On Collective Rational Action and Collective Irrationality

Jan van Eijck, CWI Amsterdam and Uil-OTS Utrecht
Rineke Verbrugge, Institute of AI, University of Groningen

ESSLLI 2009, Bordeaux, July 24, 2009

Overview

- Six Questions

- "For that which is common to the greatest number . . ."

- The Tragedy of the Commons

- Individual Rational Action – Looking After Number One

- Individual Interest and the Invisible Hand

- Collective Rational Action

- Dilemmas of Collective Responsibility . . .

- A Modest Proposal for ESSLLI 2010, Copenhagen

"For that which is common to the greatest number ..."
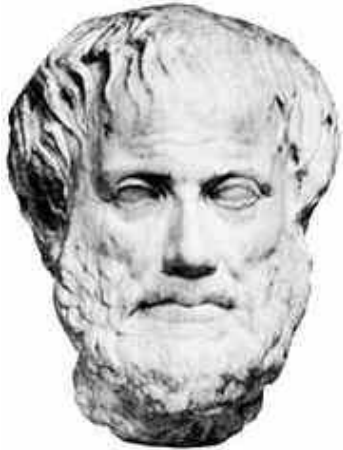
"For that which is common to the greatest number has the least care bestowed upon it. Every one thinks chiefly of his own, hardly at all of the common interest; and only when he is himself concerned as an individual. For besides other considerations, everybody is more inclined to neglect the duty which he expects another to fulfill; as in families many attendants are often less useful than a few."

Aristotle, Politics, Book Two (about 350 B.C.)

Six Questions

Please be prepared for some interaction. Have a sheet of paper ready, with room for answers to six questions:

Question 1

Question 2

Question 3

Question 4

Question 5

Question 6

Rational for the one, disastrous for the many

- Farmers grazing their goats on a common meadows.

- Citizens of Bordeaux who want free parking in the inner city.

- Prosperous families wanting to drive bigger and bigger SUVs.

- Airport hubs wanting to attract ever more air traffic.

- Fishermen roaming the oceans in ever bigger fishing trawlers

- Logging companies cutting down ever more tropical forest.

- Developed countries exporting their industrial waste to developing countries.

- US citizens defending the Second Amendment right to keep and bear firearms. ("NRA: The largest civil-rights group ever")

The Tragedy of the Commons

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both men and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy.

Garrett Hardin, 'The tragedy of the Commons', in Science, 1968 [7].

