

# SuperCooperators

*Altruism, Evolution, and Why We Need  
Each Other to Succeed*

Martin A. Nowak  
with Roger Highfield

FREE PRESS

New York London Toronto Sydney



FREE PRESS  
A Division of Simon & Schuster, Inc.  
1230 Avenue of the Americas  
New York, NY 10020

Copyright © 2011 by Martin Nowak and Roger Highfield

All rights reserved, including the right to reproduce this book or portions thereof in any form whatsoever. For information address Free Press Subsidiary Rights Department  
1230 Avenue of the Americas, New York, NY 10020.

First Free Press hardcover edition March 2011

FREE PRESS and colophon are trademarks of Simon & Schuster, Inc.

For information about special discounts for bulk purchases,  
please contact Simon & Schuster Special Sales at 1-866-506-1949  
or [business@simonandschuster.com](mailto:business@simonandschuster.com).

The Simon & Schuster Speakers Bureau can bring authors to your live event.  
For more information or to book an event contact the Simon & Schuster Speakers Bureau  
at 1-866-248-3049 or visit our website at [www.simonspeakers.com](http://www.simonspeakers.com).

DESIGNED BY ERICH HOBGING

Manufactured in the United States of America

1 3 5 7 9 10 8 6 4 2

Library of Congress Cataloging-in-Publication Data

Nowak, M. A. (Martin A.)  
SuperCooperators : altruism, evolution, and why we need each other to succeed /  
Martin A. Nowak, Roger Highfield.  
p. cm.

Includes bibliographical references.

1. Game theory. 2. Evolution (Biology)—Mathematical models.
3. Cooperative societies. I. Highfield, Roger. II. Title.

QA269.N687 2011  
519.3—dc22 2010035517

ISBN 978-1-4391-0018-9  
ISBN 978-1-4391-1017-1 (ebook)

They found that players can behave altruistically to maintain the Earth's climate given the right set of circumstances. The first ingredient of cooperation was information. The students were more altruistic when provided with expert information describing the current state of knowledge in climate research. Furthermore, if players were allowed to make their contributions publicly instead of anonymously, personal investments in climate protection increased substantially. The reputation effect was surprisingly strong, according to Milinski. People really do like to be seen to do the right thing.

### THE CLIMATE GAME

In an elegant experiment, Milinski and his team came up with another insight into what motivates people to give the commons due respect. This time the game was conducted over ten rounds with six players to show how to deal with dangerous climate change. They organized the game to study whether a group can reach a collective target through individual sacrifices, when everybody is sure to suffer if they don't achieve their target.

This game scenario is most realistic if we allow levels of greenhouse gases to continue to rise at the current rate. Many of the extrapolations assume a smooth rise in the risk of mishap as levels of carbon dioxide rise. But there are some, such as the father of Gaia theory, James Lovelock, who have expressed concerns about abrupt change if the climate crosses certain thresholds and undergoes fast, irreversible transitions. For example, the deep circulation in the Atlantic Ocean could collapse, switching off the warmer currents that help keep winters mild in Britain.

In an extreme case of a climate flip, the temperature in northwestern Europe could fall up to 5 degrees Celsius. A version of this scenario was popularized in Roland Emmerich's film *The Day After Tomorrow*, where a change in ocean current circulation caused by global warming triggers snowstorms in New Delhi, tornadoes in Los Angeles, and ice sheets that move faster than a man can run. This is wildly over the top. In reality, such changes would occur over decades. Even so, by the stan-

dards of evolution and geologic history it is an eyeblink. Even if these climate lurches never come to pass, some societies are highly vulnerable to even modest levels of climate change. Poor nations and communities are particularly at risk of disruption, from major migrations to wars over precious resources, such as water.

Against this vivid backdrop of what losing the Climate game really means, all players start out with 40 euros in their private accounts. In each round, players can transfer 0, 2, or 4 euros into a "climate account." One can think of their investment as being equivalent to giving up flying, leaving the car at home to walk to the local grocery store, or abandoning other activities that drive climate change. Note that this particular Climate game is not identical to a classical public goods game but a variant on that theme with different rules. In the former, there is no incentive to give anything (as game theorists say, the Nash equilibrium is to give nothing). In Milinski's game, if everyone gives exactly 2 euros in each round then there is no incentive to deviate from this.

