Moving Worlds Apart: Exploring Social and Spatial Mobility Through Spatial networks

Research on spatial and social mobility has often emphasized the greater geographic mobility of upper social classes. To provide a more comprehensive depiction of the social stratification of spatial mobility, this paper applies spatial network analysis. Regions are modeled as nodes and mobility flows between regions form the links connecting them. This approach allows the construction of spatial networks that capture the full spectrum of movements within a country. We then examine how these networks vary according to individuals' social trajectories. The analysis draws on data from the French Labor Force Survey (1982–2024), covering 1,095,031 individuals. Spatial mobility is defined as residing outside one's region of birth. Results show that different social trajectories have distinct spatial mobility patterns. The mobility of upper social classes is structured around a highly centralized network of affluent regions, forming "migratory highways" that connect distant regions. In contrast, lower-class spatial mobility is more often into localized migratory clusters, driven primarily by proximity. Both social origin and current social position shape these networks. These findings show that life opportunities unfold in distinct geographic spaces across social groups, highlighting the importance of subnational approaches to understanding the life prospects of the lowest classes.

Introduction

In a 1988 paper on internal migrations within the UK and intragenerational mobility, Mike Savage described the relationship between spatial and social mobility as a "missing link". Indeed, at that time, the topic of spatial migration was scarcely addressed by social mobility researchers. This was likely due to the fact that the literature on intergenerational mobility has largely relied on national-level data and has focused predominantly on Western countries—countries between which migration involved only a relatively small share of the population. Since then, a substantial body of research has emerged examining subnational variations in intergenerational social mobility (Chetty et al., 2014; Zwysen 2016; Bell et al., 2019; Lindeman, Gangl, 2019; Connor and Storper, 2020; Buscha et al., 2021; Morris 2023; Breen and In, 2024; Granström, Engzell, 2025). These variations indicate that, even within the same country, people do not share the same occupational structure and that individuals' access to different jobs and economic opportunities can be easier or more limited depending on where they live or where they are born.

This literature should revive interest in the relationship between social and spatial mobility because spatial mobility is key to explaining the extent to which subnational inequalities affect life opportunities. Individuals' life chances depend on the opportunities available within the specific occupational structures to which they have access and this depends on the range of their spatial mobility. If spatial mobility within a country was perfect, individuals could freely move to take up jobs wherever they wished, and subnational inequalities would have little impact on social mobility. It means that describing social mobility at a national level would be sufficient to describe people's fate. By contrast, in a context of no spatial mobility, people in different regions would effectively live like in separate countries: the broader national environment would be irrelevant, and life opportunities would depend solely on the characteristics of the region where one was born.

Research on spatial and social mobility typically shows a positive association between upward mobility and spatial mobility. From this perspective, spatial mobility can help reduce inequalities in opportunities if individuals born in poorer regions relocate to wealthier areas (Yu, Athey, 2023; Breen, In, 2024). However, because spatial mobility is costly, it can also reinforce inequalities (Hecht, McArthur 2023). Individuals from higher social classes have greater resources, making it easier for them to be spatially mobile, which may partly explain their higher likelihood of accessing top positions. This mechanism is particularly salient given that spatial mobility is often not merely advantageous but may be a near-essential condition for securing employment in elite occupations. Thus, spatial mobility simultaneously serves as a pathway to upward mobility for individuals from lower classes and as a prerequisite to access a privileged position more readily fulfilled by those of higher origin. Understanding spatial mobility is therefore crucial for a comprehensive understanding of social mobility.

Existing research on social and spatial mobility typically characterizes spatial mobility using relatively simple measures: a dichotomous indicator of whether an individual is mobile or not, a continuous measure such as the distance moved, or a more specific measure such as relocation to a wealthier region (e.g., northern Italy or Paris in France). However, spatial mobility may vary in many additional ways that are highly relevant for understanding social mobility. Drawing on methods from geographical network analysis and migration studies, we propose a novel approach that provides a more comprehensive characterization of spatial mobility and its relationship to social mobility.

Rather than simply measuring whether individuals are mobile, we use network analysis to capture all mobility flows between regions. In this approach, regions are represented as nodes in a network, and flows between regions constitute the connections between nodes. This allows us to construct spatial networks that describe the relationships between regions. These networks reveal not only which regions are most closely connected through population flows but also which regions occupy central positions within the network. They further indicate whether spatial mobility is concentrated within specific regions or more evenly distributed across the country. We demonstrate that, depending on their social trajectory, individuals not only differ in the likelihood of moving spatially but also exhibit fundamentally distinct spatial networks, reflecting qualitatively different types of spatial mobility.

To describe these different types of spatial mobility, we draw on the distinction proposed by Akbari (2021). To describe the structure of international migration networks, Akbari identified two migration patterns: “International Migratory Highways” and “Migratory Clusters”. We show that members of the managerial and professional class exhibit spatial networks corresponding to migratory highways: their migration flows are largely asymmetric and directed toward the wealthiest regions. These networks display distinct topological characteristics: high centralization, concentration of flows toward a limited number of central regions, and low modularity, indicating that the network cannot be readily partitioned into smaller, internally cohesive migration clusters. Furthermore, we show that the topology of networks associated with attaining higher social positions is strongly influenced by the economic characteristics of regions. In these networks, a region's centrality is highly correlated with its GDP. Thus, upward mobility is closely linked to relocation toward affluent cities.

In contrast, the spatial networks of lower-class individuals correspond to what Akbari (2021) termed migration clusters. These clusters involve short-range movements within larger regions and are not directed toward major economic centers. The resulting networks are considerably less centralized and exhibit higher modularity, indicating that spatial mobility is largely confined to well-defined regions. No single region dominates; instead, individuals reside across multiple regions that are only loosely connected. In those networks, there is little or no correlation between a region's centrality and its GDP.

Finally, we also show that the topology of the spatial networks depends on both social origin and destination. While the class of destination primarily shapes network structure, social origin also plays a significant role, and the effects of origin and destination are largely additive. Consequently, networks most strongly characterized by migratory highways are those of managers and professionals who are socially immobile, whereas networks most strongly characterized by migration clusters are those of children of manual workers or farmers who remain socially immobile.

