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Cooperazione. Visioni economiche ed evidenze sperimentali

Roberto Burlando

Giugno 2007

TRE **"**VISIONI" metodologiche nelle scienze in generale e in economia.

- individualismo metodologico
- olismo
- approccio sistemico

In economia continua a prevalere l'individualismo metodologico, che è alla base dell'approccio definito "riduzionista" in questa disciplina.

• ***Approccio riduzionista*:**

un sistema viene suddiviso in più sottosistemi, fino a scomporlo ai minimi termini; le proprietà osservabili ai livelli inferiori vengono estese ai livelli superiori

•***Approccio sistemico*:**

un sistema viene studiato definendone le proprietà collettive; parallelamente ne vengono studiate le singole componenti.

La materia vivente

La materia vivente, pur rispettando le leggi della fisica e della chimica, raggiunge un livello organizzativo e funzionale specifico, ad alta complessità, che non è spiegabile solo con la conoscenza delle proprietà dei suoi componenti più semplici (Proprietà Emergenti).

Ciò significa semplicemente ammettere che **la materia vivente è un particolare stato evolutivo della materia (Buiatti), non spiegabile solo con le leggi della fisica**.

Si tratta di **uno stato evolutivo acquisito dalla materia non vivente nel corso della sua evoluzione,** che ha dato origine - oltre tre miliardi di anni fa - alle prime forme di vita sulla Terra.

In altre parole, se si scompone un organismo vivente in tutte le sue parti, non riusciremo a ricomporre lo stesso organismo vivente: avremo tutt'al più un organismo morto.

Man mano che i livelli di complessità salgono

lungo la gerarchia dell'atomo, della molecola, del gene, della cellula, del tessuto, dell'organismo e della popolazione,

compaiono nuove proprietà come risultato di interazioni e di interconnessioni che emergono ad ogni nuovo livello.

(S. J. Gould)

L'ecosistema terrestre e il sistema economico e sociale sono sistemi complessi

La teoria dei sistemi è considerata una delle più grandi conquiste intellettuali e scientifiche umane.. eppure non è ancora stata adottata in modo significativo in economia, perché?

Alcuni aspetti di analisi dei sistemi complessi:

- **Il sistema non è mai riducibile alla somma delle sue componenti né il suo funzionamento a quello delle singole componenti e una parte non può controllare il tutto**
- **I sistemi complessi sono dotati di anelli di retroazione (feedback) negativi (stabilizzanti) o positivi (esplosivi**
- **L'interazione tra gli elementi di un sistema complesso è attivata in genere da una differenza (informazione)**

- **I sistemi biologici presentano una pluralità di fini e non tendono alla massimizzazione di alcune variabile**
- **Presentano una combinazione di comportamenti di tipo competitivo e cooperativo**
- **In contesti espansivi generalmente sono i comportamenti competitivi a favorire il successo, in contesti non espansivi in genere sono quelli cooperativi**
- **In un contesto non espansivo un certo grado di competizione tra specie diverse favorisce lo sviluppo, la competizione intra-specifica generalmente danneggia la specie stessa**

Queste considerazioni sono alquanto lontane dalle assunzioni "normali" della teoria economica standard, che si fonda su:

- individualismo metodologico e atomismo sociale
- ipotesi di massimizzazione di una sola funzione (profitto o utilità)
- retorica della concorrenza, ipotizzata quale soluzione di tutti i problemi di efficienza economica (e intesa in modi opposti, come concorrenza perfetta e come totale libertà di azione delle imprese monopolistiche o oligopolistiche)
- pretesa di universalismo e a-storicità. Nessuna distinzione tra situazioni istituzionali (e culturali e religiose) diverse e diversi percorsi o fasi di sviluppo.

L'utilizzo di una concezione meccanicista e riduttiva dei sistemi biologici e sociali sta contribuendo fortemente a portare il nostro pianeta al disastro

L'obiettivo della crescita economica continua e illimitata è in contrasto con le leggi fondamentali della natura e in particolare con quelle della termodinamica

L'ecosistema terrestre è un ciclo chiuso
*(*salvo che per l'energia che riceve dal sole e per i rifiuti che produce e che non sono riassorbiti)

Un sistema chiuso non è compatibile con la crescita infinita di uno o alcuni dei suoi sottosistemi (la popolazione e l'economia)

Alcuni limiti della teoria economica predominante

Teoria economica predominate (approccio neo-classico walrasiano e teoria della scelta razionale)

Tardiva e ancora minima considerazione di
- principi della termodinamica e di
- altre conoscenze essenziali da fisica, biologia e teoria dei sistemi.