The players were told that after ten rounds the game would end and a computer would tally up the climate account. The team would win if the climate account contained at least 120 euros. That would mean, given there are six players, that each one had to contribute an average of 2 euros per round. If they did this, the money they'd contributed would be the equivalent of bringing carbon dioxide emissions to safe levels, and thus saving the world. As a bonus, each player received whatever is left in his private account, which works out at 20 euros. In the simplest variant of the game, losing means that nobody gets anything. They go home empty-handed. However, at least they have a home to go to. (If we lose the real climate game that may not be the case.) But, of course, they can invest nothing and hope others make up the shortfall. After each round, they would be told how much was invested, but if the tally suggested someone had not paid his fair share, no one would be able to figure out who had shortchanged the climate account.

To make the game easier to play, and to analyze, the players had three choices. Milinski classified the investments of 0, 2, or 4 euros as "selfish," "fair," and "altruistic." Stepping back from the game for a moment, it is easy to translate this into something relevant to the climate debate.

At the time—pre Barack Obama's more enlightened policy on climate change—that the paper came out, the United States would count as “free riders” who did the equivalent of contributing nothing, the United Kingdom played “fair,” and France and Sweden would be “altruists.”

So if all players always play fair, then the climate account will reach exactly 120 euros, the climate will be saved, and every player will keep 20 euros in his private account. Note that 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. This is an example of a Nash equilibrium, wherein players look for outcomes in which each player is making an optimal choice, given the choices the other players are making.

People, however, may not stick to the Nash solution. There is an incentive to contribute less and hope that others will, in turn, compensate. If one player invests 0 in one round and is a free rider, then another player must be altruistic and invest 4 for the total sum to stay on target. This aspect of the game adds a little twist: the free riders now have to rely on the altruists to save the climate. They think that by giving nothing they can force others to donate. But without the altruists, the free riders risk losing their money too. So we come to the conclusion that without altruists there is no incentive to free ride. Without saints, there are no sinners.

To take into account the uncertainties of real life—and there are indeed many when it comes to climate change, including “unknown unknowns”—the game came in three versions, where losing led to a 10, 50, and 90 percent chance of disaster. In the latter, if players failed to invest 120 euros overall, Milinski devised the game so that there could be a 90 percent chance that the climate is lost and thus a 90 percent chance that all the players lose all of their money—the money in the climate account and in their personal accounts too. That meant that there was a one in ten chance that the players could take their money home even if the climate account did not reach its target.

When the game was played by ten groups of six students with the 90 percent chance of disaster, half succeeded. Those groups who failed had accumulated 113 euros on average in their climate account after

ten rounds. Ironically, some of the groups came very close to the target but fell slightly short. Players tended to experiment with gamesmanship at first, so that the group loses more and more ground. By the final rounds, there's usually little they can do to recover from the deficit.

Here is a typical example of how the games played out. After eight rounds of one particular game, the climate account contained 90 euros. In the ninth round, to save the world, four of the six players contributed the maximum amount of 4 euros each. The two remaining players were free riders. In the final round, one of the free riders contributed 2 euros while the other remained stingy. Three of the altruists gave 2 euros each. They needed 14 euros but only came up with 8. It seems that the altruists felt that they had already contributed enough. The motives of the free riders were unclear. The final amount came to 114 euros. Everything was lost.

What happened when the link between playing the game and wrecking the planet was more remote? In one version there was a 50 percent chance that the climate would be lost if the target sum was not reached (where hanging on to your money pays out as well as the fair strategy). In the second version, designed to encourage even riskier behavior, there was only a 10 percent chance the world is doomed (when the rational strategy is to hang on to your 40 euros, since this pays out 36 euros over ten experiments compared with the fair strategy, which only yields 20).

