Money and Trust among Strangers

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ALMA MATER STUDIORUM - UNIVERSITÀ DI BOLOGNA
IL PRESENTE MATERIALE È RISERVATO AL PERSONALE DELL'UNIVERSITÀ DI BOLOGNA E NON PUÒ ESSERE UTILIZZATO AI TERMINI DI LEGGE DA ALTRE PERSONE O PER FINI NON ISTITUZIONALI

Research questions

- Cooperation in **small** vs. **large** groups
- Cooperation under **gift-exchange** vs. **monetary trade**

Research questions

Cooperation

is the joint effort by two or more people

that generates a benefit for all

Examples: cooperation in social dilemmas like in a common pool resource, public good, prisoner's dilemma, etc.

Research questions

We study cooperation in societies
with and without a specific "institution"

Experiments are useful because they allow to detect unambiguously the causal effect of the institution on the target variable (cooperation level) and to uncover the mechanisms of those effects

Money is an institution that has emerged
to overcome the challenge of cooperation in society

Summary of results

1. Without money, cooperation declined as we enlarged the size of a group.
2. With money, cooperation was supported by monetary trade, which worked equally well in small and large societies.
3. Once the convention of money took hold, participants abandoned norms of reciprocity and inter-temporal exchange of gifts, in favor of offering help only for immediate compensation.
4. We show that in large networks of strangers monetary systems provide an evolutionary advantage.

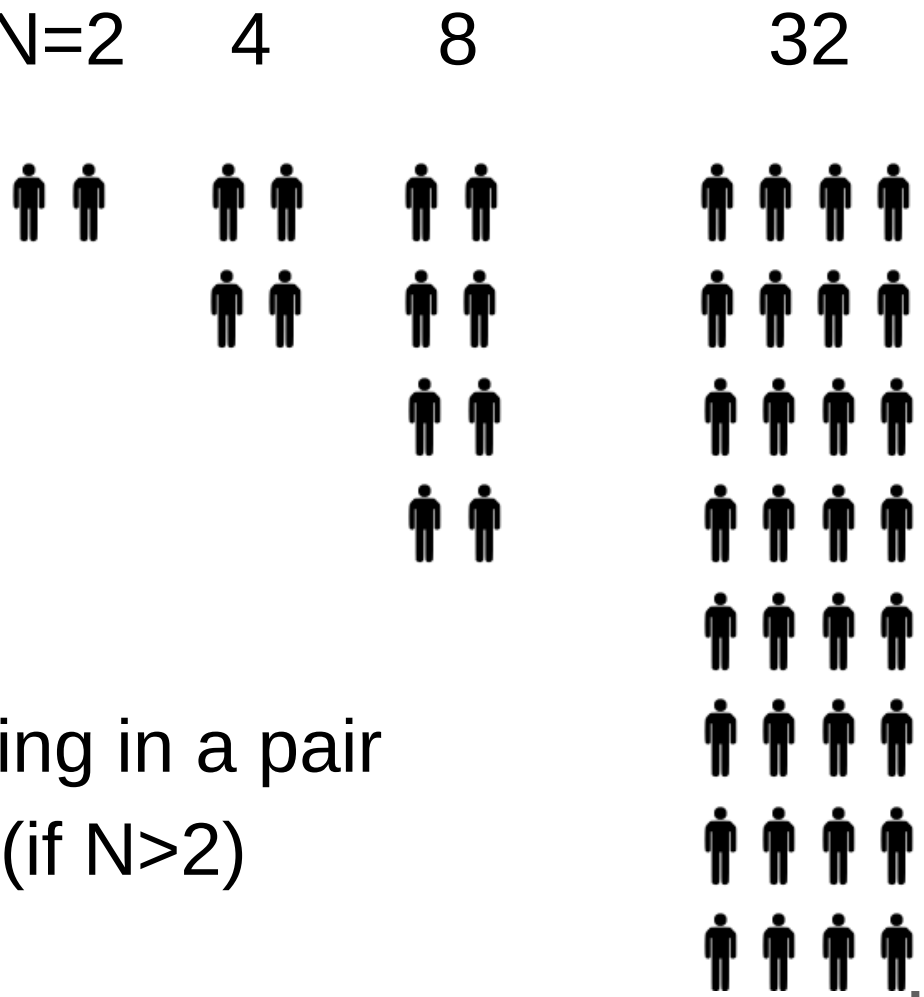
Outline

- Control Condition
  - design
  - theoretical predictions
  - results
- Tokens Condition
  - design
  - theoretical predictions
  - results
- Evolutionary model

Control condition

Experimental Design: Control

Intertemporal
cooperation
in an economy
of N agents



- Indefinite repetition
- Stage game: gift-giving in a pair
- Strangers matching (if N>2)
- With role switching

