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Drilling down below opinions:
*how co-evolving beliefs and social structure
might result in collective opinion change*

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Scoping & Motivation

Simplicity is *Not* Truth-Indicative

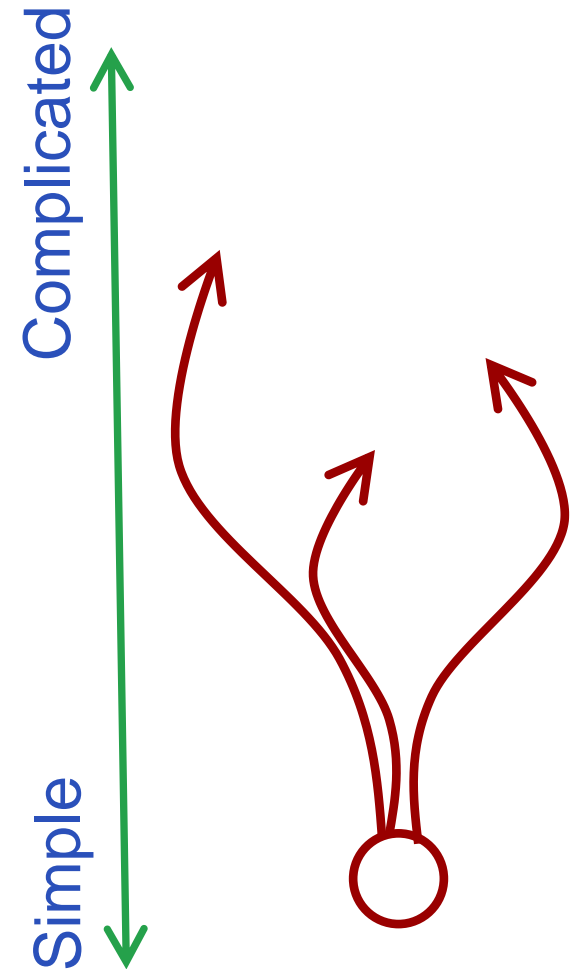


- Simpler models have huge pragmatic advantages: ease of development, verification, understanding your model, exploration, communication, etc.
- But social phenomena are not arranged for our benefit as academics – here there is no reason to suppose that simple models will be adequate
- Simplicity is not an indicator of truth (Edmonds 2017)
- But this does depend on your modelling purpose
- Simpler does not make a model more general (unless you know, *beforehand*, what is essential and what can be safely omitted)

KISS – keep it simple stupid!



- Start with a simple model and add a feature only when the simpler is shown not to work
- Trouble is it maybe a combination of mechanisms that are required – trying them one at a time might not work
- Might be suited for analogical models (way of thinking about things) or theory exploration (does not tell you about world)



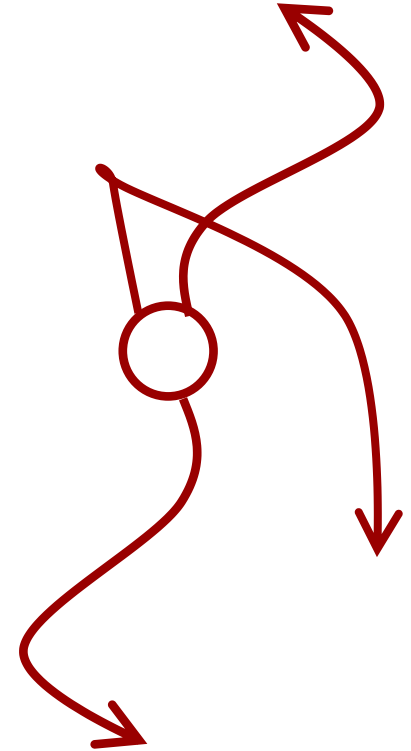
KIDS – keep it descriptive stupid!



- Start with the available evidence of what is important
- Then explore variations from there, maybe showing some are not required
- Trouble is this can make for complicated models so care is needed in development and further work will be needed to understand your model
- Suited to empirical models
- (Edmonds & Moss 2005)

Complicated

Simple



This Model

- This model makes a step towards the more complicated
- Presented as an illustrative model, to show what is possible and of interest
- It points towards more complicated empirical models
- This is FAR simpler than most of my models, for example my model of social influence as to whether to vote

My "Voter" Model



Complicated



Simple



Rosaria Conte (1954 – 2016)



- The importance of cognitive modelling
- That many social phenomena have cognitive as well as social parts that interact to produce what is observed
- Downwards as well as upwards 'causation'
- e.g. Social Norms



Rosaria, me and my grandson's class teddy some years ago

Conte, R., et al. (2001). Sociology and Social Theory in Agent Based Social Simulation: A Symposium. *Computational and Mathematical Organization Theory*. 7(3):183-205.



The Model

Essential features



- a multidimensional voter model but with interaction between beliefs of an individual...
- ...based on Thagard's model of Cognitive Coherence
- So beliefs are structured and opinions derive from the whole set of beliefs
- Described in (Edmonds 2012)
- Plus social network rewiring rules
- Described in (Edmonds 2017)
- Thus both individuals' beliefs and the society are structured



Explanatory Coherence

- Thagard (1989) etc.
- A network in which beliefs are nodes, with different relationships (the arcs) of consonance and dissonance between them
- Leading to a selection of a belief set with more internal coherency (according to the dissonance and consonance relations)
- Can be seen as an internal fitness function on the belief set (but its very possible that individuals have different functions)
- The idea of the presented model is to add a social contagion and network change processes to this

Model Basics



- A network of nodes and arcs
- There are, n , different beliefs $\{A, B, \dots\}$ circulating
- Each node, i , has a (possibly empty) set of these “beliefs” that it holds
- There is a fixed “coherency” function from possible sets of beliefs (of an agent) to $[-1, 1]$ for each kind of agent
- Beliefs are randomly initialised at the start
- Beliefs are copied along links or dropped by nodes according to the change in coherency that these result in

Coherency Function



- Gives a measure of the extent to which different sets of beliefs are coherent
- Assumes a background of shared beliefs
- Thus maybe
 - $\{A\} \rightarrow 0.5$ and $\{B\} \rightarrow \{0.7\}$
 - but $\{A, B\} \rightarrow -0.4$if beliefs A and B are inconsistent
- Different coherency functions will be applicable to different sets of ‘foreground’ candidate beliefs and backgrounds of shared beliefs

