AccesSim : Une modélisation multi-agents interactive et pédagogique de la mobilité piétonne en milieu urbain
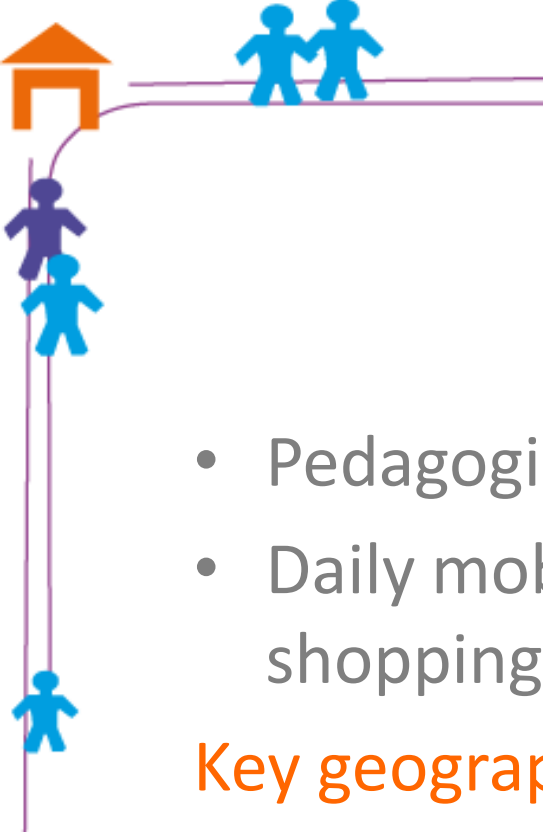
Matthieu Delage, Florent Le Néchet, Thomas Louail, Hélène Mathian, Sébastien Rey Coyrehourcq

Géographie-Cités (Univ.Paris 1, Univ. Paris 7, CNRS)
LVMT (Université Paris-Est Marne-la-Vallée)
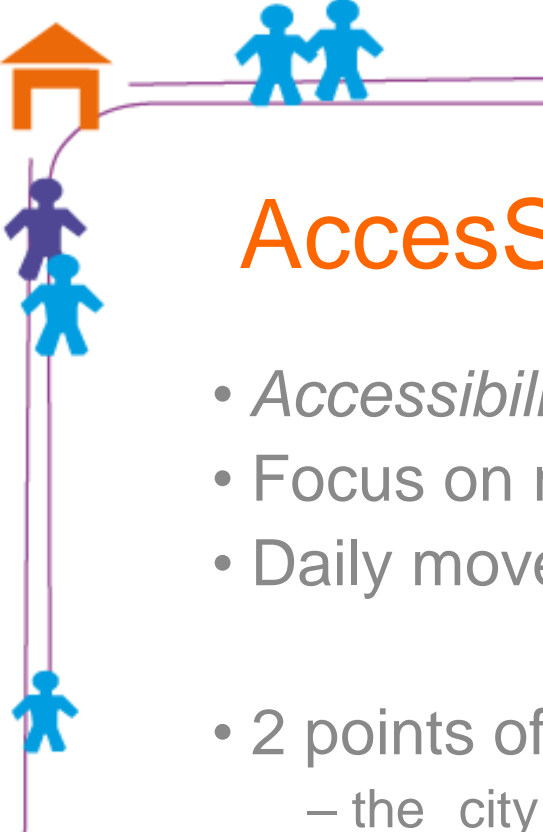IBISC(Univ. Evry Val d'Essonne)

Key geographic notions tought by simulation

- Pedagogic and interactive project

- Daily mobility in urban fabric, associated with shopping or proximity service

Key geographic notions

- Accessibility of territories

- Interlinkages between geographical scales

- Social / spatial mixity?

AccesSim : principles & framework

- *Accessibility* in an urban environment
- Focus on regular pedestrian movements
- Daily movements by residents to access services

- 2 points of view on *accessibility*:
  - the city resident : individuals equal needs to services access => *territorial planning*
  - the services : frequentation depends upon the overall accessibility and user potential => *geo-marketing*

- Netlogo modeling

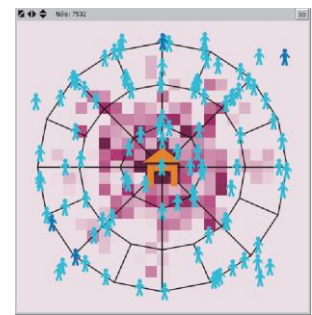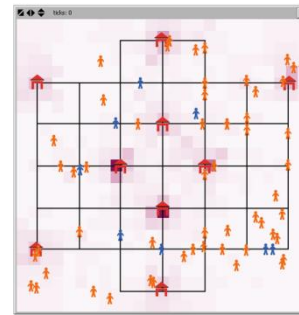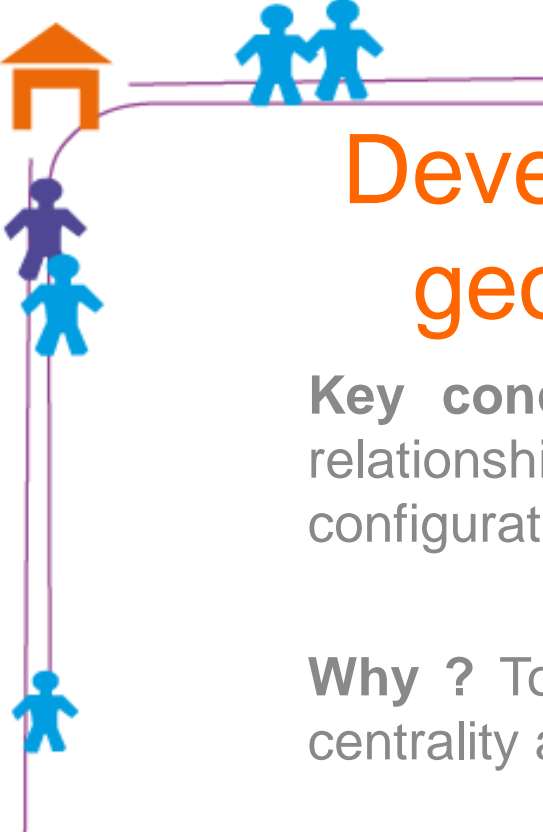# Scales and entities

