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SEGREGATED NETWORKS IN THE CITY

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Abstract

Segregation has been one of the most persistent features of urban life and, accordingly, one of the main subjects of enquiry in urban studies. Stemming from a tradition that can be traced back to the Chicago School in the early twentieth century, social segregation has been seen as the natural consequence of the social division of space. Such naturalized understanding of segregation as 'territorial segregation' takes space as a surrogate for social distance. We propose a shift in the focus from the static segregation of places—where social distance is assumed rather than fully explained—to how social segregation is reproduced through embodied urban trajectories. We aim to accomplish this by exploring the spatial behaviour of different social groups as networks of movement that constitute opportunities for co-presence. This alternative view recasts the original idea of segregation as 'restrictions on interaction' by concentrating on the spatiality of segregation potentially active in the circumstances of social contact and encounters in the city. This approach to segregation as a subtle process that operates ultimately through trajectories of the body is illustrated by an empirical study in a Brazilian city.

Introduction: does space really matter in social segregation?

One of the key issues about segregation is that we carry in ourselves the signs of the idiosyncrasies that define our identities—the very signs we are recognized and differentiated by, signs that cannot be simply disposed of or avoided. Ultimately, segregation is felt at the moment of the recognition of the body, a key aspect of the materiality of social relations, and it operates through the presence (or absence) of the body itself. Whether we agree or not on such an initial definition, we must admit that segregation is out there—pervasive. We are reminded of it when cars burn in Paris, in separated buses for immigrants in Foggia, and in the different areas for different social classes in Rio de Janeiro. Space is usually seen as both the materialization and means of segregation. We see spatial segregation as a way to engender social distance. Space separates. However, people hardly remain static in segregated territories. They move through the city in different areas and in different situations, they commute to work and go to places for socializing. Socially different people may even use the same public spaces and can be side by side on the street. We might well think that mobility could render space an obsolete form of segregation. But, if that is the case, why do we still observe segregation as an active part of life in our cities? If we are so mobile, why does the other remain mostly unknown to us? Our cities still seem efficient machines for engendering distance between the different.

We shall examine in this article the interplay of mobilities and forms of segregation. We are going to suggest that *territorial* segregation cannot easily account for *social* segregation, as we seem to take for granted. We will argue that, since our societies are interaction systems of high mobility, we need to see space from more than a static viewpoint. Through a critique of usual approaches to space as a surrogate for social distance, we shall propose a look into the spatiality of daily actions, making sense of *urban trajectories* and *encounters* as key features of segregation. That would entail a shift from a focus on the static segregation of places—where social separation is assumed rather than fully understood in its material manifestation—to *how social segregation is experienced and reproduced through our embodied trajectories*. To be sure, this approach

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will not ignore the role of spatial forms. In fact, as our empirical study will show, residential segregation has a key role in structuring the segregated trajectories of social actors. In undertaking it, we intend to show that space plays a more pervasive role in the enduring experience of segregation than usual views would allow.

This aim implies penetrating an elusive maze of movement and encounters in cities. In order to do so, this work builds on a rather eclectic use of ideas, from Linton Freeman's view of segregation as restrictions on interaction to Giddens' view of the role of encounter in social reproduction. Indeed, our approach relates closely to Freeman's idea, and applies it to understanding segregation as *the restriction on the presence of the other* in our performances, immersed in the delicate fabric of encounters that holds social systems together.

The next section of the article introduces a brief genealogy of conceptions of segregation, addressing how they emerged from particular contextual and epistemological conditions that have shaped our imagination of the *spatiality of segregation* and how it explains *social* segregation. The third section begins to break away from the spatial reduction of segregation to the social division of space by asserting the integrative and segregative potential of encounter, while the fourth identifies the central role of *mobility* in the generation of circumstances for encounter. The fifth section relates encounter-producing mobility to *social difference*, showing income to be an active factor in shaping mobility, especially in unequal societies. The sixth section will develop these ideas into a method applied in an empirical study of the urban routes of socially different actors in a Brazilian city. We expect to verify a series of hypotheses concerning whether (1) different mobility levels can be associated with different income groups; (2) different levels of diversity in the spheres of sociability in personal networks can be associated with different income levels; (3) traces of the potential influence of mobility can be found in the diversification of spheres of sociability in different income groups. The seventh section explores the implications of these concepts and findings for social life in cities, while the concluding section will relate them to the problem of the invisibility of otherness as a result of the reproduction of segregation. This approach as a whole aims to understand how elusive forms of social difference penetrate everyday life to become social distance and turn the other into a form of *unknown otherness*––a subtle process that operates ultimately through our daily performances and bodily trajectories in urban space.

A brief genealogy of a spatial reductionism: segregation as social division of space

> 'social relations are so frequently and so inevitably corrupted with spatial relations; … physical distances, so frequently are, or seem to be, the indexes of social distances.'
> Robert Park (1952 [1916]: 117)

This extraordinary phrase from Park, one of the leading theorists of the Chicago School in the first decades of the twentieth century, synthesizes a socio-spatial view that still seems to pervade our understanding today. Segregation is a most exemplary case of conflation of social and spatial relations—limitations on social contact easily defined by its apparent spatiality. In fact, the conflation seems to have reached a level where territorial segregation has become a surrogate for social segregation, a fully acceptable explanation for low levels of interaction among the socially different. This dominant understanding of segregation related to places rather than people can be traced back to Charles Booth's pioneering work on patterns of income, class and residential distribution in London in 1889. Such an inherently spatial view of segregation has found theoretical support in the Chicago School, most specifically in Burgess' (1928) seminal

work on residential segregation in American cities. Indeed the Burgess zone model of social patterning intrinsic to urban growth has been largely influential.

