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Mobility Privilege and COVID-19: Determinants of a Spatially Differentiated Experience in the Lockdown-ed Delhi Region

Samuel Benkimoun

Introduction

- 1 A bit more than a year after the first nationwide lockdown was announced in India by the central government, Delhi authorities announced, on April 19, 2021, a second lockdown in the federal capital, as a response to the skyrocketing resurgence of COVID-19 cases. This measure was also resorted to, albeit to a lesser extent, with the institution of a weekend curfew during another rise in cases in January 2022. This repetition of history, combined with the considerable acceleration of research expectations during the current pandemic period, makes it worthwhile to take stock of the first lockdown episode, proclaimed on March 24, 2020, to go into effect the following day, which was already an unprecedented event in the history of the country. Moreover, the growing burden of infectious diseases, fostered by some structural mutations both at the South Asian (Zaidi, Awasthi, and deSilva 2004) and the global levels (Baker et al. 2022), would lead us to assume that similar risks may be faced once again in the near future.
- 2 Limiting interpersonal contact and reducing individual movement were immediately identified as the main ways to contain the pandemic. This quickly raised a major challenge for cities throughout the world. Indeed cities are often considered to be defined by a mode of organization based on the concentration of population and activities, with subsequent networks linking the various functional areas (Berry 1968; Lévy 2000). One could reasonably argue that commuting flows are a core component of the urban experience. Therefore, the complete disruption of these flows that occurred

challenged the general understanding of the city. Mobility networks can be seen as primary sources of social interaction, and hence the agents of the structuring of social life (Kaufmann, Bergman, and Joye 2004). At the same time, they contribute to the blurring of some of the preexisting categories rooted in the spatial binaries of “here” and “there” (Cattan 2012). It is then captivating to observe what surfaced when movement was suddenly curtailed, at least for the most tangible part of it.

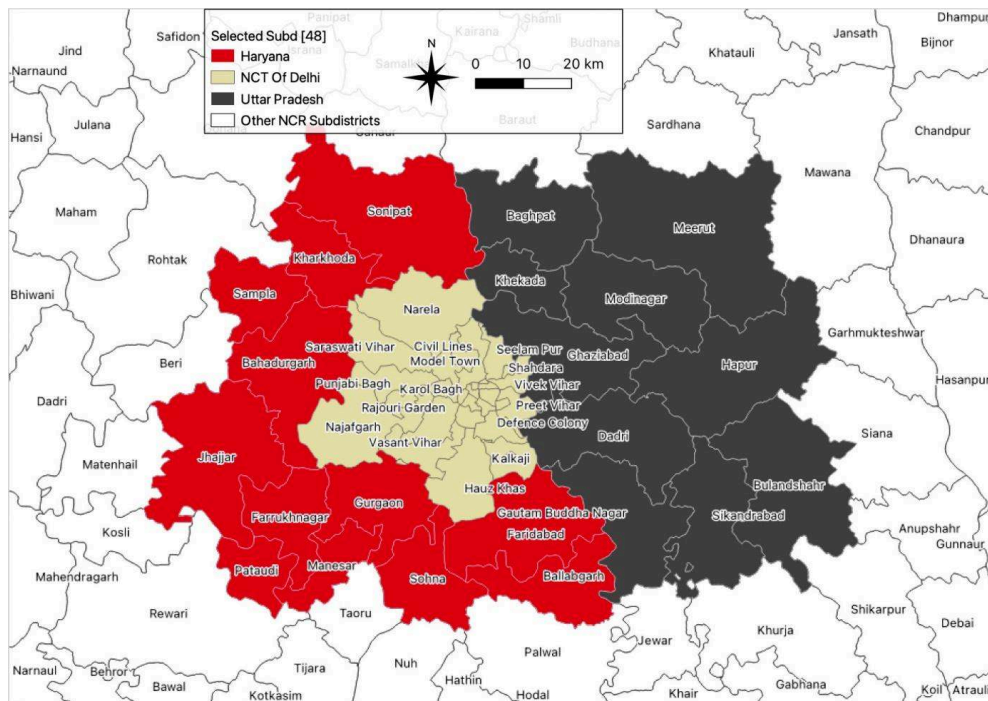
- 3 Mobility and health have typically been related through a causal approach of classical spatial epidemiology, trying to highlight the crucial role of human movement in spreading pathogens (Haggett 1976; Brockmann 2010; Baker et al. 2022). Lesser is said about how mobility can itself be a component of health, if one’s vision of health is not limited to the sole absence or presence of disease. From mortality to morbidity, and then from morbidity to well-being, the understanding of health has evolved through time towards something more encompassing and adaptable (Brüssow 2013). It now implies a more socially and culturally constructed vision of the phenomenon, at least in some research fields (Taïeb, Heidenreich, Baubet, and Moro 2005). The ways in which mobility can be considered a component of human health are multiple. For those who see the healthy individual as able to produce action, motion expresses physical ability. Mobility is also what determines your access to health resources and infrastructures. But above all these different dimensions is the freedom for individuals to implement their own strategies in space, to reach any resources they value, and presumably to ensure their survival. Hence, in the COVID-19 setting, in addition to the lives lost and the global morbidity of the disease, be it directly from the symptoms or the increase in mental health issues or domestic violence for example (Krishnakumar and Verma 2021), the mobility alteration has contributed to this burden, when not directly impacting the expression of the formerly mentioned symptoms.
- 4 A problem that is dear to geography is the one of scale. The virus, as it was circulating from one continent to another, stimulated a kind of global awareness, called for some global action, and countries understandably took inspiration from one another. The virus was said to affect everybody, hence everybody had to undergo the same restrictions, which seemed logical. However, in a new instance of the classical social science puzzle of equality *versus* equity, the hassle that this uniform response to the COVID-19 problem has presented for the poorest classes has been quite blatant (Wasdani and Prasad 2020; de Bercegol, Goreau-Ponceaud, Gowda, and Raj 2020; Venkatasubramanian, Ferry, Guérin, and Govindan 2020; Parulkar 2020). This mainly illustrated the discrepancy between global scale solutions and local contexts (Arabindoo 2020), be it at the national but also regional or neighborhood scale. There is an opportunity here to provide a systematic and quantified approach, investigating a unique sub-urban scale, thanks to the input of geospatial data related to movement in particular.
- 5 Approaches using movement data have bloomed during the COVID-19 period. However, works that manage to reintegrate it into a socio-demographic context in order to explain the effects of containment policies on various strata of the population are scarcer (Pullano et al. 2020; Bonaccorsi et al. 2020; Borkowski, Jążdżewska-Gutta, and Szmelter-Jarosz 2021; Mironowicz, Netsch, and Geppert 2021; Barrios et al. 2021; Garnier, Benetka, Kraemer, and Bansal 2021). Even less numerous are those that take into consideration the countries of the global South (Barbieri 2020; Park 2021; Woskie 2021). Finally, the countrywide scale seems to be favored, with often an

inclination for cross-country comparisons. The detailed study of an urban network as such is rarer, especially within the framework of critical mobility theories. This study aims here at a comprehensive overview of the impact lockdown measures had on urban spaces and networks, how they interacted with existing spatial dynamics (segregation, migration, informality, centrality, etc.) and how it highlighted the unequal nature of mobility.

