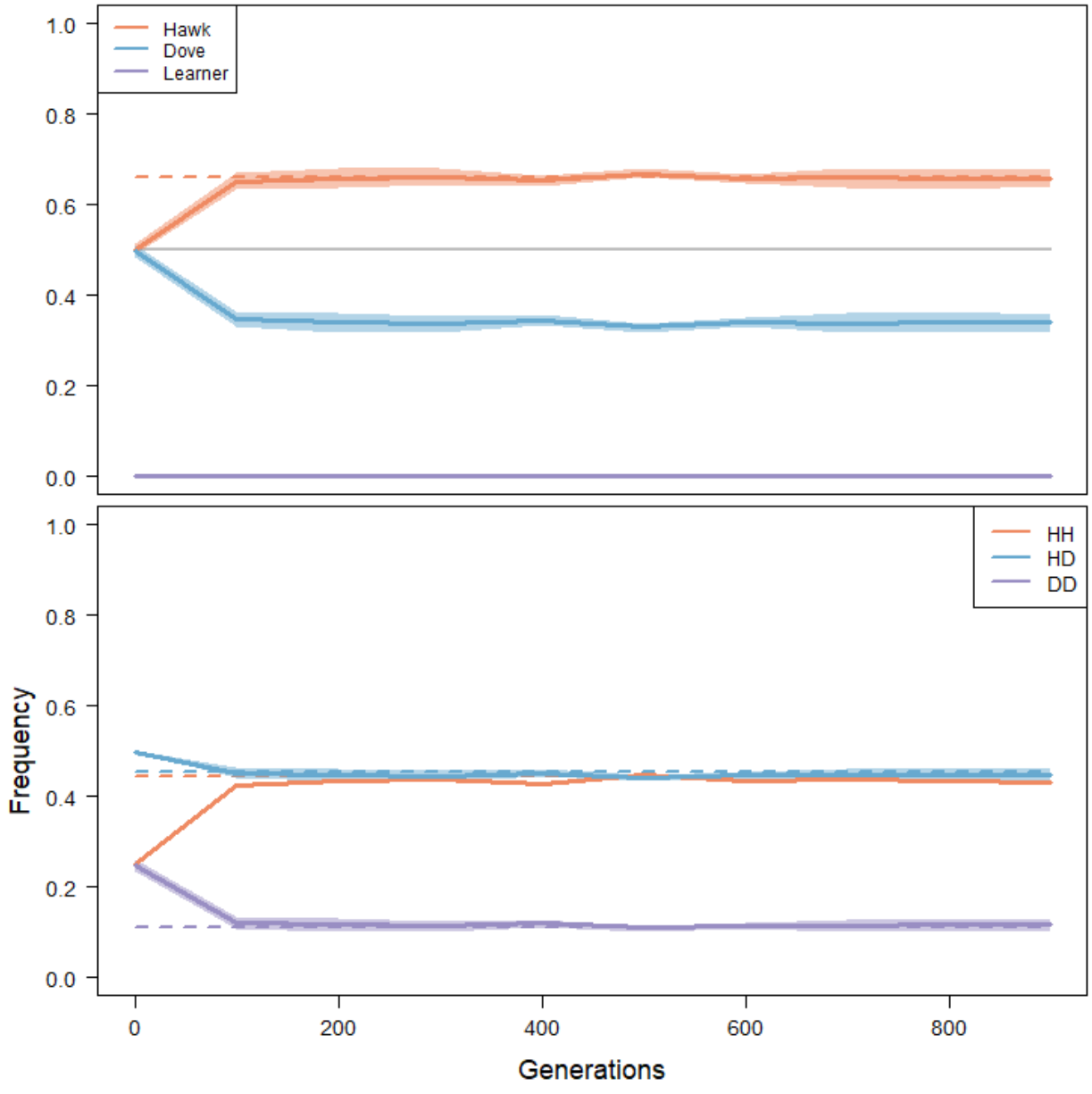
The hawk-dove game

$$w_H = p_H \frac{V - C}{2} + (1 - p_h) V$$

$$w_D = p_H 0 + (1 - p_H) \frac{V}{2}$$



The hawk-dove game



What about signals?

What about signals?

When are signals honest?

- Impossible to fake
- Individuals have common interests
- Handicap principle (signal´s cost is proportional to quality)
  - Social costs?

