


Building a Global Brain Glossary



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Why a glossary?

- To define what we talk about
- To avoid ambiguities
- To build a common language for an interdisciplinary endeavor
- To keep up-to-date with new:
 - concepts
 - practices
 - trends.

Which sources?

- Existing reference materials
(e.g. specialized encyclopedia and dictionaries)
- Francis' papers and
the Principia Cybernetica Project (PCP)
- Scoopit
- ... new definitions

How to build a glossary?

- **DEFINITION** - to explain the meaning and link it to a general theoretical evolutionary-cybernetic framework.
- **EXAMPLE** - to illustrate the definition
- **CHALLENGE** - to mobilize further research
- **REFERENCES** - because *ex nihilo nihil fit* (nothing comes from nothing)
 - internal ("see also")
 - external

Example: "Action"

- **DEFINITION**

- a change in the state of affairs governed by a causal relationship.

- **EXAMPLE**

- Very simple actions are chemical reactions between molecules,
 $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
(production of water by the combination of hydrogen with oxygen).

- **CHALLENGES**

- What is the difference between an action and a re-action?
- Is an action necessarily intentional?

- **REFERENCES**

- Internal: agent, event, state, challenge
- External
 - Heylighen, F. 2011. "Self-organization of Complex, Intelligent Systems: An Action Ontology for Transdisciplinary Integration." Integral Review (to appear). <http://pespmc1.vub.ac.be/Papers/ECCO-paradigm.pdf> .

How to improve it?

- Collective intelligence!
- Intranet: https://complexity.vub.ac.be/gbii/?q=content/glossary_of_global_brain_terms
- Add new entries / definitions / examples / challenges / references
- Correct; complete; improve.

MIT Collective Intelligence 2012 Highlights



Introduction

- **First** conference on Collective Intelligence, Cambridge, MIT.
- What is the current state-of-the-art in collective intelligence?
- My mission: summarize 2 intense days in 13 mins.
- A very partial selection
- I'll be very quick, and just highlight stimulating new research
- Don't worry, videos and papers of the conference will soon be available.



Outline

- Animal Collective Intelligence
- Human Collective Intelligence: the c-factor
- Wikipedia and Wiki surveys
- Information Propagation
- Prediction Markets

Animal Collective Intelligence (Couzin)

- What is collective intelligence?
 - Group of individuals acting collectively in ways that seem intelligent.
 - Models, simulations of animal behavior.
 - Proportion of informed individuals out of 100
 - Example: fish swarm going in a preferred direction.
 - 1: nothing: 5: works; 10: works perfectly!
 - When the population is larger, you need less people to lead !
 - Minority - majority control: phase transition as you add more uninformed individuals.
 - Uninformed individuals inhibit extremism!

Deborah Gordon (Stanford)

Regulation of foraging in ant colonies

- 11 000 species of ants!
- No central control, direction, yet impressive complexity.
- The species in consideration: no pheromone! No stigmergy!
- Water problem in the desert
 - too much foraging: loose water
 - too less foraging: not enough water.
 - How to regulate the foraging activity?
- What ants do
 - Ants meet each other communicating with their antennae ... that's all they do.
 - How do a forager assess the return rate?
- Response in interactions
 - The interaction creates a stimulus, and there is a threshold to go out
 - the rate at which inactive foragers leave the nest depends on the rate at which successful foragers return with food
- "Neuronal ants?"



Human Collective Intelligence: the c-factor (Woolley & Chabris)

- Individual intelligence
 - IQ tests
 - Spearman: **g-factor** (+correlations between mental tests)
- Collective intelligence
 - Can we detect and measure CI in humans?
 - Does CI exist in groups?
 - g-factor for human groups?
- **c-factor?**
 - tasks that is predictive of group performance?
 - how can we use this information to build a better science of groups?

The c-factor

- What are the tasks?
 - Problem: face-to-face tasks... to things developed in the web.
 - e.g.: creativity and idea generating tasks (**divergent**)
 - e.g.: how good does this group pools group information (**convergent**)
 - e.g.: reproduce a text (motor **coordination** accross members)
 - e.g. : negotiating a shared **decision** about something

Conclusion - What predicts CI?