- 6 The study area focused on here is centered on Delhi and its hinterland, including the localities of the wider metropolitan region. This is another defining aspect of this study’s approach: the focus on the mobility network scale, which appears to be the most coherent one with regard to the functional reality of the city. The issue of mobility and inequalities can then be apprehended with an emphasis on their spatial variation within the local components of the network. This ultimately makes it possible —without minimizing the arduousness of this period for the population as a whole—to observe how seemingly uniform health regulations—that we are not discussing from an epidemiological point of view—designed at the national scale, might result in quite broadly differentiated experiences when being superimposed onto a local tissue of pre-existing disparities.

Geographical context

Figure 1



- 7 Figure 1 gives several elements of context about the way the network is understood here. The exact delimitation of the perimeter was determined by the availability of data on movement, as described further in the paper. A total of 48 sub-districts is covered:
 - 27¹ are part of the Delhi National Capital Territory (NCT), meaning the city of Delhi itself (by administrative definition) and its Union Territory governing body.

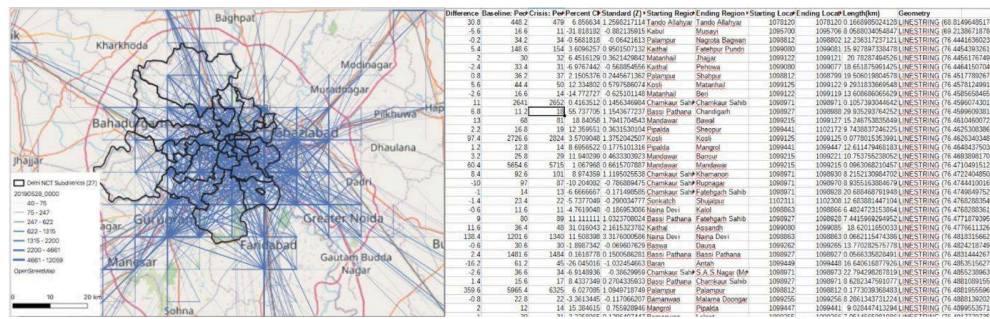
- 21 are part of both the Haryana and Uttar Pradesh states, which are all constituents of what is called the National Capital Region (NCR), which is an even larger planning perimeter that could roughly be defined as the metropolitan area.
- 8 The study area therefore encompasses the central city and its wider region whose estimated population is no less than 35 million inhabitants (NCR Planning Board 2020). It seems crucial to include the peripheral sub-districts, as their economic and demographic importance is characteristic of Delhi's development and sprawl over the past few decades (Jain, Siedentop, Taubenböck, and Namperumal 2013). The administrative perimeter of the NCT has grown more and more disconnected from the demographic and morphological expansion of Delhi (Dupont 2000). Movement data depicts peripheral localities like Gurgaon, Ghaziabad, or Noida—generally referred to as “satellite towns”—as strong hubs in the network, meaning that they polarize a large number of circulation flows. Trivially expressed, they have somehow outpowered localities belonging to the historical center of Delhi. The sub-district administrative level is quite unprecedented in studies of this kind and is likely to provide an interesting range of nuances to the socio-demographic settings of the geographical units. Some even lower administrative levels such as the *ward* do exist, but the Census of India data at this scale is rather limited. More critically, the resolution of the movement data is not granular enough to operate at such a thin scale with precision.

Approach: data and theoretical framework²

Digital measure of movement through the Facebook dataset

- 9 The analysis of mobility—at least for the quantitative aspect—strongly relies on the insights taken from the processing of a massive movement dataset provided by the digital and social media giant, Facebook. It is important to mention that this data is not open access. It was accessed as part of the so-called “Data For Good” framework, wherein Facebook is opening up segments of its data to researchers and Non-Governmental Organizations.³ The agreement was initially made for the study of dengue fever spatiality in Delhi, but came out in the nick of time with the beginning of the COVID-19 crisis, when other main actors in the digital market started to release data of their own as well. This dataset (see Figure 2) contains information on movement captured in near-real-time—every 8 hours, precisely at 5:30 AM, 1:30 PM, and 9:30 PM Indian Standard Time—from users of the social media platform, all above the age of 18 and anonymized, who shared their live location with the mobile application. In short: the dataset provides information about the aggregated number of users who moved from location A to location B. Only the location where the users spent the most time during the 8-hour time period is retained as a reference, to tell if a user has moved or not; and if so, from where to where. Around 550,000 trips were captured per time interval of 8 hours for the study area in pre-COVID times. The spatial resolution of the data may vary, but the one used for this paper is made of a grid with 2 km-sided tiles whose values were reattributed into the sub-districts using the pro-rata of the overlapping surface. This information was also used to create a network graph and compute local centrality indicators (Csárdi and Nepusz 2010) that are interesting to describe geographical units through their position and importance in the network rather than a pre-established reputation.

Figure 2

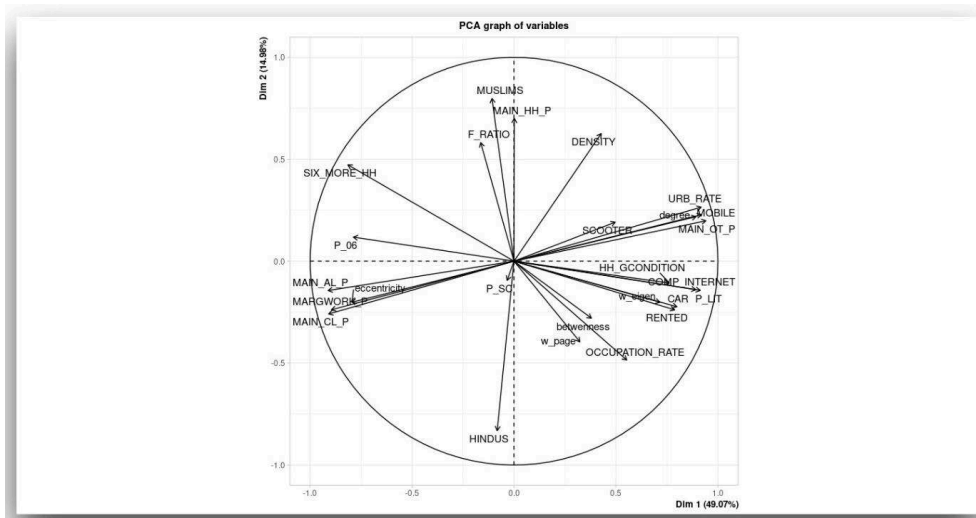


10 Getting accurate data on movement has been a long-time struggle in mobility studies, especially because of cost constraints in collecting it via survey work or empirical observation. The digital boom that has occurred over the past decades, and the emergence of sensors and GPS technology have drastically increased the availability of geospatial data. It is now integrated into the search for solutions to urban problems (Zheng, Capra, Wolfson, and Yang 2014; Louail et al. 2014; Maeda et al. 2019), and to a wider extent to the urban governance itself within the *smart city* paradigm. The sanitary crisis has reinforced this tendency, pushing data integration to a new level with the emergence of numerous online trackers for monitoring the pandemic or state-sponsored contact-tracing apps. But the data cannot be used blindly, and a social dimension must be brought into it in order to avoid the pitfall of digital positivism (Fuchs 2017). A problem that has emerged from the digital revolution in geographical research is the use of spatial data as an epistemology of its own, with subsequent reductionist analysis (Kitchin 2013; Wilson 2018). An attempt to supersede this peril was made by intersecting movement data with socio-demographic qualifiers, relocating the observations in the field of mobility and urban theories, and reflecting on the context of data production.