- Geographical reality
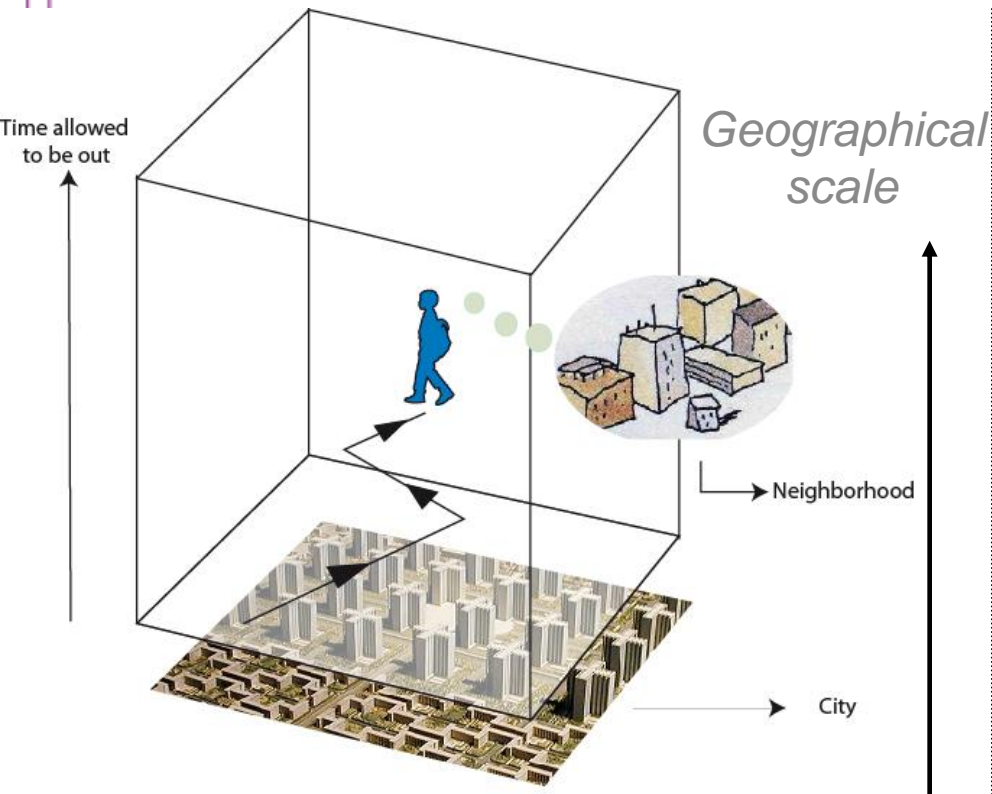
- Accessim
  - Shops and people as individual agents

  - Neighborhoods agents
  - City transport network

Time allowed to be out

Geographical scale

Neighborhood

City

# Developing a teaching tool of geographical core notions

Key concepts : Accessibility in an urban setting, relationships between services localisations, network configuration, accessibilities of the services

Why ? To familiarize schoolchilds with the notions of centrality and territorial inequalities
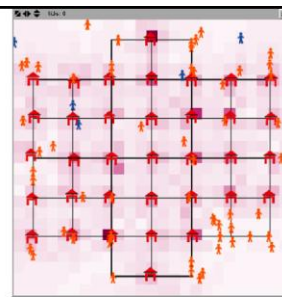
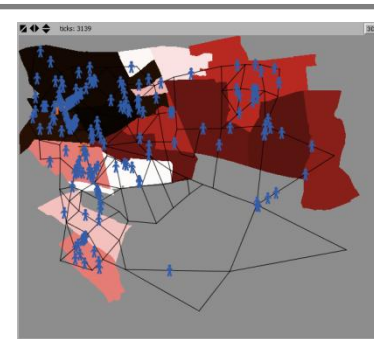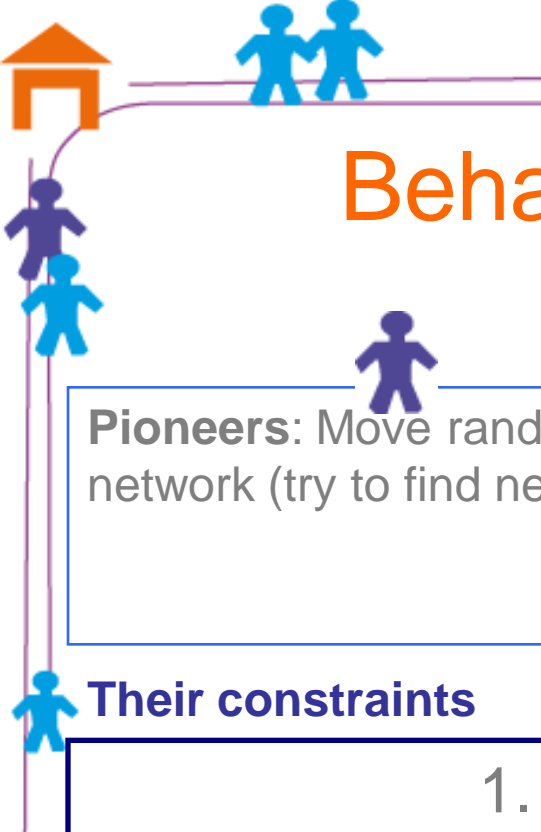**How ?** By simulating it and by playing it !
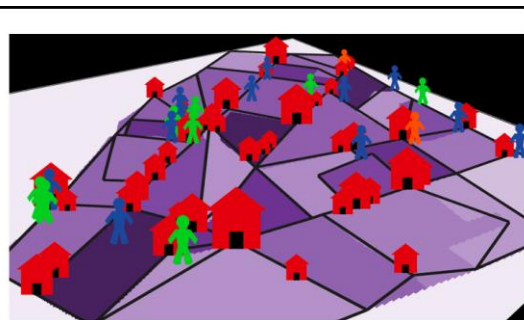
Paris Neighbourhood
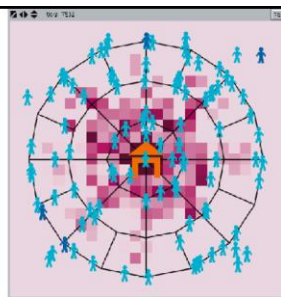
Radioconcentric Neighbourhood