These findings indicate that, despite their higher spatial mobility, the upper classes exhibit mobility concentrated within a limited number of densely connected, highly centralized regions, particularly around the capital, Paris. Subnational inequalities are therefore less consequential for explaining their life opportunities, as they can exploit economic structures across the country. In contrast, for the lower classes, mobility is shorter-range and less extensive, making subnational inequalities more critical in shaping life chances. Their mobility is largely confined to smaller regions, making them highly dependent on the characteristics of their region of birth. Individuals from different social classes thus experience distinct geographies of opportunity, demonstrating that people do not inhabit the same occupational structure, even when living within the same country.

Literature review and hypotheses

Spatial mobility and upward mobility

Spatial mobility is generally seen as providing advantages for occupational attainment (Fielding 1992; Mulder, Van Ham, 2005; Bernard, Bell, Charles-Edwards, 2014; Chetty, Hendren, and Katz 2016; Connor, Storper, 2020; Ballarino, Panichella, 2021; Buscha et al., 2021). Moving from rural places to urban and richer ones has often been shown as a way to escape social origin (Fielding, 1992; Lehmer, Ludsteck, 2011; Ballarino, Panichella, 2021).

However, the positive effect of spatial mobility may also be largely explained by the “selection into trajectory” hypothesis. According to this view, individuals who migrate already possess certain advantages (Kratz, Brüderl, 2012; Impicciatore, Panichella, 2019; Ballarino, Panichella, 2021). The observed correlation between spatial mobility and upward mobility would therefore be driven by these pre-existing characteristics. Supporting this interpretation, Ballarino and Panichella (2021) found evidence of a selection effect—particularly among women—though they also identified a remaining positive effect of spatial mobility for men.

In a study designed to assess the effect of moving to a more advantaged neighborhood, Chetty, Hendren and Katz (2016) employed a natural randomized experiment to address selection bias. They demonstrated that when young people were randomly selected to relocate to better areas through a program, this move had a positive effect on their future income. This finding highlights that the impact of spatial mobility largely depends on the specific type of mobility under consideration. In this case, moving to a more favorable neighborhood environment proved particularly beneficial for low-income youth—especially when the move occurred early in life.

More broadly, Impicciatore and Panichella (2019) emphasized that the relationship between migration trajectories and social mobility is multifaceted. Examining south-to-north migration in Italy, they showed that outcomes varied by social origin: for some, the move was associated with upward mobility, while for others it reproduced “the southern upper classes in the North” (Impicciatore, Panichella, 2019).

These results underscore that the causal effects of spatial mobility should not be conceived as homogeneous. Rather, spatial mobility constitutes one element within broader life-course trajectories, and its significance is likely to vary according to individuals’ social origins and the characteristics of their destinations. A more detailed examination of these two dimensions is therefore required.

Who moves?

Hecht and McArthur (2023) offer a critical perspective on the literature on income mobility, arguing that it tends to focus exclusively on the upward mobility of the relatively disadvantaged people and assumes spatial mobility to be a causal driver of social mobility. In contrast, they contend that social origin itself shapes patterns of spatial mobility, since more affluent individuals possess greater resources and opportunities to relocate. Consequently, spatial mobility may function as a mechanism through which social class advantages are reproduced, as the ability of higher-status groups to move provides them with access to more advantageous residential environments.

Empirical studies support this interpretation: advantaged groups are more likely to move and particularly to undertake long-distance residential relocations (Savage, 1988; Horowitz, Entwisle, 2020; Hecht, McArthur, 2023). What remains less clear, however, is why the most privileged groups tend to move more frequently, given that they already come from affluent areas that offer extensive opportunities. One possible hypothesis is that such moves are not always voluntary but instead required for the attainment or maintenance of elite positions. High-status roles are relatively scarce, often tied to highly specific resources or opportunities that are not available across all the country. Thus, despite their advantages, members of the upper classes may face constraints on where they can reside if they wish to secure or preserve their privileged positions.

Notably, the majority of individuals from the highest social strata possess a tertiary education. Attainment of such qualifications frequently necessitates relocation to specific urban centers, particularly to access prestigious institutions. The skills and knowledge acquired in these locations are often context-specific and may not be readily transferable across regions. Consequently, to fully realize the returns on their education, individuals may be compelled either to remain in the area where they studied or to migrate to regions in which the local opportunity structure corresponds to their qualifications—for instance, financial centers for those with finance degrees or industrial hubs for engineers.

Spatial mobility can therefore have diverse effects on social inequalities. It may produce a cumulative effect if individuals from higher social origins possess greater resources to relocate to more advantageous areas, thereby further increasing their likelihood of attaining a higher social class. Conversely, it can generate a boosting effect by enabling the most disadvantaged to better compete with the more advantaged. In this scenario, the benefits of mobility for the already privileged may be limited, as they already have substantial resources, whereas the less advantaged gain new pathways to upward mobility. Evidence from Italy supports this interpretation: Ballarino and Panichella (2021) found that the positive impact of spatial mobility was strongest for individuals from middle and lower classes, particularly those from rural areas, suggesting that boosting effects may outweigh cumulative effects in shaping social outcomes.

Mobility to where?

Research on spatial and social mobility typically assumes that relocation is directed toward wealthier areas and from rural to urban regions, providing access to enhanced opportunity structures. Upward mobility indeed often involves moving to economically prosperous regions, such as northern Italy, the South-East of England (Findlay et al., 2009; Fielding, 1992), or the Paris metropolitan area in France (Lelièvre, Bonvalet, 1994). Moving to the richest regions may, however, involve significant personal costs, especially when those regions are far from where a person currently lives. By contrast, relocating to nearby regions may allow individuals to find employment while maintaining family ties and social networks.

