Differential effects of different types of noise on opinion dynamics (TBC)

ODCD 23

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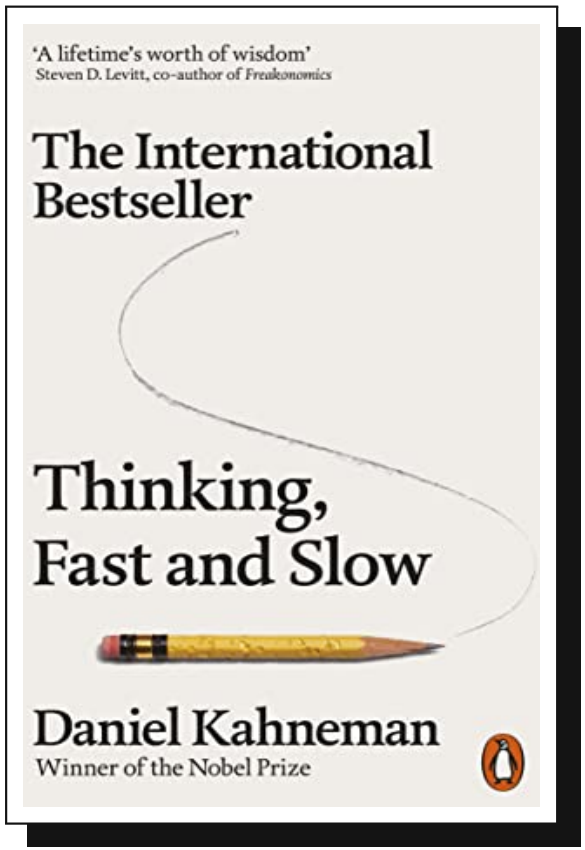
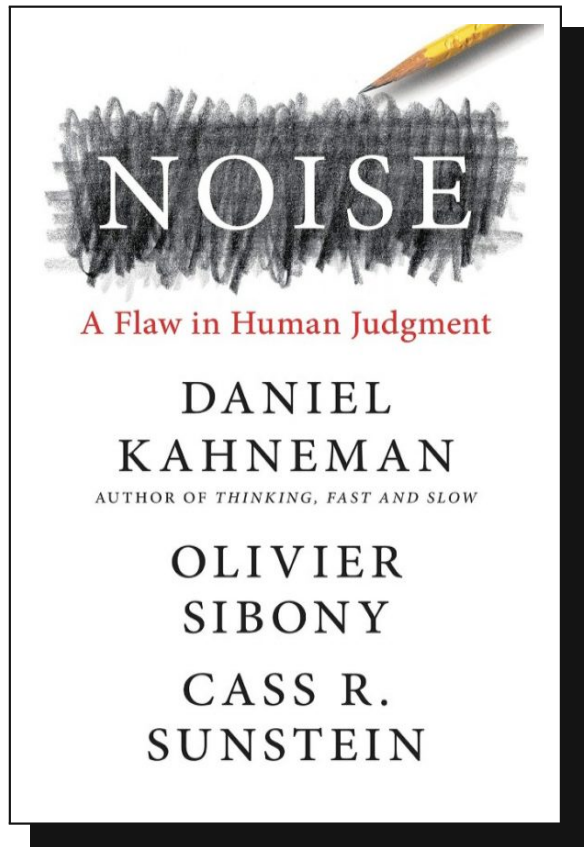
7 School of Business, Social & Decision Sciences, Constructor University Bremen, Germany

Bias and noise

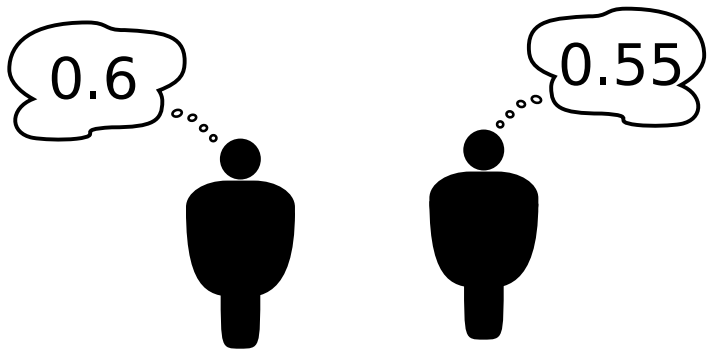
Bias:
systematic error in human behaviour/cognition



Noise:
random error in human behaviour/cognition

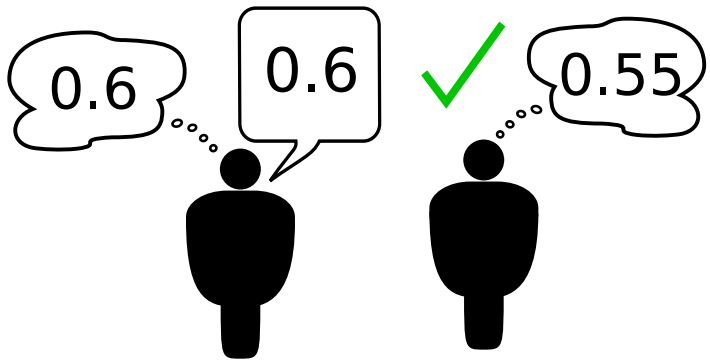


Opinion dynamics with bias



Confirmation bias

Opinion dynamics with bias

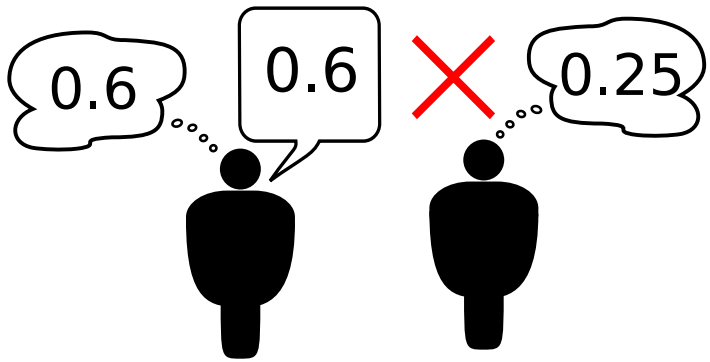


opinion converges to the weighted mean

Confirmation bias

Agents influence each other **only if** their opinions are similar (bounded confidence).

