# A network agent-based model of interaction between immigrants and a host population: self-organised and regulated adaptation

Carlos M. Lemos, Department of Religion, Philosophy and History, University of Agder, Kristiansand, Norway
Ross J. Gore, Virginia Modeling, Analysis and Simulation Center, Old Dominion University, US
Laurence Lessard-Phillips, Institute for Research into Superdiversity, University of Birmingham, UK
F. LeRon Shults, Department of Religion, Philosophy and History, University of Agder, Kristiansand, Norway
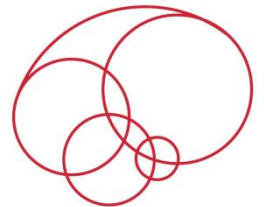
MODELING
RELIGION IN
NORWAY

Aims

- Employ modeling and simulation to identify facilitators and barriers to integration between a host and immigrant population.

- Research objectives:
  - **Formalise, develop and extend** in an agent-based model **Berry's model of acculturation strategies** so that it applies to both hosts and immigrants within a population;
  - **Quantify the effects of modeling interactions** between a host and immigrant population using classical game theory versus other models of social influence;
  - Demonstrate the **extent to which social network structure and homophily influence** these processes; and
  - **Quantify** the extent to which **language proficiency** of the host and immigrant population has an **influence**.