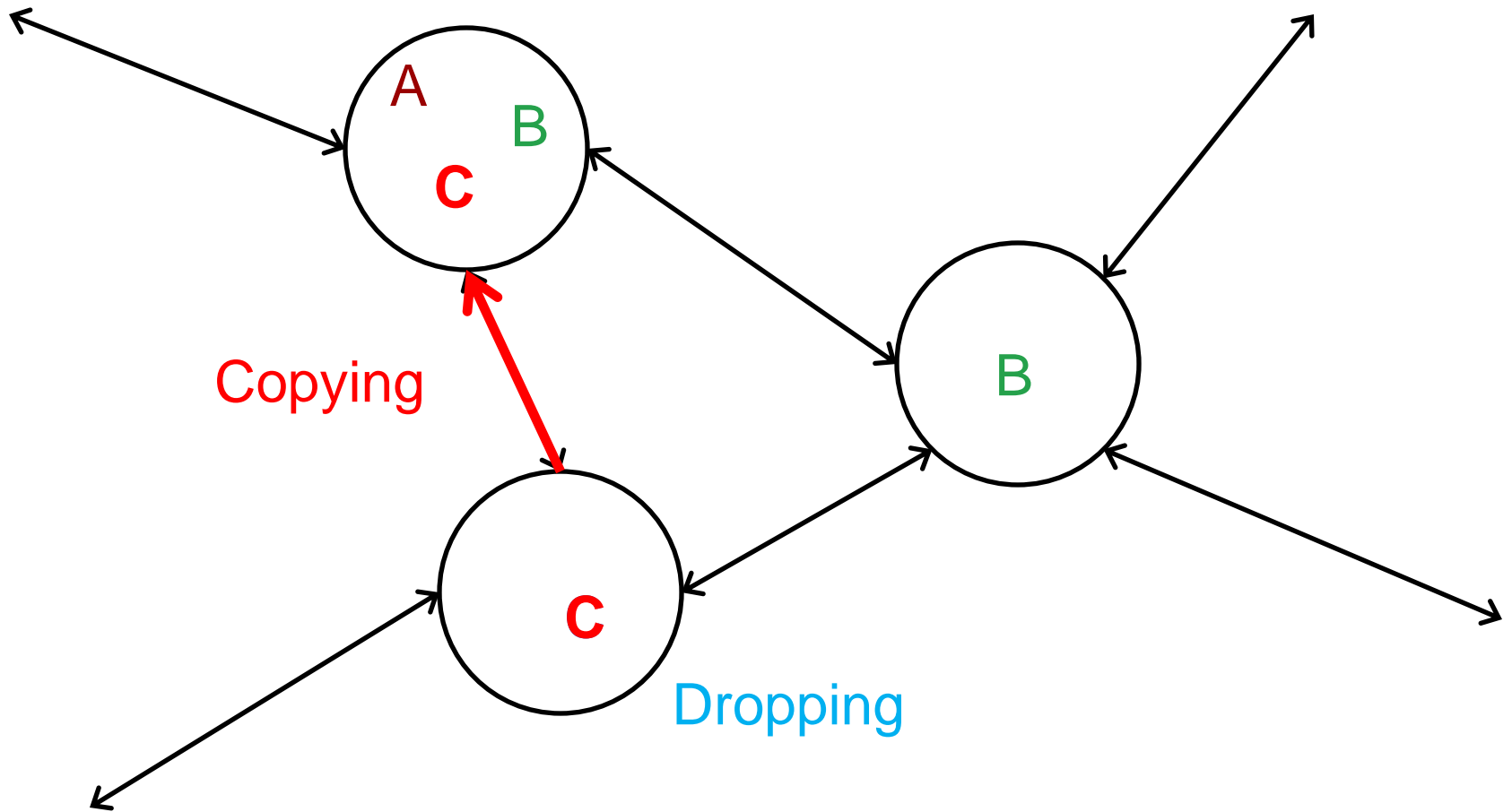
Belief Change Processes



Each iteration the following occurs:

- **Copying**: each arc is selected; a belief at the source randomly selected; then copied to destination with a *probability* related to the change in coherency it would cause
- **Dropping**: each node is selected; a random belief is selected and then dropped with a *probability* related to the change in coherency it would cause
- $-1 \rightarrow 1$ change has probability of 1
- $1 \rightarrow -1$ change has probability of 0
- There are different ways of doing this mapping

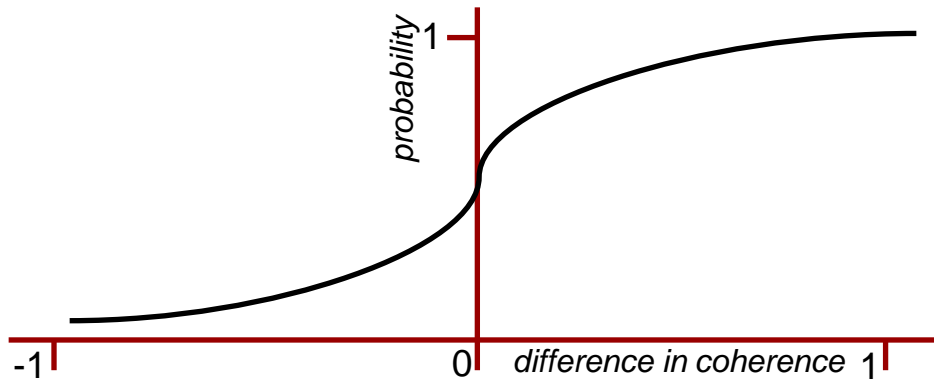
Illustration – *Belief Change*



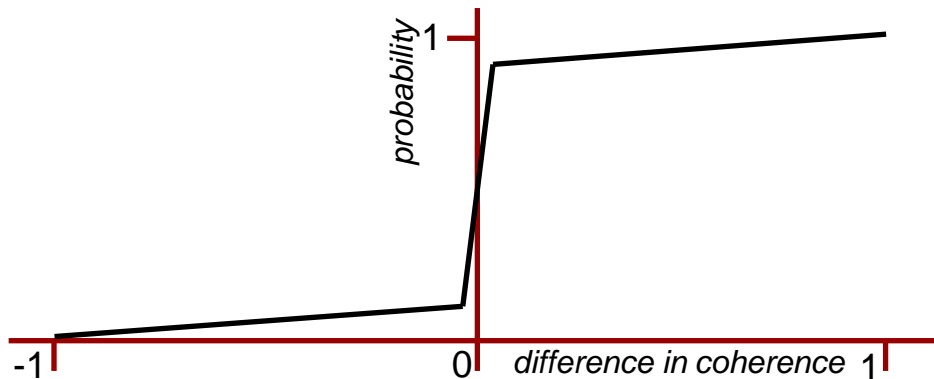
Scaling of Impact of Coherence



- There are a variety of ways to map a change in coherence to a probability (of the change)



A '*weak*' mapping – probably changes to increase coherence



A '*strong*' mapping – almost certainly only changes to increase coherence

Network Change Processes

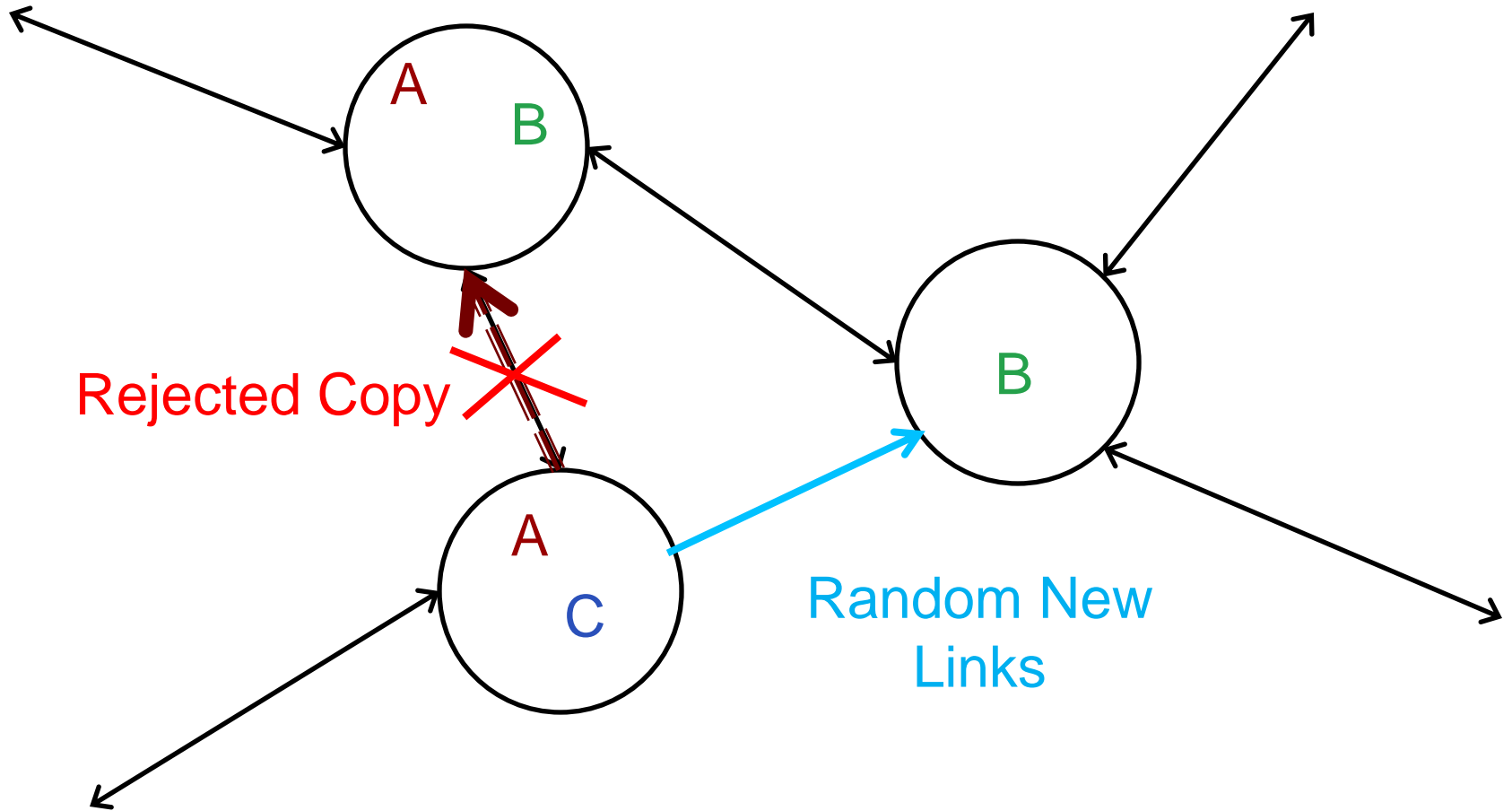


Each iteration the following occurs for each agent:

- **Link Drop**: with a probability: if a belief copy was *rejected* by the recipient, then drop that in-link.
- **New Links**: with another probability, create a new random link with a random other (probably with a friend of a friend, otherwise any)

In order to maintain the average link density I added the following ‘kludge’: If there are too many links (as set by arcs-per-node) increase the rate of link drop, if there are not enough, reduce the rate of link drop.

