

Paris by night ... and by day

Daily mobility and social dynamics of places around the clock



@Stephen Wilkes

Guillaume Le Roux, Julie Vallée, Hadrien Commenges

UMR Géographie-cités (CNRS - Université Paris 1 – Université Paris 7)



Context and theoretical approach

RelatHealth project



- Health behaviors and health outcomes have been related with place-based components such as :
 - residents' social profile ;
 - proximity to urban services (e.g. health services, commercial, recreational or cultural resources).
- But, until now, place-based components have often been defined without accounting for people's **daily mobility**
 - In **RelatHealth project**, we propose to adopt more relational approach to place effects on health considering people's place experiences
 - Following time-geographic perspective, this project aims at exploring the spatial logics of inequalities in health in cities
- Research question :

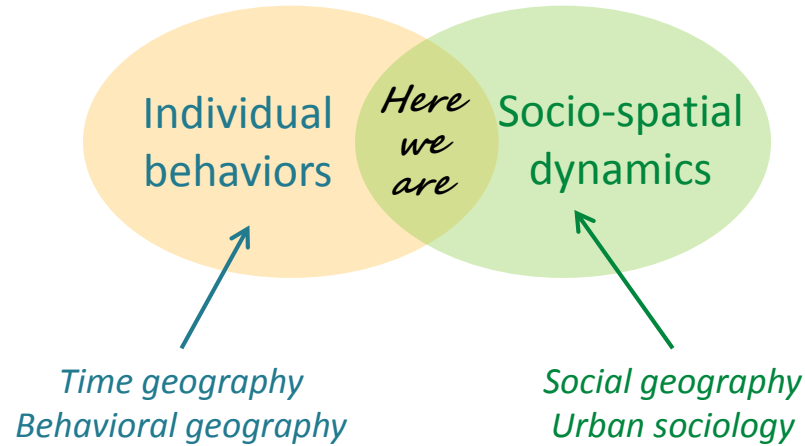
In which extent place-based components – which may vary according to people's daily mobility – impact health outcomes and health behaviors?
- 2 cities : Paris (France), Montreal (Canada)
- Researchers in Geography and Epidemiology

Justifications

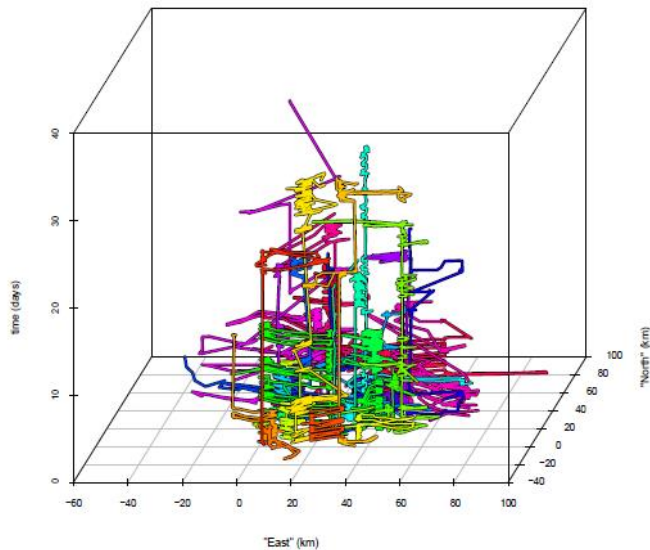


- **Presentation focus.** Exploring how daily mobility modify...
 - social composition of places over 24 hours
 - people's social environment over 24 hours
- Interests for **academics** : contributions...
 - ... about urban segregation
 - Much quantitative work on residential segregation but few taking into account daily mobility
 - Daily trips are socially differentiated and may promote either co-presence of social groups or on the contrary *entre-soi* practices
 - ... about place effects
 - Neighborhood effects generally based on resident population through census data => considering people's activity spaces and the visiting population in neighborhoods may be more adequate to characterize social environment
- Interests for **public actors**
 - For targeting deprived areas to implement public interventions
 - For targeting populations stuck in deprived areas

Theoretical inspirations

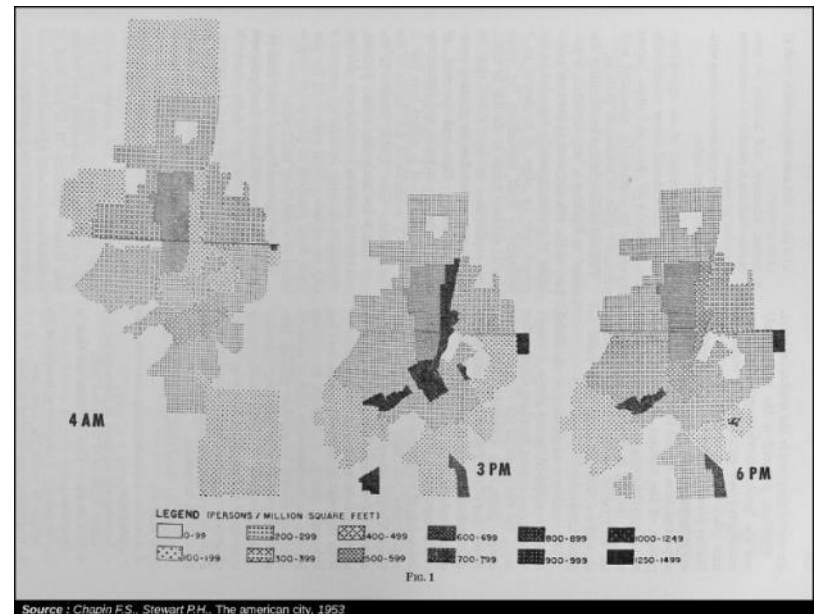


Recent papers: time geography



Palmer, 2013

Old papers: day-time population studies



Research hypotheses



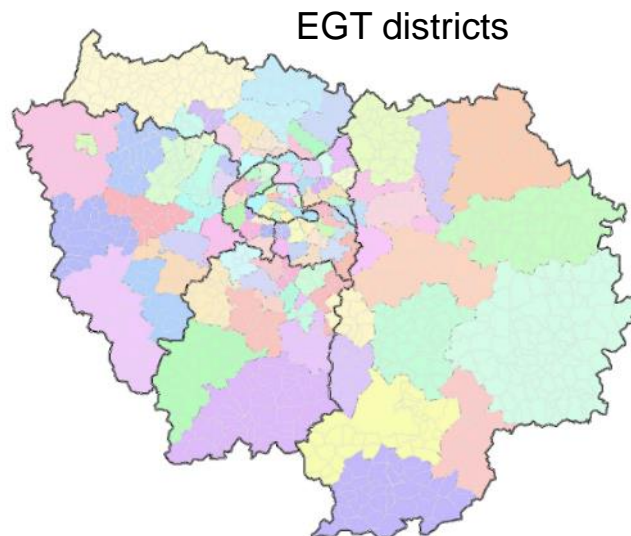
- 2 levels :
 - Spatial dynamics (AREAS)
 - Individual daily paths (PEOPLE)
- **Hypothesis 1** (*spatial dynamics*):
Social composition of areas in the Paris region vary around the clock
- **Hypothesis 2** (*individual daily paths*):
Social environments to which people are exposed vary over 24h as they move and other people also move.
These variations depend on individual characteristics, daily mobility practices, and on the characteristics of their residential environment.



Data and methods

Data

- *Data*: Enquête Globale Transport 2010
- *Studied area* : Ile-de-France (Paris region)
- *Sample*:
 - 25 500 inhabitants of the Paris region over 16 years
 - All their trips during a weekday (4 am -> 3 am)
- *Spatial units*: 109 districts in the Paris region (14 in Paris)
 - Unit used to extrapolate results
 - Groups of *arrondissements* / municipalities of about 100 000 inhabitants
 - Constant sampling rate by district and calibration on census data



Methods

- *Data transformation:*

Trips table

Individual	Trip	District of departure	District of arrival	Time of departure	Time of arrival	Reason/ activity	Mode of transport
1	1	A	B	8:00	8:45	Home>Work	Car
1	2	B	A	18:15	19:00	Work>Home	Car
2	1	C	B	8:10	8:20	Home>Accompaniment	Walk
2	2	B	D	8:20	9:00	Accompaniment>Work	Metro
2	3	D	E	17:00	17:30	Work>Shopping	Walk
2	4	E	C	18:00	18:40	Shopping>Home	Metro



Stations and trips table

Individual	Station	District of the station	Starting time	Ending time	Activity
1	1	A	4:00	8:00	Home
1	2	Individual mode	8:00	8:45	In transport
1	3	B	8:45	18:15	Work
1	4	Individual mode	18:15	19:00	In transport
1	5	A	19:00	4:00	Home
2	1	C	4:00	8:15	Home
2	2	B	8:15	8:20	Accompaniment
2	3	Collective transports (Rail)	8:20	9:00	In transport
2	4	D	9:00	17:15	Work
2	5	E	17:15	18:00	Shopping
2	6	Collective transports (Rail)	18:00	18:40	In transport
2	7	C	18:40	4:00	Home

- *In transportation:*
 - **Soft modes** => stations in the districts of departure and arrival (half/half)
 - **Hard modes** => stations in fictive spaces