Theoretical inspirations

Acculturation

- Berry (1997)
 - Framework for research
 - Acculturation strategies

Social Cohesion

- Importance of cooperation (Chan et al. 2006)
  - 'Easy' to model

Modelling inspirations

- Axelrod's ABM of culture dissemination (1997)
  - Interactions with sufficiently similar agents
  - Successful interaction: becoming more similar
- Hammond/Axelrod ABM of ethnocentrism (2006)
  - Strategy in PD game: evolution of cooperation/defection
- Santos-Pacheco-Lenaerts ABM of cooperation in dynamic network (2006-2016)
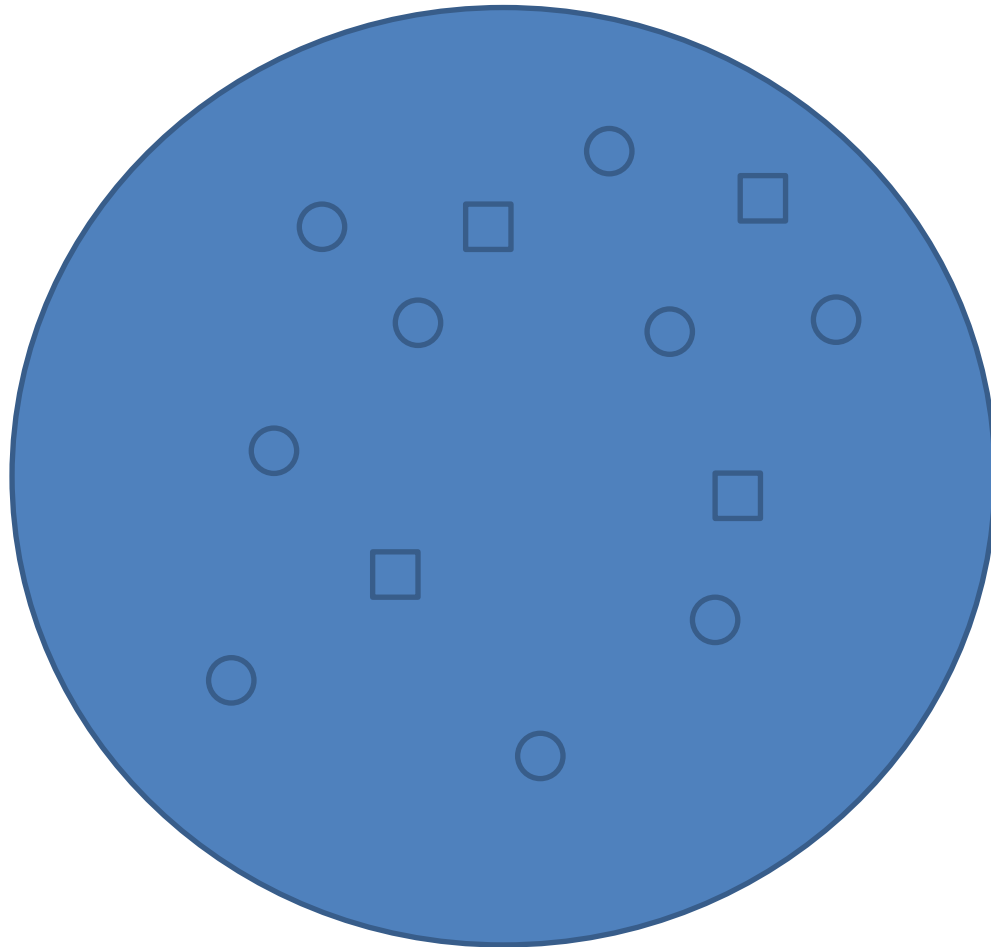 - Changing links depending on outcome of PD game
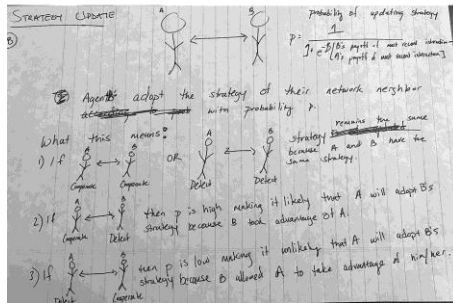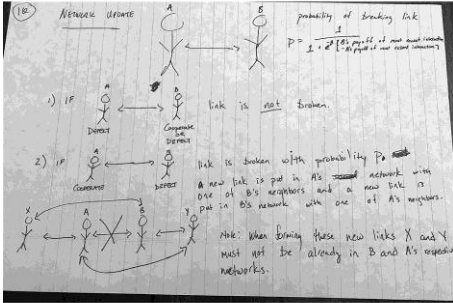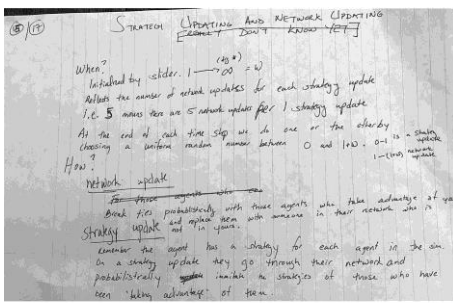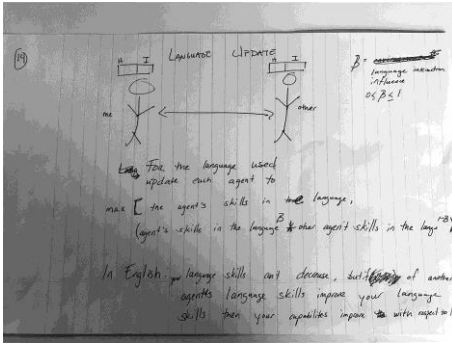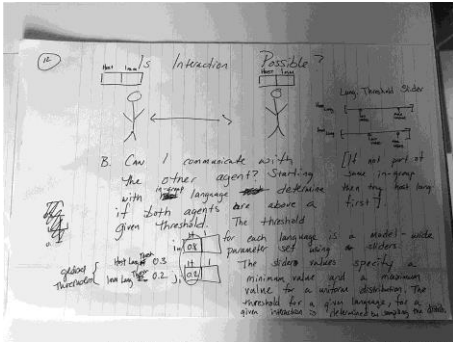