Opinion dynamics with bias



Confirmation bias

Agents influence each other **only if** their opinions are similar (bounded confidence).

Noise in the bounded confidence model

x_i = receiver opinion; x_j = sender opinion.

$$x_i \mapsto \begin{cases} x_i + \mu \cdot (x_j - x_i) & \text{if } |x_i - x_j| \leq \epsilon \\ x_i & \text{else} \end{cases}$$

Where does the noise come in?

Noise in the bounded confidence model

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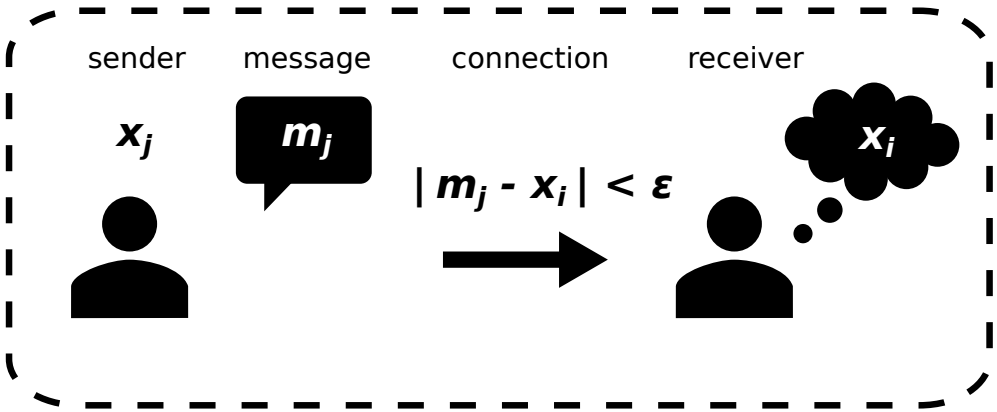

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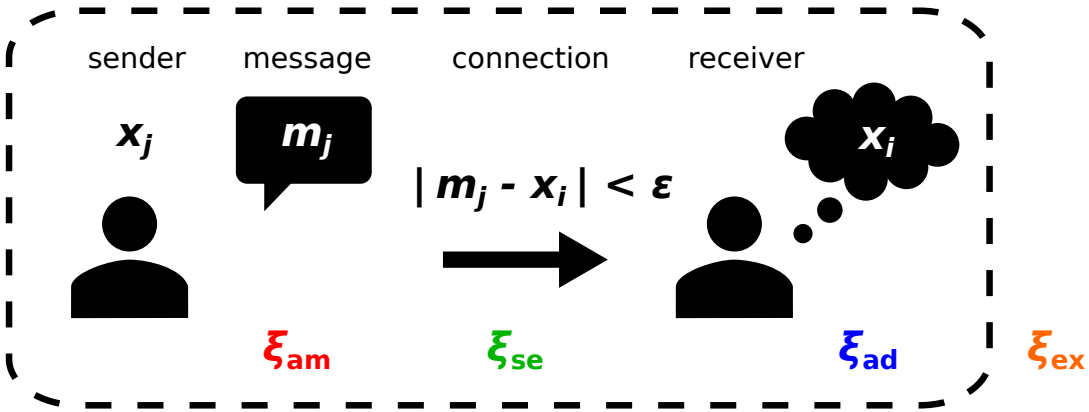

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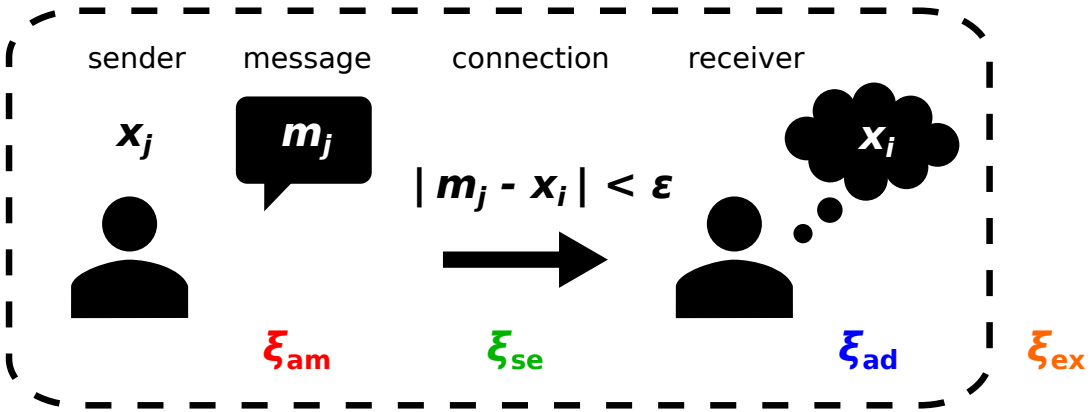
$$x_i \mapsto \begin{cases} x_i + \mu \cdot (x_j - x_i) & \text{if } |x_i - x_j| \leq \epsilon + \xi_{\text{se}} \\ x_i & \text{else} \end{cases}$$



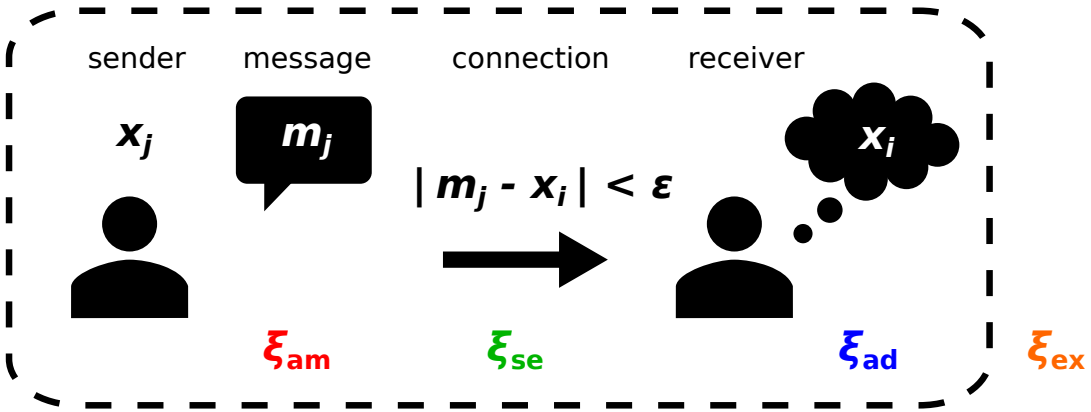
Selection noise ξ_{se}

The noise ξ is drawn from a Gaussian distribution $\mathcal{N}(0, \nu)$ (truncated at the bounds 0 and 1)