What happened this time? Milinski found that only one of ten groups reached the target in the 50 percent version and not a single one of ten groups succeeded in saving the world in the 10 percent version. This outcome is not surprising because in both cases there is no rational incentive to invest in the climate account. In fact, it is astonishing that in these circumstances people invested any money at all in saving the world. Yet in the 50 percent and 10 percent treatments, people donated on average 92 euros and 73 euros, respectively. These investments may have been the consequence of a "framing effect"—participants were told that the game was about saving the climate and thus the world. The conclusion is heartening in one sense: people are willing to gamble for the climate. But the findings are depressing in another: unless they

fully realize the extent to which the planet is in peril, people will fail to do enough to save it.

## GAME THEORY CAN SAVE THE WORLD

Much effort has been invested in trying to work out how to protect commons. Elinor Ostrom, who is affiliated with Indiana and Arizona State universities, has looked at the role of sanctions in tending commons, whether fish stocks or pastures—what she calls common-pool resources, or CPRs. Based on real-world evidence she amassed on the management of common pools, she concluded more tolerable outcomes arise when users themselves devise rules and enforcement mechanisms. But she concluded that sanctions should be graduated, mild for a first violation and stricter as violations are repeated. Her pioneering insights into how to resolve conflicts led to her sharing the Nobel Prize in Economics in 2009.

In this chapter, we have shown an alternative to the use of punishment and sanctions. One fundamental conclusion drawn by Milinski and his team is that the public must be well informed about the risks of climate change. Ordinary people must have a reasonable understanding of what is going on with the global ecosystem. If the public is misled into thinking that the risk is small, then they will not cooperate. If people know that the risk is high, then they will be much more inclined to club together to curb climate change.

The role of scientists must be to provide honest, reliable information. If they embellish and inflate the risk, then there is a danger that they will lose the confidence of the public. To cry wolf can turn out to be as damaging as underplaying the risks. There are many who feel that the dangers of BSE (“mad cow” disease), AIDS, and swine flu were exaggerated (and, of course, there are many experts who rightly counter these arguments by pointing out that the death tolls would have been much worse if they had underplayed the risks). Like some other highly charged aspects of science, such as embryonic stem cell research, germ line gene therapy, and conservation, passionate advocates must

take care not to spin and distort, even if they mean to back a good cause. They must accept the results of good quality research and peer-reviewed studies, even if they undermine their beliefs. They must focus on the positive effects of climate change as much as the negative.

There is a related issue: public understanding of science. Many climate change predictions are couched in terms of risks and probabilities. They rest on making certain assumptions. When presenting this information to a public that is hazy about the difference between climate and weather, or finds it hard to work out a percentage, even a clear, carefully drafted message can be misinterpreted. There is evidence in Britain, for example, that careless presentation of seasonal forecasts harmed public confidence in the predictions.

Transmitting the message with high fidelity is crucial. As Hardin realized, although we must invent environmental solutions, from wind power to fusion energy, only behavioral solutions can save us in the long run. We must learn how to cooperate on a global scale, to respect the needs of others, and to avoid an excessively wasteful lifestyle, where everyone "just fires away," as Hardin put it. Today, we need to avoid a culture where everyone "just drives away."

One way that we can become more familiar with the Tragedy of the Commons is for us all to play the kinds of games devised by Milinski. Let's do it at company retreats, at schools, and in the home. Let's devise a fun version for the web. We all need to get the feel for being involved in a global-scaled "collective-risk social dilemma" and learn strategies for its solution.

Cynics may sneer at the prospect of applying the findings of idealized experiments to the real world. Admittedly, the scale of the real thing is daunting. The group playing this climate "game" consists of 7 billion individuals. The real climate game does not consist of rounds. No one knows how well we are doing when it comes to curbing carbon dioxide emissions. And, indeed, experiments conducted by Milinski on public goods games suggest that the more players there are, the harder it is to cooperate.

In this respect at least, there seems to be a ray of hope: all the big decisions are made by relatively small groups of politicians, such as



the G8 leaders, the heads of the Group of Eight forum, who represent the governments of eight nations of the northern hemisphere: Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States. Perhaps this small number improves our chance of cooperation. And because they are not relatively naïve biology students, but sophisticated well-advised politicians, perhaps the outlook is even rosier. Milinski has done experiments to investigate this theory, but alas, placing the fate of the Earth in the hands of a few politicians does not seem to make much difference. He explains: "The politicians lost out in our games because people wanted them to invest less than other politicians did for their countries. Those who invested their country's money to help rescue the climate lost their reputation within their country."

