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Title

Realistic decision-making processes in a vaccination game

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Social dilemma; vaccination game; SIR model

Highlight

- We establish new strategy adaptation model for vaccination games.
- The models presume that an agent decision-makes according to what extent free-riding can be successful.
- The models show different characteristic from the conventional rule based on Pairwise Fermi update.

Abstract

Previous studies of vaccination games have nearly always assumed a pairwise comparison between a focal and neighboring player for the strategy updating rule, which comes from numerous compiled studies on spatial versions of 2-player and 2-strategy (2×2) games such as the spatial prisoner's dilemma (SPD). We propose, in this study, new update rules because the human decision-making process of whether to commit to a vaccination is obviously influenced by a "sense of crisis" or "fear" urging him/her toward vaccination, otherwise they will likely be infected. The rule assumes that an agent evaluates whether getting a vaccination or trying to free ride should be attempted based on observations of whether neighboring non-vaccinators were able to successfully free ride during the previous time-step. Compared to the conventional updating rule (standard pairwise comparison assuming a Fermi function), the new rules generally realize higher vaccination coverage and smaller final epidemic sizes. One rule in particular shows very good performance with significantly smaller epidemic sizes despite comparable levels of vaccination coverage. This is because the specific update rule helps vaccinators spread widely in the domain, which effectively hampers the spread of epidemics.

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