See http://www.garretthardinsociety.org/articles/art_tragedy_of_the_commons.html and http://members.aol.com/trajcom/private/trajcom.htm
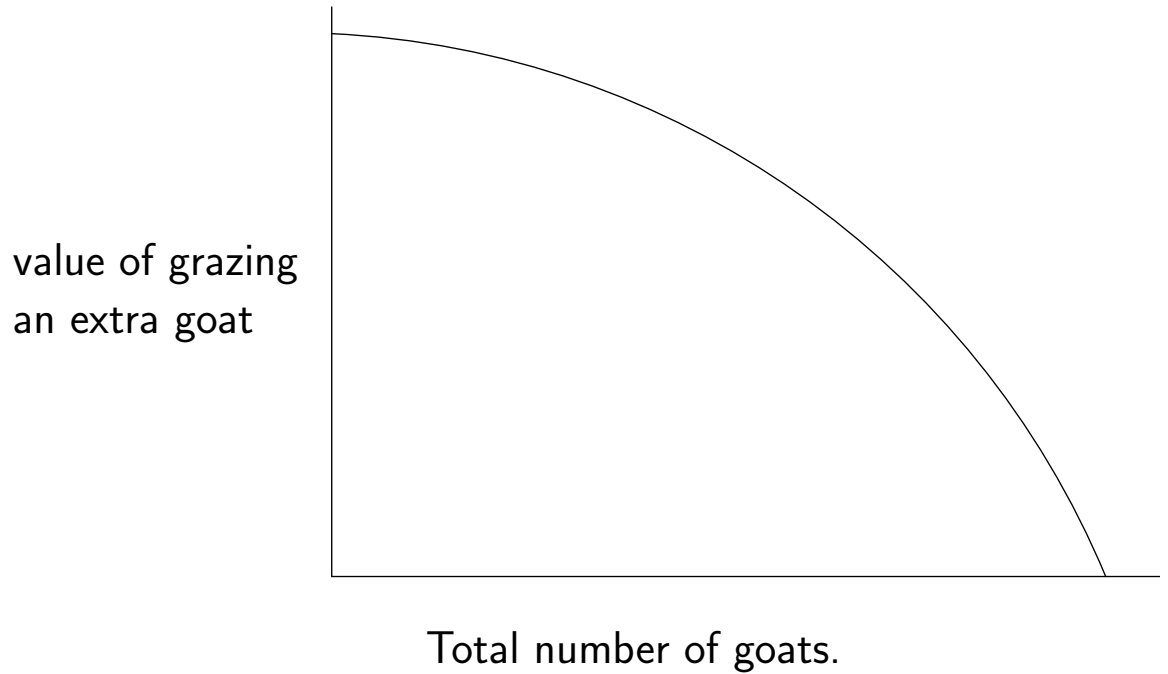
Garrett Hardin (1915–2003) was a microbiologist and ecologist. 'The Tragedy of the Commons' is his most well-known essay.
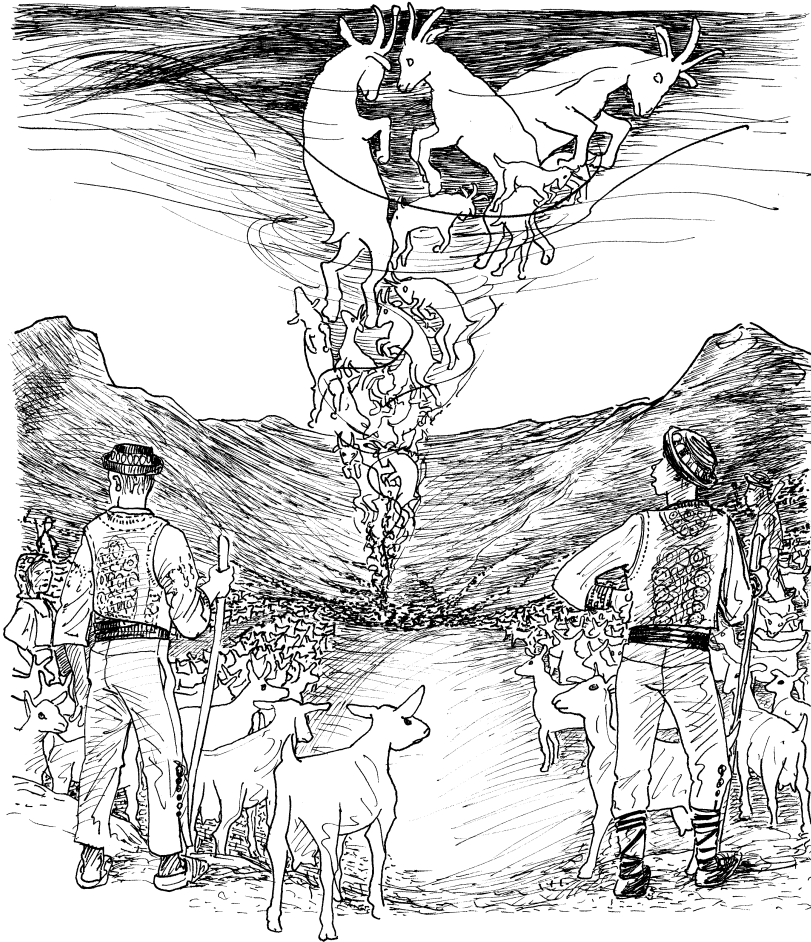

'While I may be a bearer of bad news,
I try to convince people that
what sounds like bad news is better
than "good news" that's wrong.'

Interview in Skeptic magazine, 1996.

The Tragedy in a Picture, from [6]

value of grazing an extra goat

Total number of goats.

picture by
Marco Swaen

From the Fourth IPCC Assessment Report

The climate system tends to be overused (excessive GHG concentrations) because of its natural availability as a resource whose access is open to all free of charge. In contrast, climate protection tends to be underprovided. In general, the benefits of avoided climate change are spatially indivisible, freely available to all (non-excludability), irrespective of whether one is contributing to the regime costs or not. As regime benefits by one individual (nation) do not diminish their availability to others (non-rivalry), it is difficult to enforce binding commitments on the use of the climate system [9, 8]. This may result in "free riding", a situation in which mitigation costs are borne by some individuals (nations) while others (the "free riders") succeed in evading them but still enjoy the benefits of the mitigation commitments of the former [13, page 102].