Intersection with socio-demographic data from the Census

11 One way to contextualize the movement data will be by connecting it to Census of India variables. The latest took place back in 2011,⁴ which is undoubtedly a limitation. Yet from many perspectives, and despite some contestable categorizations (Gill 2007), it remains the most continuous and reliable source of information to investigate India's socio-demographic trends on a thin scale. This amount of information helps to determine—once the movement numbers are aggregated by sub-districts—the variations of post-lockdown movement across social categories and locales. Variables were selected⁵ in accordance with their supposed role on individuals' mobility, and in such a way that no major multicollinearity⁶ would affect the analysis. The correlation circle in Figure 3 projects all the variables having been considered in the models in a 2D plan, and what are the relationships between all of these, leading some to be favored over others. In short: variables whose vectors are pointing towards the same direction tend to be positively correlated with each other, and negatively when pointing in opposite directions. If both vectors form a 90° angle, they are presumably not correlated.

Figure 3



PCA showing the Census variables and centrality indicators at sub-district level for the study area

Mobility theory and disentangling the notions of mobility and movement

- 12 One of this paper’s main objectives is to go beyond the conflation of movement and mobility: these two notions are often used interchangeably, and need to be disentangled. This is no trivial semantic nitpicking, and shall rather make it possible to grasp the unequal nature of mobility, which makes it a privilege, whether it be motion or, less intuitively, stationarity.
- 13 Mobility, as understood here, would consist in being able to choose between moving or not, depending on a set of circumstances, and on the ability to mobilize some means to access some distant resources. It represents the “potentiality to be mobile in space” which can also take the form of an “active renunciation” of physical movement (Kaufmann et al. 2004). Jacques Lévy speaks of mobility as a “competence” to arbitrate between means and non-mobility, interactive or non-interactive, which can be constituted as a capital (Lévy 2000).
- 14 Movement, as a physical transfer from one point to another in space, is then only a component, not mobility in itself which encompasses the whole construction before, during, and after the motion itself (Cresswell 2011; Urry 2012). Larsen and Urry even consider other dimensions of mobility, including objects, information, and ideas, and point out how individual movement can be mediated by the use of certain technologies and modes of communication (Larsen and Urry 2016). It makes sense to consider that nowadays, one can override distance to express his presence in a space of representation with the use of technology, when not commissioning somebody else to move on one’s behalf through the “invisible” workforce behind the transport and delivery systems. Hence virtualization is not a negation of displacement or spatiality, and constitutes an important component of mobility (Cresswell 2006). The command of such mediating devices, and the power induced by a high mobility potential feeds into social hierarchies. In his seminal book “Speed and Politics,” Paul Virilio describes how maintaining populations in a state of constant circulation can serve a domination

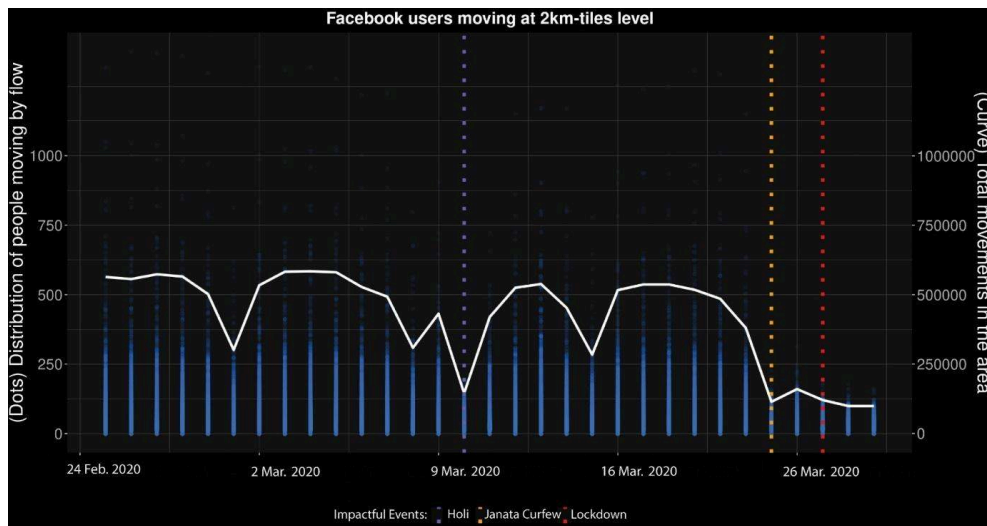
purpose on the part of governing bodies (Virilio 1977). Again this would reinforce the conviction that the degree of constraint that weighs on movement really determines to what extent it contributes to one's mobility.

- 15 An interesting parallel can be drawn with the accepted definition in sociology under the designation "social mobility", which Raymond Boudon (1974) defined as "the differences in social achievement according to social background" and which would also have spatial implications on a way individuals are able to connect with existing networks (Cass, Shove, and Urry 2005). This paper does not elaborate here on the ongoing debate about the contested existence of a "spatial capital" *per se* independent from the other forms (Mace 2015), in a context of the inflation of "capitals" tentatively distinguished by researchers. However, I would certainly locate my understanding of mobility as resulting from a spatial expression of Pierre Bourdieu's distinct forms of capital (Ripoll and Veschambre 2005).
- 16 Leaving aside the scientific literature, a simple definition from the dictionary would also translate that idea with good accuracy. Thus, the "mobility" entry in the Cambridge Dictionary indicates the following: "the ability to move freely or be easily moved,"⁷ where the terms "ability" and "freely" will particularly stand out as the present use case will demonstrate. This brings the consideration that the semantics of mobility already encompass that social dimension. In order to not make this research more jargonistic than needed, it was then decided to keep using the term *mobility* under this general understanding, that will in any case be clarified even further throughout this paper. Nevertheless, it is worth noting that Kauffmann, Bergman, and Joye (2004), borrowing from the natural sciences, coined the use of the term "motility" to express the link between movement and forms of capital, explaining unequal relationships to movement. This terminology can also prove useful for the present analysis.
- 17 If movement is generally connoted positively and associated with freedom, a "liquid" society, the elite's lifestyle, and the power to abolish the "friction of distance" (Costas 2013), stationarity can be as much of a privilege even though not so loudly praised. I argue for the existence of mobile individuals whose territoriality might not require them to physically come out of the house to be manifested. Indeed, the reading of the lockdown situation defended here mainly lies along a line of division between active renunciation to movement for some population fringes on one hand, and compulsion to circulation on the other. This individual arbitration takes place in a context where movement and interpersonal contact were clearly identified as a source of risk, and widely reproved by public opinion. What is at stake, however, is often nothing less than survival by adjusting one's location and maintaining one's income. This stands particularly true in the context of India, where the "work from home" setting, and the flexibility that comes with it, is far from available to all. As this paper will try to showcase, if movement globally decreases due to regulations, mobility remains on the same side through a few mediated forms, and is still a privilege.

