

Achieving faster decision-making with neutrality

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The Significance



Image source: Stock photos.

The prolonged Brexit process cost the UK about £600m/week in lost output. Source: Goldman Sachs

Slow consensus in politics, planning, and trade talks carries measurable, **multi-billion-pound costs** that drag on growth and public services.

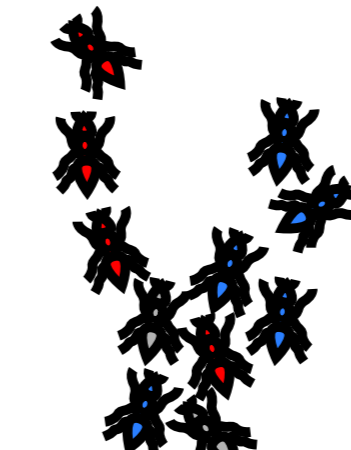
More efficient **decision-making** processes in voting, community development and funding allocations **benefit British businesses and society.**

The Challenge

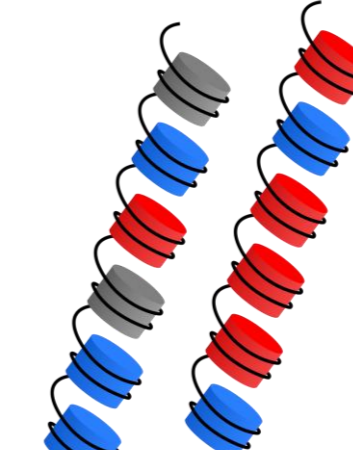
- In many cases, **group decisions must adapt** to new evidence.
- Sometimes, individuals adopt a **neutral position**.
- **Effective decision-making protocols** require understanding consensus formation and its change in the face of **neutrality**.
- Current modelling approaches fail to capture the role of neutrality in decision-making.



