Gambling for global goods

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The human species has the sad capacity to destroy the climate of this planet. Many of our current behaviors and policies are almost ideally geared to meet this "goal" as quickly as possible. The per capita CO_2 emission of the United States is approximately twice that of the United Kingdom or Japan and three times that of France or Sweden. Why is this the case?

Preserving the global climate is the biggest public goods game ever. It is a game that concerns all of us, and we cannot afford to lose it. Once the global climate is destroyed, not even enormous stock market gains could make us happy anymore. In a simple and elegant experiment, Milinski, Marotzke, and colleagues (1) have examined the ability of people to solve what they call a "collective risk social dilemma."

To play Milinski's game, you need six players and some money. Initially, all players receive 40 euros in their private accounts. The game has 10 rounds. In each round, players can transfer 0, 2, or 4 euros into a "climate account." At the end of the game, the climate account must contain at least 120 euros. In this case, the climate has been saved and each player receives whatever is left in his private account. If the climate account does not reach its target, then the climate is lost with a 90% chance. In this case, all players loose all of their money.

Thus, in every round, players must choose one of three options: invest 0, 2, or 4 euros into the climate account. Milinski *et al.* (1) call these moves "selfish," "fair," and "altruistic." If all players use the fair option (invest 2 euros) in every round, then the climate account will reach exactly 120 euros and every player will keep 20 euros in his private account. This solution is a Nash equilibrium (2). No single player can deviate from this solution and increase his personal gain. If one player contributes more, then he will have less income in the end. If one player contributes less, then the target will not be reached and the expected income for all will be much lower.

People, however, may not stick to the Nash solution. For maximizing their own income, there is an incentive to contribute less and hope that others will compensate. If one player invests 0 in one round, then another player must invest 4 for the total sum to stay on target. People who invest nothing are "free riders." They rely on altruists to save the climate. But without altruists the free riders also would make no income in the end. Therefore, without altruists there is no incentive to free-ride.

Milinski played this game with 10 groups of six students. Half of the groups reached the target, and the other half failed. Those groups who failed had accumulated 113 euros on average in their climate account after 10 rounds. Ironically, some of the groups came very close but just did not make it. Clearly, this outcome is the worst possible one and minimizes the expected gain of all players.

Fig. 1 illustrates the game of a group who failed to protect the environment. After eight rounds their climate account contained 90 euros. In the ninth round the six players contributed 16 euros in total. In the final round they needed 14 euros but only came up with 8. The altruists felt that they had already contributed enough. The motives of the free riders were unclear.

It is tempting to compare the people in Milinski's experiment with countries. Then, given the current per capita CO_2 emission, the United States would be "free riders," the United Kingdom and Japan would play "fair," and France and Sweden would be "altruists."

Milinski *et al.* (1) also investigated two variants of their experiment. In one version there is only a 50% chance that the climate is lost if the target sum is not reached. In the other version there is only a 10% chance. In these treatments, people generally fail to protect the climate: Only 1 of 10 groups reached the target in the 50% version and 0 of 10 groups in the 10% version. This outcome is not so surprising because in both treatments there is no rational incentive to invest in the climate account. Without any investment the expected income per player is 20 euros in the 50% version and 36 euros in the 10% version. It is astonishing that people invested at all in these settings. In the 50% and 10% treatments, people invested on average 92 euros and 73 euros, respectively. These investments may have been the consequence of a framing effect because people were told that the game was about saving the climate.

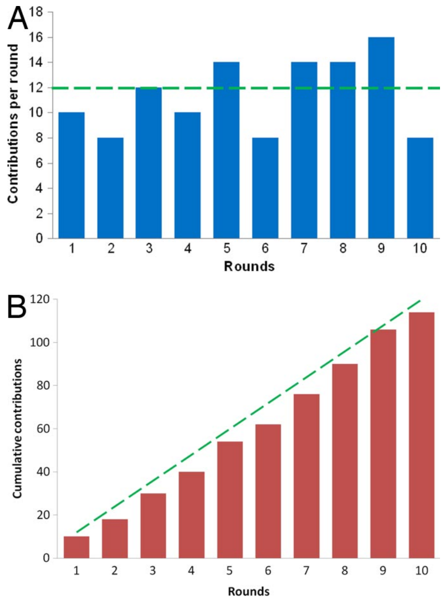

Fig. 1. Climate lost. Here is an example where a group failed to reach the target. After eight rounds, their climate account contained 90 euros. In the ninth round, four of the six players contributed the maximum amount of 4 euros each. There were two free riders who contributed nothing. In the final round, one of the free riders contributed 2 euros and the other still nothing. Three of the altruists gave 2 euros each. It was not enough. The final amount came to 114 euros. Everything was lost. The dashed green line represents the target amount that should be invested per round (*A*) and the cumulative target for each round (*B*).

However, these observations also suggest that people are willing to gamble for the climate.

A major conclusion drawn by Milinski and his colleagues (1) is that people must be well informed about the risk of climate change (3–5). If people are misled to think that the risk is small, then they will not cooperate. If people know that the risk is high, then they might cooperate. The role of scientists must be to inform people about the risk. Moreover, we must invent environmental so-

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lutions (6–9) and behavioral solutions. But only behavioral solutions can save us in the long run. We must learn how to cooperate on a global scale, how to respect the needs of others, and how to avoid an excessively wasteful lifestyle.

Evolutionary dynamics are constructive because of cooperation. Whenever evolution invents something entirely new (such as the first cell, multicellular organisms, or human society), cooperation is involved. Cooperation means that one individual pays a cost for another to receive a benefit. Natural selection opposes cooperation unless specific mechanisms are at work (10). Two such mechanisms are direct and indirect reciprocity. Direct reciprocity means that I cooperate with you because you have cooperated with me (11, 12). Indirect reciprocity means that I cooperate with you because you have cooperated with others (13–15). These two mechanisms are the key components to understanding any prosocial behavior in humans.

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Indirect reciprocity works through reputation. Helpful people have the reputation of being valuable members of the community and are more likely to receive help than are free riders.

Procedures should be installed to publicize the reputation of individuals and organizations in the struggle to protect the environment. Environmentally friendly behavior could be rewarded with tokens of reputation, which may ultimately be regarded as valuable signals. Environmentally unfriendly acts could also be marked. For example, certain cars could have mandatory stickers such as, "Environmentalist warning: this car is highly inefficient; its emissions contribute to lung cancer and hazardous climate change."

The ingenious experiment of Milinski *et al.* (1) is thought provoking and captures the essence of the problem. Let us play this game at company retreats, at schools, and at home. We all need to get the feel for being involved in a "collective risk social dilemma" and learn strategies for its solution.

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