Specific methods and results

Results: *hypothesis 1*



Hypothesis 1 (*spatial dynamics*):

Social composition of areas in the Paris region vary around the clock

Indicators to assess the social composition of the districts hour by hour:

- Number of people located in the district
- Social level of the district = mean of the *educational status* of the present population
 - *Educational status* = mean of the number of years of study of the household adults
- Social mixity of the district = entropy index computed on 4 groups of educational achievement of the present population

Analysis methods:

Principal component analysis (PCA) followed by a hierarchical clustering (HCA)

Variables used in the PCA (districts as statistical units):

- Mean and amplitude of the social level and the social mixity computed hour by hour
- Rate of change of the average population, social level and social mixity between 3 time slots (day-time 8:00-18:00, evening 18:00-23:00, night 23:00-8:00)

Results: *hypothesis 1*

Figure 1: Clusters of districts according to their social composition and dynamics over 24 hours

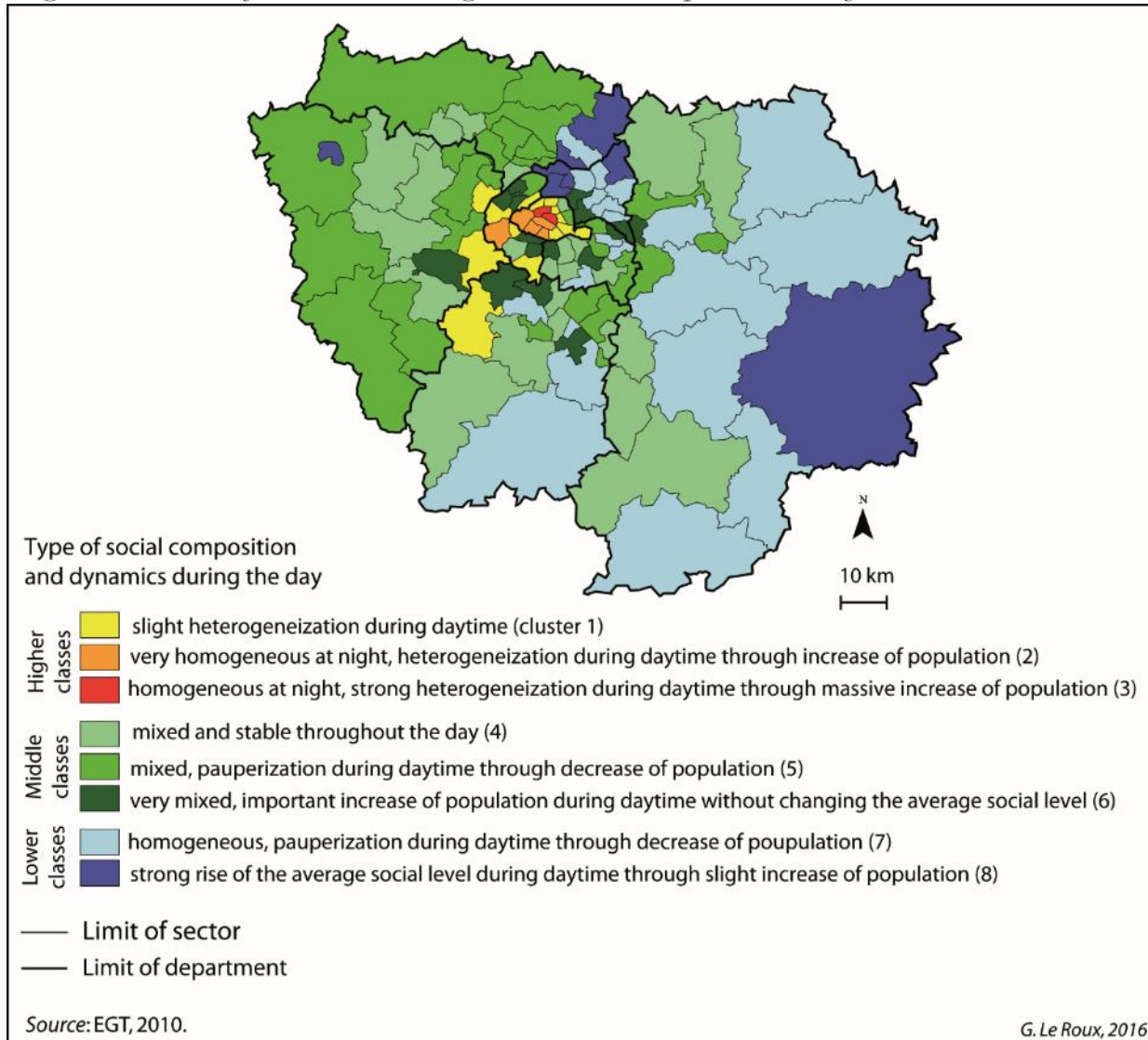
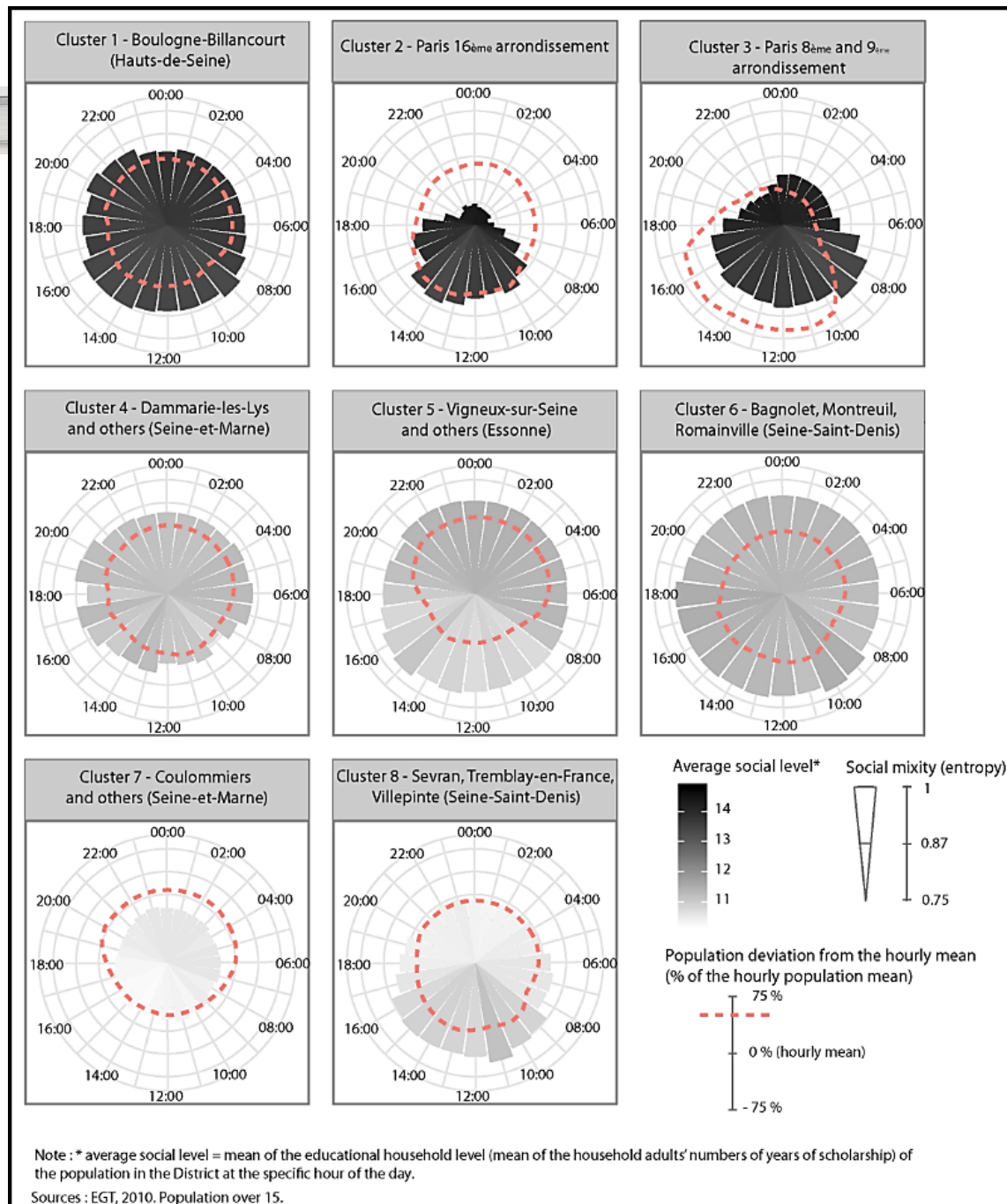
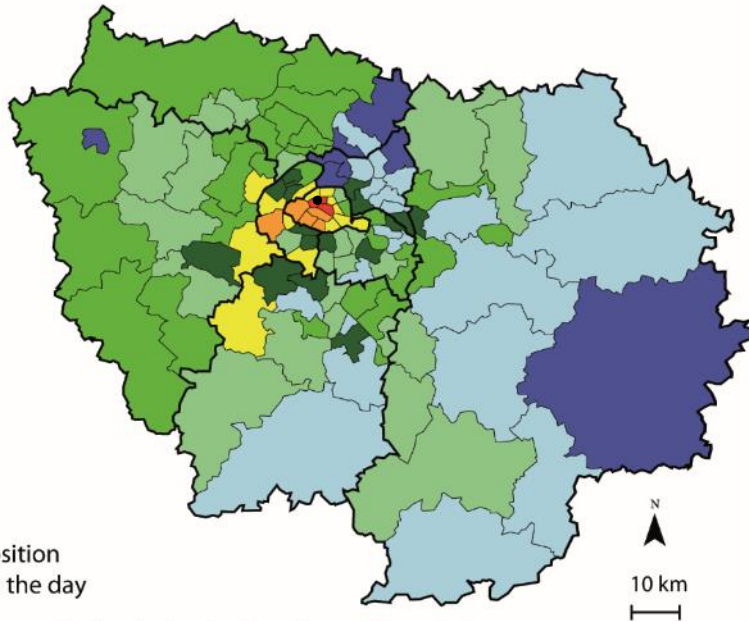


