PoSITeams
Positive Systems Intelligent Teams
an Agent Based Simulator for Studying Group Behaviour

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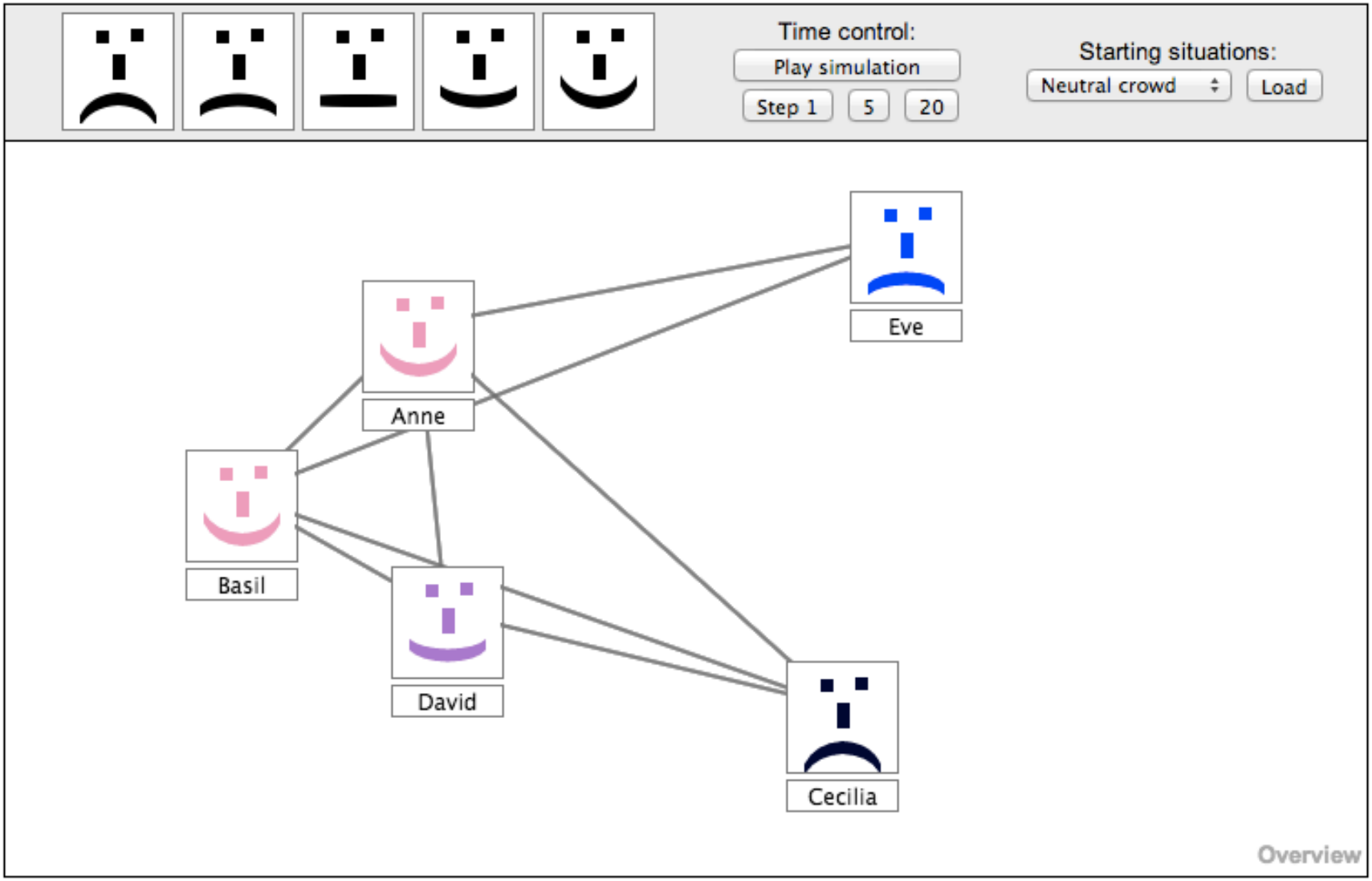