Decline in movement: contrasting realities in the Delhi metropolitan area

A global decrease in movement

Figure 4



Evolution of movement in the study area

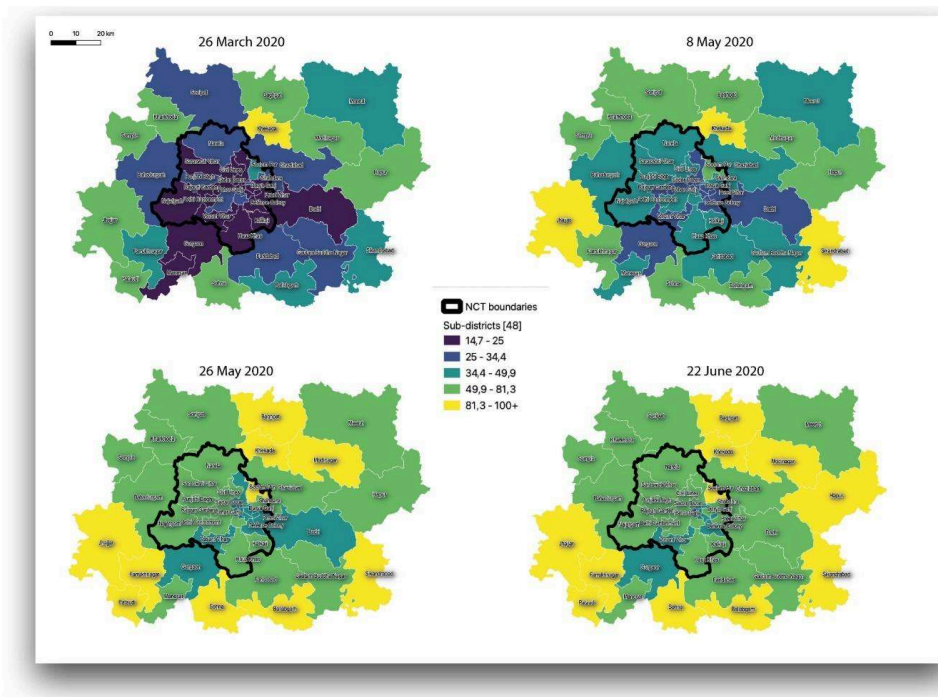
Made with R-ggplot package.

- 18 What the data tells us first in Figure 4, not very surprisingly, is that movement did indeed plummet post-lockdown. However, it can give a precise estimation of the magnitude of the lockdown repercussions on Delhi's circulation networks: from 550,000 observable trips on the weekdays of February 2020, the amount goes down to approximately 100,000 in the days following the lockdown implementation on March 24, 2020. That is to say a drop of roughly 80%. Interestingly, during the weeks preceding the lockdown, clear drops in movement can be observed on Sundays (March 1 and March 15) with a specific pattern on the *Holi* festival long weekend too. This reveals that the kind of movement captured here tends to be predominantly work-related.

Spatial structures of movement decrease

- 19 Mapping the level of outgoing movements by sub-districts (using a pre-lockdown baseline measured in February, see Figure 5), four different dates give pause: one sufficiently close to the lockdown implementation (March 26, 2020) and successive ones a bit further to see the beginning of a recomposition in the movement networks (May 8, 2020; May 26, 2020; and June 22, 2020). Looking at the outgoing movements, the focus is more on "who" is moving, as opposed to the "where," which is better described by incoming movements.⁸ The morning time-slot was judged to be the apt one, better able to describe the movement with a constrained nature, typically linked to a job activity.

Figure 5



Index of outgoing movement by Sub-districts of the Delhi agglomeration for the time slot 5:30 am to 1:30 pm, base 100 for the averaged level of weekdays up to February 2020, in the FB Data For Good dataset. Classification made by Jenks natural breaks method in the first period of time, and kept for the 3 others to see the evolution.

Made with QGIS and AI

- On March 26, it is observable that a sharper decrease occurred in the South Delhi sub-districts, as well as in Noida (Dadri sub-district), Gurgaon, and a few others located in Central Delhi. One interpretation could be that these sub-districts are part of the more privileged areas of the agglomeration, with a higher share of people having regular jobs and resources to work remotely. The Central Delhi areas are also home to many governmental quarters, with most of the public offices remaining closed for the whole period, lesser outgoing trips can be expected.
- On May 8, another interesting trend is that, beyond the global resumption of movement with no unit left under 25%, the process seems much more advanced in the peripheral crown surrounding Delhi. This group of sub-districts, which never drop below 50% of their initial level, have resumed to a level edging 100% in the case of smaller to medium towns like Jhajjar, Pataudi, Sikanderabad or Khekada. In comparison, apart from Seelampur, all the Delhi NCT sub-districts are still under the 50% threshold. The prevalence, among the dwellers, of agricultural work or other activities for which the presence on-site is non-negotiable could explain those higher values found in the peripheral sub-districts.
- On May 26 and June 22, the NCT and its immediate vicinity had decently recovered its level of movement (between 50% and 80%) while sub-districts of the outer belt were already back to a quasi-normal volume (over 80%, and sometimes even over 100%). Contrariwise, Gurgaon, as well as a few exceptions from the NCT such as Vasant Vihar, remain under 35%. Another peculiarity is recognizable within the NCT bounds: sub-districts from the North-East of Delhi (Shahdara, Seelampur, and Seema Puri) display a higher movement index. This could be due to the calibration of the baseline value for outgoing movements at a lower level. Indeed, in late February, prior to the lockdown, the area underwent a dramatic

episode of communal violence targeting Muslim communities,⁹ which must have affected individual propensity to leave the house at that time.¹⁰

Contours of the socio-demographic factors of movement evolution post-lockdown

20 In an endeavor to conjecture on specific mobility patterns with respect to socio-demographic factors, a linear regression model was applied to the movement data. As mentioned earlier, variables were selected keeping in mind to the need to maintain low collinearity in the model¹¹ (see Figure 3). Additionally, the model was optimized to retain a reasonable number of variables (controlling a sufficient number of predictors, but keeping it intelligible for interpretation) and maximize the goodness of fit (in other words, the explanatory force of the model regarding the movement index outcome) using the Akaike Information Criterion¹² (AIC). The coefficients visible in Figure 6 quantify the effect on the dependent variable (the movement index at each of the 4 dates) of an increase of one unit for the concerned variable, all other things being equal. For example, in Table 1, on March 26, an increase of 1 point of the female ratio in a sub-district would result in an increase of 8.4 points in the movement index. The significance of such a relationship is indicated by the p-value, which indicates the probability of the null hypothesis being true. A threshold of 5% or 10% is generally retained in social sciences, hence the coefficients that can be deemed “significant” were left in bold. The main results of the models will be summarized, in an attempt to derive some possible interpretations. With the usual caveat that a correlation does not always mean causation, one will keep in mind that each predictor also embeds some underlying effects that could be explanatory too.