The direction and scope of spatial mobility should be strongly conditioned by social origin and destination. Individuals from higher social strata possess greater resources to engage in long-distance relocation. At the same time, the pursuit or maintenance of high-status positions should constrain them to locations where elite opportunities are concentrated, effectively restricting their choice to a limited set of affluent urban centers. Conversely, occupations prevalent among lower social strata, such as hairdressing, cashier or Warehouse worker, are geographically dispersed, enabling employment access across a broader range of locations. Consequently, these individuals should be less compelled to move far from their place of origin and should often undertake only short-distance relocations within their regional context.

To analyze these different dynamics of spatial mobility and their variation across social classes, the geographical conceptualization of mobility in social mobility research remains overly simplistic. Most studies rely on basic measures—mobility versus immobility, distance moved, or rural-to-urban relocation. Those approaches have demonstrated that higher-status individuals undertake long-distance moves more frequently, revealing that mobility is both more common and qualitatively distinct among these groups. However, they provide limited insight into how the structure of mobility interacts with social origin and destination. As we shall see, research in geography has developed methodological tools that can enrich the analysis of spatial mobility and provide a better understanding of its relationship with social mobility.

Geographical Network analysis and spatial networks

In the 1960s, geographers began employing network analysis to describe different social phenomena such as migration flows, transport infrastructures, and trade relations (see Uitermark, van Meeteren, 2021, for a historical overview of the use of social networks in geography). Within migration research, spatial networks have been developed to describe migration structures (Abel, Sander, 2014; Tranos et al., 2015; Danchev, Porter, 2018; Windzio, 2018; Akbari, 2021).

A spatial network is a network in which nodes—corresponding to geographic units such as cities, regions, or countries—are connected by links weighted according to the flow of migrants between them. Such networks firstly provide a clear visualization of interregional or international connections. They also allow for the systematic analysis of network structure. Key quantitative indicators include centrality measures, which capture the importance of individual nodes. For example, degree centrality reflects the number of direct connections a node has. Another important metric is modularity, which identifies communities—densely interconnected subgroups within the network—thereby revealing clusters of nodes with particularly strong internal migration flows.

Many studies in geography have applied these indicators to analyze relationships between geographical entities. For example, researchers have examined the structure of city networks based on passenger train and air travel flows, or on the density of daily or weekly movements between spatial locations (Smith, Timberlake, 2001; Zhong et al., 2014). These analyses have enabled the identification of the most central cities and the characterization of their properties.

The study of network modularity has also proven particularly valuable for understanding geographical inequalities, as it allows for the detection of communities. In spatial networks, these communities correspond to larger regions encompassing regions with significant internal flows. For instance, Cramer-Greenbaum (2024) analyzed residential moves within the city of Zurich and, using communities detections algorithms, identified patterns of urban residential mobility that transcend political boundaries and commonly perceived geographic areas. Gamsu and Donnelly (2020) examined student flows between different regions in the UK for higher education, revealing “regional divisions and socio-spatial hierarchies of schools and universities” (Gamsu, Donnelly 2020).

These concepts and tools from geographical network analysis can offer important insights for sociology, particularly in understanding the relationship between spatial and social mobility. Prior geographical studies typically focus on a single mobility network to characterize overall network properties, without considering that these properties may differ substantially across subgroups of the population defined by social class of origin or destination.

From a sociological perspective, spatial networks offer a major improvement over traditional spatial mobility measures: these networks provide a comprehensive mapping of movements between regions. By analyzing how network properties vary with social origin and destination, we can uncover the mechanisms through which spatial mobility shapes and channels social mobility.

Spatial networks and social mobility: hypotheses

Studying the structure of international migration networks, Akbari (2021) identified two distinct migration patterns, which he termed “International Migratory Highways” and “Migratory Clusters.” In the first pattern, migration flows are largely asymmetric, directed toward major immigration centers, whereas in the second, flows are mostly symmetric and concentrated within specific geographic areas. We propose to apply this distinction to the study of the relationship between social and spatial mobility.

At the national level, this distinction can be used to characterize two types of spatial mobility. Migration flows toward major economic centers correspond to migration highways, whereas migration clusters represent short-range movements within larger regions that are not oriented toward economic hubs.

These different spatial patterns are expected to correspond to distinct forms of social mobility. As argued above, attaining a high social class, regardless of origin, typically requires access to favorable economic structures and, consequently, relocation to affluent regions. Therefore, the spatial network of individuals achieving high positions should be characterized by significant migration flows toward a small number of the wealthiest regions, corresponding primarily to migration highways. From a topological perspective, the concentration of flows toward major cities should produce a centralized network. Additionally, it should exhibit low modularity, since the richest cities should be interconnected, while most other regions should remain disconnected. In other words, the network should not be easily divisible into smaller, internally cohesive migration clusters, aside from the division between the economic centers and the periphery. Based on this reasoning, we propose the following hypothesis:

> *Hypothesis 1a. Individuals belonging to the highest social class exhibit a more centralized spatial network with lower modularity.*

As described above, children from the highest social class are more likely to be spatially mobile due to their greater resources. Given their privileged origin, they are more likely to come from affluent, urbanized areas and, consequently, tend to remain within these richer regions. Based on this reasoning, we propose a similar hypothesis: regardless of their class of destination, children of the highest social class should exhibit more centralized spatial networks with lower modularity. Furthermore, the effects of social origin and destination are expected to be cumulative, as these influences operate largely independently. Thus, children of the highest class who remain socially immobile are anticipated to display the most centralized and least modular networks.

> *Hypothesis 1b. Children of the highest class have more centralized spatial networks and with a low modularity.*
> *Hypothesis 1c. The most centralized spatial network and the less modular one is the network of children of the highest class that are socially immobile.*

We expect children from the lowest social class to exhibit the opposite pattern. We have argued that lower-class positions are more common and less concentrated in major urban centers. Individuals occupying these positions are less likely to migrate along major economic "highways" and are instead more likely to undertake short-range movements within surrounding regions, generating migration clusters—for example, within the South or within the North of the country. A spatial network characterized by multiple migration clusters corresponds to a decentralized structure, lacking a dominant economic center, and can be divided into distinct communities representing these clusters, resulting in higher network modularity. As with the highest class, the effects of social origin and destination are expected to be cumulative. Accordingly, we propose three hypotheses that mirror those formulated for the highest social class, but in the opposite direction.