Time control:
Play simulation
Step 1
5
20
Starting situations:
Neutral crowd
Load
Eve
Anne
Basil
David
Cecilia
Overview

Agent based Social Simulation

- Agent simulations are very actively growing field
  - So far most activity in computer science and artificial intelligence
- Applications, e.g.:
  - Information diffusion in social networks
  - Emergence of social phenomena
  - Crowd behaviour – disasters, evacuation – fire
  - Analysis of markets
- **Operations Research – the Science of Better** – could also benefit from the agent approach in **improving the performance of social systems**
- **We developed a web-based organisational social simulator, that focuses on the effects of positivity**

Simulating the effects of emotions in teams

- **Simulating positive and negative affect**
  - Helps study how they influence people and groups
  - Illustrates/visualises behaviours
  - Supports personal decision making:
    How can I best adjust my behaviour to have a positive impact on my group?

- **Bridging Positivity Research and Operations Research**
  - Analysis and "optimization" of social behaviour in groups and organizations

Positivity research in psychology

- Barbara Fredrickson (2004)
  - Ratio of positive to negative affect (P/N) influences behaviour (high P/N people “flourish”)
  - **Broaden-and-Build theory**: higher P/N
    - broadens awareness
    - builds personal resources

Positive affect between people

- John Gottman (2005)
  - **Mathematics of Marriage**: A non-linear dynamic model to describe the effects of a Married couple's positive and negative interaction
  - Can predict the dynamics and success of marriage

- Marcial Losada (2005)
  - **Dynamics of teamwork**: A higher average P/N in communication in team work predicts higher team performance

Social agent models

- Tibor Bosse et al (2009)
  - **Contagion of emotions** in agent models, see e.g. *A Multi-Agent Model for Mutual Absorption of Emotions*
- Mark Hoogendoorn at al (2010)
  - Using the Broaden-and-Build theory to study the **interplay of information and emotions**, with an application to evacuation planning, see *An Agent-Based Model for the Interplay of Information and Emotion in Social Diffusion*

Our approach

- We introduce the **Systems Intelligence** lens (Hämäläinen and Saarinen 2004)
  - Focus: The structure of the system/organisation and the agents' ability to act intelligently in a system
  - Seeing and using leverage points

- **We use the B-and-B theory in an interactive framework to study and illustrate the behaviour of agents in organizations**
  - User makes initial assumptions of the structure of the organization and the agents' initial states
  - User can play around with the scenario and parameters easily

The model in Po**SI**Teams

- Agent's emotions
  - State variables: amount of positivity/negativity received P(t) / N(t)
  - Decay over time: old inputs become less significant
  - The ratio P(t)/N(t) defines the agent's interaction style
  - **"Build": a high P/N causes negativity to have less effect**

- Interactions
  - Simulated as a two-dimensional space where agents connect with the nearest other agents
  - **"Broaden": a high P/N causes the agent to increase the number of connections with other agents**

Equations

$$C_i(t) = \{\text{set of agents interacting with agent } i \text{ at time } t\}$$

$$\begin{aligned} b_i(t) &= 0, \text{ if } P_i(t)/N_i(t) < 3 \\ &= 0.05, \text{ if } 3 \leq P_i(t)/N_i(t) < 4 \\ &= 0.15, \text{ if } 4 \leq P_i(t)/N_i(t) < 5 \\ &= 0.25, \text{ if } 5 \leq P_i(t)/N_i(t) \end{aligned}$$

'build': negativity reduction

$$\begin{aligned} d_i(t) &= 0, \text{ if } P_i(t)/N_i(t) < 0.9 \\ &= 1, \text{ if } 0.9 \leq P_i(t)/N_i(t) < 3 \\ &= 3, \text{ if } 3 \leq P_i(t)/N_i(t) < 4 \\ &= 4, \text{ if } 4 \leq P_i(t)/N_i(t) < 5 \\ &= 5, \text{ if } 5 \leq P_i(t)/N_i(t) \end{aligned}$$

