12 January, 2018

Modelling multidimensional opinion exchange in community networks with application to information operations using agent based models

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About Sandtable

- We are a data science company
- We specialise in building agent based models of human behaviour
- We are a team of data scientists, behavioural scientists and computer scientists
- We are pioneering the development of data-driven ABM
- We have developed a cloud based model platform that allows us to create computationally intensive, data driven behavioural simulations
- We have been working with organisations in a range of different behavioural domains including:

Public Health England, TESCO, BBC, NATO OTAN, Coca-Cola, groupm

- Our R&D has been supported by grants from the UK Govern vate UK
- We have ongoing research relationships with a range of leading universities including:

UNIVERSITY OF OXFORD, UCL, KING'S College LONDON, LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

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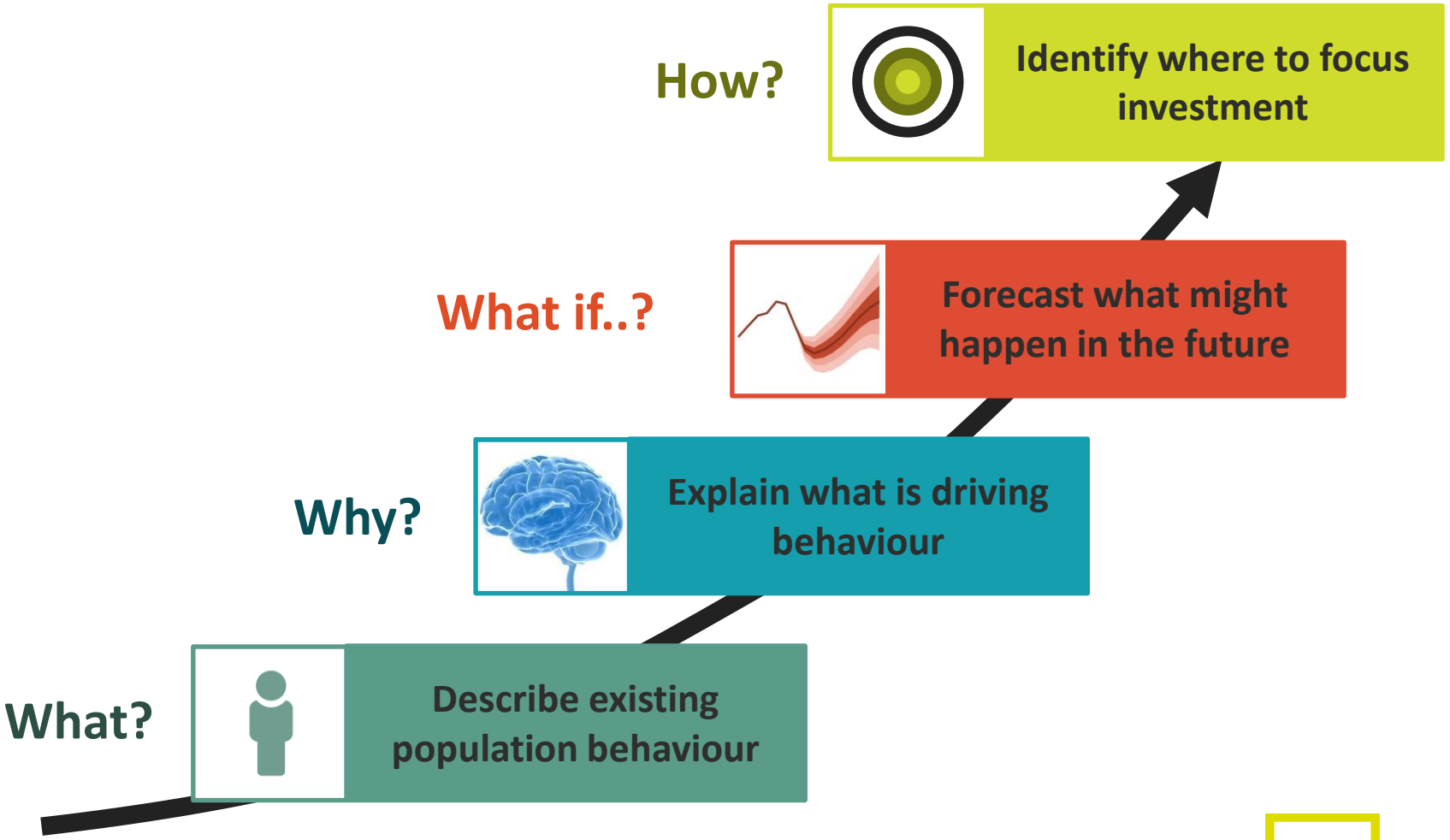
We help our clients to better understand human behaviour



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Modelling multidimensional opinion exchange in community networks with application to information operations using agent based models

- There are good models of kinetic effects in conflict situations.
- Recently, a bigger and more significant proportion of conflict is taking place in the information domain (fake news etc.).
- Better models of opinion dynamics in the information domain are necessary.
- **How do opinions change when people interact with their environment?**

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Breaking the problem down

- How do opinions change as a result of direct interactions between two individuals?
- How can we move beyond interactions of just two individuals and accurately represent current social structures?
- How can we approach this complex modelling task using real world data?