Noise in the bounded confidence model

x_i = receiver opinion; x_j = sender opinion.

$$x_i \mapsto \begin{cases} x_i + \mu \cdot (x_j - x_i) + \xi_{\mathrm{ad}} & \text{if } |x_i - x_j| \leq \epsilon \\ x_i & \text{else} \end{cases}$$



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Selection noise ξ_{se}

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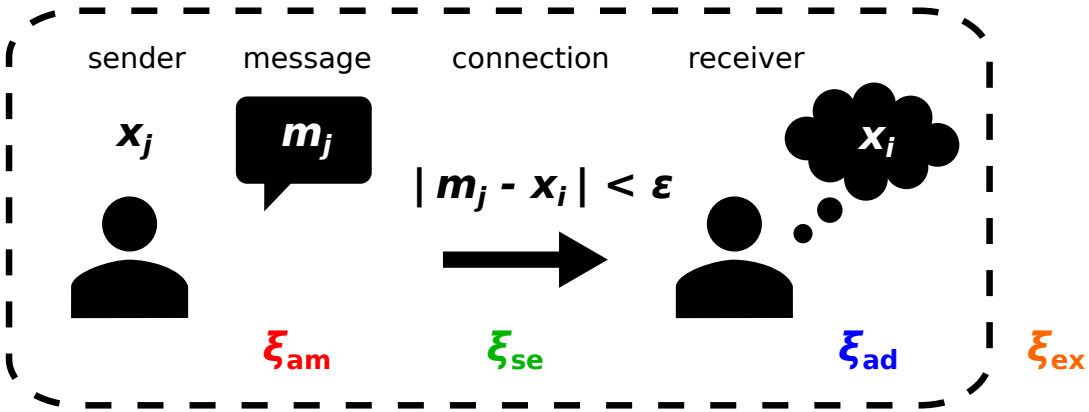

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Selection noise ξ_{se}

Adaptation noise ξ_{ad}

Exogenous noise ξ^*_{ex}

*with some probability

Noise in the bounded confidence model

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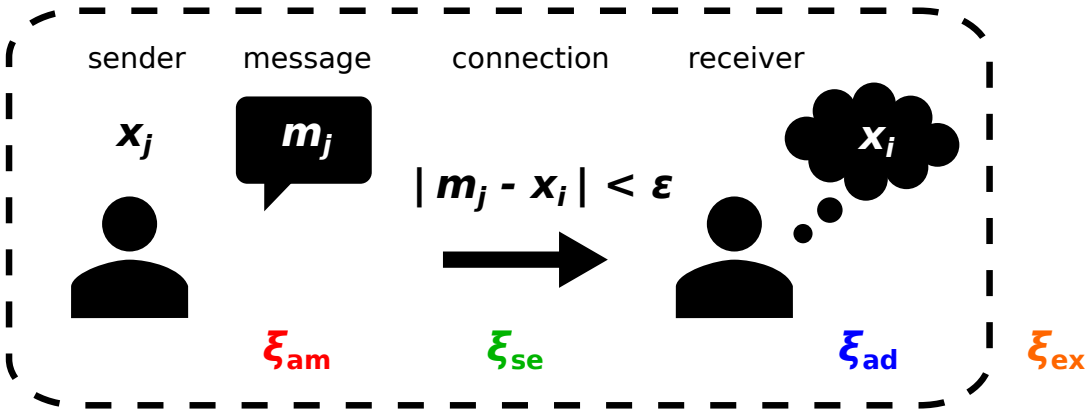
$$x_i \mapsto \begin{cases} x_i + \mu \cdot (m_j - x_i) & \text{if } |x_i - m_j| \leq \epsilon \\ x_i & \text{else} \end{cases}$$

where $m_j = x_j + \xi_{\text{am}}$



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Ambiguity noise ξ_{am}

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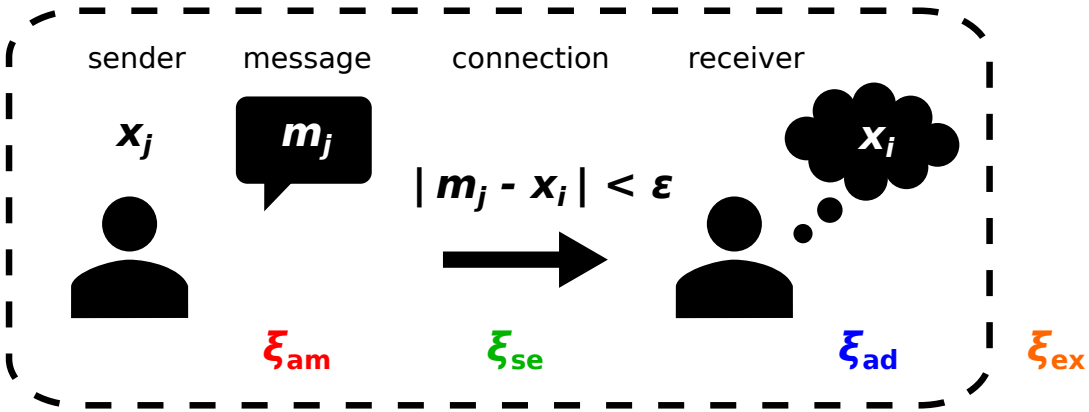

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Ambiguity noise ξ_{am}	Selection noise ξ_{se}	Adaptation noise ξ_{ad}	Exogenous noise ξ^*_{ex}

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Noise in opinion dynamics

Different models & different types of noise

- Klemm et al. (2003)
- Dietrich Stauffer (2004)
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- **this talk**