Social costs are an underappreciated force for honest signalling in animal aggregations

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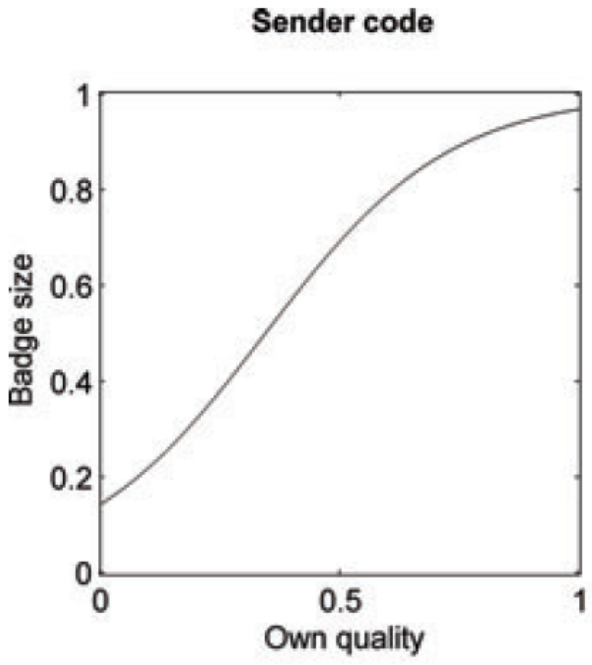
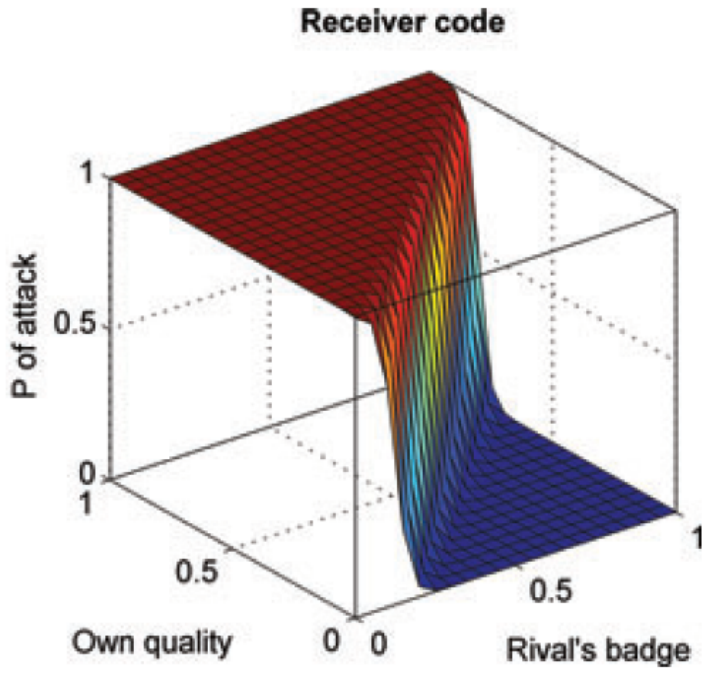
What about signals?





What about learning?

Associative learning

Reinforcement learning theory

$$\Delta V_{t(s)} = \alpha \underbrace{(R_t - V_t)}_{\text{prediction error}}$$

Reinforcement learning theory

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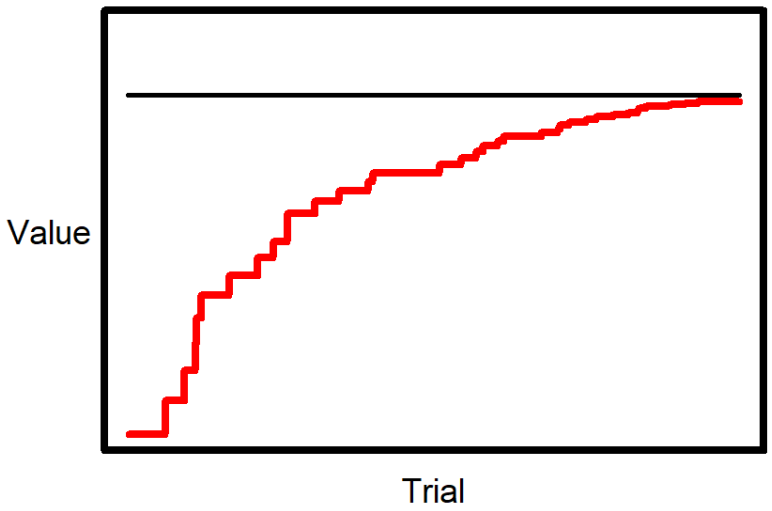