« Manhattan » Neighbourhood

Champs / Marne

Behaviours of the children-agents

Pioneers: Move randomly on the network (try to find new bakeries)

Followers : Choose the most popular *OR* the quickest path to the services.
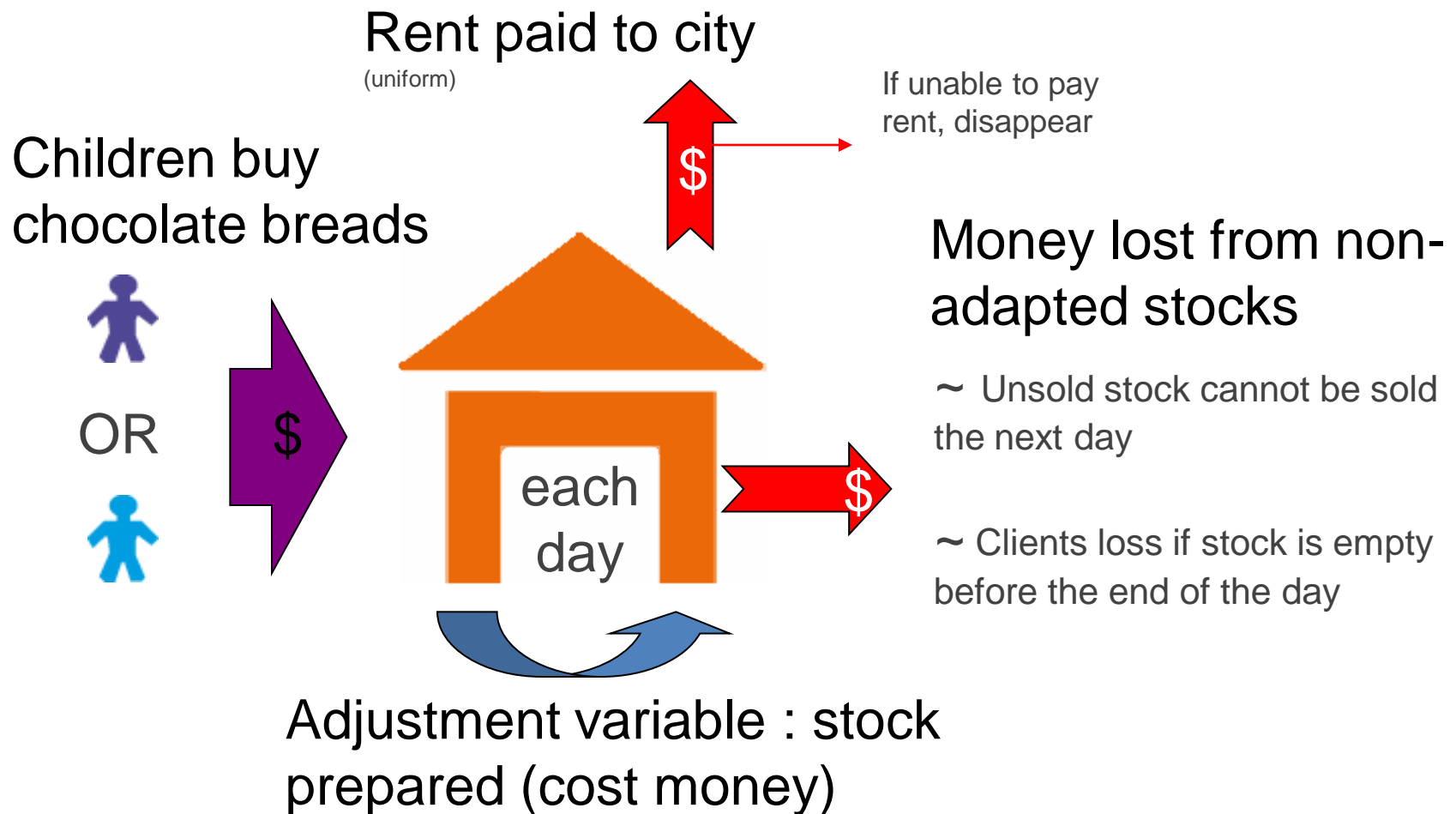
Their constraints

1. They *need to go* to the bakeries
2. They *have to* come back home after a *fixed* time
3. They *memorize* their current path only and its distance cost
4. They *share* this perfect information in their neighborhood

Their limits…

- They don't come back home… just disappear !
- They have no habits, each time looks like… the first time

- Simple Algorithm
  - Renewal of the stock is deterministic and based upon the children demands (adapted from Comets 2004)