Figure 6

Table 1:		Table 2:	
Dependent variable: 26 March 05:30-1:00 outgoing movements (sub-district level)		Dependent variable: 8 May 2020 05:30-1:00 outgoing movements (sub-district level)	
P.06	1.835 (1.212)	P.06	3.752*** (1.167)
P.SC	-0.471 (0.367)	P.SC	-0.511 (0.351)
MAIN_HH.P	-3.581* (1.899)	MAIN_HH.P	-2.842** (1.096)
RENTED	-0.112 (0.211)	RENTED	0.022 (0.188)
w_eigen	-31.263*** (8.191)	w_eigen	-33.133*** (7.280)
HENDUS	0.056 (0.212)	HENDUS	0.338 (0.189)
F.RATIO	8.408** (3.254)	F.RATIO	9.252*** (2.897)
DENSITY_c	-2.973 (2.391)	DENSITY_c	-1.178 (2.128)
SCOOTER	-0.853** (0.353)	SCOOTER	-0.762** (0.314)
Constant	-212.861** (104.117)	Constant	-280.047*** (107.555)
Observations	48	Observations	48
R ²	0.735	R ²	0.756
Adjusted R ²	0.697	Adjusted R ²	0.728
Residual Std. Error	11.716 (df = 38)	Residual Std. Error	10.427 (df = 38)
F Statistic	13.019*** (df = 9, 38)	F Statistic	16.047*** (df = 9, 38)
Note:	*p<0.1, **p<0.05, ***p<0.01	Note:	*p<0.1, **p<0.05, ***p<0.01
Table 3:		Table 4:	
Dependent variable: 26 May 2020 05:30-1:00 outgoing movements (sub-district level)		Dependent variable: 22 June 2020 05:30-1:00 outgoing movements (sub-district level)	
P.06	3.655** (1.397)	P.06	6.223*** (1.292)
P.SC	-0.606** (0.268)	P.SC	-0.763** (0.353)
MAIN_HH.P	-4.521** (1.885)	MAIN_HH.P	-3.352* (1.857)
RENTED	0.171 (0.213)	RENTED	0.315 (0.286)
w_eigen	-31.213*** (8.340)	w_eigen	-30.872*** (8.610)
HENDUS	0.245 (0.216)	HENDUS	0.248 (0.208)
F.RATIO	8.401** (2.807)	F.RATIO	8.982*** (2.178)
DENSITY_c	3.178 (2.437)	DENSITY_c	2.788 (2.339)
SCOOTER	-0.622* (0.300)	SCOOTER	-0.680* (0.345)
Constant	-302.211** (107.880)	Constant	-448.160*** (108.722)
Observations	48	Observations	48
R ²	0.719	R ²	0.718
Adjusted R ²	0.682	Adjusted R ²	0.682
Residual Std. Error	11.042 (df = 38)	Residual Std. Error	11.458 (df = 38)
F Statistic	10.800*** (df = 9, 38)	F Statistic	10.774*** (df = 9, 38)
Note:	*p<0.1, **p<0.05, ***p<0.01	Note:	*p<0.1, **p<0.05, ***p<0.01

Regression tables on the movement indices at the 4 selected dates

Factors of decrease in movement

- Centrality (“w_eigen,” weighted eigenvector centrality): the centrality¹³ of a sub-district in the urban network seems to be a strong determinant of its ability to adapt to the movement restriction. This indicator is particularly interesting since it is computed from the very recent pre-lockdown movement data, meaning that the study may rely not exclusively on the Census information, dated 2011. It is measured between 0 and 1, and could explain a variation of more than 30% of the movement level between the more central (Gurgaon and Noida’s Dadri sub-district) and the more peripheral sub-district (Khekada and Karkoda). As shown in Figure 3 this variable is indeed very positively correlated with other variables from the Census such as the ratio of households in good condition, literacy, internet equipment, or the share of service employees,¹⁴ which would reflect higher economic stability and ability to access remote resources—basically to remain “mobile” and connected to the networks without necessarily resorting to physical movement. Another aspect is the existence of relocation strategies, from Delhi towards the coveted hill stations, that supposedly highly-mobile privileged classes could implement (Denis et al. 2020). They supposedly had the ability to put to good use their access to information regarding the lockdown decision, due to higher social capital, and their ability to access efficient transportation modes, due to high economic capital, which are core components of mobility.
- Ownership of a two-wheeler (“SCOOTER”): even though to a moderate degree, this predictor operates negatively on movement, in a somewhat counter-intuitive way. In normal times, two-wheeler ownership would probably stimulate your propensity to movement. However, scooters being still costly enough, this indicator could simply be a middle-class marker expressing higher capital and more flexibility to adopt an incentivized stationarity.

- The share of household-industry workers (“MAIN_HH_P”) has a moderately negative impact on captured movement too. In this case, it seems important to have a look at the spatial distribution of the feature. The highest share of household-industry workers is found especially in sub-districts of Old Delhi such as Darya Ganj or Kotwali, and some neighboring units such as Gandhi Nagar, Pahar Ganj, or Sadar Bazar, which remained at a very low level of outgoing movement. Those units also have in common an important Muslim population share, and one can wonder if the hostile climate of communal tensions, latent in Delhi through this period, did not have an impact on the travelling patterns towards the outside (Centre for Study of Society and Secularism 2021).
- The rate of Scheduled Caste (“P_SC”): The caste factor comes to complicate a bit the understanding, and this study is certainly not pretending here to resolve such a complex and debated question. Nonetheless, some attention can be paid to the distribution of the Scheduled Caste (SC) population in the study area to see if some structure emerges. When it comes to SC population ratio, some high figures are found in very central sub-districts such as Karol Bagh (43%), Chanakya Puri (25%) or Parliament Street (24%), which also boast some luxurious housing units and concentrate administrative functions. This reminds us first of all of how heterogeneous Delhi urban space remains (Dupont 2004): even the sub-district scale intertwines some very heterogeneous realities. Beyond that, some hypotheses on the job losses affecting these communities more severely, hence limiting their movements, or the anxiety of tougher repression in such areas of power for whoever was caught on the roads, can hardly be verified within the scope of this study. However, Sriti Ganguly’s study on the marginalized Balmiki settlements of Central Delhi (2019) informs us that these communities, who had initially settled into the area by the British to perform sanitation jobs, have some ties with villages in Haryana and Uttar Pradesh, while newer settlers came from Bihar or West Bengal. The eventuality of temporary relocations or return migration to some remote place of origin could then be put forth, especially as this caste coefficient becomes significant at the two later dates only. This delay could correspond to the time needed to prepare for such travel, involving communities whose mobility is precisely undermined by socio-economic vulnerabilities.

Factors of “lower decrease” in movement

- The share of the younger population (“P_06”): the share of the population between 0 and 6 years old (at the time of the Census, meaning around the 10–15 years-old category in 2020), although out of the scope of the Facebook data, is another element that could differentiate the sub-districts of the study by demographic structure at this point in time. Higher rates are particularly found in the eastern part of the study area, beyond the NCT borders, in peripheral sub-districts of the Uttar Pradesh state. The coefficient of this variable remains positive at all times but grows stronger on the latter two dates. This would tend to confirm: (1) the existence of a specific trend for areas hosting a younger population, which could typically translate into “more mouths to feed” and labor continuity needed (2) relocations of Delhi working classes still connected with their village background in those same areas, who came back with a few weeks of delay, and which would explain why the movement levels are sometimes higher than their pre-lockdown baseline.
- Female ratio (“F_RATIO”): the female ratio has a strong positive impact on the level of movement. One could suppose that women may have lesser access to telework-able jobs or devices of remote access to resources. One must also note that low female ratios (around 44%) are also characteristic of the administrative centers and sub-districts of New Delhi

(Parliament Street, Vasant Vihar, Chanakyapuri, and Delhi Cantonment) which, as described earlier, were the most “responsive” to the travel restrictions. Conversely, some slightly higher ratios (around 48%) are found in peripheral localities like Hapur, Farrukhnagar, or Pataudi. This trend would confirm this dichotomy around the nature of the jobs and movement constraints in the peripheral areas of the metropolitan area, with a possibly heavier burden on female workers.