Experimental Design: Control

•448 undergraduate volunteers from Purdue University, each of whom participated in only one session and played five long-run interactions

• We ran 10 sessions of 32 or 64 subjects:
  5 for the Control and 5 for the Tokens condition
•The experiment involved no deception
•On average, sessions lasted 2.5 h, and subjects earned $US 27.28

•Each subject played the first four cycles of a session in groups of fixed size. The size of the group was 32 in the last cycle of every session

Treatments and sessions

	Control			Tokens		
# subjects/group	2	4	8	2	4	8
# sessions	1	2	2	1	2	2
# subjects/session	32	32	64	32	32	64
# groups in supergames 1-4	16	16	16	16	16	16
# groups in supergame 5	1	2	4	1	2	4

- 448 subjects in total

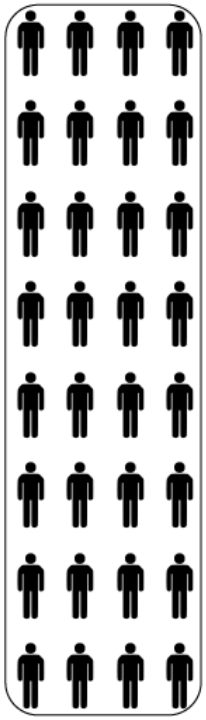
- On average sessions lasted 2.5 hours, and subjects earned 27.5 US dollars.

Sessions with N=2

32 participants in the room:

cycles 1-4

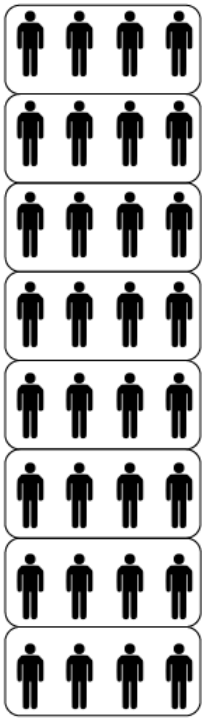
cycle 5



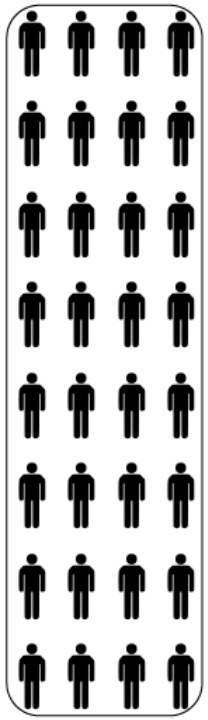
Sessions with N=4

32 participants in the room:

cycles 1-4

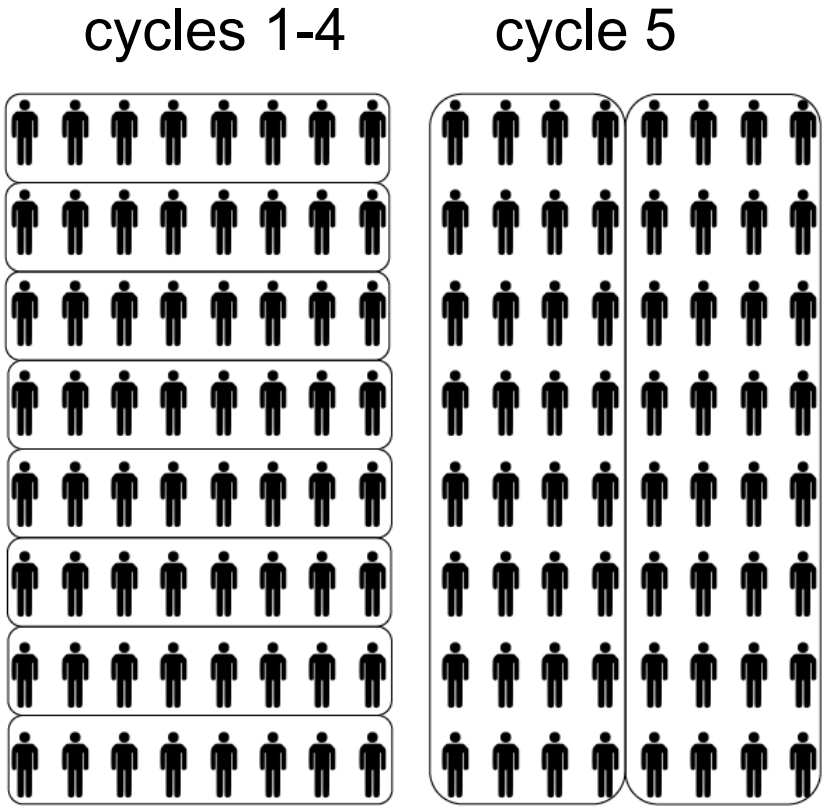


cycle 5



Sessions with N=8

64 participants in the room:



