

# Two sides of emergence in participatory simulations

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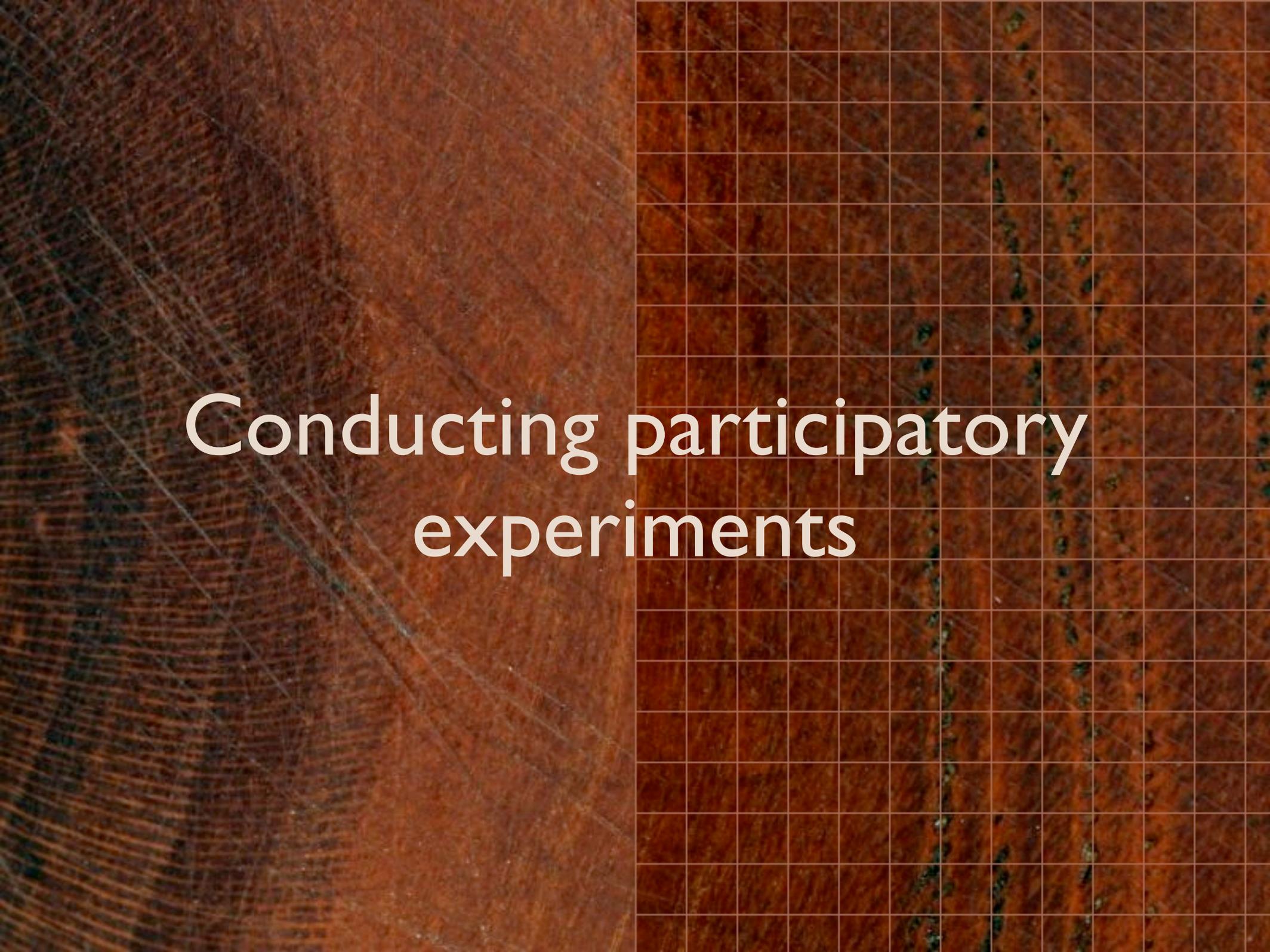
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# Introduction

- Emergence in participatory simulations is two-folded:
  - Collective phenomena may emerge as in multi-agent simulations. This emergence is more or less controlled.
  - Giving human players freedom relative to the initial model can make a modified model emerge, and especially new roles can appear.

# Overview

- How we conducted participatory simulations: methodology, model, question and experiments.
- What we observed: results & analysis.
- Why emergence in participatory simulations is two-sided.