Many lines of work stemmed from this view in the following decades: Duncan and Duncan's (1955) dissimilarity index, Liberson (1961) on ethnical assimilation, Tauber and Tauber (1964) on black migration, Guest and Weed (1976) on causal relations in social and residential segregation, Massey and Denton (1988) on spatial patterns of racial segregation, and Quillian (2002) on black–white residential segregation and migration, among many others. Thomas Schelling (1969) famously showed how the effects of individual preferences on location unfold into patterns of residential segregation, and how an integrated society would generally unravel into a segregated one even though no individual actor strictly prefers this (see also Pancs and Vriend, 2007). Extensive empirical work reinforced the conflation. Farley (1977) found that ethno-racial residential segregation was much greater than the segregation of social classes in American cities, a pattern independent of education or income levels. The dynamics of territorial segregation as product and means of engendering social segregation certainly remains an area of great academic interest.[1]

The fixation on territorial segregation related to systems of identity[2] might be traced back to the origins of the concept: a persistent ethno-racial segregation in American cities and elsewhere since Burgess and Park's time (*cf.* Iceland and Douzet, 2006; Frantz, 2011). We should also consider the epistemology latent in such approaches: the view into sociospatial relations from the standpoint of long temporalities of *production* rather than the fast pace of social *reproduction*, and the focus on visible, nearly static spatial features rather than the elusive condition of contact between actors. Thus, the temporality of segregation in most approaches is the temporality of the production of space. Its spatiality is that of segregated areas. Segregation is usually seen as a form of geographically manifested social differentiation, having weak interaction between groups as a result, space taken as a substitute for social dissimilarity and distance. This view might have overshadowed other dimensions of segregation and deeper roles of space as highlighted in an interesting French debate stemming from Chamboredon and Lemaire's work in the 1970s, including Brun and Chauviré (1983), Brun and Rhein (1994), and Iceland and Douzet (2006). These works seek to challenge the racial origins of the concept of segregation, the residential outlook, the fixation on instances of social production and the hypothesis of a correspondence between social distance and spatial distance (see also Frantz, 2011). More recently, some innovative approaches have focused on the segregation of individuals in social spheres and routinized activities (e.g. Schnell and Benjamini, 2001; 2005; Dixon *et al*., 2005; Selim, 2015). Some of these works emphasize activity spaces and the individual agent's experience of isolation from, or exposure to, actual everyday life spaces of other groups. However, these approaches still tend to be centred on a representation of actors as dispersed/aggregated entities. Another class of study based on Hägerstrand (1970) focuses on the spatiotemporal paths of actors and interaction in personal social networks (Lee and Kwan, 2011). Our approach shares key points with such views (see Netto and Krafta, 1999; 2001; Netto *et al*., 2010).

In short, we suggest that (1) contextual specificities motivated the origins of this reduction; (2) the *context-dependency* of the concept is generally forgotten; and (3) the idea of territorial control is applied even in contexts where other segregative forces might be at work. Essentially, we suggest that this understanding should be reversed in favour of consideration of how social and spatial distances may be intertwined in more subtle and complex ways. This re-evaluation of the spatiality of segregation is

1 See Portugali *et al*. (1994), Singh *et al*. (2009), De Koning (2009), Maly (2009), Nagle (2009) and Vaughan and Geddes (2009), among many others.

2 Although territorial segregation may be related to a stable spatial configuration of identities and differences, a definition of socially homogenous areas reinforcing identity leads to a clear-cut definition granted by space even in the absence of the body. The incorporation of actors' trajectories in city space may contribute to a less stable definition of identities, as actors circulate in different areas.

even more necessary if we take into account the experience of segregation in modern and contemporary cities, where—since Georg Simmel's time—our daily lives are strongly constituted by *movement*. Ever since Park and Burgess, mobility seems highly underestimated, being mostly represented by migration and having the slow temporality of residential location as its expression (*cf.* Maloutas, 2004; 2007). Not surprisingly, the temporalities and spatialities inherent in (daily) mobility as the capacity to join social situations in urban space have been overlooked. In an intentional break from such views of segregation and their accompanying epistemologies, we wish to explore a perception of mobility closer to that of Simmel (see Frisby and Featherstone, 1997)—a property of a 'world in flux, whose substantive contents are themselves dissolved in motion' (Frisby in Maloutas, 2004: 195). Highly interdependent forms of mobility exist, including people's physical travel for work, leisure, family life, pleasure, migration and escape, which are central to making and maintaining complex connections in a networked society (Urry, 2002). We wish to expand on this view and incorporate connections that constitute at once the elusive conditions of contact between actors, and what Giddens (1984) understands as a key feature of social integration—encounters—and explore them as active features in segregation.

The social effects of co-presence, or the meaning of encounter

> 'All restrictions on interaction, whether they involve physical space or not, are forms of segregation—in social space.'
> Linton Freeman (1978: 413)

Freeman studied segregation through social network analysis, understanding that 'existing measures of segregation refer not to limitations on interaction but to restrictions on access to some physical space'. His powerful definition shares interesting points with Brun and Chauviré (1983) on the idea of segregation as a deliberate procedure that aims at preventing certain types of contacts, especially among socially different actors. Such a view allows relations with the concept of *homophily*, the tendency of individuals to associate with those sharing similar characteristics, with effects on solidarity groups (Bolt *et al*., 1998), community integration (Maly, 2009) and mobility in social networks (Jackson, 2009).

But what exactly does an encounter consist of? If we wish to remodel the spatiality of segregation around the circumstances of encounter, its meaning for social integration must be clarified. Indeed, encounter and co-presence may imply different things in different contexts—from open possibilities of interaction to rejection and fear of the other. Simmel (see Frisby and Featherstone, 1997) defines encounter as the most direct and 'pure' form of interaction. Co-presence is understood as bodies positioned within the boundaries of a same social situation and place, within a field where presence can be perceived by another actor (through sight or other senses). 'Co-presence affords access to the eyes. Eye contact enables the establishment of intimacy and trust, as well as insincerity and fear, power and control' (Urry, 2007: 70), a unique 'sociological achievement' that effects interactions (Frisby and Featherstone, 1997: 111). *Encounters* can, in turn, be defined as being co-present within a distance where focused interaction becomes possible through facial engagement (Goffman, 1963), gesture and verbal communication.

A phenomenological view might help in unveiling the scope of encounters in social experience. The encounter begins with an awareness of the other as a presence —a reciprocal attention, the direct consciousness of her existence and the relationship between us within a (spatially) shared experience. This may be illustrated anecdotally by an emblematic—and not altogether usual—situation in which a boy leaves his gated community and uses public transport to move around the city, and is likely to come

into contact on the bus or in the streets with a wider range of identities than those found near his home. Being aware of the other means realizing the existence of other identities constituted in different social contexts. 'My experience of the Other in the world that involves me' (Schütz and Luckmann, 1973: 60) allows us to collect traces of their identities. It is related to the heuristic experience of a socially differentiated world against which our own identities must be relativized. It allows the 'unveiling of the other', the recognition of the other in her otherness—or, as Levinas (1969) puts it, the *experience of alterity*. The recognition of the other in her otherness can only be fully achieved as physical experience. We experience the other from different perspectives and levels of proximity and anonymity while sharing the same spaces. Recognition leads to what Schütz and Luckmann (1973: 67) call 'reciprocity of perspectives'—'the mirroring of the I in the experience of the stranger', a key dimension of the socialization process.

