High-threshold complex contagion and negative ties in the diffusion of stigmatized health measures: an empirical agent-based model

CS2Italy 2025 - 1st Conference on Computational Social Science
17 January, 2024, University of Trento

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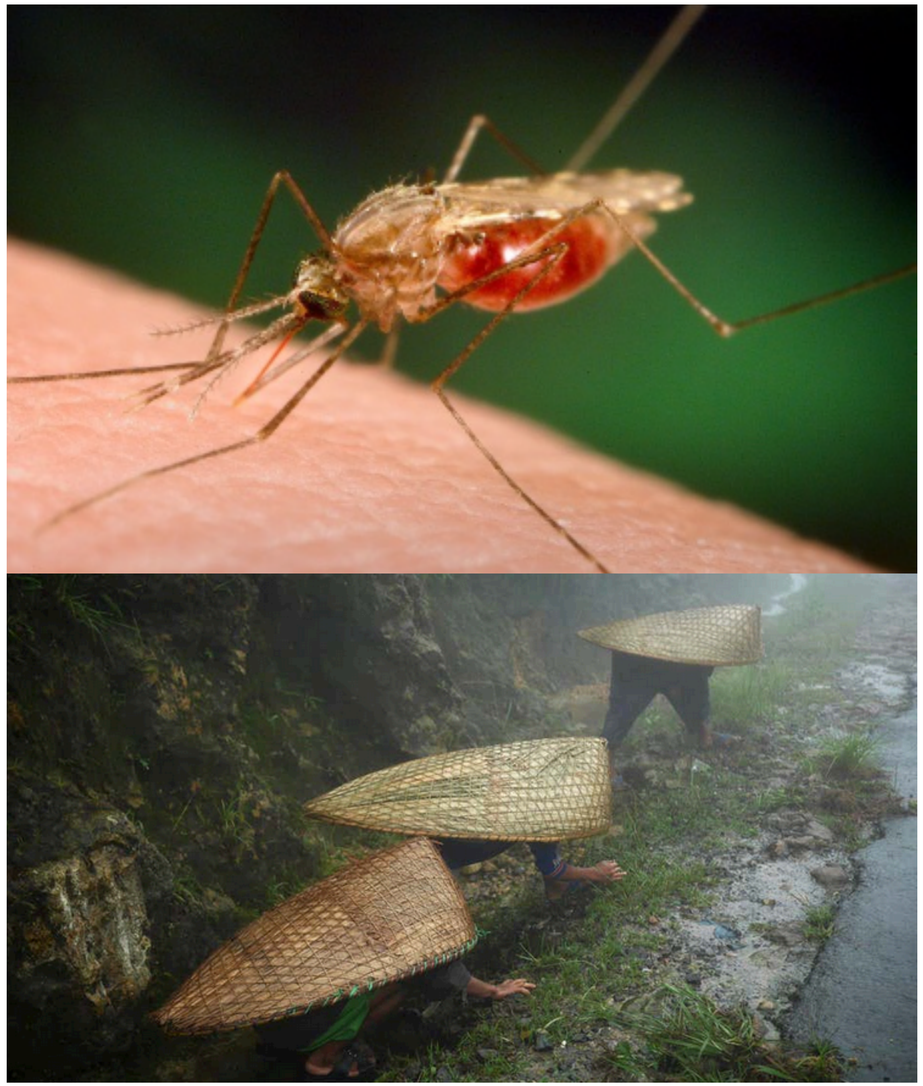
Low adoption of malaria preventive measures in hard-to-reach populations

- **Malaria** is still to be fully eradicated: Epicenters are often located among **hard-to-reach populations** in the Global South
- Geographical marginalization + low socio-economic status —> poor access to health care
- resistance to instituzionaled health practices (cultural/religious beliefs) despite top-down policy —> **low adoption rate of key preventive measures**
- **Meghalaya (North-Eastern India)**: mountainous area with patches of tropical forest - **Tribal population** (Garo and Khasi-Jaintia)
- **Challenge 1: lack of fine-grained data**