Dai punti di vista psicologico, antropologico, sociologico: ignoranza di

- differenze individuali e culturali e loro effetti economici
- funzionamento dei diversi sistemi sociali e interazione con i sistemi produttivi ed economici in genere
- concezione delle modalità di scelta individuale (razionalità strumentale) e del funzionamento dei mercati.
- addirittura negli indicatori utilizzati

Necessità di un RIORIENTAMENTO dell'ECONOMIA

1) **Sul piano normativo**:
riguardo il suo ethos complessivo e i rapporti con l'etica.

Il modello neoclassico walrasiano non rappresenta certo un grande ideale.
L'equilibrio economico generale competitivo, al di là del suo assoluto irrealismo, garantisce solo merci ai prezzi più bassi, nulla di più.
Al meglio si tratta del "paradiso" solo per dei consumisti e materialisti.

Non è davvero difficile immaginare ideali di riferimento preferibili e almeno altrettanto "possibili".

2) Sul piano positivo:
occorre ri-costruire una teoria economica fondata sulla realtà,
non su descrizioni immaginarie, matematicamente sofisticate ed eleganti ma assolutamente irrilevanti.
- sia sul piano antropologico e psicologico, di come gli individui scelgono e agiscono,
- sia su quello del funzionamento delle istituzioni, a partire dai mercati, e delle società umane

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Roberto Burlando

Giugno 2007

Methodological implications of Exper Eco for Economics

The fact that economics is becoming more and more an experimental science - as testified by the exponential growth of books and papers in and on experimental economics - is posing hard methodological and epistemological questions for standard economics.

e.g. "No reality, please, we are economists" (T.H.E)

Different views about the relation between theory and actual behaviour:

- deduction vs induction, i.e. axiomatic approach vs practical/empirical
- models and abstraction

Deductive (i.e. theory driven, axiomatic) vs. **Inductive** (empirical) approaches (start from real data whether from the lab or "social" ones). This is a major distinction within economics and a dispute that is going on since many years (perhaps even centuries, starting with Descartes and in economics with Ricardo).

A priori and deductive approach dominant after the marginalistic revolution, and shared by neo-classical economics, GEE, NCM, Austrians (and Alchian the father of right-wing evolutionary economics).

Incorporated into M. Friedman's "Methodology of positive economics" (1956), stating that:

- the real task of economics and its test is not description but only prediction (falsified by f. i. Lucas critique).
- realism of assumptions is irrelevant

A common distinction in EE: experiments dealing with

- **Individual behaviour / choice**
  Individual DM under uncertainty, various economic choices (intertemporal consumption, saving, investment etc.)
- **Group (or interactive) behaviour / Social dilemmas**
  PD and PG, bargaining, coordination
- **Markets and institutional arrangements**
  Auctions, different market arrangements, financial
- **Macro Theories**
  Labour markets, Fiscal and monetary policies etc.

Individual behaviour

- *individual behaviour under risk:* Expected Utility, SEU and their axioms and implications; alternative theories
- *learning:* individual and organised, biases and heuristics; responses to asymmetric and incomplete information
- *individual choices*:
  - intertemporal choices (saving and consumption, Hicks-Slutsky and life-cycle-permanent-income models)
  - expectations formation and forecasting; search and optimal stopping rules;

Group behaviour and interactive play in social dilemmas

- often set up in Game theoretical terms
- focussing especially on Co-operation vs. Free Riding, fairness vs. self-interest
- prisoner's dilemma, public goods (VCM), tax compliance and evasion common resources and externalities, etc.
- Bargaining, UG and dictator game
- co-ordination games
- attempts to test alternative notions of equilibrium within GT, or to develop new concepts in evolutionary GT and in low-rationality GT (Roth)

Rational Choice under Uncertainty – Risk.

Risk vs Uncertainty

Utility

Expected Utility **EU and SEU**

V.Neumann – Morgenstern (47) , Savage (54).

Assumptions needed to construct a VN-M Utility function

Tests on the assumptions

Tests on alternative specifications

Risk: the relation between actions and outcomes is determined by a probability distribution over the events (or states of the world).

Any action is like the purchase of a lottery ticket, in which you know the πs of any of the events. To each action is attached a prospect vector, associating the range of possible outcomes following from the very action with the π of their occurrence.

Usually prospect = income.

Uncertainty: impossible to define a probability distribution (even a subjective one) over the events, or even to provide a complete list of the possible events or outcomes resulting from some actions.

How are we to represent a choice in conditions of risk or uncertainty?

some terminology…

Event: it is what does happen (or could happen)

The future is characterised by the fact that various events might happen. Some of them are compatible, others are mutually exclusive.