- NOT group satisfaction(-.07 cohesion, motivation)
- NOT personality
- Proportion of **females** in the group ($r=.23$) is predictive
 - but... too many in the group, the performance decreases
 - a majority is good!
 - why? social sensitivity.
- **Abstract reasoning** and **processing speed** are good indicators in individual and collective intelligence.
- **CI measure + IQ** of members allow to predict the scoring on other tasks of this group. (prediction of future performance)
- A moderate level of **cognitive diversity** is good, too much is bad (parabolic curve)
- Uneven distribution in **speaking turns** negatively predicts c (when someone dominates, CI goes down)

Wikipedia and Wiki surveys (Kraut; Peng et al.)

- Robert Kraut (CMU) Collaborative development in Wikipedia.
 - More contributors improve quality but only up to a certain point (inverted U curve).
 - 2/3 of the influence is from non-leaders in Wikipedia.
 - Biggest effect in leadership: being friendly!
- Thermodynamic principles in social collaborations: a Wikipedia case study
 - Does wikipedia become more ordered and efficient?
 - Thermodynamic model
 - IN: new editor, new knowledge
 - OUT: pages, discussions
 - particles: editors
 - energy: edits
 - Boltzmann distribution: Power-law distribution
 - Energy
 - free energy: part which can produce work.
 - free energy is going up in Wikipedia!
 - power law distributions maximize entropy efficiency

Wiki surveys:

open and quantifiable social data collection. (Salganik)

- Quantification OR openness in empirical research?
 - Quantification
 - “hard” science
 - pb: surveys don't include necessarily all the relevant information
 - Open
 - interview, focus groups
 - pb: harder to quantify
- Hybrid model - wiki surveys
 - wanted properties:
 - greedy
 - take as much information as possible
 - collaborative
 - the participants can shape the questions
 - adaptive
 - in a survey, we ask question when we already have the answer

“Which do you think is a better idea for creating a greener, greater New York?”

- 1 question, 2 answers possible. (repeat)
- Upload your ideas.
- 28 800 votes
- 464 ideas uploaded



vs.



- **More**

- See ArXiv: 1202.0500
- See www.allourideas.com; free website to do wiki surveys.

Information Propagation (Adamic)

- Information **propagation** and **filtering** over social networks
- Research Questions
 - How much does Facebook influences social behavior?
 - How much are we influenced by our friends? What is the role of weak and strong ties of friends?
 - Empirical study of the competition and recombination of memes in Facebook.
- Conclusion
 - Strong ties are individually more influential
 - Weak ties bring novel information and opportunities
 - Weak ties are more abundant and responsible for the majority of information spread

Prediction Markets (Wolfers; Chen)

- Used to predict public events, but also in big companies (Google, Microsoft, IBM)
- Betting is expressing one's opinion in a credible way.
- It works!
- Example: Obama to be re-elected in 2012.
 - Think the event will occur? ... buy shares
 - Think the event will not occur? ... sell shares



Barack Obama to be re-elected President in 2012

Last prediction was: **\$6.00** / share

Today's Change: ▼ **-\$0.03** (-0.5%)

Contract Type: 0-100 ?

60.0%

CHANCE



Event: [2012 Presidential Election Winner \(Individual\)](#)



Mechanism design for prediction markets (Yiling Chen)

- **Goals of prediction markets:**
 - **elicit** and **aggregate** information about some event of interest
 - **elicit**: elicitation to express information
 - **aggregation**: updating beliefs after observing market price.
- **Design objectives**
 - Liquidity; bounded budget; computational tractability; expressiveness
- **Three models**
 - Continuous double auction
 - Standard market
 - Automated Market Makers (Hanson 2003, 2007)
 - Buyers buy from the market makers
 - Seller sell from the market maker.
 - Duality-based market maker
 - solves the problem of a market mechanism with all advantages!
 - (Abernethy, Chen , Vaughan 2011, 2012)
- Market: dynamical **weighting** mechanism (Justin Wolfers)
 - Like a learning mechanism? like neural networks?

Conclusion

- Stimulating and high quality conference
 - Most of the CI 2012 papers at:
<http://arxiv.org/html/1204.2991v1>
 - Videos of the conference will soon be online
 - Collaborations with MIT to explore!
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- A lot to read and further research!

Thank you for your attention!

Questions are welcome now or later:
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