Individual Rational Action — Looking After Number One

Individual rational action consists of:

- knowing what you want,

- knowing the rules of play for achieving your goals,

- taking the right steps to achieve your goal, or get as close to it as you can.

These are skills that can be learnt.

Soft tools: creative visualisation, psychotherapy, . . .

Hard tools: risk analysis, decision theory, probability calculus, game theory.

It is all about your risk, your profit, your strategy to prosper as much as possible.

Individual Interest and the Invisible Hand

Modern democracies are organized in such way as to allow maximal bandwith for individual rational action.

Justification of this (often) given in terms of Adam Smith's invisible hand:

> It is not from the benevolence of the butcher, the brewer or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves not to their humanity but to their self-love, and never talk to them of our necessities but of their advantages. Nobody but a beggar chooses to depend chiefly upon the benevolence of their fellow-citizens.
>
> Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, 1776

'Greed is Good' Speech in Wall Street (Oliver Stone, 1987)

"The point is, ladies and gentlemen, that: Greed, for lack of a better word, is good. Greed is right; greed works. Greed clarifies, cuts through, and captures the essence of the evolutionary spirit. Greed, in all of its forms, greed for life, for money, for love, knowledge, has marked the upward surge of mankind and greed, you mark my words, will save not only Teldar Paper but that other malfunctioning corporation called the USA."

Inspiration for 'Greed is Good'

The defense of greed is a paraphrase of the May 18, 1986 commencement address at the UC Berkeley's School of Business Administration, delivered by arbitrageur Ivan Boesky (who himself was later convicted of insider-trading charges), in which he said, "Greed is all right, by the way. I want you to know that. I think greed is healthy. You can be greedy and still feel good about yourself."

http://en.wikipedia.org/wiki/Wall_Street_(film)

Adam Smith Does Not Agree
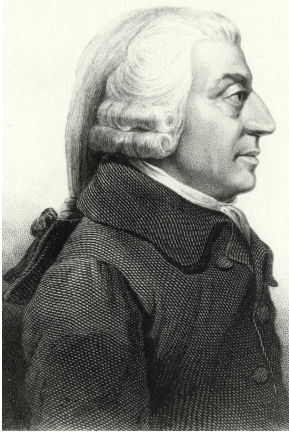
"The man of the most perfect virtue, the man whom we naturally love and revere the most, is he who joins, to the most perfect command of his own original and selfish feelings, the most exquisite sensibility both to the original and sympathetic feelings of others."

Adam Smith, The Theory of Moral Sentiments, [14]

Individual Interests — A Simple Betting Game

A gambling game against 'the house'.

- You start with wagering one euro.

- The representative of the house flips a coin.

- If the coin lands heads, you win, and the house pays you twice your current wager.

- If the coin lands tails, you lost your wager. However, you can decide to double your stakes and go on for the next round, at least . . . as long as your funds allow this.

Assume the coin shows tails three times in a row. You have raised your stake twice already. It is your turn now. Your stake has risen by now to four euros. Your choice: either accept the loss of your 4 euros, or draw your purse and increase the stakes to 8 euros . . .

Are you willing to play this game? This is QUESTION ONE. Please write down your answer.

Analysis

- Your likelihood of winning is always one half.

- You may arrive at a stage where you wager all you have.

- If you win you get twice your stake, if you lose your stake is lost.

- The value of the game is the likelihood of winning times the payoff.

- The value of the game is always equal to the stake.

Individual Interests — The St Petersburg Game

Daniel Bernoulli
1700–1782

Keep tossing a fair coin, until the coin shows tails. Your prize:

- In any case 2 euros.

- Every time the coin lands heads, your prize gets doubled.

This game always yields a profit for you, so it is only natural you have to pay for the privilege to play it. How much would you be willing to pay? This is QUESTION TWO. Please write down your answer.