Illustration – Network Change



Summary



- Individuals maintain internal coherence – tending to accept beliefs or drop beliefs to increase the coherence of the whole set
- Beliefs are suggested over the social network
- The certainty/noisiness of these processes depends on the confidence/susceptibility of the individual (some belief ‘noise’)
- The network changes by probabilistically:
 - Adding new links, but preferring friends-of-friends
 - Dropping links where suggested beliefs were rejected
 - Keeping at least one link each (adding one if not)
- (for runs shown kept the node/link ratio constant)



Example Runs

An Illustrative Example



- 20% of agents (stars) are such that the ‘yellow’ beliefs are attractive and the ‘blue’ ones unattractive (due to coherence with background beliefs), they are also ‘strong minded’ in the sense that they only change their mind if it increases their coherence
- 80% of agents (circles) are such that the ‘blue’ beliefs are attractive and the ‘yellow’ ones unattractive, they are also ‘weak minded’ – they only have a slight tendency to change their mind if it increases their coherence (more probabilistic in their belief change)
- Both change their links (or not) similarly and both are agnostic with respect to the ‘red’ belief

The Run Variants



- 10 runs of each variant

Runs with

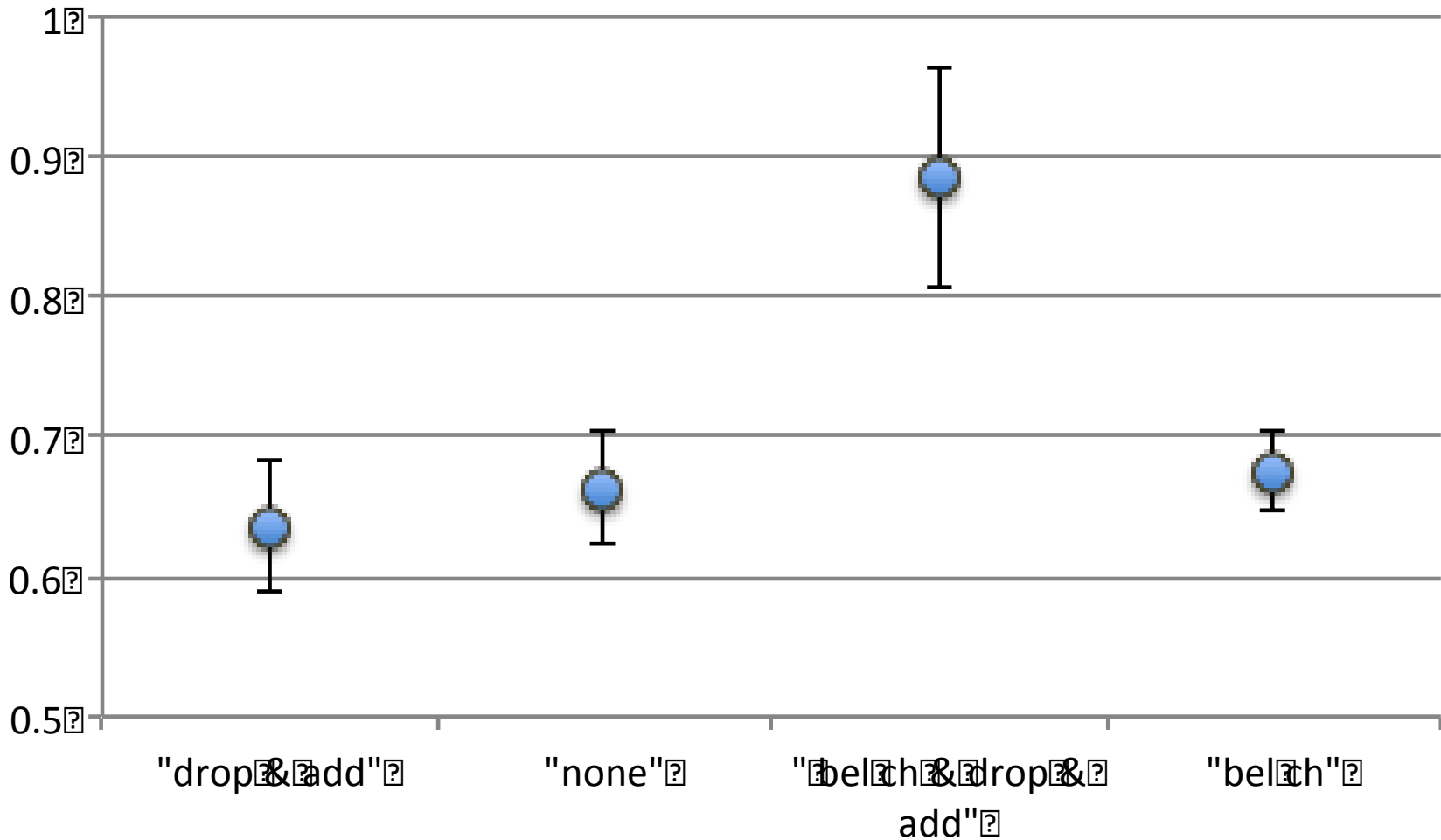
- no belief change and no link change
- with belief change only
- with link change only
- with both belief and link change

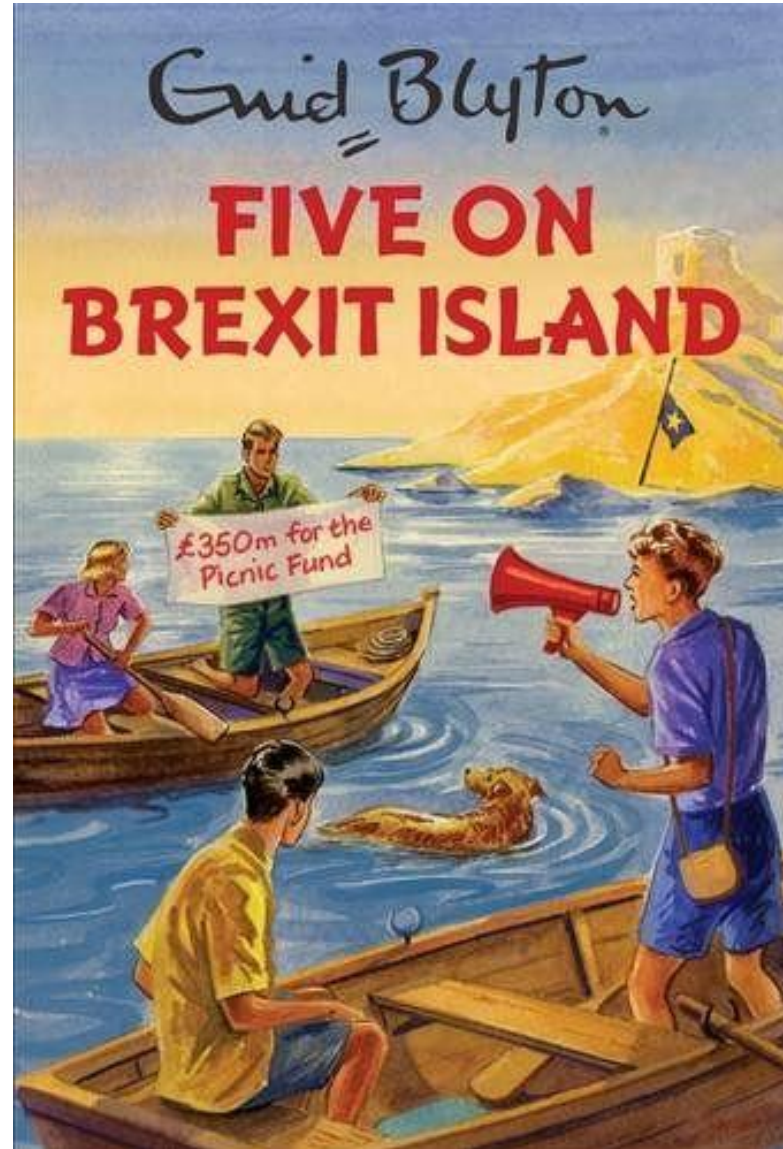
(there is some random chance of changing beliefs)

Output shown in terms of:

- Animation of one typical run
- Average results over the 10 runs for each option