However, let's return to a point raised by the game that generated the advertisement. The players were more cooperative if their peers could see how generous they were. **It sounds glib, but reputation is a very powerful force. In fact, it is much more powerful force than many of us realize, one that has been harnessed across human societies for millennia.**

## THE POWER OF REPUTATION

*On each landing, opposite the lift-shaft, the poster with the enormous face gazed from the wall. It was one of those pictures which are so contrived that the eyes follow you about when you move. BIG BROTHER IS WATCHING YOU, the caption beneath it ran.*

—George Orwell, *Nineteen Eighty-Four*

Totem poles are monuments to the power of reputation. They are erected for various reasons, from the mortuary poles raised in honor of a person who has perished, to memorial poles that commemorate important occasions. Some of the decorations are recognizable, from frog to beaver, raven, wolf, bear, eagle, and human; others are more mysterious, varying hugely from family to family, clan to clan, and place to place in the Pacific Northwest of North America. The faces

on the poles can be dramatic, with open mouth and bared teeth. They are vigilant, with alert, black painted eyes that seem to miss nothing. The eyes are honed from cedar, yet so sensitive are we to the power of reputation that these wide eyes have an effect on us. The decision to paint eyes that seem to see members of a tribe exploits the fact that the more people know that they are being watched, the more charitable they become. Cooperation kindled by indirect reciprocity has led to an arms race when it comes to establishing one's own reputation and discerning the reputations of others.

No wonder that George Orwell's Big Brother, the dictator of Oceania, was always watching the citizens of the totalitarian state, or that religions contain the idea of an omnipresent God who "sees through everything." Or indeed that the symbol of moral pressure is the ever-watchful eye in heaven. For millennia, this link between behavior and being observed has been used by religions to make traditional societies more honest and fair. They remind us that our actions have consequences.

Just the thought that we are being observed is very persuasive. One can even think of conscience, our inner sense of right and wrong, as a gauge of how we will be viewed by others. Even two eyespots on a computer screen background are enough to boost generosity. Indeed, the electrical activity recorded emanating from the scalp of normal subjects has been shown to register more activity in response to isolated eyes than it does to full faces.

The effect was neatly illustrated by a little experiment carried out at Newcastle University, Newcastle upon Tyne in the UK. The common room in the university's psychology department had an "honesty box" in which fifty students, staff, and academics were asked to pay for tea, coffee, and milk. The system had been operating for many years, so users had no reason to suspect they were being used as guinea pigs in an experiment. Over ten weeks, the researchers placed a sign on the door of the cupboard where the honesty box sat above the kettle and coffeemaker.

Pictures of flowers alternated on a weekly basis with pictures of eyes—male or female, always looking directly at the observer. The expressions ranged from alert and watchful to manic. Every week the

money collected in the honesty box was counted up. On weeks when the eyes image was shown, takings were almost three times more than during the flower weeks. The eye pictures were probably influential because they made the coffee drinkers fret about what others would think of them. There's evidence that a robot with large, humanlike eyes can have the same effect. The eyes seem to make us more aware that if we advertise we are good, we improve our chances of being helped at some future date.

Manfred Milinski and the economist Bettina Rockenbach described the remarkable nested effects of gaze on the watcher and the watched: "Observer Alice should take into account that the behavior of Bob (the observed) changes and therefore should conceal her watching; Bob should be very alert to faint signals of being watched by Alice, but he should avoid any sign of having recognized Alice's watching when switching from selfish to altruistic behavior. He should avoid turning his gaze in the direction of the recognized observer. On the other hand, as soon as Alice sees that Bob has recognized that he is being observed, she should eventually not reward the observed altruistic behavior."

Examples of this observer effect can also be found in nature. Take, for example, the cleaner fish we encountered in chapter 1. The cleaner wrasse gets its dinner by plucking parasites off the bodies of its "client" fishes, even from inside the mouths. The fish grooms its clients in the friendliest way when other client fish watch, but without an audience it is sorely tempted to nibble off pieces of its client's skin. In a similar way, experiments reveal that in a so-called Dictator game, where a person has to give away money to another, the amount they share drops by 50 percent if the recipient is unable to identify the donor.