Value of the St Petersburg Game

number of throws	probability	prize	expected payoff
1	$\frac{1}{2}$	2 euros	1 euro
2	$\frac{1}{4}$	4 euros	1 euro
3	$\frac{1}{8}$	8 euros	1 euro
4	$\frac{1}{16}$	16 euros	1 euro
5	$\frac{1}{32}$	32 euros	1 euro
6	$\frac{1}{64}$	64 euros	1 euro
7	$\frac{1}{128}$	128 euros	1 euro
8	$\frac{1}{256}$	256 euros	1 euro
9	$\frac{1}{512}$	512 euros	1 euro
10	$\frac{1}{1024}$	1024 euros	1 euro
11	$\frac{1}{2048}$	2048 euros	1 euro
12	$\frac{1}{4096}$	4096 euros	1 euro
$\vdots$	$\vdots$	$\vdots$	$\vdots$

Analysis

- Total expected value of the game is the sum of the expected values for all the possible runs.

- There is an infinity of possible runs.

- The run n heads in a row, followed by tails gets less likely as n increases, but the payoff of 2^n euros compensates for this: each run has expected value of 1 euro.

- So the total expected value of the game is infinite.

- Does this mean that for a rational player no price of entry for playing the game should be too high?

- No casino has the St. Petersburg game on offer, not even in Las Vegas. Why is this?

Consider again . . .

What price of entry would you be willing to pay for the privilege of playing the game?

You may now revise your answer to QUESTION TWO.

Note: $2^{11} = 2048, 2^{12} = 4096, 2^{13} = 8192, 2^{14} = 16384, 2^{15} = 32768, 2^{16} = 65536, 2^{17} = 131072, 2^{18} = 262144, 2^{19} = 524288, 2^{20} = 1048576.$

A run of 19 heads in a row, followed by tails, yields a prize of more than one million euros.

The Bystander Effect

Aristotle's observation that one often gets better service in a house with just a few servants than in a house with many is an example of what is called the bystander effect.

Perhaps most famous example of the bystander effect at work: the case of Kitty Genovese who was stabbed to death in a park, in 1964, by a serial rapist and murderer. She had screamed through the attack, and her screams had been heard by many people. Still, she was not rescued.

Possible Explanations

- Ambiguity: some witnesses reported they just were not sure of what was happening.

- Lack of clues: everyone was uncertain about what happened, looked to others for clues, but saw that others were just as uncertain, so no-one acted.

- Diffusion of responsibility: everyone felt that others could respond to the emergency, and maybe even assumed that someone had already done so.

Game Theoretic Explanation of the Bystander Effect

Action brings benefit B, and taking action has a cost C. Assume that $B > C$. It is a minor inconvenience to call the police, and the benefit of preventing a murder is great.

Suppose I am the only witness. Then it is clear what I should do:

I do nothing	-100
I call the police	-1

Suppose there is one other witness. Then we have:

	other witness does nothing	other witness calls police
I do nothing	(-100,-100)	(0,-1)
I call the police	(-1,0)	(-1,-1)

Now suppose there are 6 witnesses altogether. Then here is the game form:

	Number of others calling the police					
	0	1	2	3	4	5
I do nothing	(-100,-500)	(0,-1)	(0,-2)	(0,-3)	(0,-4)	(0,-5)
I call the police	(-1,0)	(-1,-1)	(-1,-2)	(-1, -3)	(-1, -4)	(-1,-5)

Variation on the Prisoners Dilemma: The Dilemma of the N+1 Prisoners

I am in prison. There are N other prisoners. They all, like me, have the choice between keeping silent or talking (to incriminate the others in order to get a lighter sentence).

I do not know what they are going to do. What do I do?

	Number of Others Keeping Silent										
	0	1	2	3	4	5	6	7	8	9	10
I keep silent	-2	-1	0	1	2	3	4	5	6	7	8
I betray	-1	0	1	2	3	4	5	6	7	8	9

Note 1: Whatever the others do, it is always in my interest to betray. The more of the others keep silent, the better for me.

Note 2: The tragedy of the commons is an $N + 1$ prisoners' dilemma.

Here is QUESTION THREE for you: Would you keep silent or talk?

The Dilemma of the Prisoner among a Group of Buddhists

	The Buddhists keep silent	The Buddhists betray
You keep silent	(0,0)	(-2,1)
You betray	(1,-2)	(-1,-1)

You are a prisoner among Buddhists.

You know that none of the Buddhists will betray anyone (it is against their vows — the fourth precept, 'Mindful Speech').

What do you do? This is QUESTION FOUR for you. Please state your answer.

