NORMAL = NORMATIVE? THE ROLE OF INTELLIGENT AGENTS IN NORM INNOVATION

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WORKSHOP IN POLITICAL THEORY AND POLICY ANALYSIS
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EMIL, “EMergence In the Loop: simulating the two way dynamics of norm innovation”

- **Theoretical Objectives**
  EMIL is aimed at providing a theory of norm innovation by means of agent-based simulation, understanding not only how new norms emerge, but also how they immerge in the minds of autonomous agents.

- **Technological Objectives**
  EMIL is aimed to provide an instrument, a simulator (EMIL-S), for conducting experiments on norm innovation, and show how it applies to specific scenarios.

- **Application Objectives**
  Forecasted impact of the project is to contribute to the regulation of e-communities by handing out a simulator for the emergence of new norms in complex social systems.
EMIL CONSORTIUM

- National Research Council, Institute of Cognitive Science and Technology
  Key Personnel: R. Conte (Coordinator)
- University of Bayreuth, Dept. of Philosophy
  Key Personnel: R. Hegselmann
- University of Surrey, Centre for Research on Social Simulation
  Key Personnel: N. Gilbert
- Universität Koblenz-Landau
  Key Personnel: K.G. Troitzsch
- Manchester Metropolitan University, Centre for Policy Modelling
  Key Personnel: B. Edmonds
- AITIA International Informatics Inc.
  Key Personnel: L. Gulyás
OUTLINE

- A social cognitive view of norms
- Normative MAgent architectures:
  - BOID
  - EMIL-A
- Simulation model and results
- Conclusions and future work.
A SOCIAL COGNITIVE DEFINITION OF NORMS

- Norms = behaviors spreading in population \((P_i)\) as long as
- Corresponding prescriptions and mental constructs (Conte and Castelfranchi, 1995; 2006) spread over \(P_i\)
- N-beliefs: beliefs that for given sets of agents, in given set of contexts, given actions are obliged/forbidden/permitted
- N-goals: goals to (not) achieve/accomplish obligatory/forbidden/permitted actions.
PROPERTIES OF NORMS

1. **Multi agent**
   - Involving more than one agent
   - More than one social role: Observer, Legislator/Source, Addressee/Recipient, Defender

2. **Hybrid**
   - behaviour
   - mental construct

3. **Dynamic**: undergoing two processes
   - *emergence*: process by means of which a norm not deliberately issued spreads through a society
   - *immersion*: process by means of which a normative belief is formed into the agents’ minds (Castelfranchi, 1998; Conte et al., 2007)
Social phenomena are due to the agents’ behaviors, but... the agents’ behaviors are due to the mental mechanisms controlling and (re)producing them.

- How the norm should work through the minds of the agents? How is it represented?
- Which are the proximate mechanisms underlying the normative behavior?
- What does it mean to conform to a norm from a mental - not just a behavioral - point of view? What does it mean to obey?
IMPLEMENTING NORMS ON AGENTS

- BOID
- EMIL-A
THE BOID ARCHITECTURE

- BDI architecture with obligations: Beliefs, Desires, Intentions, Obligations.
- Interactions at study: which component is overridden?
  - Realism: B override all others
  - Selfishness: D override obligations
  - Sociality: O override intentions.

- How are O acquired?
- How do agents tell that something is a new norm?
How do agents find out norms?

How do agents acquire new norms autonomously?
EMIL A

- is able to recognize N, tell what is a N and what is not and form a N-bel corresponding to N;
- is able to assess whether it is concerned by N;
- accepts N, forms a N-goal corresponding to N;
- decides to comply with N or not (intention);
- is able to re-issue N, to prescribe it to other fellows subject to N, and
- is able to observe, monitor their behaviors wrt N and react in a positive or negative way to them.
CONFORMITY AS ROUTINE BEHAVIOR

Our quite rich cognitive characterization of the representations and processes underlying a behavior obedient to a norm

.... shouldn’t however give the idea of behavioral conformity as always based on such a complex ‘reasoning’ and ‘deliberation’.
Norm conformity and obedience become a *habit*, an *automatism*, a *routine* behavior.

But before, norms must be acquired (*immergence*)
AGENTS AND AUTONOMY

- Autonomy in beliefs
  - Norm recognition process
- Autonomy in goals
  - Norm adoption process (Conte and Castelfranchi, 1995).
NORM RECOGNITION
Each input is presented as an ordered vector

- Source (x);
- Action transmitted (a) (potential norm)
- Type of input:
  - Behaviors
  - Messages: assertions (A), behaviours (B), requests (R), deontics (D), evaluations (V), sanctions (S);
- Observer (y);
**N-RECOGNITION MODULE**

- $V_c = N$-threshold
- $V_c = 8$

- **LTM**
  - N-bel: It is prohibited to smoke
  - N-Board

- Decision:
  - $> V_c$
  - (Candidate N-Bel "It is prohibited to smoke")
  - $< V_c$

- **Agent x**
- **Agent y**

- X: smoke
- Prohibition
- y
NORM RECOGNIZER AT WORK 1/6

The Observer

N-Board: empty
Layer 2: empty
Layer 1: empty
NORM RECOGNIZER AT WORK 2/6

The Sender

Agent 2 | a1 | D(a1) | Agent 1

The Observer
At least one time the action \((a_1)\) must be presented as Deontic \((D)\).
The number of observed behaviors must reach the threshold value (8 in this case) to allow the generation of a new normative belief.
NORM RECOGNIZER AT WORK 5/6
A new Normative Belief (NB) concerning the action \( a1 \) is generated and stored in the Normative Board.

