Evolution, Cooperation, and Multilevel Selection

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Sept 23 2015

Our menu for today

- Multi-Level Selection

--A simple idea with a complex history.

- Biological applications

--Water striders

--Animal and plant breeding

--Human health (cancer, infectious diseases, microbiomes)

- Human social applications

--Core design principles

--Scale-independent

--A practical framework for improving the efficacy of groups

Multi Level Selection

A simple idea with a complex history

MLS theory is based on three assumptions

1) Natural selection is based on relative fitness.

2) Traits that are "for the good of the group" typically do not maximize relative fitness within the group.

3) For these traits to evolve, there must be a process of selection among groups in a multi-group population.

"Selfishness beats altruism within groups. Altruistic groups beat selfish groups. Everything else is commentary."

--D.S. Wilson and E.O. Wilson (2007). Rethinking the Theoretical Foundation of Sociobiology. Quarterly Review of Biology. 82: 327-348.

A nested set of relative fitness comparisons in a multi-tier hierarchy

- **Among genes within organisms.**
- **Among organisms within groups.**
- **Among groups within a multi-group population.**
- **Among ecosystems within a multi-ecosystem population**

The general rule: Selection at any given level requires a process of selection *at that level* and tends to be *undermined* by selection at lower-levels.

In human terms…

- **What's good for me can be bad for my family.**
- **What's good for my family can be bad for my clan.**
- **What's good for my clan can be bad for my nation.**
- **What's good for my nation can be bad for the planet.**

The complicated history…

- In the 1960's, a consensus formed that higher-level selection is possible in principle but is almost always weak compared to lower-level selection.
- Other theories developed to explain the evolution of altruism

--Kin selection (=inclusive fitness theory)

--Reciprocity (=evolutionary game theory)

--Selfish gene theory

- All of these were later shown to include the logic of MLS theory within their own frameworks.

--They all assume the existence of multiple groups.

--The traits labeled altruistic or cooperative are selectively disadvantageous within groups.

--Require between-group selection to evolve.

Equivalence

- "In earlier debates, biologists tended to regard kin and multilevel selection as rival empirical hypotheses, but many contemporary biologists regard them as ultimately equivalent, on the grounds that gene frequency change can be correctly computed using either approach. Although dissenters from this equivalence claim can be found, the majority of social evolutionists appear to endorse it (p 28)."

--Birch, J., & Okasha, S. (2014). Kin Selection and Its Critics. *BioScience, 65(1), 22–32*

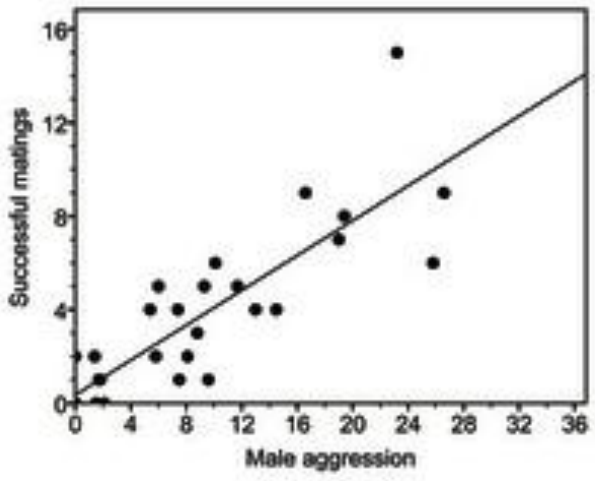
Individual Differences in Male Sexual Strategies