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The relative disagreement model

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A model for opinion (ex)change

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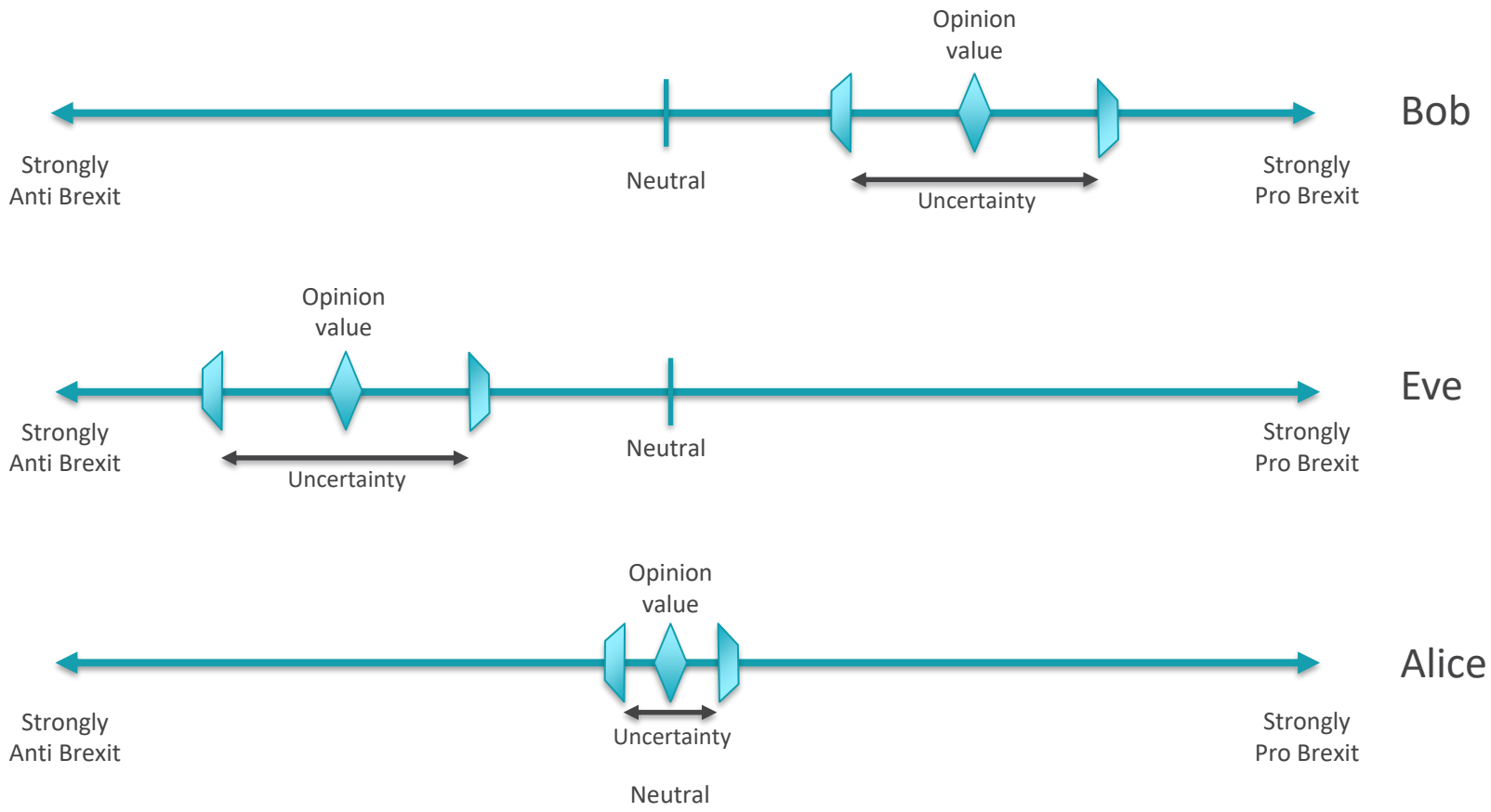
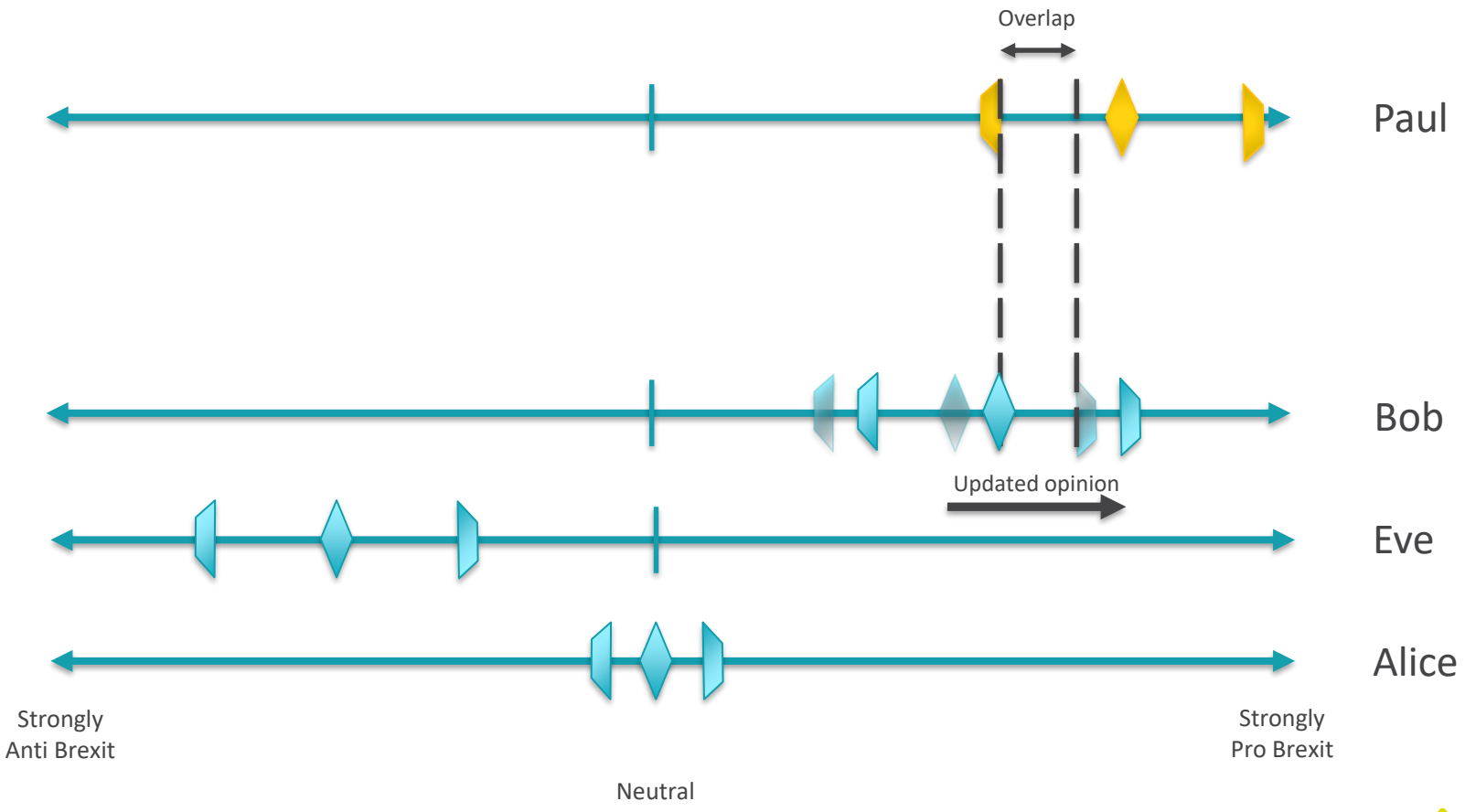
Core principle behind the relative disagreement model