The awareness of the other may be followed by an interesting transition from *perception* to *interaction*—that is, engaging in communicative exchange by discursive and non-discursive means. In a systematic absence of the other, our experience of the social world seems less complex. Encounter in situations of mutual recognition, and its transition to a full sense of coexistence and interaction involves largely unconscious *negotiations* of boundaries, ranging from rejection and tolerance to openness and the 'welcoming of the other' (Levinas, 1969). This includes non-discursive means of negotiating, likely to be active in situations of co-presence, identification, role-taking and tacit cooperation.[3] Taking this further, encounters also involve the possibility of group formation, the association of actors stimulated by the recognition of similarities or interests (*cf*. Weigert, 2010; Young, 1990). The importance of co-presence and encounter should be stressed simply because actual interaction cannot be taken for granted in unplanned situations of encounter. It is too contingent. But we can be certain that interaction can only emerge if its material condition is met: actors must be co-present in urban situations. Co-presence is the raw material, the key ingredient. If there is co-presence as the material opportunity for interaction, actual interaction might follow, even if in unpredictable ways.

Does it then follow that conditions for encounter mean that a city is less segregated? If the concept of segregation is considered to imply restrictions on interaction, allowing for encounter may be seen as a fundamental way of reducing the experience of segregation. This article aims to clarify how this may happen, answering questions like 'how can the encounter with the other occur? Are our cities any good at creating the conditions for contact among the socially different? Are they prevented by territorial and spatial forms of segregation?' The usual approaches seem poorly equipped to throw light on the subtle dimensions of segregation active in the urban rhythms of encounter. So, if we are to understand the integrative/segregative potential of encounter, we must turn to the fabric of daily actions beyond segregated areas, to discuss more nuanced spatialities of segregation. Of course, the fact that people may be in the same space says little about the nature of their interactions. This is perhaps most obviously related to how people move—by car, public transport, on foot—and the different potential for encounters these forms of movement entail. Social groups and contexts with a 'car culture' or countries with good public transport facilities may generate different structures of opportunity for encounter.[4] We therefore need to examine the structures of encounter shaped by different forms of mobility.

3 We refer here to a line of studies of the condition of actors in situations of interaction and identification stemming from the work of G.H. Mead (1967: 200; 253) on role-taking, the reciprocity of perspectives in social situations (e.g. Cicourel, 1971), mechanisms of tacit cooperation (Goffman, 1963), and so on.

4 A question raised by one of the referees.

Encounter-producing mobilities

A closer look into the urban practices of different groups requires a concept that can identify how actors perform their actions spatially. This implies movement, but is mobility an absolute capacity, shared by social actors equally? Different forms of mobility might be associated with different groups and forms of urban experience. We need also to differentiate a person's mobility from the range of her urban routes. Lower-income actors may have to overcome greater distances, due to being less able to afford accessible residential locations, but that does not mean they are able to move with less restriction. Income may have effects on people's ability to afford transport and overcome distance, as well as their ability to attend activities. Range alone does not define a person's mobility. Location also matters, and here approaches to spatial segregation still have considerable input. An accessible location means being closer to more activities, and able to engage in more of them and more efficiently. So mobility can be defined at the level of personal routes, as a way of perceiving such differences, such as ability (1) to overcome daily distances in one's routine (distance in time); (2) to access and perform activities available in the city (assessed as the number of activities performed in time); and (3) to move freely in space, in any direction (assessed as changes in direction within an actor's path).

Encounters are either more dispersed in the streets or polarized in places of work, leisure and consumption, bus stops, underground stations, complex buildings and so on. Of course, the nature of encounter and how it might unfold into interaction may be quite different in different activities and places, but we are not at this stage looking into the contents of interaction—only its raw materials. If the city is understood as a network in its own right,[5] places of activity can be seen as 'attractors': a substantial part of social life unfolds within buildings, for example, communication and the possibility of relating our acts to others. We may join in a particular activity if it interests us, if we have a role to play in it, if we can afford it, if we can get there—and if we know that it exists in the first place. All these aspects mean that at least some activities are often not interesting or not accessible (socially and spatially) to everyone. Nevertheless, they still have effects on personal actions, like triggers to a network of daily movements emanating from residential locations. If movement left visible traces in space, such networks of appropriation could reveal the potential for encounters to unfold in the city.

One of the aims of this study is to map these networks of movement. In fact, the idea of mapping trajectories is far from new. Hägerstrand (1970) made the first systematic attempt to trace the trajectories and the constraints of time–space over action. As we shall see, more recent empirical approaches have been able to record movement and identify mobility patterns.[6] If we could grasp at least part of these trajectories, we might have a better idea of the spatiality of the actions of socially differentiated actors, and how opportunities of encounter between them might emerge.

How can these forms of mobility be identified and how might they affect social contact and the formation of social networks? First, we need a definition of social network to understand how the spatiality of encounter shapes the experience of segregation. This does not aim to redefine social-network theory, but proposes a way of addressing social networking that explores a concept of networks of encounters and how they are materialized as potential fields within urban routes. The concept will not be used as a mathematically identifiable arrangement of personal ties, but as an open set of convergences and divergences of actors' lifelines in time, taking into account the time–space situations where contact occurs. In this view, actors are not graphically

5 We devise this form of analysing the city from configurational studies, namely Kruger (1979), Hillier and Hanson (1984) and Krafta (1994).

6 A method developed by Gonzales *et al*. (2008) uses extensive data recorded through mobile phone communication in American cities to map spatial paths, showing a remarkable tendency to recursivity in movement.

