Socio-Cognitive Systems:

and example to show their nature and importance

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Socio-Cognitive Systems

- Much human (and other social agent) cognition only makes sense within its social context
- Indeed I argue it is more useful to think of the human brain as a social organ rather than to provide a putative "*general intelligence*"
- Much social structure is only possible given the existence of key cognitive abilities (e.g. face recognition, language, social norm recognition)
- This workshop (and the journal we are launching) is for simulations/systems that *explicitly represent* the social and the cognitive *together*

Model Basics

- Network of nodes and arcs
- Fixed set of nodes in these examples
- There are, *n*, different beliefs {A, B, ...} 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 to [-1, 1]
- 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

Belief Coherence (from Thagard)

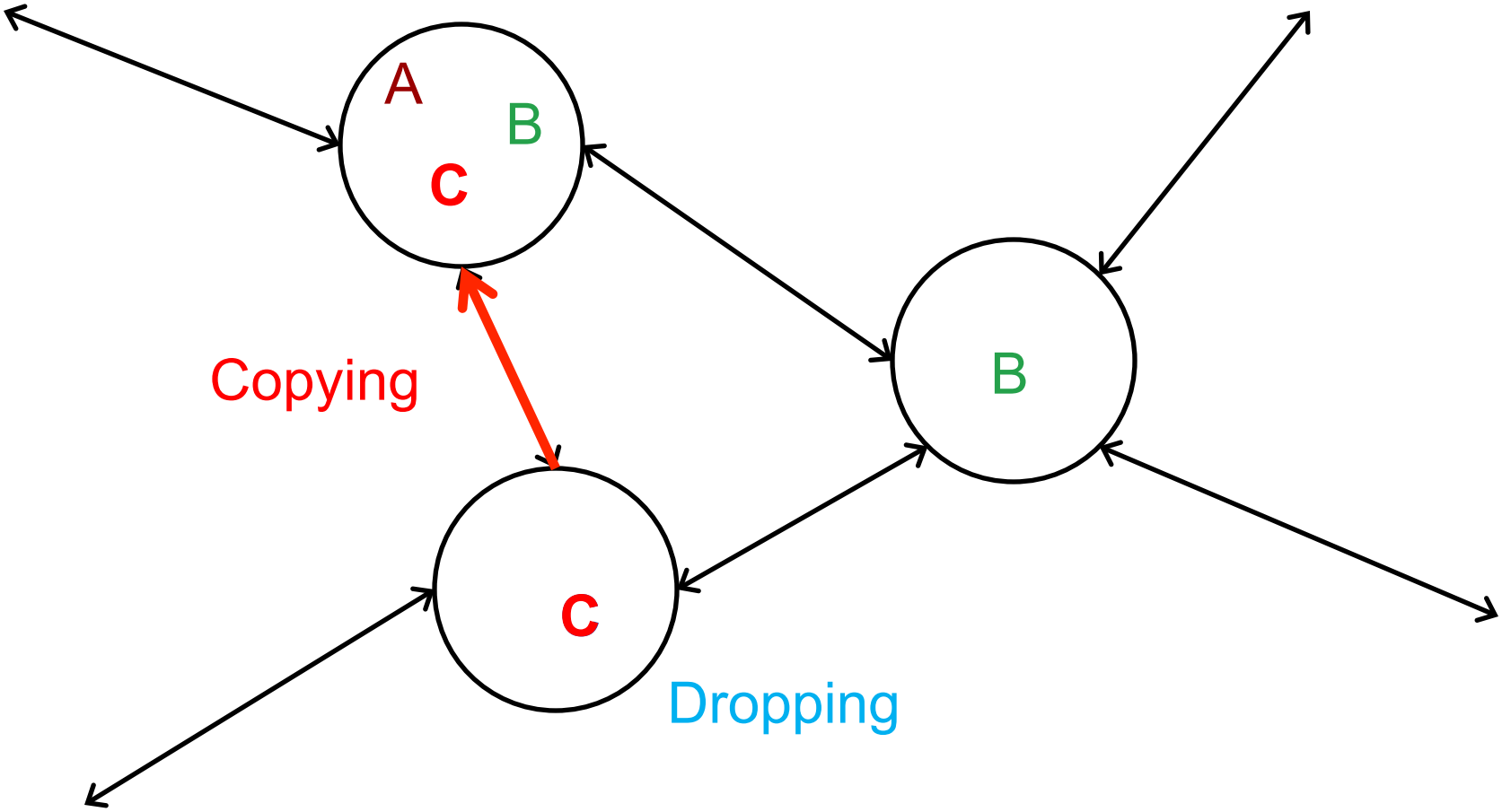
- *People believe new stuff dependent on the coherency with the stuff they already believe*
- Implemented via a measure of the extent to which different sets of beliefs are coherent
- (Assumes a background of shared beliefs)
- Thus maybe {A}➔0.5 and {B}➔{0.7} but {A, B} ➔-0.4 if beliefs A and B are inconsistent
- The probability of gaining a new belief from another or dropping an existing belief in this model is dependent on whether it increases or decreases the coherency of the belief *set*