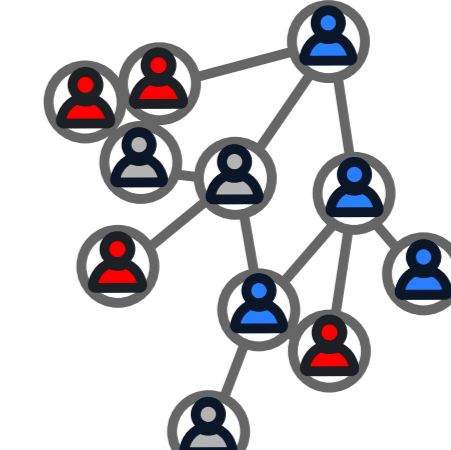
Voting



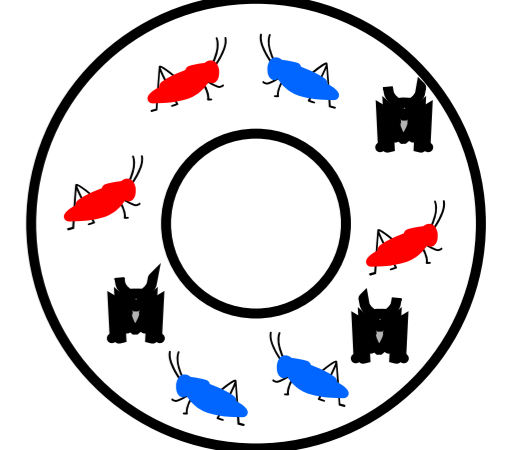
Ant foraging



Nucleosome modifications



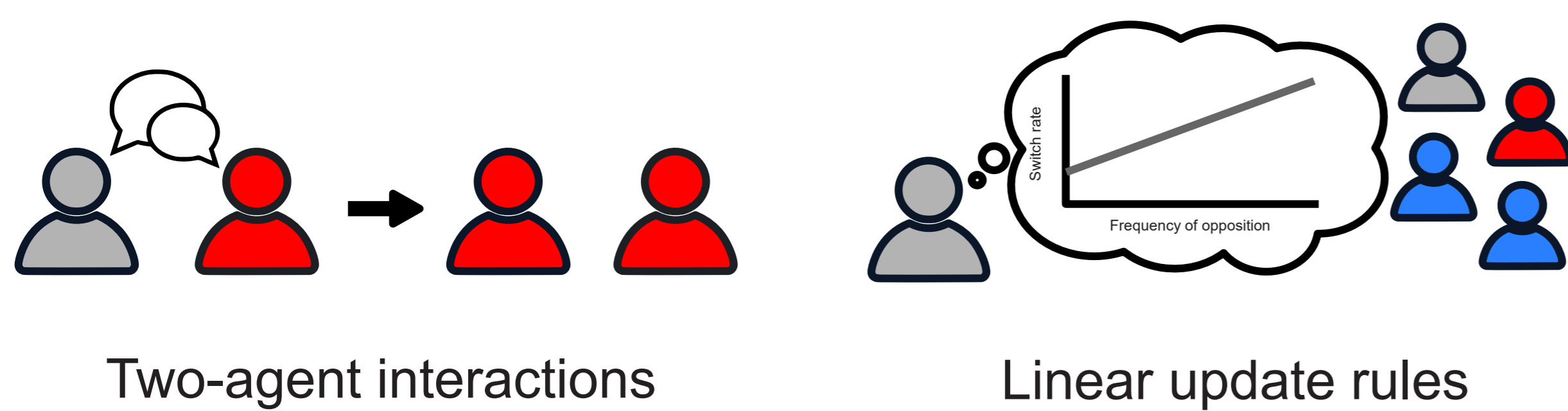
Social Networks



Animal Collective Motion

The Methodology: Mathematical Model for Decision-Making

1. Assumptions



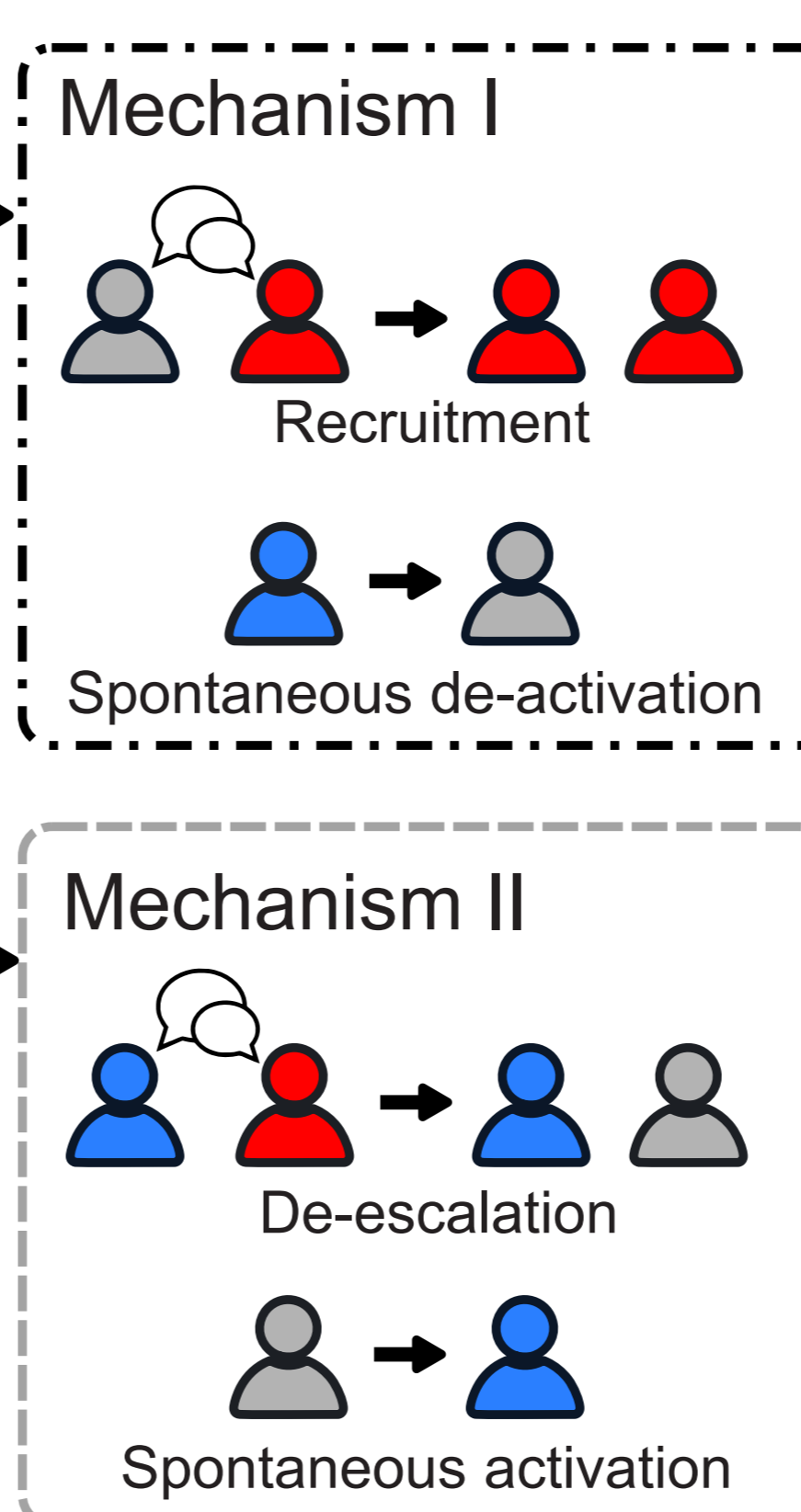
2. Mathematical Model

$$\frac{dx}{dt} = \underbrace{s \cdot \begin{pmatrix} x \\ y \\ w \end{pmatrix}}_{\text{Vote change}} + \underbrace{\begin{pmatrix} x \\ y \\ w \end{pmatrix} \cdot R \begin{pmatrix} x \\ y \\ w \end{pmatrix}}_{\text{Spontaneous}} + \underbrace{\begin{pmatrix} x \\ y \\ w \end{pmatrix} \cdot R \begin{pmatrix} x \\ y \\ w \end{pmatrix}}_{\text{Pairwise Interactions}} + \underbrace{\eta_x(t)}_{\text{Fluctuations}}$$

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Theoretical Analysis

3. Predictions

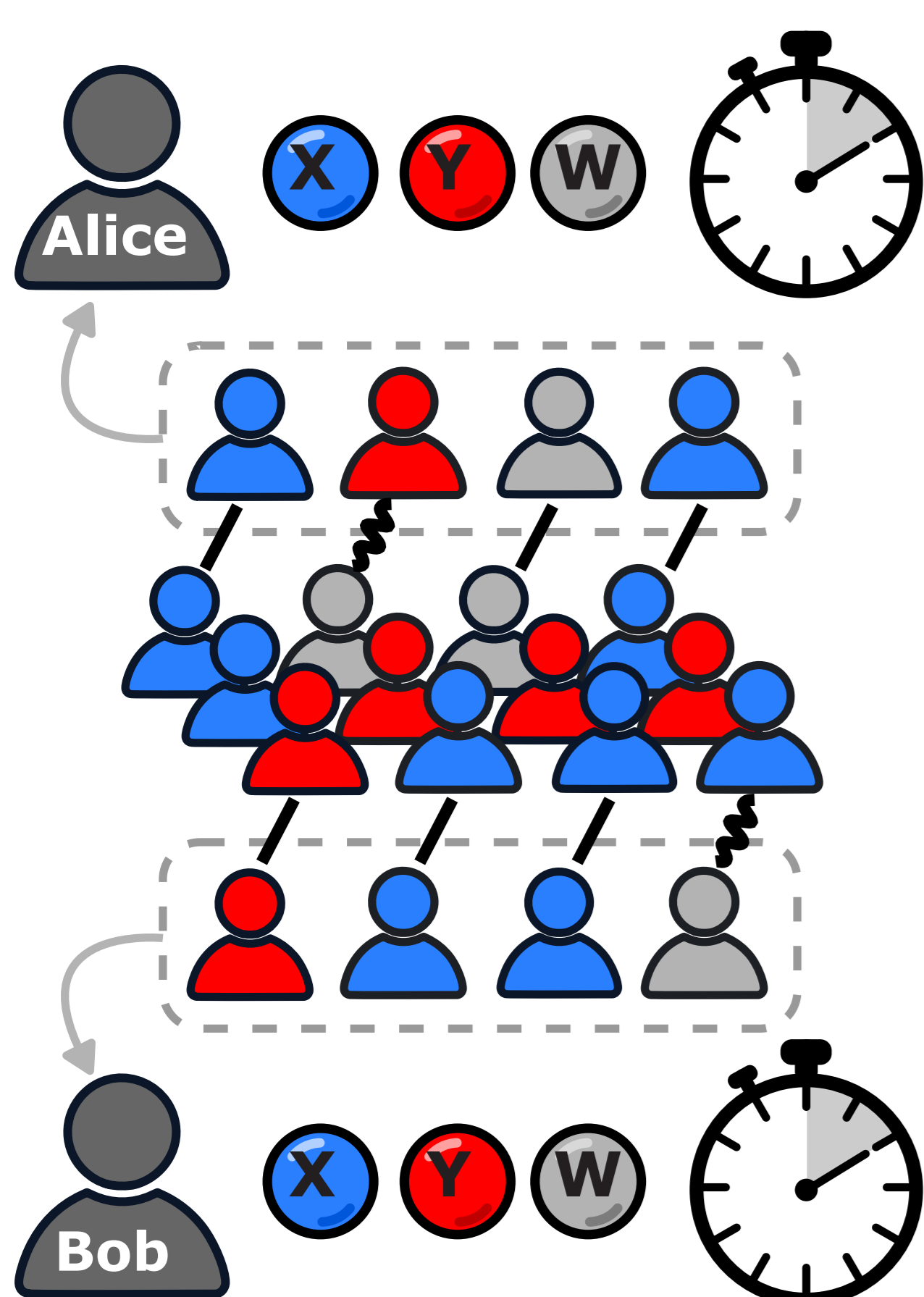


Our **separation of timescales** theory predicts:

- Two mechanisms for **consensus formation and change**.
- *Mechanism I* maintains the same **number** of abstentions as majorities change.
- *Mechanism II* increases the number of abstentions.
- *Mechanism II* is **faster at forming and reverting majorities**.