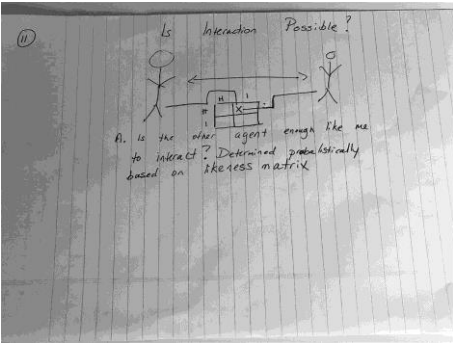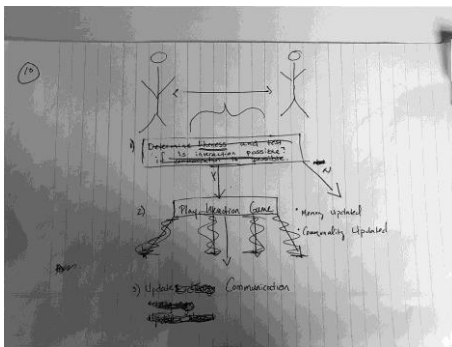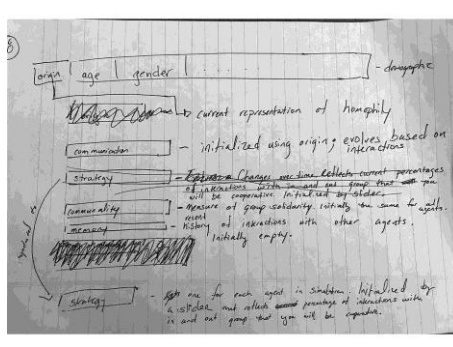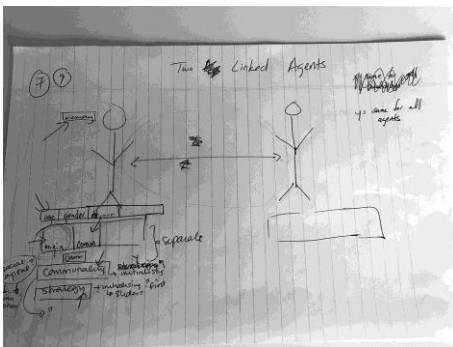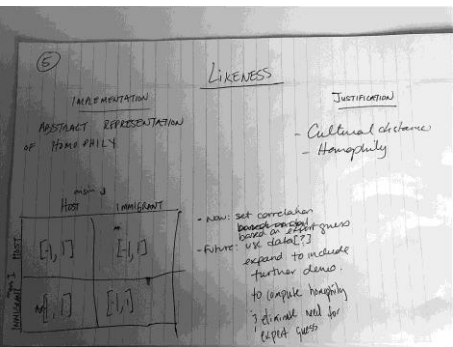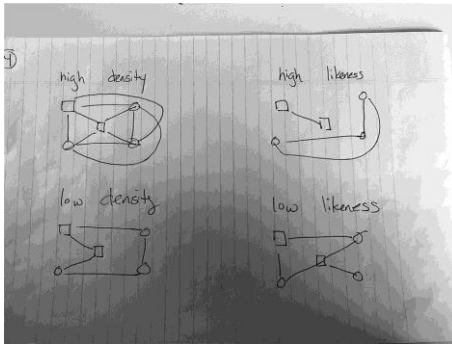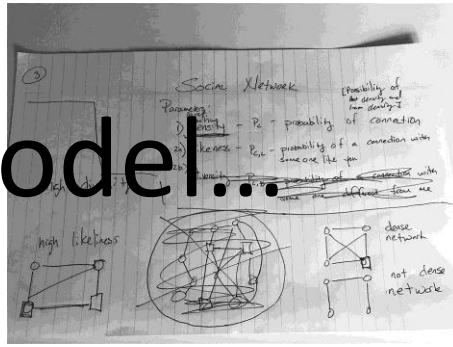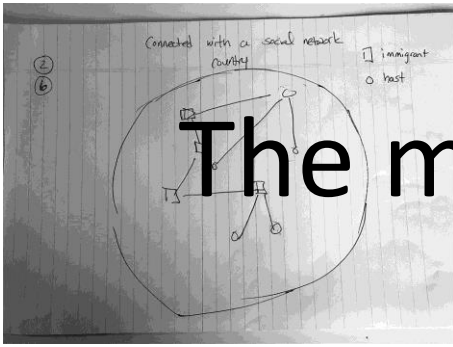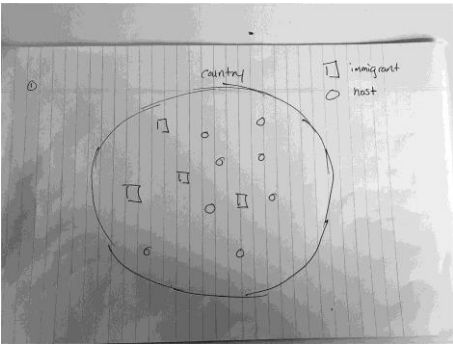
The model...
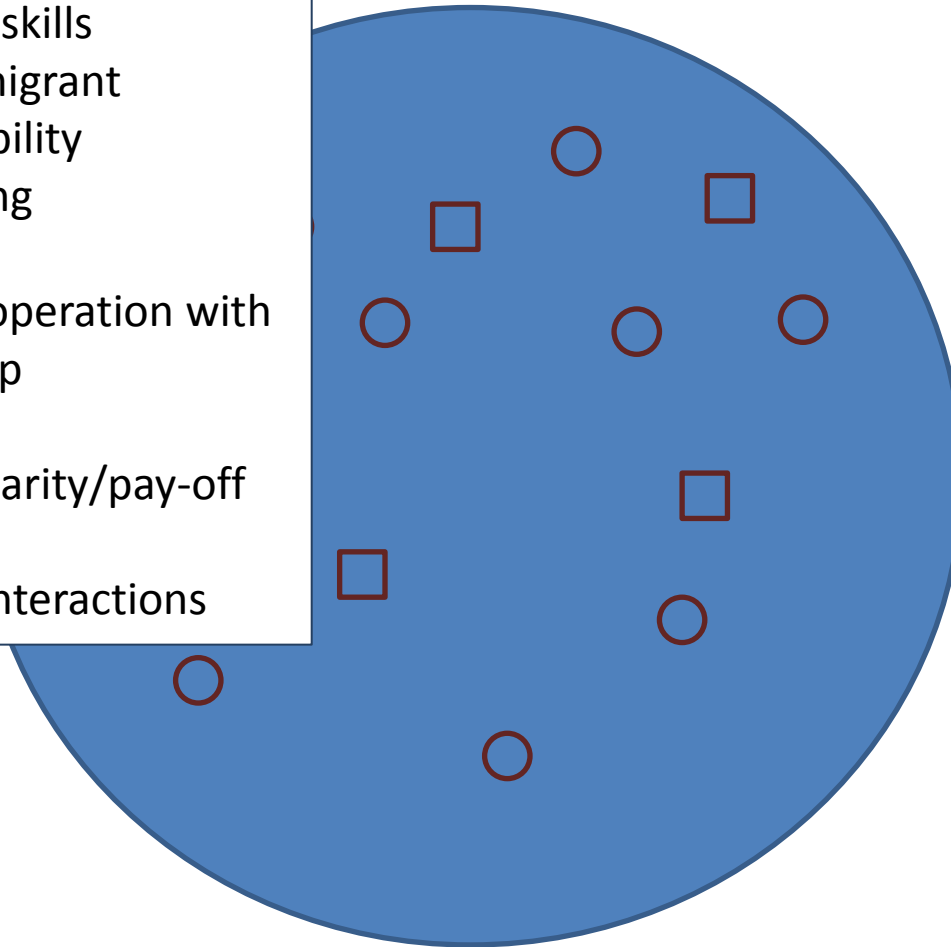...so far

