Cooperation: enjoying collective intelligence.

Alessandro Merletti de Palo, Maria Gisa Masia, Alessandro Mancinella, Mariangela Nitti, Ilario Tito, Kanwar Ujjawal Singh

Introduction

"Could Homo economicus simply be replaced by Homo sociologicus, Homo altruisticus, [..] Homo reciprocans?"[1]
The CCI definition of collective intelligence ('groups of individuals doing things collectively..')[2] implies that the inter-action between individuals plays a key role in the process of generating intelligent outcomes. We intend to focus on the cooperative interactions and on their framework. Verifying a definition of cooperation and understanding how to enable in an environment subsequential cooperation conditions may contribute to different research streams of collective intelligence. This article firstly provides a proposal to define human cooperation based on current literature, describing a possible framework. Then it shows how we intend to verify such definition comparing the human behaviour context both in the macro and the group levels. Finally we show preliminary results about the *diverse* perspectives of the social representation of cooperation.

Cooperation, a definition proposal

The term "cooperation" is currently used in many social and scientific fields though it covers different kinds of interactions that may differ from the meaning, the values and the expectations people and scholars bind to the word itself. Terms and *concepts* like "exchange", "collusion", "collaboration", "compromise", "cooperation", "altruism", "win-win dynamics", "do-ut-des".., are used interchangeably both in literature and in common language[1,3,4,5,10,13,16,17]. Dictionary and rare literature definitions vary[4]. The activities and results[5,6] generated by the many terms also bring to relevant confusion. How can we understand cooperation dynamics without a definition of what cooperation is? In this abstract we will differentiate cooperation from "collaboration" using the latter for any generic inter-action. Comparing the current literature we propose the following definition:

Cooperation is acting together neutrally with mutual enjoyment

"Enjoyment" refers to both the relationship (empathic pleasure derived by the interaction, feelings) and the real (creating/realizing common material rewards: results) benefit-levels. It also refers to behavioural[7] and neuroscientific[8,9] findings about attitude and pleasure in cooperation. *"Neutrally"* means with no disadvantages for third parties, like what happens, instead, in collusion. *"With"* instead of *"for"* implies the enjoyment to also occur in the process beginning and middle, not only in the end.
In other terms, cooperation is a balance where egoism and altruism are both satisfied without excluding one another and for every participant, avoiding internal and external conflicts (competition).[1,3,7,10,13,16,17,18,24]
The definition also merges the i-cooperation (self-oriented concurrent goals) and g-cooperation (group oriented joint goals) constructs in Tuomela[10]. Considering that *diversity* in human identities-perspectives[11] generates different interpretations of a "joint goal"[10], the two constructs can be merged into a single one: even when the goal and the benefits are common, every identity has her own interpretation of the goal. In this multiple perspective context, diversity acts as a *potential* raising alternatively either collaboration efficacy or presence of conflicts, depending on the aggregation/integration level[11,12].
Finally, cooperation can be enjoyed even if the real goal isn't achieved: other valuable benefits, like relationship, development, learning by error-memorization may be a relevant outcome useful for positive evolutionary processes -and enjoyment.
Inspired by Hamilton's equation[1], we propose the following mathematical approach to summarize the definition. In our model b is the real benefit already deprived of costs while r represents the relationship benefit. Being cooperation an inter-action involving *time* (t), it can be seen as a continuous process. If n>1 individuals are interacting, for i=1 to n, $e_i(t)=b_i(t)+r_i(t)>0$ is the total enjoyment for the individual i. We think of cooperation as a variable *equivalence* rather than a *performative construct*. The average enjoyment of the group will be $E_{avg}(t)=(\sum_{\square=1}^{\square} e_i(t))/n$. With $d(b_i(t),r_i(t))=\int_0^{\square} f(b_i(s),r_i(s),E_{avg}(s))ds$ the group enjoyment will continuously ("*with*" in the definition) influence the enjoyment of the individual. If for every i=1 to n $e_{i,t} \simeq E_{avg,t} >0$, and there are no external disadvantages ($ext_d <= 0$), the interaction is *cooperative*.