'broaden': min. connection count

$$u_i(t) = P_i(t)/(P_i(t) + N_i(t))$$

agent i's interaction style at t

$$P_i(t+1) = 0.95P_i(t) + \sum_{j \in C_i(t)} u_j(t)$$

positive affect at $t+1$

$$N_i(t+1) = 0.95N_i(t) + \max(0, \sum_{j \in C_i(t)} (1 - u_j(t)) - b_i(t))$$

negative affect at $t+1$

Web-based implementation

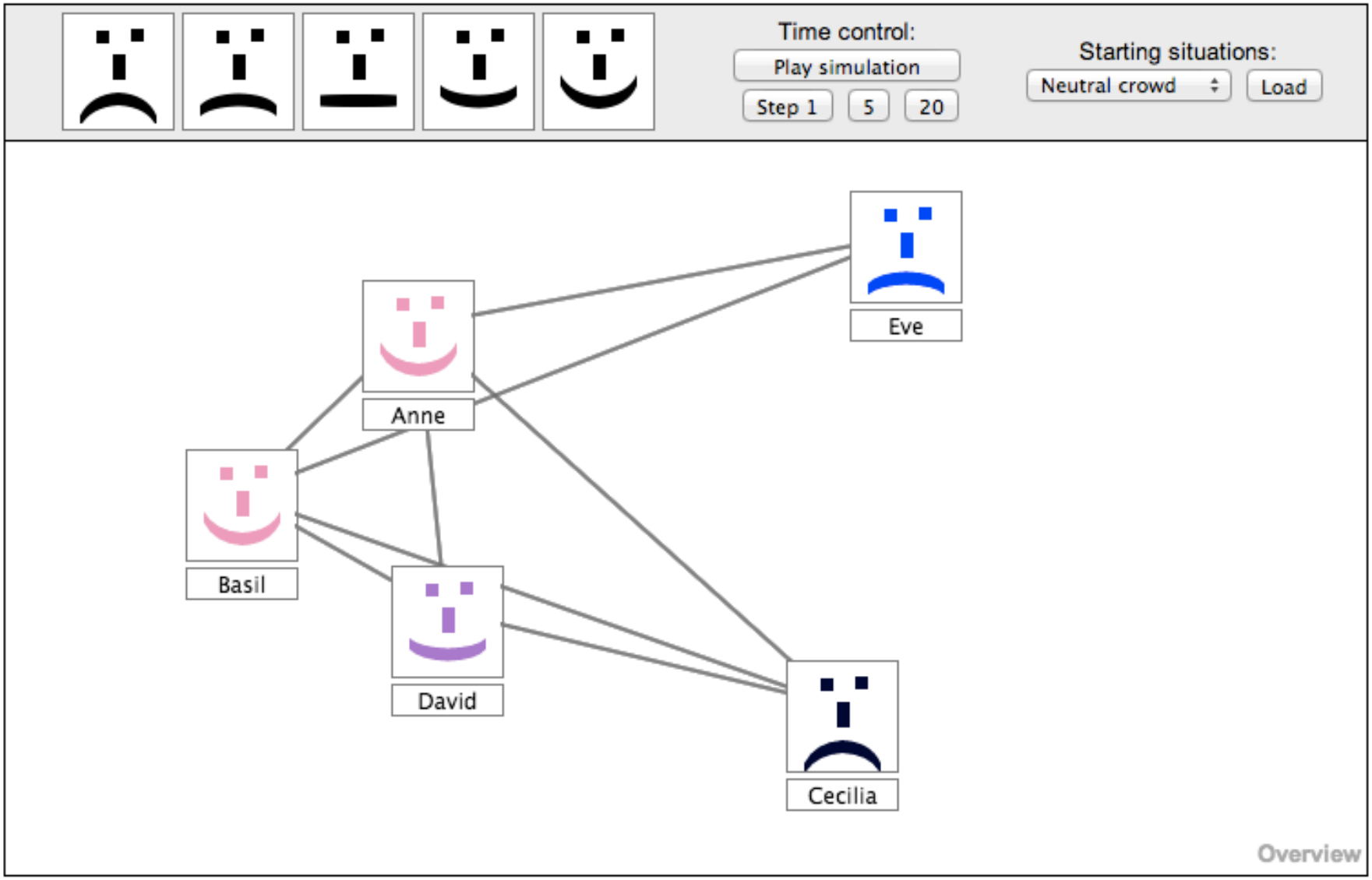
- For **ease of use** and **easy distribution**
  - HTML5 and Javascript
  - Supports all modern web browsing devices