Layer 1:

\[ B(a1) \times n \text{Times} \]

Layer 2:

\[ D(a1) \]

The Observer
**N-RECOGNITION MODULE**

N-bel: It is prohibited to smoke

Agent x  X  smoke  Assertion  y  Agent y
A SIMULATION STUDY
NORM-RECOGNIZERS VS SOCIAL CONFORMERS

- What are observable effects of norm recognition?
- Implement different populations (Andrighetto et al., 2008, Campennì et al., 2008):
  - Social conformers follow actions most frequently done in observation window (parameter)
  - Norm recognizers take input from others, form beliefs and act based on those.
AGENT AND WORLD

4 contexts:
- following its agenda and time of permanence, each agent moves among contexts;
- in each context, agents can produce 1 out of 3 actions;
- 1 action is the same for all of the contexts.
Each is provided with:

- Norm-Recognition Module
- Agenda: individual time of permanence (in contexts);
- New normative beliefs contribute to choose action;
- If normative board is empty, action is randomly chosen.
SOCIAL CONFORMER

- Each observes other agents in same context
- According to conformity rate, imitates most frequent action

Conformity rate = 9
SIMULATIONS' RESULTS
PRELIMINARY FINDINGS

- **Social conformers (above):**
  - Each colour represents one action
  - No difference within ticks
  - Strong difference
    - Among ticks (no belief)
    - Among scenarios (no memory)
    - Most frequent action (dark blue) is distributed throughout the simulation: nothing emerges!

- **Norm recognizers (below):**
  - Fuzzier
    - Rows (autonomy)
    - Columns (beliefs)
  - After 60th tick, one action common to all scenarios: something emerges…
  - What is it? Let’s look into agents beliefs…
IMMERGENCE

- At the 30th tick a normative belief starts to spread
- What has happened in the interval?
- Other normative beliefs got formed, although earlier is more frequent
- Immergence is earlier: it takes time for effect to emerge
LATENCY OF NORMS

- Time interval between N-bel's appearance and convergence on corresponding action.
- Actually, a complex loop
  - from N-Belx to N-actionx
  - from N-actionx to N-bely
  - from N-bely to N-actiony
  - Etc.
- Immergence ≠ 2nd-order emergence: not a reflected upon emergent phenomenon but involved in emergence!
**TO SUM UP**

- Social conformers do not converge on one action
- Normative agents converge on the common action.
FOLLOW-UP QUESTIONS

- Only common actions?
- What happens with physical barriers and/or (cultural) drifts?
- Equally frequent norms might emerge in different sub-populations: norm innovation?
LET US SIMULATE A BARRIER

At a given run, agents get stuck to current locations, they can no longer move across settings.
NORMATIVE BELIEFS

No barrier

Yes barrier
BUT IN 300 TICKS...
SOCIAL CONORMERS VS NORM RECOGNIZERS: FINAL REMARKS

- In a multi-scenario world, unlike social conformers, norm recognizers converge.
- Norms immerge in the minds before emerging in behavior.
- A normative belief corresponds not necessarily to the most frequent action.
- Statistical frequency is not sufficient for a norm to emerge.
- Barriers are sufficient (not necessary) for norm-innovation.
- Norms have a latency time.
SOCIAL CONFORMERS VS NORM RECOGNIZERS: NEXT STEPS

- Add more heterogeneity: agents endowed with different individual abilities to recognize norms and to comply with them.
- Add more complexity: more realistic scenarios
- Add punishment and sanctioning
- What about inertia (i.e. the time for a norm to disappear)? During inertia, norms may compete in the same population.
- Internalization
  - What does this really mean? Why does it matter? Which is the model of this mental mechanism?
TRAFFIC SCENARIO

- One-way road with cars moving from North to South
- Two meadows with children moving between East and West
- Car drivers and children learn how to behave reasonably in this scenario and internalise emerging norms

K. Troitzsch, 2008
TRAFFIC SCENARIO RUNNING

- the first (simulated) minute (20 pedestrians, random cars)
- several (simulated) minutes later (again 20 pedestrians, random cars)
- the same, some pedestrians have not learnt to use the crossing
THANK YOU FOR YOUR ATTENTION

References and online simulations can be found on http://labss.istc.cnr.it/