Rent paid to city
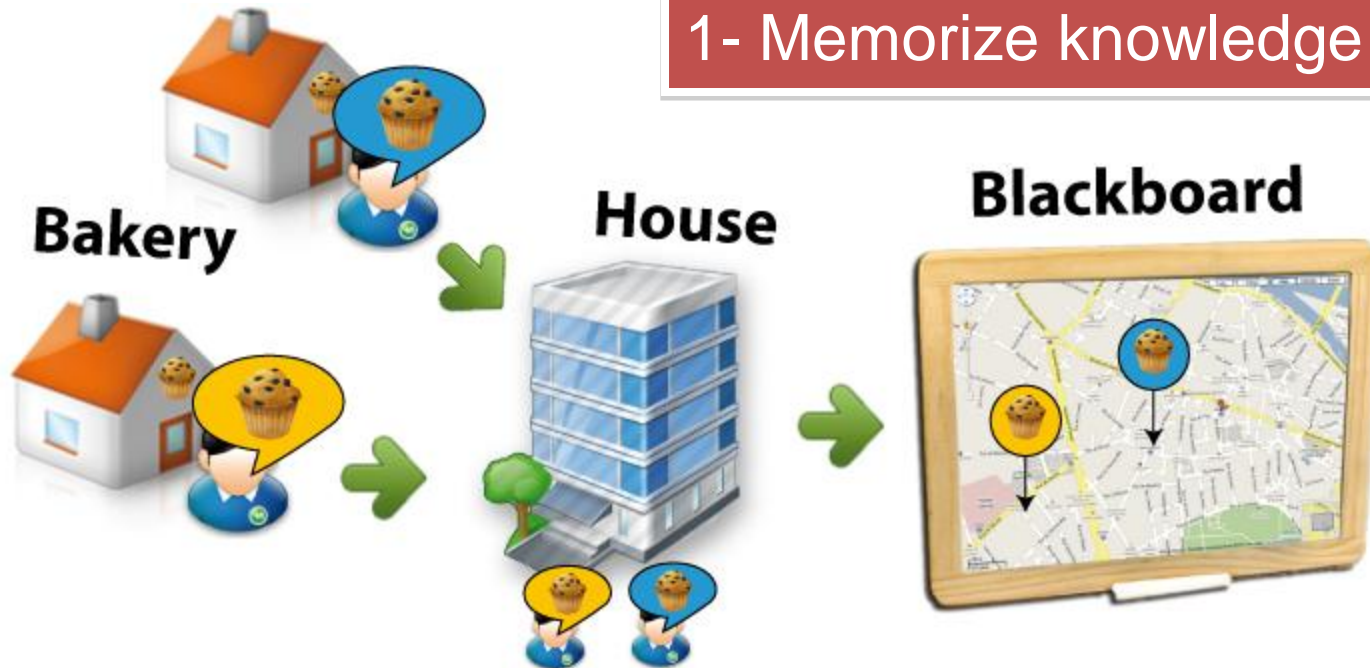(uniform)

If unable to pay rent, disappear

Children buy chocolate breads

OR

$

each day

$

Money lost from non-adapted stocks

~ Unsold stock cannot be sold the next day

~ Clients loss if stock is empty before the end of the day

Adjustment variable : stock prepared (cost money)

Behaviors of the neighborhoods

- Memory place
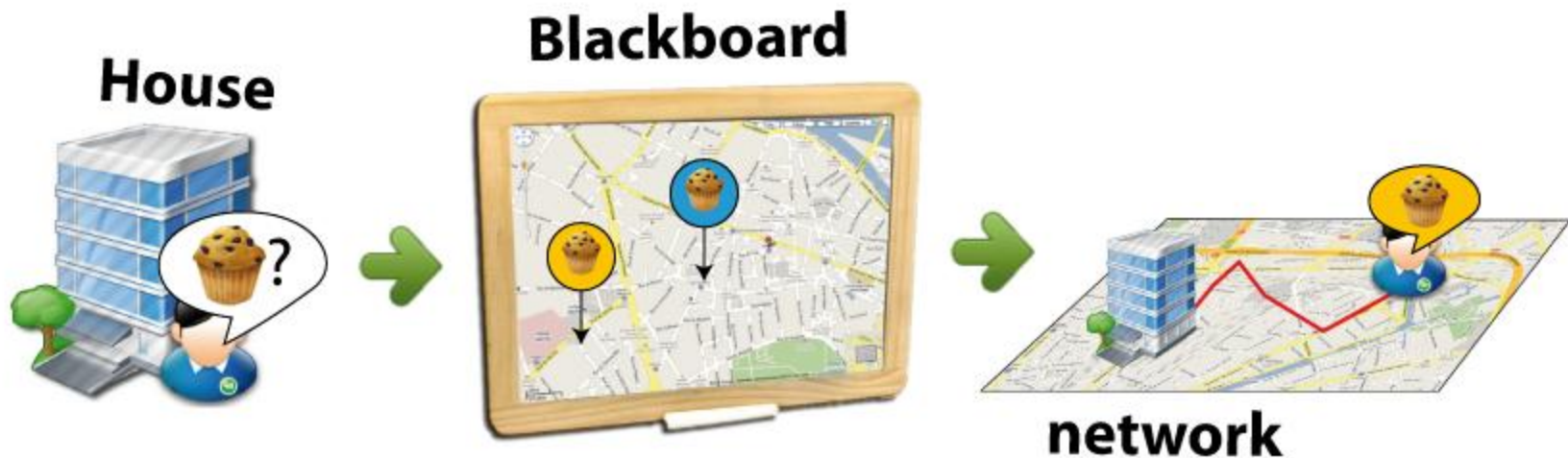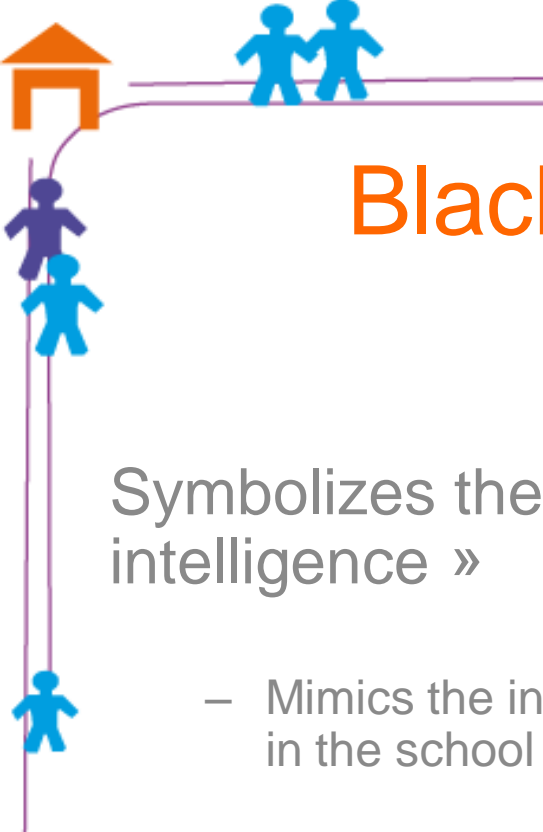- Knowledge associated

