Like members of human societies, genes "cooperate" and "compete" to promote survival.

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BOOKS *et al.*

GENOMICS

# *The social gene*

## Advances in genetic research prompt a pair of scientists to update the "selfish gene" metaphor

*By* **Joseph Swift**

Genetic research has moved rapidly since the publication of Richard Dawkins's *The Selfish Gene* 40 years ago (*1*). In the intervening years, we have come to realize that many of the most interesting and important phenomena in human biology are not caused by any single gene. Processes like the immune system's ability to recognize infection, or the timing of our sleep-wake cycle, for example, are the product of many genes working together in a highly integrated way. Citing a wealth of recent research that explores the ways genes work together to produce complex biological processes, Itai Yanai and Martin Lercher argue that it is time to embrace a new, more holistic, metaphor in their book, *The Society of Genes*.

"Genes do indeed behave in ways that can be described as selfish," they concede. "But genes, like humans, do not live in isolation." It is therefore useful to think about our genes as members of a society in which different genes play specific roles.

Rather than focus on any one gene, Yanai and Lercher invite the reader to step back and observe how genes assemble together to make a global genetic system, or genome. From here, one can see that the labor within the genome is not divided equally. Whereas many genes encode for proteins that perform a single monotonous task, such as breaking down a certain type of sugar or producing a specific skin pigment, there are others that serve such fundamental roles that their removal would lead to the crumbling of the genomic society altogether. Among the latter group are genes that manage the behavior of a host of other genes.

When genes are mismanaged by their masters, organisms can be transformed in dramatic ways. For example, in humans, when *SOX9* fails to direct its wide range of subordinates succinctly, sex reversal and skeletal malformations can occur.

Given that catastrophic things tend to happen when genes don't work together properly, changes to how the genomic society is run are a rare occurrence. When genes with new abilities evolve, Darwinian selection determines whether they will join the ranks as productive members of society. Our ancestors obtained genes that could interpret light as color and a gene for a more efficient oxygen-carrying hemoglobin in this very way.

And then there are the genes that don't contribute to society at all. Instead, they secure their position by hijacking the system. The *LINE1* gene, for example, encodes only for its own dispersal, copying and pasting itself throughout our genome while providing the society with no clear benefit. The "bad behavior" of genes amounts to scandal in the genomic society, and learning about their exploits is one of the most enjoyable elements of reading the book.

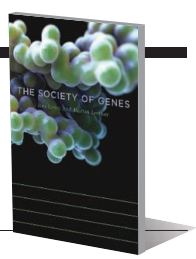
There are even genes that work to ensure the survival of individual cells within an organism by wreaking havoc on others. In fruit flies, for example, a pair of genes involved in sperm production work in concert to produce both a poison and its antidote. The toxic compound is released from the cell, while the antidote is retained. In this way, surrounding sperm cells without the gene pair are killed. On reading about such systems, one begins to realize that it's not quite right to imagine our genome as some idealized republic. This is a society that is easily compromised from within its own ranks.

Despite the genome's complexity, the authors are careful to keep the text accessible. Indeed, at times the reader may be reminded of those rare high-school teachers who could reveal the simple beauty hidden within abstract scientific theories.

The book's greatest strength is its remarkable use of metaphor. However, at times, the comparisons confuse rather than clarify. There must be a simpler way to explain retina biology than to compare it to both the structure of an Israeli kibbutz and the design of a color television, for example. But this is a minor shortcoming for a work that largely succeeds in translating the findings of an esoteric science into something that is easily understood.

In the years since *The Selfish Gene* was published, the human genome has been sequenced, along with the genomes of many other species. Indeed, probing one's own genes is beginning to become routine. Thus, *The Society of Genes* represents a timely and welcome handbook for navigating this post-genomic era.

**The Society of Genes**
*Itai Yanai and Martin Lercher*
Harvard University Press, 2016. 294 pp.

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### REFERENCES

1. R. Dawkins. *The Selfish Gene* (Oxford Univ. Press, Oxford, 2016).

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