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SOME ANALOGIES OF HIERARCHICAL ORDER
IN BIOLOGY AND LINGUISTICS*

Martin Zwick
Systems Science Ph.D. Program, Portland State University
Portland, Oregon
Zwickm@pdx.edu
http://www.sysc.pdx.edu/Faculty/Zwick

I. INTRODUCTION

The ubiquity of hierarchical order is obvious, and the obvious is hard to explain, but a number of
workers [1] have suggested the possibility of constructing a theory (or cluster of theories), rooted
in such disciplines as thermodynamics, information theory, topology, and logic, which might
reveal the underlying unity of a wide variety of branching and multi-level systems. It is the
purpose of this paper to contribute to both the empirical and theoretical aspects of this
discussion, by examining levels of structure and function in molecular biology and linguistics,
and by developing, from parallelisms between these two areas, a hierarchical model of possibly
greater generality.

We consider first the hierarchy of spoken language [2]: phoneme, morpheme, word, sentence,
utterance, discourse; or of written language: letter, syllable, word, sentence, paragraph, section,
chapter, book. These lists are straightforward up to and including the "sentence," beyond which
they are somewhat arbitrary. The items "utterance," "paragraph," etc., are meant only to
Holism and Human History

There is something within us...that demands we pursue the whole story of the whole cosmos if we are to be whole persons, in order to know who we are, where we are from, where we are going, and how we should live.

1. A story of 'culture'

July 19, 2009

By Martin Zwick
Research: Systems Philosophy

Themes

- Systems theory and philosophy
- Philosophy of science
- Science-religion dialog
- Systems ideas and sustainability

Papers

Unifying the Theories of Inclusive Fitness and Reciprocal Altruism

Jeffrey A. Fletcher and Martin Zwick

1. Department of Zoology, University of British Columbia, 6270 University Boulevard, Vancouver, British Columbia V6T 1Z4, Canada.
2. Systems Science PhD Program, Portland State University, Portland, Oregon 97207

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Online enhancement: appendix

Abstract: Inclusive fitness and reciprocal altruism are widely thought to be distinct explanations for how altruism evolves. Here we show that they rely on the same underlying mechanism. We demonstrate this commonality by applying Hamilton's rule, normally more than 40 years ago, Hamilton developed an explanation for the evolution of altruism among relatives based on the idea of inclusive fitness (Hamilton 1963, 1964, 1970, 1972, 1975). His most famous result, known as Hamilton's rule (HR), is usually interpreted as specifying the conditions under which the indirect fitness of altruists (due to helping relatives have more offspring) sufficiently counterbalances the immediate self-sacrifice of altruists. In this way, the altruistic trait can increase overall. This mechanism is also known as kin selection (Maynard Smith 1964).

Twenty-five years ago, Axelrod and Hamilton (1981) launched a still vigorous area of research (for reviews, see Dugatkin 1997; Sachs et al. 2004; Doebeli and Hauert 2005) in which computer-based models of the iterated prisoner's dilemma (IPD) are used to study the evolution of cooperation via reciprocal altruism (Trivers 1971). In
Jeff Fletcher: Research

Research Interests

My research focuses on evolution theory—especially theories of altruism evolution (inclusive fitness, multilevel selection theory, reciprocal altruism) and how these theories relate to each other. I am also interested in how general theories (that apply to systems across many disciplines) such as game theory, information theory, chaos theory, and theories of "complexity" can be used in novel ways to investigate problems in evolutionary biology. My methods focus on evolutionary simulations and analytical models, as well as some empirical work on neotropical social spiders. My use of models has led me to think more deeply about the role models play in the scientific method and how this role is not well defined (e.g., in comparison to the role of empirical experiments). Finally, I am intrigued by the intersection between scientific and social understandings, both in how social forces influence the course of scientific advancement and in how scientific understanding is applied (or misapplied) to social problems.

Publications


One of the Top Cited Proceedings of the Royal Society B Articles for 2009

Research: Artificial Life and Theoretical Biology

Projects

Evolution of cooperation
(Fletcher, Zwick)

Structure and dynamics in cellular automata & random networks
(Zwick)

Evolutionary simulations
(Redau, Fletcher, Zwick)

Genetic algorithms
(Shervais, Zwick)

Random Boolean networks: reverse engineering, combinatorics, ensemble sampling
(Myers)

Papers

8. BEING ALTRUISM
7. Life altruism
6. Sentience altruism
5. Species altruism
4. GROUP ALTRUISM
3. INTERACTION-BASED ALTRUISM
2. KIN ALTRUISM
1. SELF-INTEREST

(Predominantly)
cultural realm
(top-down)

(Predominantly)
biological realm
(bottom-up)