Figure 2: Social level and mixity hour by hour for districts



Results: *hypothesis 1*



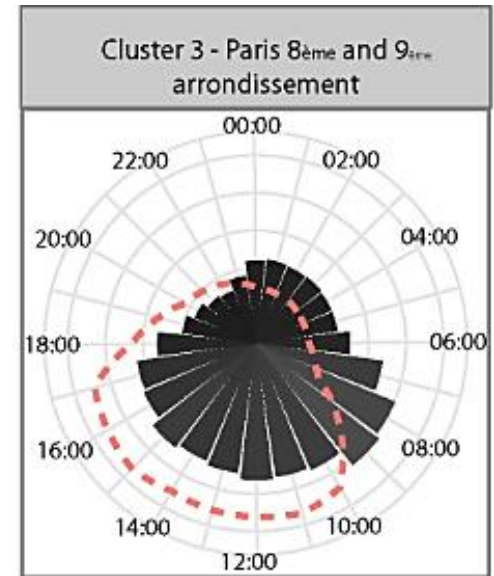
Type of social composition and dynamics during the day

- | | |
|----------------|---|
| Higher classes | slight heterogeneization during daytime (cluster 1) |
| | very homogeneous at night, heterogeneization during daytime through increase of population (2) |
| | homogeneous at night, strong heterogeneization during daytime through massive increase of population (3) |
| Middle classes | mixed and stable throughout the day (4) |
| | mixed, pauperization during daytime through decrease of population (5) |
| | very mixed, important increase of population during daytime without changing the average social level (6) |
| Lower classes | homogeneous, pauperization during daytime through decrease of population (7) |
| | strong rise of the average social level during daytime through slight increase of population (8) |

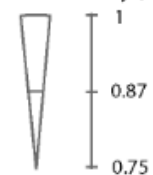
— Limit of sector
— Limit of department

Source: EGT, 2010.

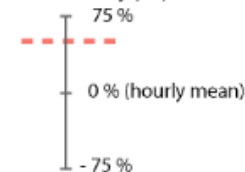
G. Le Roux, 2016



Average social level* Social mixity (entropy)

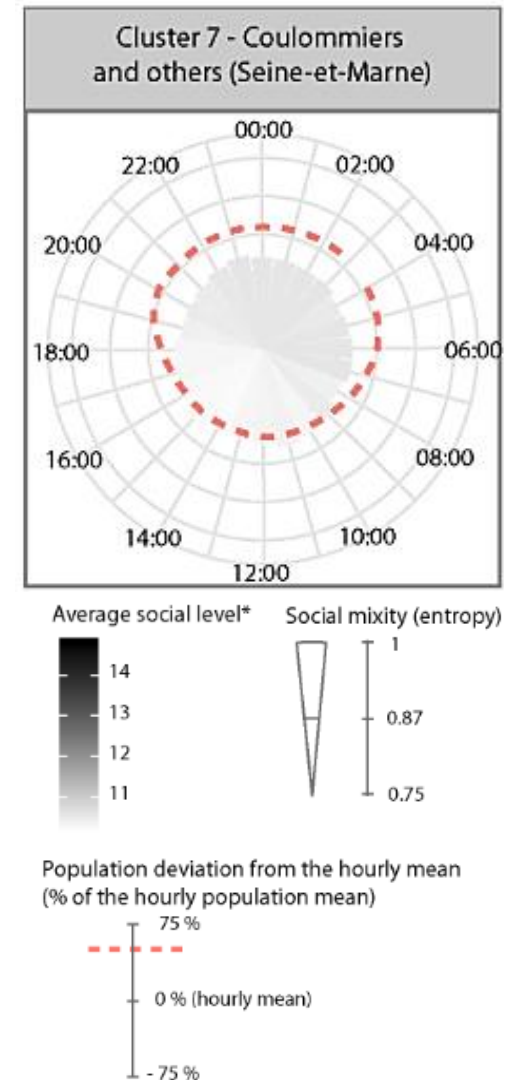
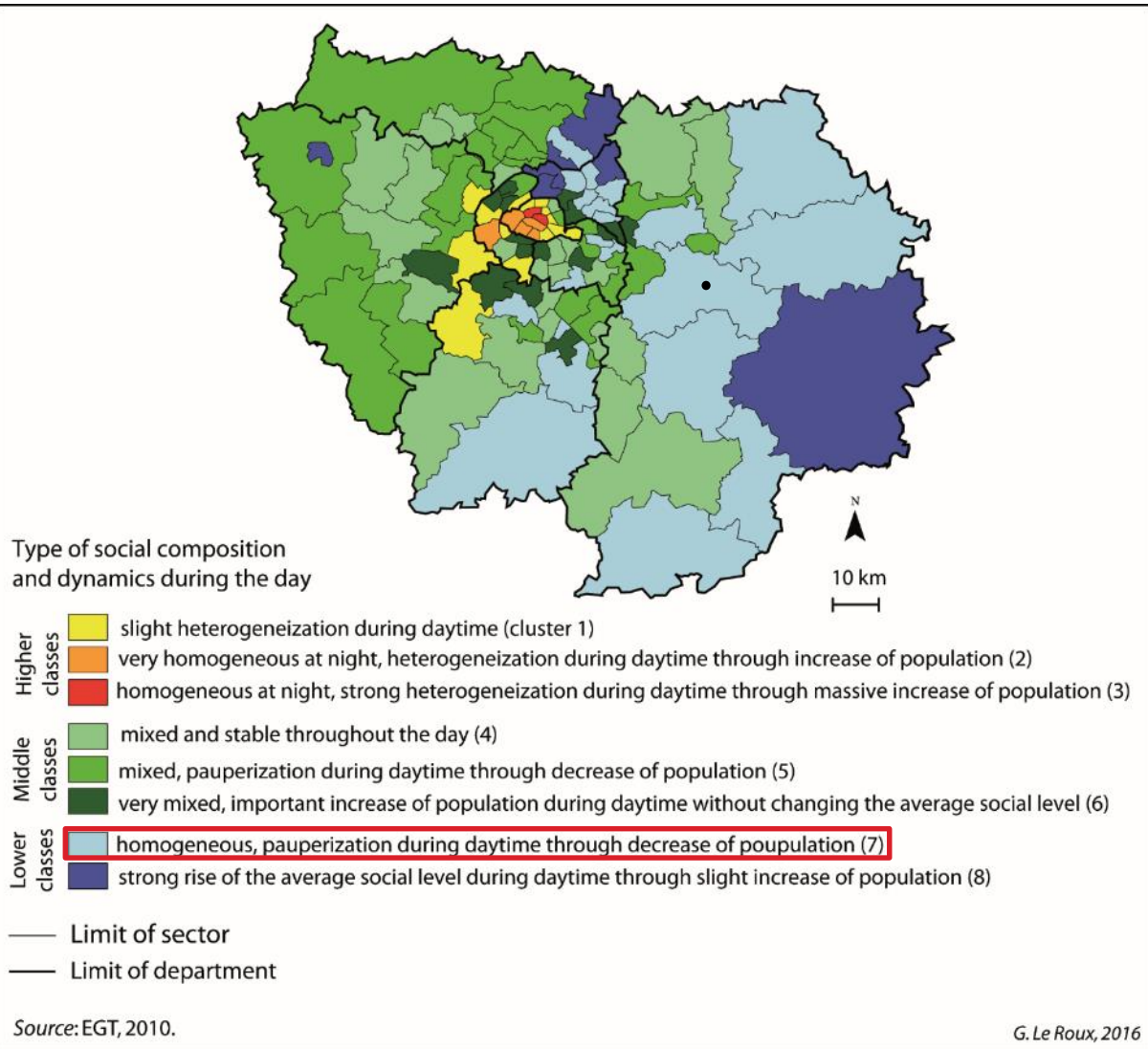


Population deviation from the hourly mean
(% of the hourly population mean)



re

Results: *hypothesis 1*



Results: *hypothesis 1*



Key results:

- Some districts, whose social composition at night are similar, experience very different social changes during day-time.
- A large part of peripheral districts undergo a decrease in their average social level during day-time through a “filtering process”.
- Most districts dense in jobs know a strong social heterogenization during day-time, whether they are upper class’ or lower class’ places of residence.