Reinforcement learning theory

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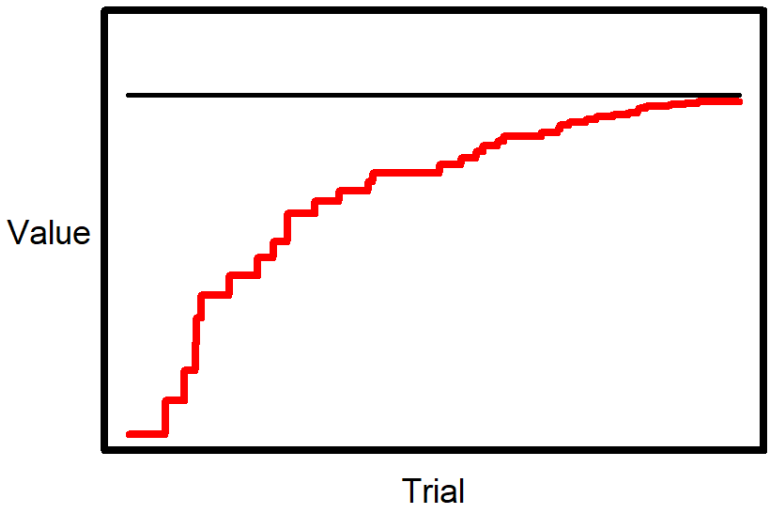
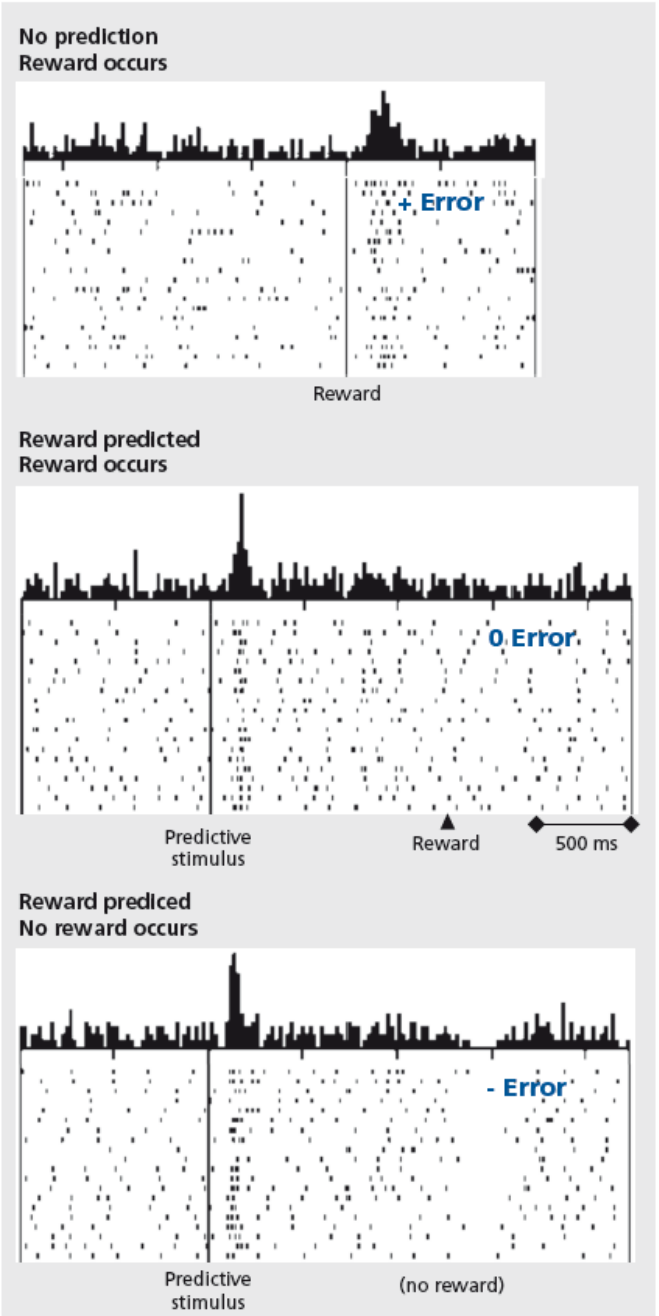