Omar Eldakar

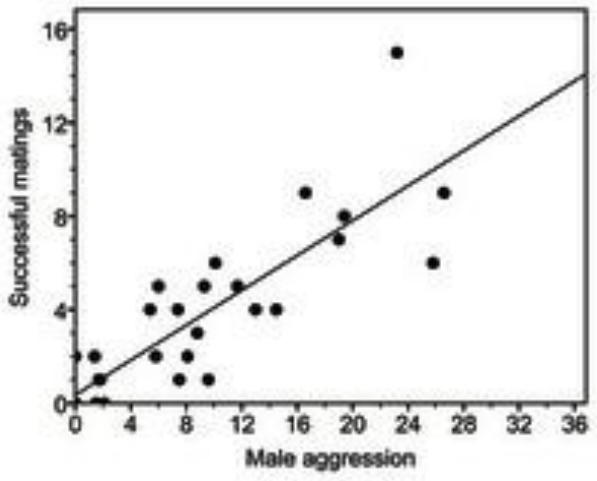
Psychopaths and Gentlemen

- Males differ enormously in their aggressiveness toward females.
- Individual differences stable.
- Why do they coexist?
- Experimental pools with 6 males, 6 females
- Composition of males varies from 100%, 66%,33%, 0% aggressive.

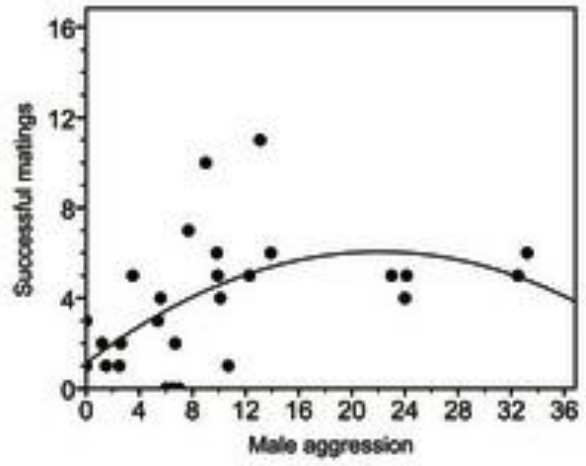
Psychopaths have the relative fitness advantage within groups



Psychopaths have the relative fitness advantage within groups



But groups with gentlemen are three times more productive than groups with psychopaths. Females run away from psychopaths and cluster around gentlemen, providing a group-level advantage.



Featured in Science Magazine ☺

Artificial selection for egg productivity in hens

In both experiments hens are housed in multiple groups (cages).

- Experiment 1: Select the best egg-layer within each group.
- Experiment 2: Select the best group of egg-layers in a population of groups.

Within-group selection

Between-group selection

“That first experiment describes my department! I have names for those three chickens!”