1- Memorize knowledge

Bakery

House

Blackboard

Behaviors of the neighborhoods
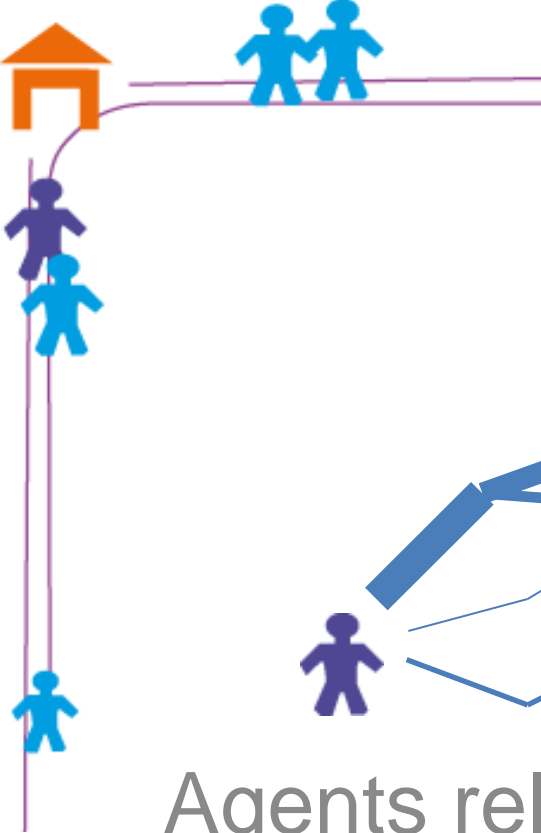
2 - Get knowledge

Blackboard communication and reactive optimization

Symbolizes the « collective intelligence »

– Mimics the information exchanged in the school yard

– Blackboard communication (shared read-write memory)

– On the long run results in reactive, non-intentional shortest path "optimization"

– Chocolate taste is uniform

Object "Path"

Congestion : Slow movements on high streets
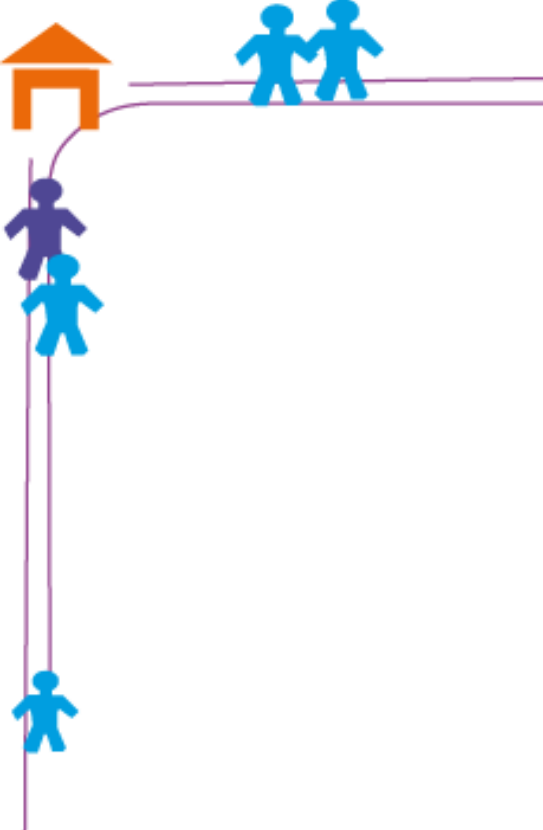
Dynamic path gestion :
Shortest path is only slowly adopted

Interaction with bakeries dynamics
Blackboards can forget

Agents reluctant to change

Choice between shortest path "so far" and most popular path

T = ratio of times

F = ratio of uses

Threshold for T / F

Vidéos 1 & 2

2 Games

•2 roles for the child-player

MAYOR

– GOAL : Be re-elected
– Starting point : already-constituted city (densities, networks)

– Has "authority" over the positioning of all the bakeries

– 3 real-time indicators to assess his development strategy:
  • The rate of satisfied children-agents (to MAX)
  • The average distance they walked (to MIN)
  • The wealth accumulated by the bakeries (to MAX)

• BAKER

– GOAL : Be the most popular baker in town
– Starting point : already-constituted city (densities, networks) AND pre-located bakeries

– What's the best possible location for a new bakery ?

