

MISINFORMATION CAN PREVENT THE SUPPRESSION OF EPIDEMICS

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BACKGROUND

The effectiveness of non-pharmaceutical interventions, such as mask-wearing and social distancing, as control measures for pandemic disease, relies upon a conscientious and well-informed public who are aware of and prepared to follow advice. Unfortunately, public health messages can be undermined by competing misinformation and conspiracy theories, spread virally through communities already distrustful of expert opinion.

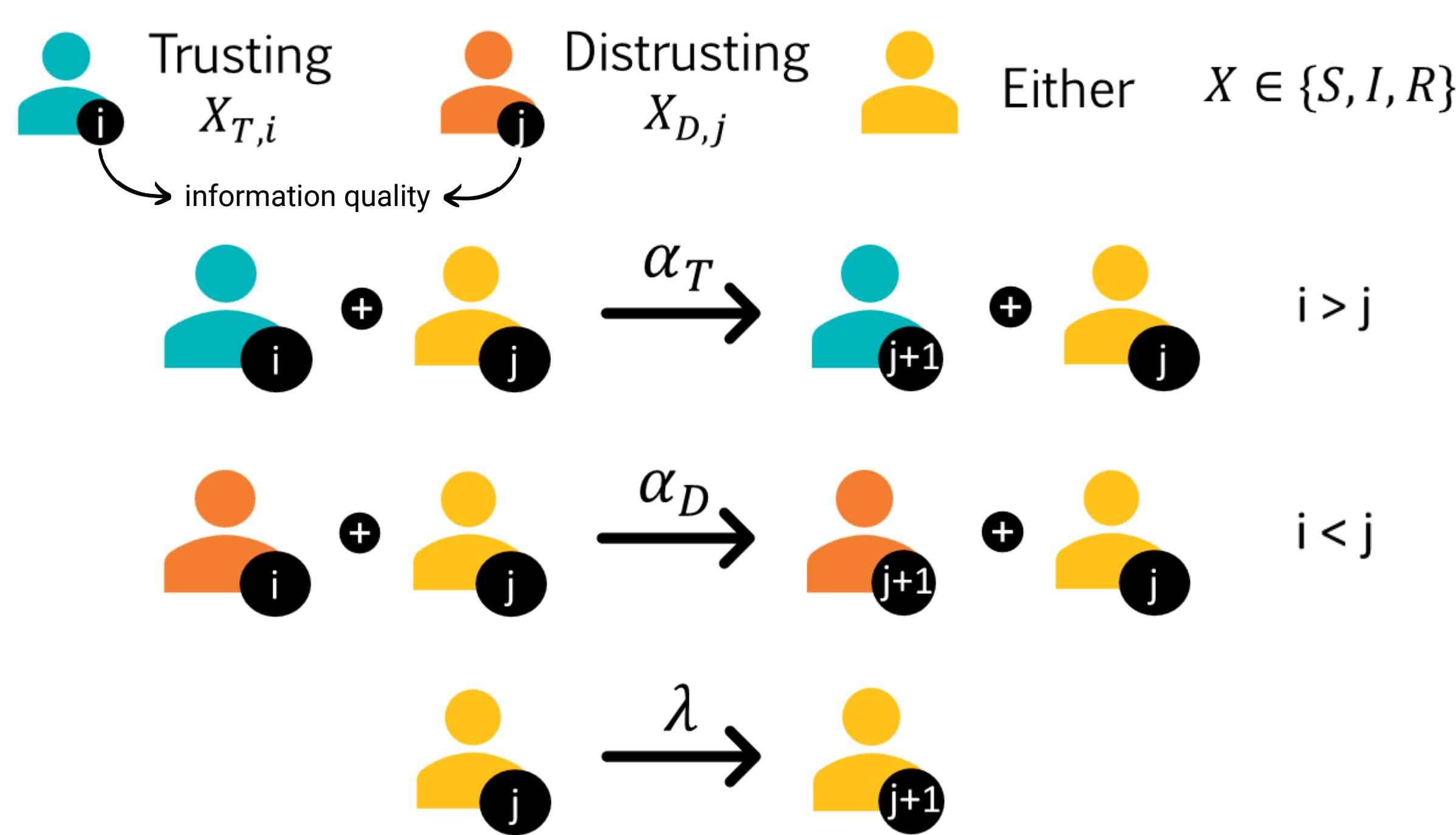
MODEL

The model merges information and disease dynamics to investigate the effects of awareness-driven behavioural changes on epidemics.

The population has a fixed size, N , and is composed of **Trusting** and **Distrusting** individuals. Trusting individuals seek higher quality information, whereas distrusting individuals are prone to misinformation. The level of protection adopted by individuals depends on the quality of the information attained by them.