Country

Host

Immigrant

Agents
- Demographic characteristics (origin, age, gender, …)
- Communication skills
    - Host & immigrant language ability
        - Evolving
- Strategy
    - Level of cooperation with in/out group
- Communality
    - Group solidarity/pay-off
- Memory
    - History of interactions

Host
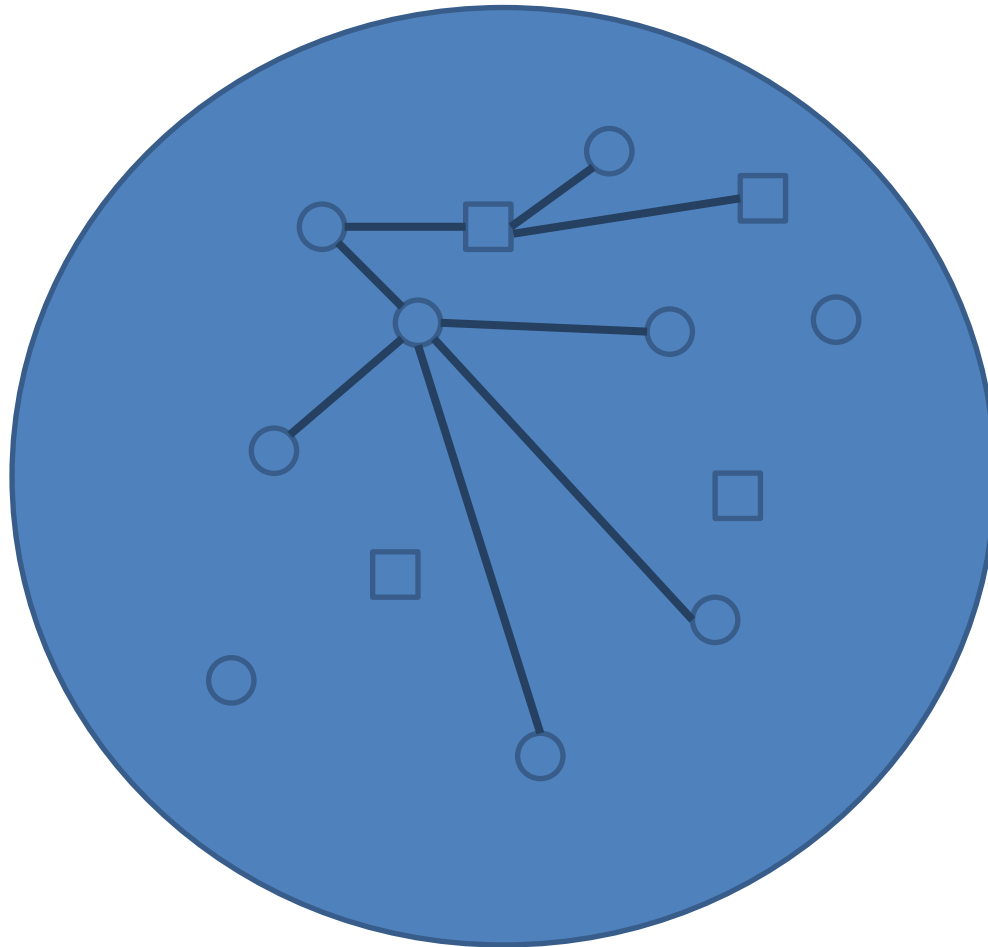Immigrant

Agents in a country
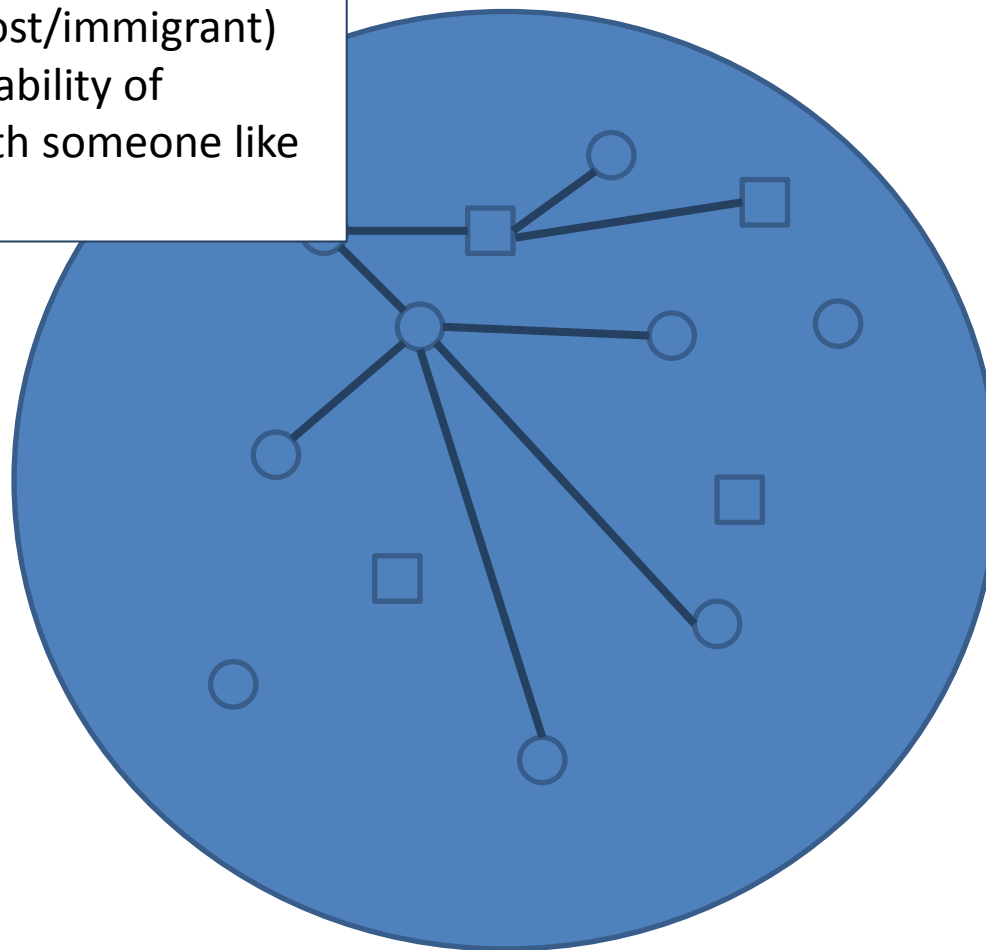Connected in a social network