> *Hypothesis 2a. Individuals belonging to the lowest social class exhibit less centralized spatial networks with higher modularity.*
> *Hypothesis 2b. Children of the lowest social class exhibit less centralized spatial networks with higher modularity.*
> *Hypothesis 2c. The least centralized and most modular spatial network is observed among children of the lowest social class who remain socially immobile.*

These initial hypotheses link social mobility to the topological characteristics of spatial networks. Such networks can also reveal how the economic attractiveness of a region interacts with social mobility. We hypothesize that, for individuals from the highest social class, the network will be centralized around the wealthiest regions, implying a positive correlation between a region's centrality and its GDP. In contrast, for the lowest social class, we do not expect such a correlation, as mobility is likely to occur primarily within their broader region rather than toward wealthier areas. Based on this reasoning, we propose the following hypotheses.

> *Hypothesis 3a. In the spatial networks of children from the highest social class—or of individuals belonging to this class—the centrality of a region is expected to be positively correlated with its GDP.*

Hypothesis 3b. In the spatial networks of children from the lowest social class—or of individuals belonging to this class—the centrality of a region is expected to show little or no correlation with its GDP.

Hypothesis 3c. Among socially immobile individuals, the spatial networks of children from the lowest social class are expected to exhibit the weakest correlation between region centrality and GDP, whereas the networks of socially immobile children from the highest social class are expected to exhibit the strongest correlation.

These hypotheses focus on the contrast between the top and bottom of the social hierarchy. Confirming them would demonstrate that individuals with different social mobility trajectories also exhibit distinct patterns of spatial mobility, highlighting that social and spatial mobility are closely intertwined phenomena. From a methodological perspective, this approach would further illustrate that network analysis and spatial networks provide powerful tools for generating novel insights into both forms of mobility.

Methods

Data

We use the French Labor Force Survey conducted each year from 1982 to 2024. We keep in the sample individuals who were at least 30 years old and born after 1950. We have a dataset containing 1,095,031 respondents for whom the social class of the father has been measured. The territorial unit that we used is the French "department" (NUTS 3 region). We have the department in which each individual is born as well as the one in which he lives. Metropolitan France comprises 96 departments. However, the two departments of Corsica have been merged due to the unavailability of certain socioeconomic data at a separate level. As a result, our analysis considers 95 departments.

We collected data on the GDP of departments from INSEE, the national statistical office. For departmental GDP, data are available only from the 2000 onwards. We have calculated the average GDP for each department over this period. During this period GDP inequalities between departments had almost no variation over time. We restricted the sample to individuals born after 1950 to limit large discrepancies between the period during which individuals were active in the labor market and the timing of the departmental GDP measure. Despite this restriction, an important discrepancy remains, making our regional wealth measure an imperfect proxy.

The occupation classification

In the data, the occupation is coded using a French classification (the PCS classification). We rely on the latter to code the social class. This provides a six-class classification. This classification has the advantage to be used a lot in the French system, it is therefore quite well-known by employers and employees and it plays an important role in structuring inequalities, as work conditions in many contexts depend on the official position in the classification. It is very close to classifications such as EGP or ESeC (the European Socio-economic Classifation).

Table 1 Social class classification

Social class	Description

Class 1	Manager, Professionals, and large employers
Class 2	Intermediate Occupations
Class 3	Small employers and self-employed in non-professional occupations
Class 4	Farmers
Class 5	Lower white collars
Class 6	Manual workers

Spatial networks

To describe spatial mobility, we use tools from network analysis. In this framework, each department is represented as a node, and the flows of movement between departments are represented as links connecting these nodes. We therefore obtain a directed network structure. Each edge is assigned a weight w_{ij}, corresponding to the share of individuals born in one department and living in another:

$$w_{ij} = \frac{m_{ij}}{\sum_j m_{ij}}, \ i \neq j, \qquad (1)$$

where m_{ij} represents the number of individuals born in department i and living in department j. In order to focus only on mobile individuals, we exclude self-loops by setting $m_{ii} = 0$ for all departments.

We construct a spatial network for each social trajectory, with each trajectory representing a distinct subpopulation. In total, we build 49 networks: 36 for each specific social trajectory (6*6), to which we add 6 based solely on class of origin and 6 based on class of destination. Finally, we also build the network for the whole population without any class distinction.

Network analysis indicators

To understand how spatial networks may vary with the social mobility to which it is associated, we shall focus on three topological characteristics of the networks: the degree-centrality of each node, the centralization of the network, and the modularity of the network.

The degree-centrality of a department corresponds to the weighted in–degree centrality and represents the sum of the shares of in-migrants to a department:

$$C_i = \sum_{j \in \upsilon_{in}(i)} w_{ji} \qquad (2)$$

where $\upsilon_{in}(i)$ is the incoming neighborhood of node i (the set of departments from which at least one individual moves to department i).

The centralization of a network quantifies how concentrated connections are around the most central node (department). We use an adaptation of Freeman centralization indicator for the case of weighted networks. We consider the strength as centrality indicator and we assume, as maximally centralized graph a

$$C = \frac{\sum_{i=1}^{n} (C_{max} - C_i)}{(n-1)(n-1)} * 100 \qquad (3)$$

where C_{max} is the maximum node centrality, C_i is the centrality of node i, and n is the total number of nodes. The formula $(n - 1)(n - 1)$ gives the maximum possible level of centralization, which occurs in a star network, where a single node receives all the weights from the other nodes and assigns no weight to them. We multiply by one hundred to have an indicator between 0 and 100.