Design: Stage game

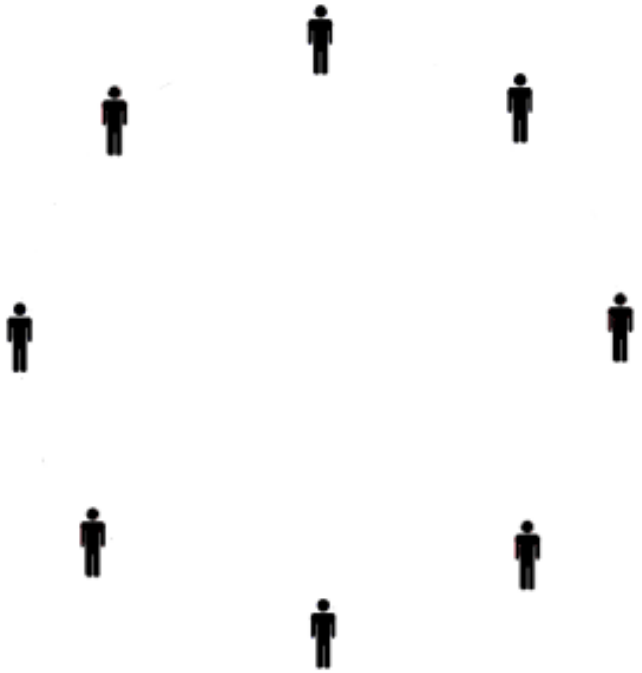
- Players interact in pairs, one as a producer and one as a consumer.
- The producer can help or not.
- The consumer has no choice to make.
- Helping creates a **surplus** of 6 CU.
- **Cooperation** occurs whenever help is given; otherwise, **defection** occurs.
- Roles of consumer and producer are **randomly assigned** in every period.

Design: Indefinite repetition

- Expected duration of a supergame: 17 periods.
- Every supergame lasts at least 3 periods. From period 3 on, there is a **93% probability** of an additional period.
- **5 supergames** in a session.
- At the beginning of every supergame, groups are formed so that no one ever met the same person in more than one supergame (**absolute stranger**), except for the last one.

Design: Roles and matching

Consider for example a group of 8 players.



- In every period, roles are assigned randomly.
- Consumers and producers meet in random pairs.

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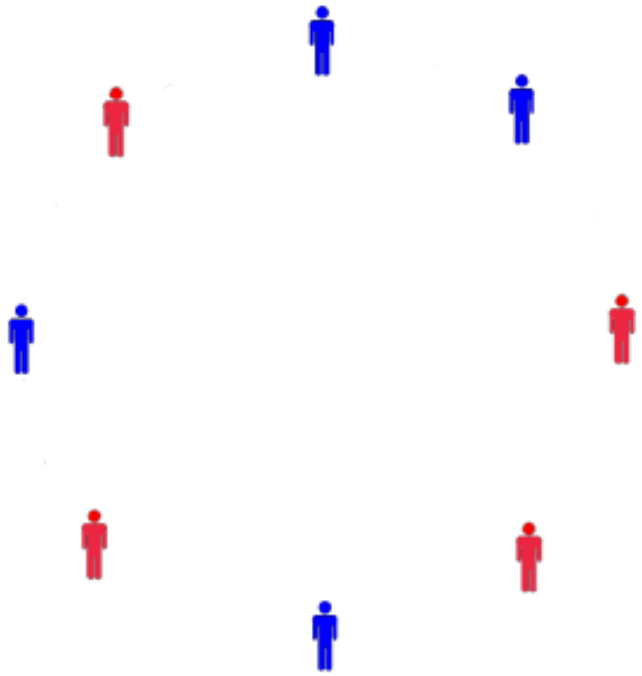

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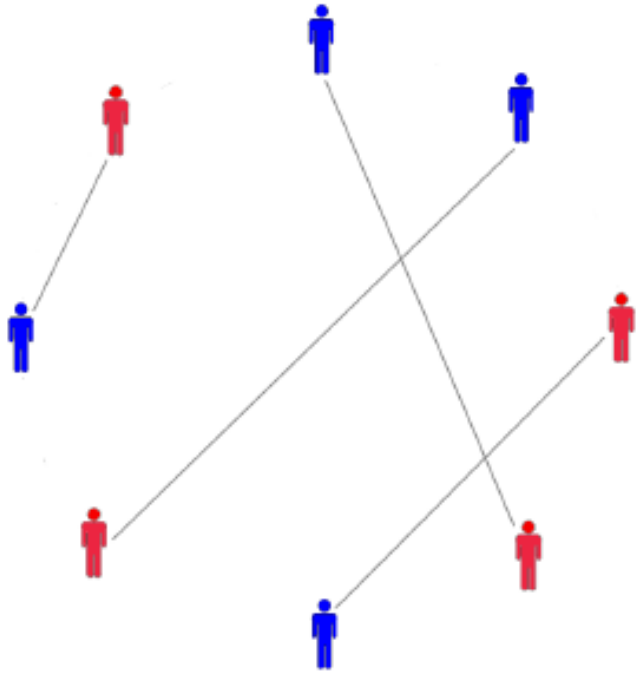

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- Consumers and producers meet in random pairs.