So the future can be though as a space (made of various conditions of the world), which is divided in events.
Which event does happen determines the "**state of the world**".

Outcome (consequence).
An outcome is the consequence that is implied by a specific event happening. So to each event it does correspond a specific outcome.

Action
An action is what someone decides to do. The combination of an action and an event (i.e. a future state of the world) determines the outcome.

Therefore the outcome usually depend on an action, which is in our control, and on an event, which is not.

A simple way to express risky choices is in terms of lotteries.

A lottery express the probabilities of alternative events and associates to each an outcome (payoff)

If and only if people have preferences over **risky choices**, or lotteries, that satisfy certain **axioms (of "rational choice**"), then their preferences can be expressed via a [V.N-M] Utility function.

It is then possible to analyse the course of action of the individual in terms of maximization of **Expected Utility**.

E.G. Throwing a Coin.

Space of the events: E_1 and E_2 (Tail or Cross)
Events: Tail, Cross
Consequences: €O , €100
Action A_1 : Bet on Tail
Action A_2 : Bet on Cross

How is this situation represented?
Action/State of the world

	Tail	Cross
A1	100	0
A2	0	100

i.e. if I choose A1 and tail is drawn I win 100 etc.

SEU: V.Neumann – Morgenstern (47) , Savage (54).
Formal, axiomatic theory, resting on axioms of consistency rather than on traditional (psychological ?) assumption of Utilitarianism.

Assumptions needed to construct a VN-M Utility Function.
Start with the same needed for a normal Utility function, i.e.

1. **reflexivity**
2. completeness
3. transitivity
these conditions enable to constitute a preference ordering.
…if also
4.continuity

⇒ Utility function, unique up to a positive monotonic transformation

Plus..
5. *dominance*, or preference increasing with probability. (when π of a preferred outcome Δ, the prospect improves)

6. *continuity* 2. It is always possible to find a π mix such that for any 3 prospects the combination of the best and worst of them is regarded as indifferent to the middle one.

7. *strong independence*. in any prospect any component object or prospect can be replaced by an object or prospect indifferent to it and there will be indifference between the resulting prospect and the original one.

⇒ **cardinal U. function**:

⇒ preserves the ratios of differences between the utilities of objects, so it is unique up to a linear transformation (monotonicity is not enough). ordinal U function only preserve the ordering.

Is EU (or SEU), besides being an elegant theoretical approach, also a practically relevant one?

i.e. do individuals behave as this theory predicts (or imply)?

Many evidences that they do not. They both violate some of the axioms and act in different ways.

Alternative theories may be seen as attempts to explain systematic violations of the principles of "rational choice" (SEU) observed in individual behavior. e.g.

axiom violated		theory
independence	→	Disappointment
transitivity	→	Regret

Alternative theories of DM under uncertainty

SEU
Prospect
Regret
Disappointment
Disappointment Aversion
Weighted EU
Implicit EU
Rank EU

Experiments designed to test alternative specifications

IDEAS ABOUT RATIONALITY IN ECONOMICS:

Instrumental: the methodology of positive economics

Procedural: H. Simon and how organizations works

Expressive: finding out your preferences, values etc.

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Roberto Burlando

Giugno 2007

The Public Good problem

A Public Good is a good which is both:

- non-rivalled (many people can enjoy it at the same time) and
- non-excludable (too costly making someone paying for his consumption).

Examples of Public Goods are: clean air, public parks etc, and we can think of Public Bads as pollution, global warming, street crimes etc.

Public Goods have a positive value to everyone, but they are susceptible to underprovision because any individual has a private incentive to Free Ride off others' contributions and spend his money on private goods.

If everyone follows such individual incentive, the good is either not produced at all or produced at an inefficient low level.

Theoretical presumptions :

-among economists. decentralised allocation mechanisms cannot be relied upon to provide the public good

-among social psychologists and sociologists. there are various influences on individual behavior that induce at least some degree of contribution.

When the choice is restricted to a binary one (i.e. either contribute a given amount or none) the Public Good problem is reduced to a standard Prisoner's Dilemma.

Normally **no production at all is the Nash Equilibrium** for the PG (as well as for the PD) problem,

and **this theoretical equilibrium outcome is Pareto-dominated** by the non-equilibrium outcome where everyone contributes to the Public Good.

Problems related to the presence and provision of Public Goods.