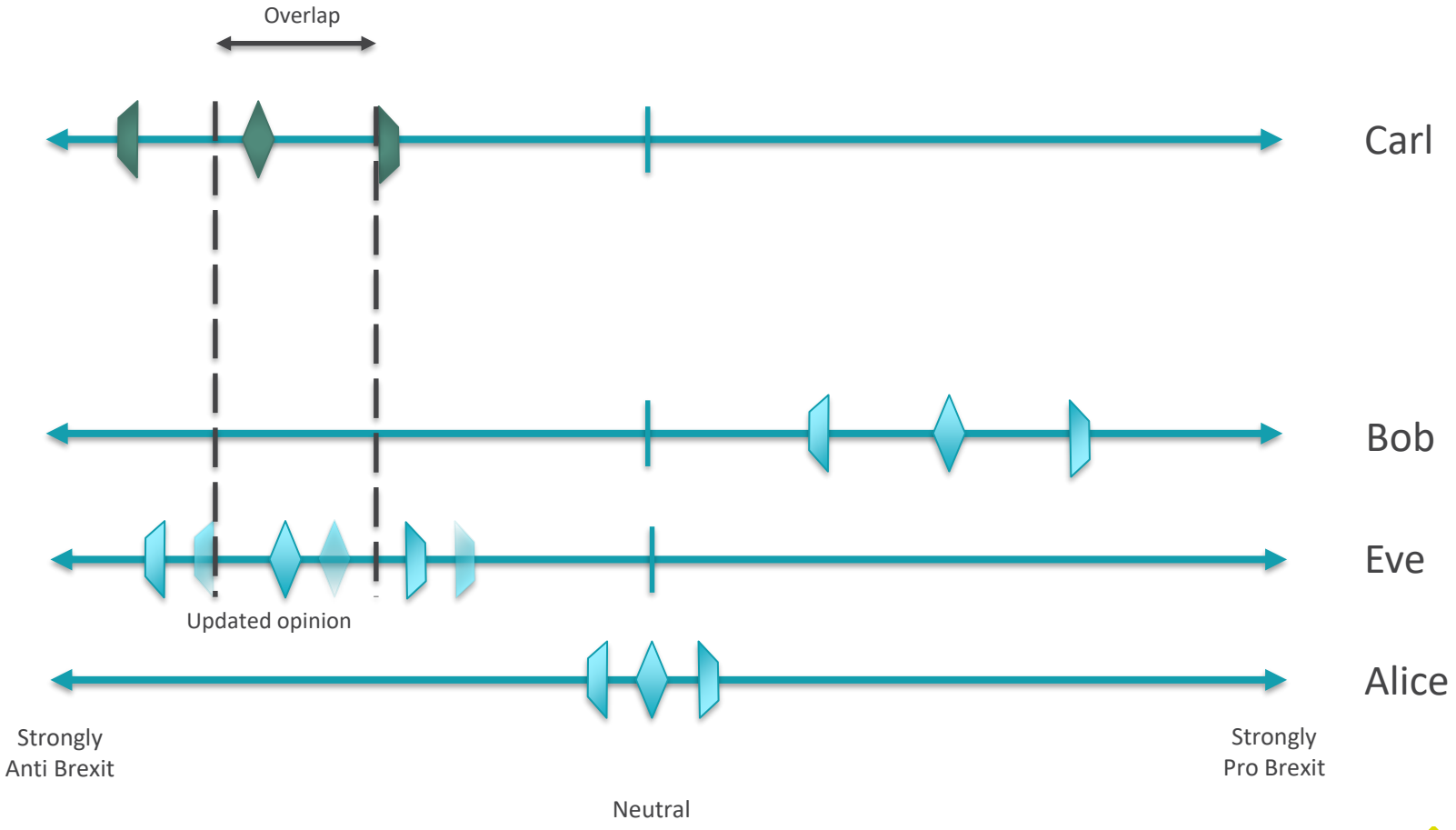


Based on research from the following papers:
Meadows, M., & Cliff, D. (2014). The relative disagreement model of opinion dynamics: Where do extremists come from? DOI: 10.1007/978-3-642-54140-7_6,
Amblard, F., & Deffuant, G. (2004). The role of network topology on extremism propagation with the relative agreement opinion dynamics.
DOI: 10.1016/j.physa.2004.06.102

