

# Experimental Methods in Social Sciences (in particular economics)

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**Within- and Between-Subject Design**

# Within- and Between-Subject Design

- Within-subject design: same participants experience different treatments
  - treatment effects are thus assessed within subjects
- Between-subject design: each participant takes part in only one treatment
  - treatment effects are thus assessed across subjects

# Within- and Between-Subject Design

- Main advantage of within-subject design
  - individual variation is controlled for
  - hence statistical power is potentially higher
  - very simple tests with very little assumptions can be applied
    - sign test
- Main disadvantage of within-subject design
  - experimenter demand is likely to be stronger
    - experimental hypothesis is much easier to guess if participants experience several treatments

# Strategy Method

- Related to within-subject design is strategy method
  - each participant makes choices for several possible situations (e.g., different first-mover choices) before knowing which one is relevant
    - allows to assess complete strategy
    - reaction to differences among situations can be assessed within subject
    - potentially experimenter demand enlarges treatment effect
    - but desire for consistency can also undermine treatment effect

# Within-Subject Design

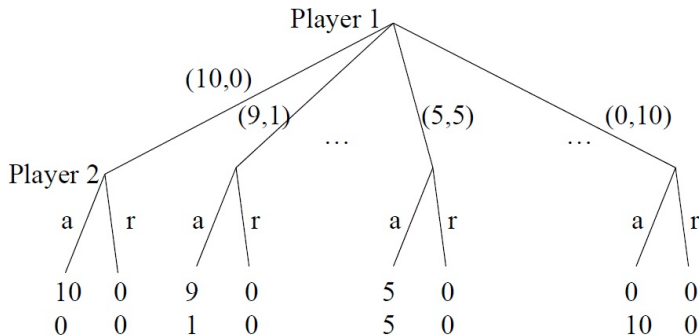
- Alternative motivation for within-subject design
  - assume we are interested not so much in treatment effects but in behavioral patterns across different situations
  - then we need to consider behavior of same participants across these situations

# The Ultimatum Game

(Güth, Schmittberger, Schwarze, JEBO 1982)

- Player 1 (“Proposer”) suggests split of, e.g., €10
- Player 2 (“Responder”) accepts or rejects
- If Player 2 rejects, both get 0

Figure: Ultimatum Game



# Ultimatum Game Results

- Results from ultimatum game are in conflict with the prediction derived based on common knowledge of rationality and selfishness
  - offers are often equal to or close to half of pie
  - low offers are frequently rejected
- The same holds for many other experiments (gift-exchange, public-good, centipede game,...)
- These results can be rationalized by assumption that participants are inequality averse

# Fehr and Schmidt (QJE, 1999)

- Player  $i$  is assumed to maximize

$$U_i(x) = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max[x_j - x_i, 0] - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max[x_i - x_j, 0]$$

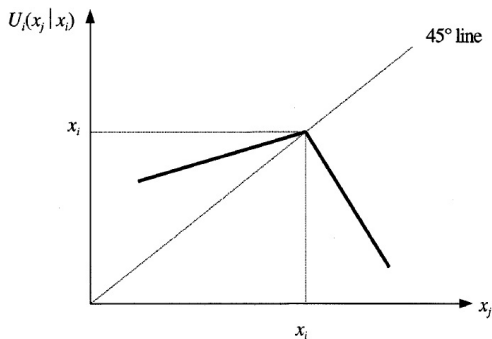
- Where
  - $n$  is the number of players
  - $x = (x_1, \dots, x_n)$  is the vector of monetary payoffs
  - and the further assumptions
    - $\beta_i \leq \alpha_i$
    - $0 \leq \beta_i < 1$
    - so players worry more about being behind than about being ahead
    - and they never worry so much about being ahead that they would throw away money



# Fehr and Schmidt (QJE, 1999)

- Utility of  $i$  as a function of  $x_j$  for given  $x_i$

Figure: Fehr-Schmidt preferences



# Fehr and Schmidt (QJE, 1999)

- Model allows to rationalize results from ultimatum game, dictator game (UG without rejection option) and other experiments
  - rejections in the UG decrease in  $s$ 
    - reject offers below  $s$  if  $s < \alpha_i / (1 + 2\alpha_i)$
    - e.g. reject offers below  $1/3$  if  $\alpha_i \geq 1$
  - positive offers in DG
    - offer 0 if  $\beta_i < 1/2$
    - offer  $s/2$  if  $\beta_i > 1/2$
    - problem: offer is  $(0, s/2)$  only rationalizable with  $\beta_i = 1/2$

# Individual Consistency with Social Preference Models

- Fehr and Schmidt claim in a number of papers that their model combined with a parameter distribution estimated based on UG data is consistent with results in a number of other papers
  - this claim itself is controversial (Binmore and Shaked, JEBO 2010)
- But it also inspires another important question:
  - does the model just fit aggregate data in an “as if” fashion?
  - or does it capture individual’s preferences?
  - i.e., do individuals behave consistent with this model across several choices?
- Consistency with general axiom of revealed preferences across several dictator games has been observed by Andreoni and Miller (Econometrica, 2002)
- Consistency with Fehr-Schmidt models across different games is investigated in Blanco, Engelmann, and Normann (GEB, 2011)