Design: Information

We compare experimental conditions in which players interact as

partners (N=2)

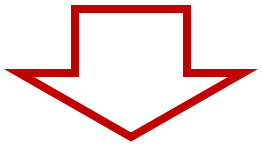
strangers (N=4, N=8, N=32)

- consumers and producers meet in **random pairs** in every round
- identities are undisclosed, hence there is **no scope for direct or indirect reciprocation**.
- after each round, the **number of defections** in the group is made **public**

Theoretical predictions

- self-interested players can achieve 100% **cooperation** if all of them follow a simple common rule, or **social norm**:
  - a producer helps as long as every producer in the group helps
  - otherwise he stops helping anyone forever after.

- It is the **quality of monitoring** that matters for cooperation, **not the group size** *per se*.



- In the experiment defections were made public, hence **cooperative equilibrium is sustainable in groups of any size** N (Kandori, 1992; Ellison, 1994).

Results: Control condition

In the Control conditions:
the larger the group, the lower the cooperation rate.

- 70.7% with N=2
- 49.1% with N=4
- 34.2% with N=8
- 28.5% with N=32

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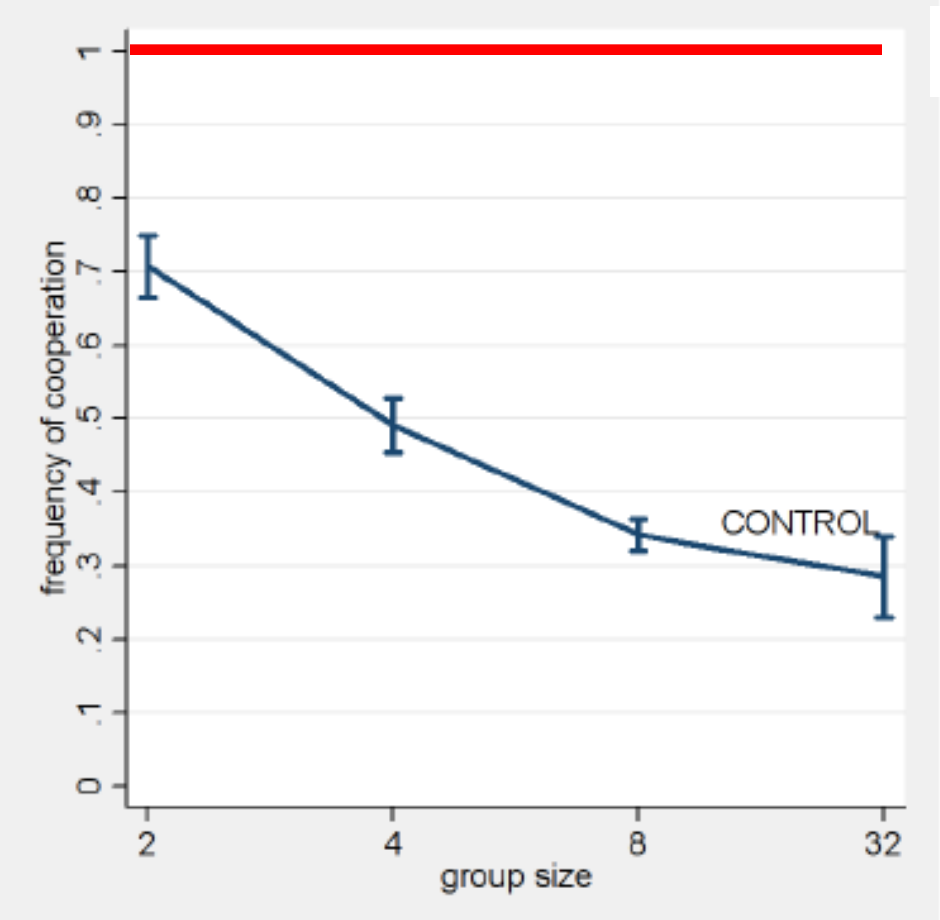


efficiency frontier = 100%

- 70.7% with N=2
- 49.1% with N=4
- 34.2% with N=8
- 28.5% with N=32

Results: Control condition

The effect of the group size on cooperation is statistically significant according to a linear regression model.

	Control conditions
Group size	-0.079***
	(0.010)
Group size-squared	0.002***
	(0.000)
Constant	0.775***
	(0.019)
Dummies for cycles	Yes
N	199
R-squared	0.245

Why is cooperation declining?