When people behave in a charitable way, it reveals much about the fact that their behavior has been honed down the generations by ancestors wanting to make a good impression whenever they find themselves in circumstances where they suspect they are being watched. This need to impress was felt as keenly in a close-knit hunter-gatherer clan as in today's surveillance society. As we are about to see, the knowledge that our behavior is being observed—or that it may be observed—could provide policy makers with new leverage to deal with climate change.

## HARNESSING REPUTATION

*Words have a longer life than deeds.*

—Pindar

A simple message has already emerged from my research on the Tragedy of the Commons. **Whenever individual behavior is relevant to the public good, it should itself be made public to help avert tragedy.** Advertising is critical. When playing a public goods game, others have to know that you are doing your bit for the world. Only then can an individual's regard for his or her own reputation be fully exploited.

With my colleague Thomas Pfeiffer I tried to flesh out some examples of what this would mean for the ultimate Tragedy of the Commons, climate change. We need new ways to advertise how people behave. Domestic appliances already carry energy ratings. This idea should be extended as broadly as possible. Energy costs of individual households could, for example, be published by local newspapers. Companies could be ranked according to their emissions and their investments in climate protection. In America, where gas guzzlers persisted long after Europe and Japan, where new technology allowed them to be replaced by more efficient engines, stickers could be used to mark out the polluting vehicles with pitiful efficiency.

The bottom line of our experience with automobiles is that it is not enough to develop clean technology, we have to encourage people to use it too, just as Hardin realized long ago. Certain cars could have mandatory stickers, similar to those used on cigarettes, such as **WARNING: THIS CAR IS HIGHLY INEFFICIENT; ITS EMISSIONS CONTRIBUTE TO LUNG CANCER AND HAZARDOUS CLIMATE CHANGE.** Exposing who on your block or in your office uses the most energy might be a good incentive for everyone to reduce their carbon footprint.

Although these types of policies could raise issues related to privacy rights, the potential gains for the environment could be great. In the summer of 2006 there was an extreme drought in my hometown and everyone was repeatedly asked to cut water consumption. It was no longer legal

to water our gardens. But then it emerged that thirty of the one thousand houses in my town consumed a significant fraction of all the water in the neighborhood. The local newspaper ran an article with the headline exposing the "thirsty thirty." The article read: "We know that five of the top 30 (and two of the top three) reside on Stratford Way. Two live on Weston Road, two on Sandy Pond Road, two on Tower Road and none live in North Lincoln. At least 6 of the top 10 have in-ground pools and one also has a whirlpool. Another has a hot tub but, alas, no pool. Most of the top 10 have either five or six full bathrooms plus at least two half bathrooms."

Many of the citizens of my town could figure out who the water hogs were. And if the water hogs realized this, I am sure that they made plans to cut their consumption accordingly. It struck me as an interesting example of how to make people cooperate. Knowing who uses what resources will allow those who contribute to reap reputational benefits, helping to compensate them for the costs they incur. When people publicly display their commitment to conservation, it is likely to increase the social pressure on free riders to do the right thing. A realignment of the internal compass of millions of individual minds can do much to augment government policies.

Many organizations are already becoming wise to this way of thinking. Hybrid cars such as the Toyota Prius have easily recognizable designs, which in effect advertise their driver's commitment to cleaner energy. Volunteers to environmental cleanup days receive T-shirts advertising their participation. In a scheme run by a local electricity company that was adopted by my colleague David Rand, if you chose to pay more to tap into electricity generated by alternative means, such as wind, you were given a "gone green" flag to plant in your garden.

Like it or not, billions of us are involved in the very real game of global warming. Even if we avert dangerous shifts in the global climate, we are still likely to face more extremes in climate and weather in the short term. Droughts, torrential downpours, heat waves, and floods are likely to occur more frequently. Sea levels will rise, along with the risk of extreme storm surges. Much more can and should be done to harness the power of reputation to encourage us to cooperate to avert dangerous climate change. This is one public goods game that none of us can afford to lose.