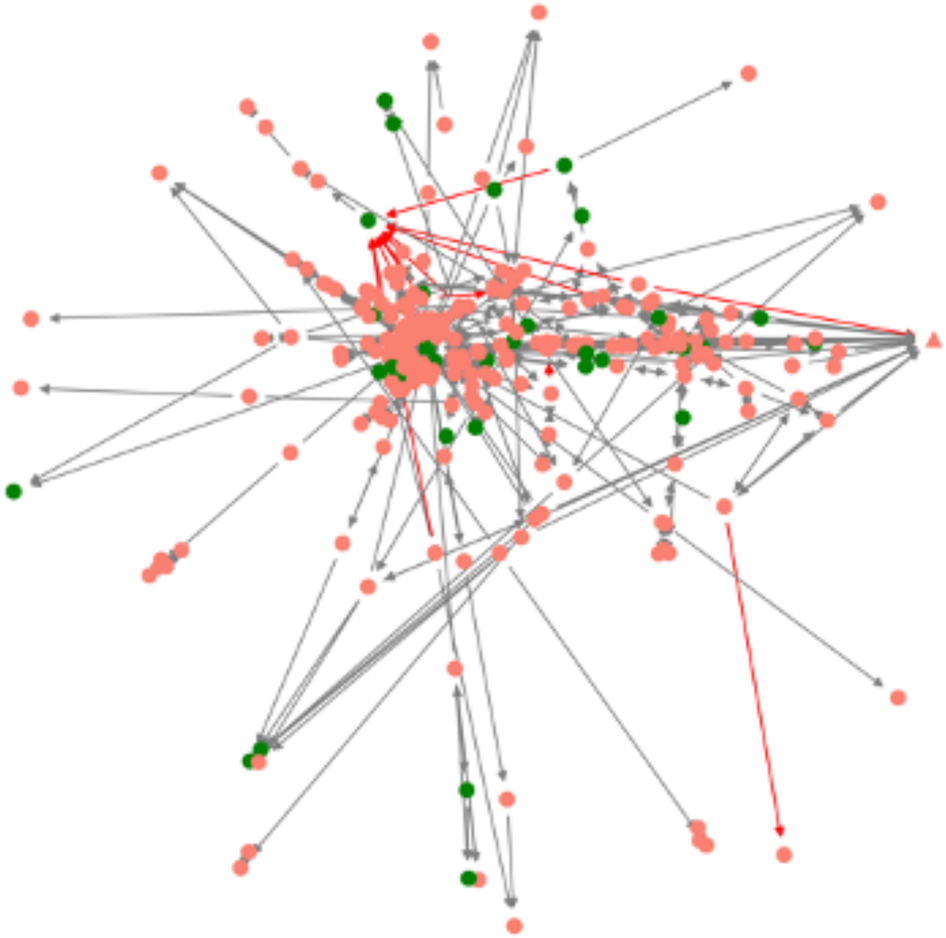


Data

- Data collection: 2020-2021 face-to-face questionnaire administration
- Network data:
  - **Positive ties**: Who do you talk to about health?
  - **Negative ties**: Who do you avoid talking to about health?
- Behaviour: Cream use

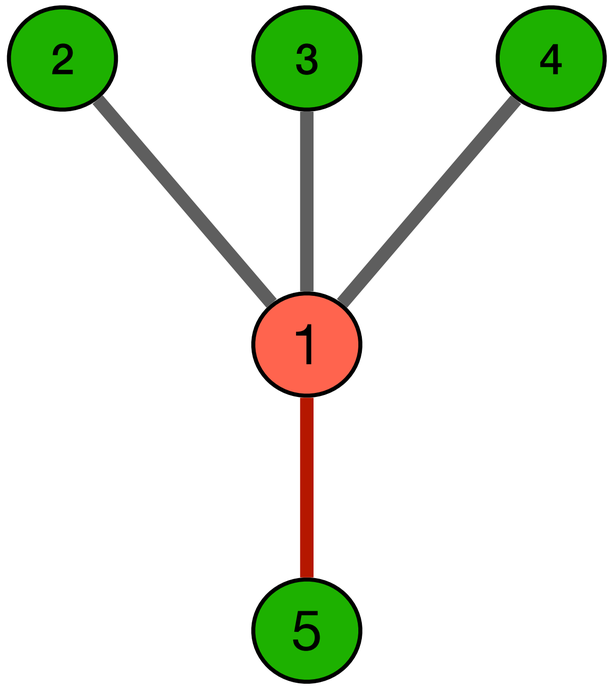
Descriptives:

- **cream adoption rate = 14.96%**
- # individuals (nodes) = 254
- # positive ties =
- avg. degree (positive ties) = 2.41
- # negative ties = 15
- avg. degree (negative ties) = 0.06



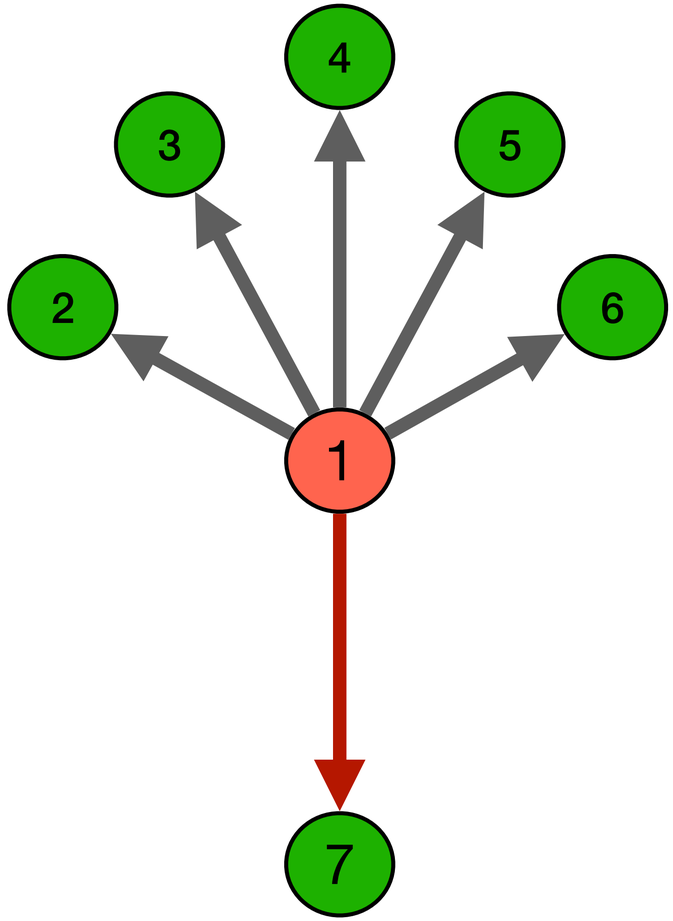
Threshold-based diffusion + negative influence

- Obstacles to preventive measure (**insecticidal cream**) **adoption**:
  - stigmatized (misalignment with traditional health culture)
  - easily observable behaviour
  - small, tight community (tribal villages)
- **Dual-side diffusion mechanism**:
  - **Positive influence**: strong reinforcement from **adoption** by **positive ties** (**threshold**-based contagion; Centola & Macy, 2007)
  - **Negative influence**: **adoption** by **negative contacts**
- Assuming **idiosyncratic** case characteristics:
  - positive impact of within-household adoption (fixed effect)
  - Positive tie with ASHA increases propensity to adoption
  - Positive tie with the traditional healer decreases propensity to adoption
- **Challenge 2: estimating unobserved thresholds**