– Compares its development to that of other bakeries
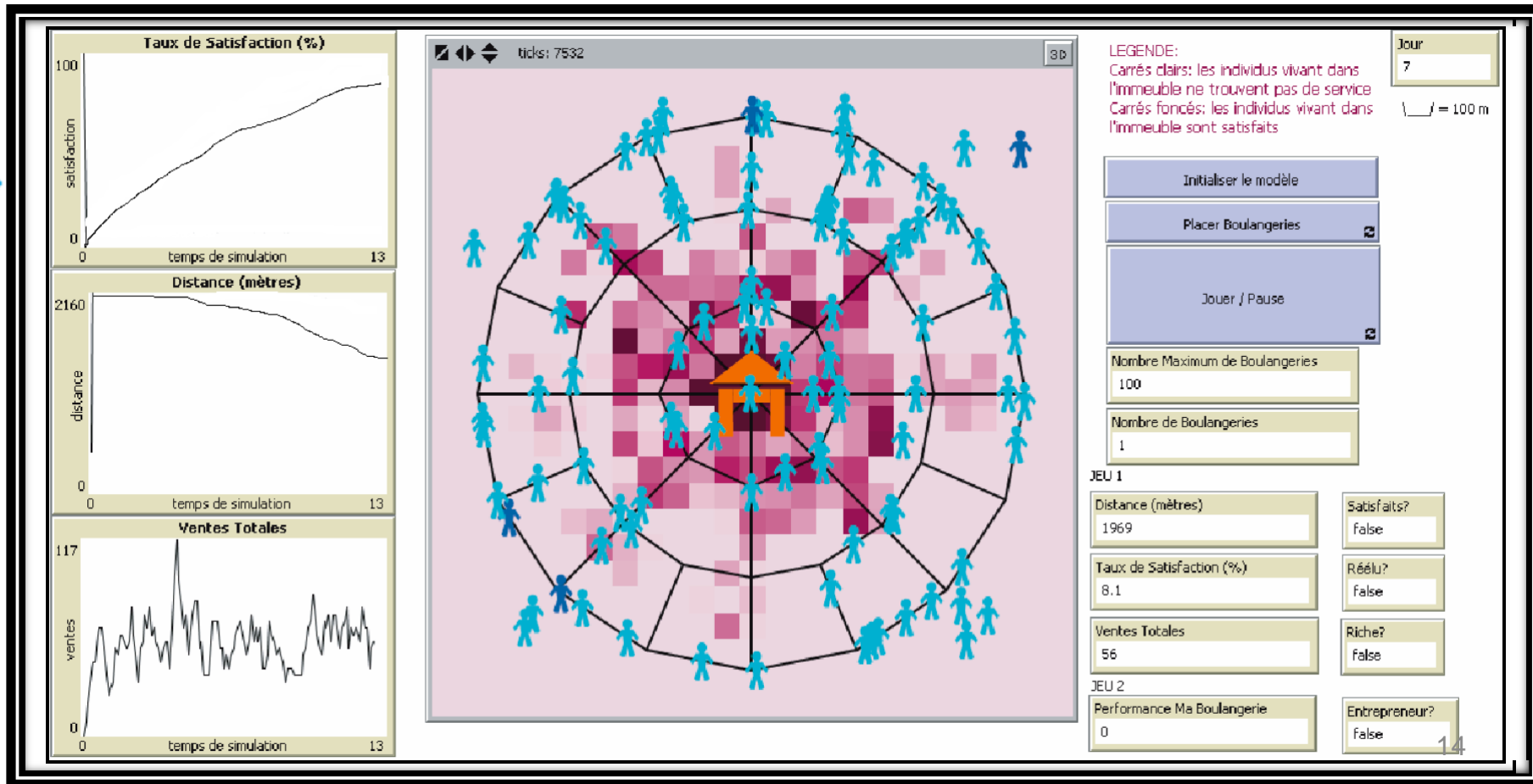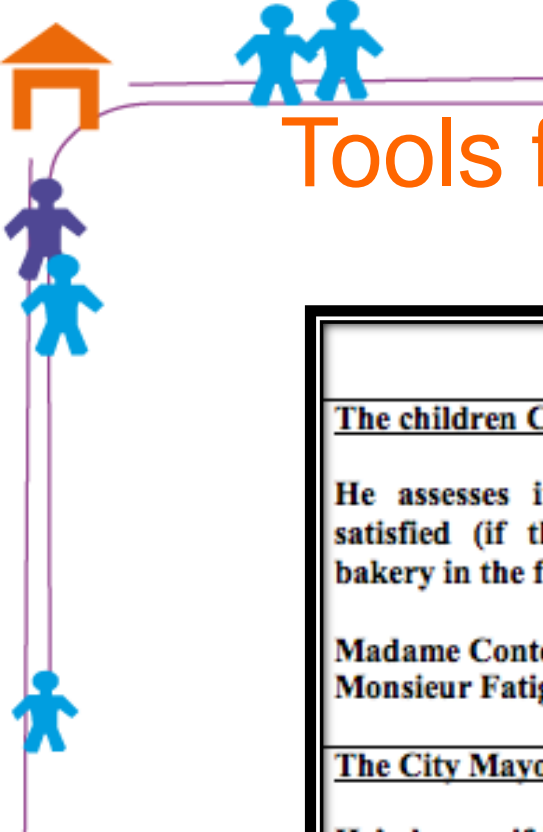– Bakeries disapear if not successful => trial and error strategies and on-the-fly visual evaluations

13
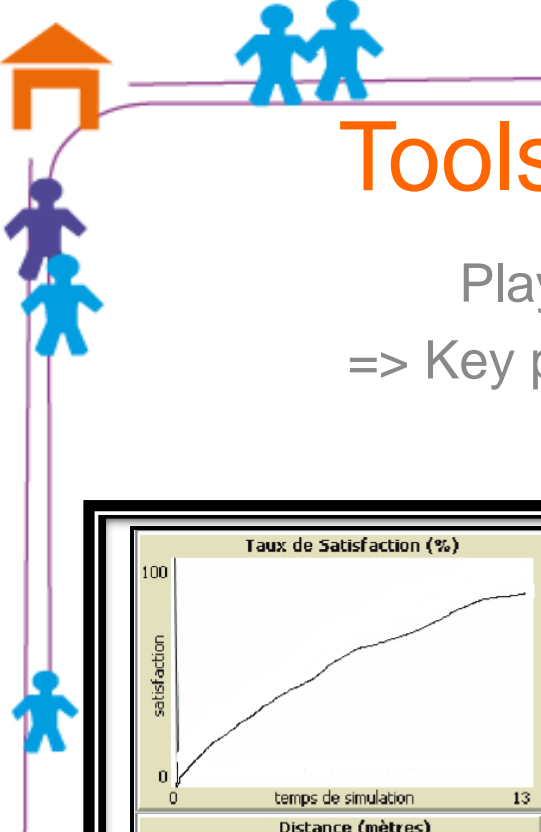
Tools for ABM Learning : GUI

Player ergonomy *vs* developer ergonomy
=> Key parameters and indicators on the front only

