

## Reply to Farrell: Improved individual estimation success can imply collective tunnel vision

Analyzing the data of the wisdom of crowd experiment by Lorenz et al. (1), Farrell (2) points out that information exchange improves individual estimates of answers to factual questions. He furthermore suggests that information exchange increases individual rewards and that this comes with an increase in confidence in their estimates. However, it has to be noted that individual rewards were revealed only after subjects specified their confidence. [This also shows that the reference to Danchin et al. (3) is not fitting, because in the foraging example, subjects were constantly aware of the external metric, namely the success of the foraging activities of other individuals.] Moreover, although the original experiment was designed to study social interaction effects, Farrell applies a psychological perspective. In fact, Farrell's commentary (2) focuses on individual-level effects, whereas Lorenz et al. (1) concentrated on group-level effects and show how aggregating micro-outcomes can lead to unexpected macro-level effects.

The individual reward in the experiment by Lorenz et al. (1) is a function of individual error. However, even when social information decreases individual error and consequently increases individual reward, this does not prevent collective side effects of a reduction in the range of answers and an increase in collective certainty. The *diversity prediction theorem* (4) helps to explain why this is the case. It states that the average individual error is equal to the collective error plus group diversity (see ref. 5 for a derivation). When the collective error remains constant, this implies that the individual error decreases, if the diversity of the group decreases. As this essentially applies to the experiment by Lorenz et al., an increase of reward was expected to occur.

The wisdom of crowd effect works for diverse groups with a small collective error compared to their average individual error. Here, asking many instead of one strongly improves the accuracy of aggregated estimates as a matter of statistics. This illustrates why social influence undermines the wisdom of crowd effect from a collective viewpoint. Social influence through

information sharing tends to diminish independence of estimates, to reduce the diversity and balance of opinions, and thereby to undermine the value of asking many instead of one.

Farrell mentions that the question of over-shrinkage (i.e., too much convergence of opinions) is relevant for determining standard errors. Our main practical implication is related. When the wisdom of crowd effect is undermined, as experimentally observed, there is a practical danger: when an external decision maker is confronted with diverse opinions and high average confidence in a team of experts, the conclusion may be that the truth must lie somewhere in between. That is, one is likely to assume the wisdom of crowd effect is applicable (as in round 1 of the experiment), whereas it might in fact have been undermined by social influence (as in round 5). This may be easily overlooked, because social influence is so ubiquitous and opinions tend to stay diverse. Our point is that this danger not only exists *despite* improved rewards, but *because* people try to increase their benefits.

Although social influence reduces the group's range of estimates, and individuals become more confident of their estimates, the truth often ends up in peripheral regions. This may be considered as a collective tunnel vision.

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