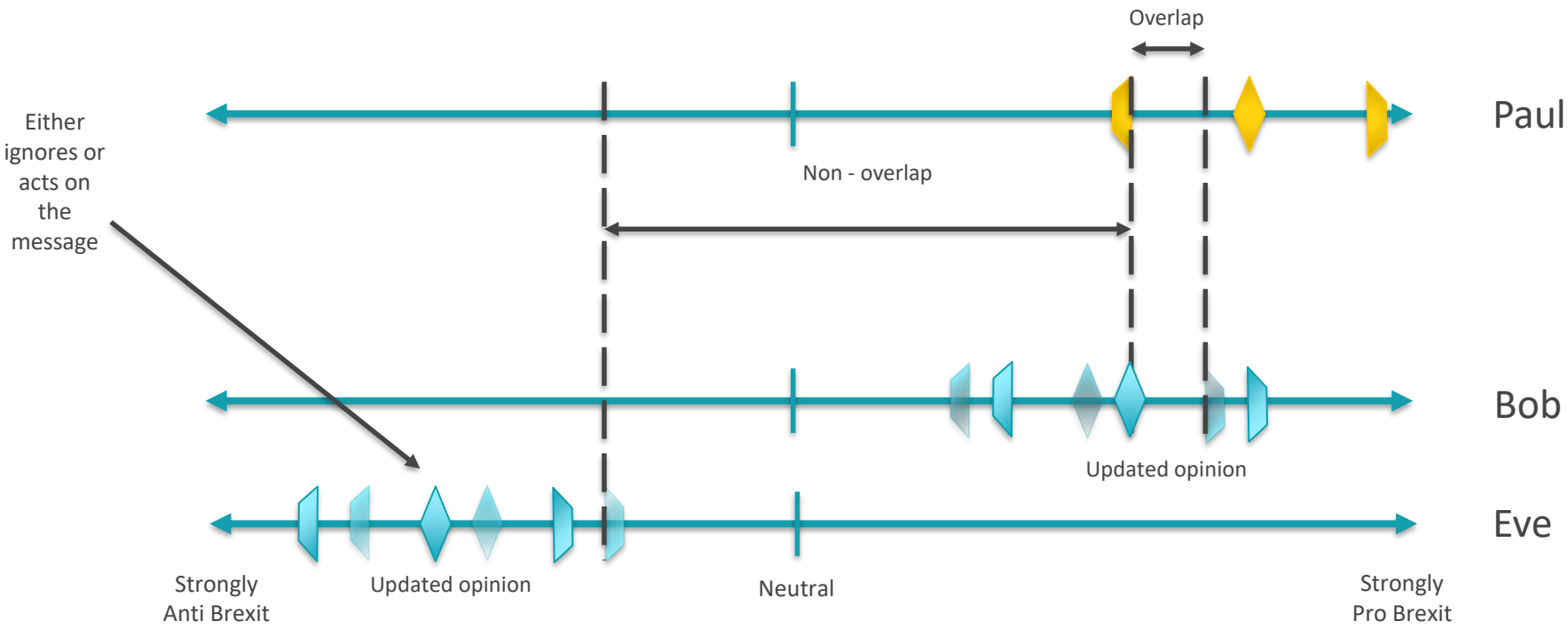
Core principle behind the relative disagreement model



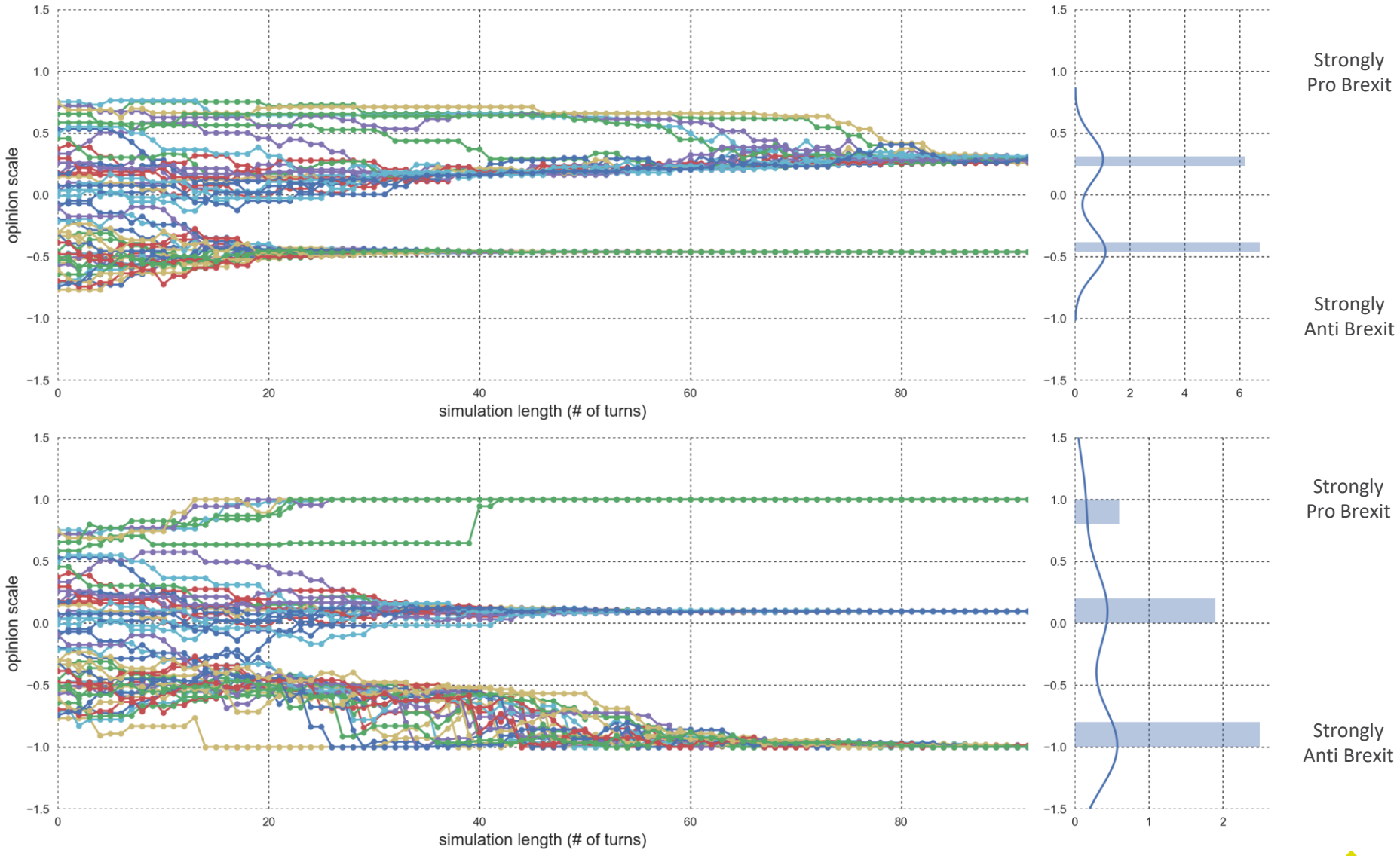
Core principle behind the relative disagreement model