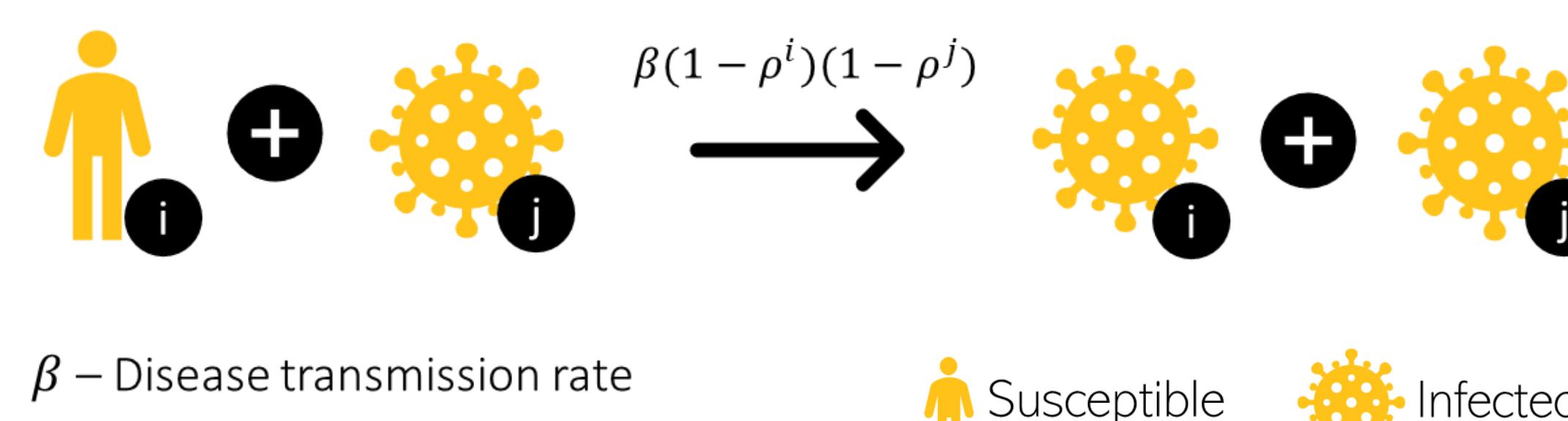
The disease spreads according to the *SIR* model. In the *SIR* model, the population is categorised into three compartments, the susceptible (S), the infected (I) and the recovered (R).

Awareness dynamics:

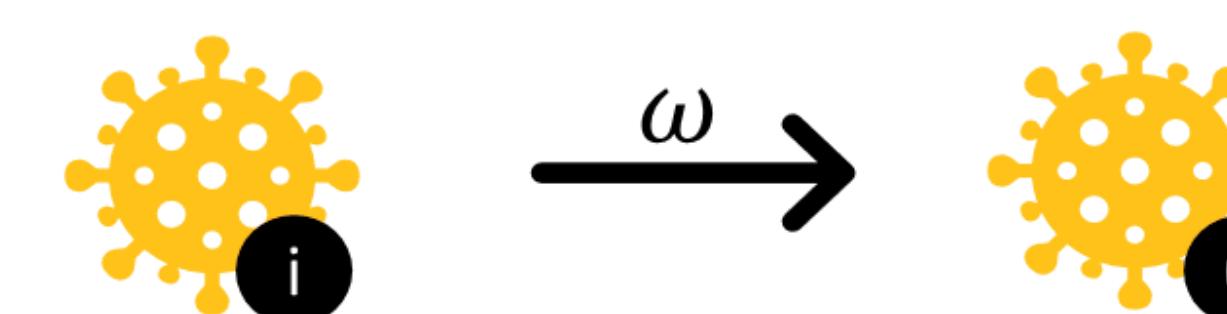


Coupling awareness and disease:

- Reduction in transmission:



- Information refreshing:



RESULTS

The model's interactions lead to an extensive system of ODEs which we solved numerically to obtain the following results:

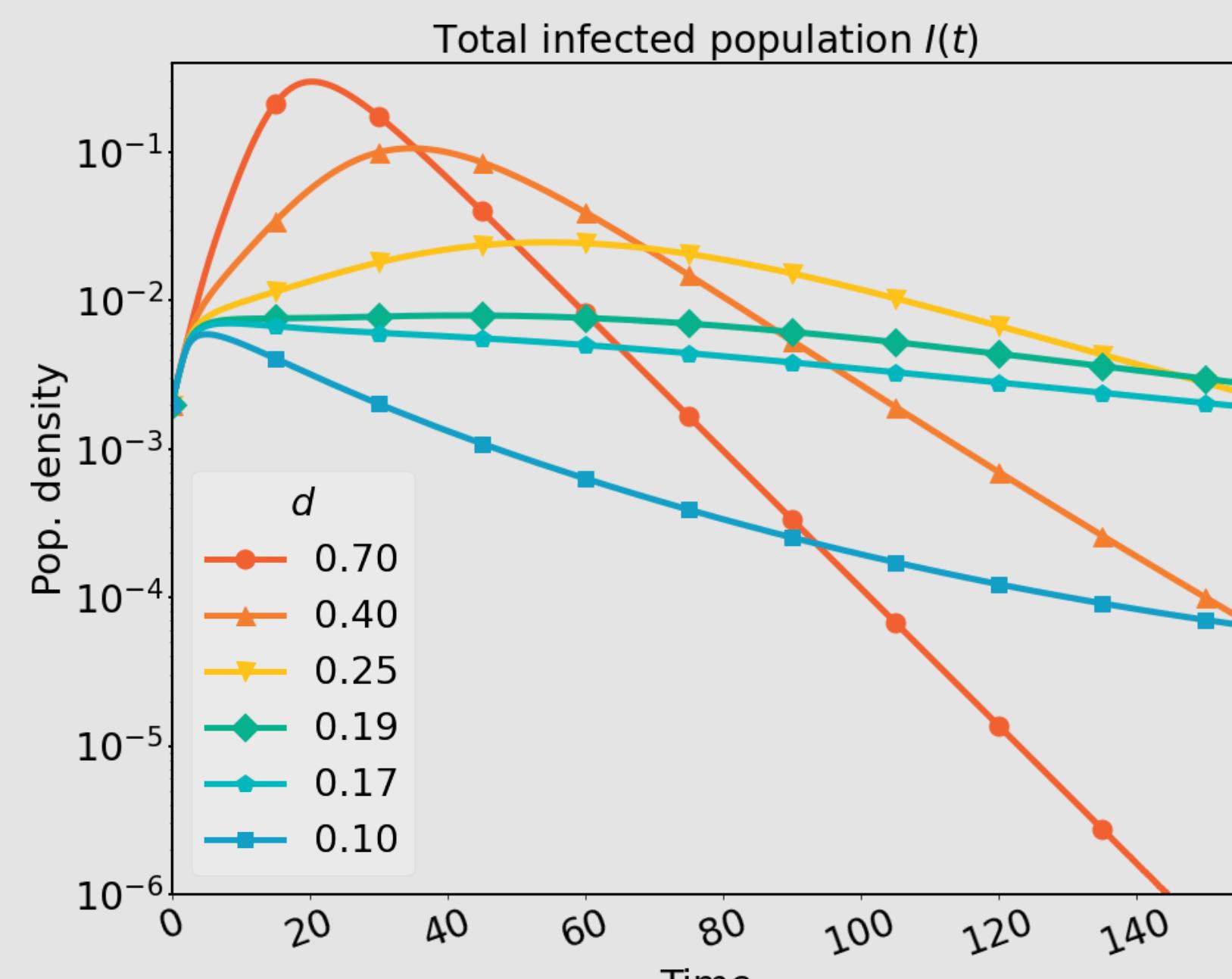


Figure 1. The effect of decreasing the density of distrusting individuals, d , on the total number of infected individuals. A similar effect is observed when increasing the effectiveness of the information-mediated protection parameter, ρ .

In the limit of fast information spread, $\alpha_T, \alpha_D \rightarrow \infty$, we can obtain an estimate for the critical ρ and density values

$$x^\pm(d) = \frac{-d\left(1+dy-\frac{y}{R_0}\right) \pm \sqrt{d^2\left(1+dy-\frac{y}{R_0}\right)^2 + \frac{4}{R_0}\left(1+\frac{\omega}{\sigma+\lambda}\right)(1-d)(1+dy)}}{2(1-d)(1+dy)},$$

where $x = 1 - \rho$ and $y = \beta/(\sigma - \beta d)$.

There is a critical distrusting density

$$d_M = \frac{\sigma}{\beta} = \frac{1}{R_0}$$

above which suppression of the disease is not feasible irrespective of the value of ρ .