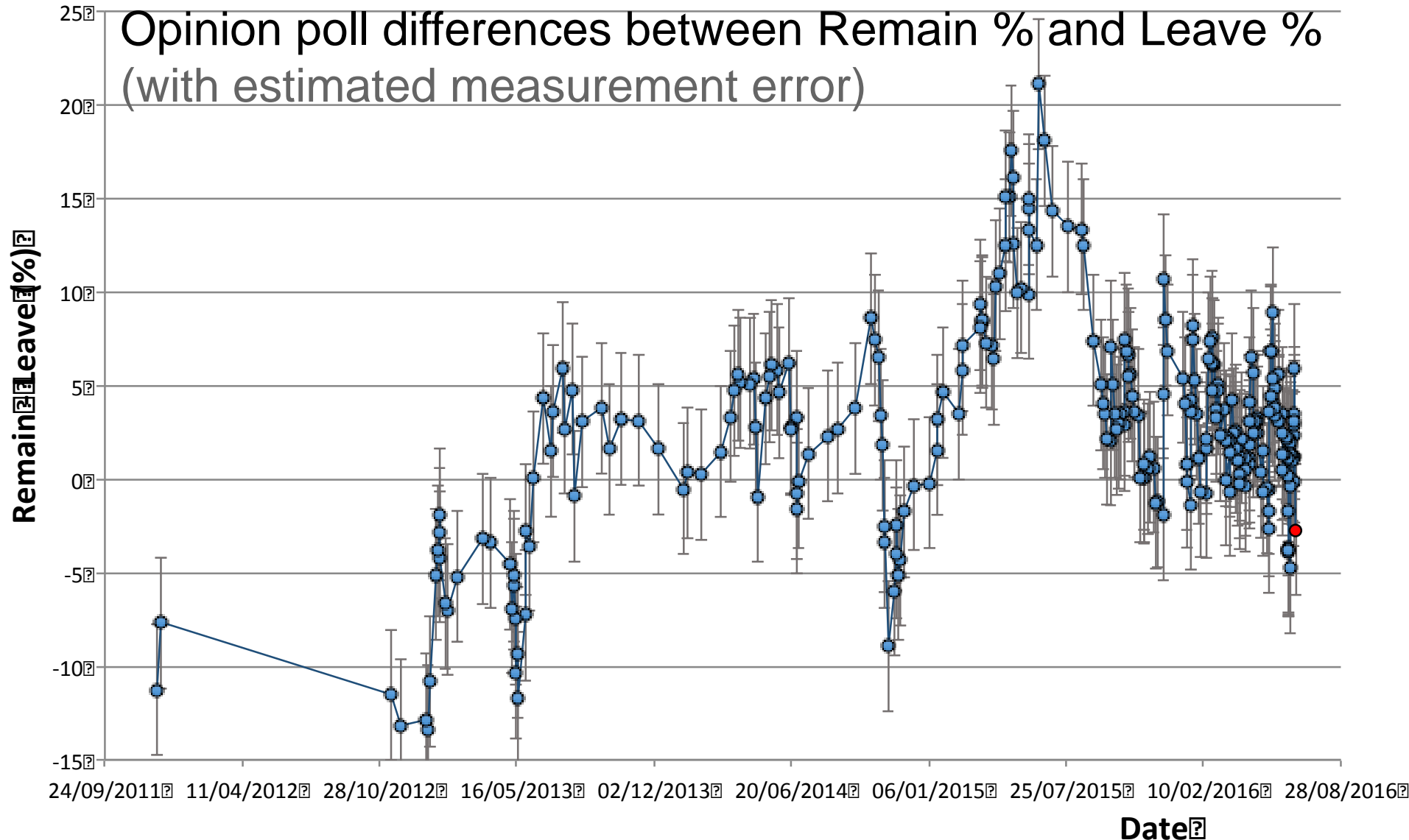
Proportion of same kinds linked together