14

	Satisfied (True)	Unsatisfied (False)
The children Council chief: He assesses if the children are satisfied (if they can go to the bakery in the fixed time budget) **Madame Contente= Miss Happy** **Monsieur Fatigué= Mr Tired**	Madame Contente	Monsieur Fatigué
The City Mayor: He's happy if he is re-elected. For that, he needs at least of 50% children satisfied. **Madame réélue= Miss re-elected** **Monsieur non-réélu= Mister non re-elected**	Madame Réélue	Monsieur Non Réélu
Treasury Secretary: The bakeries have to sell a lot to pay a lot of taxes **Monsieur Plein aux As= Mr Rich** **Monsieur Rien dans les Poches= Mr Poor**	Monsieur Plein aux As	Monsieur Rien dans les Poches
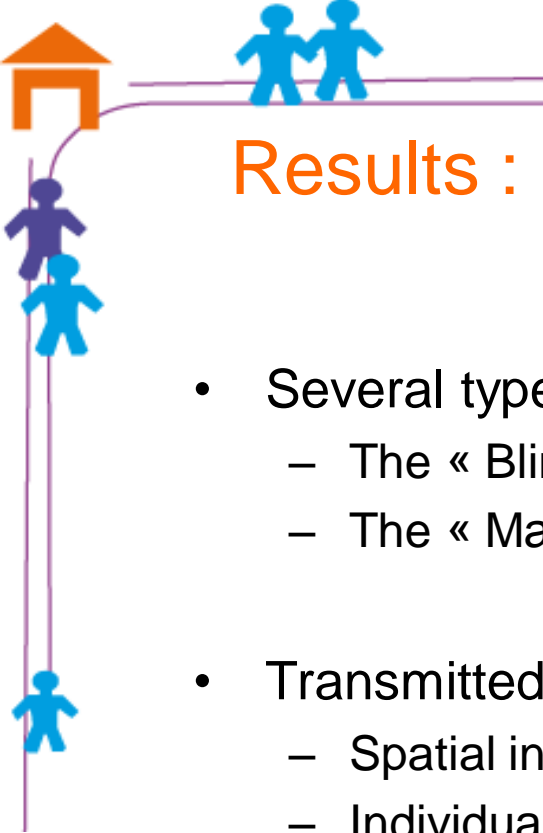
Results : Benefits from children and modelers points of view

- Several types of player strategies
  - The « Blind red fish » strategy
  - The « Maths professor's son » strategy

- Transmitted notions
  - Spatial inequalities based on accessibility
  - Individual vs. Collective interests
  - Choices, compromises, multi-criteria decision support
  - Good identification of the child-player to the 2 roles

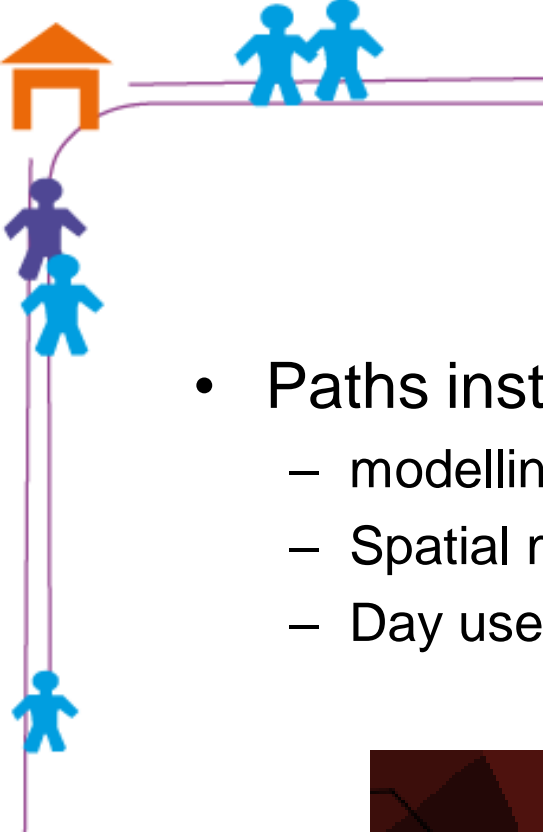- Positive feedback for the team members on their own modeling projects

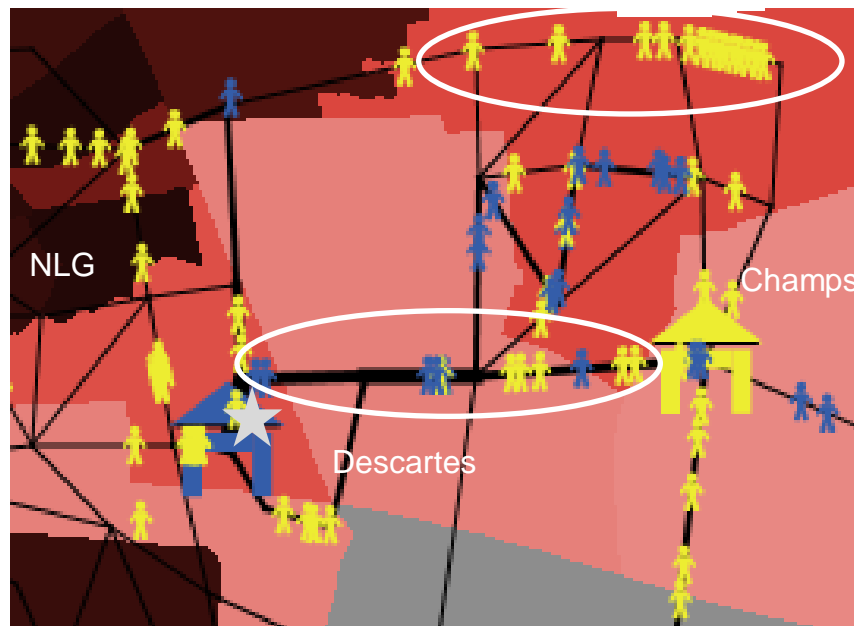Actifs type « 1 »