Results: *hypothesis 2*



Hypothesis 2 (*individual daily paths*):

Social environments to which people are exposed vary over 24h as they move and other people also move.

These variations depend on individual characteristics, daily mobility practices, and on the characteristics of their residential environment.

Indicators to assess individual's social environment throughout the day:

Social level of the district where individuals are located hour by hour = 24 variables

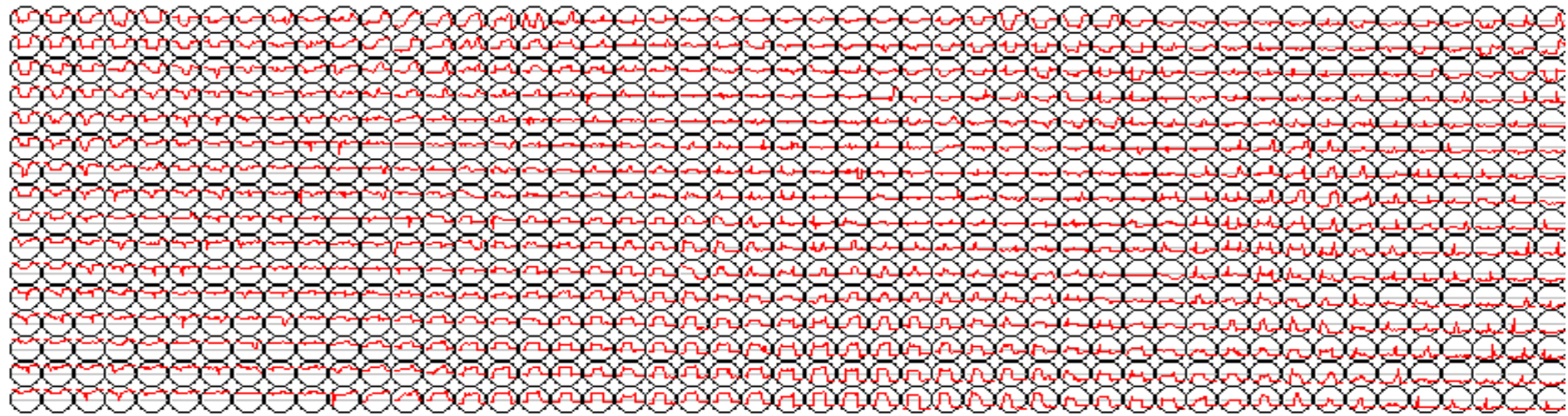
Analysis methods:

Self-organizing map clustering (SOM) (or Kohonen map)

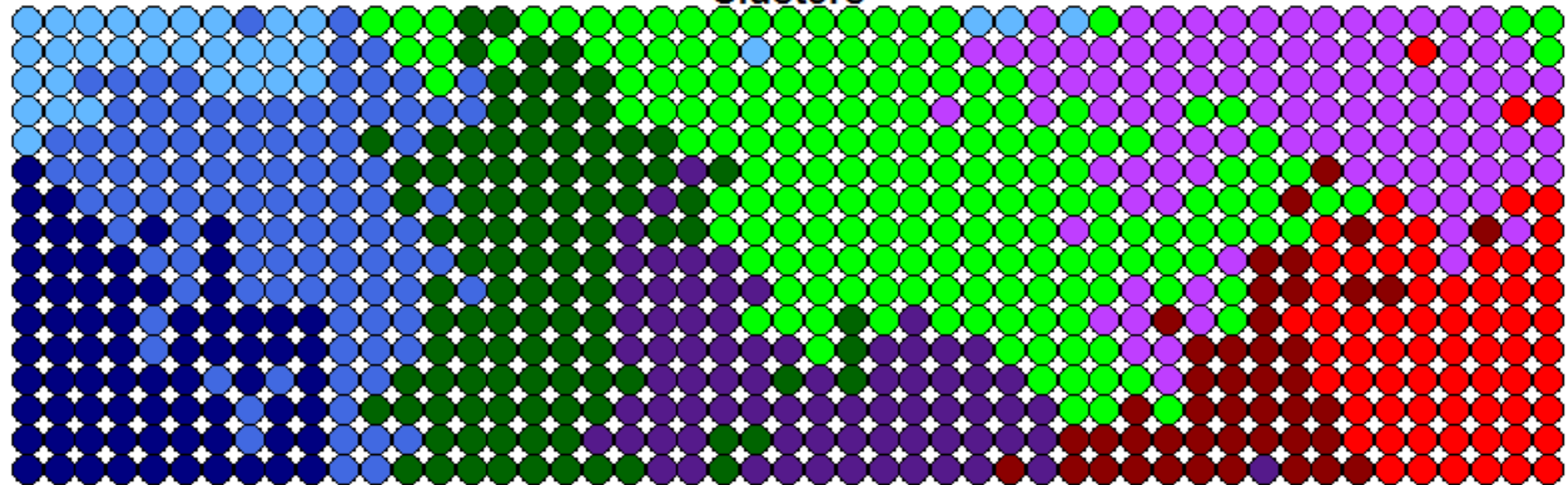
Results: *hypothesis 2*



Figure 3: SOM on the individuals' social environment over 24 hours and hierarchical clustering

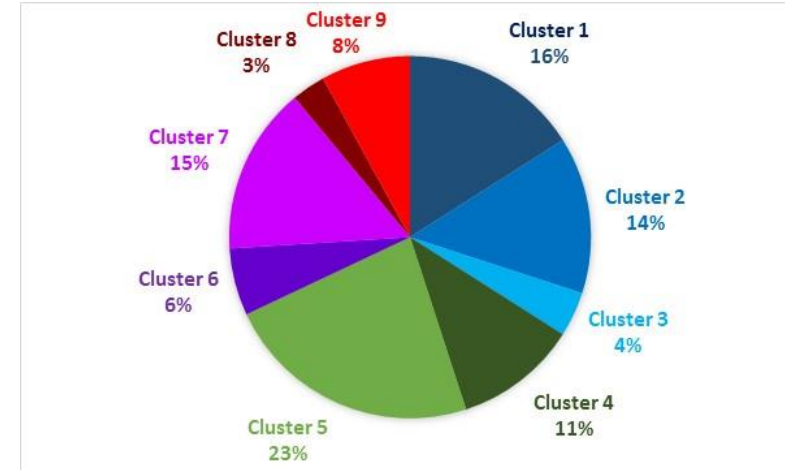
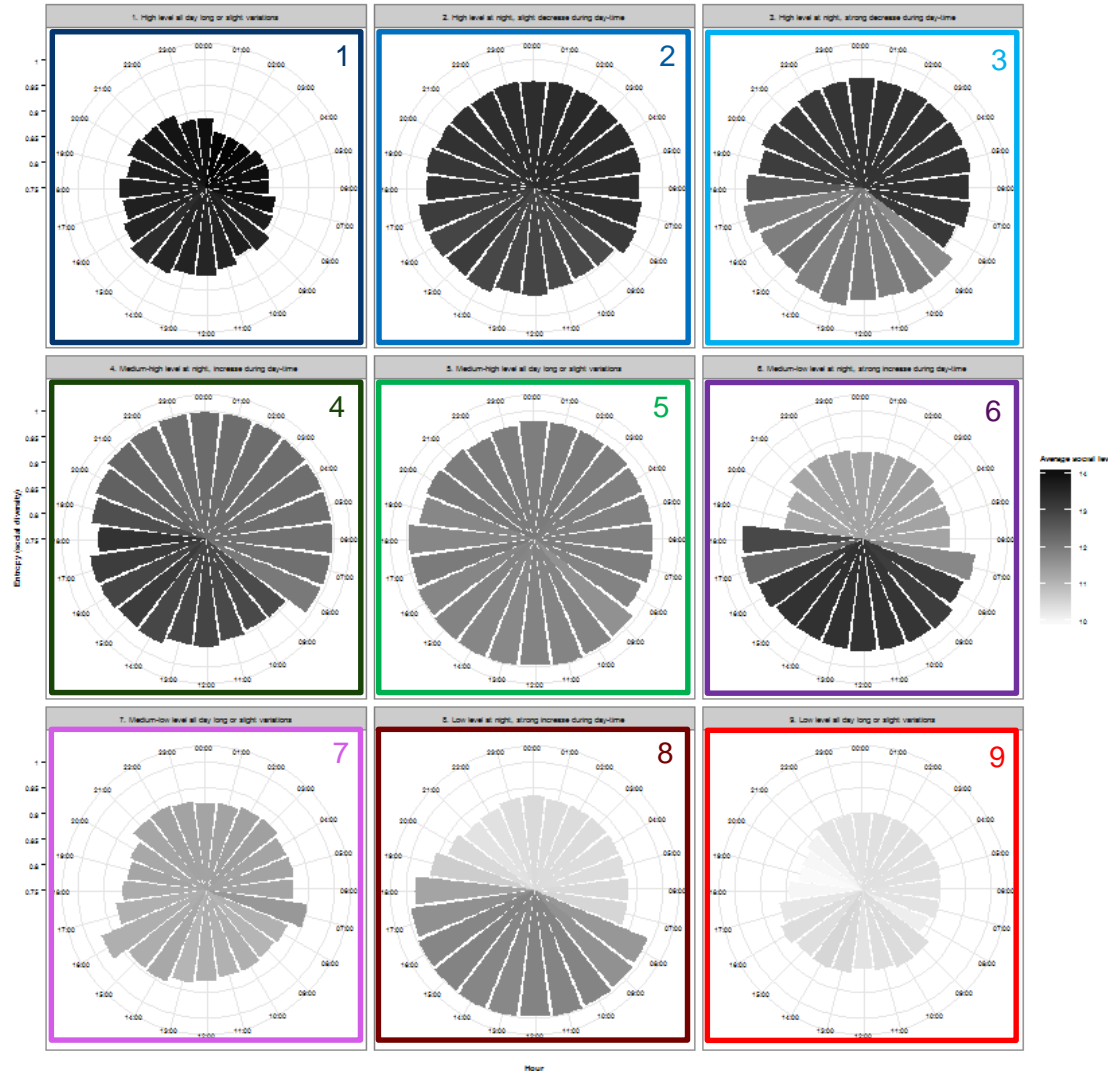