--Professor to me, after a lecture

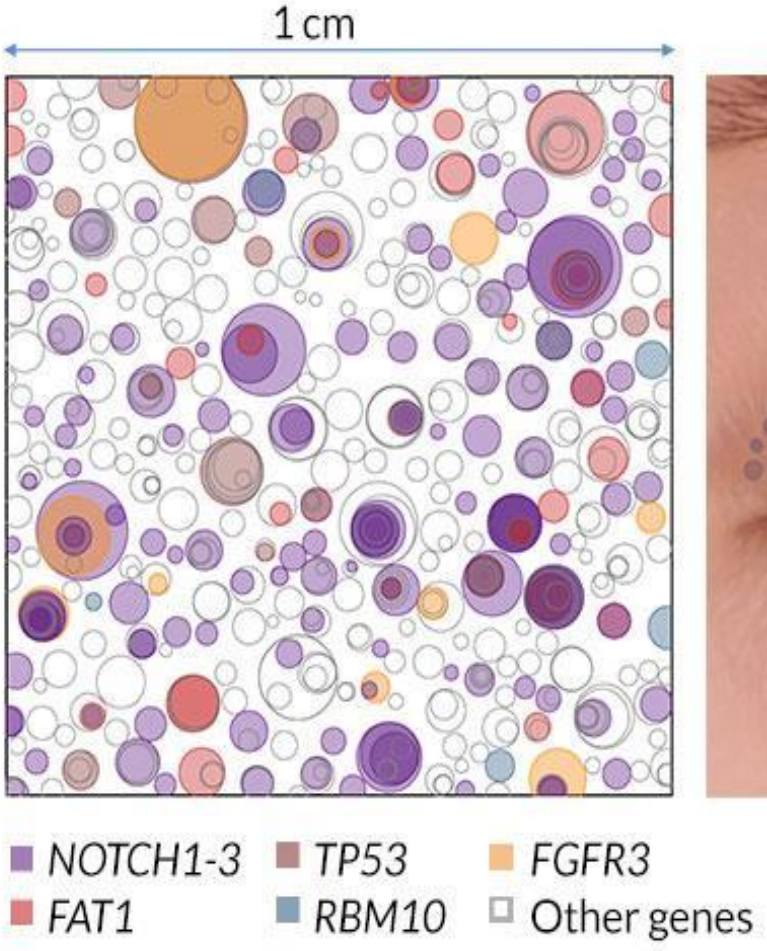
Cancer

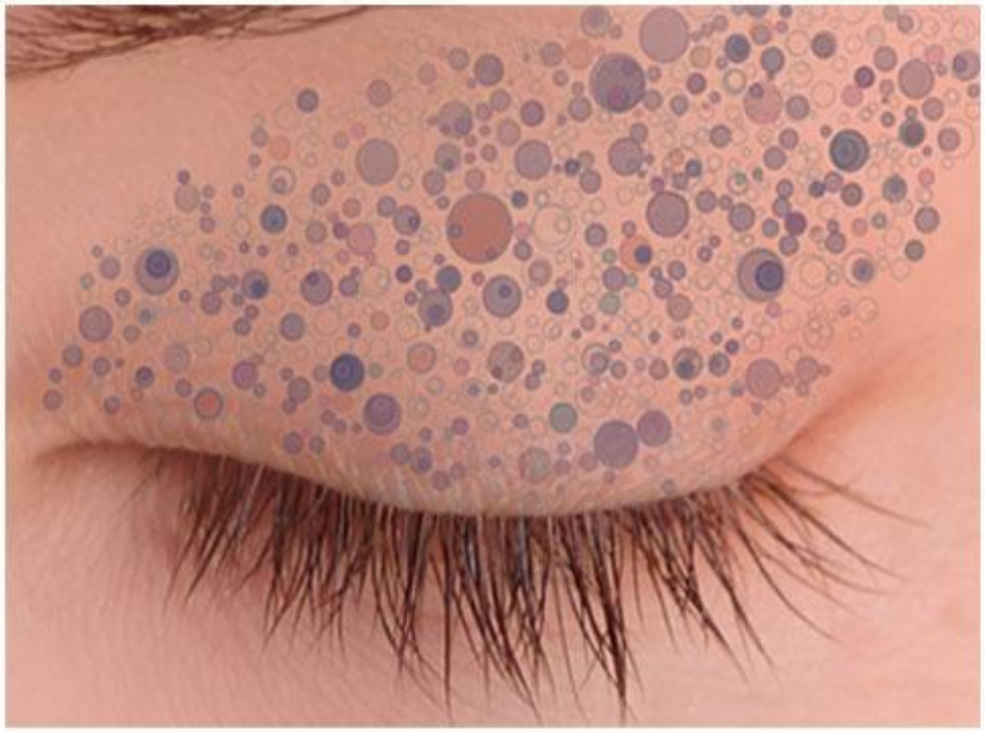
- The cells of a multi-cellular organism start out identical…
- …but mutations occur with every cell division.
- Within-organism selection favors cells that proliferate compared to neighboring cells (neoplasms & cancers).
- Evolution has no foresight. Consequences for the whole organism are irrelevant.
- Every cancer is a unique evolutionary event.
- Defenses against cancer evolve by between-organism selection.

Pepper, J., Findlay, S. C., Kassen, R., Spencer, S., & Maley, C. (2009). Cancer research meets evolutionary biology. Evolutionary Applications, 2, 62–70.

Horne, S. D., Pollick, S. A., & Heng, H. H. Q. (2015). Evolutionary mechanism unifies the hallmarks of cancer. International Journal of Cancer. Journal International Du Cancer, 136(9), 2012–21. http://doi.org/10.1002/ijc.29031

Neoplasms in normal middle-aged humans





Infectious diseases, microbiomes, & more…

- All of these reflect two levels of selection.