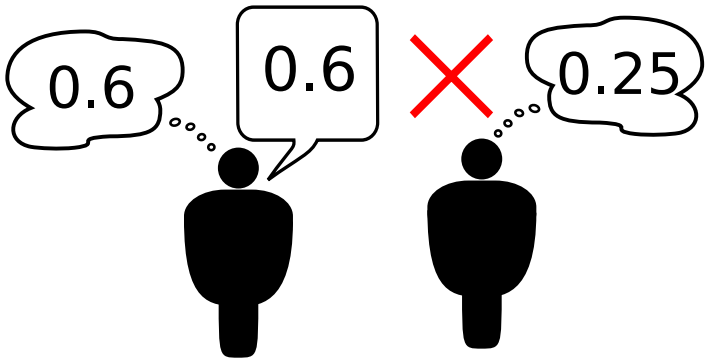
Opinion dynamics with bias and ambiguity noise

Confirmation bias

Agents influence each other **only if** their opinions are similar (bounded confidence).

Ambiguity noise

Opinion dynamics with bias and ambiguity noise



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Ambiguity noise

Any socially-transmitted message is inherently uncertain and, thus, noisy.

Opinion dynamics with bias and ambiguity noise

Confirmation bias

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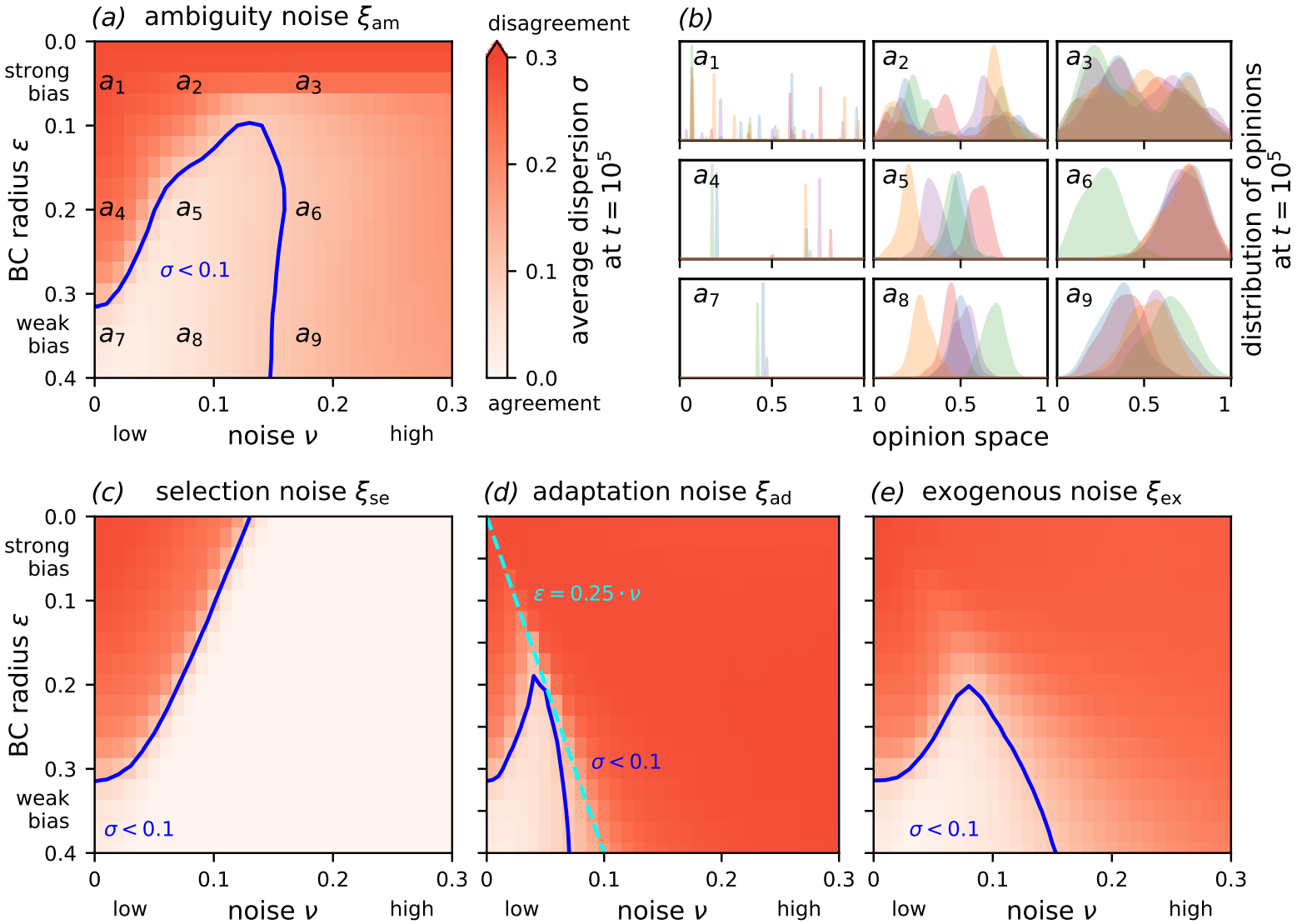
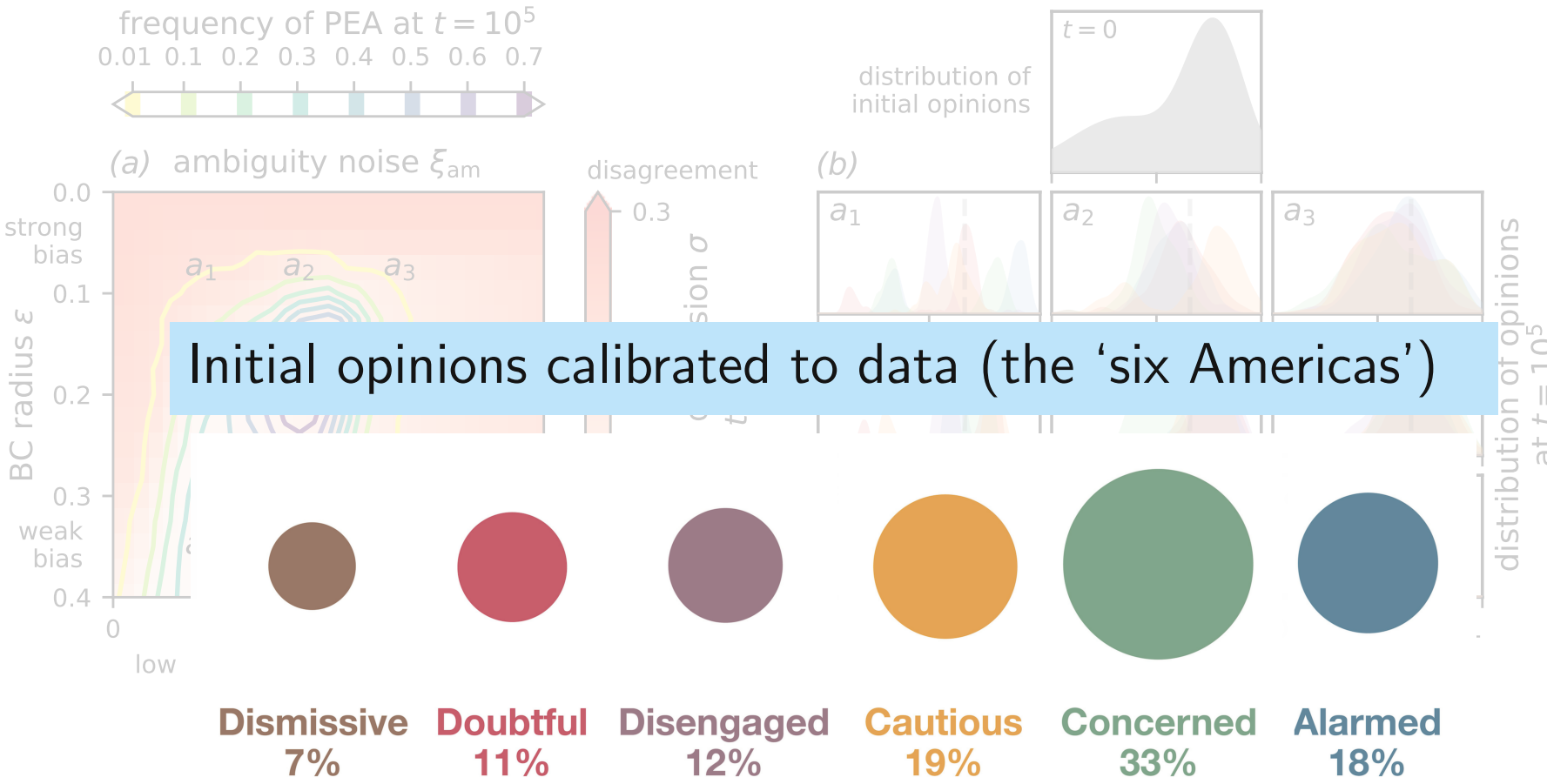
Results I: uniform initial opinions