Core principle behind the relative disagreement model



The relative disagreement model on a population scale



Summary – Modelling opinion (ex)change

- There is a good model of opinion exchange
- The model can be extended to an multi-attitude model
- However this is only part of the solution as it mainly solves modelling agent – agent opinion dynamics
- A big part of opinion evolution however is emerging from social interactions.

Networks

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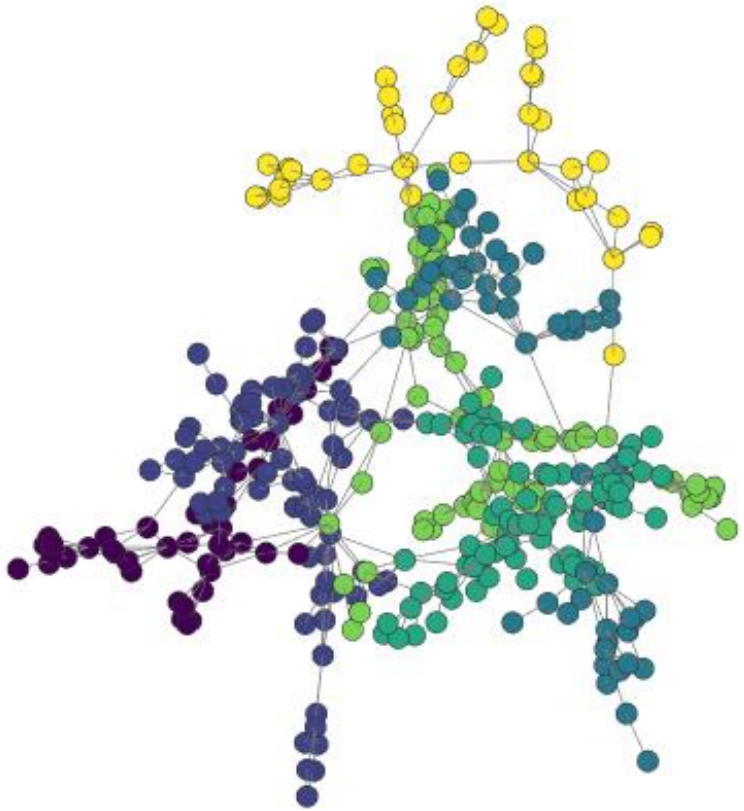
Representing social structures

