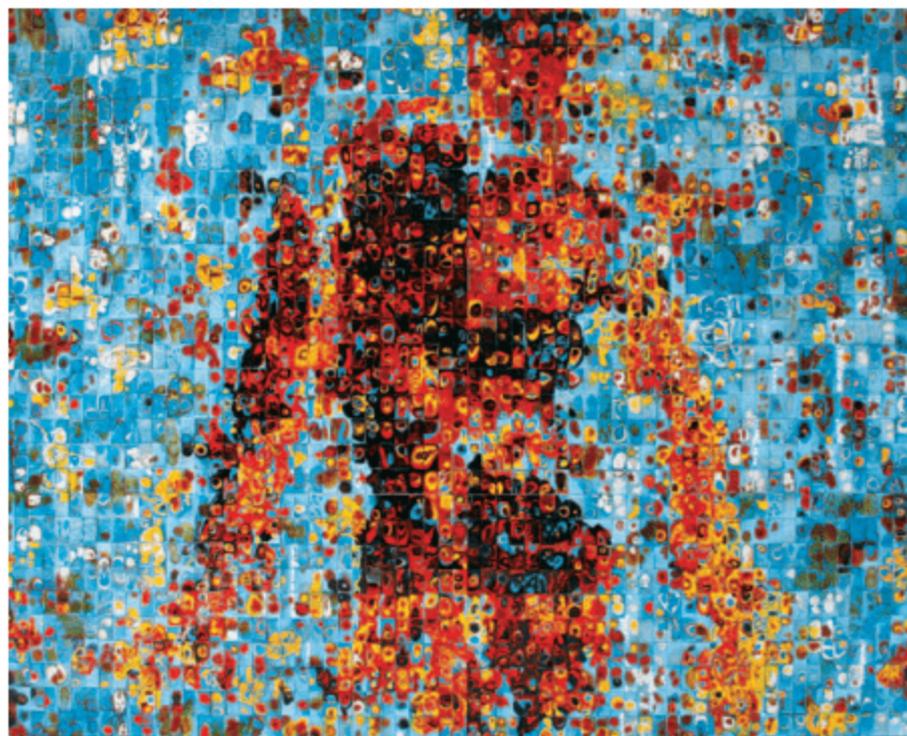


SPRING BOOKS

COURTESY OF THE ARTISTS AND JAVAY, SACRAMENTO, CALIFORNIA



Size Matters: Figure 2 (2007) by Ian Harvey and Koo Kyung Sook.

EXHIBITION

Size Matters

San Jose Institute of Contemporary Art,
California.
Until 18 June 2011.
www.sjica.org

This Spring Books special issue displays a selection of works from *Size Matters*, an exhibition featuring ten North American artists who address ideas of size and scale. The works view the world from unusual perspectives, from Ian Harvey and Koo Kyung Sook's wall-sized enamel and shellac mosaics of human figures to the miniscule sculptures of Dalton Ghetti, carved from the graphite points of pencils. Expressed in a range of media, including photographs, paintings and video, the works comment on biological building blocks, knowledge, emotions and the environment.

BIOLOGY

A revolution in evolution

Manfred Milinski enjoys Martin Nowak's paean to the power of cooperation to shape animal and human societies.

Leading evolutionary theorist Martin Nowak sees cooperation as the master architect of evolution. He believes that next to mutation and selection, cooperation is the driving force at every level, from the primordial soup to cells, organisms, societies and even galaxies. Without cooperation, he says, our predecessors would still be RNA molecules. He sets out his groundbreaking ideas in *SuperCooperators*.

Co-authored with science journalist and editor of *New Scientist* Roger Highfield, *SuperCooperators* is part autobiography, part textbook, and reads like a best-selling novel. Nowak celebrates his oeuvre on the evolution of cooperation and challenges the mathematical basis for theories of kin selection and punishment. He is correct that this

part of evolutionary theory needs revisiting, but it is too soon to tell whether his bold ideas will hold up to empirical testing.

Game theory is central to Nowak's work and the book highlights five ways to work together for mutual benefit: direct reciprocity, indirect reciprocity, spatial games, group or multilevel selection and kin selection. Direct reciprocity is the tit-for-tat exchange of resources, which may be generous but is open to exploitation. Nowak believes that indirect reciprocity, where I help you and

➔ **For another book review on cooperation, see:**

someone else helps me, is the most important mechanism driving human sociality. It enforces the power of reputation, gained



SuperCooperators: Altruism, Evolution, and Why We Need Each Other to Succeed
MARTIN A. NOWAK WITH ROGER HIGHFIELD
Free Press: 2011.
352 pp. \$27

by helping or refusing help, which is spread through gossip, thus selecting in evolutionary terms for sophisticated language. "Indirect reciprocity is the midwife of language and of our big, powerful brain," he says.