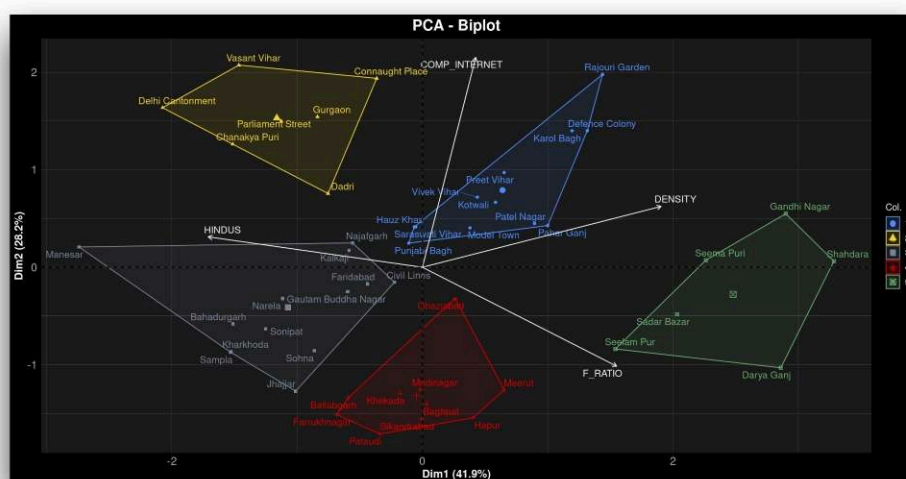
- 21 No clear effect appears for the density, the share of people living on rent, and the share of the Hindu population as per the regression outputs.
- 22 The rural/urban indicators were not included as those categories are still strongly debated in the scientific literature on India (Bhagat 2005, Dupont 2004). A centrality index based on movement flows possibly gives a better idea of spatial hierarchies and connectedness to Delhi’s continuum, as compared to an arbitrary rate of the urban population.
- 23 However imperfect, the variable selection appears to cover a variety of life conditions that readily spark reflection on the various determinants of mobility among social groups.

Heuristic classification for a network approach: population exchanges between sub-district types

- 24 Having had a look at *who* was moving, an interesting perspective was to investigate the *where*, looking at flows between types of spaces. An objective is to comprehend if, after the lockdown was enacted, any kinds of connections were maintained more than others over time, and others disrupted more quickly. The idea is to observe whether some particular spatial fragmentations, opposing certain types of space might have emerged during the episode where “social distancing” was sometimes understood in a bit too much of a literal sense (Rahman 2020).

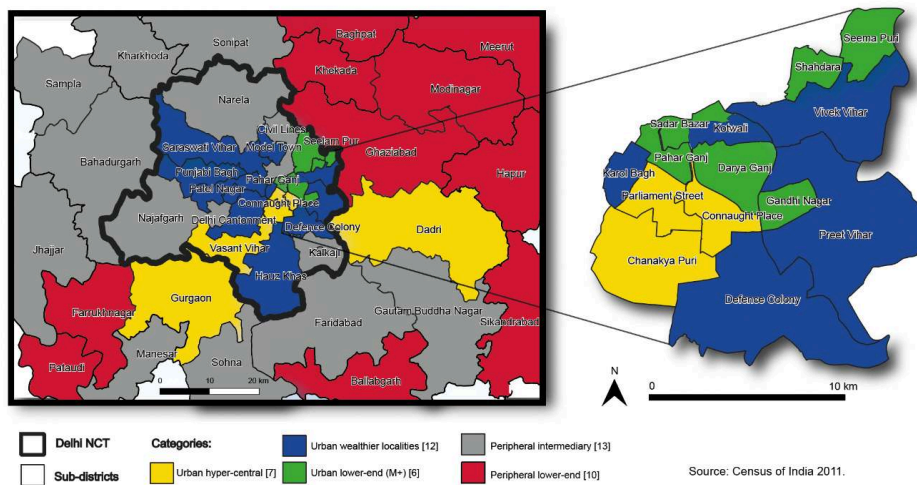
Figure 7

Figure 7. Classification by PCA and k-means method on the sub-districts.



Classification by PCA and k-means method of the sub-districts

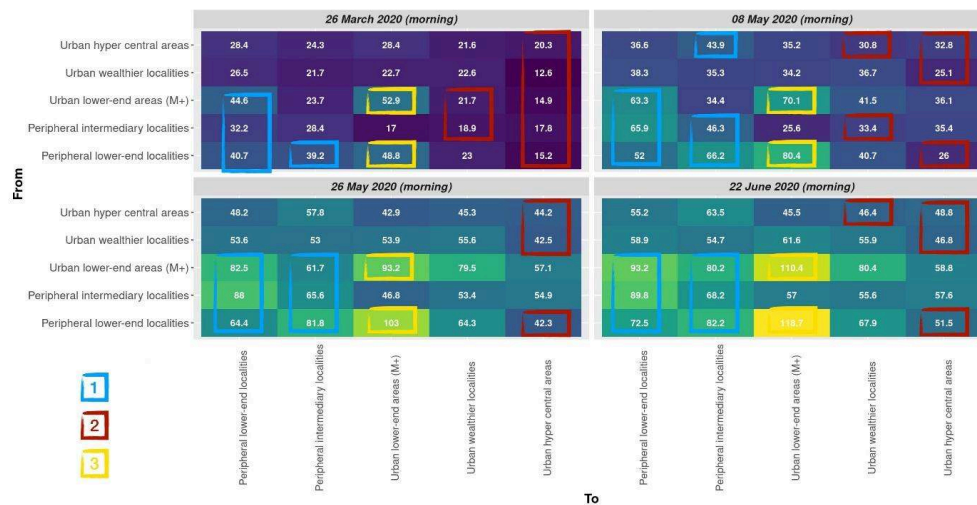
Figure 8



Mapping of sub-district classification

25 Therefore, a classification was performed on the sub-districts, as shown in Figure 7. This classification, largely elaborated in a heuristic manner, offers two advantages: (1) one being readability, by only involving 4 variables, one related to demography (female ratio), one to land occupation (density), one to the economic situation of the households (owning a computer with internet), and one to religion (Hindus). A PCA was performed to locate the sub-districts in a two dimensional space and get a clear reading of how they relate to those indicators. A k-means clustering was then applied to generate 5 classes based on those positions. (2) Secondly, as shown in Figure 8 when mapped (in the geographical space this time), the spatial structure of the classification appears coherent, with identifiable patterns. To make the classification more analytic and comprehensive, it is possible to use the spatiality of each category and combine it with the socio-demographic profile emerging from the data. From here, both peripheral categories can be identified, one with a more economically challenged setting, mostly on the UP side; and one being a bit more affluent and with a higher ratio of Hindus on the Haryana side, biting on the margins of the NCT (probably rather excessively). The New Delhi sub-districts along with Gurgaon and Noida’s Dadri sub-district are also gathered in one central category, surrounded on each side by the relatively wealthy parts of Delhi; the poorer and very dense areas of Delhi, mostly in the North-East, constitute the last group.