Belief Change Processes

Each iteration the following occurs:

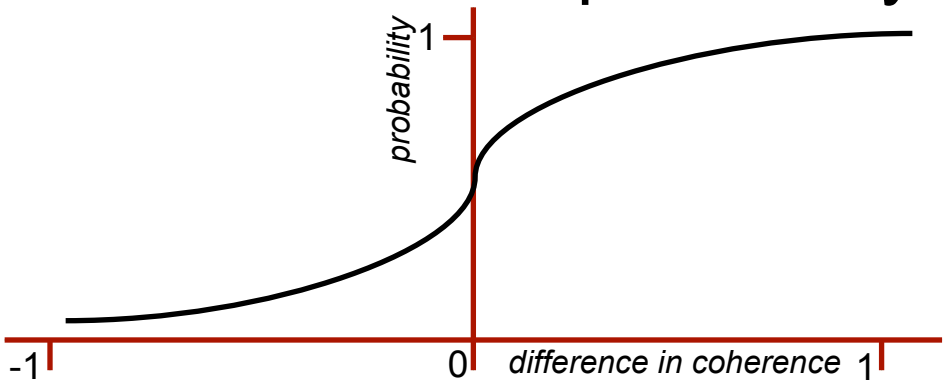
- Copying: each arc is selected; a belief at the source randomly selected; then copied to destination with a *probability* related to the change in coherency it would cause
- Dropping: each node is selected; a random belief is selected and then dropped with a *probability* related to the change in coherency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

