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Modeling social interactions to improve collective decision-making

How are we affected by other peoples' opinions? To answer this question, scientists¹ at the CNRS, Inra and Université Toulouse 1 Capitole conducted a study in France and Japan, quantifying this impact on our decisions. They identified five behaviors common to both countries: a majority of subjects make a compromise between their opinion and that of others (59% of people in France), some hold to their opinion (29% in France), whereas others follow faithfully, amplify or contradict the information they receive. The study also shows how social information can help a group collectively improve its performance and the precision of its estimates. From this analysis, a model has been developed that reproduces the results of the study and predicts the performance of a group depending on the amount and quality of information exchanged between its members. The long-term goal would be to develop algorithms for decision-making support tools. The results of this study were published on November 6, 2017 in *PNAS*.

The fast growth of digital technologies and content availability is making us interact more with others. Increasingly, social networks are becoming important sources of information that we choose to take account of or ignore. Many e-commerce sites make extensive use of review and scoring systems, which allow their customers to use the opinions of others to make their own choices. Without even considering false information, that is sometimes difficult to detect, we are each exposed to too much information to process it correctly every time.

These observations call for the development of tools to help in collective decision-making, which could assist with processing information and making decisions in a group that uses social interactions. The group of researchers involved in the study focused on the impact of social information, i.e., the way that others affect what we do. Under what conditions can this social information increase the effectiveness of our collective decision-making?

The experiments involved 186 people in France and 180 in Japan. Each participant had to estimate values, such as Gandhi's age when he died, or the number of stars in our galaxy, and give a degree of confidence in their answer. After the first stage, the average of the previous

¹ The French laboratories involved in this study :

The Centre de recherches sur la cognition animale (CNRS/Université Toulouse III – Paul Sabatier)

The Laboratoire de physique théorique (CNRS/Université Toulouse III – Paul Sabatier)

TSE Recherche (CNRS/Université Toulouse 1 Capitole/INRA/EHESS) laboratory from Toulouse school of economics



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participants' responses – the social information—was given to them, and the subject had to reply again to give a final estimate. One of the unique features of this study is the introduction of virtual agents who were controlled by the researchers without the knowledge of the participants—and always gave the correct answer. These agents, whose number varied, therefore favorably influenced the social information sent to subjects.

This work shows how social information leads the group to collectively improve its performance and the precision of its estimations. It can also accurately measure how sensitive subjects are to social information. The researchers identified five sensitivity profiles that are independent of cultural bias, because they are present in both countries. In France, an analysis of almost 11,000 responses shows that 29% of the people sampled hold to their opinion, 4% strictly follow the information given to them, and 59% find a compromise between their initial opinion and the social information. Thinking that the rest of the group has, the same way as they did, underestimated their initial response, 6% of people amplify the social information received. Finally, 2% end up contradicting their own estimation and that of the group, most often without being able to justify their decision. In addition, the further a participant's personal feeling is from the social information received, the more sensitive this subject is to the information. In another more surprising result, the scientists have shown that the performance of a group may be improved by a limited quantity of incorrect information, which compensates for a human cognitive bias that underestimates quantities.

Based on these experiments, a mathematical model has been developed. It faithfully reproduces the social information sensitivity mechanisms observed experimentally and predicts the impact of the amount and quality of information exchanged between the individuals in a group on their collective performance. A better understanding of the governing processes of how social information influences individual choices and collective information opens new perspectives. Personalized algorithms could be developed to anticipate the different types of answers according to the form of social information received. This could contribute to improving cooperation and collaboration on the scale of groups.



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Experimental set-up used for the analysis of the impact of social information on group performances in collective estimation tasks. © G. Theraulaz

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