Appeals to Conscience of No Avail

Es ist eine Krankheit, das schlechte Gewissen, das unterliegt keinem Zweifel,
aber eine Krankheit, wie die Schwangerschaft eine Krankheit ist.
— Friedrich Nietzsche, Zur Genealogie der Moral

[It's an illness, a bad conscience, there can be no doubt about that, but an illness in the way pregnancy is an illness. — On the Genealogy of Morals]

Conscience a Disadvantage in the Struggle for Survival
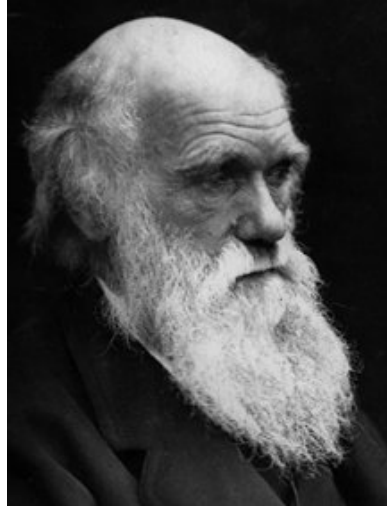
- Those without conscience have an advantage by convincing others to act on their conscience. It increases their likelihood of survival.

- The wimps that let themselves be talked into following their conscience are at a disadvantage with respect to those without one.

A Quote from Darwins 'The Descent of Man'

"But it may be asked, how within the limits of the same tribe did a large number of members first become endowed with these social and moral qualities, and how was the standard of excellence raised? It is extremely doubtful whether the offspring of the more sympathetic and benevolent parents, or of those who were the most faithful to their comrades, would be reared in greater numbers than the children of selfish and treacherous parents belonging to the same tribe. He who was ready to sacrifice his life, as many a savage has been, rather than betray his comrades, would often leave no offspring to inherit his noble nature.

The bravest men, who were always willing to come to the front in war, and who freely risked their lives for others, would on an average perish in larger numbers than other men. Therefore, it hardly seems probable that the number of men gifted with such virtues, or that the standard of their excellence, could be increased through natural selection, that is, by the survival of the fittest; for we are not here speaking of one tribe being victorious over another" [1, Chapter 5].

The Moral Appeal as a Double Bind

Overt Message You are BAD, BAD, BAD if you thrive at the expense of the community.

Hidden Message You are SILLY, SILLY, SILLY, if you let yourself be talked into carrying the burden of others.

Punishment of Free-riders

Binary reciprocity is the simplest kind of helping others. Societies thrive if there is generalized reciprocity, or "paying it forward".

Two things help generalized reciprocity to emerge [11]:

- shared information

- a reputation mechanism by which an agent's social score depends on whether they are free riders or are paying it forward.

Agents who are known to be free riders, are not helped anymore.

In a public goods game with 1,000 participants on the Internet, participants dealt out many more altruistic punishments when it was cheap to do so and had high impact on the free-riders, than when it was expensive or had low impact [4].

When hearing a moral appeal, find out who is talking

Find out whether they have an interest at stake.

- Proverb: "When a fox preaches, take care of your geese."

- How does one recognize foxes? Simple. Their moral appeals are always aimed at preventing the institution of a binding regulation (which would go against their interests).