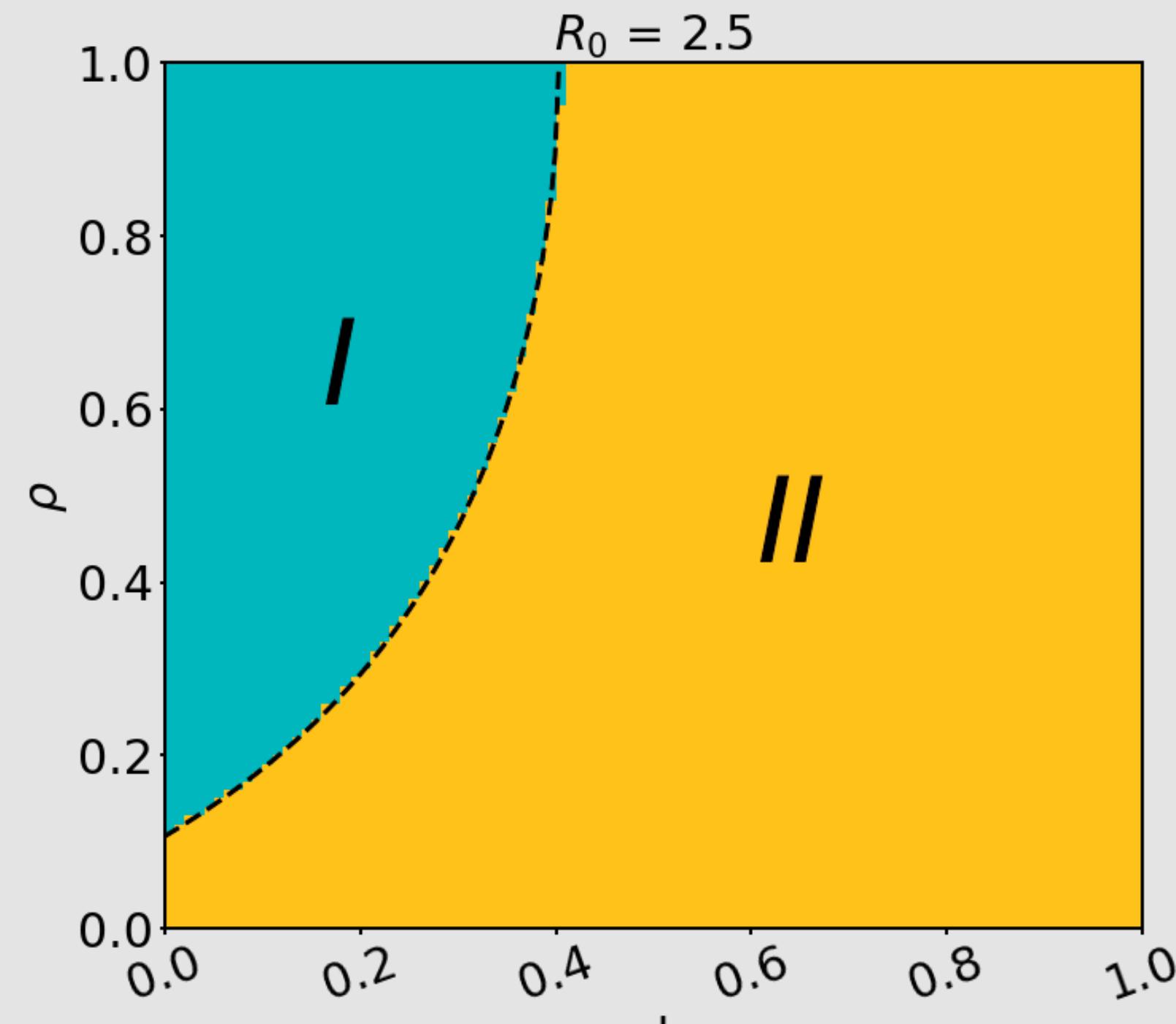


Figure 2. The figure shows the agreement between the theoretical prediction (dashed line) and the boundary between the suppression (I) and mitigation (II) regions obtained numerically.

CONCLUSION

We propose and analyse a simple model of the interaction between disease spread and awareness dynamics in a heterogeneous population composed of **trusting** and **distrusting** individuals. We show that, **as the density of the distrusting population increases**, the model passes through a phase transition to a state in which **major outbreaks cannot be suppressed**. Our work highlights the urgent need for effective interventions to increase trust and inform the public.



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Related literature

1. Sontag A., Rogers T. and Yates C. A. 2022 Misinformation can prevent the suppression of epidemics. *J. R. Soc. Interface* **19**: 20210668. 20210668.
2. Funk S, Gilad E, Watkins C, Jansen VAA. 2009 The spread of awareness and its impact on epidemic outbreaks. *Proc. Natl. Acad. Sci. USA* **106**, 6872-6877.
3. Funk S, Salathé M, Jansen VAA. 2010 Modelling the influence of human behaviour on the spread of infectious diseases: a review. *J. R. Soc. Interface* **7**, 1247-1256.

Check the publication!