--Among species and strains within the organism

--Among organisms.

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Human Social Groups

- Elinor Ostrom received Nobel prize in economics in 2009.
- Studied groups that manage common-pool resources such as forests, fields, fisheries, and irrigation systems.
- She showed that these groups are capable of managing their affairs if they possess **certain core design principles**.

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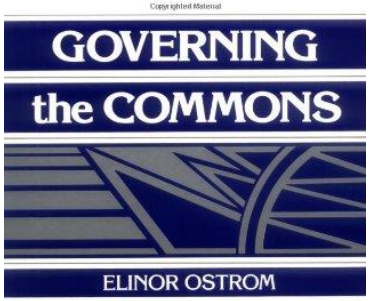

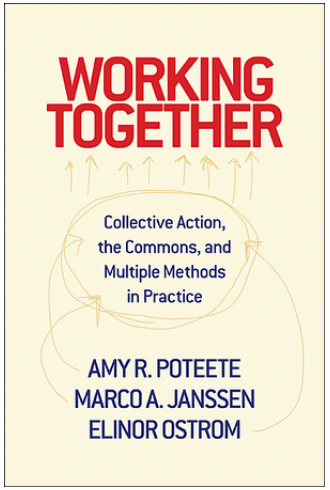

Generalizing the Core Design Principles

- Wilson, D. S., Ostrom, E., & Cox, M. E. (2013). **Generalizing the core design principles for the efficacy of groups**. *Journal of Economic Behavior & Organization*, *90*, S21–S32.

Volume 80, Issue 2,
October 2011

80(2) 265–374
(2011)

ISSN 0167-2681

JOURNAL OF Economic Behavior & Organization

Special Issue on the work of James Buchanan

Guest Editor: Peter Boettke

CONTENTS

www.elsevier.com/locate/jebo

Making Groups Work

All groups whose members are trying to work together to achieve common goals are faced with a common set of problems.

- Coordinate appropriate action for the task at hand.
- Suppress disruptive self-serving behaviors within the group.
- Avoid interference and cultivate appropriate relations with other groups.

This is true **for all social species**, not just humans.

Core Design Principles for the Efficacy of Groups

1) Strong group identity and purpose
2) Proportional equivalence of costs and benefits
3) Consensus decision making
4) Monitoring
5) Graduated sanctions
6) Fast, fair conflict resolution
7) Local autonomy
8) Polycentric governance among groups

Some observations

- The core design principles are intuitive.
- Some groups adopt them without requiring coaching.
- Some change methods have converged upon them.
- Yet, they are sadly lacking from many groups and change methods.

Why don't more groups employ the design principles?

- Conflicts of interest within the group.
- Conflicts of interest in the multi-group environment.
- Competing narratives.
- The idea that unregulated individual and corporate self-interest robustly benefits the common good is fundamentally at odds with MLS theory.
- There is a legitimate concept of the invisible hand that follows from MLS theory, but it is very different than the received version.

Wilson, D. S., & Gowdy, J. M. (2014). Human ultrasociality and the invisible hand: foundational developments in evolutionary science alter a foundational concept in economics. Journal of Bioeconomics, 17(1), 37–52.

How General are the Core Design Principles?