Host

Immigrant

Agents in a country
Connected with a social network
- Density: probability of connection (host/immigrant)
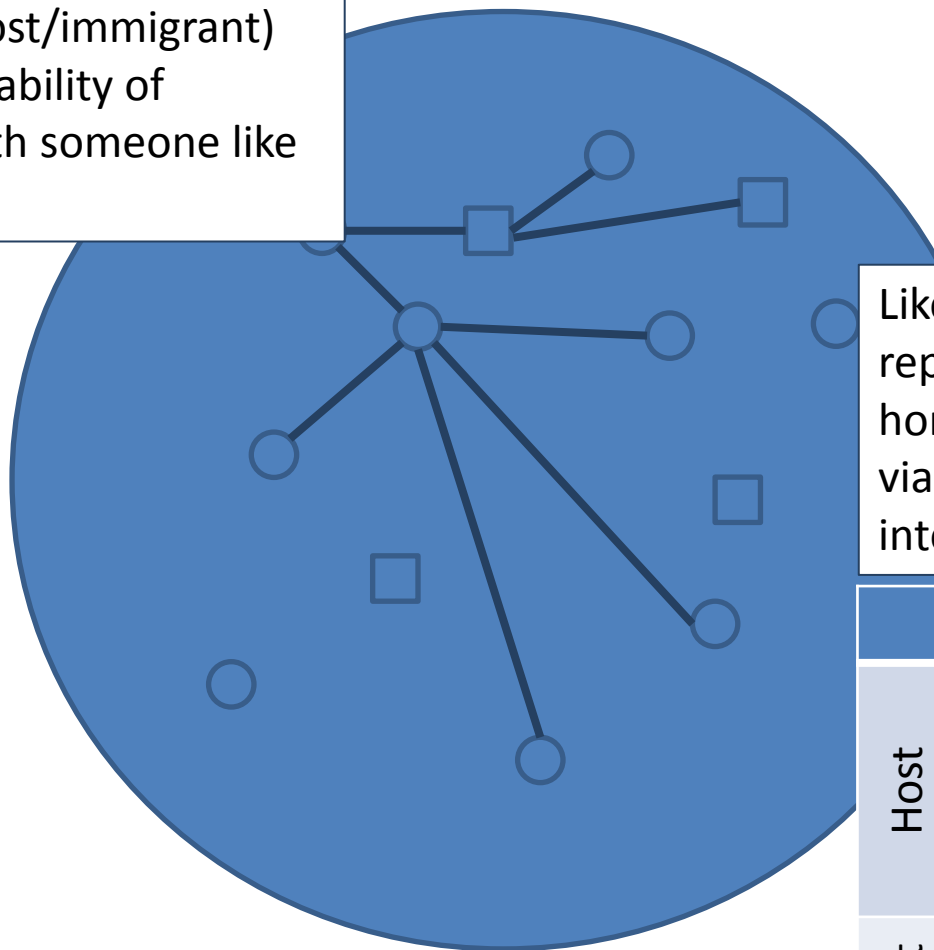- Likeness: probability of connection with someone like you