We also thought about a possible framework. Comparing other interactions terms and their meaning in natural language, as briefly shown in the next table, we constructed the following framework model for cooperation:
Cooperation is a *neutral*, balanced relational interaction between *diverse*[11,12] individuals, based on *freedom of choice*[3], *trust/reliance*[1,3,13], *respect/care*[3,14], *transparency*[1] and *common codes*[14,15] that generates for every participant a *mutual* and result-independent adequate enjoyment, in which the real *benefits* aren't exclusive of the relational ones.

For the sake of clarity we list interactions types other than cooperation fulfilling all the proposed conditions but the listed one(s).

Type of interaction fulfilling most of the conditions	Main condition(s) not fulfilled $e_i \neq E_{avg}$, $ext_d > 0$	Wrong and confusing terms
Altruism [Egoism]	Equivalence, self [or other's] real benefits: goods	Cooperation for altruism or egoism [1,3,16..]
Fear, unaccountability	Trust: expectations.	Cooperation for manipulated obligation [3]
Collusion, opportunism, exchange, commerce	Care, empathy[14,16,17], neutrality: effects.	Cooperation for collusion, do-ut-des [16, 6..]
Fraud	Transparency, truth: information access.	Cooperation for fake collaboration [5]
Slavery/obligation/forced labour	Freedom: choice, personal identity.	Cooperation for obligation [17, 3, 5]
Conflictual collaboration	Understanding, common codes.	Cooperation for generic collaboration
Fanaticism	Diversity, personality.	Cooperation for homologation, uniforming [11]

Approaches to test the definitions

We are verifying the robustness of the cooperation definition by pursuing three streams of research. In more details we are testing dynamically the conditions stated above through *data*, *mindsets*, and *behaviours* and in *groups*, *countries* and *virtual interactions*.

1. we compared *existing* international indicators** to give a measure of the conditions of cooperation: *common benefit, trust, care(including neutrality), transparency, freedom of choice, common codes* and the *diversity* variable/potential. Then we evaluated their correlations and their reverse influence on conflicts, used as opposite of cooperation. We applied it also with the World Giving Index (WGI), considering that a distributed altruism behavior at a large scale interaction -like a country one- can distribute enough enjoyments to represent an approximation of the cooperative equivalence[18]. We hope in the future we could identify a more relevant *country cooperation indicator*.

2. we are *investigating* the social representations or *perspectives* in the diversity sense[11] about cooperation. We are analyzing how individuals intend cooperation through the sense making creation processes. This will help us into applying cooperation to our same research: taking care of the *diversity* between the people representations and our model we can find *common codes* and insights for better development and possible interventions.

3. we are designing a web-based platform to enable people to cooperate together and use data analysis to collectively understand their virtual *behaviour* and compare it with the model. The website is based on the wisdom of crowds and applies the delphi method[19] to decision making[11] and group forming rather than prediction. The platform is currently in its beta stage (see www.cooperacy.org). We will also evaluate the model by direct observation of groups interactions and their social capital [20].

A model of the determinants of cooperation**

As stated above, a cooperation index for countries is missing. We decided to correlate 28 international indicators** with *conflicts* and *WGI* indicators in order to validate our model. We decided to adopt the Partial Least Squares Path Modeling (PLS-PM) technique, which allows to build an overall model implying the use of unobservable variables.

Two separate models** have been estimated to measure the impact of the conditions of cooperation on both the conflict and WGI levels. We came out with the following assumptions from the two models:

1. Common codes, care, transparency, trust, common benefit and freedom of choice are highly correlated. This is probably due to an underlying dimension (cooperation?). Diversity(linguistic) appears to be independent or *inversely correlated*.
2. Transparency *positively*(sic!) affects the level of conflicts ($\beta = 1.14$).
3. Common codes and trust negatively affect the level of conflicts.
4. Freedom of choice, (linguistic) diversity and respect are influential on the WGI index.