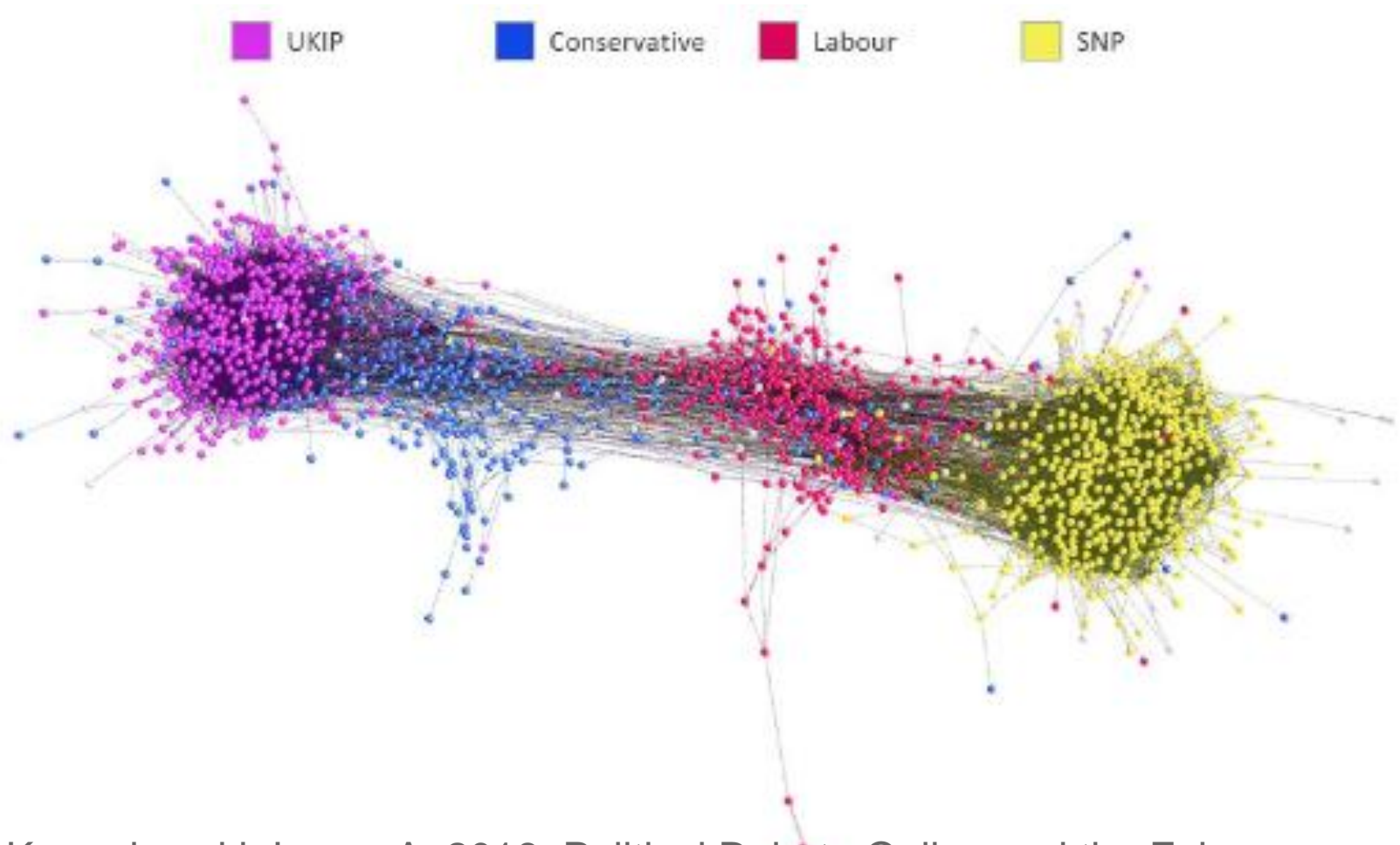


Starting to Model Brexit

The Road to Brexit – *a complex set of collective shifts in opinion*

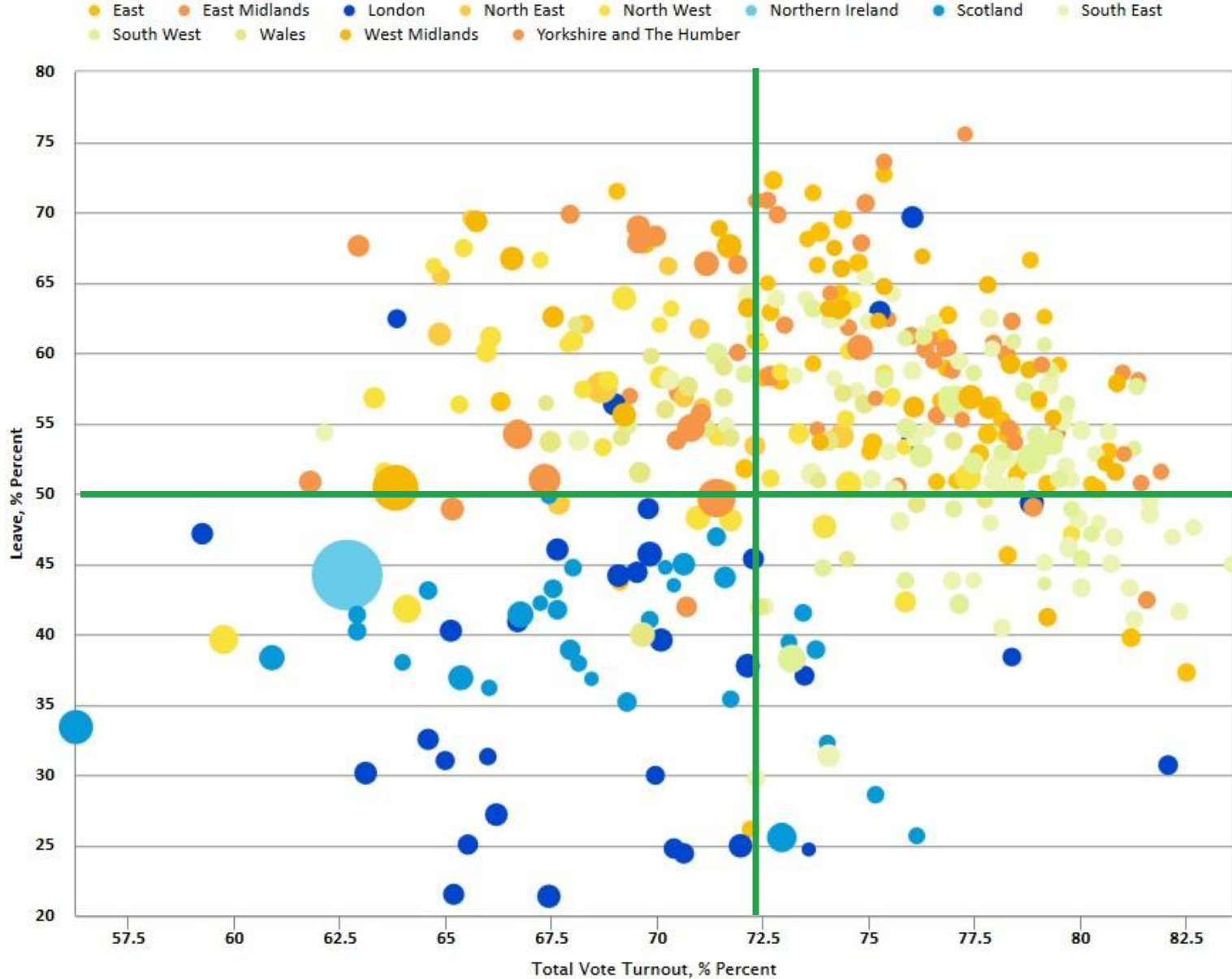


Re-tweet network between 4 groups of 500 supporters of four UK parties



Krasodonski-Jones, A. 2016. Political Debate Online and the Echo Chamber Effect. Demos. <http://www.demos.co.uk/project/talking-to-ourselves/>

Net Leave Vote vs. Turnout



Towards a 'Brexit' example

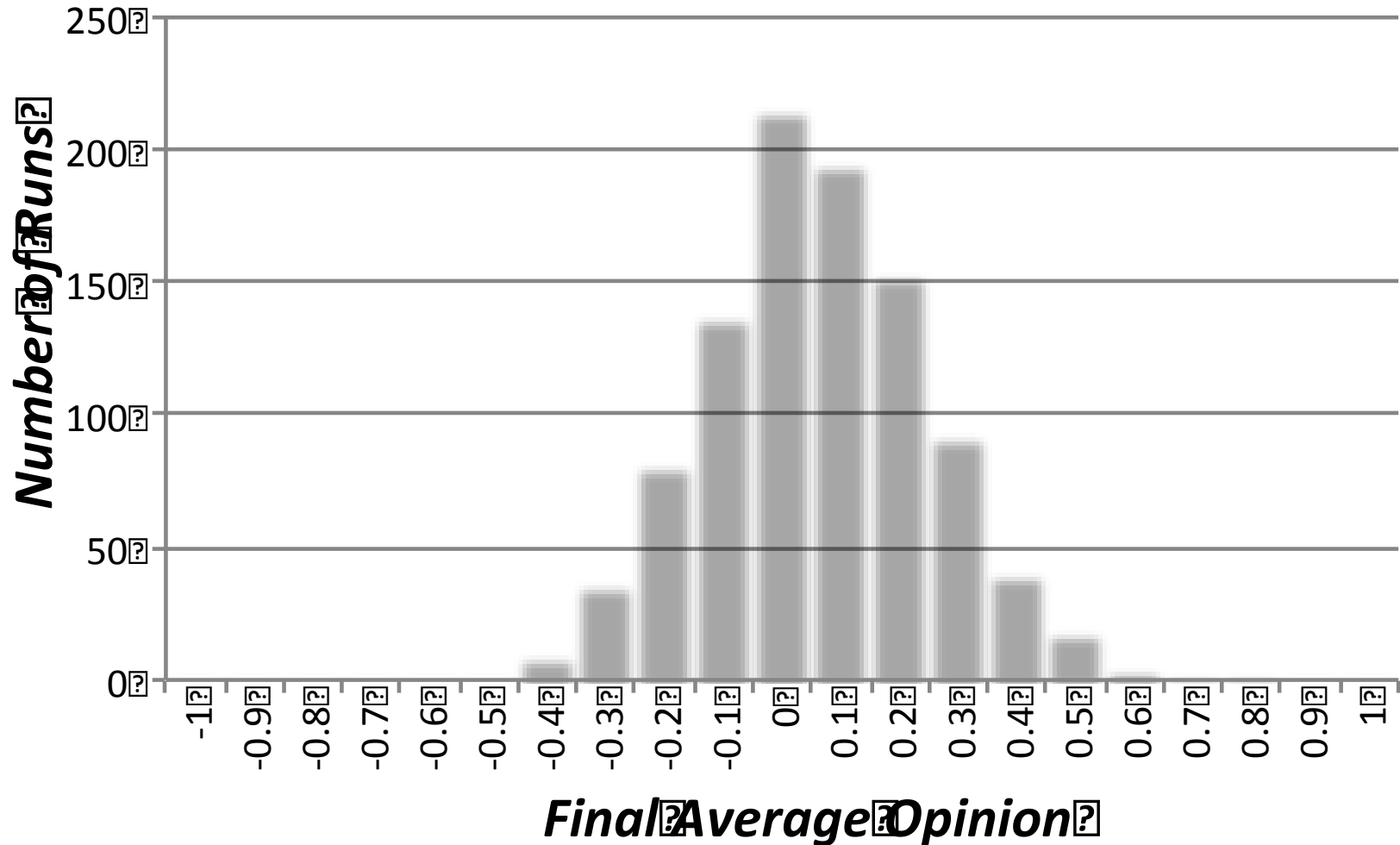


3 groups: floaters, yellows and blues

1. 70% Floaters, (circles) towards either yellow or blue (but not both) beliefs, weak scaling function
2. 10% Yellows, (stars) are for yellow and against blue with a strong scaling function (pro-brexit)
3. 20% Blues (triangles) are for blue and against yellow, with a medium scaling function (remain)

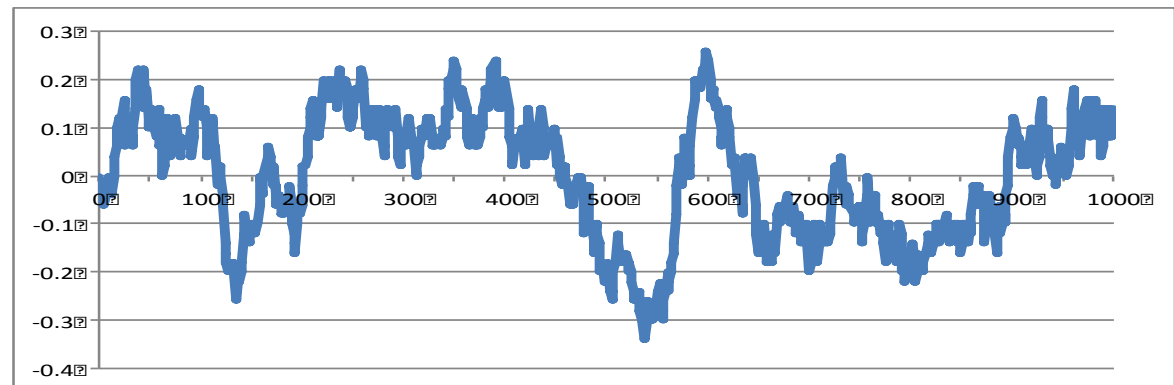
Groups start separate (to allow for self-reinforcement), with random beliefs, but then both network and beliefs co-develop

Distribution of Final Average Opinions (1000 runs)