Host

Immigrant

Agents in a country
Connected with a social network
- Density: probability of connection (host/immigrant)
- **Likeness**: probability of connection with someone like you

Host

Immigrant

Likeness matrix: Abstract representation of homophily based on origin via correlation, transformed into a probability

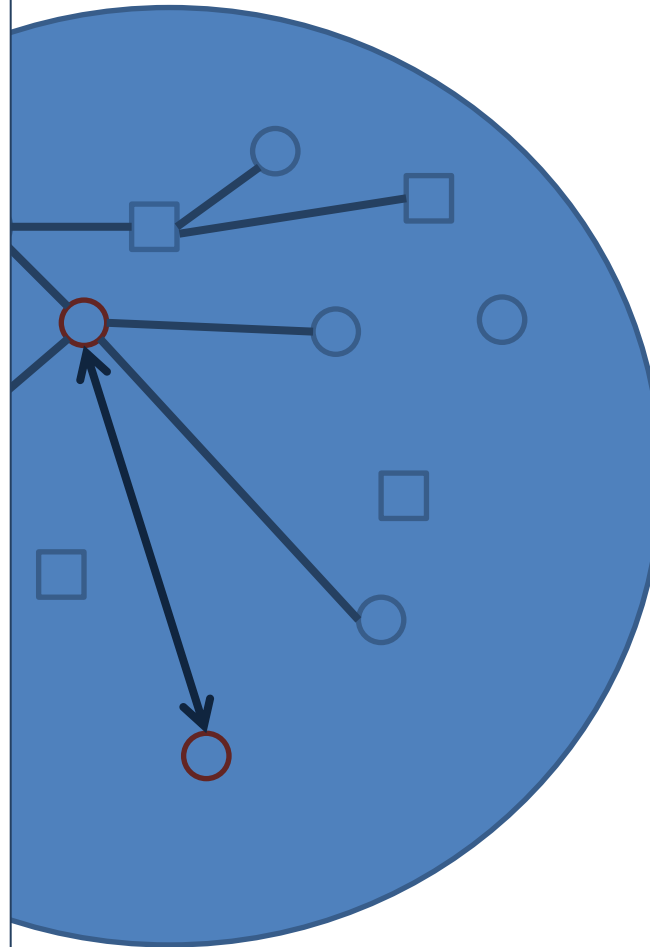|	**Host**	**Immigrant**
Host	[-1, 1]	[-1, 1]
Immigrant	[-1, 1]	[-1, 1]

