Solving Cooperation Problems in Heterogeneous Groups

Experimental Evidence from India

Game Theory and Society
ETH Zurich, July 27–30, 2011
Negative relationship between Heterogeneity and Economic Growth

Possible interpretation (e.g. Alesina/Ferrara 2005):

- Diversity as an obstacle to cooperation
- Cooperation is needed in almost all areas of economic activity
- Countries that lack institutions to ensure cooperation legally (i.e. developing countries) heavily rely on voluntary cooperation

Data: Penn World Table 6.3, Roeder 2001; n=139
1 Heterogeneity and Cooperation
   Prior Findings

2 Basic Experimental Set Up
   Public Goods Game in Pure and Mixed Groups

3 Extended Experimental Set Up
   Leading by Example

4 Summary and Policy Implications
Heterogeneity and Cooperation: Some Experimental Findings

- Several studies use the public goods game (PGG) to compare cooperation levels across cultures (e.g. Brandts et al. 2004; Henrich et al. 2005; Kocher et al. 2008):
  - They only compare outcomes of homogeneous groups
  - No evidence on the interaction of cultural diversity within groups

- Koopmans/Rebers (2009) study consequences of heterogeneity within groups
  - Conditional cooperation only in homogeneous groups
  - “Diversity” is limited to varying Christian denominations and political party preferences
Basic Experimental Set Up
Measuring Cooperation

Cooperation modeled as a standard linear Public Goods Game (PGG)

\[
\text{individual profit} = 200Rs - c_i + 0.5 \sum_{j=1}^{n=4} c_j
\]

- **200Rs**: Individual Endowment (4.5 Euro)
- **\(c_i\)**: Individual Contribution
- **0.5**: Efficiency factor \((\beta = \frac{1}{4} \times 2 = 0.5)\)
- **\(n\)**: Number of group members (4)

Dilemma:
- Under selfish preferences, rationality and common knowledge over rationality: contributing 0 is the individually optimal choice
- Socially optimal: contributing everything
1. A group consists of 4 people, each having a game name and a budget of 200 Rs.: 

2. Each group member can decide on how much to contribute to the common pool, for example:
3. The sum of contributions to the common pool is **doubled** by the experimenters:

4. Finally, the doubled sum of all contributions is **distributed back** to the 4 group members in equal shares:
### Basic Experimental Set Up

<table>
<thead>
<tr>
<th>Location</th>
<th>St. Aloysius College, Mangalore, India</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension of Heterogeneity</td>
<td>religious affiliation (Hindu, Muslim)</td>
</tr>
<tr>
<td>Participants</td>
<td>432 male students</td>
</tr>
<tr>
<td>Implementation</td>
<td>one-shot PGG, group size of four, efficiency factor 0.5, paper and pencil</td>
</tr>
</tbody>
</table>

India offers (sad) **advantages for high validity** in experimental testing:

- large stakes due to low development
- religious affiliation as a relevant social category due to polarized stereo-typing and (violent) tensions between religious groups
- culturally and economically distinct subject pool due to Non-WEIRD participants
Basic Experimental Set Up

Design (baseline treatments)

<table>
<thead>
<tr>
<th>Type</th>
<th>Signal</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>pure Hindu</td>
<td>hhhh</td>
<td>(24)</td>
</tr>
<tr>
<td>pure Muslim</td>
<td>mmmm</td>
<td>(8)</td>
</tr>
<tr>
<td>mixed</td>
<td>hhmm</td>
<td>(12)</td>
</tr>
</tbody>
</table>

Numbers of independent cases (i.e. observed groups) in brackets.

Signal of partners’ affiliation

to ensure anonymity each participant had to choose 1 of 6 typical ‘game names’:

- Trishul
- Thulasi
- Mantra
- Namaz
- Zakkat
- Haj

In each group chosen game names were common knowledge.
Baseline Treatments

**Beliefs**

Saliency of in-group thinking:
- Belief for religious fellow in pure group: 135 Rs.
- in mixed group: 172 Rs. (z=0.065)

**Contributions**

- NO difference between pure & mixed groups
- Contribution level 58% on average
- Self-serving bias 17% on average

90% CI Wilcoxon rank-sum test
Baseline Treatments

**Conditional Cooperation** *(reciprocity with self-serving bias)*

OLS regression; dep. var: individual contribution

<table>
<thead>
<tr>
<th></th>
<th>pure</th>
<th>mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>belief</td>
<td>0.746***</td>
<td>−0.200</td>
</tr>
<tr>
<td>constant</td>
<td>16.331</td>
<td>132.445***</td>
</tr>
<tr>
<td>n</td>
<td>128</td>
<td>48</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.277</td>
<td>0.015</td>
</tr>
<tr>
<td>$adj. R^2$</td>
<td>0.272</td>
<td>−0.007</td>
</tr>
</tbody>
</table>
Findings  
Participants expect low contributions by non-fellows. However, if faced with non-fellows, they do not cooperate less. No conditional cooperation in mixed groups (*hhmm*).