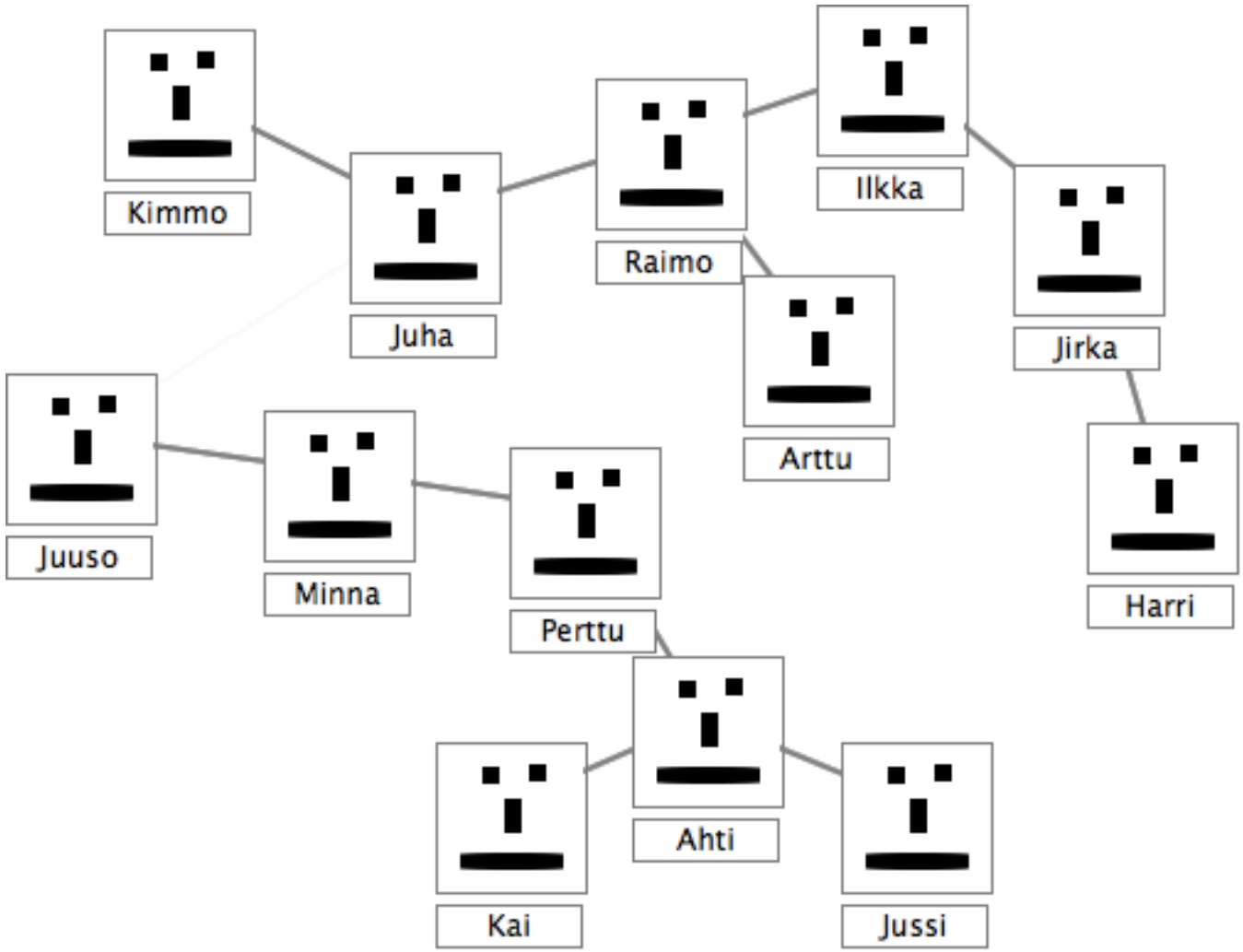
- Effective and transparent visualisation
  - Agents' states shown as "smileys" on the screen