Two linked agents
- Encounter
  1. Is interaction possible?
     - Based on likeness
     - Based on communication threshold
  2. Play interaction game
     - Choose strategy (based on origin)
     - Play game
     - Record interaction in memory
  3. Update
     - Every interaction
       - Memory
       - Communality
       - Communication skills
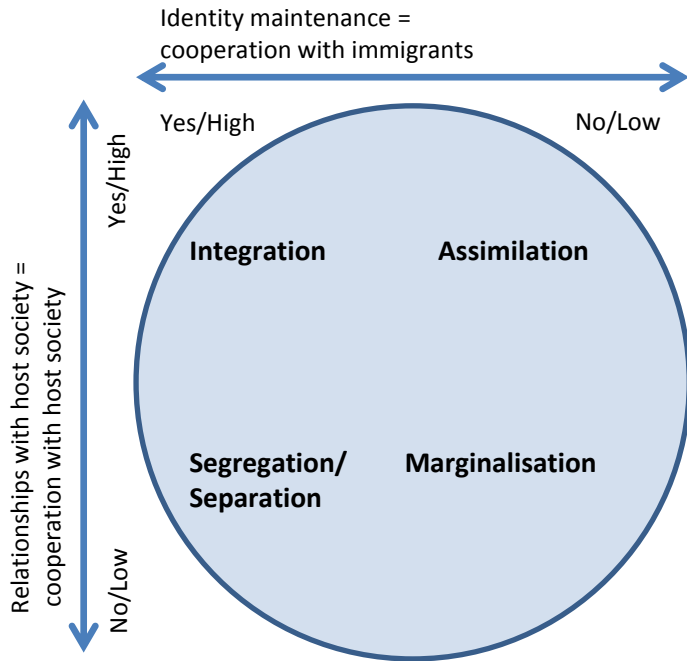   - End of time step
       - *Network*
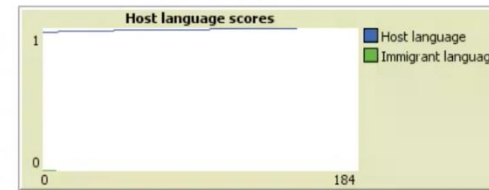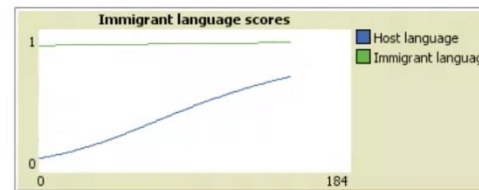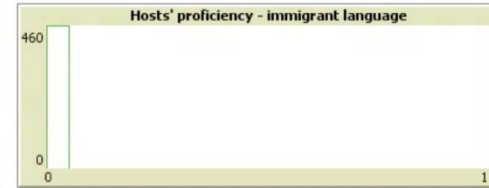   - *Strategy*

○ Host

□ Immigrant

Potential outputs...

Mapping onto Berry's framework

Identity maintenance = cooperation with immigrants

Yes/High — No/Low

Relationships with host society = cooperation with host society

Yes/High — No/Low

Integration   **Assimilation**

Segregation/ Separation   **Marginalisation**

Language ability
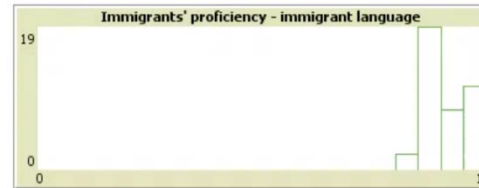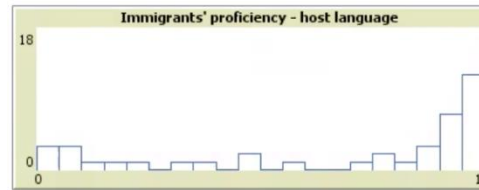
Structure of social networks (for in & out groups)

What it looks like so far...
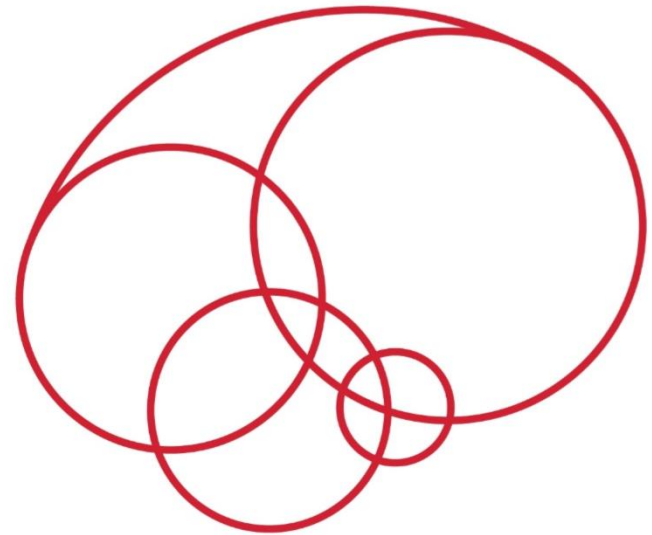
What it looks like so far...

Next steps

- Find data
  - Statistics Norway
  - Implementation to other countries?
- Current developments
  - Language/communication sub model
  - Game playing/rewiring sub model
- Future iterations:
  - Expand model (include more elements)
  - Explore effects of other social interaction models

Questions? Comments?

THANK YOU!