To detect communities we use the Infomap algorithm (Rosvall, Bergstrom, 2008). The algorithm detects communities of departments that are strongly connected by migration flows. In this framework, departments are grouped together when people tend to move frequently within the same group and less often across groups. Importantly, these groups are not defined by geographical proximity, but by actual mobility practices. Two departments far apart geographically may belong to the same cluster if they exchange many migrants, while neighboring departments may fall into different clusters if migration between them is weak. Infomap is especially appropriate for migration studies because it respects directionality (origins vs. destinations matter) and it uses flow intensity (larger migration streams have more influence). For a more detailed and technical description of the algorithm, see Rosvall and Bergstrom (2008).

To measure the robustness of the partition we use the classical measure of Newman-Girvan modularity (Newman, Girvan, 2004):

$$Q = \frac{1}{w}\sum_{i,j}\left(w_{ij} - \frac{c_i^{out} c_j^{in}}{w}\right)\delta(g_i, g_j) \qquad (4)$$

Where:

w_{ij} : weight of the directed edge from i to j;

$c_i^{out} = \sum_j w_{ij}$: outgoing centrality of node i;

$c_j^{in} = \sum_i w_{ij}$: incoming centrality of node j;

$w = \sum_{ij} w_{ij}$: total weight of the network (that in our case is one);

g_i : community of node i;

$\delta(g_i, g_j)$: Kronecker delta, equal to 1 if i and j belong to the same community, 0 otherwise.

For some networks, the algorithm identified a single community, reflecting the near-complete nature of the underlying networks. To compute modularity, we applied a sparsification procedure by removing links corresponding to flows below the 2% threshold. In the last section, we conduct robustness checks using alternative threshold values.

It is worth noting that the comparison of modularity across networks remains limited, because even though networks with the same number of nodes and similarly constructed links can be compared under controlled methodological conditions, this measure is still sensitive to network size, density, and overall structure.

Results

Spatial mobility and social trajectory

To describe the relations between social and spatial mobilities, Table 2 presents the share of mobile individuals for each social trajectory. The margins of the table provide the share of mobility separately for each social class position and for each social origin, while the interior provides it for each combination of origin and position.

Irrespective of the trajectory, some classes appear as more spatially mobile than others. This is particularly the case of the manager and professional class, with 67% of all members of this class being spatially mobile, against 32% of the manual class or 17% of the farmer class. The lower non-manual class and the small employers are more mobile (43%) than the two other lower classes. The intermediary class is in the middle (52%). Spatial mobility is therefore quite well associated to the social hierarchy: on average the higher the class in the hierarchy, the higher the spatial mobility rate.

Table 2 Spatial mobility and social trajectory

Position / Origin	Farmer	Small employer	Manager and Professional	Intermediate	Lower non Manual worker	Manual worker	All
Farmer	14%	32%	58%	40%	30%	23%	28%
Small employer	38%	38%	63%	51%	45%	37%	47%
Manager, Professional	69%	62%	74%	66%	61%	56%	68%
Intermediate	52%	54%	69%	56%	50%	42%	56%
Lower non manual worker	48%	51%	69%	57%	49%	41%	53%
Manual worker	32%	41%	58%	45%	37%	29%	38%
All	17%	43%	67%	52%	43%	32%	48%

Both the class of origin and the class of destination are correlated to spatial mobility and in a similar way. It means that when one looks at the table in a row (by origin) or in a column (by destination), the patterns will be the same. For example, if we look at the table by column, we observe that for most social destinations, having a manual class origin or a farmer origin lowers the mobility rate: 32% of the manual class are mobile, but this is the case for 29% of those that have a manual class origin and 23% of those that have a farmer origin. Similarly, 43% of lower non-manual individuals are mobile, but only 37% when they are children of the manual class or 30% when they are children of farmers. Finally, only 58% of managers and professionals from blue collar origin are mobile (against 67% of all managers and professionals).

If we now inspect the table by row, we can make the same observations. For example, in most cases of social origin, becoming a manual class worker or a farmer is associated with lower mobility rates: among the children of manual workers, 29% of those who also become manual workers are spatially mobile, compared to 58% of those who become professionals or managers, and 45% of those who enter intermediate occupations. At the top of the social hierarchy, 68% of the children of managers and professionals are spatially mobile. In comparison, only 56% of individuals from manager and professional backgrounds who become manual workers are mobile, versus 74% of socially immobile children of managers or professionals. More broadly, across all social origins, attaining a managerial or professional position is consistently associated with the highest levels of spatial mobility.

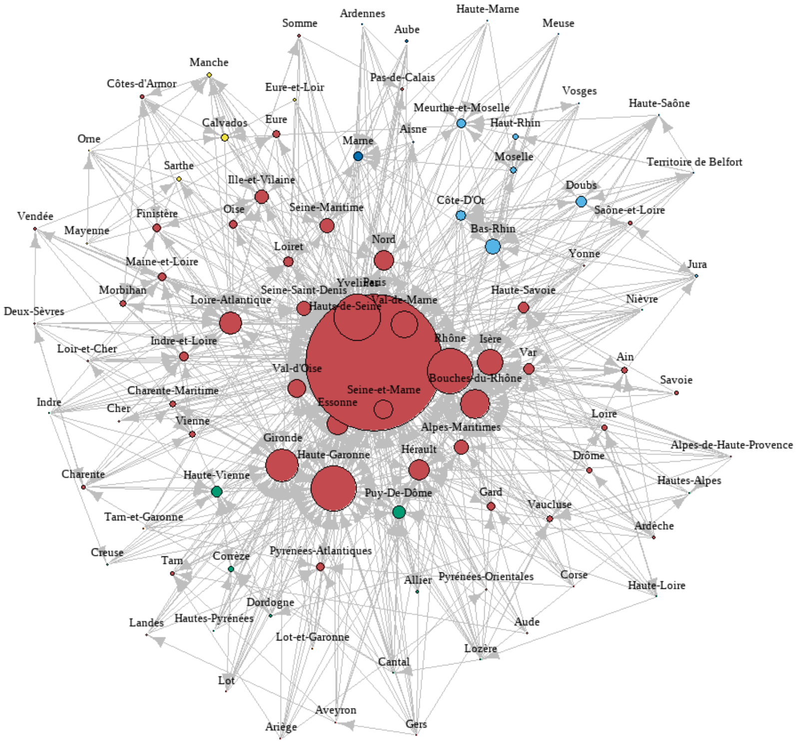
Social trajectory deepens the contrast observed when comparing either class of origin or class of destination alone. The most spatially mobile individuals are children of managers and professionals who themselves become managers and professionals (74%). In contrast, the least mobile are children of farmers who remain farmers (14%) or become manual class workers (23%), followed by children of manual class workers who remain in the same class (29%).