Illustration – *Belief Change*

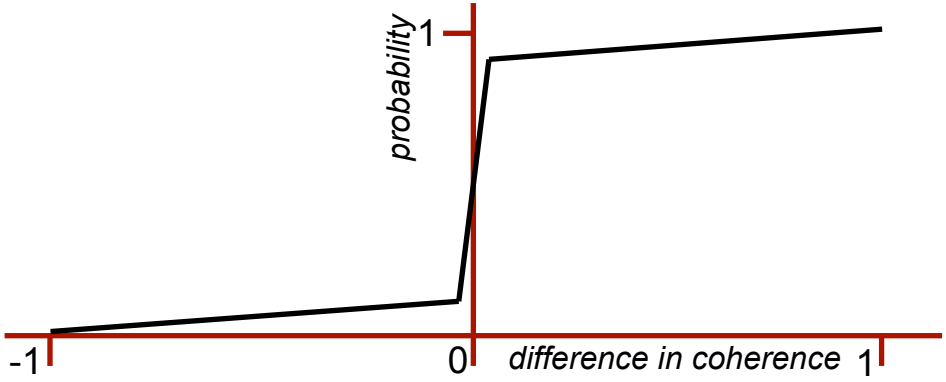


Scaling of Impact of Coherence

- 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

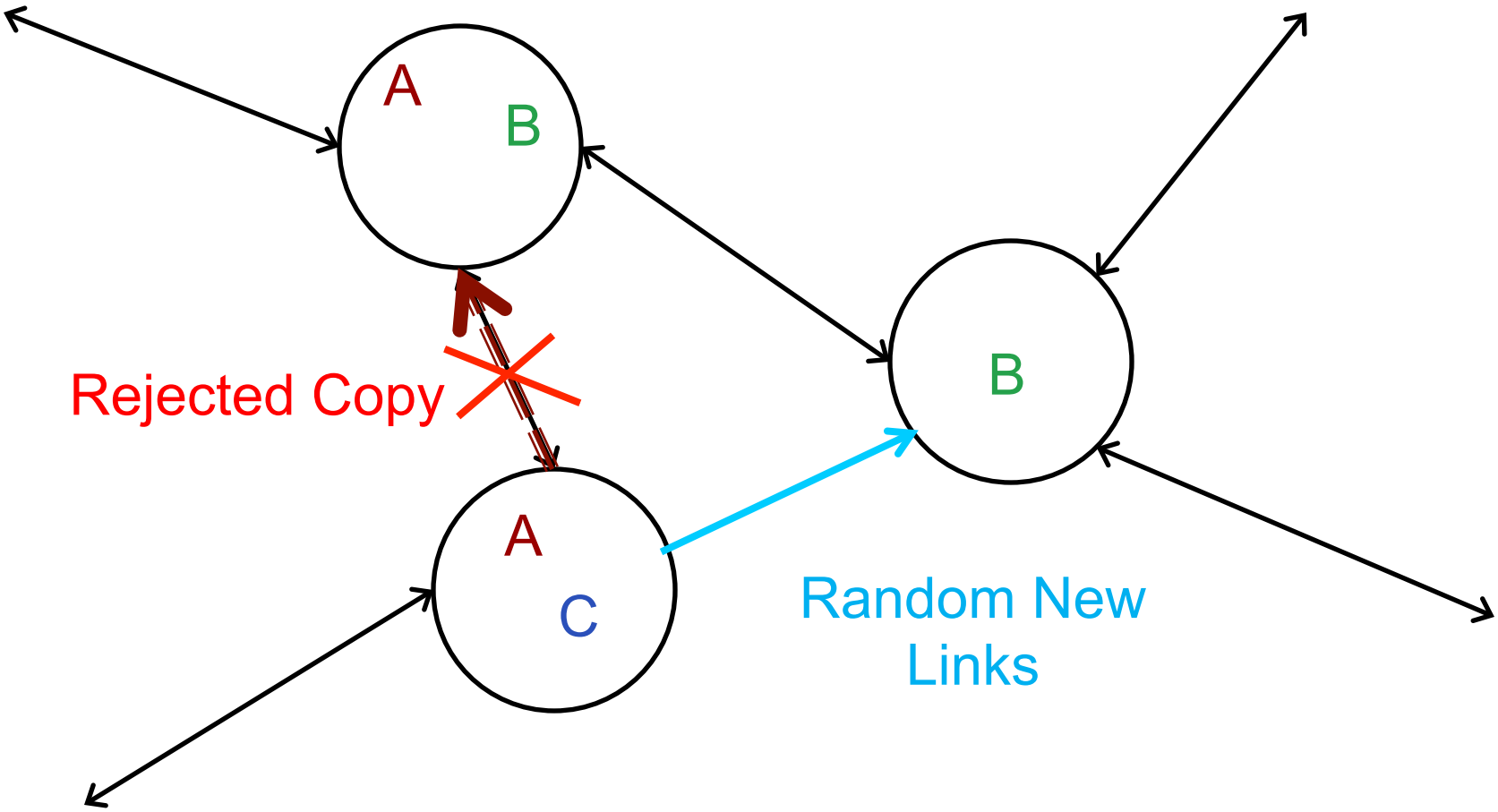
Network Change Processes

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 (with a friend of a friend if possible, otherwise any)

In order to maintain the average link density I added the following 'cludge': 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*

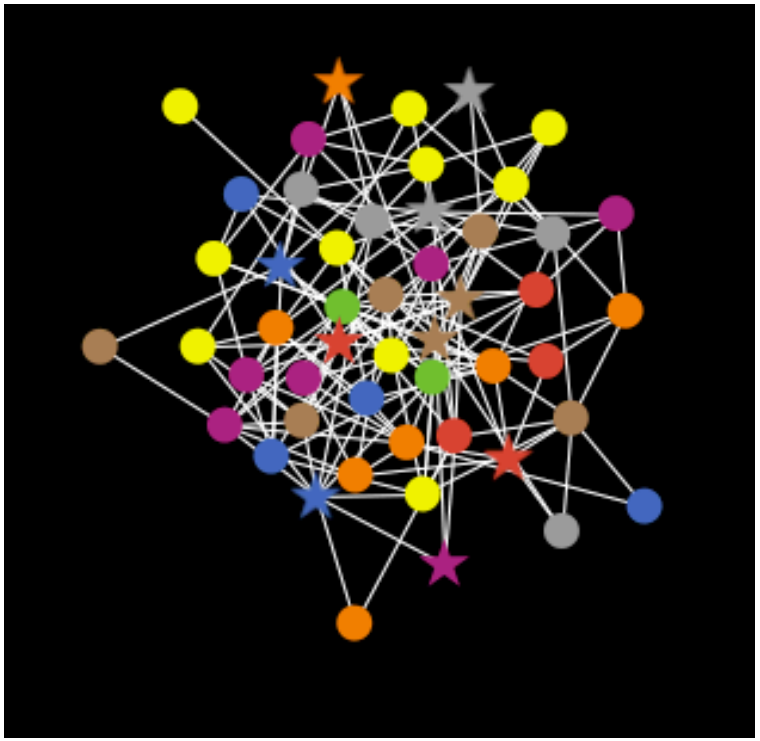


An Illustrative Example

- 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' in the sense that they only have a 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