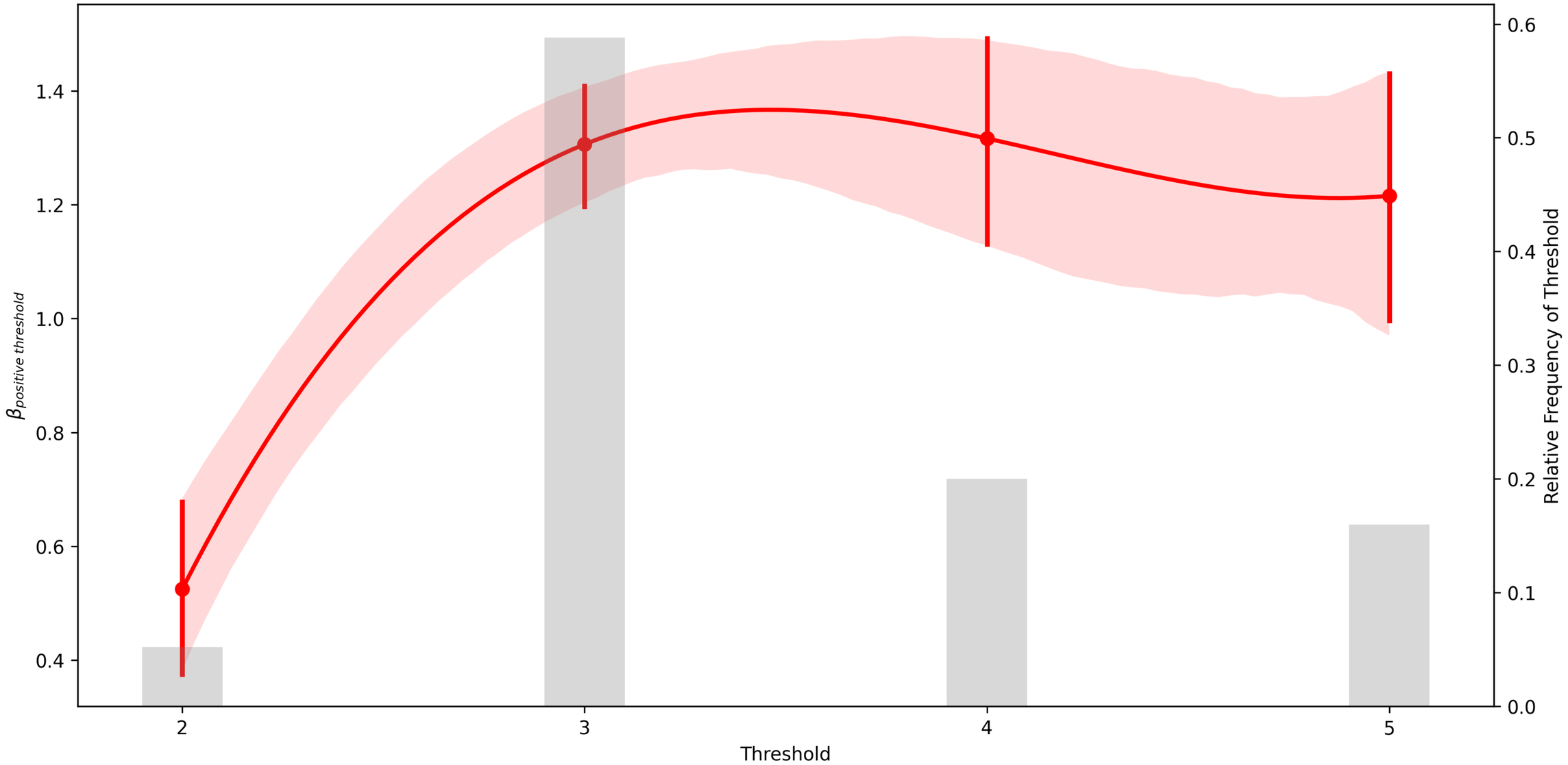


ABM estimating unobserved behaviour

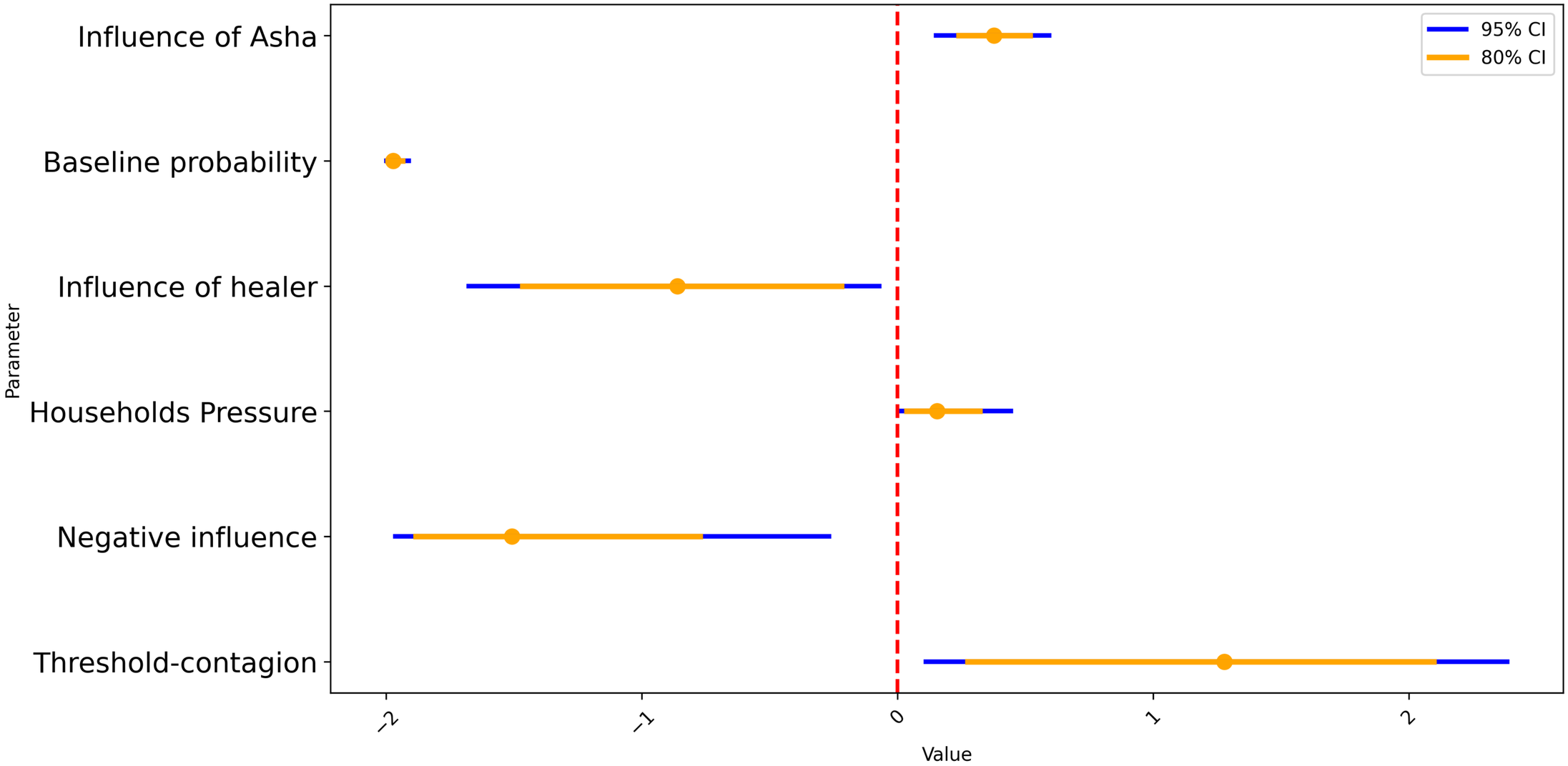
- ABM of the diffusion process in the empirically-observed networks (Bianchi & Renzini, *forthcoming*)
- Model of villagers' cream **adoption** (binary choice) as a discrete-choice model (Mc Fadden, 1978): **logistic objective function** of personal networks' composition
- **Estimating**:
  - **threshold levels** for uptake contagion
  - impact of threshold-based **positive influence**
  - impact of **negative influence** (= adoption by one negative contact)
- **Assuming:**
  - positive impact of within-household adoption (fixed effect)
  - ASHA and traditional healers as stubborn agents