- Foxes are always in favour of giving both foxes and chickens free range.
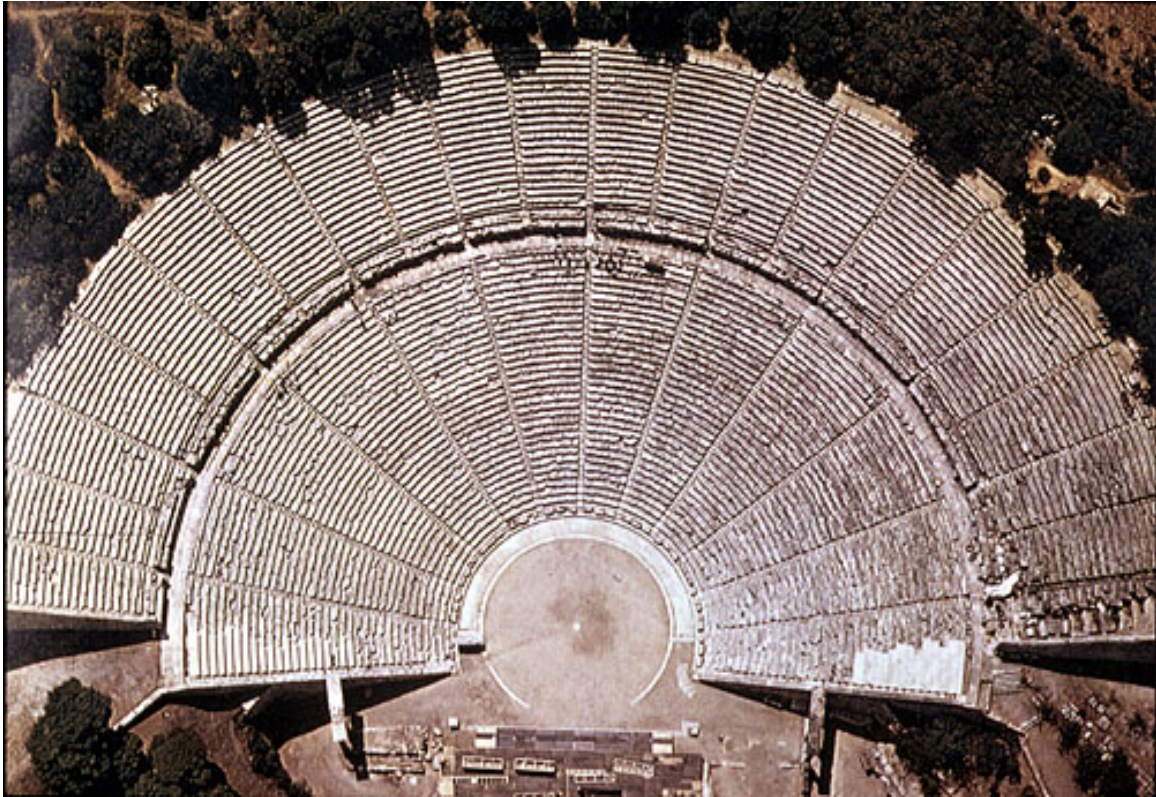
Examples of Foxes

Charlton Heston
"From my cold dead hands!"

Alan Greenspan "The Maestro"
and Ben Bernanke "Helicopter Ben"

Common Experience—The Theatre at Epidauros

The Findings of Emile Durkheim

Sociologist: Emile Durkheim, the founding father of our discipline, was deeply aware of the fact that people need a community to belong to. In a truly groundbreaking work [3], he studied suicide rates in a great diversity of populations across Europe, and found a clear correlation between lack of social constraints — what Durkheim called 'anomie' — and likelihood to kill oneself. Durkheim drew the conclusion that people need obligations and constraints to instill their lives with structure and meaning. People who are religious, married and with children are much less likely to kill themselves. Suicide, at first sight the most individual act one can imagine, is explained in terms of what links — or fails to link — an individual to society.

Collective Action

- Effective collective action can never be the sum of individual actions.

- Needed for successful collective action:

  - common knowledge of the moral stature of those influencing the group,

  - common knowledge of what is the interest of the group as a whole,

  - common knowledge of the collective willingness to take action.

- Social structures for this are all structures that foster the sense of community (Epidauros is a paradigm).

Collective Intentions

Three levels:

A general intention E-INT(φ) is defined just like "everyone believes":
$$\text{E-INT}(\varphi) \leftrightarrow \text{INT}_1\varphi \wedge \ldots \wedge \text{INT}_n\varphi$$

A mutual intention means: everybody intends that everybody intends, and so on (just like common belief). By co-recursion:
$$\text{M-INT}(\varphi) \leftrightarrow (\text{E-INT}(\varphi) \wedge \text{E-INT}(\text{M-INT}(\varphi)))$$

A collective intention means that there is a mutual intention, and a common belief about the mutual intention [2]:
$$\text{C-INT}(\varphi) \leftrightarrow (\text{M-INT}(\varphi) \wedge \text{C-BEL}(\text{M-INT}(\varphi)))$$

Collective Action and Resolution of N+1 Prisoners' Dilemma

If a group knows that they are a group, and that they are under mutual constraint, mutually agreed upon, the $N+1$ prisoners' dilemma resolves itself. Suppose there are 11 prisoners, and the individual payoffs are as follows:

	Number of Others Keeping Silent										
	0	1	2	3	4	5	6	7	8	9	10
I keep silent	-2	-1	0	1	2	3	4	5	6	7	8
I betray	-1	0	1	2	3	4	5	6	7	8	9

Then the collective payoff of everyone keeping silent is $11 * 8$, and the collective payoff of everyone defecting is $11 * -1$, so we get:

Everyone keeping silent	88
Everyone incriminating each other	-11

Mutual Constraint, Mutually Agreed Upon

- How to arrive at mutual constraint, mutually agreed upon?