- Neighborhoods
- Schools
- Businesses
- Churches
- Intentional Communities

Neighborhood Park as Common-pool Resource

The School Social Environment

1) Strong group identity and purpose
2) Proportional equivalence of costs and benefits
3) Consensus decision making
4) Monitoring
5) Graduated sanctions
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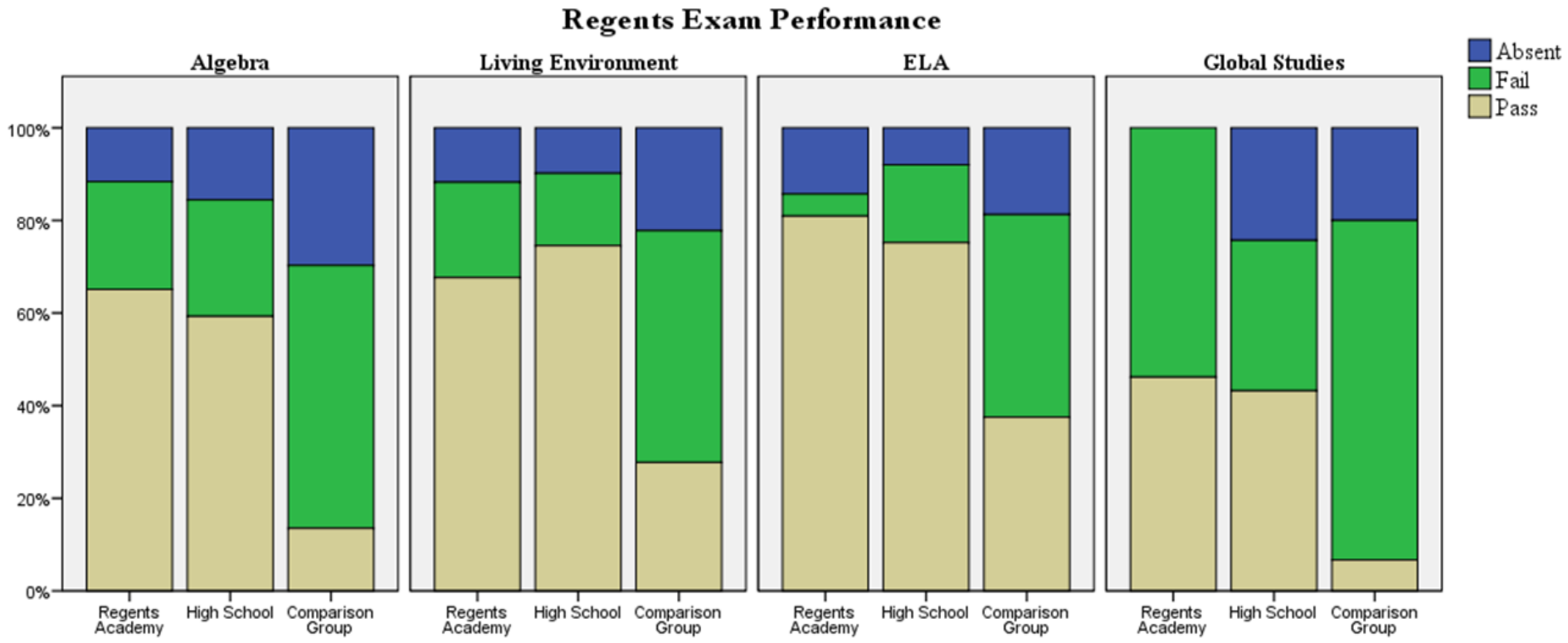
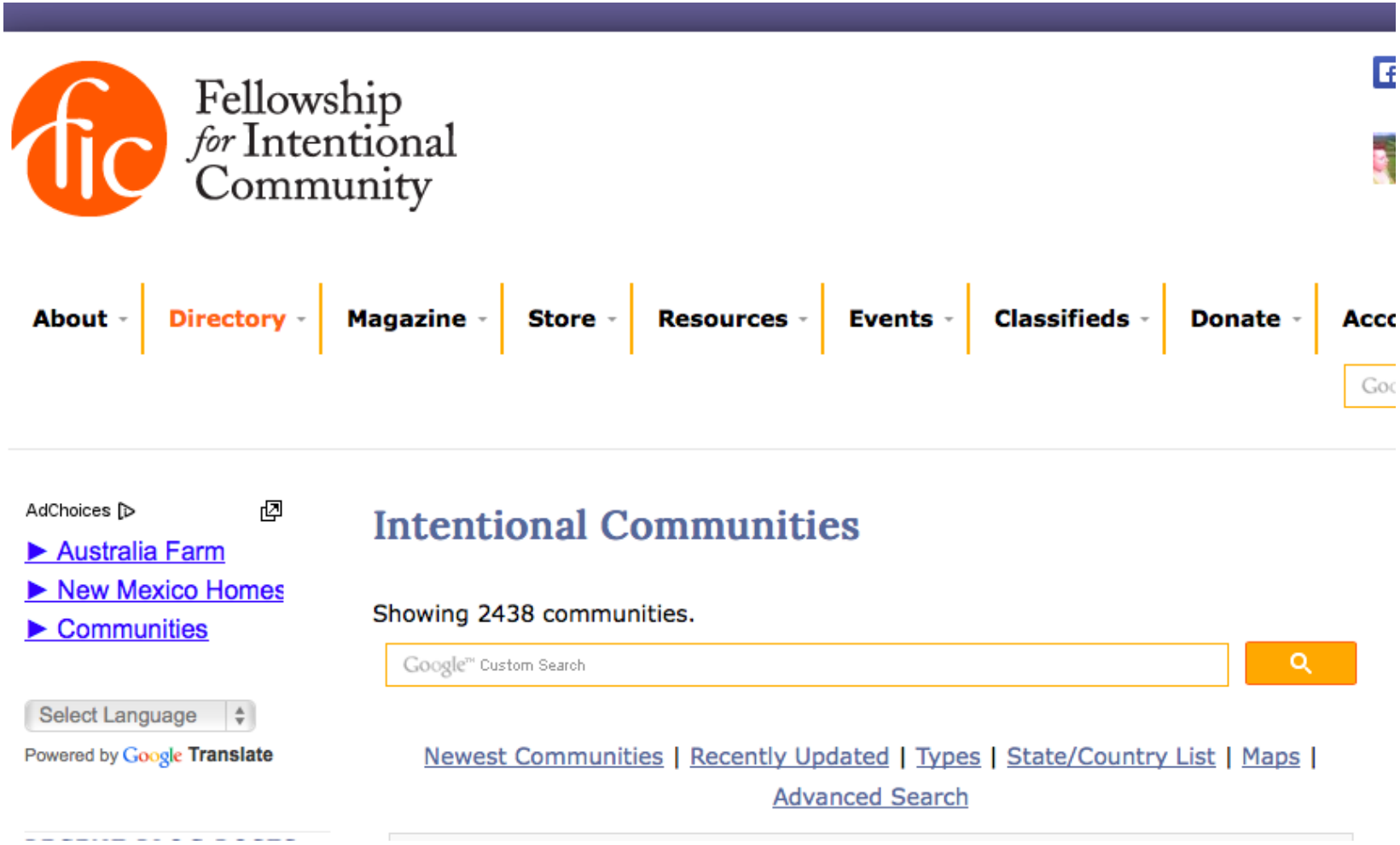
8) Polycentric governance among groups