- are people selfish or co-operative ?
- do people behave differently when confronting Public Goods decisions than when making private good decisions ?
- are altruism and fairness concepts that can be ignored by social scientists, and in particular by economists ?
- is the representative agent approach a good enough approx. for the setting?
- can markets provide optimal allocation of Public Goods, such as air pollution or public health ?
- how do current political institutions perform in the production (and funding) of Public Goods ?
- what other organisational arrangements (rather than free market or current institutions) would better serve the interests of society ?

The baseline VCM experiment

The players decide how much of a given endowment to invest in either a Group or a Private account.

Let it be:

Ei = initial endowment (tokens or money),

Ii = individual investment in the group account, out of Ei

so Ei - Ii = investment in private account,

Ri = individual gain in a round (return on investment).

Then we have $Ri = Ei - Ii + F(\sum Ij), j = 1,...n$ (1)

with the partial derivative $\partial Ri/\partial Ii = -1 + F'(\sum Ij)$, (2)

where F' = MPCR (marginal per capita return)

Baseline VCM Experiment

$Ri = Ei - Ii + F(\sum Ij) j = 1,...n$

Ei - Ii is both the individual investment in the private acc. and the return from it

$F(\sum Ij)$ is the individual return from the group account,
where $F' = \partial F/\partial I$ = MPCR (marginal per capita return) and
$\sum Ij$ is the sum of individual contributions to the group account.

Since the partial derivative $\partial Ri/\partial Ii = -1 + F'(\sum Ij)$,
if MPCR < 1
then Max (Ri) implies setting Ii = 0, because $\partial Ri/\partial Ii$ is negative.

Therefore **contributions to the private account are individually optimal whenever MPCR < 1**,

the form of investment is indifferent only when MPCR = 1,
and whenever MPCR > 1 it is individually optimal to contribute to the group account.

Group return, instead, is increased more from contributions to the group account as long as $n * MPCR > 1$ (or MPCR > 1/n),
while when MPCR < 1/n, no greater increase to group return is derived by group contributions.

So **the public good**, or the free-rider, **problem emerges only** whenever **1/n < MPCR < 1**

because in this case each individual player can benefit from others' contribution while not contributing herself.

Experimental Designs to Test Alternative Hypothesis

- partner/stranger distinction
- restart (and cognitive dissonance)
- international comparison
- framing
- final round effect
- patterns of sequencing in the partners/strangers sessions
- punishment
- individual differences / players heterogeneity

The Recent Experimental Literature on Public Goods

and the role and meaning of repetition.

- Early Experiments: differences, agreement and research agenda.
- Discriminating between alternative hypotheses via experimental design
- Noise and Confusion versus Kindness
- Framing, Observability, Reciprocation and Social Norms
- Value orientation, Attitudes and Individual Differences

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Roberto Burlando

Giugno 2007

Do we learn only to be selfish?

Learning, cultures, players heterogeneity and strategies in Public Good experiments

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Problems usually associated with - the private provision of public goods
- experiments on VCM

- can **markets** provide optimal allocation of Public Goods?

- how do current (political) **institutions** perform in the production (and funding) of Public Goods ?

- what **other organisational arrangements** might better serve the interests of society in this respect?

- **do people behave differently** when confronting Public Goods decisions w.r.t. private good decisions ?

- are people selfish, co-operative or what ? and are **altruism, fairness, reciprocation, inequality aversion** etc. concepts that can be ignored by social scientists, particularly by economists ?

- is the **representative agent approach** a reasonable one in this context?

One of the main facts in Experiments on the Private Provision of Public Goods is that contributions decline with repetition

The problems with repetition.

Repetition was the most noticeable difference across early studies, because some were single period games, other multi-period ones.

There is a general tendency for FR to increase with repetition in all the experimental studies (including our ones).

But: What does repetition really imply?
Why does it produces decay only in certain environments?
(i.e. the PG setting as opposed to other environments)

There are still various competing explanatory hypotheses for the decay of contribution with repetition:

- **learning**. Only in time some players realise that not contributing is a dominant strategy. Or people are **confused** and the the data about their decisions are **noisy**… Noise and errors are normally only in the direction of higher contribution rates.

- **strategic play**, in the form of **reputation building.** Perfectly rational and selfish players may find it convenient to pretend and be co-operative (so inducing their group partners contributions) until almost the end of the game (this requires giving up backward induction).

- hypothesis of "**non-standard behaviour**", namely some forms and degree of **altruism** or **kindness** and/or compliance with **social norms**.

- **players heterogeneity**, i.e. some FR, some Co-op and.. possibly various types of *Reciprocators* (likely the larger and possibly the most interesting group)

Standard attempts to explain the phenomenon of decaying contribution in repeated linear public goods games:

- are based on a 'representative agent' approach
- quarrel about the degree of selfishness (plus an 'error' component) or altruism within the experimental sample.