Clusters



Results: *hypothesis 2*

Figure 4: Social level and mixity hour by hour for individuals illustrating the typical profile of the clusters



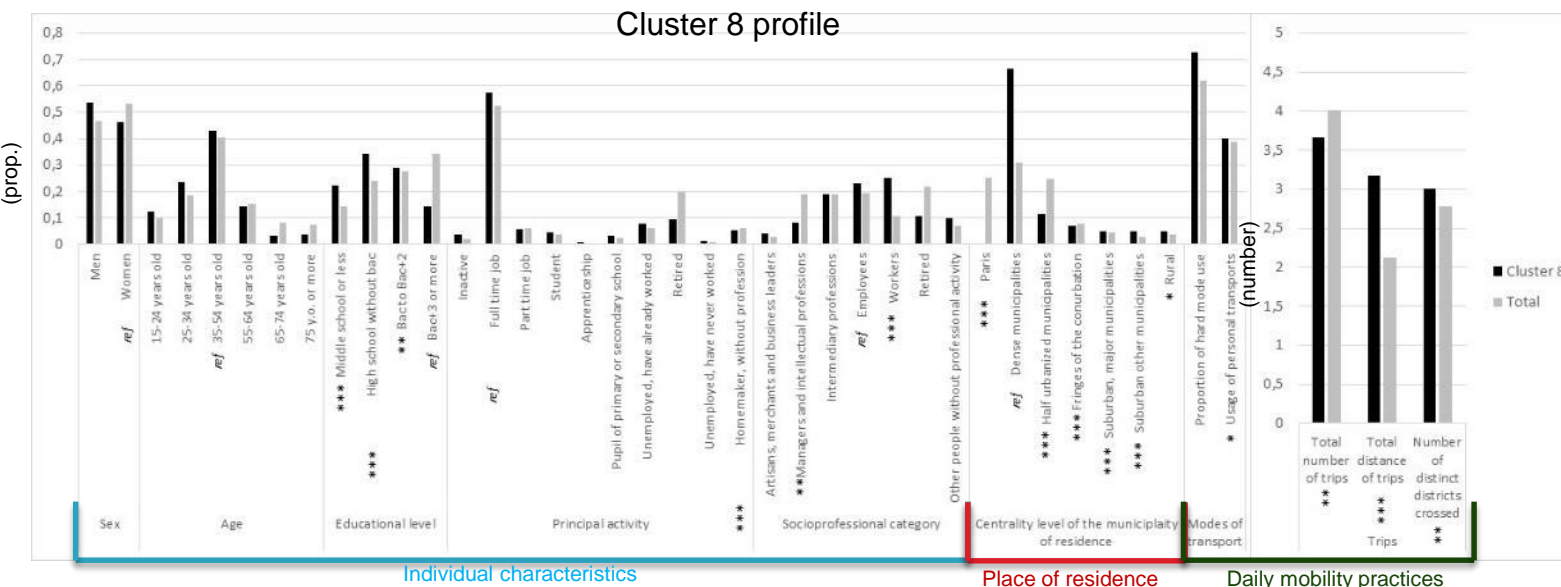
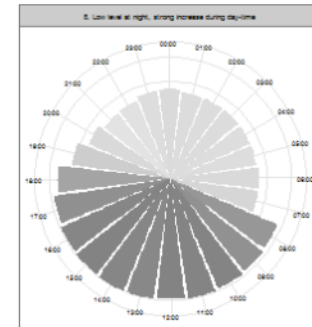
Cluster 1 : very high all day long (+++ =)
 Cluster 2 : high all day long or slight decrease during the day (++ =)
 Cluster 3 : high at night, decrease during the day (++↘)

Cluster 4 : middle-high at night, increase during the day (+↗)
 Cluster 5 : middle-high all day long or slight decrease during the day (+ =)
 Cluster 6 : middle-low at night, strong increase during the day (- ↗)
 Cluster 7 : middle-low all day long or slight decrease during the day (- =)

Cluster 8 : low at night, increase during the day (-- ↗)
 Cluster 9 : low all day long or slight variations (-- =)

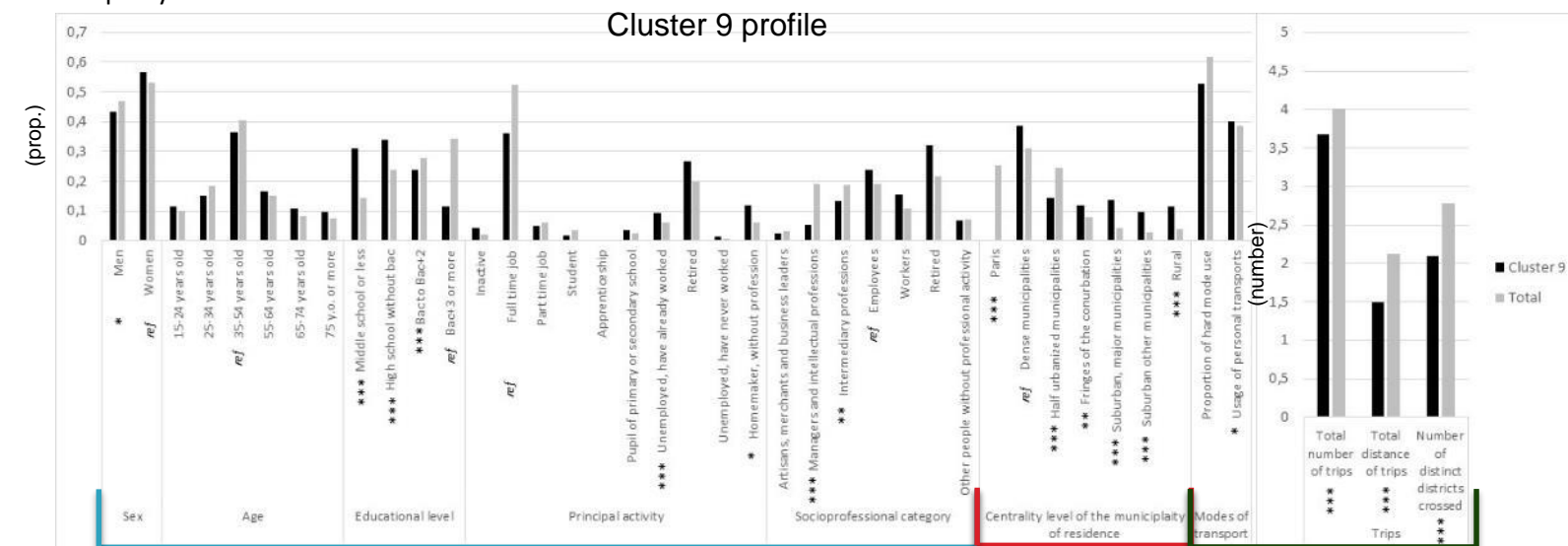
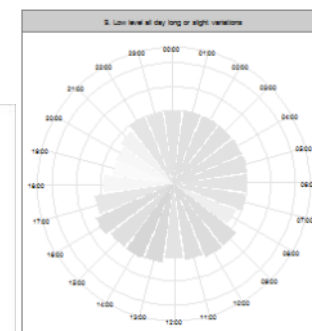
Cluster 8 (3.4%) : Low at night, increase during day-time

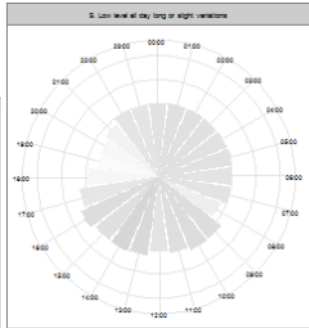
Man, 52 years old, specialized worker, lives in Saint-Ouen (93, north close to Paris). He lives alone. He went by RER to work in Arcueil (94, south close to Paris).