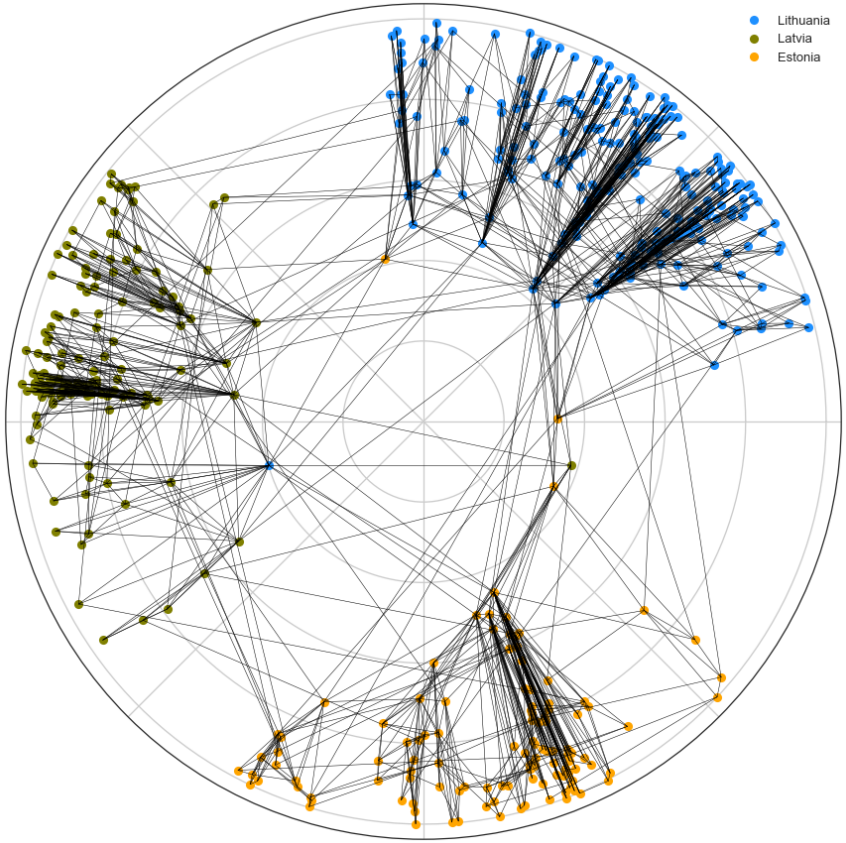
Properties of social networks

- High degree of clustering
- Heavy-tail degree distribution
- Community structures



Generating attribute specific networks:

- Using popularity and similarity to grow networks where similar people are connected to each other (Birds of a feather …)



Research based on: Papadopoulos, F., Kitsak, M., Serrano, M. Á., Boguñá, M., & Krioukov, D. (2012). Popularity versus similarity in growing networks. *Nature*, *489*(7417), 537–540. https://doi.org/10.1038/nature11459

Summary - Networks

- Using network theory we can accurately represent social structures.
- These networks, combined with the relative disagreement model allow us to simulate a variety of realistic scenarios.
- The approach is flexible, scalable, and granular.
- These stochastic models provide us with near perfect information of their opinion dynamics.

Combining RD models, attribute based networks and agent based models for real world applications