Demonstration

http://salserver.org.aalto.fi/sim/positeams/

The PoSITeams interface

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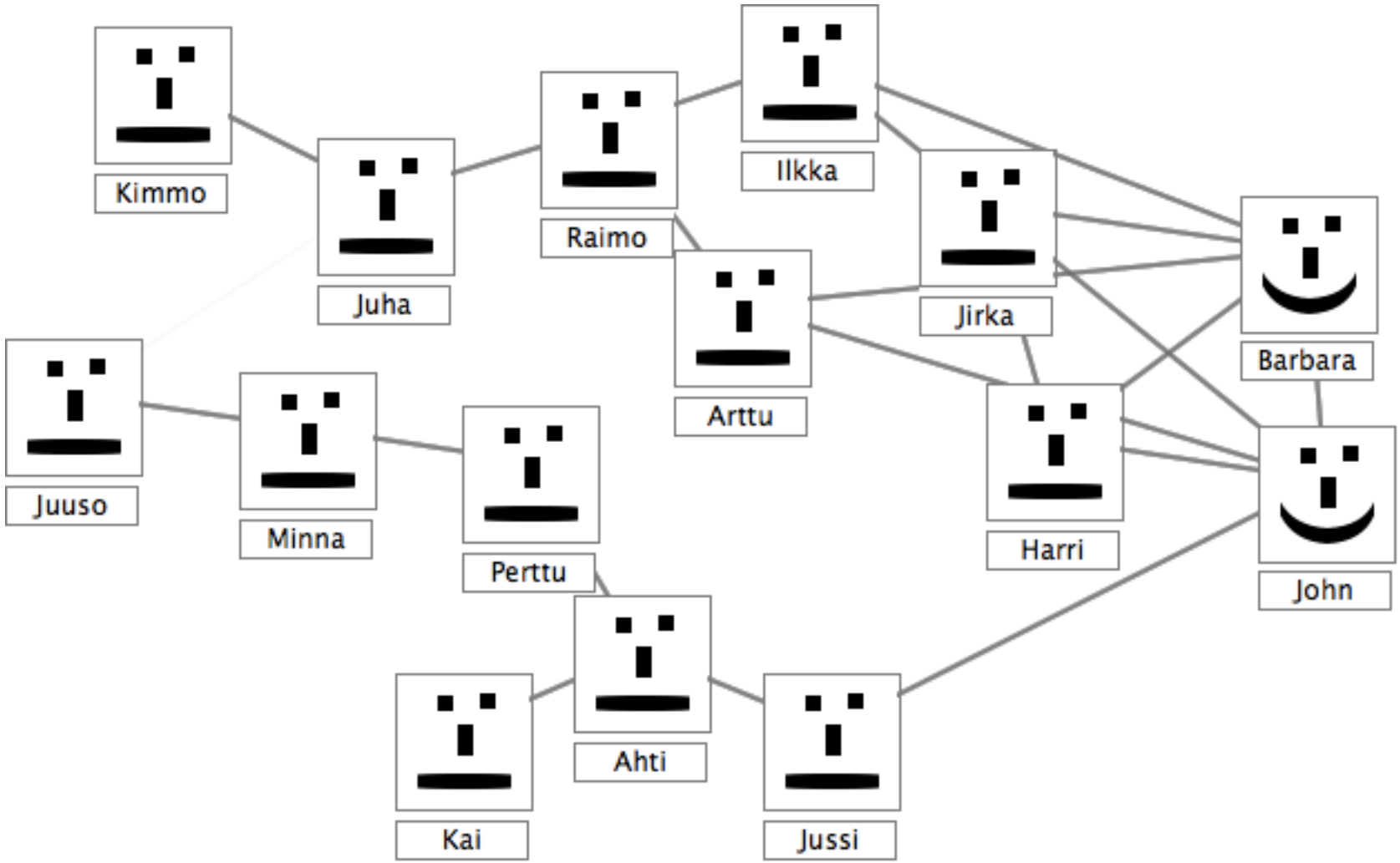
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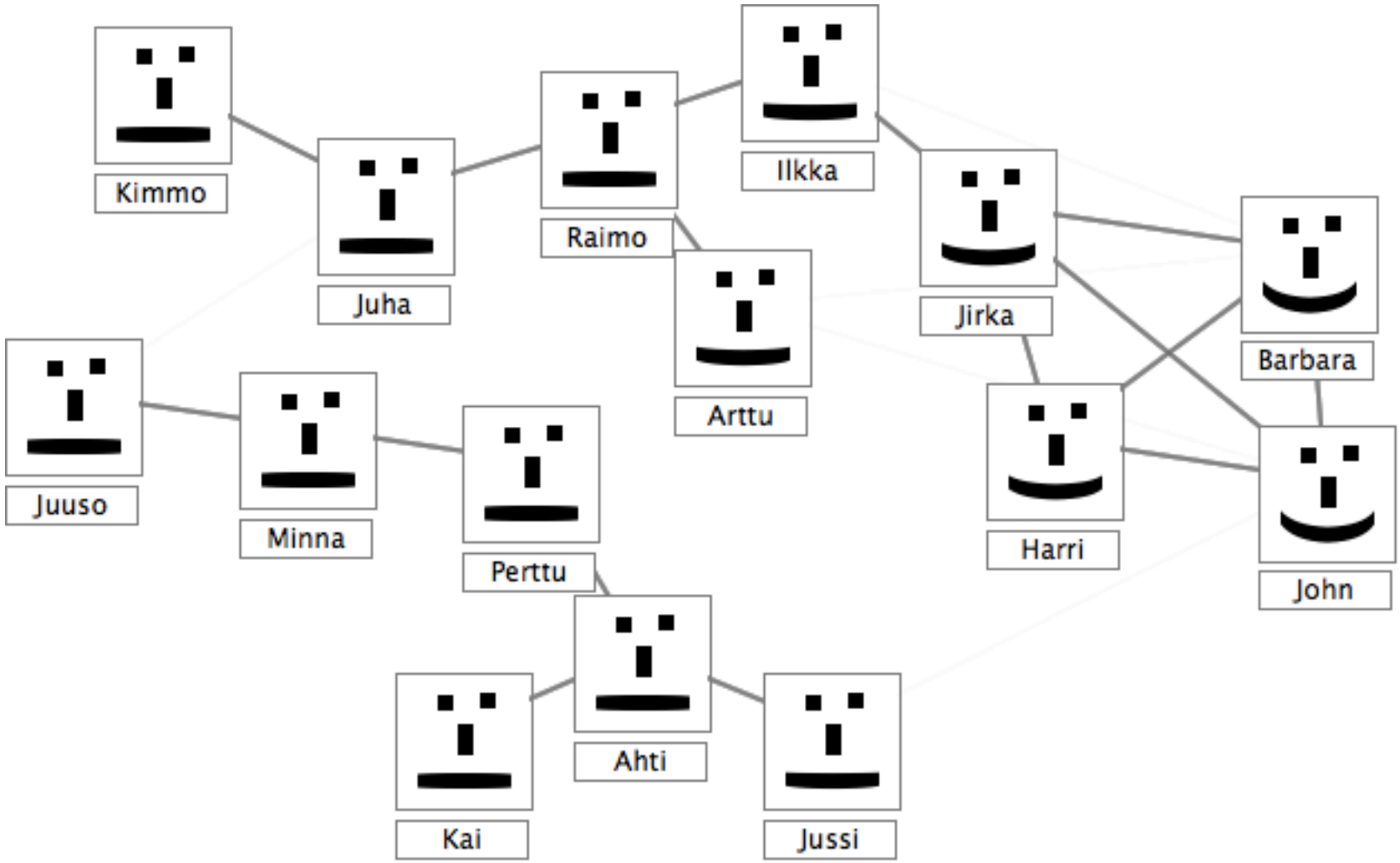
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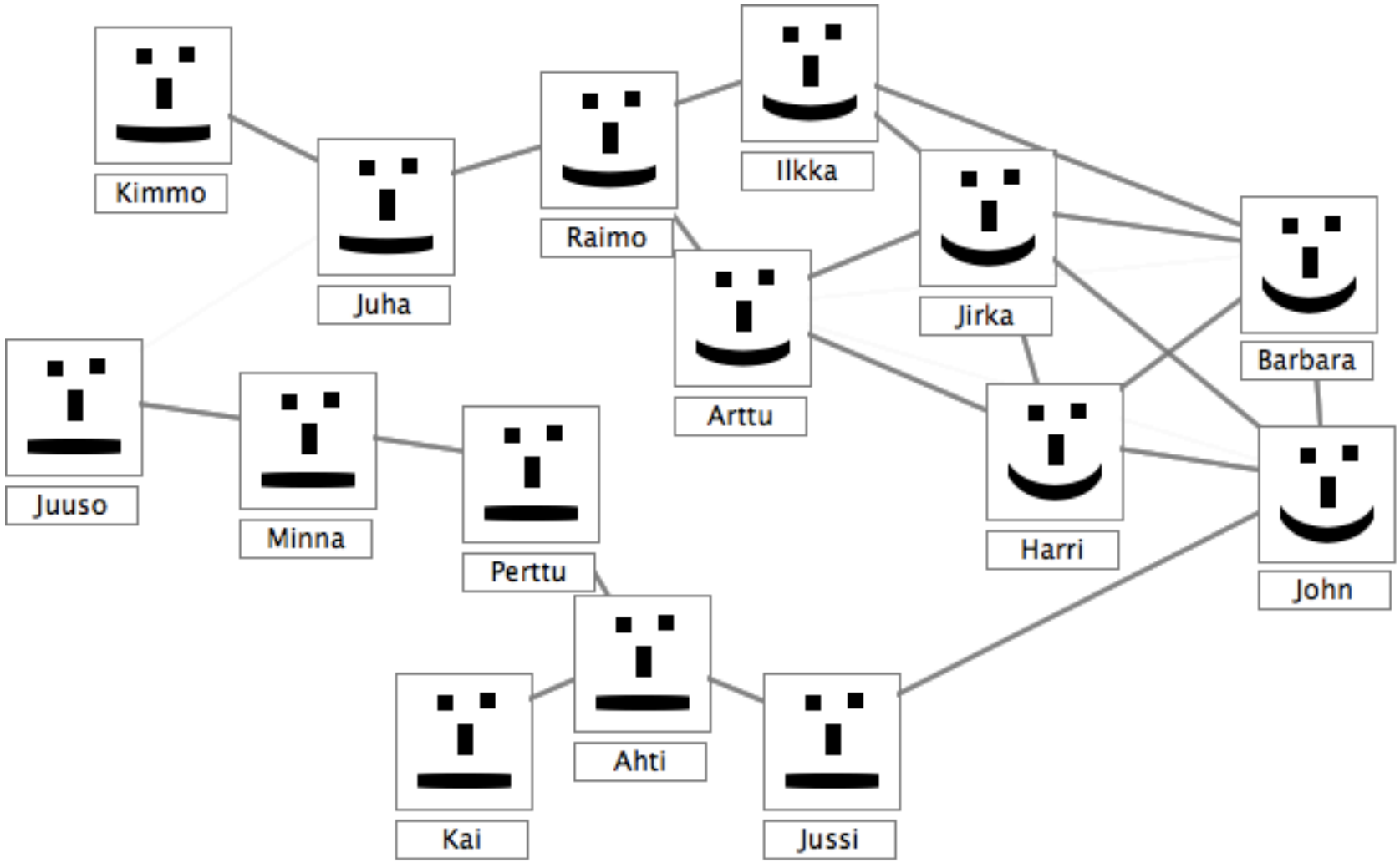