To summarize, the table reveals three key findings. First, spatial mobility is closely linked to social hierarchy: individuals in higher social classes tend to be more mobile, while those in lower classes are generally less mobile. Second, both social origin and destination are correlated to spatial mobility, and their effects reinforce one another. As a result, reproducing the highest social class corresponds to the most spatially mobile trajectory, whereas reproducing the lowest class aligns with the least mobile one. Third, the observed link between spatial and upward social mobility appears to be driven by the fact that the highest class is also the most mobile one. Consequently, individuals who either attain or reproduce this class tend to exhibit higher levels of spatial mobility.

The topology of spatial mobility network

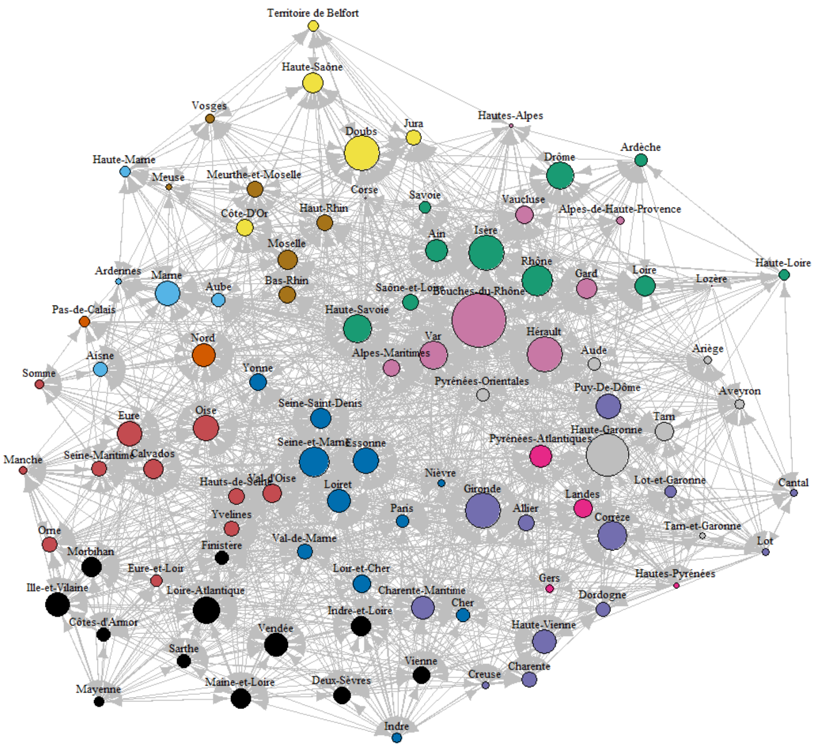
So far, our focus on the share of spatial mobility has relied on a binary distinction—individuals are either mobile or not. While useful, this approach offers a limited view of spatial mobility. To provide a richer and more detailed understanding, we turn to the spatial mobility networks. To illustrate the advantage of our network approach, Figures 1a and 1b present a visualization of two of our 49 spatial networks. Figure 1a presents the spatial mobility network of the socially immobile children of managers and professionals, while figure 1b presents the spatial mobility network of socially immobile children of manual workers.

Figure 1a Spatial mobility of the socially immobile children of managers and professionals.



Note: The sizes of the node correspond to their in-degree centrality. The colors correspond to the clusters detected by the infomap algorithm.

Figure 1b Spatial mobility of the socially immobile children of manual workers.



Note: The sizes of the node correspond to their in-degree centrality. The colors correspond to the clusters detected by the infomap algorithm.

Those two networks are very different and represent quite well the opposition between a network with migratory highways and one with migratory clusters. The first one is ultra-centralized around Paris. After Paris, some of the biggest nodes are the departments around Paris: Haut de Seine and Yvelines which are geographically the suburbs of Paris. The other nodes which are bigger than average correspond to those containing other French major cities: Rhône (Lyon), Haute-Garonne (Toulouse) or Gironde (Bordeaux). The network seems to depend a little on geographical distance, but with a lot of inconsistencies, especially because departments containing big cities are close to Paris, regardless of their distance.

Compared to the networks of the socially immobile children of managers and professionals, the network of the socially immobile children of manual workers is much less centralized. Paris is in the center of the network and its size is not particularly big. The network appears quite decentralized with many different areas that correspond this time to geographical French regions. In contrast to the previous network, this one bears a strong resemblance to the geographical map of France. The top of the network corresponds to the east of France, and the bottom of the network to the west of France. The left of the network corresponds to the north of France, while the right of the network corresponds to the south of France.

These initial networks reveal that the children of manual workers and those of managers and professionals differ not only in their likelihood of spatial mobility but also in the nature of that mobility. The mobility patterns of children from managerial and professional backgrounds are highly centralized around Paris and link together France's major cities. It corresponds to what we call a network with migratory highways: people mainly move toward hubs and between hubs. In contrast, the network of the children from manual worker backgrounds is mostly characterized by migratory clusters: movements are more constrained by physical distance and mostly occur within smaller and localized regions. As a result, unlike the mobility network of the children of managers and professionals, the network for children of manual workers aligns much more closely with France's physical geography.

We shall now extend the analyses to more networks to confirm those results. Table 3 provides two indicators for each of the 49 networks: the centralization of the network and its modularity.