- Pledges, Promises, Laws, Sanctions

- Civilisation always comes at the cost . . .

Civilisation and its Discontents
— Sigmund Freud

Creation of Common Intention: An Example from [5]

Sociologist: Communication and ostentation certainly play a role in the emergence of collective social structures. The way in which the care of the poor got organized in medieval Europe is a nice example. The clergy played a role in this, and they may have liked to believe that people started to contribute to collective charities out of a moral sense instilled by the Church. But in fact what the clergy did was much more effective. They created a communication structure where everyone knew how much everyone else was contributing to poor relief. Making a contribution to the collective soon became a matter of honor. One might say that collectives come into being as a result of common knowledge and common action.

Creation of Mutual Constraints

Logician: First we need the insight that it is urgent to limit our ecological footprint, to live wisely on this planet. Next, we need to see that we have to be forced to live wisely, that we cannot do it without communities that support us and keep us on track. So we need to build and rebuild our communities, for they will have to impose the mutual constraints.

Computer Scientist: For all that to happen there has to be a universal sense of urgency, like the sense of urgency that was felt in the US after Pearl Harbor.

Unesco Manifesto 2000

Recognizing my share of responsibility for the future of humanity, especially for today's children and those of future generations, I pledge — in my daily life, in my family, my work, my community, my country and my region — to:

(1) respect all life, (2) reject violence, (3) share with others, (4) listen to understand, (5) preserve the planet, (6) rediscover solidarity.

Recognizing my share of responsibility for the future of humanity, especially for today's children and those of future generations, I pledge — in my daily life, in my family, my work, my community, my country and my region — to:

1. respect the life and dignity of every person without discrimination or prejudice;

2. practise active non-violence, rejecting violence in all its forms: physical, sexual, psychological, economical and social, in particular towards the most deprived and vulnerable such as children and adolescents;

3. share my time and material resources in a spirit of generosity to put an end to exclusion, injustice and political and economic oppression;

4. defend freedom of expression and cultural diversity, giving preference always to dialogue and listening rather than fanaticism, defamation and the rejection of others;

5. promote consumer behaviour that is responsible and development practices that respect all forms of life and preserve the balance of nature on the planet;

6. contribute to the development of my community, with the full participation of women and respect for democratic principles, in order to create together new forms of solidarity.

Fifth Question to You

QUESTION FIVE: Would you be willing to sign the manifesto, yes or no?

If your answer is Yes, you are in the good company of the Dalai Lama and other winners of the Nobel Peace Prize.

Go to http://www3.unesco.org/manifesto2000/

If not, you may wish to state your reasons why not.

Knowledge Based Obligation

See 'The Logic of Knowledge Based Obligation' [12]. Presuppositions of First Order Obligation:

- Opportunity (a medical doctor happens to be present when Suzie gets a heart attack has an opportunity to help)

- Ability (a medical doctor may have obligations that a layperson has not)

- Knowledge (a doctor who does not know that Suzie is ill may have no obligation to help her)

There are also Second Order Oligations:

- Duty to maintain/acquire an ability (can you think of examples?)

- Duty to get/keep informed (can you think of examples?)

Knowledge Based Obligation for Scientists [5]

Logician: Martin Rees [the president of Royal Society] has urged scientists to get more involved in public debate, to speak out against minority "maverick" views [10]. Only those who understand how science works—and I suppose that includes all of us—can appreciate the difference between peer-reviewed papers in top-ranking scientific journals and mere pamphlets on the internet. We are skilled in distinguishing false from true in scientific matters, and I believe that this skill comes with responsibilities. We can see that there is a consensus on climate change. The scientific consensus is that there is global warming, that it is to a large extent anthropogenic, and that it is dangerous.

Ignorance as an Excuse for Inaction?

Consider the following pair of quotes:

- "Wir haben es nicht gewußt" [We did not know about it at the time.]