# Conducting participatory experiments

# How we built sociological participatory simulations

- We started from an initial (sociological) model.
- There was a (sociological) question related to this model: would some behavior emerge?
- The model was simplified to (a) let the behavior emerge (or not) and (b) to make it easy to play.
- We conducted participatory simulations favoring emergence.
- Analyzing the log, the behavior emerged and more...

# Model of (a part of) the coffee market

- Two classes of agents: **producers** and **buyers**.
- **Producers** buy fruits (“cereza”) and transform it in “pergamino”.
- **Buyers** buy pergamino.
- Transformation process of cereza into pergamino takes 3 days.
- Coffee is delivered one or two weeks after the exchange agreement.



# The sociological question

- **Do coffee producers form coalitions to respond to buyer offers?**
- Two forms of coalitions were modeled:
  - cooperatives (sociedad/alianzas)
  - direct coalitions
- Cooperatives are well known but producers refuse to speak about direct coalitions.
- A third kind was imagined by computer scientists: broadcast (Contract.NET-like).

# Simplifications of the model

- **The producers are controlled by the players.** The buyer is controlled by the experimenter.
- All actions were **broken into primitives** to avoid forcing players into our model (where coalitions emerge).
  - Exchanges & negotiation among producers are replaced with sending money, coffee and messages.
- Players could not negotiate with the buyer.

# Experiments were conducted

- The SimCafé interface was implemented using a **scalable participatory simulation** framework called “Simulación”.
- Students played the role of coffee producers, **one per computer**.
- The first experiment was used to **calibrate** the game (parameters are set in an XML file).



The background of the slide is a close-up photograph of a brown leather surface. The leather has a fine, pebbled texture. On the right side of the image, there is a semi-transparent grid overlay, likely representing a mesh or a coordinate system used in a technical or scientific context. The text "Results & analysis" is centered in the lower half of the image.