Animations

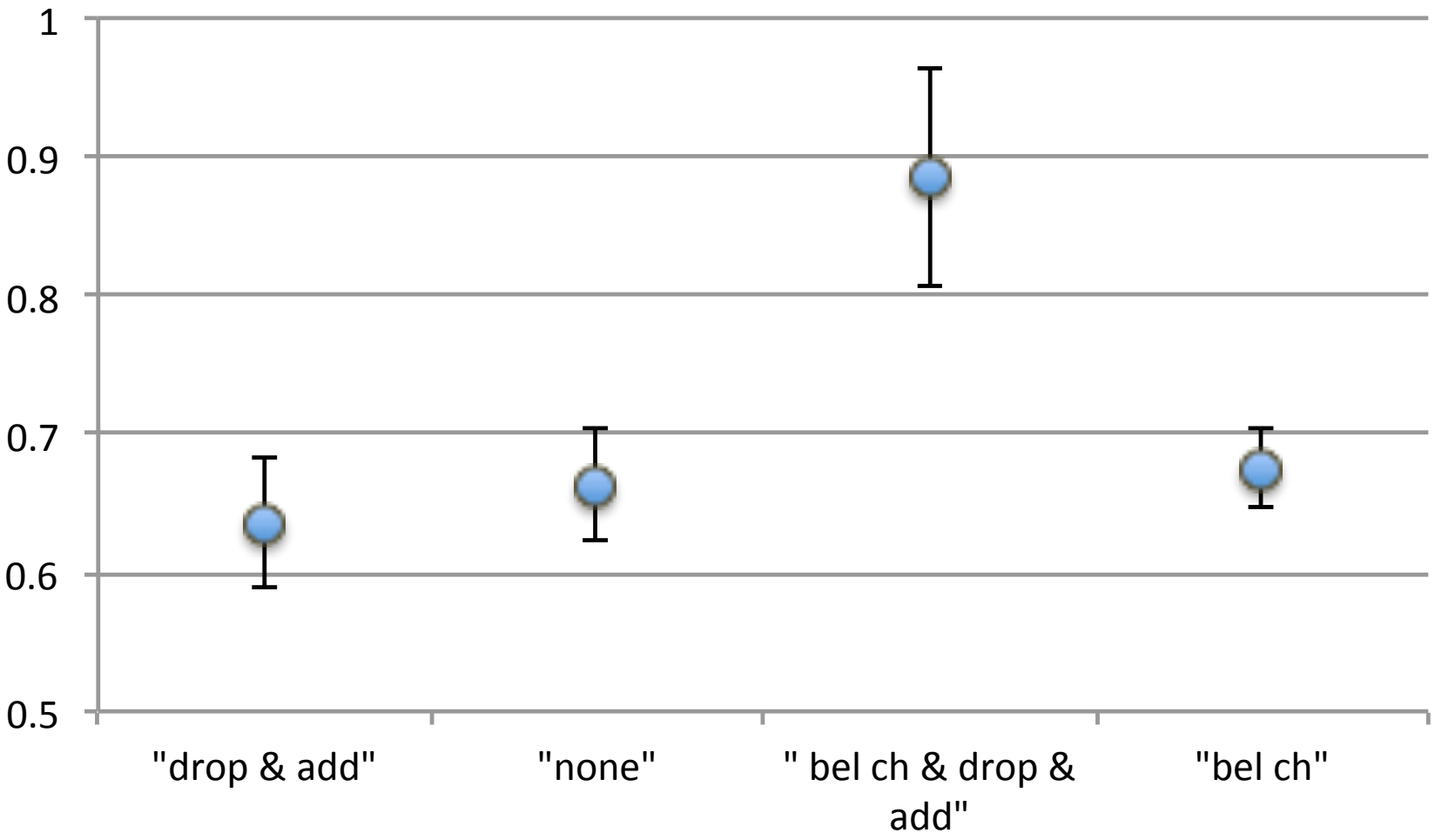
- Atomic beliefs: yellow, red, blue
- Agents shown in colours indicating the mixture of beliefs held (or if none, grey)
- Links are relationships such that the beliefs of one might be adopted by the other
- Star nodes or triangle nodes are minorities
- Circle nodes are of the majority