Interpretation 1  
Heterogeneity does not hinder cooperation (as long as diverse actors are forced to interact with each other).

Interpretation 2  
Heterogeneous beliefs might foster homophily and lead to fractionalization: If group formation was endogenous, actors would possibly choose pure groups and thus segregate (e.g. Schelling 1978).
Extended Experimental Set Up
Can We Enhance Cooperation?

- **Leading by example**, as an institutional device to increase cooperation (e.g. Gächter/Renner 2004, Güth et al. 2004, Van der Heijden/Moxnes 2003)

- An exogenous **leader** (first mover) decides about his contribution in PGG, **followers** (second movers) decide after they learn about leader’s contribution

- Saliency of leader behaviour reduces uncertainty for followers and – in theory – has two positive effects:
  - Leader anticipates followers’ behaviour and strategically contributes more in order to trigger positive reciprocity (first order effect)
  - Followers update their prior belief in a positive way and contribute more: conditional cooperation (second order effect)

- Does Leadership work under heterogeneity?
Design (extended treatments)

<table>
<thead>
<tr>
<th>Control</th>
<th>Hindu Leader</th>
<th>Muslim Leader</th>
</tr>
</thead>
<tbody>
<tr>
<td>pure Hindu</td>
<td>hhhh (24)</td>
<td>Hhhh (17)</td>
</tr>
<tr>
<td>pure Muslim</td>
<td>mmmm (8)</td>
<td>-</td>
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Numbers of independent cases (i.e. observed groups) in brackets.
Leadership Treatments

Beliefs

![Bar chart comparing baseline and leadership beliefs](chart.png)
Leadership Treatments

Contributions

Baseline

Leadership

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Baseline</th>
<th>Leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>hhhhh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mmmm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hhmm</td>
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The diagram compares the mean contributions between the Baseline and Leadership treatments. The y-axis represents the mean contribution, ranging from 0 to 150.
Can Leaders Induce (at least some) Cooperation?

**Reactions to Leaders:** OLS regression; dep. var: followers’ contribution

<table>
<thead>
<tr>
<th>Hindu Leader</th>
<th>( Hhhh )</th>
<th>Hindu in ( Hhmm )</th>
<th>Muslims in ( Hhmm )</th>
</tr>
</thead>
<tbody>
<tr>
<td>leader’s contr.</td>
<td>0.25*</td>
<td>0.71**</td>
<td>-0.11</td>
</tr>
<tr>
<td>constant</td>
<td>84.12***</td>
<td>13.92</td>
<td>88.44**</td>
</tr>
<tr>
<td>( n )</td>
<td>51</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.084</td>
<td>0.625</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Since there are 3 followers in each group, good leadership is rational only if mean marginal effect >0.33
Leadership doesn’t work. Leaders anticipate second movers’ low propensity to follow suit. Thus, bad leadership is ex post rational.

Leaders’ Contributions
Heterogeneity and Cooperation: What can we learn?

- Cultural traits affect strategic interaction!
- Religious heterogeneity affects expected cooperativeness but not actual contributions!
- Religious fellows are expected to be more cooperative than non-fellows.
- However, conditional cooperation preferences only prevalent in pure groups.

- Institution of Leadership reduces cooperation levels in most group structures!
- Second-movers (Hindu) only follow leaders in pure groups, Hindus and Muslims strongly discriminate against leaders of another religion.
- Only irrationally optimistic leaders try to trigger cooperation.
Generalization of Results

- Decentralization of problem-solving in heterogeneous groups to avoid bad leadership
- Third party group formation to avoid fractionalization thru belief-based homophily
- Incentivization of good leadership in both, heterogeneous and homogeneous groups

Further Research

- Endogenous group formation
- Variation of leadership assignment procedure (e.g. quiz, election)
- Replication with alternative dimensions of heterogeneity
- Positive aspects of heterogeneity, e.g. crowd wisdom
Thank you for your attention!