E Pluribus Unum: An Evolutionary Model of Trust and Accountability

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Outline

• Motivation
• Objective
• Model
• Results
• Interpretation and Conclusion
Motivation

• Mutual Accountability (e.g. Paris Declaration)
  – Malabo Declaration
  – Biennial Review

• Behavioral Literature on Cooperation

• Trust literature
Objective: to begin formalizing the cooperation, accountability, and trust behaviors described today

RESEARCH QUESTIONS:
• Can we represent trust, cooperation, and accountability in a formal model?
• What are the implications for cooperative behavior and accountability?

INFORMAL ACCOUNTABILITY
• Not a punishment concept
• Deviations from group-optimal behavior return to group-optimal behavior
Prisoner’s Dilemma

• Theory
  – Cooperative behavior is optimal
  – Dominant strategy: non-cooperation

• Yet people cooperate
  – Empirically
  – Experimentally

• Evolutionary economics
  – “Emergence” of cooperative behavior
Model

• 3-player repeated ‘Prisoner’s Dilemma’
• evolutionary model
• Examine trust and accountability
  – We will think of players as government, private sector and civil society, but it applies equally to a 3-step value chain, and generalizes to n>3 players.
3-Player Model Details

- Action
  - Cooperate
  - Don’t cooperate (defect)
  - All actions are ‘noisy’

- Strategy
  - Generally cooperate
  - Rarely cooperate (generally defect)

- Payoffs
  - Best if all cooperate
  - Single cooperator has smallest payoff (lack of reciprocity)

- Switching Strategies
  - Typically based on payoffs
  - Noisy actions can generate switches

- Introduce Trust
  - Creates another form of strategy switching
Payoffs

\( P_i \): Non-cooperative action \( \quad \pi_i = 1 \)

\( P_i \): Non-cooperative action

\( P_j \) nor \( P_k \) cooperates \( \quad \pi_i = 0 \)

\( P_j \) or \( P_k \) cooperates \( \quad \pi_i = 3 \)

\( P_j \) and \( P_k \) cooperate \( \quad \pi_i = 6 \)
Trust

• Two types of trust
  – Trust in other players
  – Trust in system
    • High level of trust in system means need less trust in other players
    • Low level of trust in system means need more trust in other players

• [0,1]

• How trust operates
  – Trustworthiness increases with cooperative action
  – “High trust” means play cooperatively regardless
  – “Low trust” means return to payoff-based strategy switching
Trustworthiness

If player $i$ cooperated at time $t-1$:

$$\tau_t = (1 - \delta)\tau_{t-1} + \frac{1}{8}(1 - (1 - \delta)\tau_{t-1})$$

If player $i$ was non-cooperative at time $t-1$

$$\tau_t = \frac{3}{4} \times (1 - \delta)\tau_{t-1}$$

$\delta = .2$
System Trustworthiness

- Specified exogenously $\tau_S = 0.5$
- Sensitivity analysis
- Both forms of trust influence action
  - $P_i$ adopts a cooperative strategy if systems trustworthiness plus individual trustworthiness is high enough
- “Trust but verify” (i.e. adopt strategy, but check before taking action)
“Mutation” (Strategy Switching)

• Payoff: \( \text{IF } \pi_{i,t-1} < \left( \frac{\pi_{j,t-1} + \pi_{k,t-1}}{2} \right) \)
  THEN \( S_{i,t} = -S_{i,t-1} \)

• Trust: \( \text{IF } \left( \frac{\tau_{j,t-1} + \tau_{k,t-1}}{2} \right) + \tau_{sys} > 1 \)
  THEN \( S_{i,t} = 1 \);
  ELSE apply payoff rule
RESULTS
Individual trustworthiness
Group Behavior

• Set model parameters and initial conditions
• Track individual behavior over 50 generations
• Iterate 2500 times
• Examine tendencies in individual behavior by generation
• Emphasis on trustworthiness
RESULTS: BASELINES
No trust
Baseline with trust, neutral initially
RESULTS: TRUST
High initial individual trust

Trust level for all players at all iter/Gen

Gen

Trust

0.0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0.8

0.9
Low Initial Individual Trust
Trust Leader

Trust level for all players at all iter/Gen
System trust

Trust level for all players at all Iter/Gen

- Trust
- Gen
System Trust Dominates Individual Trust

![Chart showing trust levels over generations](image-url)
INITIAL CONDITIONS
Initial Conditions Matter (with trust)
Reprise: No trust, neutral initially
No trust, cooperative initial conditions
Reprise: trust, neutral initially
Reprise: Initial Conditions (with trust)
Initial Conditions Matter: Non-Cooperation
Initial conditions: Non-cooperation, high systems trust
Conclusions

• Evolutionary models a good research tool
  – Can model complex situations
  – Simple model yields rich results
  – With policy implications

• Emergence of informal accountability
Conclusions: Getting to Cooperation

• We can get to cooperation
  – To a certain extent, in all simulations
  – But inevitably in some simulations
  – Multiple things need to go right

• Strong systems trust, neutral or better initial conditions

• Strongly cooperative initial conditions, neutral or better systems trust

• Individual trust plays a smaller role than systems trust
Policy Implications

• Change initial conditions
  – Biennial Review
  – Joint Sector Reviews
  – National Agricultural Investment Plan
  – Stakeholder Capacity
Policy Implications

• Strengthen systems trust
  – Biennial Review
  – Joint Sector Reviews
  – National Agricultural Investment Plan
Policy Implications

• Introduce trust leader ?? Can she influence systems trust ??
  – Champions for Change
  – Apex Civil Society Organization (e.g. CNC)
  – Apex Private Sector Organization (e.g. TNZ PAC)
  – Cross-Ministerial Development Agency (e.g. ETH ATA)
  – Continental (& regional) CAADP Champion
Policy Implications

• Invest in multiple policy levers
• Systems change: make the systems more trustworthy, re-orient the path (initial conditions)