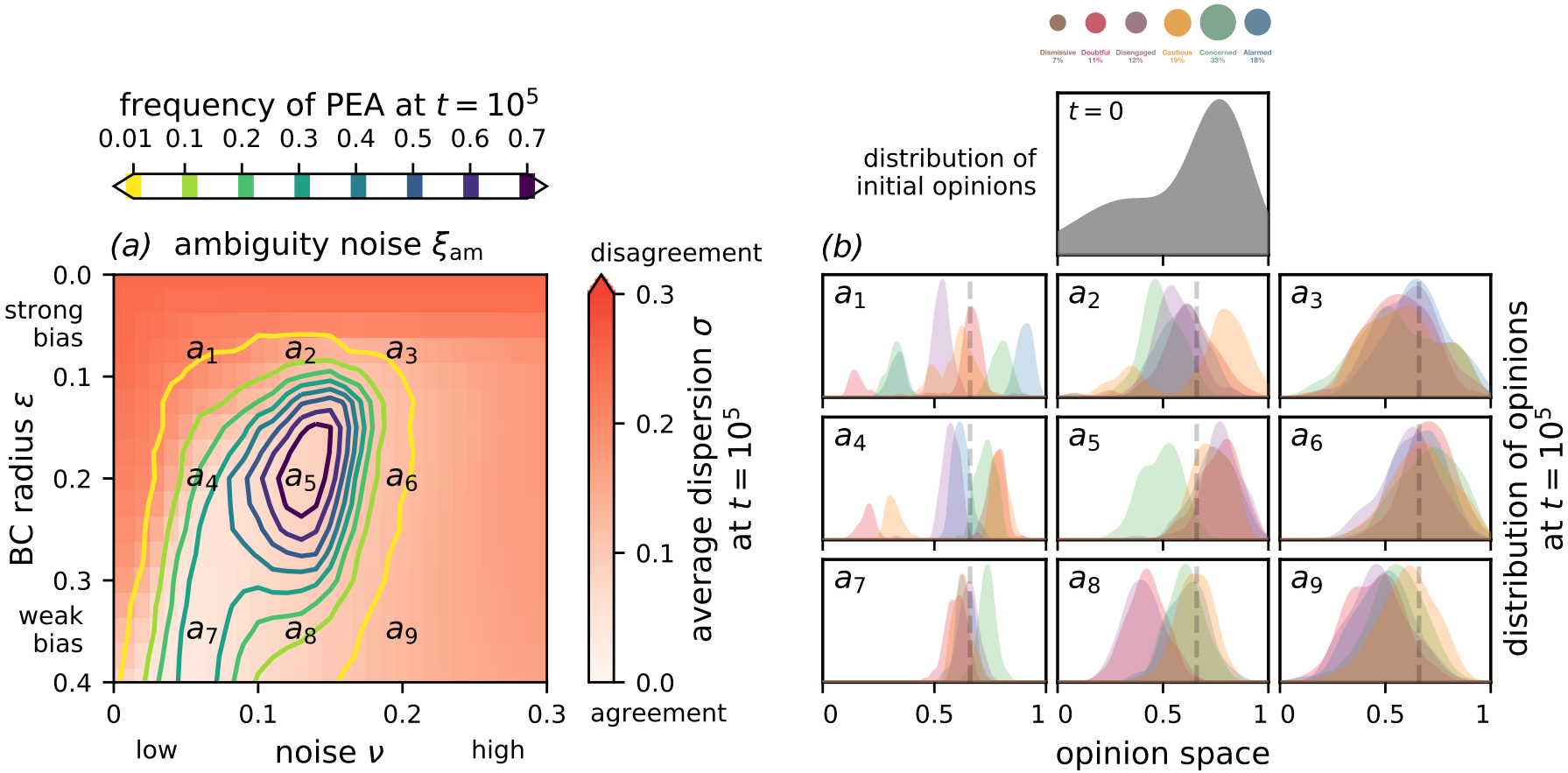
Results II: applied to the climate change debate



Initial opinions calibrated to data (the 'six Americas')

according to (Maibach et al., 2011).

