

Belief Evolution in Heterogeneous Populations

Ricardo Moll, Sevan Ficici, Kobi Gal, Whitman Richards



The Goal

Model the evolution of conflict between culturally distinct populations that differ in their conventions (e.g., cultural, legal etc...)

Questions of interest

- How do populations mediate their actions with others whose conventions conflict with their own.
- How do populations of varying size and preferences evolve over time.
- How should an exogenous force intervene to encourage or force desired outcome.



Running Example

Driving rules for new country.

- Drive on left or right

New immigrants

- prefer to drive on the side that is common to their home country.
- prefer not to crash with other drivers.



Coordination Game

Groups G_1 and G_2 have different preferences structures.

Distinction between

- preference (convention)
- strategy (what to do given agent's preferences and other's actions)

In this model there are four types of populations (e.g., those that prefer to drive on the left, but drive on the right)

G_1 (right-side preference)

a1	o
o	b1

G_2 (left-side preference)

a2	o
o	b2



Evolutionary Paradigm

Consider those who prefer to drive on left.
Their benefit from any action is perceived according to their own conventions in game G_1 .

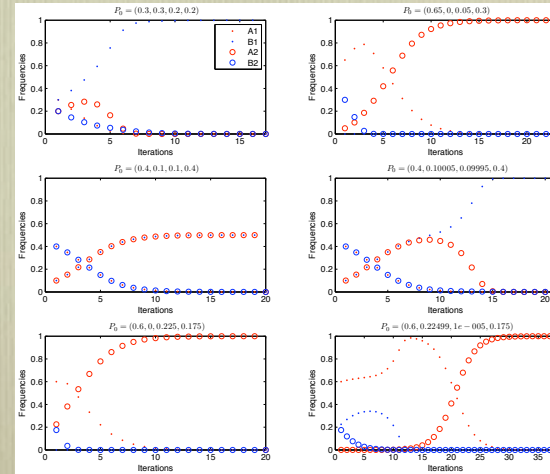
For an action A at interaction t , their "fitness" is $P_A^t(g_1) + P_A^t(g_2) \cdot a(g_1) + (P_B^t(g_1) + P_B^t(g_2)) \cdot b(g_1)$
At time $t+1$, the proportion of those playing action A who prefer to drive on the left is

$$P_A^{t+1}(g) = \frac{W_A^t(g) \cdot P_A^t(g)}{\sum_{g' \in G} W_A^t(g') \cdot P_A^t(g') + W_B^t(g') \cdot (1 - P_A^t(g'))}$$

Replicator dynamics

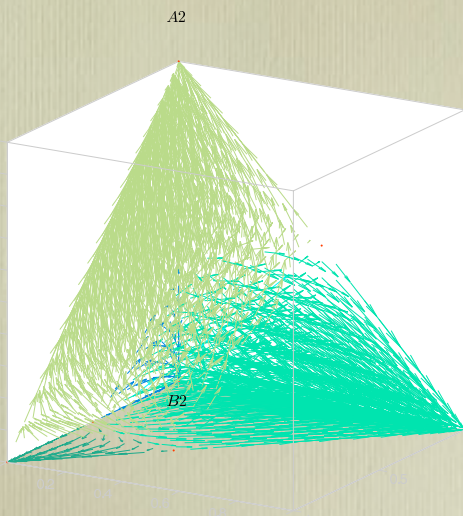


Some Example of Strategic Evolution



A players prefer G_2

B players prefer G_1



- A1
- B1
- A2
- B2
- critical point
- mixed equil

$$G_1 = \begin{bmatrix} 4 & 0 \\ 0 & 7 \end{bmatrix}$$

$$G_2 = \begin{bmatrix} 7 & 0 \\ 0 & 4 \end{bmatrix}$$

Stable points
all B_1
all A_2
Unstable point
mixed A_1, B_2
two more saddle points
 B_1

All critical points lie on a plain



Modeling Intervention

Government can choose to

- encourage immigration from different countries. (preserving conventions)
- intervene and educate citizens to drive on left- or right-hand side. (preserving population size)
- Actions may be associated with different costs