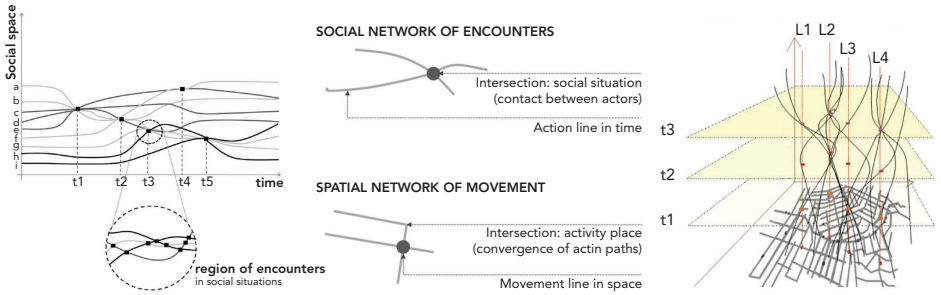

FIGURE 1 Encounters in social space (left), homological relations (centre) and action paths converging in space-time (right)

represented by vertices, as in social network analysis (SNA),[7] but as lifelines converging on positions in space–time. Lifelines resemble actual spatial paths, with encounters as their vertices. This inversion seeks to produce a more intuitive representation of encounter as a key factor in the relational settings of actors and the role of space and time in building social networks, absent in usual SNA representations (see Figure 1). We propose to add more layers to this idea, assessing how movement shapes encounters and *identifying mobility patterns potentially related to socially different actors*.

The conditions of encounter: mobility and income

What are the chances of meeting someone of a different social status? While the approach here allows for other identity markers as potential features in shaping appropriation and possibilities of segregation, we shall focus on a strong feature of Brazilian society: social inequality generated by differences in income levels, a key factor in class segregation. Let us examine a number of conditions of the encounter, some supported by previous studies and others in need of empirical assessment. First, the formation of social networks in cities depends substantially on circumstances of encounter. In fact, the importance of encounter in social and microeconomic networks has been stressed since Jacobs (1961; 1969), and further emphasized more recently by Sassen (2001), Gordon and Ikeda (2011), and Batty (2013). A theory of the effects of linear paths on the density of encounters has recently been put forward by Bettencourt (2013). Second, cities are spatially produced and arranged in a way that, in principle, renders social situations relatively accessible to participants, namely as location and accessibility patterns identified in spatial economics, in a long tradition stemming from Weber (1909), Hansen (1959) and Alonso (1964).

If these conditions make empirical sense, less mobility and a higher dependence on proximity may impose limitations on opportunities for encounter. Constraints on mobility relate to *localism*—a dependence on proximity for creating social relationships (see Marques, 2012). In this case, the density of encounters would increase especially near the home, a key factor in creating and sustaining relationships. Furthermore, there is a range of activities that is not dependent on proximity to the home, such as those located near work, which may increase the range of urban routes. Public transport and increasing ownership of private cars in developing countries also allow broader and more complex paths of movement over the city, but budget remains a key limitation. Higher-income groups, on the other hand, would have greater mobility and opportunities for creating relationships on broader spatial scales, increasing their chances of contacting different personal networks. By extension, personal networks with more mobility may blend more easily with other networks—within and even between different social fields.

7 For example, Granovetter (1973), Freeman (1978; 2006), and Wasserman and Faust (1994).

These inferences allow an initial hypothesis: that different levels of mobility embedded in action paths may have effects on the opportunities of encounter and the diversity of social networks. This hypothesis would have implications for the materialization of social networks operating within and between social classes in space:

Different levels of mobility ➔ Distinct networks of movement in urban space ➔ Different encounter opportunities ➔ Homophilic personal networks ➔ Segregated class networks

In fact, a string of studies exists to support the idea of substantial variations in levels of dependence on proximity for social networking according to class and income—in Brazil, the country of our case studies, and other countries. Santos *et al*. (1985) identified a particularly intense relationship between poor communities and the appropriation of the public spaces surrounding their residential spaces in Rio de Janeiro. Holanda (2000) developed a comprehensive study of places appropriated by different classes and the higher dependence of poorer people on proximity for setting up personal networks in Brasilia. Marques's (2012; 2016) studies in São Paulo and Salvador analyse the socialization profiles of less affluent actors in forming social networks, and reveal differences between the structures of personal networks in different social classes. Less affluent actors tend to have networks with fewer nodes (friends and acquaintances) and links (relationships) and fewer sociability spheres. His studies also show that middle-class networks tend to be distributed over a wide territory and included virtually no neighbours, similar to de-territorialized 'personal communities'—with a different pattern from that of less affluent actors. Finally, research on family budgets in Brazil has shown that transport spending increases more than proportionally with income.[8]

A similar relationship between income and network formation can be found in other countries. Analyses in California and Israel (Fischer and Shavit, 1995), France (Grossetti, 2007), Finland and Russia (Lonkila, 2010) and China (Lee *et al*., 2005), among others, suggest that personal networks vary according to class more than to cultural and regional contexts.[9] The inverse relation between dependence on proximity and income also finds support in Briggs (2005). These studies allow serious consideration of the idea that socially specific patterns of appropriation of space actively shape actors' networking capabilities, pointing to stronger localism and homophily in low-income networks. Furthermore, Marques also shows that broader, more diverse social networks may help overcome the negative effects of spatial segregation. This finding reinforces our case for the importance of spatial behaviour and mobilities in overcoming any territorial determinism in social segregation.

Bearing in mind Young's (1990: 227) concept of 'unassimilated otherness', there is an important reason why socially different people seem frequently invisible to one another in everyday life. To assume location and distance as a proxy for social division obscures the subtle roles of space in social segregation and ignores people's daily efforts to convert their spatial reach into situations of encounter and opportunities for interaction. A look into a specific group may already offer hints about the importance of mobility: higher-income actors may segregate themselves socially, controlling interaction and social homogeneity in urban areas territorially as well as spatially by settling

8 Empirical data on transport expenses in Brazil show that higher income groups not only spend more than low-income groups, they spend more proportionally. Considering a division of income into seven levels, the two lowest income groups spent 9.7% and 11.1% of their incomes on transport, whereas the two highest income groups spent 19.8% and 17.7%, including vehicular movement, according to the national Families' Budget Report (POF—Brazilian Institute of Geography and Statistics, IBGE 2008–2009).

9 This is not a self-evident relation, since we must take into account different potential causes for network diversity. The causal force of class factors depends on how homophilic a society and its classes are. See Fischer and Shavit (1995), Grossetti (2007), Lonkila (2010), Lee *et al*. (2005) and Marques (2012; 2016).

in intentionally less accessible locations. These actors overcome spatial segregation in order to generate and sustain larger and more complex social networks in the same sense that social actors in general need to overcome distance to generate interaction and cooperation in order to assert social and material reproduction (see Hillier and Netto, 2002). Nevertheless, the reverse may also be the case: increasing the complexity of social networks tends to reduce the negative effects of spatial segregation. Actors seem to benefit from this circular movement, and they do so through one factor: the higher mobility allowed by higher income.