Table 3 Centralization and modularity

Position Origin	Farmer	Self employed	Manager, Professional	Intermediate occupation	Lower non-manu al	Manual	All
Farmer	2.22 /0.31	2.75/ 0.23	6.64/ 0.15	3.14/ 0.38	2.37/0.43	2.11/ 0.46	2.36 /0.32
Self employed	3.08/0.27	2.95/ 0.39	9.15/ 0.25	3.23/ 0.33	3.03/ 0.33	2.35/ 0.38	3.91 / 0.30
Manager, Professional	4.40 /0.04	6.57/ 0	12.52/ 0.08	4.76/ 24	4.22/ 0	3.53/0	9.30 / 0.25
Intermediate occupation	2.26/0.29	3.93/ 0.33	7.21/ 0.24	3.18/ 0.30	2.74/0.29	2.92/ 0.33	3.53/0.29
Lower non-manual	3.32/0.29	2.72/ 0.32	5.82/0.23	3.03/ 0.26	2.46/ 0.29	2/0.33	2.55 / 0.29
Manual	2.31 /0.25	2.48/0.37	4/ 0.28	2.62/ 0.32	2.54/0.35	2.16/0.37	2.32/ 0.30
All	1.71/0.32	2.31/0.30	8.48/0.25	2.95/0.29	2.42/0.29	2.02/0.30	3.25/0.51

Note: the first number in the cell corresponds to the indegree centralization of the network. The second number corresponds to the modularity obtained on the network, while removing links below 2% (see method section).

The centralization and the modularity of the mobility networks reflect quite well the social hierarchy with a stronger centralization and a lower modularity being a characteristic of the networks of the highest classes. For a given social origin, being manager or professional is always associated with the most centralized network and the less modular one, which confirms the hypothesis 1a. Similarly and confirming hypothesis 2a, for each origin, being a manual worker or a farmer is almost always associated with having a less centralized network. The same result can be observed for origin by column: for a given destination, being from a managerial and professional background increases the centralization of the network, whereas being from a manual background tends to lower it (hypotheses 1b and 2b).

The results only partly confirm the cumulativity of the effects of origin and destination (hypothesis 1c and 2c): the most centralized network and the less modular network is the network of the children of managers and professionals that are socially immobile. The result is a little less clear for the less centralized networks. The network of socially immobile children of manual workers is among the least centralized ones (2.16), but it is not the least centralized one. The least centralized ones are the networks of manual workers who are children of the lower non manual class or of farmers. Being from lower classes and staying in them therefore still quite well associated to less centralized networks and with higher modularity.

We can draw different conclusions from these results. Firstly, the spatial mobility associated with different social trajectories does not only vary in strength but also in type. It means that the different social classes do not move to the same places and the same parts of France. Secondly, these results allow us to reconsider or to better understand the previous results of the stronger spatial mobility of the highest class. Whereas managers and professionals are much more spatially mobile, their mobility occurs within a quite limited network built around the most important cities. Contrary to what has been described as a larger freedom, in fact their spatial mobility seems to be more limited because constrained to a relatively lower number of cities.

Territorial centrality and economic wealth

To understand how the structure of the spatial mobility network can be explained by the socioeconomic characteristics of the region, Table 4 provides the correlations between the centrality of a department in the spatial mobility network and its GDP. The correlations are given for each of the 49 networks.

Table 4 Centrality and GDP

Origin \ Position	Farmer	Self employed	Manager, Professional	Intermediate occupation	Lower non-manual	Manual	All
Farmer	-0.33	0.39	0.88	0.64	0.63	0.29	0.70
Self employed	-0.13	0.48	0.92	0.75	0.64	0.36	0.80
Manager, Professional	-0.13	0.79	0.95	0.84	0.78	0.46	0.93
Intermediate occupation	-0.11	0.53	0.91	0.68	0.65	0.43	0.79
Lower non-manual	-0.25	0.36	0.88	0.68	0.63	0.33	0.71
Manual	-0.27	0.39	0.83	0.62	0.56	0.31	0.60
All	-0.31	0.56	0.93	0.72	0.65	0.36	0.80

Note: Pearson correlation coefficient between the centrality of a department and its GDP.

The results show that the correlations vary quite a lot with the social trajectory. Confirming hypothesis 3a, the correlation is particularly strong when the social trajectory involves becoming a manager or professional. This is true for all social origins and with quite small variations: 0.95 for children of managers and professionals, 0.83 for children of manual workers, 0.88 for children of lower non-manual workers.

On the contrary and confirming hypothesis 3b, becoming a manual worker is associated with a weaker correlation between the centrality of a region and its GDP (0.36). The correlation varies quite a lot with the social origin: it is particularly weak when people come from a farmer background (0.29) or manual worker background (0.31), it goes up to 0.42 for children of intermediate occupation or 0.46 for children of managers and professionals.

We can see therefore that both origin and destination contribute to the topology of the network and in a way that polarizes the two extreme groups (hypothesis 3c), the correlation is 0.31 for children of manual workers that are socially immobile against 0.95 for children of managers and professionals that are immobile. The correlation is also much stronger when children of manual workers become managers (0.83) and professionals than when managers and professionals become manual workers (0.46). It shows that the destination is more important than the origin to explain the importance of GDP in the network.

Robustness check

To compute network modularity, we applied a filter that removes links with weights below 2%. To assess the importance of this choice, Table 5 reports the share of links removed by the filter across the 49 networks.

Table 5

Min	Q1	Median	Mean	Q3	Max	N
0.6%	5%	23%	31%	51%	84%	49

The filter eliminates a substantial proportion of links: in half of the networks, more than 23% of links are removed, and in one case as many as 84%. The networks contain a large number of weak links that make them nearly complete, and even when link weights are taken into account, community detection algorithms cannot be applied without filtering.