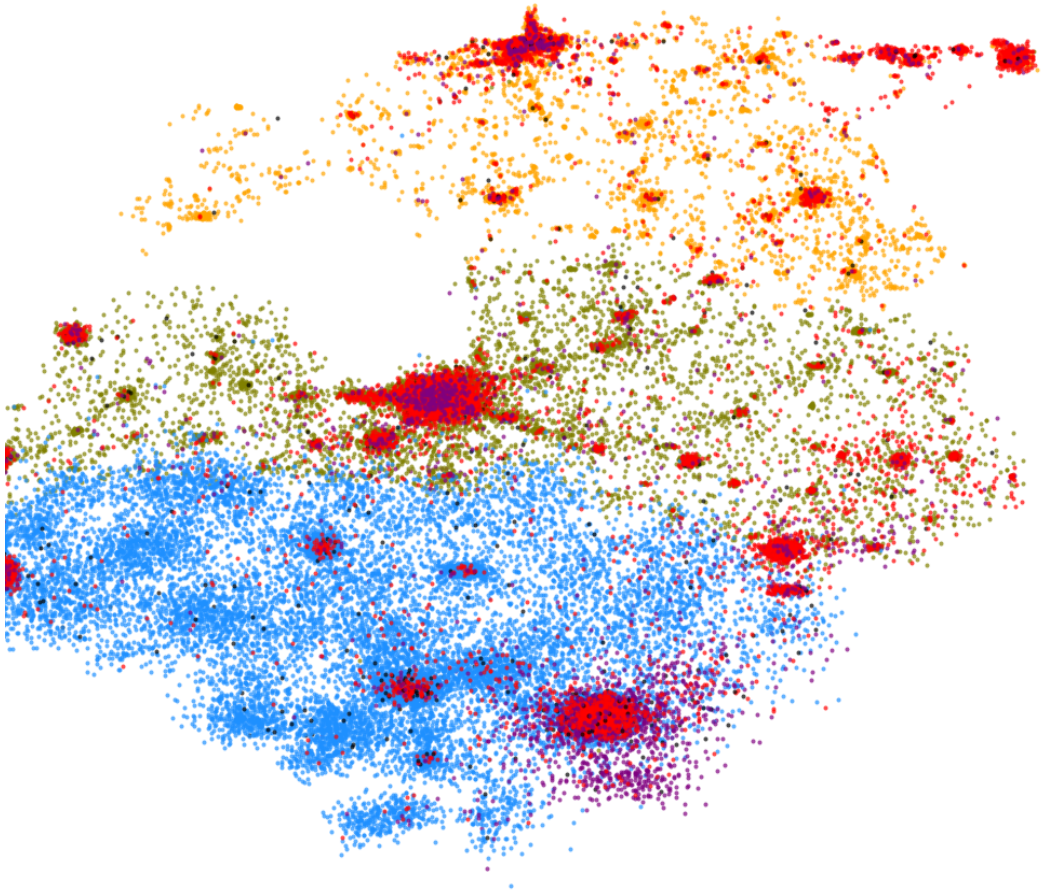
Real world applications using data

- We combine information about opinions, demographics as well as census data to grow realistic spatial and attribute based networks to be used in agent based simulations

- From: City A
- Party membership: Party B
- Attitude towards government: Very positive
- Age: 65+

- From: City B
- Party membership: Party A
- Attitude towards government: Negative
- Age: 35-45

- From: Village C
- Party membership: None
- Attitude towards government: Neutral
- Age: 18-25

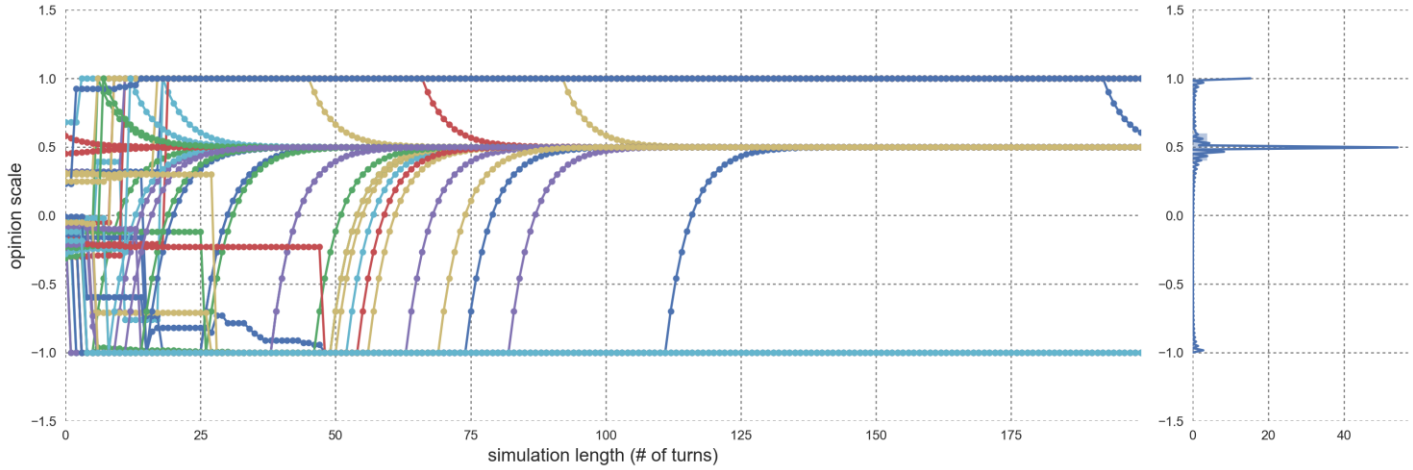


Basic metrics that we can track and modify

- Individual opinions over time
- Group opinion over time
- Group opinion diversity over time
- Location based opinion
- Messaging behaviour across the network

- Targeted messages to the whole population
- Targeted messages based on attributes
- Targeted messages based on community membership

- Etc.



Demo

What have we learnt?

- How to model opinion exchange using the relative disagreement model.
- How to represent social structures using attribute sensitive networks.
- How to combine both approaches with agent based modelling and real world data to allow for a more realistic representation of opinion dynamics.

Thank you for your attention!

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