Example run 1

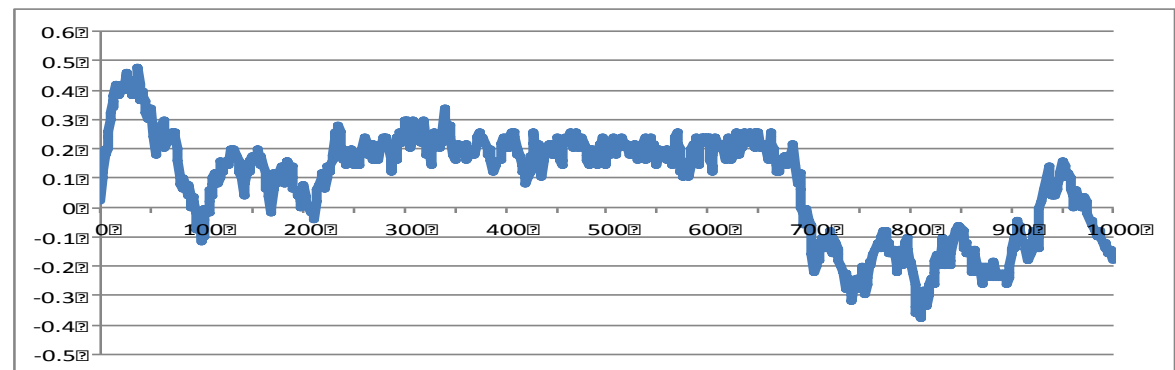
Yellow connects with floaters first, followed by the blues, these polarise the floaters, which then separate off into two groups, which then slowly convert the floaters to their own colours



Example run 2



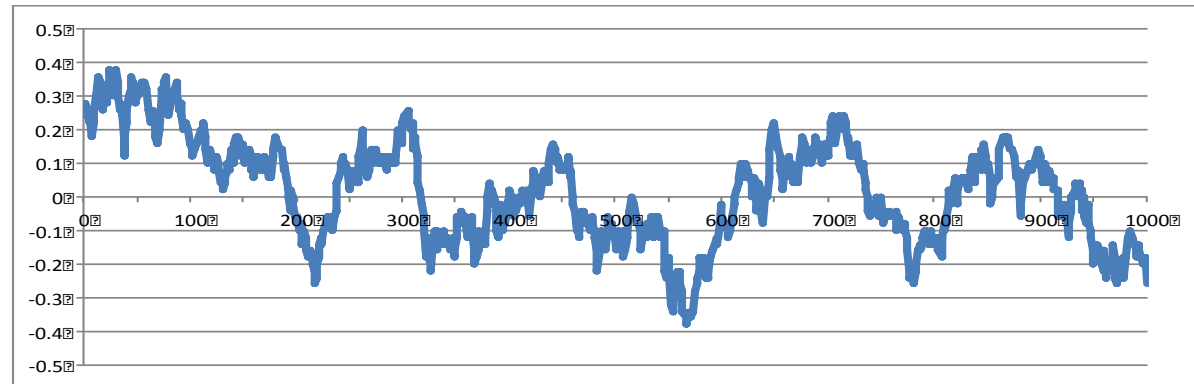
both integrate
and polarise
floaters, then a
period of islands
(blue more), then
some yellow
mutate in blue
island, which
then spreads
pulls apart, then
yellow integrates
into other and
converts more



Example run 3



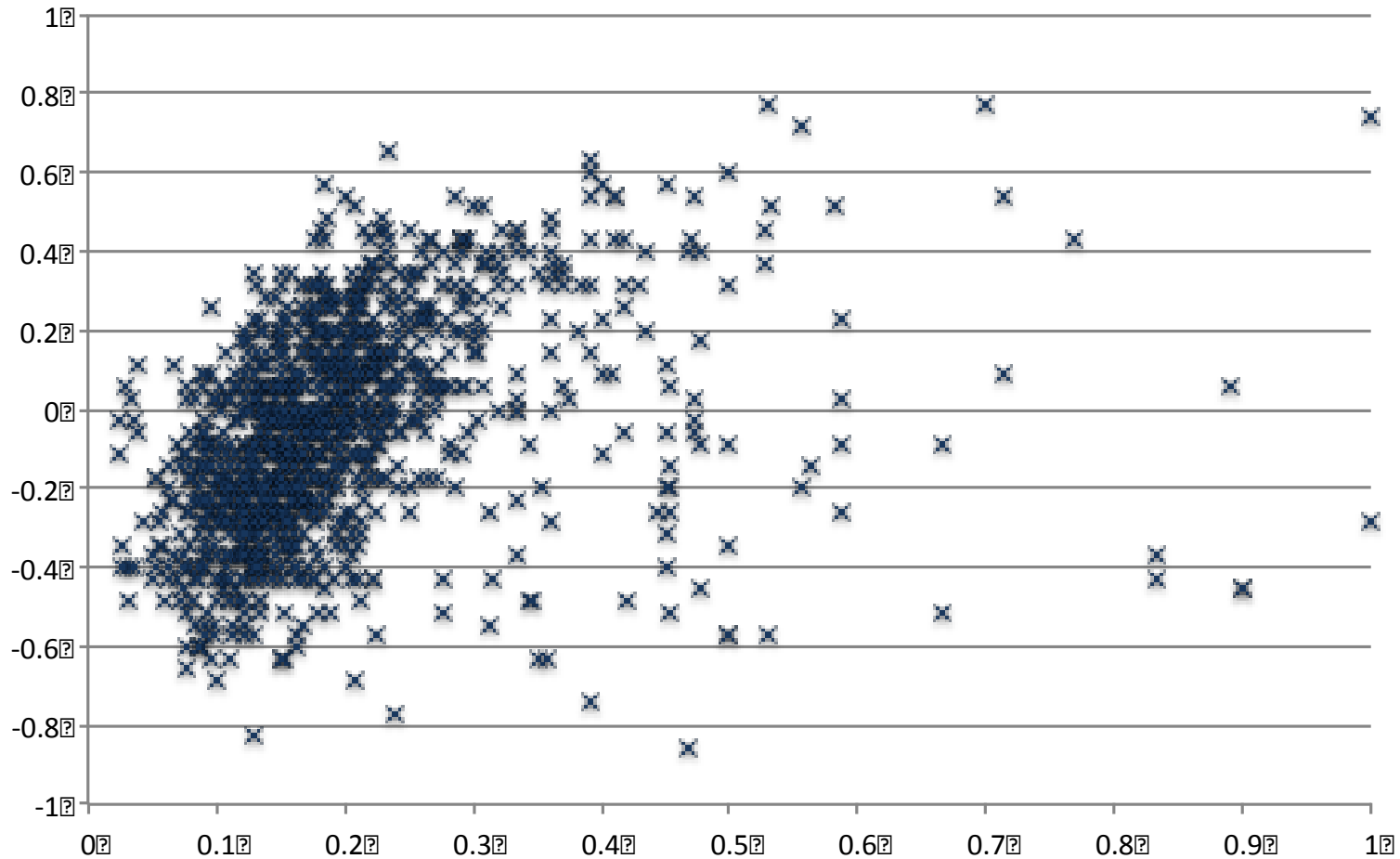
‘Westminster bubble’ of blues and yellows separate from floaters forms, seperately floaters flip each other back and forth but in a random walk which happens to end with more yellow



Opinion of Floaters against insularity of Brexitiers



Average Final Opinion of Floaters'