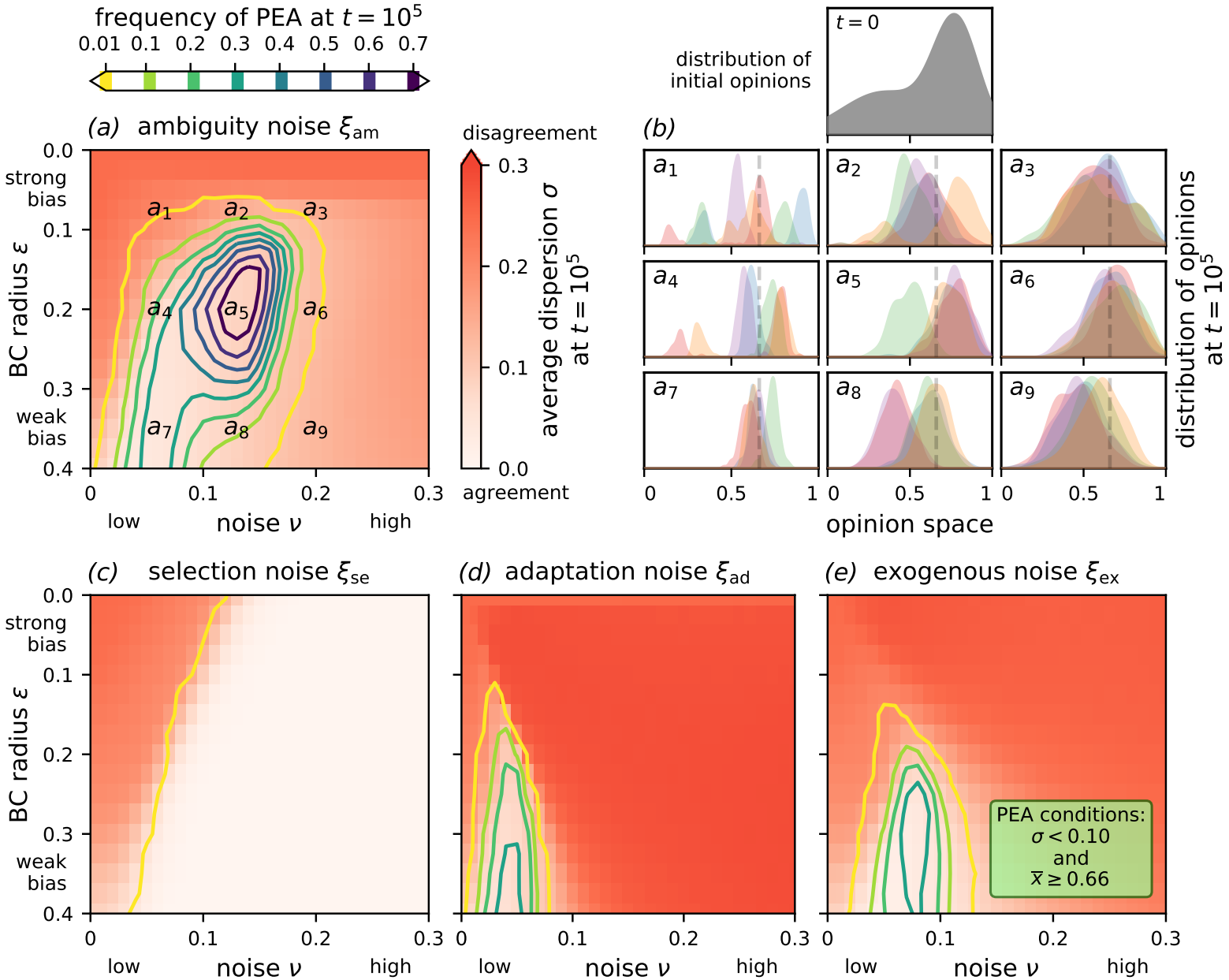
Results II: applied to the climate change debate



Pro-environmental agreement (PEA):

- low disagreement &
- high average opinion

Results II: applied to the climate change debate

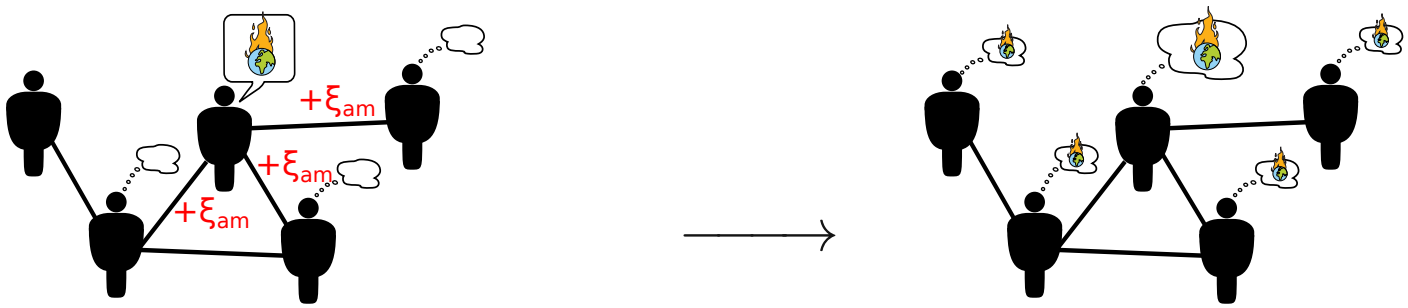


Summary

- 'Facts don't change minds' (Toomey, 2023), social influence does.
- But biases and noise interfere.
- Different types of noise $\rightarrow$ different effects on opinion patterns
- Ambiguity in communication can facilitate pro-environmental agreement in the presence of confirmation bias.