Considering the role of social difference and mobility in the formation of social networks within and between classes more clearly, the following hypotheses suggest that:

- Restriction on mobility affects the capacity for encountering actors in different spheres of sociability, and therefore the capacity for creating more diverse personal networks. In principle, the more complex the mobility pattern in relation to places in the city, the broader the potential to amplify and diversify personal networks.
- Similarities in mobility patterns increase the density of encounters between socially similar actors (that is, actors sharing similar lifestyles), increasing homophily in personal networks. Homophily varies according to levels of localism (Marques, 2012), as does mobility, it might be suggested.
- Income has a role in this. Lower-income actors are likely to face more constraints in mobility.
- Differences in mobility patterns could disconnect contact opportunities between the socially different, making the formation of personal networks across social classes incompatible.

If these material implications make sense, mobility must be regarded as a key potential factor in overcoming localism and diversifying socialization. Income retains a central role in supporting mobility—but we have to consider that *increasing mobility relates directly to increasing networking capabilities*. Mobility and income seem to be associated in circles that lead to either increased or decreased potential for creating, sustaining and expanding personal networks. Mobility, income and networking capabilities would be deeply related. But how does that happen? If networking depends on situations of encounter, we must understand the importance of mobility in the structure of encounter opportunities as the instance in which social segregation is experienced. Considering the idea of an urban setting as a system of encounter (Hillier and Hanson, 1984), we shall look for traces of social segregation in daily lives in the city.

An empirical study of the integrative/segregative potential of encounter

An empirical study was developed in Niteroi, a town in the metropolitan area of Rio de Janeiro, to illustrate this approach, interviewing and mapping the action paths of 121 actors from different social categories, and overlapping these paths to visualize potential places of encounter. Social categories were defined on the basis of three income levels (lower, middle and higher), in numbers proportional to those found in the city's population.[10] Information was collected about spatial behaviour on the day before the interviews, including every activity on that day from the moment interviewees left their homes. A weekday was chosen, since movement patterns might change

10 Income levels were based on family members' income per month: lower income (up to R $1,114 or US $490), middle income (R $1,114–$4,806 or US $490–$2,113), and higher income level (more than R $4,806 or US $2,113) (based on August 2013 rates). At that time, about 15% of Niterói's population had an income higher than R $4,806; 53% had a middle income level; and 32% lower income. The definition of income levels is related to (a) mobility: we observed that people earning more than R $4,806 could afford similar mobility levels within the city, so we could aggregate income levels above that value; (b) the number of levels allowed by a 151 actor database.

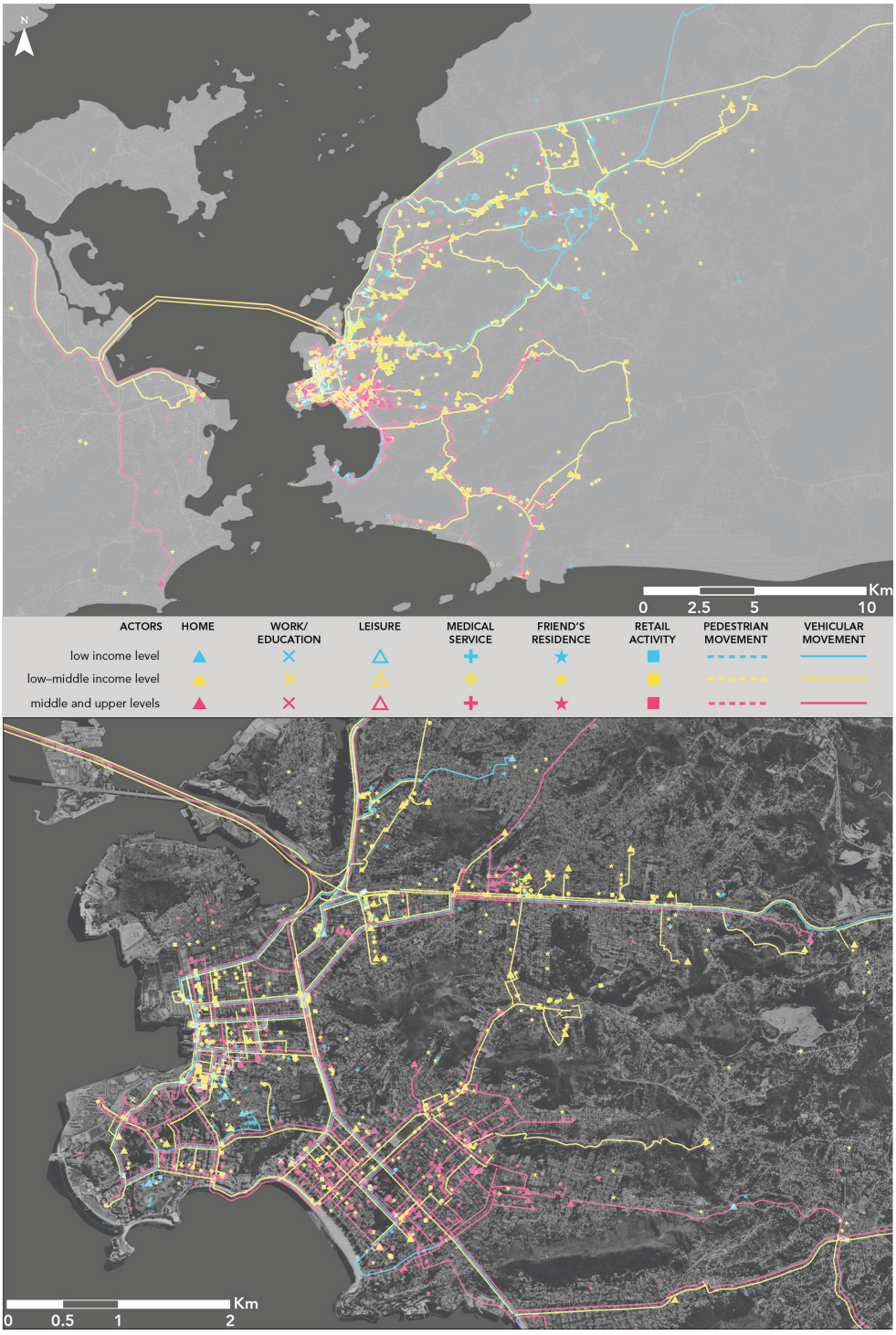

FIGURE 2 Trajectory patterns of movement of different income groups: segregation and potential co-presence in Niteroi, Brazil

TABLE 1 Average distances of urban trajectories (in kilometres)

Income Group	Home-CBD Distance	Home-work Distance	Pedestrian Routes	Public Transport	Private Vehicular Routes
Lower income	7.1	9.2	0.6	10.1	3.3
Middle income	6.1	6.2	0.6	8.1	10.7
Higher income	5.5	5.1	0.7	5.5	8.7

during weekends. Other factors that might affect mobility and thus have an effect on segregation are the age structure and employment rates in different social groups or neighbourhoods. Although the potential role of these factors can be foreseen, evaluation of their effects will not be possible in this particular piece of research.[11] Paths of occasional access to medical and educational services, leisure activities, and to the locations of five members of each interviewee's personal network were also mapped. The forms of mobility involved were pedestrian movement and private and public transport (see Figure 2).