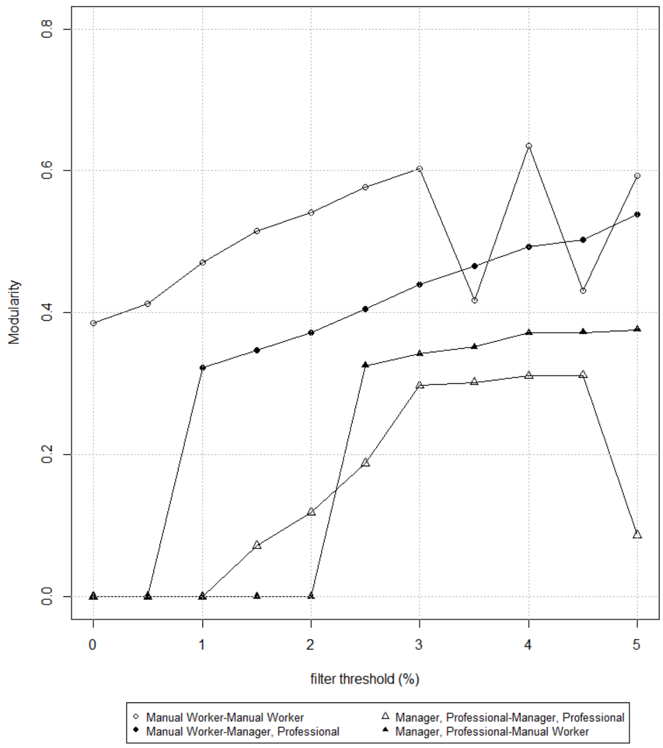
To evaluate the consequences of this filtering choice, Table 6 presents modularity estimates computed without any filter. For most networks, modularity equals zero: the Infomap algorithm fails to identify communities because the networks are nearly complete. The only cases in which modularity can almost always be computed correspond to networks where the father or the individual is a farmer or a manual worker. This confirms our earlier results showing that these categories exhibit the most modular networks. In addition, smaller populations may facilitate the identification of network partitions, as they generate fewer interregional links. This is reflected in the fact that modularity is never computable for marginal networks

Table 6 Modularity of the networks without filters

Position / Origin	Farmer	Self employed	Manager, Professional	Intermediate occupation	Lower non-manual	Manual	All
Farmer	0.30	0.24	0.18	0.38	0.40	0.46	0
Self employed	0.26	0.38	0		0.33	0.38	0
Manager, Professional	0.27	0	0	0	0	0	0
Intermediate occupation	0.29	0	0	0	0	0	0
Lower non-manual	0.30	0	0	0	0	0	0
Manual	0.25	0.38	0	0.35	0.35	0.39	0
All	0	0	0	0	0	0	0

To further assess the sensitivity of our results to the choice of filter, Figure 2 illustrates how modularity varies with the filtering threshold for four selected networks. We focus on these four networks to present parsimonious results and because they are the most frequently used in the previous analysis. On average, modularity increases as the filter becomes more restrictive (i.e., as more links are removed). For children of manual workers who become managers or professionals, modularity becomes computable when the filter is greater than or equal to 1%. For immobile children of managers and professionals, the filter must be strictly above 1%. The network of immobile children of manual workers is almost always the most modular.

Figure 2 Change in modularity depending on the filter threshold



Note: The graph provides the modularity of 4 networks for different filter thresholds. In the legend, the first category corresponds to the origin, the second one to the destination.

When the filter becomes too restrictive, however, the results become less stable. Even in these cases, modularity remains consistently higher for children of manual works compared to children of managers and professionals. For children of manual workers who become managers, modularity is generally lower than for immobile children, except at high filter levels where the modularity becomes highly unstable. Overall, higher filter thresholds lead to more inconsistent results. For this reason, we adopt a relatively low filtering threshold, which balances the ability to compute modularity with the preservation of most of the information in the networks.

Conclusion

Previous research on spatial and social mobility has primarily emphasized the positive relationship between spatial mobility and upward social mobility. This paper makes a novel contribution by analyzing how different social trajectories are linked to qualitatively distinct forms of spatial mobility, represented through spatial networks.

Firstly, we showed that depending on the social trajectory, spatial mobility networks strongly differ in their topological characteristics. The spatial mobility networks of managers and professionals are centralized around Paris and it connects Paris to the other richest regions in France. Movements of the managers and professionals are therefore largely movements toward rich regions. Following Akbari (2021), we described those networks as mainly containing migratory highways. On the contrary, the networks of the lowest classes, and especially of the manual class, are much more decentralized and have a much higher modularity. It means that people in lower classes are mobile within some well separated parts of the region and their movement are less often toward rich regions. Following Akbari (2021), we describe those networks as containing mainly migratory clusters.

Another key finding is that both social origin and destination shape the structure of the spatial mobility network. The differences between the networks are particularly pronounced between individuals who experience no social mobility and belong to different social classes. Conversely, when individuals are socially mobile, their networks tend to reflect a blend of characteristics from both their origin and destination classes. For instance, managers and professionals who come from a manual worker background tend to have less centralized networks than those from more privileged origins. Overall, the destination class plays a greater role in determining the nature of the mobility networks, while the origin class can either soften or accentuate these characteristics, depending on how similar or different the two classes are.

Our approach invites a reconsideration of the traditional view that the upper class exhibits greater spatial mobility. Although members of the highest social class are indeed more mobile and capable of relocating across significant geographic distances, their mobility often remains confined to a small number of select regions. In this sense, spatial mobility among the upper class should not be understood merely as a reflection of greater freedom or access to resources enabling them to live wherever they choose. On the contrary, it can also be interpreted as a form of social constraint tied to their social trajectory. Reaching an upper-class position often requires the capacity to move, but it also entails settling in one of the few most affluent areas of the country.

Finally, those results shed light on the fact that within the same country, the life opportunities of various social groups unfold in different geographic areas. Accessing the highest class mostly means to move spatially and to move to very specific regions, the richest of the country. For members of the upper class, birthplace has less influence on where they can live. Geographic distance poses no major barrier, and distant opportunities are often within reach. On the contrary, coming from lower classes and remaining into it often means living in a subpart of the country with little chance to move to different regions. The life prospect of the lowest classes is therefore much more dependent on physical distances and on the region in which someone is born. For those classes, the different subnational regions look much more like autonomous regions that could be studied separately. This creates a form of geographic segregation, in which people from lower class inhabit different versions of the country depending on where they are born. These findings underscore the importance of subnational approaches to better understand the life prospects of the lowest classes.

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