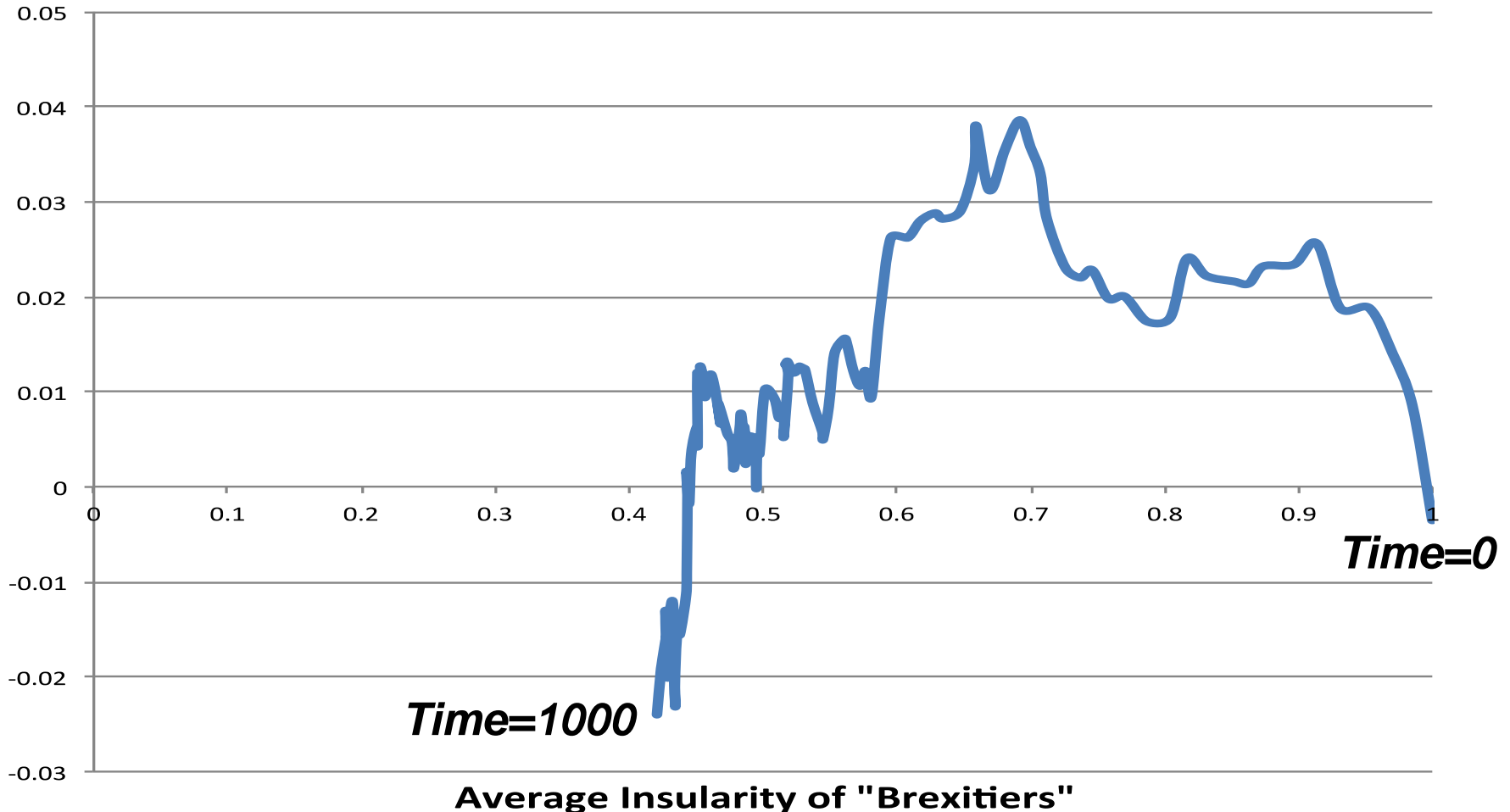


Average Final Insularity of Brexitiers'

Average opinion and insularity of "Brexiters" over time in model



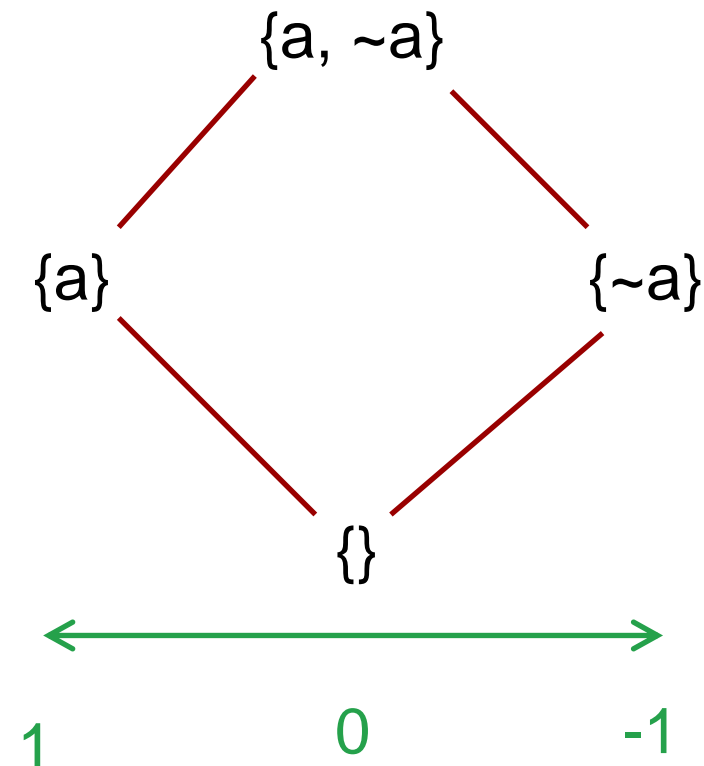
Average of av-opinion



Comparing Conflicted to Undecided



- In this model when two beliefs are incompatible and opposite (in terms of the opinion) conflicted states (where it believes both) and undecided (where it believes neither) are distinguished...
- ...whilst their opinions are the same
- Recalling Nuel Belnap's 4-valued logic (Belnap 1977)

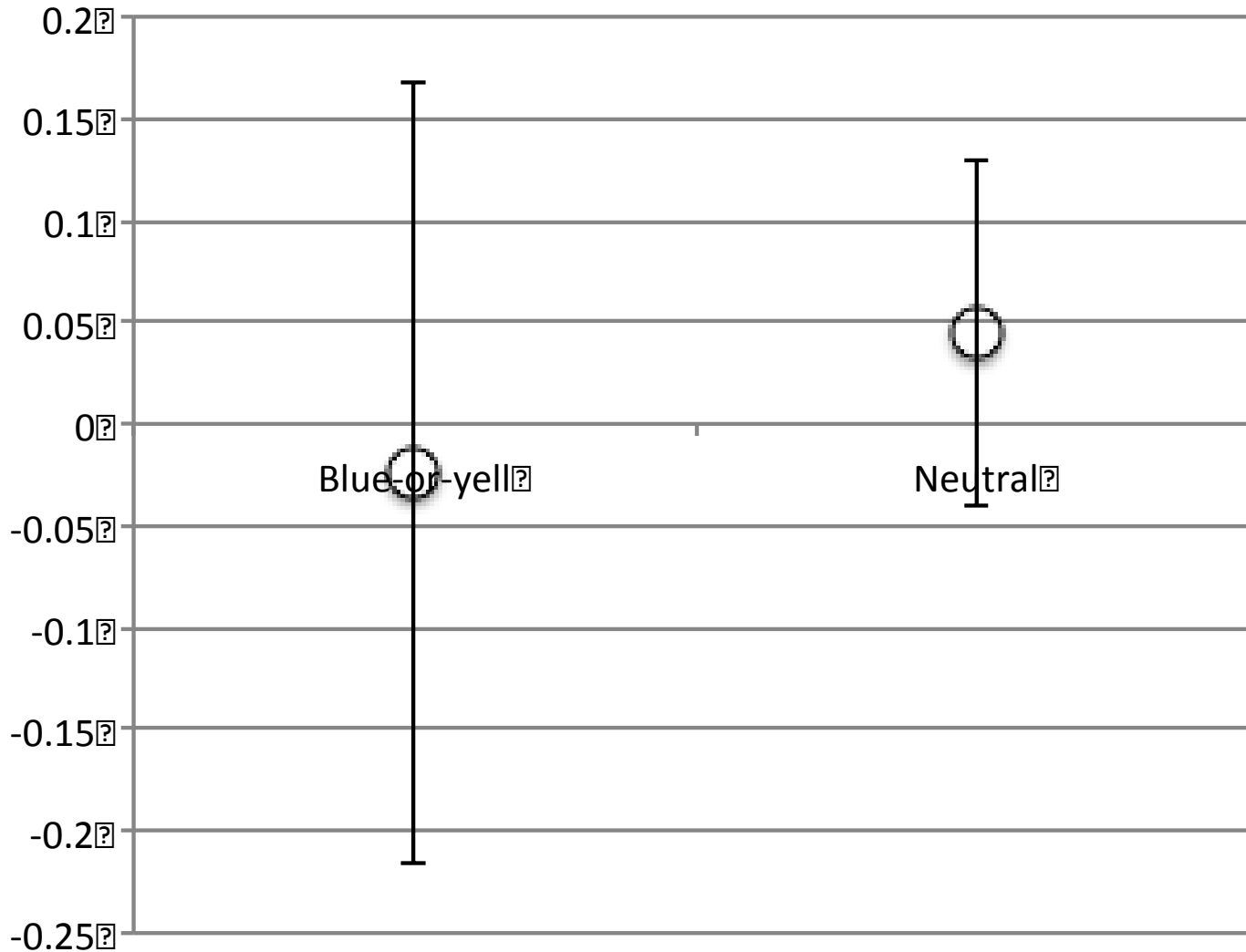


But does this make a difference?