After a number of experiments we came to the (very simple) hypothesis that there are:

- players who are very selfish (or "rational"),
- others who are quite co-operative and
- a large number who are "in between" and tend to show various kinds of reciprocity in their behaviour.

So in a number of experiments and papers we are

- trying to test the players heterogeneity hypothesis
- by purely experimental means.

We believe that theories are very useful and practical, but need building on solid evidences, so our first step in this direction is "fishing for facts".

In other words we plan to follow an inductive approach to theory building and believe this possibility to be one of the great advantage of experimental economics.

Problems with some referees and editors on this point, as they were really asking for theoretical foundations of some sort but..

Players classification in “types”

The most difficult task in this approach and in running an experiment along these lines is how to clearly identify different players types and “classify” them accordingly...

The difficulty derives mainly from the fact that not many players seems to correspond to “pure” types but rather to adopt a wide range of (non-linear) combinations of various types of behaviour (and so a complex kind of learning seems to occur) in reaction to the behaviour of others

Working without a theoretical foundation and a formal model implies that the classification criteria in use must necessarily be ‘ad hoc’, though quite reasonable, and - by definition - lack a rigorous theoretical foundation.

Up to now attempts at looking at various orientation of players used a very “crude” measure: individual contribution either overall or in the first round (s).

We have been looking for something more convincing than this and tried – in various experiments and papers – different algorithms for the classification.

In all these experiments we have been using as a crucial test of both (and unfortunately jointly)

- the heterogeneous hypotheses and
- the classification procedure

a two stages setting, in which the second stage is made of the play of “homogeneous” players within each group and the heterogeneity is across (instead of within) the groups.

Heterogeneous agents in public good experiments

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Experimental Economics 2005

In this paper we devised a classification algorithm based on different games.

In the first stage participants played:
- a strategy game,
- a decomposed game
- a PG experiment in a standard (**mixed**) setting,
- a short self-assessment questionnaire

Then, using the results of all of them in a "triangulation" we distinguish the 4 players types and

In the second stage we had them playing again the PG game, within **homogeneous** groups.

Repeated linear PG experiment (homogeneous groups)

All subjects were classified during the week between Session 1 and Session 2, and we found out the situation depicted below:

	Reciprocators	*Free riders*	Cooperators	Noisy	Total
N	32	29	17	14	92

We managed to create:
6 groups of free riders, 6 groups of reciprocators,
4 groups of co-operators, 3 groups of 'noisy' players,
2 mixed groups

The two non-homogeneous groups were formed by matching the remaining players. (One with 3 reciprocators and 1 free rider; the other of 1 free rider, 2 reciprocators, and 1 'noisy' player). For obvious reasons, these non-homogenous groups will not be considered in the main process of data-analysis below.

Main results

In the homogeneous setting:

1) the overall contribution level is significantly enhanced;

2) the decay with repetition phenomenon is replicated only in groups of 'pure' free riders, whereas in groups of cooperative and reciprocating players the contribution rate is high and fairly stable throughout the game.

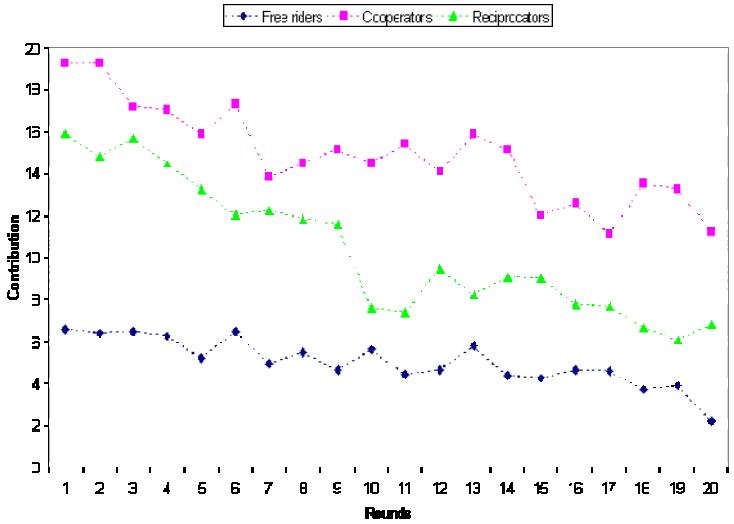
Moreover we registered a remarkable convergence among the different methods of classification.

So, it seems to us that the classification procedure did the job, at least with a reasonable approximation.