This led us to question: a) if high common codes may positively correlate high diversity levels with other LVs reversing its *inverse correlation*; b) if there are any factors that inhibit the correlation between transparency and conflicts; c) if diversity and common codes values may be able to avoid transparency to be correlated with conflicts: according to assumpion 2, it "seems" like the Tao Te Ching was right to suggest that population isn't able to handle the truth -and *shouldn't know*.

Cooperation and its social representation

The scope of this research stream is to extrapolate cultural dimensions in order to identify possible common codes between the perspective of the model and that of the people representations. This will generate better interventions and eventually refine the model with relevant insights.

In order to evaluate the meaning of cooperation in the social representation, we decided to treat the data through the T-Lab[21] emotional textual analysis method, enabling to organize the texts through lexical co-occurrences. We made a brief testing in Italy and then proceeded internationally, receiving questionnaires from different countries. The questions were:

1. What is the meaning of cooperation?
2. Can you tell me an example of cooperation that happened in your life?

In this pilot experiment we analyzed around 50 of them, and plan to expand it on a larger scale. The respondent were organized in classes according to sex, age, job. The two analysis identified six different clusters, each representing a different representation of cooperation. The indentified clusters represent the cultures of:

1-Family, nest, [words: unique, integrate, place, common, group, idea, goal, booking, family, scope, research, develop, safe, ours]*

2-Relationship regulated by power, obligation [words: help, nation, apply, international, adhere to, program, assistance, live, school]*

3-Individualism, creativity [words: to color, diverse, new, demonstrate, care, experience, I, talk, leave, create, start, cost, take away, coffee]*

4-Everyday cooperation [reason play sense employee mother cooperative lose reach association kid]

5-Group as a pair [organization persons division training specific participant occupation manner international expertise context constructive colleague]

6-Selfish goal, mutual achievement [people staff department need university information volunteer member game event dish area festival cook committee interest celebration Museum plan represent food will trivia]

According to the results some people cooperation in a group is a protection from the outside, a place where to shelter and and feel protected. ("In every game, in my rugby team, everybody collaborate to win and score.", team as a family). The cooperating group is present also in cluster 2, where a ruling dimension emerges, in which power generates norms and obligations ("It is the coordination of a number of people to accomplish a goal", University student) and 4, where the norm is tied to living together. Instead in cluster 6 cooperation is structured around a shared and predefined goal ("When Iowa State University was planning events to celebrate the 150th anniversary [..] I saw great cooperation among the various representatives"). These clusters, where the group dimension is essential part, are opposed to cluster 3 and 5 where the individual dimension prevails. The clusters produced by textual analysis show different ways of "colouring" emotionally the *cooperation*. These ways, even if different, are always present and create a dialogue one another.

Conclusion and possible next steps

We plan to continue analyzing macro indicators in countries to find out answers to the question arisen in our investigation, in particular about the possible interaction of diversity with common codes. Then, enlarging the scale of the social representation analysis, we plan to list cultural perspectives about cooperation and possible *common codes* amongst them. Finally, applying data analysis and/or possibly deep-learning through monitoring wisdom of crowds dynamics in our beta website: we'd like to find methods(or.. games[22]) able to maintain the cooperation equilibrium in teams making "smarter groups" to be *happier* groups too.