Only Changing Links

Changing Both Beliefs and Links

Proportion of same kinds linked together



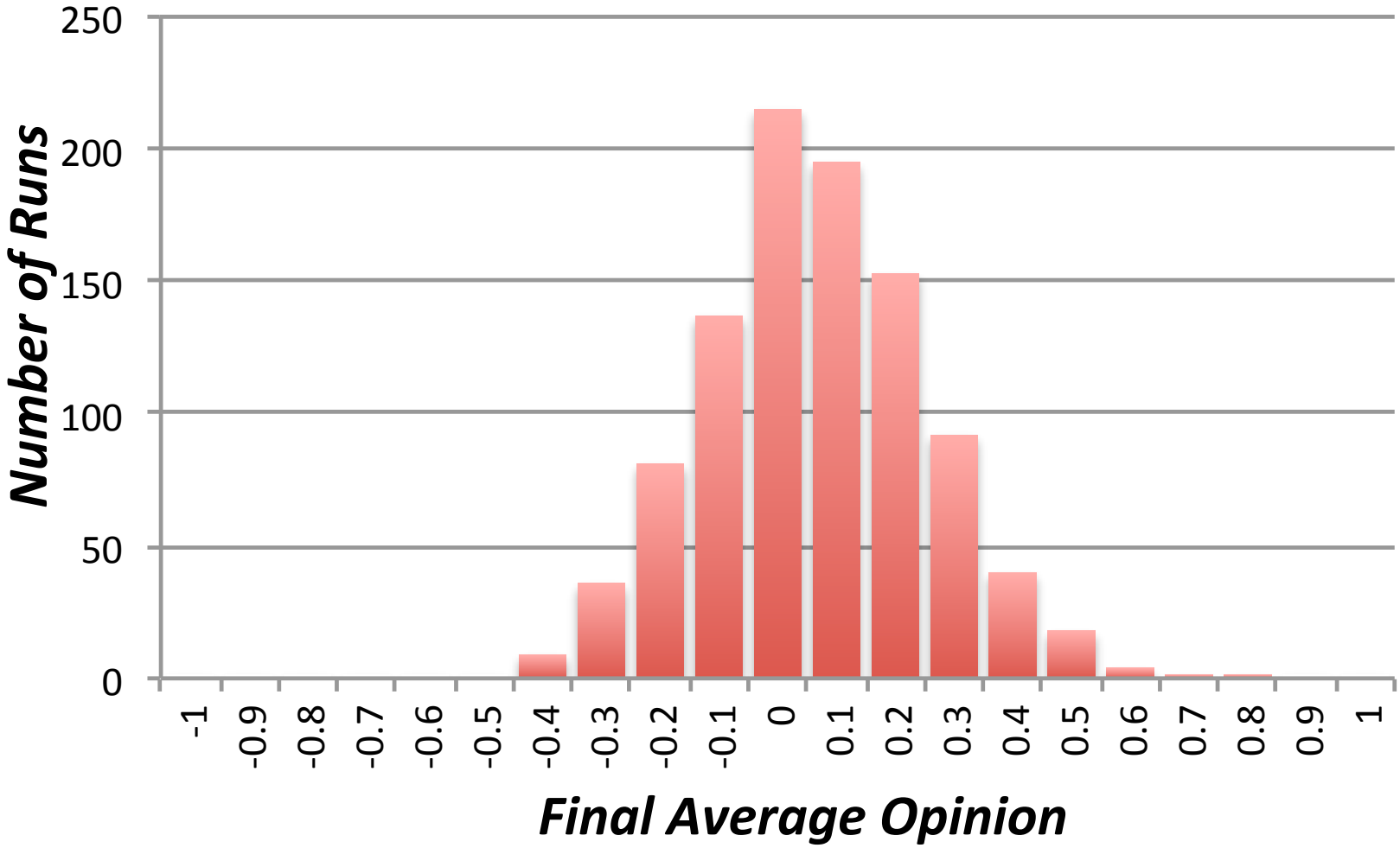
Towards an example for beliefs about MMR innoculation

3 groups: floaters, yellows and blues

1. 70% Public, (circles) towards either yellow or blue (but not both) beliefs, weak scaling function
2. 20% Scientifically informed, (stars) are for blue and against yellow with a medium scaling function
3. 10% Dissidents (triangles) are for yellow and against blue, with a strong scaling function

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)

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Conclusions – towards true socio-cognitive systems

- Sometimes you need both cognitive and social aspects for stuff to happen
- Studying the social abilities is not enough, sometimes they only really work in context
- Cognition in artificial situations that limit sociality maybe work out very differently in the wild
- Many social structures need a sufficient set of cognitive abilities to emerge and develop
- Just using cognitively 'thin' agents rules out downward causation and many other social processes