# Blanco, Engelmann, and Normann (GEB, 2011)

- Consistency of aggregate data and of individual choices with Fehr-Schmidt model across the following decisions:
  - modified dictator game (MDG)
  - ultimatum game (UG)
    - proposer
    - responder with strategy method
  - sequential prisoner's dilemma (SPD)
    - first mover
    - second mover after first-mover defection
    - second mover after first-mover cooperation
  - two-player public good game (PG)

# Blanco, Engelmann, and Normann (GEB, 2011)

- estimate Fehr-Schmidt  $\beta$  from MDG
  - e.g., A switches from left column to right column at (5,5) for some  $3/4 \leq \beta \leq 4/5$

Alternative 1				Alternative 2	
A	B			A	B
20	0			0	0
20	0			1	1
20	0			2	2
20	0			3	3
20	0			4	4
20	0			5	5
20	0			6	6
20	0			7	7
20	0			8	8
20	0			9	9
20	0			10	10
20	0			11	11
20	0			12	12
20	0			13	13
20	0			14	14
20	0			15	15
20	0			16	16
20	0			17	17
20	0			18	18
20	0			19	19
20	0			20	20

# Blanco, Engelmann, and Normann (GEB, 2011)

- Estimate Fehr-Schmidt  $\alpha$  from UG responder choices
  - e.g., B switches from left column to right column at (16, 4) for some  $1/3 \leq \alpha \leq 1/2$

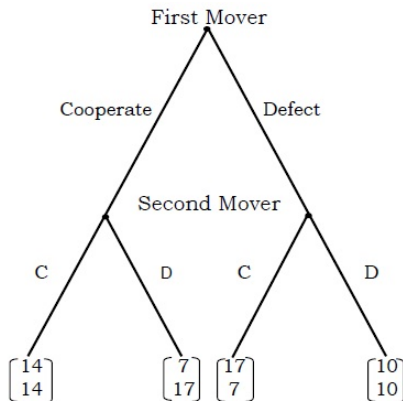
Alternative 1				Alternative 2	
A	B			A	B
0	20			0	0
1	19			0	0
2	18			0	0
3	17			0	0
4	16			0	0
5	15			0	0
6	14			0	0
7	13			0	0
8	12			0	0
9	11			0	0
10	10			0	0
11	9			0	0
12	8			0	0
13	7			0	0
14	6			0	0
15	5			0	0
16	4			0	0
17	3			0	0
18	2			0	0
19	1			0	0
20	0			0	0

# Blanco, Engelmann, and Normann (GEB, 2011)

- $\alpha - \beta$  distribution reasonably close to distribution inferred by Fehr-Schmidt from UG data
- Aggregate-level consistency check:
  - compare  $\alpha - \beta$  distribution with choice distribution
  - treats data as if coming from separate experiments
- Individual-level consistency check:
  - check whether individuals choose in other games as predicted by their estimated  $\alpha$  and  $\beta$
  - makes use of within-subject data

# Blanco, Engelmann, and Normann (GEB, 2011)

- e.g., SPD:
  - second mover should choose  $D$  after  $C$  if  $\beta < 0.3$
  - first movers who know the second-mover cooperation rate should cooperate if  $\alpha < 0.52$





# Blanco, Engelmann, and Normann (GEB, 2011)

- second movers
  - we find 38 defectors but only 20 with  $\beta < 0.3$ , so poor performance at aggregate level
  - but some support at individual level:
    - 16 out of 20 with  $\beta < 0.3$  defect
    - only 22 out of 41 with  $\beta > 0.3$  defect
- first movers
  - we find 21 cooperators and 30 subjects with  $\alpha < 0.52$ , not significantly different
  - but no support at individual level:
    - 10 out of 30 with  $\alpha < 0.52$  cooperate
    - 11 out of 31 with  $\alpha > 0.52$  cooperate

# Blanco, Engelmann, and Normann (GEB, 2011)

- overall, data fits reasonably well at aggregate level
- but few of the predicted correlations materialize at the individual level
  - in particular,  $\alpha$  and  $\beta$  are not correlated
  - 23 out of 61 violate  $\alpha \geq \beta$

	UG resp.	MDG	UG offer	PG	SPD 1st	SPD 2nd
UG resp.	–	–0.03	0.40**	0.07	–0.03	0.19
MDG		–	0.13	0.13	0.04	0.34**
UG offer			–	0.19	0.13	0.49**
PG				–	0.24*	0.41**
SPD 1st					–	0.43**
SPD 2nd						–

- Hence it seems Fehr-Schmidt model can capture several different motivations
  - e.g.,  $\alpha$  can represent negative reciprocity as well as exploitation aversion
- but these are not correlated

# Literature

- Andreoni, James and Miller, John (2002) "Giving According to GARP: An Experimental Test of the Consistency of Preferences for Altruism", *Econometrica* 70(2), 737–753.
- Binmore, Ken and Shaked, Avner (2010) "Experimental Economics: Where Next?", *Journal of Economic Behavior and Organization* 73, 87–100.
- Blanco, Mariana, Engelmann, Dirk, and Normann, Hans Theo (2011) "A Within-Subject Analysis of Other-Regarding Preferences", *Games and Economic Behavior* 72, 321–338.
- Fehr, Ernst and Schmidt, Klaus M. (1999) "A Theory of Fairness, Competition and Cooperation", *Quarterly Journal of Economics* 114, 817–868.
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