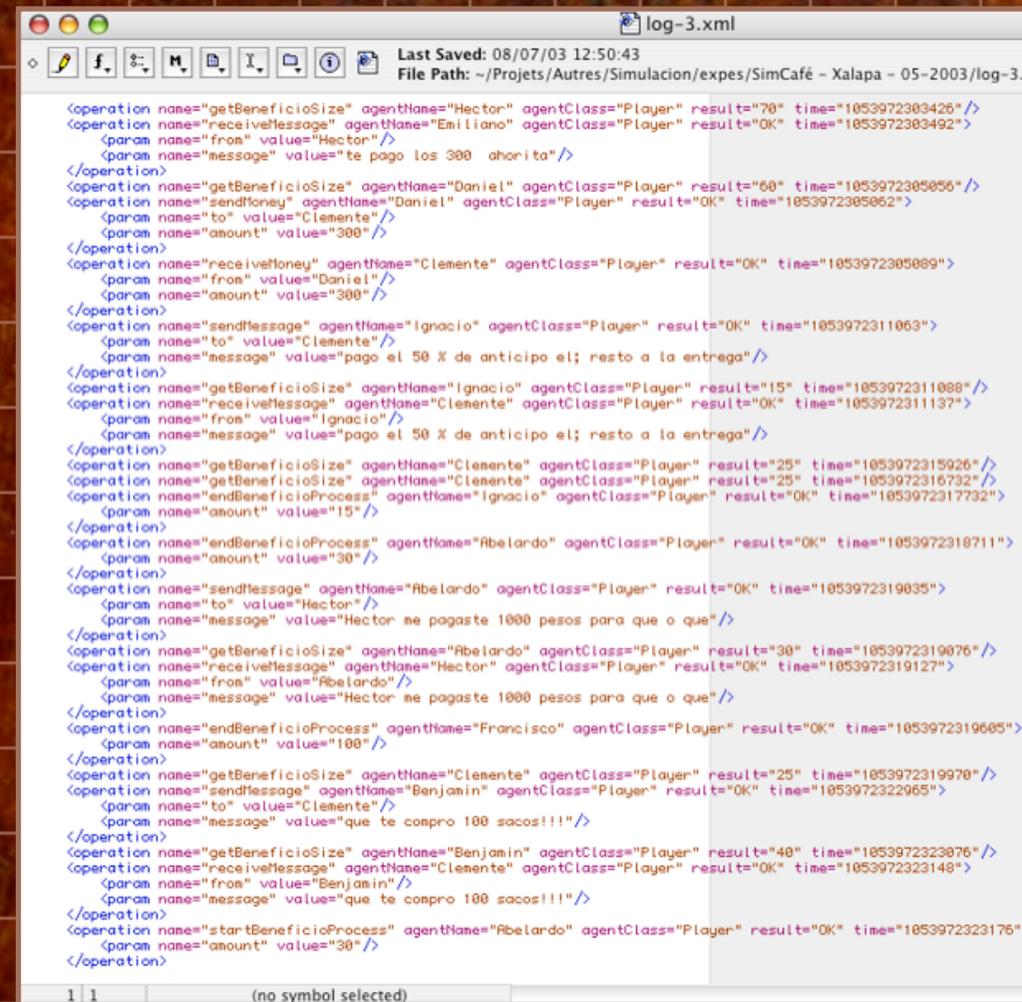
# Results & analysis

# Tools for analysis

- Analysis is based on **logs** and post-experiment **questionnaires**.

- XML Logs were collected by log agents on the network.

- Logs are **automatically processed** by an analyzer using genetic programming techniques to extract interaction patterns.



The screenshot shows a text editor window titled "log-3.xml" with a toolbar and menu. The window contains XML data representing simulation operations. The XML structure includes tags for operations, agents, and parameters. The operations listed include "getBeneficioSize", "sendMessage", "sendMoney", "receiveMoney", "sendMessage", "getBeneficioSize", "endBeneficioProcess", "sendMessage", "getBeneficioSize", "endBeneficioProcess", "sendMessage", "getBeneficioSize", "sendMessage", "getBeneficioSize", "sendMessage", "startBeneficioProcess", and "sendMessage". Each operation tag includes attributes for "name", "agentName", "agentClass", "result", and "time". Parameter tags include "from", "to", "amount", and "message". The window also shows a status bar at the bottom with "1 | 1" and "(no symbol selected)".

```
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<operation name="sendMessage" agentName="Emiliano" agentClass="Player" result="OK" time="1053972303492" />
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  <param name="message" value="te pago los 300 ahorita" />
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  <param name="amount" value="300" />
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  <param name="message" value="pago el 50 % de anticipo el; resto a la entrega" />
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</operation>
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  <param name="message" value="Hector me pagaste 1000 pesos para que o que" />
</operation>
<operation name="getBeneficioSize" agentName="Abelardo" agentClass="Player" result="30" time="1053972319076" />
<operation name="receiveMessage" agentName="Hector" agentClass="Player" result="OK" time="1053972319127" />
  <param name="from" value="Abelardo" />
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<operation name="sendMessage" agentName="Benjamin" agentClass="Player" result="OK" time="1053972322065" />
  <param name="to" value="Clemente" />
  <param name="message" value="que te compro 100 sacos!!!!" />
</operation>
<operation name="getBeneficioSize" agentName="Benjamin" agentClass="Player" result="48" time="1053972322076" />
<operation name="receiveMessage" agentName="Clemente" agentClass="Player" result="OK" time="1053972323148" />
  <param name="from" value="Benjamin" />
  <param name="message" value="que te compro 100 sacos!!!!" />
</operation>
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</operation>
```

# Emergence of coalitions

Amount	Price	Time	Agent	Resolution
200	15	200	Hector	direct
50	15	40	Abelardo	direct
500	20	200	Hector	coalition (b. 470)
30	10	40	Abelardo	direct
100	15	40	Francisco	direct
25	50	40	Clemente	direct
50	10	40	Benjamin	direct
10	20	40	Daniel	direct*
120	10	50	Abelardo	direct
800	25	250	Hector	coalition (b. 480)

# Emergence of roles

- Roles were nearly identical (the only difference concerned the throughput of the production, ranging from 15 to 100 bags per 72 hours).
- **However:**
  - Some players tried to ally and form cooperatives.
  - Some players had privileged cooperations with others (groups emerged).
  - A player adopted a trader role.

# Abelardo, trader

- Small throughput (30 bags/period).
- Broadcast messages to buy **and** sell large quantities of bags and found buyers and sellers.
- Used the current offer as an argument to sell his bags to other players.
- Offered to buy bags and pay after the buyer would have paid.



The background of the slide is a close-up photograph of a brown leather surface. The leather has a fine, pebbled texture. On the right side of the image, a white grid pattern is overlaid, consisting of thin lines that form a grid of squares. The text is centered horizontally and vertically on the leather background.