Suppose these were field data:

Interpretation would be ambiguous, as many factors co-vary with group size:

* small groups may have lower *payoffs to cooperation* (-)
* but better *peer monitoring* than large groups (+)

But these data are experimental

and the design removed the above confounds:
Identical payoffs to cooperation and peer monitoring for all N

Why is cooperation declining?

Our interpretation for the experimental data:

- **Direct reciprocation** becomes increasingly difficult to achieve in larger groups: the probability of consecutively meeting the same person declines from 100% (N=2) to 3.2% (N=32).

- Large groups are more likely to be heterogenous, hence they are less likely to adopt a common rule of behavior - **Coordination**

Tokens condition

Research questions

- **What is money?**

  Money is an object or a symbolic artifact
  that is useful only or mainly for exchange purposes

  (Winick, 1956; Polany 1957)

Previous experiments on money

Money can serve as

- ✓ **Unit of account** - it simplifies pricing (Fehr & Tyran, 2001)
- ✓ **Medium of exchange** – it replaces barter (e.g., Brown,1996, Duffy & Ochs, 2002, Lian & Plott 1988)
- ✓ **Store of value** – earn money today and spend it tomorrow (e.g., McCabe, 1989, Camera et al. 2003, Deck et al., 2006)

Previous experiments on money

- There can be theoretical reasons to use money: because it expand the efficiency frontier (e.g. Duffy and Puzzello, 2011).

In this paper: money is not necessary.
We look at behavioral reasons to use money.

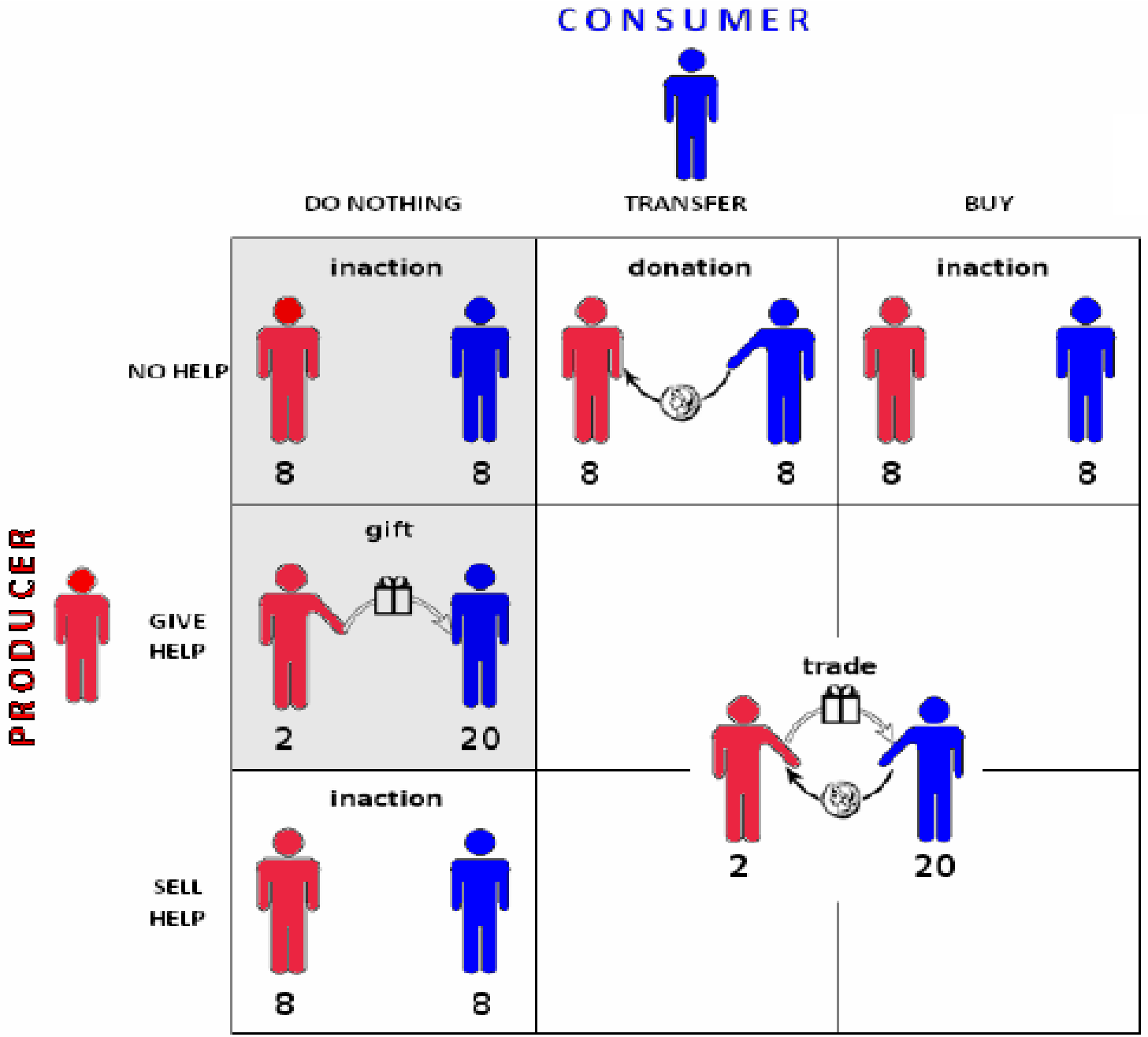
- In most papers money has redemption value (commodity-money)