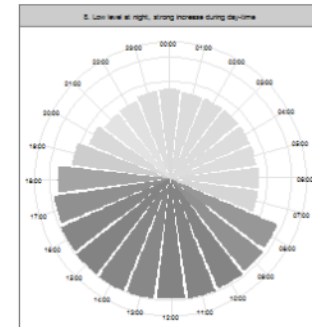
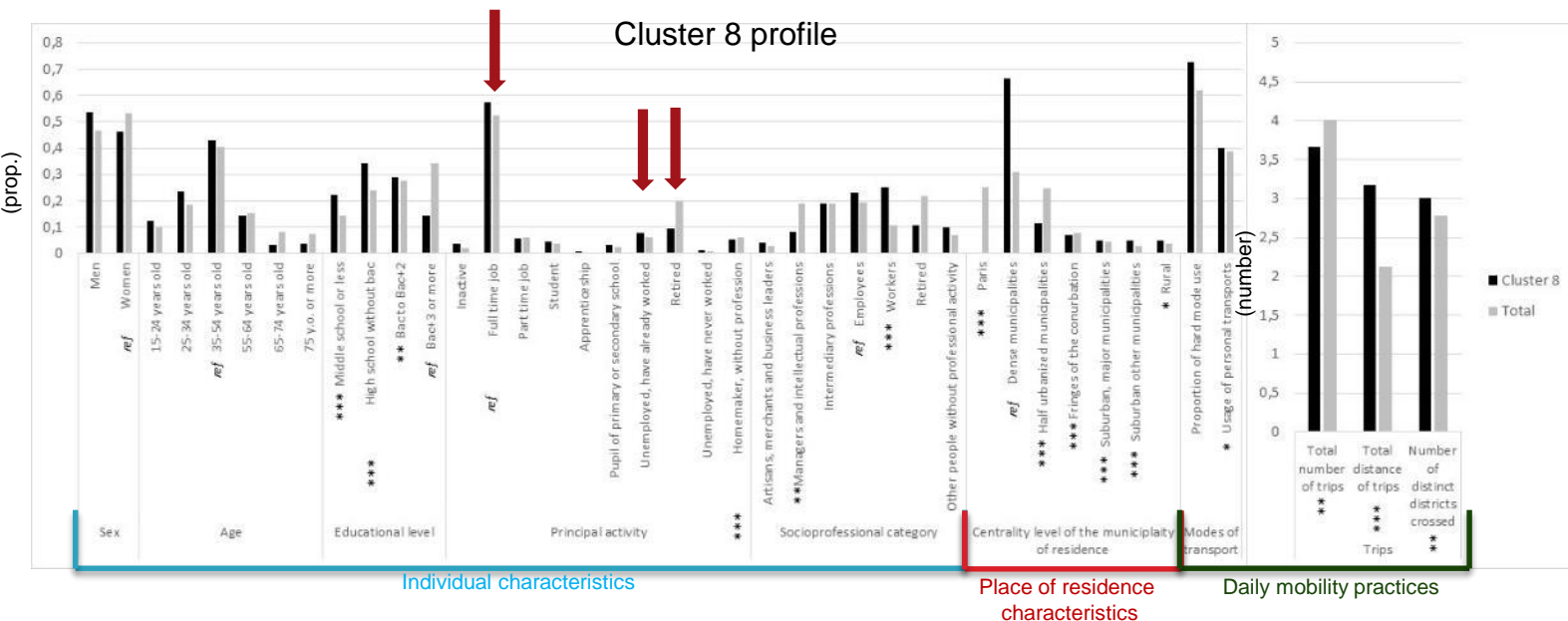
Cluster 9 (8.4%) : Low all day long or slight variations

Woman, 31 years old, unemployed cleaning lady, lives in Villeneuve-le-Roi (94, near Orly). She lives with her husband (worker) and a 3 years old child. She moved walking in Villeneuve-le-Roi to do shopping and to visit people. She stayed all day long in the same municipality.

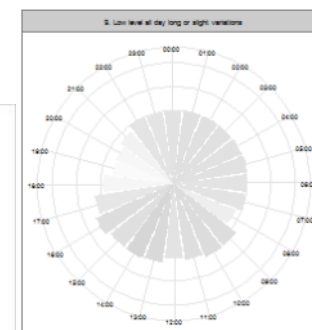
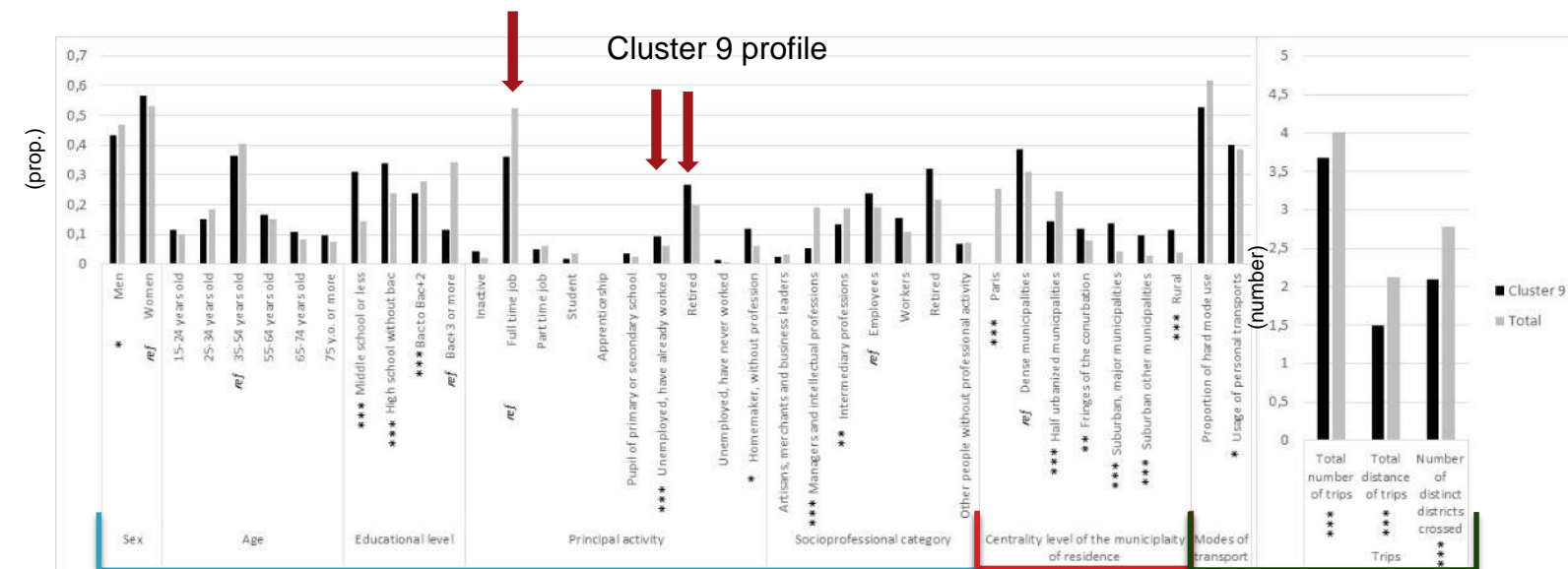




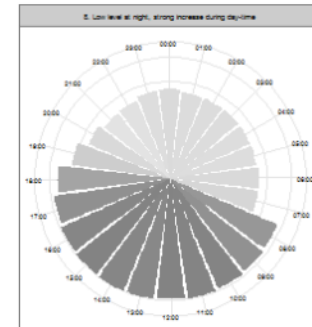
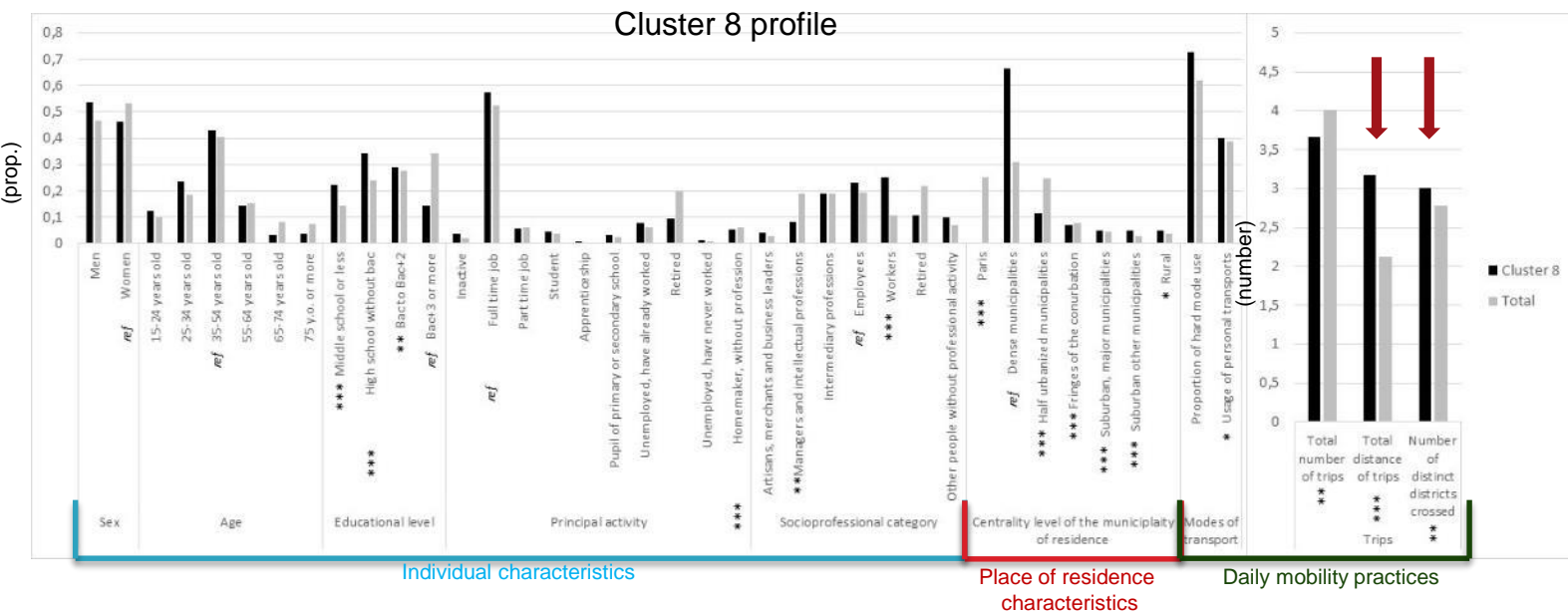
Cluster 8 (3.4%) : Low at night, increase during day-time