State Mandated Exams



Benefit Corporations

Intentional Communities



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IN THIS FOCUS ARTICLE

Blueprint for the Global Village

- All social units require the core design principles, no matter what their size.
- The design principles are easiest to implement in small groups.
- Work is required to implement them in large groups.
- Even Norway can turn selfish at the largest scale.

Interim Summary

- Design Principles Approach provides a blueprint for improving the efficacy of groups.
- Strong theoretical foundation.
- Accumulating empirical support.
- Relevant to nearly any group whose members must work together to achieve common goals.

The Next Challenge

- To make the design principles approach available to as many groups as possible worldwide.
- To create a scientific database from these groups to further improve our knowledge of group efficacy.

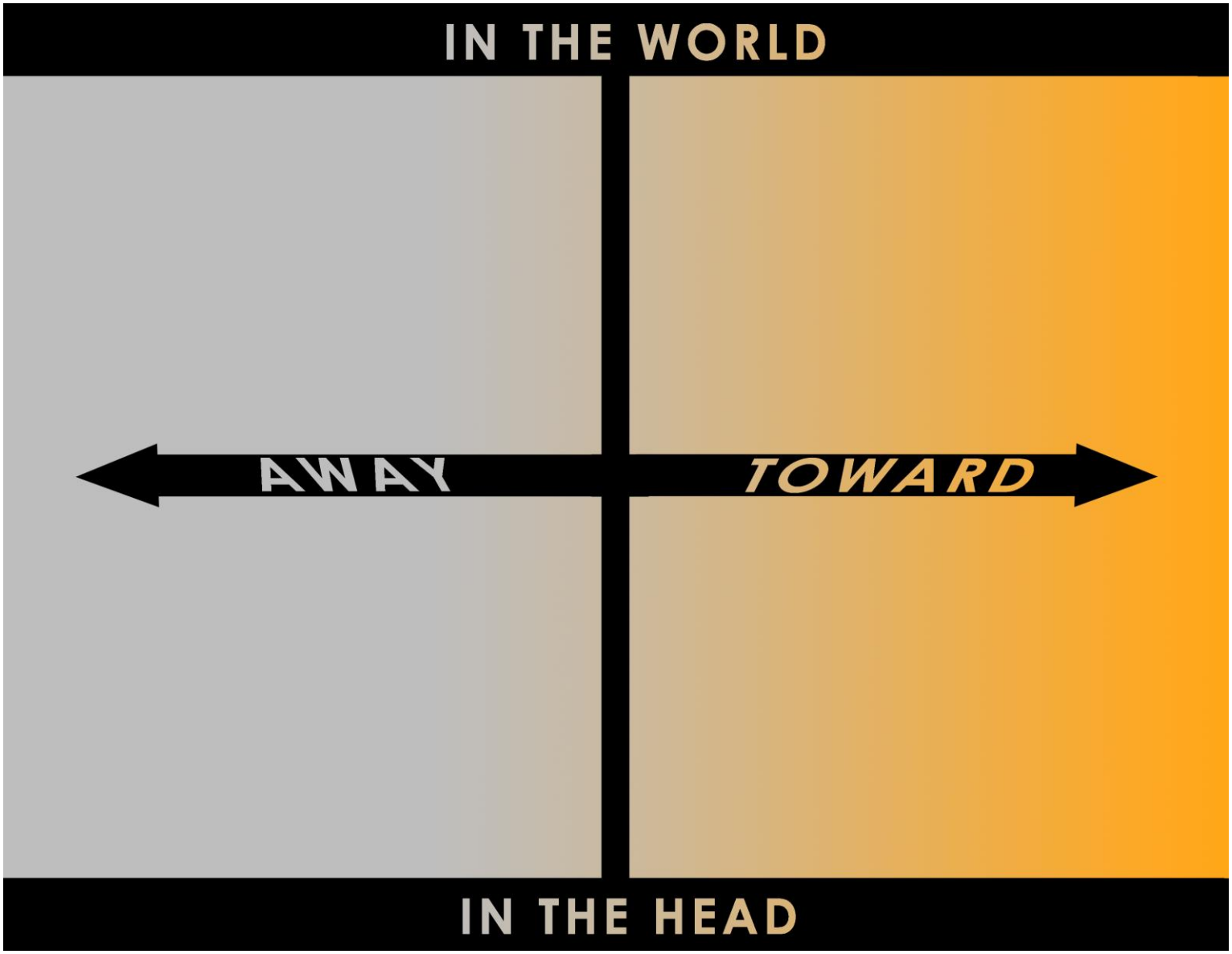
PROSOCIAL

- A practical framework for improving the efficacy of groups.
- A scientific database.
- An internet platform and network of facilitators that can potentially reach an unlimited number of groups.