The first thing to notice is the complex nature of residential location: topography and attraction to landscape features tend to contradict the classic locational principle of spatial economics. For higher-income actors, being near to the sea seems to be preferable to proximity to work, which is mostly concentrated in the CBD (Central Business District, north in figure 1) and areas like Icaraí (south). Lower-income actors are more likely to live either in northern areas or in topographically hazardous areas nearer the CBD, trading risk for proximity to job opportunities and urban facilities. Middle-income actors tend to live dispersed somewhere in between. Lower- and middle-income actors deal with greater average distances—probably a result of the spatial segregation embedded in location and land-value patterns. It is possible that there are contextual differences in these patterns—they may be different from those of North American cities, say—although it also must be added that these general patterns make sense from the perspective of spatial economics—that is, they fit descriptions proposed in classic theories of accessibility, location and land values. Interestingly, the distances covered by pedestrian movement are quite similar. Differences appear in the use of public transport, which increases as income decreases, and in the greater use of private cars typical of higher-income actors (see Table 1).

Different networks converge in the CBD—vehicular movement along longer streets, and a strong mix of pedestrian movement, with broader superimpositions of the routes of low-income and middle-income actors. Workplaces for different groups are nearer. Places for eating and drinking (proportionally fewer for low-income actors), medical services (although not the same for all groups) and bus stops seem to reinforce the overlapping of networks and potential for encounter. Major urban attractors, such as the bus terminal (mostly lower- and middle-income levels) and especially a shopping centre, which in this particular case is really a place of social mixing, play a part in the convergence of groups. Praia Vermelha, the peninsula in the south, shows an interesting overlapping of networks, including shared public spaces through pedestrian movement, with a higher presence of middle-income actors. Places for eating and drinking used by different groups are also close or even the same, as are medical services. Icaraí, the area in the south, shows more segregated routes, with weaker superimpositions. In general, however much class networks are territorially segregated in the residential location, they show an interesting convergence of paths. Points of convergence are reinforced

11 Our empirical method (based on questionnaires) and sample were designed with a very specific aim: to identify the movement patterns of actors taking income as the factor under examination. Due to such focus, we cannot infer roles of factors other than mobility and income with any certainty.

TABLE 2 Overlapping networks: extent and percentage of shared urban trajectories (from total paths)

Income Groups	Trajectories (extent)	Overlapping Trajectories	
		Total	%
All income groups	*2,608.6*	*1,550.0*	*59*
Exclusive paths (performed by a single group)	-	566.9	22
LOWER + MIDDLE income	1,799.8	182.4	10
LOWER + HIGHER income	1,156.6	19.2	2
MIDDLE + HIGHER income	2,260.7	834.1	37

by attractors located nearby, like bus stops and, most of all, places of consumption near the workplace. Public and private vehicular movement is also likely to converge on a few main streets, which creates potential for encounter once actors engage in pedestrian movement. Although these samples do not allow statistical significance, a few illustrative indicators can be drawn as traces of segregation and potential encounter between the groups observed.

1 *Proximity between places appropriated by different social groups*. One hypothesis underlying the idea of latent segregation in routes of physical movement is that proximity would affect the potential for encounter. This was assessed by analysing 121 origins of movement and 2,187 destinations, of which 760 were daily destinations and 1,427 occasional ones (leisure, medical services, friends). We defined the areas of influence of attractors in terms of potential encounter, based on pedestrian movement in a 460m radius from each place, which is roughly the distance a person covers in a 5-minute walk. Sixty-one per cent of these areas contained activities accessed by all income groups, and 9% have activities in the vicinity for middle- and higher-income groups. Proximity is stronger between those with closer income levels—which is a sign of territorial segregation.

2 O*verlapping networks*. The total extent of streets covered by action paths was analysed to verify the extent of potential co-presence of pairs of income groups or all income groups, and the extent of streets covered only by actors of a single group, bearing in mind that observations covered daily and occasional paths and we looked for possible convergences only in these spaces. The superimposition of the three income groups could only be observed in 59% of trajectories mapped—these being the spaces where encounter with socially different actors is more likely; whereas the exclusive presence of a single group was observed in 22% of urban trajectories (see Table 2).

Although the study can only show trends in segregation, potential for encounter can be observed even within the trajectories of a limited number of actors. Lower-income actors display a higher proportion of exclusive paths, indicating signs of residential segregation. Higher-income actors are likely to share more of their paths with other income groups, as they tend to move through more accessible areas and streets, especially near the CBD (see Figure 3). However, middle- and higher-income actors share 37% of total mapped trajectories, whereas lower- and higher-income actors share only 2%. This indicates a strong dynamic segregation between the richer and the poorer. If, on the one hand, the fact that 59% of trajectories were shared by members of all three income groups suggests that the city is a place of potential encounter, on the other hand, the poorer are likely to have segregated urban trajectories and little overlap with higher income groups.