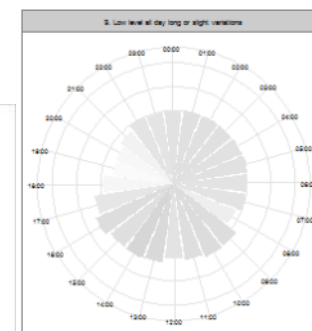
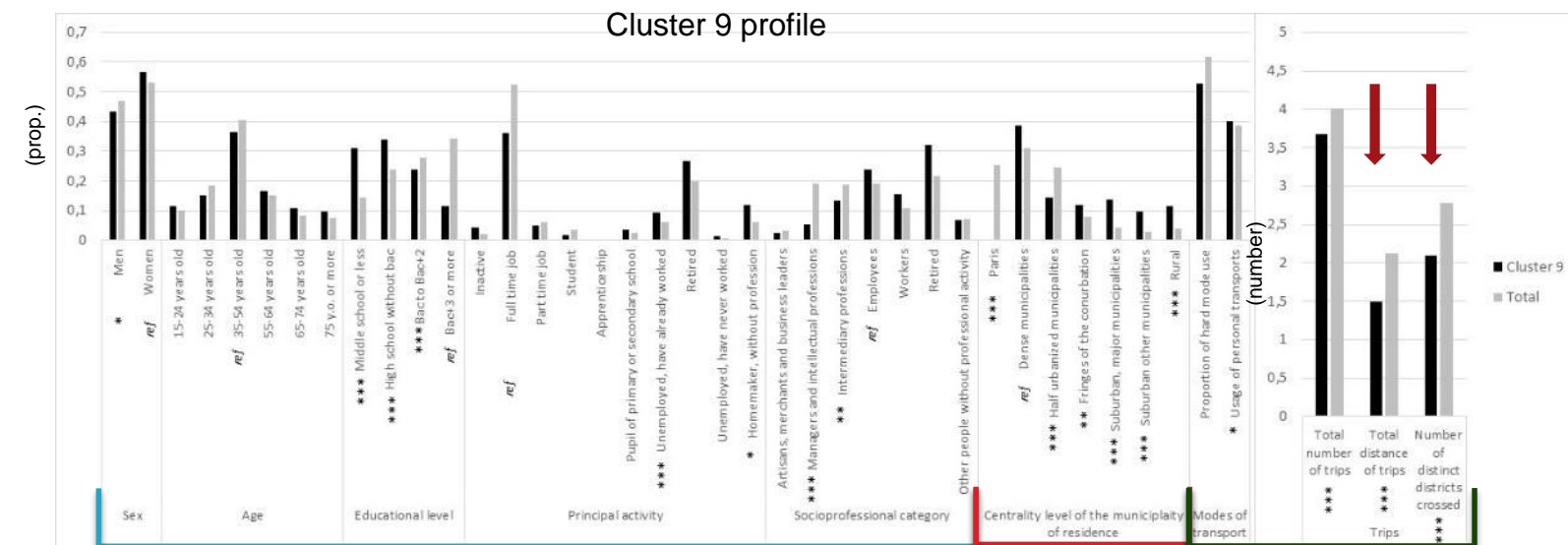
Cluster 9 (8.4%) : Low all day long or slight variations



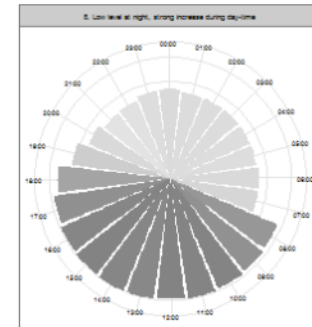
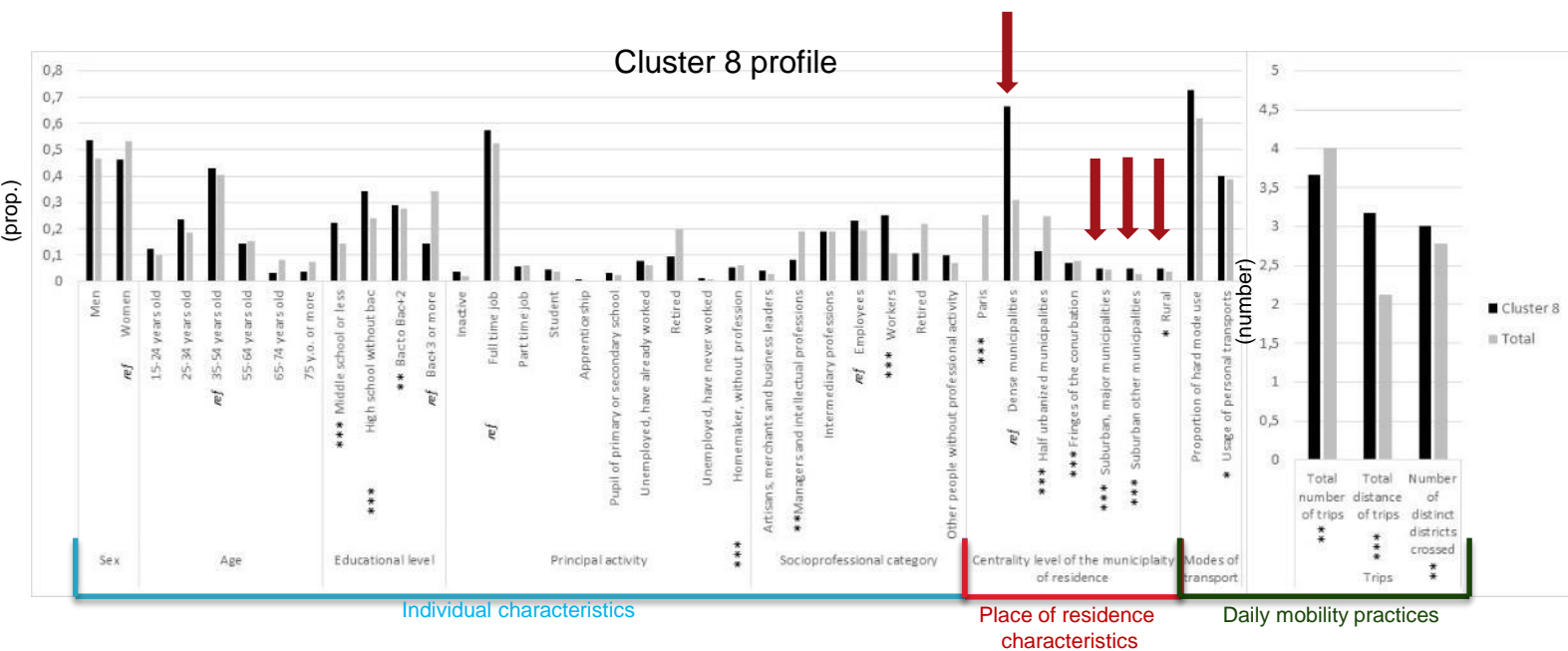
Cluster 8 (3.4%) : Low at night, increase during day-time