# Lessons of participatory simulations

# Side A: they are simulations of complex systems

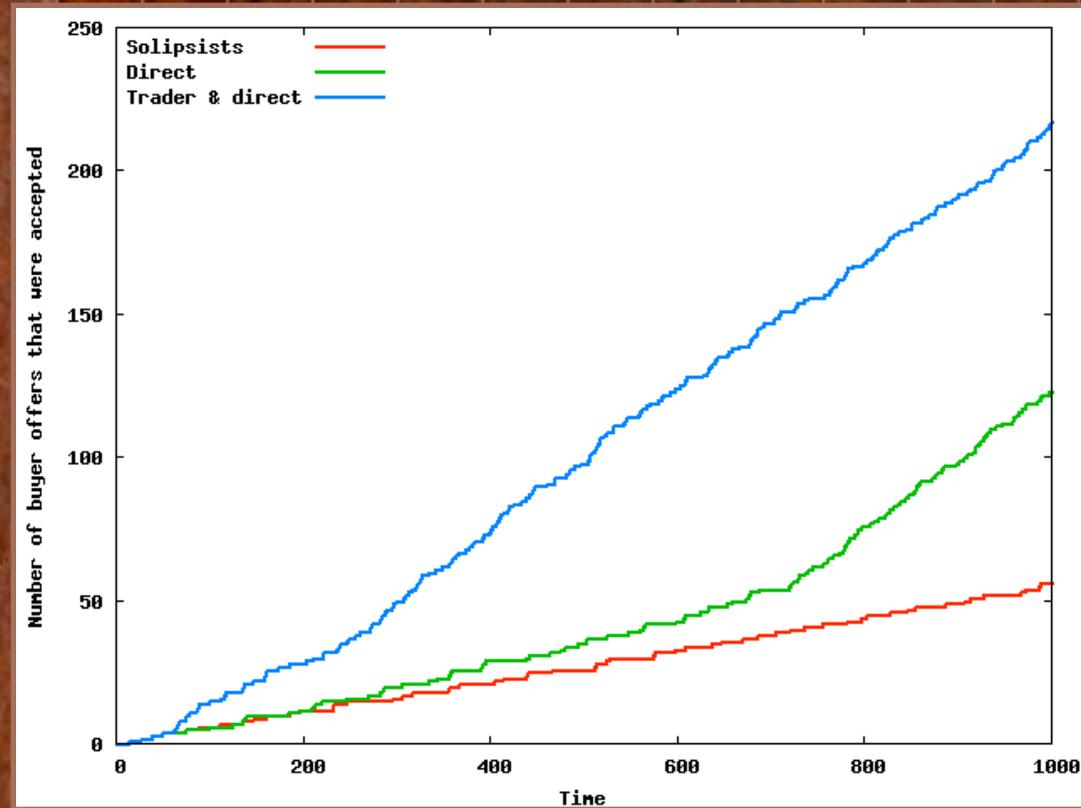
- Participatory simulations are conducted to test or to trigger the **emergence of global properties from the properties of individual components**. In the case of sociological participatory simulations, it consists in testing and validating (models of) supposed emergent collective behaviors.
- The **emerging** global properties can also be a **distributed solution** to a problem as what multi-agent systems provides.

# Side B: they are participatory

- Players (or agents) within participatory simulations are free to **behave in ways not planned** by the experimenters.
- The meaning of the simulation for players and the consequences after the simulation are often out of control. Experiments must be done with **great care**.
- If the **actions are broken into primitives**, the combination of them (the roles) can be freely chosen by players.

# The Example of SimCafé

- Side A (sociological test): coalitions were formed.
- Side B: a trader role appeared.
- Side A (distributed system solver): **the trader increased the solving capabilities** of the group as a system to accept buyer offers.



# Emergence is at the center of outcomes of participation

- Pedagogical simulations: teach (students), through **emergence of phenomena**, the link between individual and collective (emergent) behaviors.
- Negotiation simulations: make stakeholders negotiate and explicit their behavior, thus hopefully making **social learning emerge**.
- Sociological simulations: validate and consolidate sociological models questioning **emergence of social behaviors**.

# Conclusion

- SimCafé experiments, based on a tested methodology and a dedicated scalable framework, belong to a family of participatory simulations with SimBar experiments and [e-]ComMod (currently under research).
- Participatory simulations can be used to test and/or improve global properties using both sides of emergence.
- What are the conditions of the emergence of specialized roles/groups? Is free speech required?

Questions?

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