  Some limitations:

  - we assume a well-mixed population (no homophily).
  - we assume one-on-one interaction.
  - we assume non-strategic, ideology-free agents.



Social influence + Bias + Ambiguity $\longrightarrow$ Pro-environmental agreement

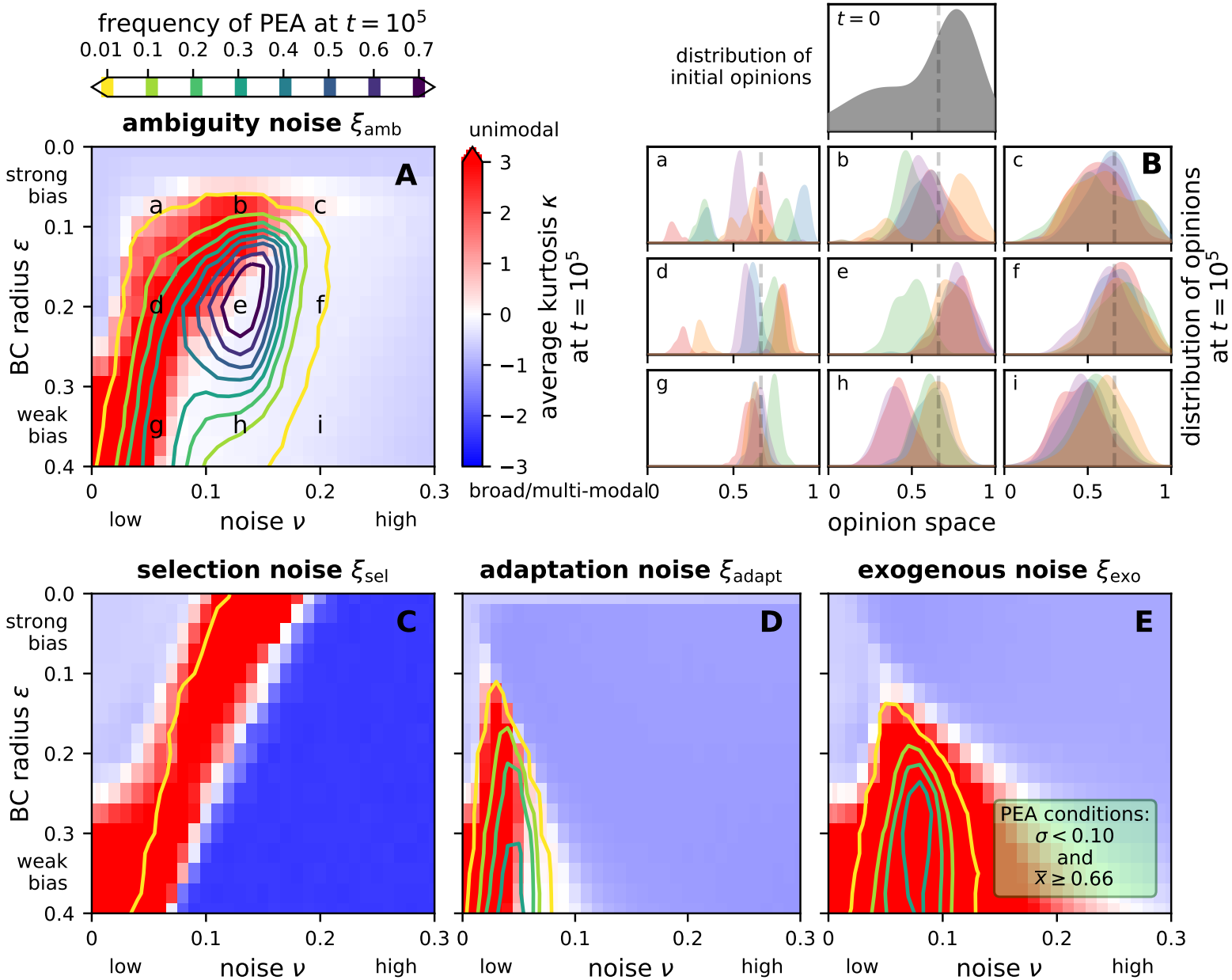
What title would you give this manuscript?

A: Noise in the bounded confidence model of opinion dynamics: Different types of noise have different effects on consensus and polarisation.

B: Noise in the bounded confidence model and the surprising effects of ambiguous expression of opinions.

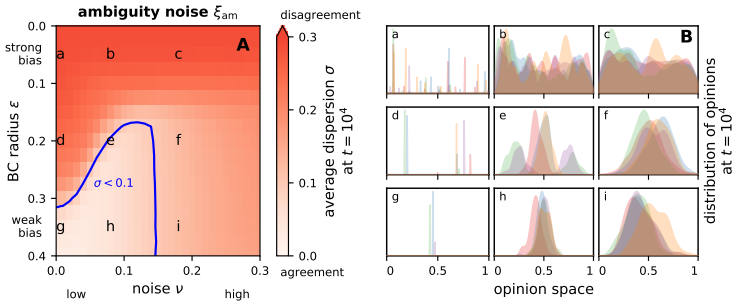
C: The ambiguous expression of opinions promotes pro-majority consensus in the presence of confirmation bias.