In this paper: money is intrinsically worthless (fiat-money)

Design: Tokens

The Tokens conditions introduce the possibility of monetary exchange.

- Money in the experiment is represented by "tokens."
- Tokens are intrinsically worthless
- The producer has an additional option:
  - to sell help in exchange for a token.
- The consumer has three options:
  - do nothing and carry over the token to the next round;
  - unilaterally transfer a token;
  - buy help in exchange for a token


CONSUMER
DO NOTHING
TRANSFER
BUY
PRODUCER
NO HELP
GIVE HELP
SELL HELP
inaction
donation
inaction
gift
trade
inaction
8
8
8
8
8
8
2
20
2
20
8
8

Design: Tokens

- two tokens given to every first-round consumer
  $\Rightarrow$ **fixed number of tokens** in a group (N)

- In some encounters **trade is impossible**, as participants cannot transfer a token or receive it:
  - either the consumer has no tokens
  - or the producer has two tokens.

- subjects know whether trade is possible or impossible, *before making their choices*.

Your ID: 1 Cycle: 2 Period: 4 4 persons in your set : ID1 (you), ID2, ID3, ID4

This period you are BLUE

You now have 1 ticket

You have met a RED with no tickets

OUTCOMES	EARNINGS
Y	RED gets 8 points You get 8 points
Z	RED gets 2 points You get 20 points

Please make a choice:

- Keep your ticket
- Give a ticket to RED
- Give a ticket to RED only if RED executes Z

Submit

Period	Your Color	Outcome	Ticket Transfer	Ticket Trading	Your Earnings
3	RED	Z	YES	SOLD	8
2	RED	Z	YES	—	2
1	BLUE	Z	YES	—	20

Your ID: 1 Cycle: 2 Period: 4 4 persons in your set : ID1 (you), ID2, ID3, ID4

Is trade possible or impossible?

This period you are BLUE

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Your choices (consumer)

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Feedback on past encounters

Period	Your Color	Outcome	Ticket Transfer	Ticket Trading	Your Earnings
3	RED	Z	YES	SOLD	8
2	RED	Z	YES	—	2
1	BLUE	Z	YES	—	20

Tokens in the experiment

- No redemption value – fiat money
- No legal value – no obligation to use or accept money
- Tokens are not necessary to carry out transactions
- Storable
- In constant supply – no inflation
- No credit system – possible liquidity constraint

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Theoretical predictions: Tokens

Monetary trade is neither necessary nor sufficient to achieve and sustain cooperation

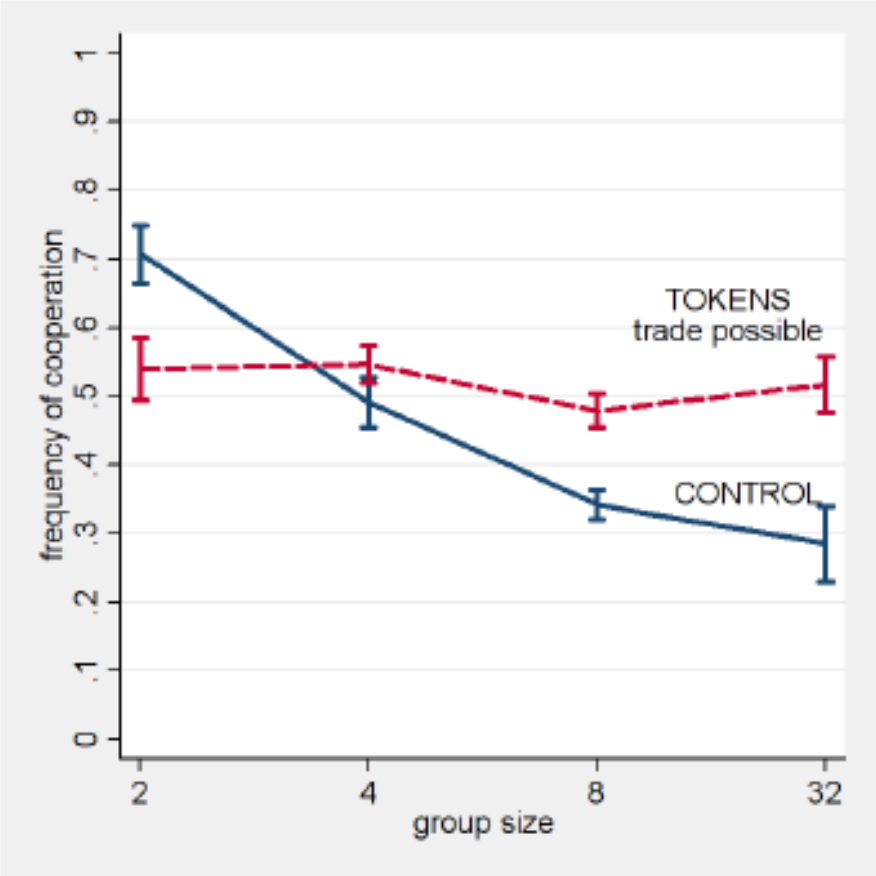
Not necessary: everyone can rely on a gift-exchange equilibrium