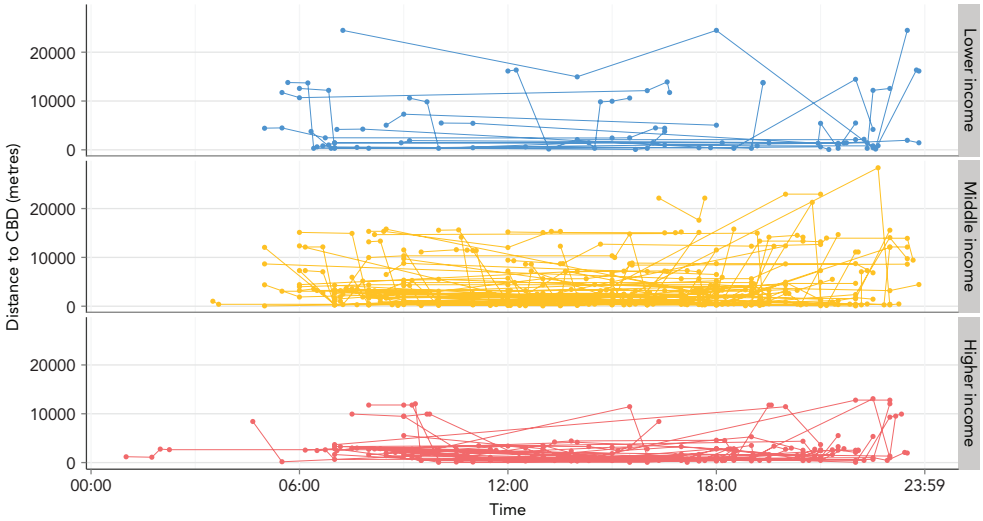

FIGURE 3 Spatio-temporal trajectories of actors with different income levels

3 *Spatiotemporal trajectories of socially different actors*. A final methodological procedure adds a temporal dimension to the analysis of urban trajectories, now seen as action paths. The space–time diagram (see Figure 3) shows potential synchronies and disjunctions in the density of encounters along paths, and helps to identify temporal compatibilities in movement patterns between socially different actors. Most actors begin their day at similar times; their homes are at different distances from the city centre, where they converge and spend a substantial amount of time in nearby locations. Spatial segregation can also be observed: most higher-income actors live and move closer to the CBD. The residential locations of low-income actors vary in relation to the CBD, but their usual places of activity tend to be concentrated in areas up to 3km from the central point. Asynchronies generated by locational differences are somewhat compensated for by the effect of the urban centre on converging co-presence. The intensification of lines indicates patterns of convergence in streets at a similar distance from the CBD, displaying the effect of location on the potential contact of different social groups in time, together with plenty of random factors.

Mobility and social life: some findings

We are now in a position to relate consistencies found in the spatial behaviour of persons in different income groups and the diversity of their social spheres and networks. As we suggested in the introduction to this work, this relation may be stated as a series of hypotheses. Let us look into them and assess our findings.

– Different income groups have different mobility levels and patterns of appropriation of urban space

We assessed mobility in personal urban trajectories using a composed measure of: (1) *extent*; (2) *number of activities* performed during the work day; and (3) *fragmentation*, i.e. the number of street segments used by actors—a property of movement along the street network, also dependent on modes of transport (a high number of segments indicates the use of many spaces, which in turn tends to increase knowledge of the urban structure); (4) *Mobility* takes into account these three factors as a form

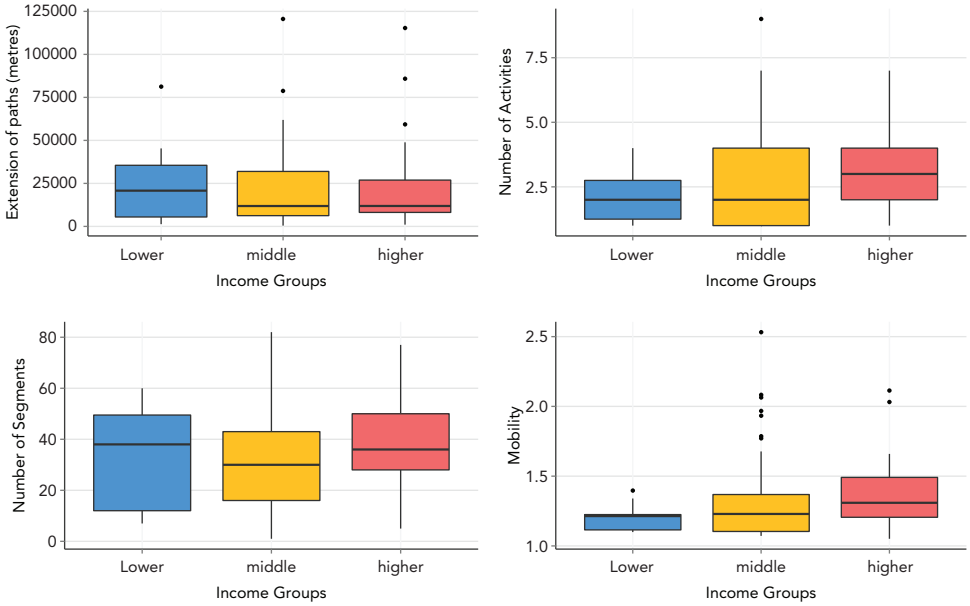

FIGURE 4 Analysis of mobility factors according to income groups

of complexity in the composition of routes and routines. Fragmentation in spatial trajectories is analysed through their linear fractal dimension and Mandelbrot's method (Mandelbrot, 1983).

$$N = r^{1-D}$$

where N is the number of segments, r is the scale factor, and D the fractal dimension.

Trajectories are converted into pixels in different resolutions, considering increasing detail according to scale (the 'Richardson Effect').[12] This method allows us to interpret mobility as a relation between the fractal dimension of trajectories in urban space and the number of activities performed in time.

$$M = D^{A}$$

where M is mobility, D is the fractal dimension and A is the number of activities.

We assessed spatial trajectories according to extent, number of activities, street segments and mobility, and our findings point to consistent differences between income groups (see Figure 4).[13]

12 We opted for a 0.7m pixel and a scaling factor of 5 times (r_{1e}= 0.7, 3.5, 17.5, 87.5, 437.5, 2,187.5). As changes between scales follow a progressive proportion, we added a *proportionality* constant (K) to the equation: $N = K \times r^{1-D}$ interpreted through natural logarithm log N = log K + (1 −D) log r where N is the number of pixels in each resolution scale, r is the scaling factor, and K is the proportionality constant.

13 The box plot graph shows the dimension of data or their spread. The line inside the boxes is the average. The lower the height of the boxes, the more concentrated and similar are the observed intensities. The points above the boxes are discrepancies, i.e. observations very different from the others.