Figure 9



- 26 Exchange matrix among categories (expressed in percentage of the pre-lockdown baseline)
- 27 When formalized as an exchange matrix showing the 4 time-steps for the morning slot, oriented by “From” and “To” directions as shown in Figure 9, the population exchange between these groups, still expressed in percentage of their pre-lockdown baseline, offers certain interesting insights. To facilitate the reading of the figure, the three main tendencies which might be identified were framed:

1. *Framed in blue*: a trend that can be observed for the peripheral localities of both categories. We have already highlighted that a higher relative level of outgoing movement was found on the outskirts, leading to the hypothesis of a necessary continuity in non-telework-able activities, and more demographic pressure. Now looking at these categories as destinations, it can be further observed that the flows reactivate faster when among the localities of these two categories. The flows from the central and wealthier categories of Delhi remain at a lower level, with a possible effect of the periodic state border closures that occurred regularly throughout the phases of the pandemic. The flows originating from the more underprivileged neighborhoods of Delhi are certainly high—with the possible under calibration of the baseline evoked in the previous section—, but interestingly higher towards the lower-end localities of Delhi outskirts (mostly located on the Uttar Pradesh side). Proximity, both in terms of distance and social composition of those localities could have favored this faster reactivation.
2. *Framed in red*: a tendency specific to the better-off localities of the Delhi NCT. The category labelled as “hyper central,” meaning sub-districts considered as major commercial/employment hubs, go through a drop in their attractivity and are far less accessed, regardless of where from. This could be interpreted as the result of numerous job losses and office shut downs. The fact that the category called “wealthier localities” (mainly located in the South and West of Delhi) shares, to a certain extent, the same pattern, particularly on the first date (March 26, 2020) might also suggest that those more privileged areas were somehow kept even more isolated than the rest of the network (including from each other). This is supposedly consistent with the visible enhancement of some of the physical arrangements restricting access to upper-end areas of Delhi by outsiders.
3. *Framed in yellow*: the urban lower-end neighborhoods with an important Muslim population. The possibility of an under-calibration, mentioned earlier, would explain some higher percentage values, but the relative analysis remains relevant and unveils how intra-category

trips seem to be privileged. Additionally, the flows from the lower-end peripheral areas are exceptionally high. The localities that are part of Old Delhi represent a significant labor market with many possibilities for unskilled jobs (Dupont 2000). This form of alternative centrality, mainly linked to informality, could be attractive for some populations from the peripheries at a time when economic opportunities are scarce. On the other hand, the flow figures from the hyper central areas remain among the lowest, as along with those from the distant peripheral areas of Haryana.

- 28 While these numbers do not call for any hasty conclusions, they do point to a few dynamics that could be worth investigating more specifically. The centrality that is measured pre-lockdown through movement flows seems to be questioned when areas characterized as “hyper-central” have a starker decline in incoming and outgoing movement than the rest of the area. But is the centrality of those places really contested? Here, a distinction can be made between centrality understood as the accessibility of a place within a network, which seems in this case to have indeed diminished, and centrality understood as the clustering of various kinds of power. Regarding the latter, which somehow relates to the “central place theory” (Mulligan, Partridge, and Carruthers 2012), there is no evidence so far that any durable redistribution occurred. One property of lasting systems is their adaptability. It is fair to believe that, although affluent areas are less occupied, their position of strength is not compromised when it comes to economic, social and political power.
- 29 In that early phase following the lockdown, the figures display what seems to be a preference for proximity. At the Indian scale, there is an observable pattern: the drop in the average travelling distance (Denis et al. 2020). The central place theory states that consumers only travel longer distances for exceptional purchases (Berry and Garrison 1958). The “essential activity” notion that flourished during the pandemic might belong to a shorter range of movement. It is also understandable that proximity, in a time of strong anxiety and devaluation of extensive travelling, could be perceived bestowing comfort. This proximity could be considered from the travelling distance angle, but also from the social angle with a preference for environments that echo one’s markers of identity and provide a feeling of safety. As an example, the Old Delhi area has operated over the past few years as a shelter for Muslim communities who supposedly find a place to express their religious identities more freely and escape discrimination there (Menon 2015). Deriving from the “invisible walls” notion theorized by Guy Di Méo (Di Méo 2011), one can consider that, in addition to the visible arrangements gating some areas, there are also some seclusion and segregation structures that bound communities’ living spaces to some specific areas. The epidemic and its fears might have reinforced those “walls.” Those antagonisms can involve different communities. As an example, North-East Indians, whose presence in Delhi is very localized, also faced social exclusion due to racial stereotypes linking them to the assumed Chinese origins of COVID-19 (E P, Dandub, Senthil, and Kaini 2022).
- 30 Behind the specific lessening of physical movement between some categories in particular, and the strengthening of certain intra-category ties, there could lie a final question. If part is due to genuine practical constraints, could it be that the COVID-19 crisis might indirectly contribute to strategies of further segregation of urban space? With the multiplication of secluding practices in urban space, associated with a “secession” mindset already observed in some elite localities (Zérah 2020), and a rampant climate of suspicion with regard to some targeted segments of the population (CSSS 2021), this question would need to be investigated more thoroughly once we are

all freed from the immediacy of the crisis. A community detection approach could also prove useful to see how clusters of interconnected sub-districts might be recomposed over time.

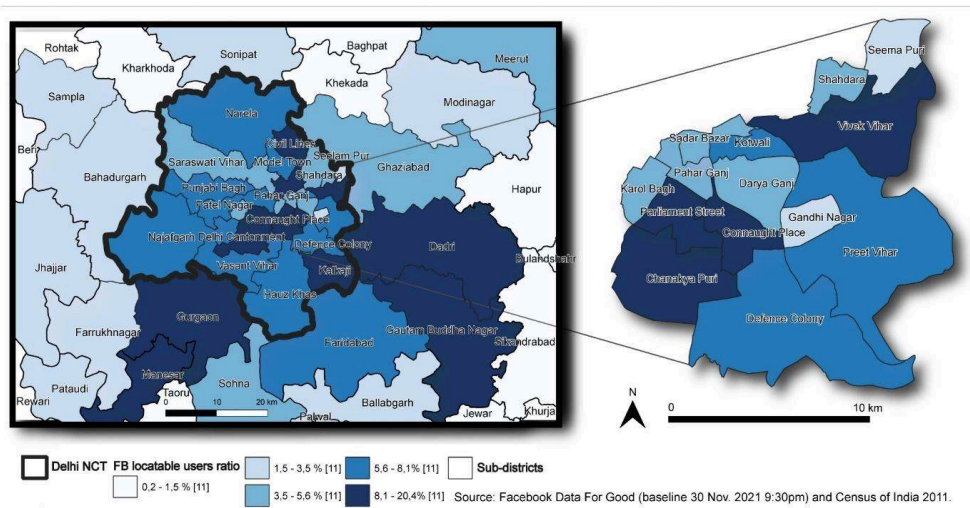
What the data doesn't show: digital blind spots

- 31 The general approach in this paper was to infer patterns of change in mobility regimes across social groups and geographical units. However, because the digital acts here both as a tool to measure these trends, as well as it takes an active part in these same trends when mobilized by individuals to turn away from physical movement, a closer look must be taken at the data and its implications. The picture of the differentiated experience of the lockdown tentatively elaborated has to be supplemented by the recognition of certain limitations of the data, which might fail to capture a part of the storyline.