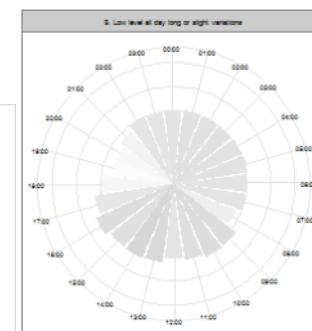
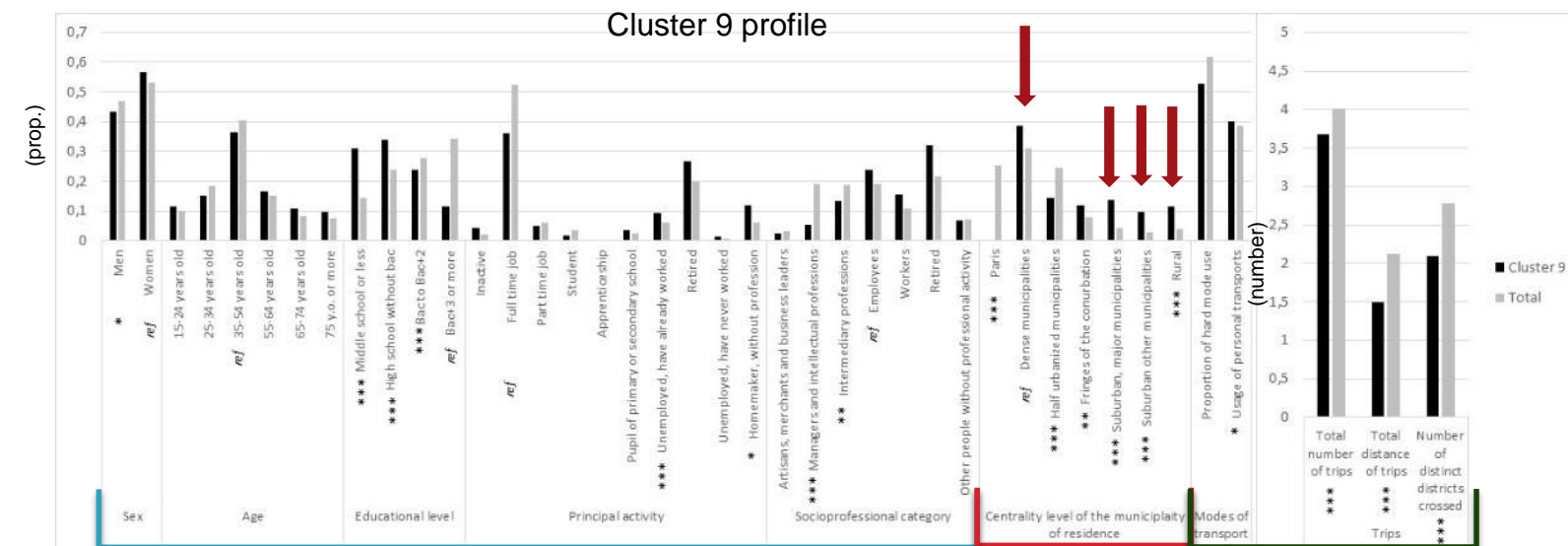
Cluster 9 (8.4%) : Low all day long or slight variations



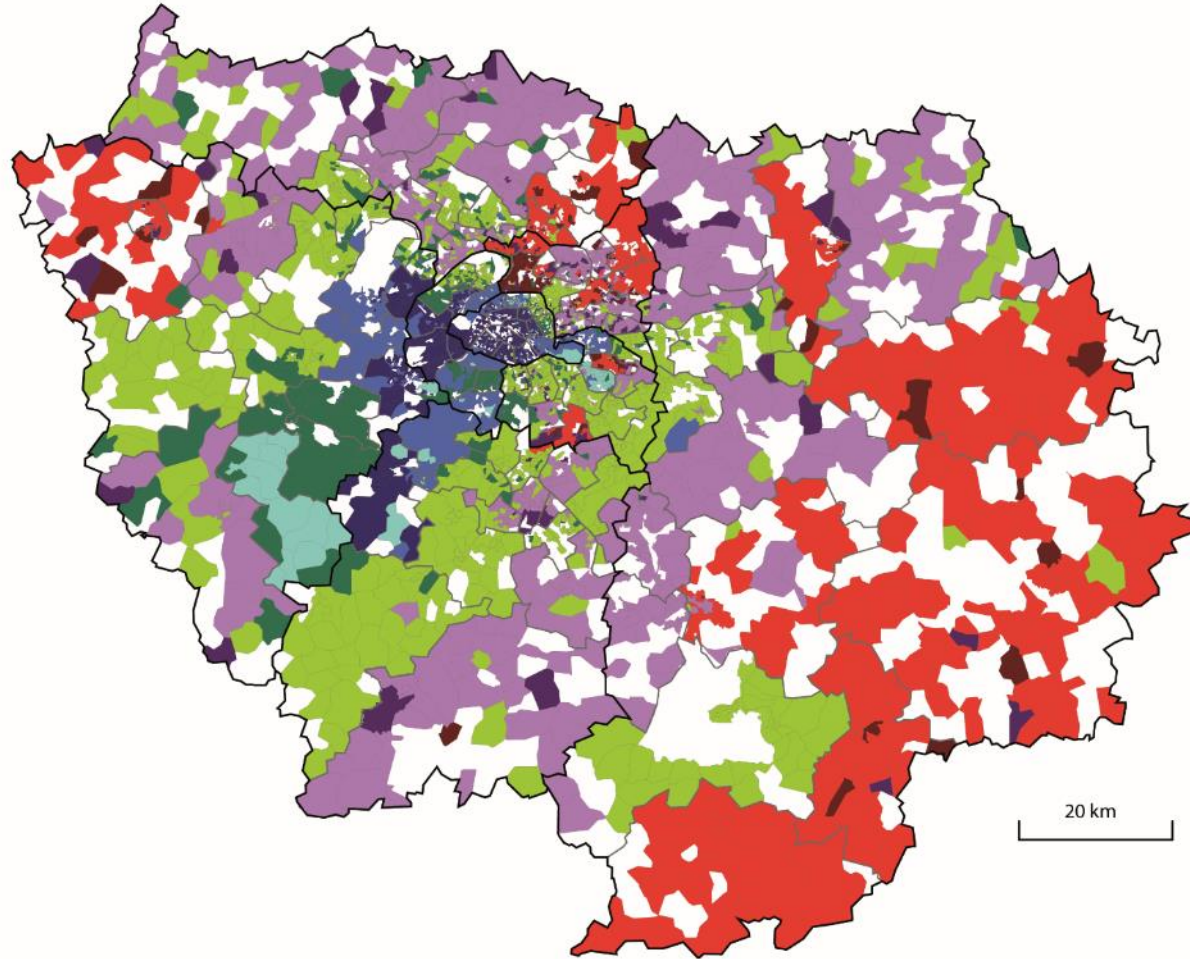
Cluster 8 (3.4%) : Low at night, increase during day-time



Cluster 9 (8.4%) : Low all day long or slight variations



Results: *hypothesis 2*



Cluster of individuals' social environment over 24h most present according to the IRIS of residence

Cluster 1 +++ =
 Cluster 2 ++ =
 Cluster 3 ++ ↘
 Cluster 4 + ↗
 Cluster 5 + =

Cluster 6 - ↗
 Cluster 7 - =
 Cluster 8 -- ↗
 Cluster 9 -- =

— Department limit
 — EGT district limit
 — IRIS limit

Results: *hypothesis 2*



Cluster of individuals' social environment over 24h most present according to the IRIS of residence

Cluster 1 +++ =
 Cluster 2 ++ =
 Cluster 3 ++ ↘
 Cluster 4 + ↗
 Cluster 5 + =

Cluster 6 - ↗
 Cluster 7 - =
 Cluster 8 -- ↗
 Cluster 9 -- =

— Department limit
 — EGT district limit
 — IRIS limit

5 km

Results: *hypothesis 2*



Cluster of individuals' social environment over 24h at the place of residence

- | | |
|---------------|--------------|
| ● Clus1 +++ = | ● Clus6 - ↗ |
| ● Clus2 ++ = | ● Clus7 - = |
| ● Clus3 ++ ↘ | ● Clus8 -- ↗ |
| ● Clus4 + ↗ | ● Clus9 -- = |
| ● Clus5 + = | |

1 km

Results: *hypothesis 2*



Key results:

- About $\frac{1}{4}$ of the population experiences variations in their social environment throughout the day
- About $\frac{3}{4}$ of the population experience similar social environments throughout the day:
 - ~ 25% in socially **mixed** environments
 - ~ 30% all the day in **rich** areas
 - ~ 20% all the day in **deprived** areas
- Daily social paths are linked with residential environment
... but people living close to one another may have dissimilar paths according to their individual profile
 - *e.g. : in non-attractive peripheries, residents commuting often change social environment throughout the day and conversely, less mobile residents (e.g. retired, housemaker, unemployed people) often experience stable or decreasing social environment*
- Variations of individuals' social environments not only depend on their mobility but also on social and spatial dynamics:
 - *e.g. : in attractive areas, less mobile residents may experience large variations, while mobile residents may only move in districts with similar social composition.*

Limits



- Principal limit : district size
 - Variability of district size : 3 à 1 326 km² (median : 14 km²)
 - Size of district and social composition: what sense for people's experience?
- Other limits:
 - Only weekdays
 - People living out of the Paris region are not included

Conclusions



Around the clock analysis offers a better view on urban segregation:

- Crossing residential and daily dynamics expresses more faithfully the social composition of areas by taking into account people who spends time in them
- Individuals' experiences of urban segregation may depend on their own mobility but also on mobility of others

Day-time is a privileged time for social mixity but mixity do not concern...

... some parts of the city :

- Non-attractive peripheries, “dormitory municipalities”

... and some population groups :

- Less mobile residents stuck in non-attractive neighborhoods
- Mobile people circulating into the least/the most deprived areas

➤ Crossing individuals' mobility and social and spatial dynamics is important ...

... when studying “neighborhood effects”

... when targeting vulnerable populations or deprived areas

➤ Further explorations: Associations between types of social environment over 24 hours and health behaviors (e.g. dietary habits) or outcomes (e.g. mental health)

Thanks!



@Stephen Wilkes