Cooperators can prevail through exchanges that are played out across and between networks and clusters of individuals, he explains. Multilevel or group selection follows among

communities that are small, numerous and isolated; mediated for example by tribal wars for resources. However, the migration of individuals between groups can undermine cooperation — egoists might take over pure altruist groups. *SuperCooperators* notes that there is plenty of evidence for group selection at the cellular level, such as strains of the bacterium *Pseudomonas fluorescens* that collectively produce a mat of polymer that allows the group to float on liquid surfaces.

More contentious is Nowak's approach to kin selection, or nepotism, in which individuals cooperate to ensure the success of genetic relatives in preference to strangers. Nowak set out his objections to this theory last year in a controversial *Nature* paper, co-authored with Corina Tarnita and Edward O. Wilson (*Nature* 466, 1057–1062; 2010). They question the theoretical basis of kin selection, or inclusive fitness theory: one of the cornerstones of the evolution of social behaviour.

Nowak and Highfield defend this view in *SuperCooperators*. After reviewing the history of evolutionary ideas about kin selection, including the lives of pioneering evolutionary theorists Bill Hamilton, George Price, John Maynard Smith and J. B. S. Haldane, Nowak criticizes key equations and calls them a recipe for disaster. He argues that the predictions of Hamilton's rule, which quantifies whether or not a gene for altruistic behaviour towards relatives will spread in a population, almost never hold. And he decries Price's fundamental equation, on which current inclusive fitness theory is based, as the mathematical equivalent of tautology.

In place of inclusive fitness theory, Nowak sketches a new model for the evolution of sociality, in which relatedness, he says, is a consequence rather than the cause of social behaviour. By assuming only one mutation — one that causes offspring to stay in the nest rather than leave — he claims to explain why progeny happen to be around to help their related mother. This model implies that offspring would help any unrelated elder in whose nest they were born, irrespective of a genetic link, and it does not explain why parents insist on caring for their own offspring rather than others. Here, in my view, relatedness is essential. Many experimental results support this, such as the sex ratios in colonies of different ant species.

In ant species in which the queen mates only once, for example, a preponderance of female reproductive offspring benefits the workers more than it does the queen: the non-reproductive workers support their mother to produce sisters, to which they are more closely related (75%) than is the queen (50%), thus more effectively perpetuating their genes than if they raised their own offspring. By contrast, in slave-maker ants, in which workers are stolen from other species and are therefore unrelated,



Size Matters: Detail from Figure 2 (2007) by Ian Harvey and Koo Kyung Sook.

the queen manipulates them to produce an equal sex ratio in her offspring for her own benefit. I anticipate that a better mathematical formulation of social evolution theory will be found that includes relatedness, is compatible with existing evidence and includes Hamilton's rule as a rule of thumb. Nowak himself states that "kin selection is a valid mechanism if properly formulated".

In another assault on established views, Nowak strongly disputes the effectiveness

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of punishment as a method for promoting cooperation. Here he splits from his erstwhile colleague, game theorist Karl Sigmund, who accepts that the stick can be as useful as the carrot. Nowak, the theorist, describes how he performed experiments. In a version of the prisoner's dilemma game — in which two isolated players may choose to cooperate and both benefit, or one defects and receives a greater reward, being eventually punished by the other — he showed that those who do not punish gain most. No one has yet showed that punishers can gain from punishing, so it is not clear why punishing exists.

Nowak performed another experiment that, alas, failed to prove that reward rather than punishment promotes public cooperation. Clearly, the jury is still out on this question.

SuperCooperators is also Nowak's autobiography. After attending an all-boys school, he relates how he met his wife on his first female-dominated pharmacology course. And he recounts moments shared with his supporters: mountain climbing with chemist Peter Schuster; walking through the ancient forests of Austria's Rauriser Urwald with Karl Sigmund; playing soccer with theoretical ecologist Bob May; or dining on a Caribbean beachfront with Jeffrey Epstein, the Wall Street tycoon who funded Harvard University's Program for Evolutionary Dynamics, of which Nowak is director.

Nowak finishes with his concern for our planet, and of how Mahler's symphony *Das Lied von der Erde* (The Song of the Earth) carries a deep resonance for him. He worries about the climate game that everyone is now playing. "I believe that climate change will force us to enter a new chapter of cooperation," he writes, but his research does not provide a recipe.

A pleasure to read, *SuperCooperators* offers an explanation of the evolution of cooperation and shows where the experts disagree. Yet Nowak's faith in cooperation is so great that he believes his approach holds for "any and every game in the cosmos" — for all evolutionary processes on Earth, in our Galaxy and others, in "agglomerations of ancient stars that lurk in the faintest, farthest reaches." We will see. ■

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