We can also imagine to apply cooperation studies on:

-Finding new economic indicators, which could enhance the possibilities of cooperation dynamics rather than those of numeric performance or opportunistic exchange of advantages ones[22]

-Establishing new dynamics in the workplaces, where labour may be seen as part of a *cooperative* and *enjoyable* teamwork, not just a performative way to get the financial benefit, approach that is in part already object of study[3]

-Understanding where a dynamic of supposed mutuality or generosity is really happening, with a special regard to charities and the cooperative form of companies, sometimes used as a tool to fraud the participants[5][6]

-Teaching or monitoring underdeveloped areas how not to compete or fight for resources but to cooperate[7] for mutual enjoyment

-Find regulations - or better: methods - to align diversified domestic interactions between social classes[1,3,11,17,18,24]

And finally, have a more satisfied and happy international community[12,24,25] establishing better relationships between the people and the governments[3,26], starting from the social representations of cooperation, in order to enable most individuals *enjoying* the mutuality[26], solve policy problems[3] and crises[25]: "Cooperative structures are central for the existence and maintenance of social institutions and, hence, society."[10], so we really "need theorems for rainbows"[11].

REFERENCES AND NOTES

* For the sake of understanding, words have been translated from Italian.

** Indexes and results: CPI 2013[T]: Transparency International; Mother's Index[RC], Save the Children; World Giving Index[W]; Greenberg's diversity (linguistic) index; Fragile State Index[RT], Fund for Peace; Direct violence containment costs[X], Ongoing Domestic and International Conflict[X]: Global Peace Index; Voice and Accountability[RT], Internet Users[T,F]: World Bank; Access to information and communication[T], Access to advanced education[T], Personal Safety[RT], Basic human needs [RC], Access to basic knowledge[CC], (deviation from the)Gender Parity[CC], Gender Parity in secondary enrollment[CC], Personal Rights[CC], Tolerance and inclusion[CC], Modern slavery, human trafficking and child marriage[RC], Freedom over life choices[F], Religious Freedom[F], Freedom of movement[F], Inequality in the attainment of education [CB], Depth of food deficit[CB], Access to piped water[CB], Access to improved sanitation facilities[CB], Access to electricity[CB], Private property rights[CB], Social Progress Index 2013.

Conflict Model

	Freedom	CBenefit	CCodes	Diversity	Care	Transparency	Trust	**Dimension**	**Conflict**	**P-value**
Common Benefit	0.6375							Choice	-0.1307	0.4099396
Common Codes	**0.8299**	**0.8841**						C Benefit	0.414	0.1851712
Diversity	-0.4629	-0.5672	-0.5784					Common Codes	**-0.4942**	**0.08506952**
Respect&Care	0.6429	**0.9469**	**0.8710**	-0.5728				Diversity	-0.1456	0.1553168
Transparency	0.7804	**0.9163**	**0.9195**	-0.4747	**0.8745**			Care	-0.2376	0.3554863
Reliance/Trust	0.7724	**0.8556**	**0.8855**	-0.4584	**0.8275**	**0.9505**		Transparency	**1.1477**	**0**
Conflict [X]	-0.5203	-0.3642	-0.5120	0.1825	-0.4019	-0.4646	-0.5875	Trust	**-1.3641**	**0**

WGI Model

	Freedom[F]	CBenefit	CCodes	WGI	Diversity	Care	Transparency	**Dimension**	**WGI**	**P-value**
CommonBenefit [CB]	0.6030							Choice	**0.563**	**0**
CommonCodes [CC]	**0.7593**	**0.8762**						CBenefit	0.392	0.17
WGI [W]	0.5819	0.3685	0.4469					Common Codes	0.305	0.19
Diversity [D]	-0.4324	-0.5466	-0.5821	-0.0725				Diversity	**0.269**	**0.01**
Respect&Care [RC]	0.5711	**0.9169**	**0.8396**	0.2761	-0.5585			Care	**-0.429**	**0.06**
Transparency [T]	0.6942	**0.9426**	**0.9168**	0.4329	-0.4741	**0.8634**		Transparency	0.372	0.42
Reliance/Trust [RT]	0.6882	**0.8771**	**0.9023**	0.3928	-0.4589	**0.8023**	**0.9579**	Trust	-0.503	**0.1**

1. Bowels S., Gintis H., (2013), *A Cooperative Species: Human Reciprocity and Its Evolution*. Princeton University Press. Communication (and transparency) have been acknowledged as much regulative as punishment quoting Bochet et al. (2006) - http://arnop.unimaas.nl/show.cgi?fid=14866 and Kollock (1998).