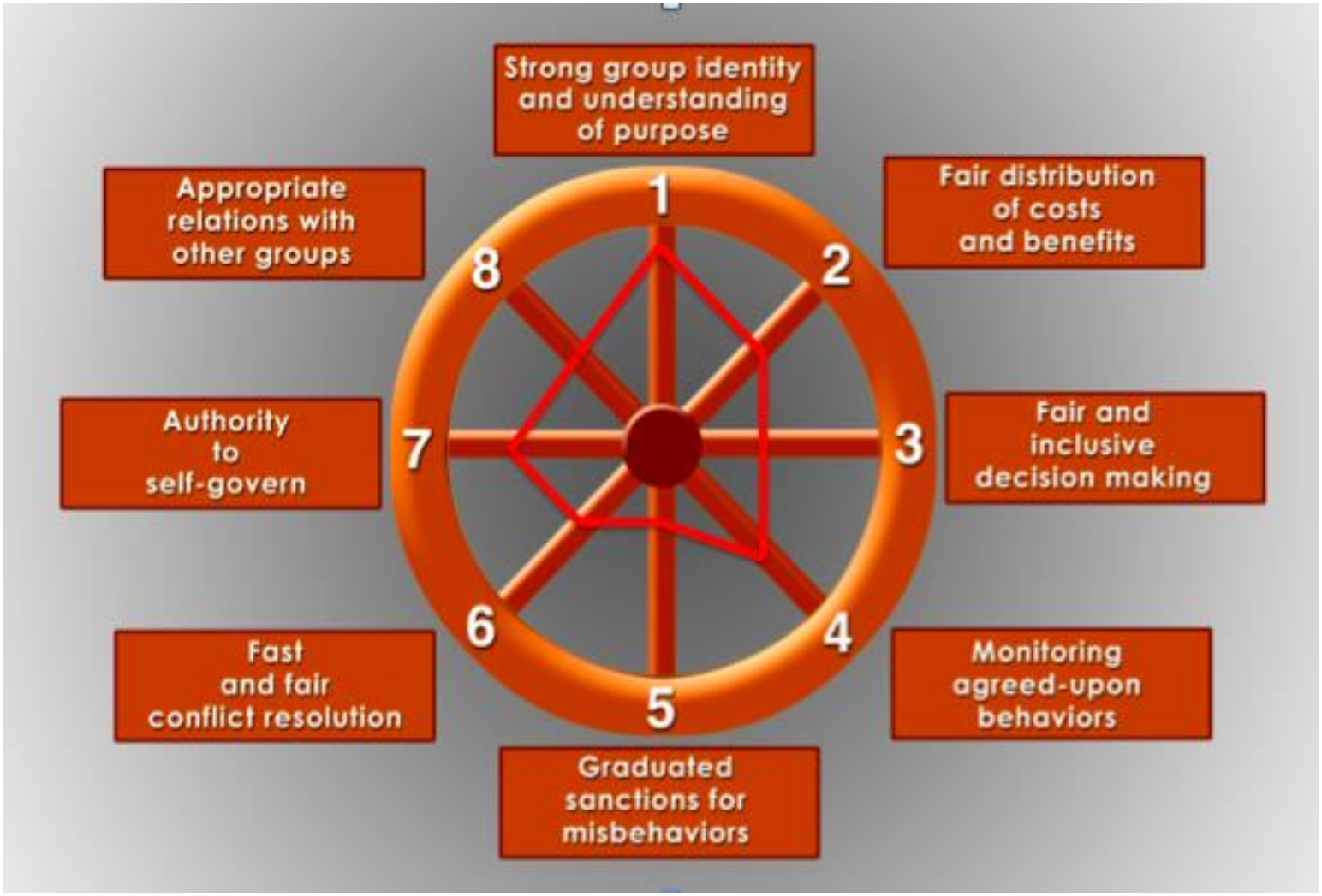
How PROSOCIAL works

- Formatted as an online course that members of a group take together.
- 30-90 minutes required for each “lesson”
- Each “lesson” completed during a comfortable period of time set by the group (e.g., 3 days).
- Entire course completed in app. 4 weeks.
- Reflect upon purpose and values of the group.
- Evaluate the group with respect to the core design principles.
- Create short-term actionable goals.
- After “graduation”, each group is provided a homepage to facilitate their interactions and to communicate with other groups.

Increasing Psychological Flexibility



Visualizing What Needs to be Done



Formulating Short Term Goals

- Short term goals should be feasible and quantifiable.
- Entire process repeated at periodic intervals.

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