Sensitivity Analysis—Kurtosis

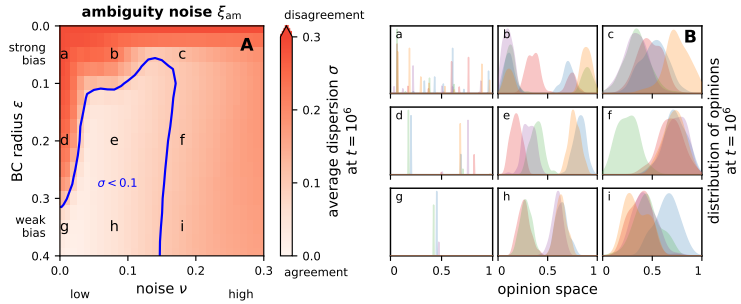


Sensitivity Analysis—Parameters

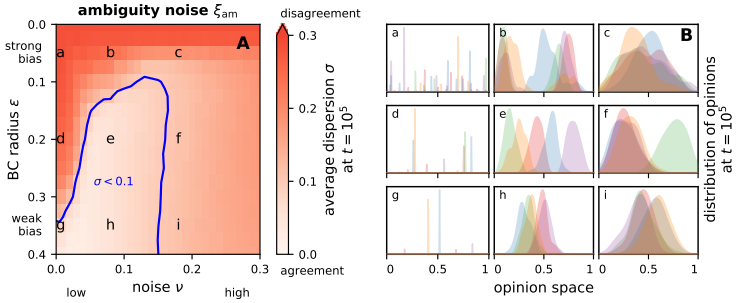
$t = 10e4$



$t = 10e6$



$n = 50$



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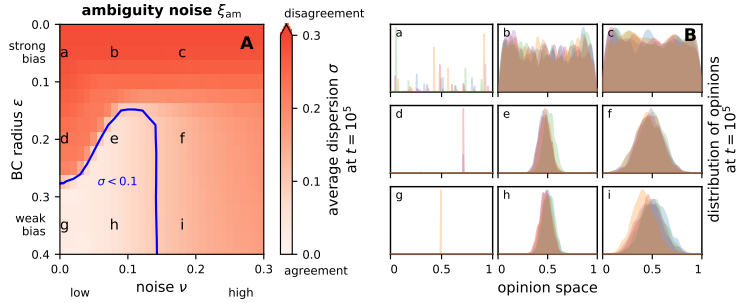
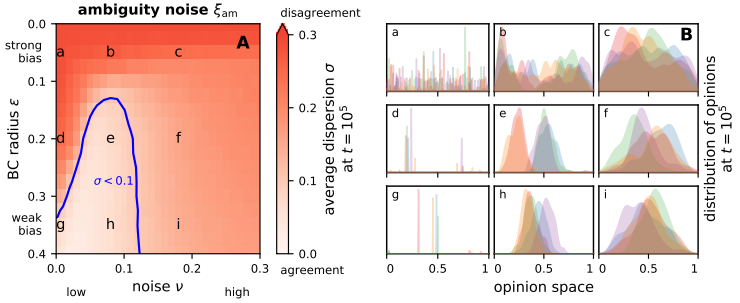
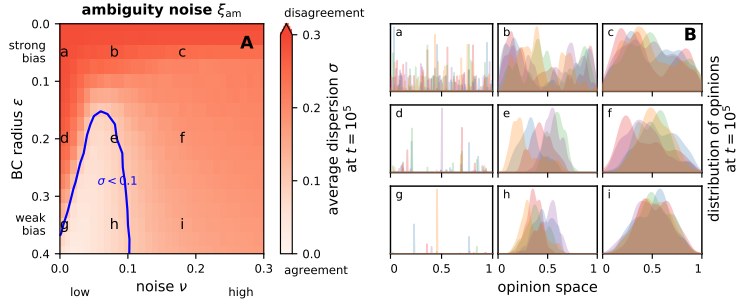


WS network $k = 6$ $p = 0.1$

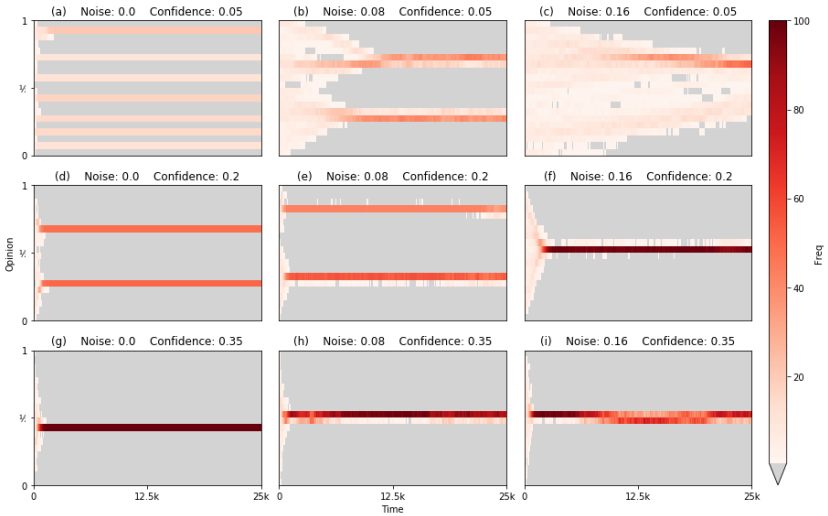


WS network $k = 6$ $p = 0.01$

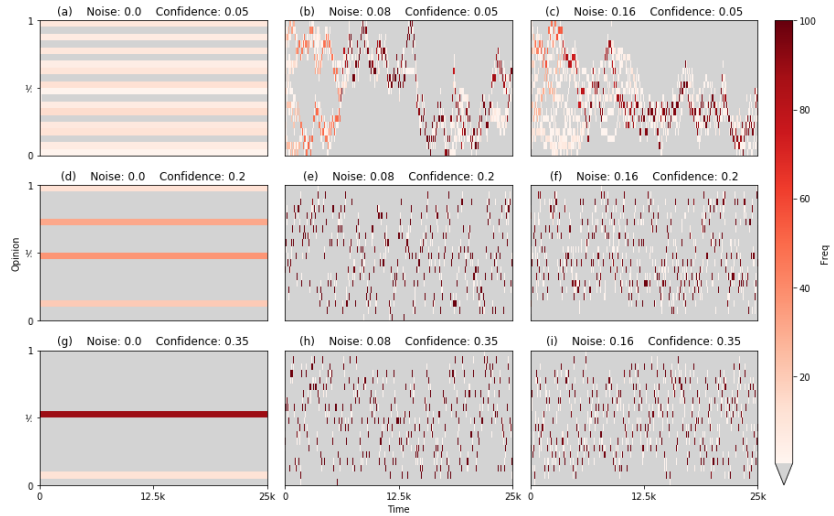


Sensitivity Analysis—Dyadic Interaction

many-to-one



one-to-many



one-to-one (dyadic)