Not sufficient: if everyone rely on monetary trade, society would achieve less than 100% cooperation (because of the impossible trades)

Monetary trade strategy: When trade is possible, all producers sell help in exchange for a token and all consumers give a token in exchange for help

Results: Tokens condition

When participants can engage in **monetary trade**, **cooperation rates and group size are not related**.



Results: Tokens condition

When **trade is possible**, there is **no significant difference in cooperation rates** across group sizes.

Tokens conditions: trade possible	
Group size	-0.016
	(0.022)
Group size-squared	0.000
	(0.001)
Constant	0.521***
	(0.080)
Dummies for cycles	Yes
N	199
R-squared	0.028

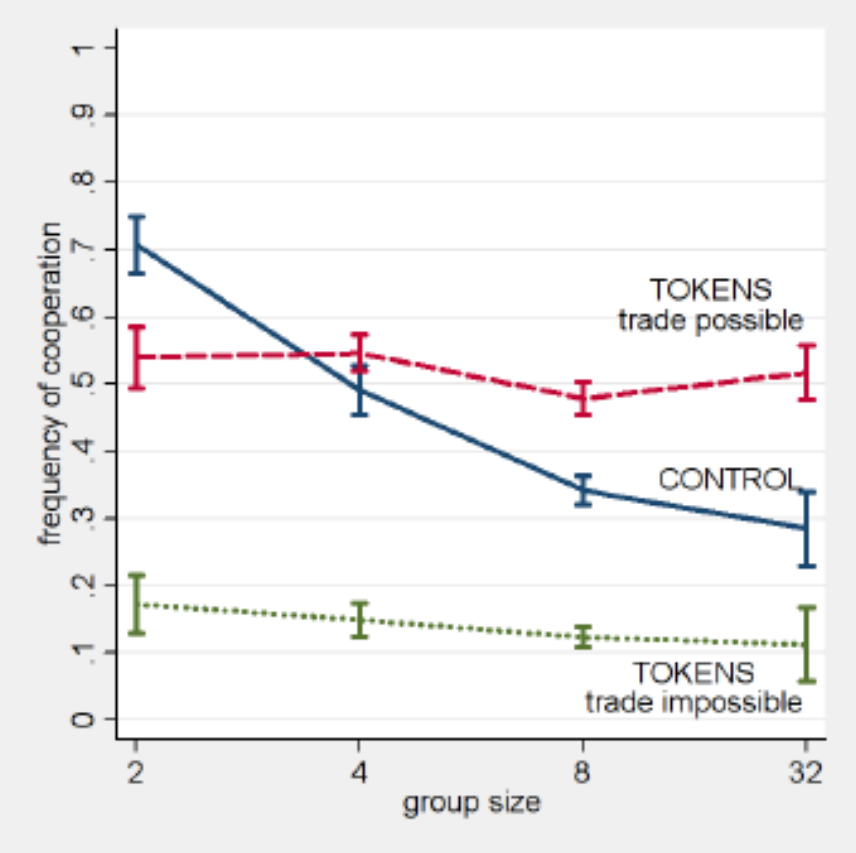
Results: Tokens condition

The availability of monetary trade significantly boosts cooperation (hence, surplus) only if groups are large enough.

	N=2	N=4	N=8	N=32
Tokens condition: trade possible	-0.168***	0.055*	0.137	0.232**
	(0.000)	(0.022)	(0.093)	(0.078)
Tokens condition: trade impossible	-0.541***	-0.342***	-0.218***	-0.173**
	(0.005)	(0.057)	(0.036)	(0.076)
Constant	0.638*	0.476***	0.371***	0.285***
	(0.053)	(0.012)	(0.030)	(0.064)
Dummies for cycles	Yes	Yes	Yes	No
N	184	192	191	21
R-squared	0.309	0.360	0.462	0.642

Results: Tokens condition

When trade is impossible, the frequency of cooperation does not exceed 17.2% in any Tokens condition, which is below the lowest level recorded in the Control conditions (28.5%).