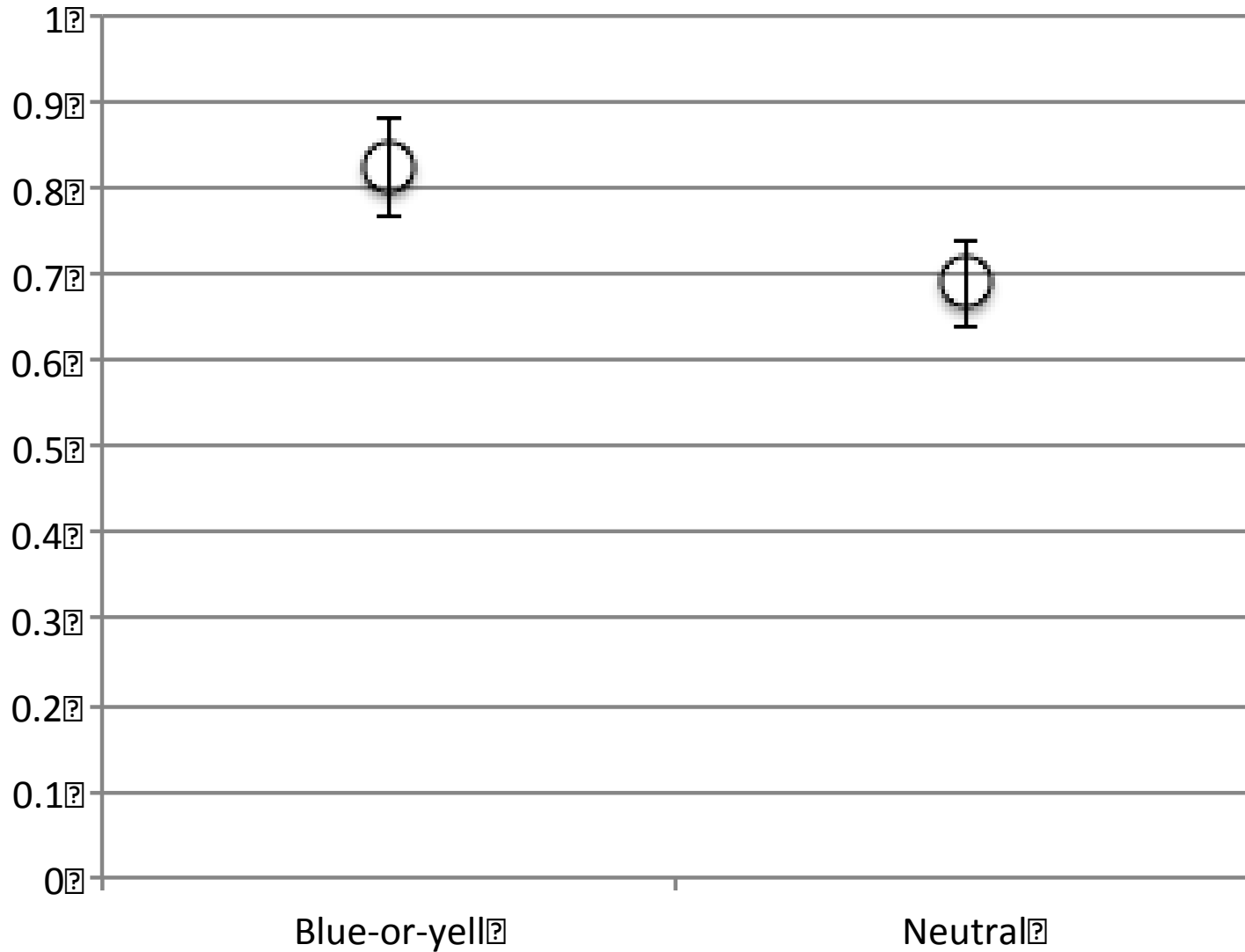


- It might be that conflating the involved cognitive processes with changes in the measurable opinions is enough in practice...
- ...but it may not be.
- Reminds me of economists' assumptions of rationality where they acknowledged they were not personally true but still claimed that *en masse* *in effect* they acted as if they were
- So compare runs of the same 'Brexit' kind but half with 'floaters' having a 'zero' coherency function (all sets of beliefs have the same coherency)

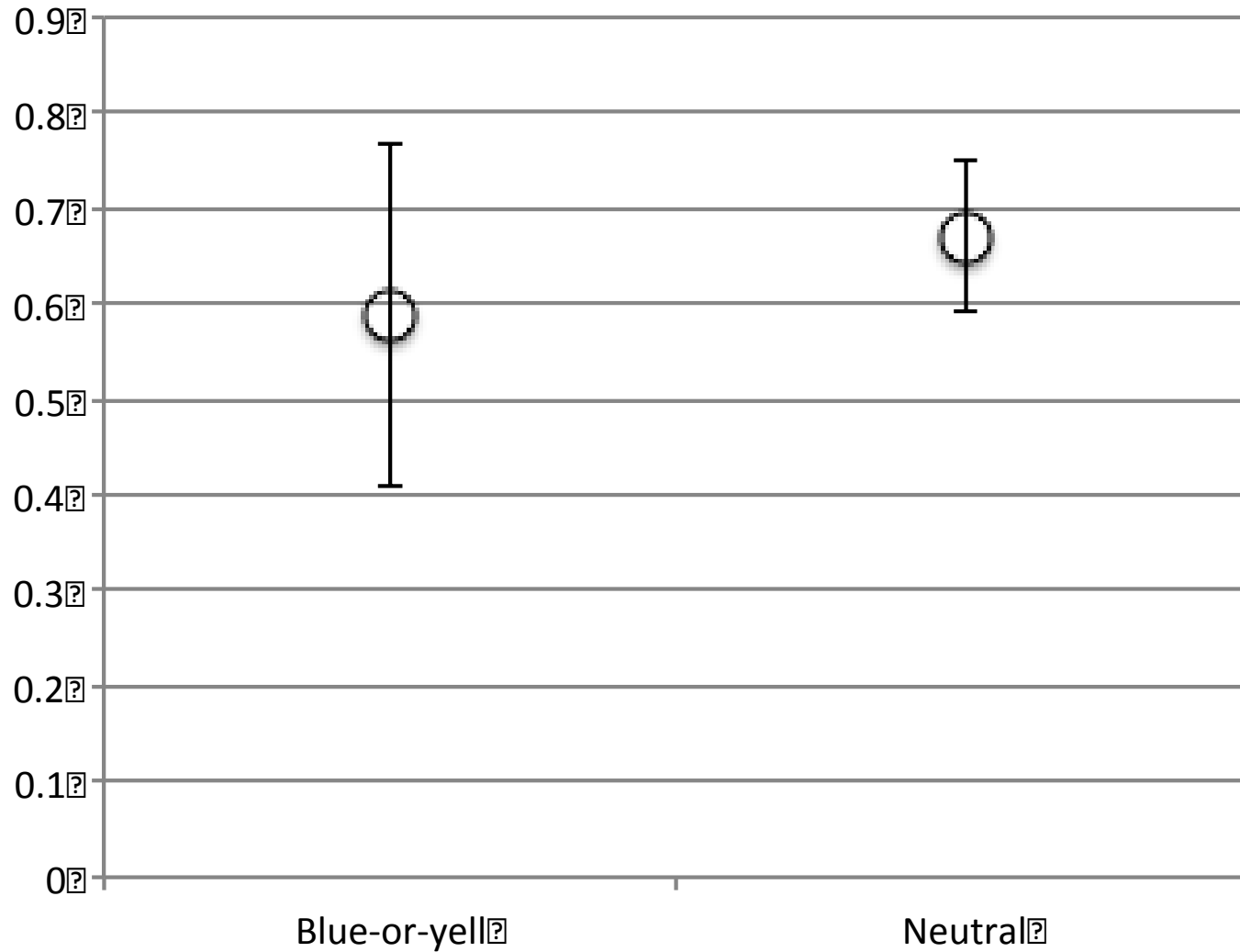
Average final opinion (av over 50 runs each condition)



Standard Deviation of final opinion (av over 50 runs each condition)



Average Insularity of 'Floaters' (av over 50 runs each condition)



Suggested Hypotheses



There are ‘competing’ processes of:

- Social influence (suggestion) vs. internal coherence with existing set of beliefs
- Social influence vs. social linking
 - e.g. an ‘extreme’ group may be good at convincing another group when connected but groups tend to disconnect from those with very different views to themselves

How processes actually happen may matter a lot:

- e.g. what influences people’s change of links – do people have a ‘whitelist’ of those they are willing to allow to influence them?

References



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- Lafuerza LF, Dyson L, Edmonds B, McKane AJ (2016) Staged Models for Interdisciplinary Research. PLoS ONE, 11(6): e0157261. DOI:10.1371/journal.pone.0157261 (but please note the correction since PLoS messed up the formatting and they don't fix the main paper after publication!. A better formatted version is at: <http://arxiv.org/abs/1604.00903>) (Open Access)
- Fieldhouse, E; Lessard-Phillips, L; and Edmonds, B. (2016) Cascade or echo chamber? A complex agent-based simulation of voter turnout. Party Politics. 22(2):241-256. DOI:10.1177/1354068815605671 (Open Access at <http://journals.sagepub.com/doi/abs/10.1177/1354068815605671>)
- Edmonds, Bruce (2016, July 9). "A Model of Social and Cognitive Coherence" (Version 2). CoMSES Computational Model Library. Retrieved from: <http://www.openabm.org/model/5116>
- Edmonds, B. (2017) Co-developing beliefs and social influence networks – towards understanding Brexit. CPM discussion paper CPM-17-235 . MMU, UK. <http://cfpm.org/discussionpapers/186>

The End



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A version of these slides will be at: <http://slideshare.net/BruceEdmonds>

A discussion paper on this is at: <http://cfpm.org/discussionpapers/186>

A version of the simulation is available to download from:
<http://openabm.org/model/5116>