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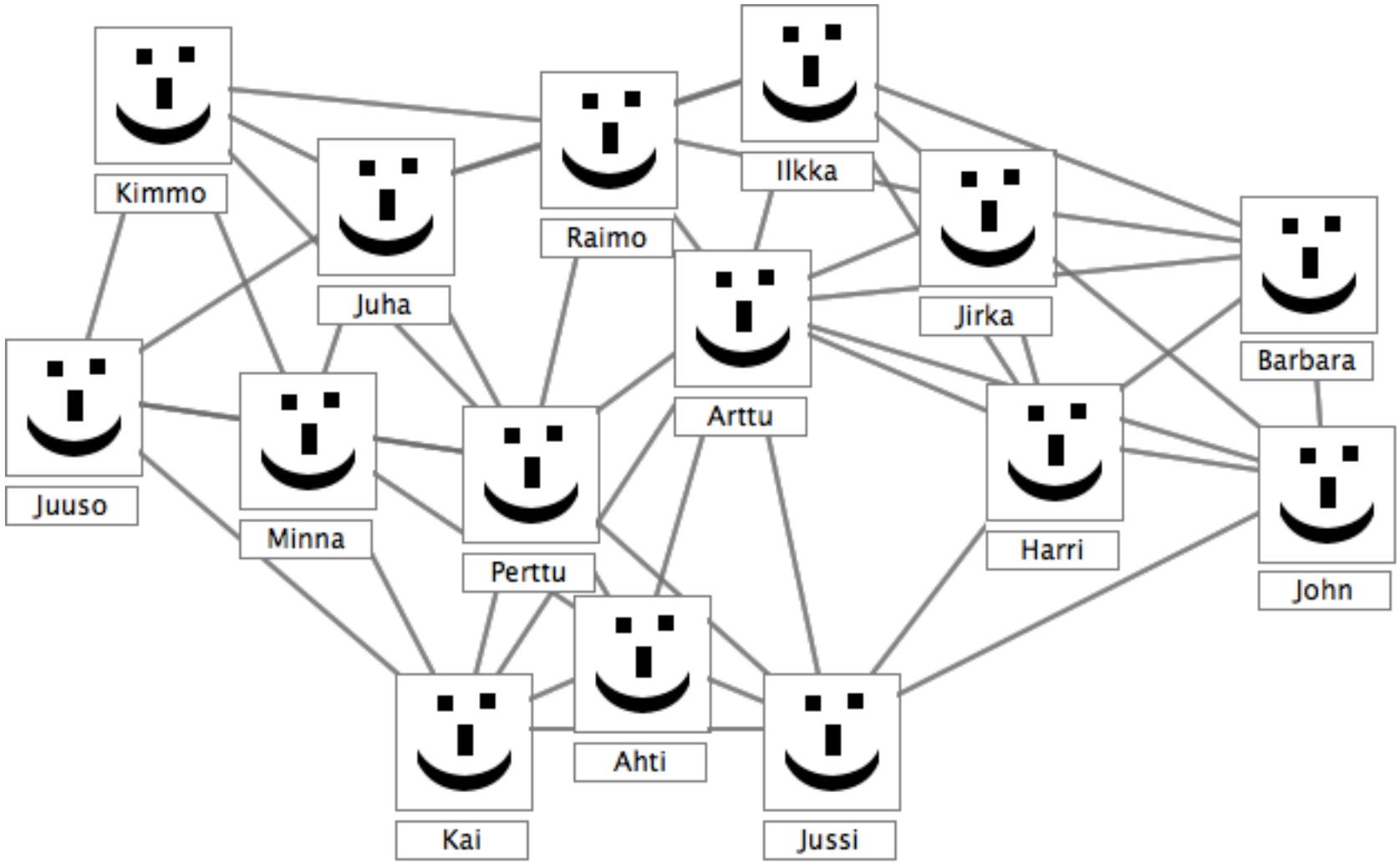
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Developing the system further

- **Improving the simulation model**
  - Enriching the models for emotion and interaction
  - Possibility for the user to decide his own agent's behaviour and make assumptions of the team members' behaviour

- Computational support **to find the most effective action and agent when the goal is to optimise team positivity**
  - Solving the simulation with e.g. a Monte Carlo approach?
  - Simulator could suggest the best course of action

Future research

- **What would a systems intelligent team look like?**
  - Robust against the effects of negativity
  - Support the development of positivity
  - What number of negative agents can be accommodated?

- **Behavioural testing by experiments**
  - Let people study their team's performance interactively by changing their own responses

References

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