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## Centralization in self-organized reference networks

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When one makes his/her decision, he/she often refers to others' opinions. We describe this situation by a network model with the nodes representing individuals and the links representing references between them. Our question is how people's reference structure self-organizes, when each individual tries to provide correct answers by referring to more accurate agents.

To answer these questions, we constructed an adaptive network model. In the model, in each iteration round, each agent makes a decision sequentially on a given problem by the majority vote among one's and his/her neighbors' opinions. Since each agent makes decision by the majority vote, his/her probability to find a correct answer by oneself, which we call his/her "ability", is different from his/her actual probability of finding a correct answer by referring to others, which we call his/her "performance". After the correct answer to a given problem is announced, each agent then rewires his/her links according to the performance of the linked individuals. The rewiring rule is as follows; each individual monitors his/her neighbors' performance and breaks the link if the neighbor's performance becomes worse than a preset threshold. We assume that all agents adopt the same threshold. Therefore the value of the preset threshold represents the severity of the society. We also assume that individuals vary in their ability.

In the self-organized reference network, we observed the strong centralization of reference, in which the number of one's followers increases more than linearly with his/her ability. Counter-intuitively, this tendency was stronger when the rewiring threshold was set lower (when they are more generous to their referents). The mean performance of each agent in the self-organized network was higher compared with random networks or the case of independent decision-making. However, the proportion of agents who give correct answers, which we call "group performance", fluctuated more in the self-organized network. To sum up, in the self-organized network, though the strong centralization of reference towards high ability agents leads to high performance of each agent on average, it also leads to a heightened risk of a temporal crash in group performance. By analytical calculations, we have confirmed that the performance-monitoring process assumed in our model yields the strong centralization of reference in the self-organized reference network.

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