The Experimental Evidence

Voting Experiments



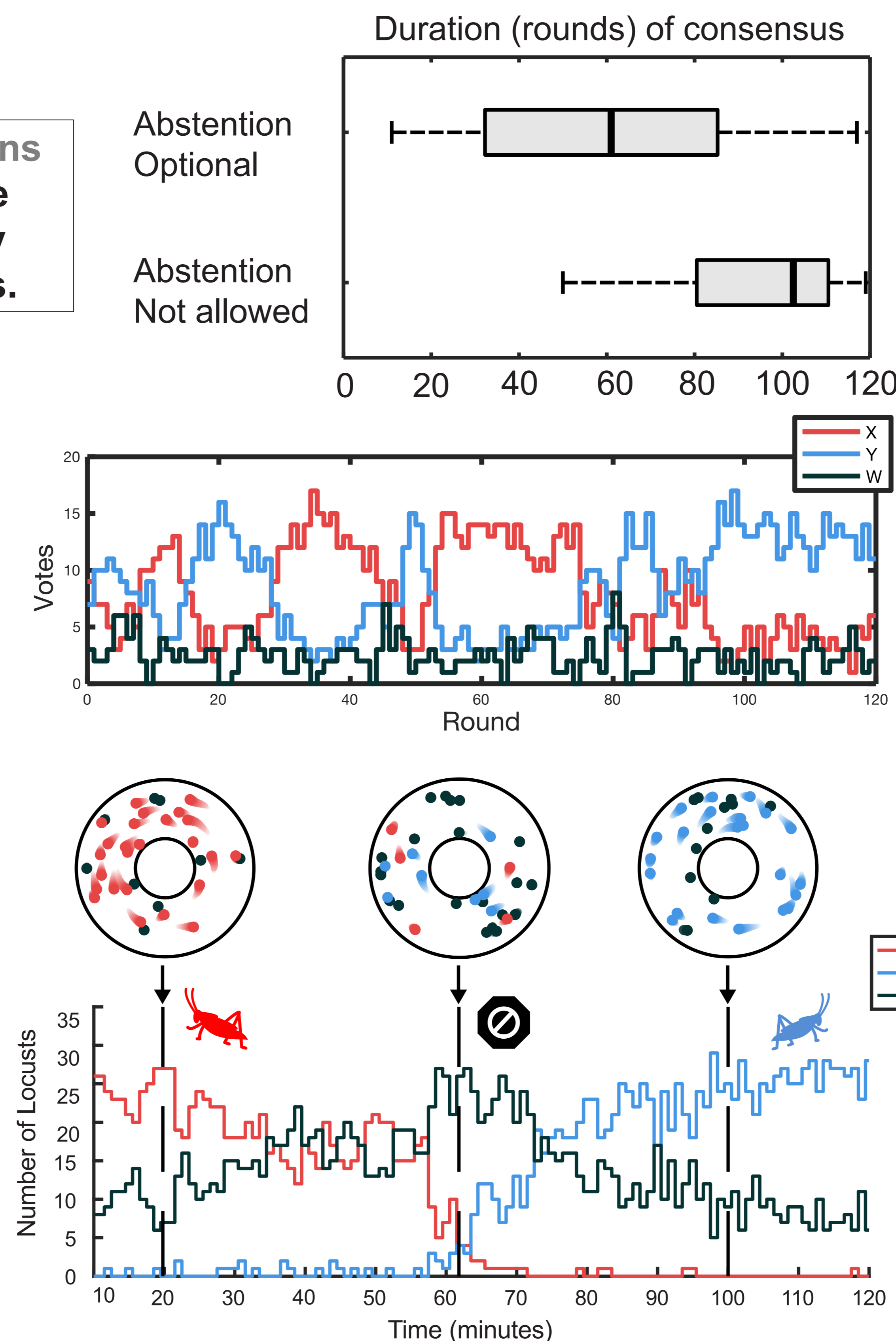
Abstentions facilitate majority switches.

Personalised noisy samples

10-second decisions

Locusts Experiments

Analysis of experiments with locusts in ring-shaped arenas reveal that **collective direction switches** coincide with **spikes in stopped (neutral) individuals**, consistent with **De-escalation mechanism (Mechanism II)**.



The Impact

Our first-principles mathematical model predicts **mechanisms for consensus change** missing from previous modelling approaches.

De-escalation mechanism is **faster** to form and change consensus.

Experimental data support **De-escalation** mechanisms and the role of **neutrality**.

Predictions suggest efficient solutions to achieve **faster decision-making**.