Estimated threshold

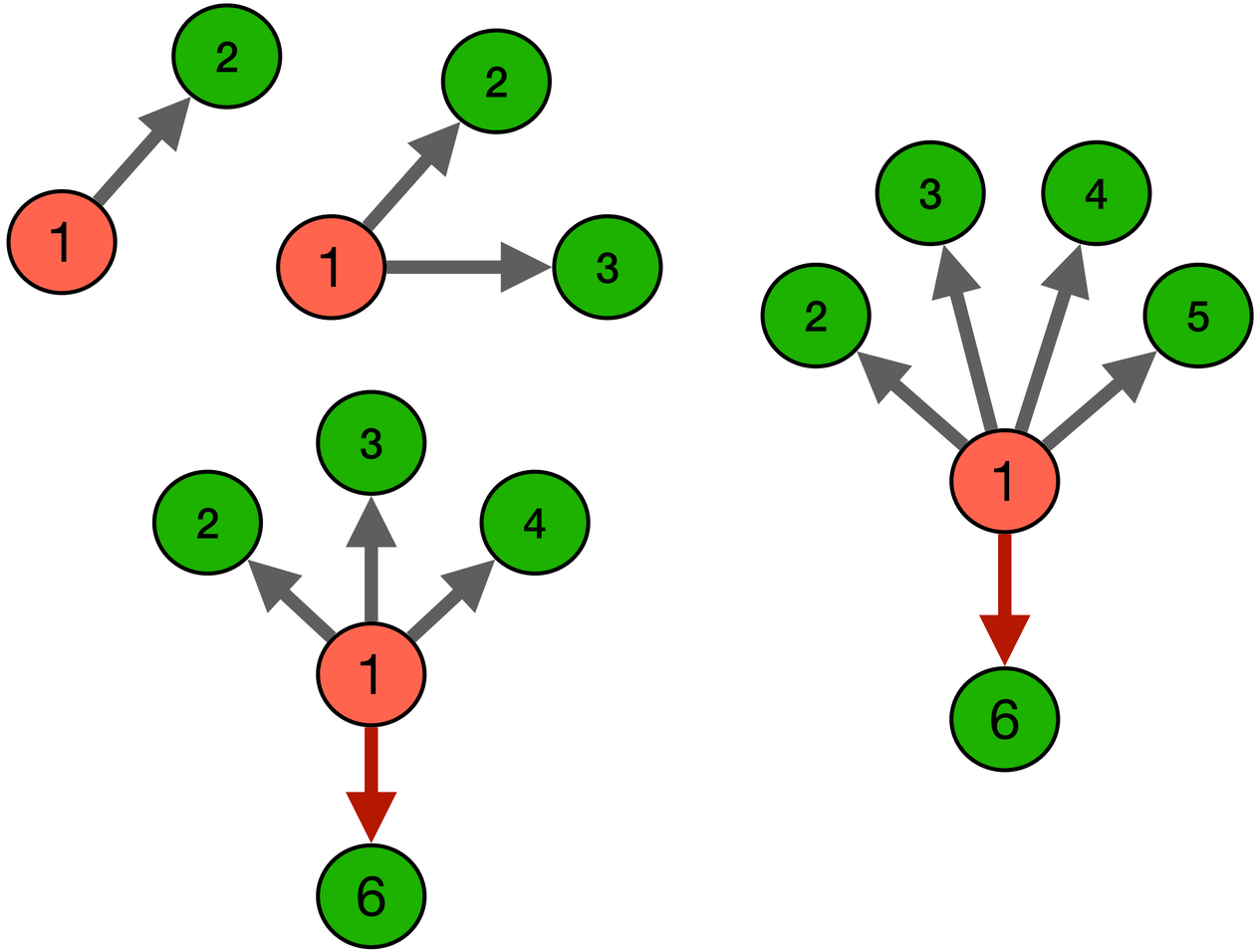


Impact of diffusion mechanism

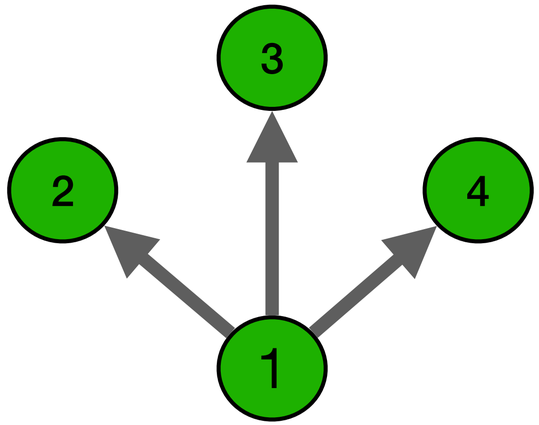


Building on shifting sands

No adoption



Adoption

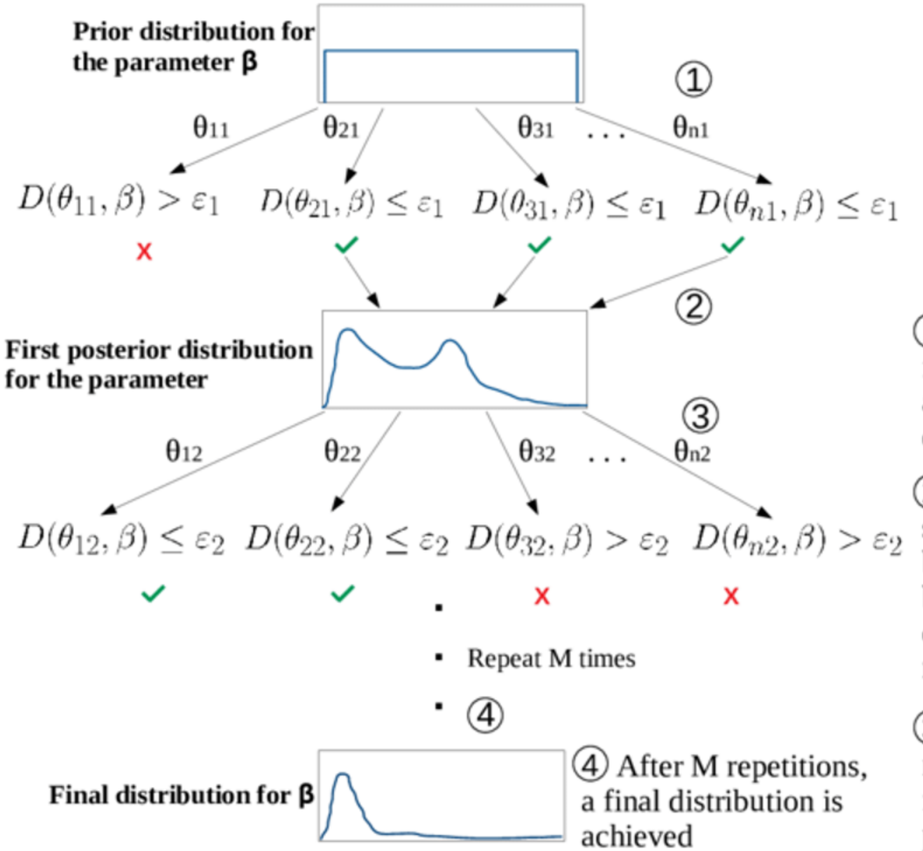


Estimation method

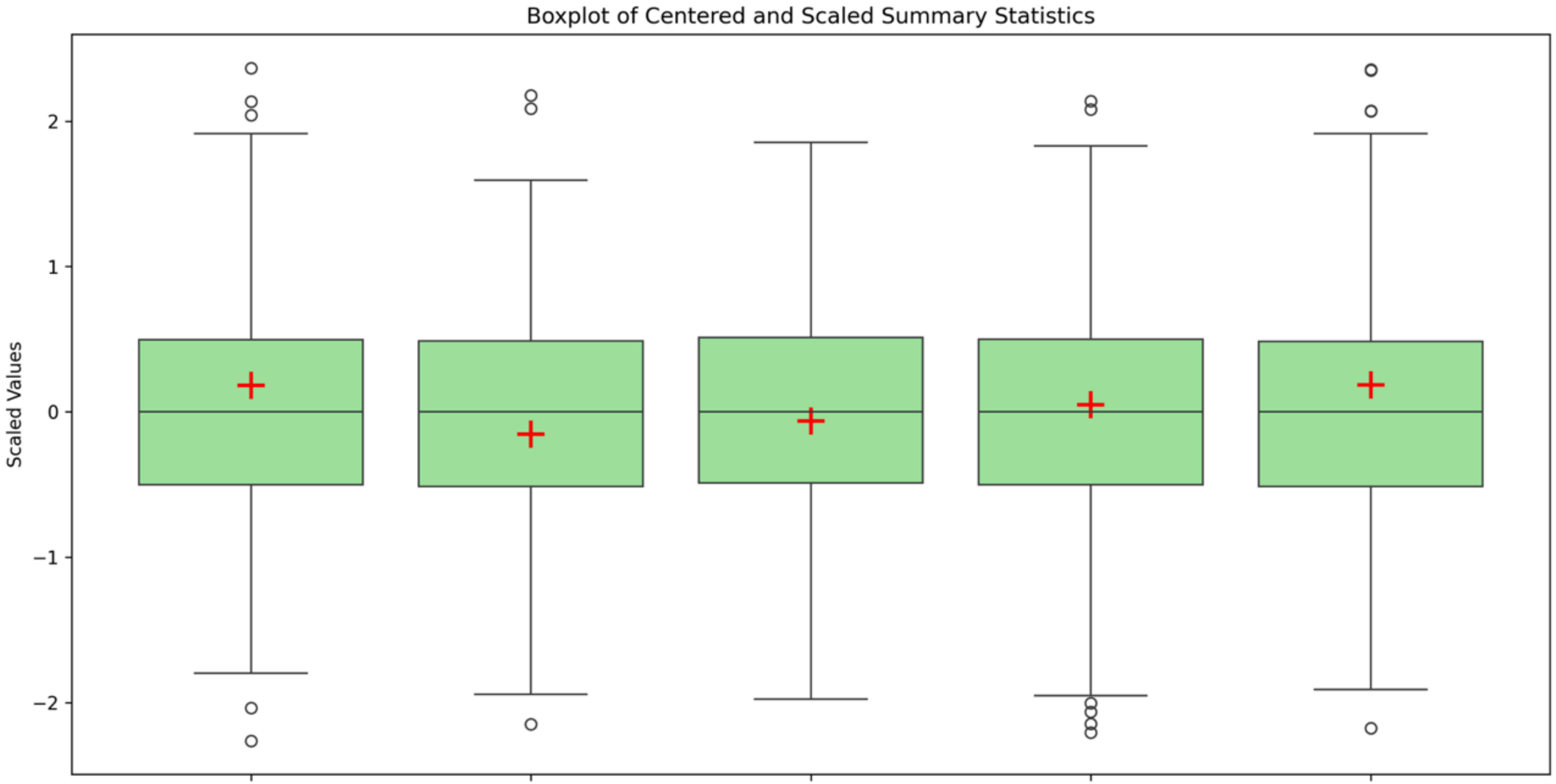
Approximate Bayesian Computation (Hartig et al., 2011)

Weakly informative priors (tested with predictive checks)

- Baseline: uniform [-3, 0]
- Threshold: {2, 3, 4, 5}
- Positive influence: uniform [0, 2.5]
- Negative influence: uniform [-2, 0]



Model fit



0.05 | 0.06 | 2.39 | 2.42 | 14.96%

Conclusions

- Diffusion of collectively beneficial, yet stigmatized behaviour might suffer from two pulling forces in one's personal network:
  - **Strong reinforcement** (high **threshold** levels)
  - High sensitivity to **negative influence**
- Computation in the social sciences is often driven by the availability of large data —> **(empirical) ABM** can reliably estimate **unobserved (or unobservable) behaviour**

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- We ran predictive checks
- Sampling from the prior distributions, simulating the model 1,000 times, then comparing summary statistics distributions to the observed ones