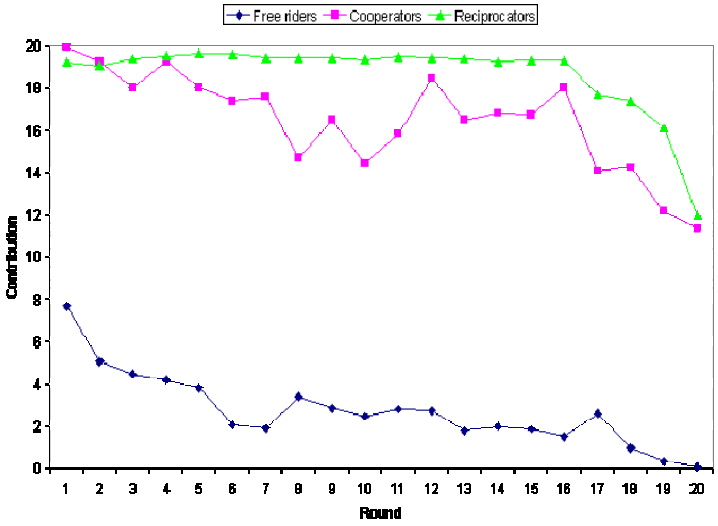
Average contribution in the repeated PG game

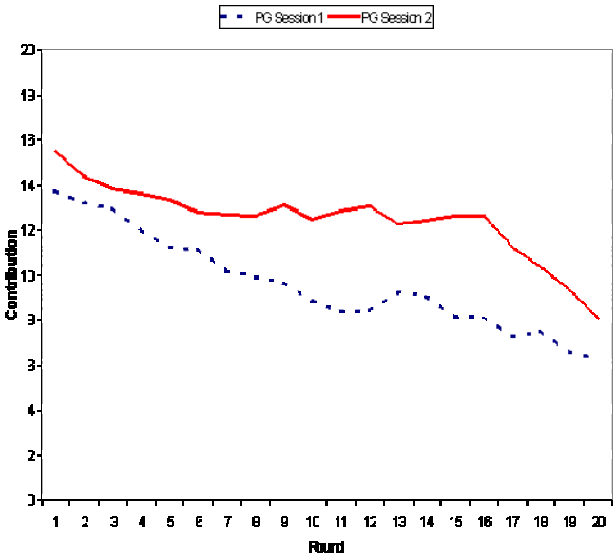
	Session 1	Session 2	Difference (2-1)
Cooperators (N=16)	14.91	16.45	**1.54**
Reciprocators (N=24)	10.38	18.65	**8.27**
Free riders (N=24)	5.03	2.71	- 2,32

Contribution in Stage 1 (random matching) by different types of players



Contribution in Stage 2 (homogeneous) by different types of players





Players Heterogeneity and Longer Run Equilibria in the Private Provision of Public Goods.

An experimental Analysis.

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Very preliminary results.

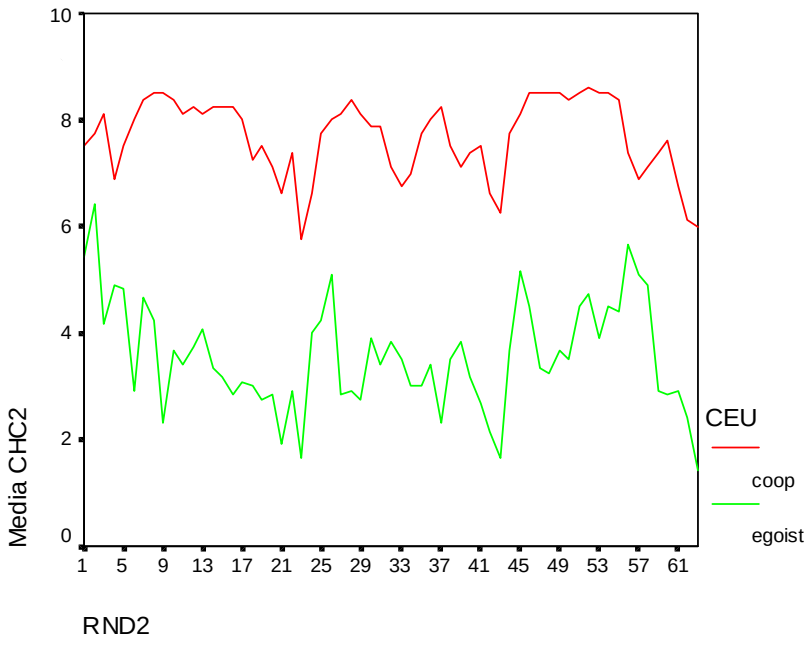
Main features of this experimental design

- Two stages, 1° with random groups composition, 2° with groups composed of "homogeneous" players (our choice)
- 60 rounds (plus 3 initial trials) with two breaks (restart test for lerning)
- a question about individual expectation in each round
- constant technology and MPCR= 0.5
- 9 tokens to be allocated
- no communication during the experiment (separators)
- a set maximum decision time within each round (10" + 5")
- anonymity of the players
- experiment conducted in Turin and Exeter
- participants from many different faculties of the local universities,
- terminal numbers distributed in a scattered way
- controls for: gender, age, subject taken and year of course

The Algorithm used for the classification of players.