Results: Tokens condition

The rule of behavior is dramatically different in the Control and Tokens conditions

In the Control conditions, 45.6% of produces make gifts

In the Tokens conditions,

a) **when trade is possible, producers no longer make gifts:**

- **They mostly choose to help for tokens** (50.4%)
- Or not to help at all (44.0%)

b) **when trade is impossible, producers rarely make gifts** (13.9%)

Results: Tokens condition

a) when trade is possible, producers no longer make gifts

	Consumer's choice			
Producer's choice	Control condition	Tokens condition		
		Trade impossible	*Trade possible*	
			Do nothing	Tranfer or Sell
No help	0.544	0.861	0.059	0.381
Give help	0.456	0.139	0.007	0.048
Sell help	-	-	0.077	0.427
totals	1	1	0.143	0.857

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Results: Tokens condition

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Control Condition **vs.** **Tokens when trade is impossible**

Results: Tokens condition

The **norm of behavior is dramatically different** in the Control and Tokens conditions.

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1. Without money, cooperation declined as we enlarged the size of a group.
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An evolutionary explanation

Trade is evolutionary stable

Consider a sequence of generations whose members can be of three possible types:

- cooperators,
- defectors,
- and traders.

Encounters are random within a generation,
$\Rightarrow$the mixture of types in the population influences everyone's payoffs.

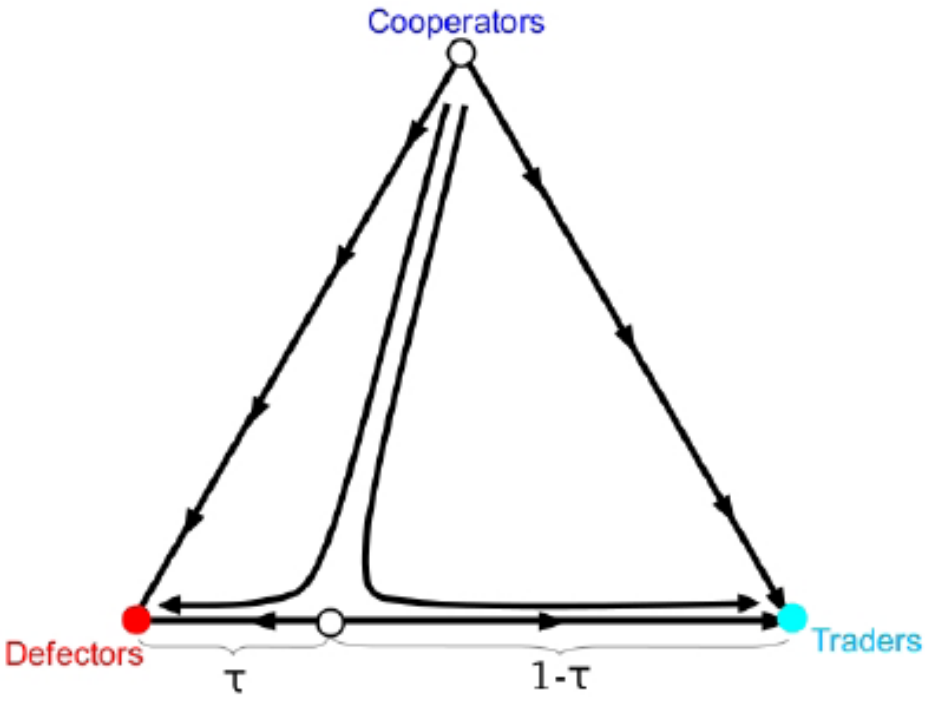
Initially, we give one token each to a share $\tau \in [0, 1)$ of players and then we follow how the mixture of types evolves across generations.

According to standard **replicator dynamics**, the share of a type **increases** from one generation to the next as long as **the payoff** of that type **is greater than the average payoff** in the same generation.

Trade is evolutionary stable

4 rest points, but **only 2 are stable**.

When cooperators coexist with some other type, the situation is neither stationary nor stable because **cooperators earn a payoff below average**.



- The basins of attraction depend on τ.
- With **many tokens**, the population is more likely to be **invaded by defectors**.

Conclusions

Experiment on gift exchange and monetary trade with N=2, 4, 8, 32.

Results:

1. Without money, cooperation declines as the size of a group increases.
2. With money,
   - cooperation is supported by monetary trade, which works equally well in small and large societies.
   - yet norms of reciprocity and inter-temporal exchange of gifts disappear, and help is offered only for immediate compensation.
3. In large networks of strangers monetary systems provide an evolutionary advantage.

These results offer a **unified interpretation** for the positive and a negative connotation of money, and suggest why it has emerged only in large human societies, but not among primitive societies

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Thank you

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