2. http://scripts.mit.edu/~cci/HCI/index.php?title=What_is_collective_intelligence%3F

3. Tyler, T. R. (2011), *Why people cooperate*. Princeton: Princeton University Press.

4. http://dictionary.com, Cambridge Dictionary, Collins Dictionary, Oxford Dictionary, Merriam-Webster Dictionary - all consulted online in Dec 2014, Wikipedia, Dec 2014, see also http://www.businessdictionary.com/definition/cooperation.html, Random House Dictionary Unabridged, 2d ed, http://psychologydictionary.org/cooperation/ - Tomasello (2009) uses the second definition for describing collaboration.

5. Franciosi, U. (2014). *Interview about the red cooperatives and fake cooperatives in Italy.* Interview, Radio Città del Capo

6. CNN, Tampa Bay Times, Center for investigative reporting (2013). http://edition.cnn.com/2013/06/13/us/worst-charities/

7. Tomasello, M. (2009), *Why we cooperate.* Cambridge: The MIT Press.

8. Sanfey, et al., Alan G. (Retrieved 20 July 2011) *The Neural Basis of Economic Decision-Making in the Ultimatum Game*. Science.

9. Damasio, A. R., (1994), *Descartes' error: emotion, reason, and the human brain*. New York: Grosset/Putnam.

10. Tuomela, R. (2000) *Cooperation, a philosophical study.* Dordrecht, Kluwer Academic Publishers.

11. Page, S. E. (2007), *The Difference, how the power of diversity creates better groups, firms, schools and societies.* Princeton University Press.

12. Surowieki, J. (2004), *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations* New York: Random House.

13. Cotesta, V. (1998), *Fiducia, cooperazione e solidarietà, strategie per il cambiamento sociale.* Napoli, Liguori

14. Woolly, A.W. et al. *Evidence for a collective intelligence factor in the performance of Human Groups,* Science, v.330 October 29/2010 pp.686-688

15. Grice, H. P. (1975), *Logic and conversation -in Syntax and Semantics, Vol. 3, Speech Acts.* New York: Academic Press.

16. Axelrod, R. (2006) (Revised ed.), *The Evolution of Cooperation*. New York: Perseus Books Group and subsequent books

17. Hammerstein, P. (2003), About relationships and emotions in cooperation see chapter 1 of *edited by Genetic and Cultural Evolution of Cooperation,* from *Dahlem Workshop Reports.* Cambridge: The MIT press.

18. Mauss, M (1967)[1923]. *The Gift.* New York: The Norton Library W.W Norton Company Inc.

19. Bezzi, C(2013), *Fare ricerca con i gruppi.* Milano: Franco Angeli

20. McLure Wasko, M., Faraj, (2005), S. *Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice* MIS Quarterly, Vol. 29, No. 1, pp. 35-57

21. Lancia F. (2004) *Strumenti per l'analisi dei testi.* Milano: Franco Angeli.

22. Press Release, (2006) "*University of Leicester produces the first-ever 'world map of happiness'*" Leicester. Retrieved 2014.

23. Bateson, G (1972), *Steps to an Ecology of Mind*. Chicago: University of Chicago Press.

24. Mead, M. (1937) *Cooperation And Competition Among Primitive Peoples.* New York and London: McGraw Hill Book Company, Inc.

25. Frieden, J. (2009), "The Crisis and Beyond: Prospects for International Economic Cooperation", Policy Paper no 5, Politics, Economics and Global Governance: The European Dimensions, December and ibid, 4.

26. Ostrom, E. (1990), *Governing the commons.* Cambridge University Press.