Participants in this experiment played only a 60 round PG game in each stage (plus 2 questionnaires in the 1° stage), and we used the data from the play in the first stage to classify them using:

- the overall average contribution (excluding the trials),
- the average difference between individual decision and group average in the previous round,
- the average difference between each individual decisions and expectations,
- the average contribution in the 3 trial rounds and first 2 rounds,
- the average contribution in the last 3 rounds,
- the evaluation of the post exp. - questionnaire



Conclusions

Standard GT predictions based on the representative agents approach and setting imply the prediction that in repeated play contribution rates should decrease, but this is clearly not what we see in this framework.

Or rather: it is true for free riders and for reciprocators in non-homogeneous groups, but certainly not for co-operators and reciprocators in homogeneous groups.

Our evidence strongly supports the heterogeneous agents hypothesis.

This should have important consequences on the experimental debate on repeated PG games (and also beyond it)

The divide between models of self-interested agents on the one hand and models of altruistic players on the other, might never be resolved simply because there are agent of both types.

It seems more interesting and fruitful to recognise not only the existence of these two types of players, but also their influence on another (large) category of players: reciprocators (or 'conditional cooperators').

This may not be relevant in *all* economic contexts, but it certainly is in a number of them (and even recent micro-econometric results seem to show the same).

In particular, representative agent models may be perfectly adequate in many circumstances for predictive purposes, but lack explanatory depth and might fail to capture some important mechanisms that tend to sustain cooperation.

Even the representative agent models 'augmented' with *altruism* or *inequality aversion* (at least as presented so far) fail to capture some relevant feature of the behaviour (and even more of its motivations) as they tend to present a sort of "continuous" in players attitudes and fail to look at the different dynamics related to the composition of the groups.

As reciprocators constitute a large portion of the experimental population (in our sample, but see also Fischbacher et al., 2001), it is possible to raise the overall level of contribution by forming homogeneous groups of players with similar attitudes towards cooperation.

The same is likely true in real life, though the social context has a significant part in shaping individual attitudes (social identity and beyond).

Letting people meet (and even choose) their partners within market-type settings without enough information and institutional arrangements (self-organisations and rules) may not be an effective means to promote cooperating behaviour, as Free Riders might choose an exploit Cooperatorors (e.g. see Page and Putterman and Keser on endogenous group formation).

As many settings (VCM ones but also markets) are characterised by

- incomplete and asymmetric information
- lack of binding rules (and institutions) and social ties

there is a tendency to emphasise and over-represent the selfish players component, as it "crowds out" the reciprocator one for whom the "instrumental exchange" is not the only motivation (Gresham law applied to motivations, Bruni and Zamagni 04).

In VCM settings this might mean approaching the Nash equilibrium instead of the social (Pareto) optimum, the real life equivalent could be the destruction of the social bonds upon which society, and even markets, rest.

SIMBIOSI E APOPTOSI

Dal gene egoista al sacrificio del sé individuale

Giuseppe Barbiero

GRUPPO DI RICERCA IN DIDATTICA DELLE SCIENZE NATURALI

Immagini e metafore

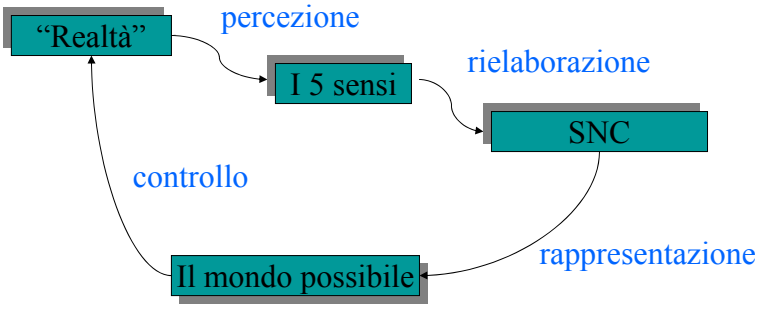
La percezione della realtà fenomenologica avviene attraverso le “finestre” dei sensi.