Actifs type « 2 »

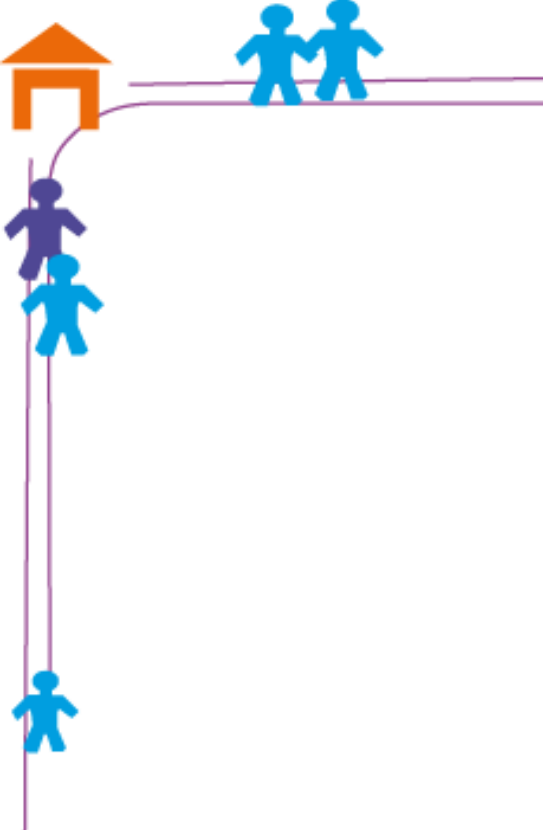Emplois type « 2 »

Emplois type « 1 »

Socio-temporal mixity

- Paths instead of zones
  - modelling real-time interaction between agents (cognition)?
  - Spatial mixity / temporal mixity
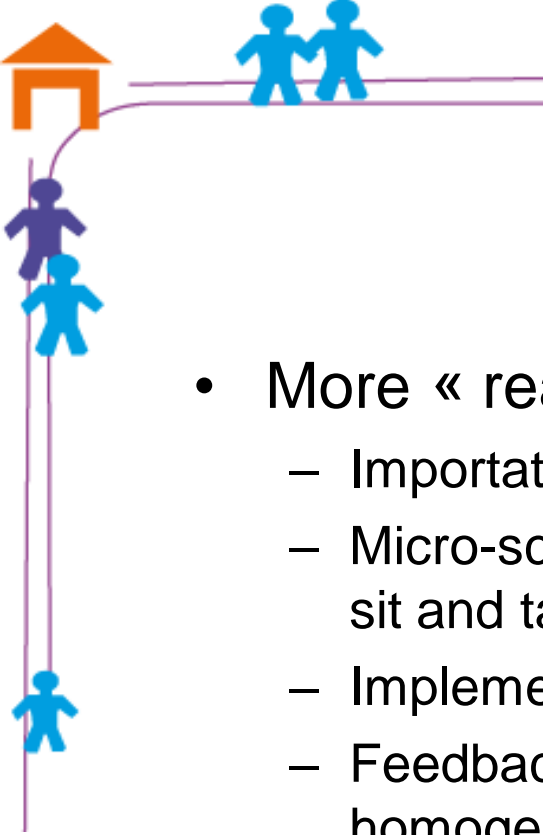 - Day users / Night users not implemented yet

Detour

NLG

Champs
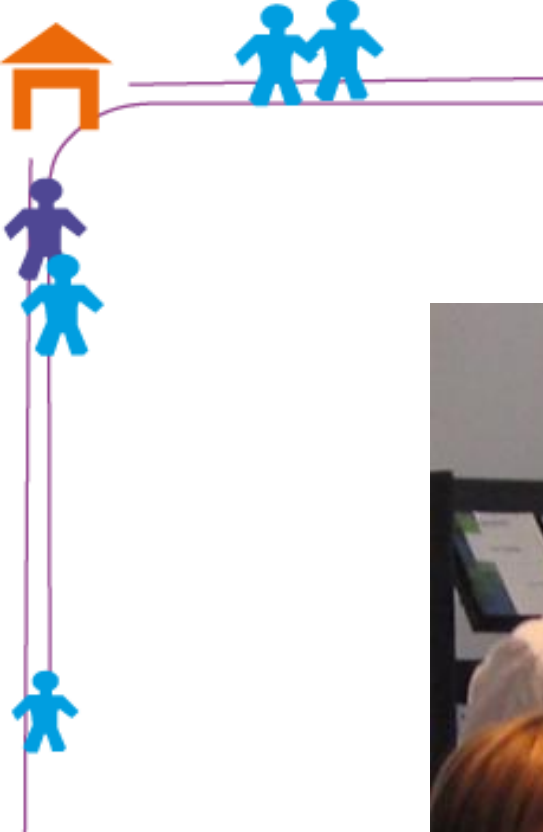
Main street

Descartes

Vidéo 3

Perspectives

- More « realistic » simulation
  - Importation of real networks from GIS
  - Micro-scale matters : attributes of streets (walkable, bars to sit and talk, etc.)
  - Implementation of time schedules
  - Feedback behaviour for agents : preferences towards homogeneity? Paths version of Schelling segregation model
  - But stick with pedagogic model : what is spatial / social mixity?
- Open question : towards calibration with real-time data
  - Synthetic population generation with adaptative behaviour
  - Cell-phone / agent-based modelling (instead of macro model / OD matrix)

Thank you !