Reinforcement learning theory

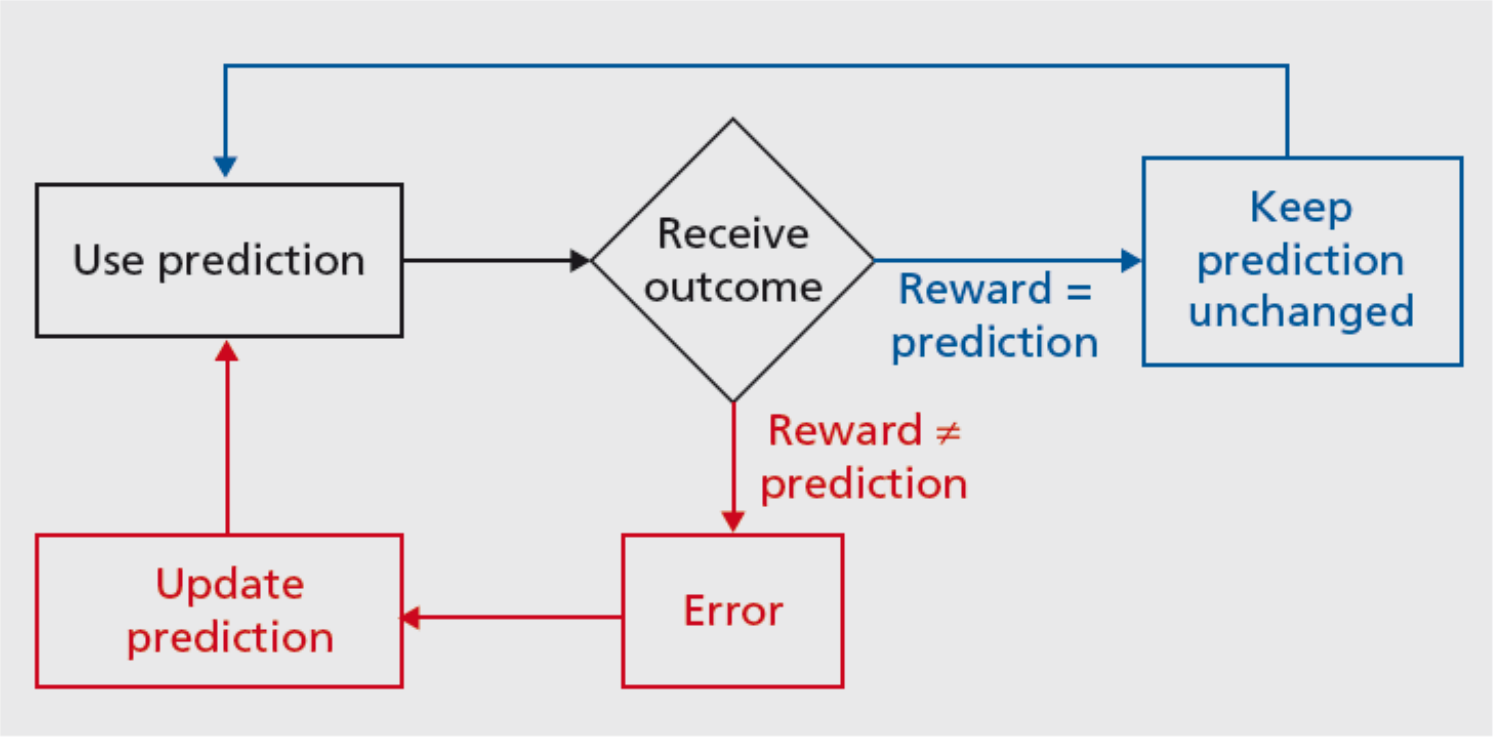
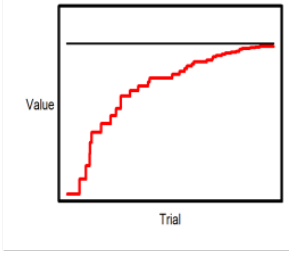
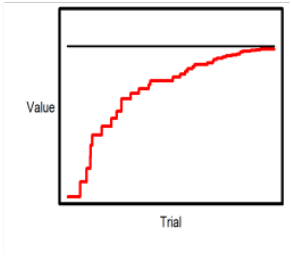


Figure 1. Scheme of learning by prediction error. Red: a prediction error exists when the reward differs from its prediction. Blue: no error exists when the outcome matches the prediction, and the behavior remains unchanged.

Environmental states

Discrete states





Environmental states

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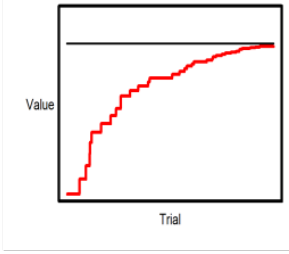
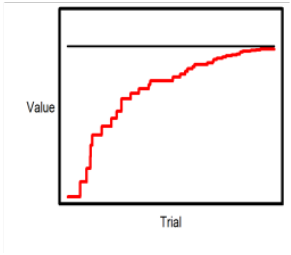
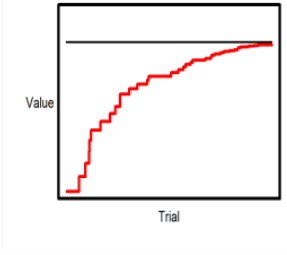




Continuos states



Continuos environmental states