TABLE 3 Diversity in different income groups

Spheres of Sociability	Lower Income %	Middle Income %	Higher Income %
Work	19	17	19
Neighbourhood	41	23	11
Education	8	17	33
Leisure	12	11	6
Family	12	16	13
Friend of a Friend	1	8	10
Religious	1	2	0
Other spheres	6	5	8
Total	100	100	100
Diversity	*1.78*	*1.97*	*1.92*

The trajectories of lower-income actors are greater in extent than those of middle- and higher-income groups. Higher-income people are likely to live closer to work and other daily activities, and to the CBD. The fact that the lower the income, the larger the variation in distances suggests a complex residential location pattern for poorer actors, consistent with the location of *favelas* near the CBD in Niterói. The number of activities composing the daily routine is also telling: the average number increases as income increases. The lower-income group shows a more defined pattern around fewer activities than the other groups. The number of segments also indicates that higher-income actors use proportionally more fragmented routes in the city, probably a result of higher private vehicle ownership and transport spending. The poorer tend to have more linear trajectories, probably due to a higher dependence on public transport (bus) along main, structural streets. Combined, these pieces of information show that higher-income actors are likely to carry on more activities with less effort and make a 'finer-grain' appropriation of the street network. Lower-income actors perform in fewer activity places—and have to cover more ground between them. Finally, the analysis of mobility in personal routes combining previous features of trajectories shows strong differences, which are consistent with income levels, corroborating this first hypothesis.

– Different levels of diversity in personal networks can be associated with different income levels

We assessed the number of spheres of sociability and diversity in the personal networks of interviewees through Shannon information entropy, considering the number of different spheres taken into account and how evenly entities (contacts in personal networks) are distributed amongst spheres. Diversity increases when the number of spheres and evenness increases. Income groups in which spheres are present in equal shares contain the highest diversity

$$Diversity = -\sum_i P_i \ln (P_i)$$

where P is the participation of friends in each sphere over the total of friends, and i is the sphere of sociability within the income group.

Middle- and higher-income actors have higher diversity in their networks than their lower-income equivalents, allowing them more 'amplified' spheres of sociability (see Table 3). It must be noted that the size of our sample and the nature of our inter-

views are not detailed enough to offer a more precise picture. Even so, these findings do not allow us to reject the second hypothesis.

– There is potential influence of mobility in the diversification of sociability for different income groups

The proportional use of the neighbourhood as a sphere of sociality is very strong for lower-income actors—a clear sign of localism (relationships dependent on proximity to home). In turn, the proportion of relationships created in educational activities or through other friends increases with income—spheres of sociability are topologically articulated around places of activity and not by proximity. Results in Niterói converge with those found through other methodologies by Holanda in Brasília and Marques in São Paulo. This finding, along with the higher localism and higher homophily of lower-income actors, suggest signs of a relationship between mobility and social networking capabilities. Probably due to sample size, however, tests of statistical significance show values too low to allow us to either corroborate or reject the third hypothesis.

Conclusion: 'this unknown otherness', or how social differences turn into social segregation

Analysis of the trajectories of the body in urban space seems to reveal segregation in ways that the analysis of segregated territories or residential patterns could not. Our study based on interviews in Niterói, in the metropolitan area of Rio de Janeiro, found associations between mobility and income levels; lower-income actors display higher degrees of localism, middle- and higher-income actors have more diverse personal networks. We observed that lower- and higher-income actors share fewer spaces than lower- and middle-income actors, and middle- and higher-income actors. Restrictions on mobility seem to affect the ability to encounter actors in different social spheres and create a wider range of personal networks. Interestingly, the middle-income group has a complex trajectory pattern, with a higher superimposition level with trajectories of other groups, which coincides with a higher diversity in its personal networks. The diversity in the social spheres of higher-income actors is higher than average, whereas they were found with the highest mobility levels in our sample. Empirical associations between *income, localism and mobility and the superimposition of urban trajectories* suggest a relationship between these factors and social networking capabilities, along with diversity in networks. Findings support the idea that similarities in income and trajectory patterns in contexts with substantial income differences may increase the density of co-presence between socially similar actors, increasing probabilities of personal networks overlapping within *class* networks. By the same token, they suggest that differences in trajectory patterns could prevent encounters between socially different actors and lead to incompatible elements in the formation of personal networks across social classes. Relationships in personal networks are formed through the recurrence of encounters, and networks might emerge more cohesively within social classes than between them.

This study intended to address the complexity of segregation by identifying its highly dynamic form at the level of movement and action paths. It allowed us to observe how social differentiation operating through income has effects on spatial behaviour and the spatiality of potential encounters. Differences in ability to access activities, suppression of places as possibilities of appropriation, and a poor sharing of spaces within the street network and activity places seem to be the raw material conditions for social distancing and the installation of segregation in everyday life. This approach also shows how social experience is therefore fragile. Possibilities for integration *and* segregation are contained within our daily paths. Different forms of mobility add complexity to the condition of 'being right there', meaning that the very possibility of

encounter may be prevented from the outset. Temporal asynchrony leads to disjunction of encounters. This not only means that if people do things at different times of the day they might not meet now or in the future, but also affects the possibility of encountering socially different individuals. Friction induced by greater distances, difficult access to transport and resources for sustaining routines and social relationships and generating new encounters might even push lower-income actors into practising forms of temporal exclusion (see Netto, forthcoming). Urban experience seems indeed to be shaped differently for socially different actors. In unequal social contexts, these differences may lead to the progressive and silent separation of different actors, entailing a systematic absence of otherness. The experience of alterity may collapse within the very workings of everyday life in the city. This subtle and most effective way of engendering the 'invisibility of the other' may well lead to the emergence of different social worlds within a same city. The systematic disjunction of encounters turns social difference into social segregation.

This approach cannot offer a precise 'geography of encounters' in space and time, however. It can only suggest potential spaces where co-presence and encounter between socially different actors are more likely to arise. Also, once there is potential for co-presence, this approach is unable to identify either the actual *experience* of social interaction or the tensions of negotiation or rejection in spaces of inter-class contact (observed as risks of fear and rudeness in public encounters, say) (Holston, 2008). This method does not allow an estimation of actual interaction. Such an aim would require either the mapping of situations of transition from encounter to interaction *post facto*, which was beyond our research aim, or require a statistically significant sample large enough to allow estimates of the rate between interactions and encounters. Our aim at this stage is to address the potential spaces for encounter, assuming that more encounters could increase the potential for interaction, but this is a complex issue which depends on the nature of social situations and the places where they occur. As Goffman (1963) puts it, the transition from co-presence to 'face engagement' and 'mutual accessibility' requires events and places that can offer conditions, as social activities and places fulfil distinct roles in social life. What this approach does identify are the basic material conditions for these experiences to occur. The conditions of encounter can hardly be overestimated: they are also a condition for a broader knowledge of the social world and for an ethical relationship with the other (Levinas, 1998). Social differences can only be naturalized if the possibility of encountering the other is firmly established as a recurring event in daily life.

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