- "Wer nichts tut macht mit." [Anyone who does nothing (when witnessing a crime) is an accomplice.]

QUESTION SIX for you: You are a trained logician (computer scientist, linguist, philosopher . . .). You understand more, so maybe, just maybe, you owe more to society. "Noblesse Oblige", as they say in Bordeaux. Here is the question: "Do you think you have a special responsibility towards society? If your answer is "yes": what are you currently doing to fulfil this obligation? If your answer is "no", you may wish to explain why not.

A Dilemma of Collective Responsibility . . .

Computer Scientist: But we are all "the next guy", aren't we? We all share a responsibility to inform ourselves about what ails society, and about what can be done. For I agree with Feynman that there are no specialists we can pass the buck to. So I am reading up on what I think is the most pressing issue that our society is facing, the prospect of climate change. But now my spouse has started to complain, telling me I should stop reading books on issues that I cannot do anything about, as it is bound to make me depressed. That's probably right. So what should I do?

Philosopher: Your spouse has a point. If you get depressed you will not be effective at anything, so your first duty to yourself, your family, and the world is not to get depressed.

A Modest Proposal for ESSLLI 2010

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

- And we need constraints, mutually agreed upon, right?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

- And we need constraints, mutually agreed upon, right?

- How about setting an example with ESSLLI 2010?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

- And we need constraints, mutually agreed upon, right?

- How about setting an example with ESSLLI 2010?

- ESSLLI gets far too many course proposals anyway, right?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

- And we need constraints, mutually agreed upon, right?

- How about setting an example with ESSLLI 2010?

- ESSLLI gets far too many course proposals anyway, right?

- How about imposing an extra constraint on course proposals?

A Modest Proposal for ESSLLI 2010

- So we need to limit our ecological footprint, right?

- And those who lead us should set the example, right?

- And academics have a special responsibility, right?

- And we need constraints, mutually agreed upon, right?

- How about setting an example with ESSLLI 2010?

- ESSLLI gets far too many course proposals anyway, right?

- How about imposing an extra constraint on course proposals?

- We think all lecturers should commit themselves to travelling to the next Summer School by bicycle.

ESSLLI 2010 Lecturer on his Way from Sevilla to Copenhagen

"Our Man in Copenhagen"

References

[1] Charles Darwin. The Descent of Man, and Selection in Relation to Sex. John Murray, London, 1871. Many online editions.

[2] Barbara Dunin-Kęplicz and Rineke Verbrugge. A logical view on teamwork. In Jan van Eijck and Rineke Verbrugge, editors, Games, Actions and Social Software. Elsevier, 2008. To appear.

[3] Émile Durkheim. Suicide. Free Press, 1897/1951.

[4] Martijn Egas and Arno Riedl. The economics of altruistic punishment and the demise of cooperation. Tinbergen Institute Discussion Papers 05-065/1, Tinbergen Institute, June 2005.

[5] J. van Eijck and R. Verbrugge, editors. Discourses on Social Software, volume 5 of Texts in Logic and Games. Amsterdam University Press, Amsterdam, 2009.

[6] Robert Gibbons. A Primer in Game Theory. Prentice Hall, 1992.

[7] Garrett Hardin. The tragedy of the commons. Science, 162:1243–48, 1968.

[8] I. Kaul, P. Conceiạo, K. Le Gouven, and R.U. Mendoz. Providing Global Public Goods. Oxford University Press, 2003.

[9] I. Kaul, I. Grunberg, and M.A. Stern. Global Public Goods. Oxford University Press, 1999.

[10] BBC News. 'Maverick' risk to science debate, November 30 2006. http://news.bbc.co.uk/2/hi/science/nature/6159371.stm.

[11] M.A. Nowak and K. Sigmund. Evolution of indirect reciprocity. Nature, 437:1291–1298, 2005.

[12] Eric Pacuit, Rohit Parikh, and Eva Cogan. The logic of knowledge based obligation. Synthese, 31:311–341, 2006.

[13] H.-H. Rogner, R. Zhou, R. Bradley, P. Crabbé, O. Edenhofer, B. Hare, L. Kuijpers, and M. Yamaguchi. Introduction. In B. Metz et al., editor, Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, 2007.

[14] Adam Smith. The Theory of Moral Sentiments. Liberty Fund, Indianapolis, 1984. First published London and Edinburgh, 1759.