La nostra specie ha la possibilità di elaborare le percezioni sensoriali mediante un sistema nervoso particolarmente complesso.

L’elaborazione delle percezioni avviene attraverso la costruzione di immagini e di metafore.

La scelta delle immagini e delle metafore da parte dello scienziato è influenzata dalla cultura e dai pregiudizi.

Il mondo come rappresentazione



Concetti strutturanti e strumenti concettuali

- Concetti strutturanti una teoria
  - Sono idee proprie di una teoria emerse in ambito sperimentale. Sono piuttosto rare.

- Strumenti concettuali come metafore
  - Sono idee mutuate da altre discipline
  - Epifore: quando prevale una corrispondenza tra referenti.
    Esempio: “La selezione naturale del più adatto”
  - Diafore: quando prevalgono gli elementi di discontinuità.
    Esempio: “Il gene egoista” (potere euristico elevato)

La metafora del “gene egoista”

Dawkins riprende e porta alle estreme conseguenze l'idea darwiniana che i processi evoluzionistici agiscono sul genotipo attraverso la selezione differenziale dei fenotipi che essi riescono ad esprimere.

L’aggettivo “egoista” proprio dell’etica viene utilizzato dai biologi in senso metaforico

Ma gene=DNA= programma della vita che, per estensione, diventa un programma “egoista”

Metafore e sistemi di valori

“Nel passaggio da un contesto all'altro analogie e metafore trascinano con sé, in modo spesso implicito sistemi di valori che si vorrebbero estranei al discorso scientifico.

“D'altra parte, proprio attraverso la mediazione di analogie e metafore si aprono a volte spazi di interpretazione prima non visibili e a partire dai quali si strutturano quadri teorici nuovi e relativamente indipendenti dallo stimolo iniziale”

Barbara Continenza

Malthus → Darwin → Spencer

Divaricazione tra tasso geometrico di crescita di una popolazione e tasso aritmetico di crescita delle risorse. (Malthus)

La selezione naturale elimina i meno adatti. (Darwin)

Tentare di migliorare le condizioni degli strati più deboli della società è un atto innaturale, nel senso che contrasta l’opera di selezione naturale. (Spencer)

Ma se Darwin …

- Non esiste un determinismo naturale della competizione

W. Godwin

- Il mutuo appoggio è un fattore dell'evoluzione

P. Kropotkin

Kropotkin e la rivoluzione russa

1902 - Il mutuo appoggio (P. Kropotkin)

1909 - I cloroplasti sono simbionti all'interno della cellula vegetale (K.S. Merezhkovsky)

1924 - Gli undulipodi delle cellule sono le vestigia di antichi batteri (B. Kozo Polyansky)

1941 - I cicli biogeochimici che sostengono la vita del pianeta sono il risultato della collaborazione tra diverse specie (V.I. Vernadsky)

Lynn Margulis

Simbiosi: è una associazione tra esseri viventi che vivono una relazione fisica e funzionale molto stretta

La cellula eucariote è il risultato di una endo-simbiosi seriale che ha coinvolto diverse cellule procarioti

Esempi di cooperazione funzionale

- La divisione del lavoro nelle colonie batteriche (Shapiro 1988; Margulis 1993)
- L'origine dei mitocondri e dei cloroplasti (Margulis 1993)
- L'origine di relazioni funzionali come l'apoptosi nei metazoi (Ameisen 1999)
- L'organizzazione sociale e il mutuo sostegno tra conspecifici (Wilson 1975)

L’apoptosi

Caenorhabditis elegans

L’apoptosi è un tipo di morte che la cellula adotta volontariamente a vantaggio dell’organismo.

Nel piano di sviluppo di *C. elegans* 131 cellule nascono, svolgono la loro funzione e poi devono morire al posto e al tempo giusto perché altrimenti il vermetto non diventa adulto.

Esempi di apoptosi

- la coda nei girini
- La piega interdigitale prima della formazione delle dita della mano nel feto
- L’endometrio nelle donne del periodo premestruale

Prove dell’origine simbiotica dell’apoptosi

- Presenza di apoptosi in organismi unicellulari (protozoi e amebe)
- Coinvolgimento di geni presenti nei mitocondri
- Coesistenza di diverse vie che portano all’apoptosi

Conclusioni

- Nei metazoi la cellula, pur conservando la propria individualità, assume una priorità diversa nel benessere dell’organismo che la trascende, anche se questo richiede il sacrificio del proprio sé individuale.
- In questo senso l’A. può essere considerata il punto più alto della simbiosi mutualistica.

SIMBIOSI E APOPTOSI

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