Digital divide

- 32 India boasts the largest number of Facebook accounts in absolute value among the World countries, with approximately 330 million.¹⁵ But the ratio is only 1 account per 4 inhabitants, which is two times less than in the USA. The context of unequal access to digital technologies and literacy, which directly determines the propensity for individuals to use Facebook is the first aspect. Put briefly, the data is better at describing some segments of the population than others. Despite a boom in access to mobile devices over the past decades, which has enabled even very disadvantaged people to be equipped with mobile phones, the benefit gained by the technology remains affected by the place of residence, or age, class, caste and gender determinants (Doron 2012; Doron and Jeffrey 2013; Arora 2016; Al Dahdah 2017). Use of social media platforms via a mobile phone is also affected by an additional layer of competition between the platforms. Each platform reaches a population with a different social spectrum. It has already been observed, using advertisement data, that Facebook's audience is largely masculine, and that internet equipment, literacy, or per capita GDP were positively affecting the user rates at the state level (Mejova et al. 2018). It appears that, despite a relatively good penetration rate in the Delhi NCT—around 11% of the Census population over 18 years old is locatable¹⁶—, there is a need to map the users' ratios against census categories to get a clear picture and see how the panel of users is socially predisposed. Rather than the morning time-slot, the night slot, starting at 9:30 PM, was opted for this time. This should make it possible to capture people during the night, supposedly at their place of residence, at least for the majority of them.
- 33 As shown in Figure 10, the rate seems to be distributed following a form of center-periphery gradient. The central sub-districts of the NCT and a few adjacent ones (in Gurgaon, Manesar, or Noida) do indeed have some higher ratios as compared to further peripheral zones. The lines of this gap seemingly follow a pattern where sub-districts having a broader male population, a higher number of service jobs, strong car ownership, and a higher density, display a stronger user rate as shown in Figure 11.

Figure 10



Rate of users of Facebook locatable in the Delhi metropolitan area

Figure 11

Table 5:			
	<i>Dependent variable:</i>		
	Facebook users ratio (in%) (sub-district level)		
P 06	0.307		
	(0.352)		
P SC	- 0.056		
	(0.082)		
MAIN HH P	0.381		
	(0.481)		
MAIN OT P	0.107 **		
	(0.041)		
HINDUS	0.045		
	(0.050)		
F RATIO	- 1.334 **		
	(0.654)		
DENSITY	- 0.0001 **		

	(0.00003)		
CAR	0.187 **		
	(0.073)		
Constant	49.994		
	(31.136)		
Observations R2	48 0.622 0.545		
Adjusted R2			
Residual Std. Error F Statistic	(df = 39) 8.025 *** (df = 8; 39)		
Note: *p< 0.1; **p< 0.05; ***p< 0.01			

Regression table on the ratio of Facebook users by sub-districts on a pre-lockdown baseline

- 34 On a univariate basis, rural population, female ratio, elder categories or marginal workers population are on the opposite end, associated with a lower Facebook user rate. Electronic device ownership, or digital literacy in those categories can indeed be questioned, and has already been observed both globally and in the Indian context (Cullen 2001; Singh 2010). These categories are already part of marginalized fringes when it comes to access to certain public services. The perspective of some ever-so “data-driven” health policies that would fail to reach certain parts of the population, be it when capturing the data or when interacting digitally with the beneficiaries of certain schemes and campaigns could then become a concern.
- 35 Coming back to the study, one must acknowledge that, although there is a significant and unprecedented proxy to hand with the Facebook data, a part of the story of the post-lockdown network reorganizations remains untold due to blind spots in representativity. Interestingly, before its ban, the TikTok platform gained some degree of popularity among lower-caste women (Subramanian 2021). WhatsApp remains extremely popular in the country, particularly for familial groups that connect several generations (Williams et al. 2022). This underlines the possible scope for diversifying the representativity of the data by including other social media sources.

The distorted and normative vision of digitized mobility

- 36 A large part of the exacerbation of inequalities following the lockdown, at least the share that is underlined in this paper, is, arguably, due to a distorted conception of mobility.
- 37 The digital apprehension of the phenomenon might contribute significantly to this vision, with an emphasis on the sole movement aspect of the concept, associated with a kind of space positivism that doesn’t really retranscribe the inequalities and struggles rooted in spatial practices.

- 38 A part of this bias occurs in a context where data on movement—including that used in this study—is produced at a global scale by major digital firms. Arbitrary concepts are projected uniformly onto a myriad of local contexts with little consideration for the social determinants and particularities. The massification of the data will tend to shift the focus onto the multiplication of circulation flows and connectivities, and convey the vision of an everso connected world, of an isotropic space with no asperities, while leaving less space to reflect on its ruptures and marginalities. The data that was accessed expresses a position differential between two time slots, and at an aggregated level to boot. It contains no particular information with respect to commuting time, let alone the mode of transportation or the financial cost of the trip, which are important aspects of qualification when addressing mobility. This is a domain where some survey data might remain useful to clarify these travelling patterns.
- 39 There is another normative aspect linked to the granularity of the data. The resolution chosen, 2 km-sided tiles in the present case, also obscures a whole set of smaller movements falling under the threshold of that spatial resolution. These shorter motions also have considerable importance, because they determine access to local resources and neighborhood-level interactions at a time when proximity is once again highly valued. From an epidemiological point of view, they are also what might fuel the community transmission that circulates a disease. However, improving the spatial resolution of such information always brings concerns with respect to the privacy of the populations, not to mention the formidable increase of the size of the datasets, which makes them more difficult to work with.
- 40 This also stands true regarding the temporal resolution and the issue of time slots. The 8 hour difference between each step only leaves room for long trips,¹⁷ which in this case proved useful to focus on job-related movements. But at the same time, this discards plenty of other movements with other kinds of purposes, and even a part of the professional activities such as delivery or transport that are precisely carried out in constant circulation. Additionally, no adaptation is proposed for the timing of these slots, which could have helped capture specific trends. The timings for India are, in fact, the consequence of a capture made at Global Standard Time, to which the +5h30 time difference is applied¹⁸.
- 41 The instantaneity of the observation due to the crisis context also masks the longer-lasting temporalities included in the act of motion. If complex daily commuting cycles, which have been hard to grasp until now, become suddenly visible, one has to keep in mind the other temporalities and ranges of motion. The COVID-19 crisis has highlighted the existence of such movements through the occurrence of certain migrations, be it on the part of urban upper-classes relocating to remote holiday sites in anticipation of the lockdown, or the massive movements of laborers going back to their remote villages, often in chaotic conditions.
- 42 There must be an interplay of spatial and temporal scales in order to get a broader picture of these ramifications, which the limited space/time boundaries of the current dataset can't always account for. This becomes particularly crucial when planning for the repatriation of the migrant populations (Pradhan and Nath 2020). The complete disruption of public means of transportation, which was at times lethal for some people dying of exhaustion walking on the roads, or in stampedes to access the few available trains, might be imputable to a lack of objective knowledge regarding internal migrations. This also raises the problem of the categorization of these populations, and

the lack of flexibility in the census categories that are hardly adaptable to people who are not tied to a single place of residence (Denis and Zérah 2014).

A misrecognition of the mobility privilege

- 43 The recognition of mobility as a privilege, and not as a freely distributed ability to breach the laws of distance, bears some heavy implications. It may seem that the first lockdown in India, notwithstanding the necessity to deal with the epidemic, was implemented in a way that showcased little regard for those disparities.
- 44 Etymologically, mobility implies movement, and in the light of what is described here, it is tempting to speak of an immobility privilege. However, the true nature of the privilege lies in the fact that despite being stationary, movement is still there. One could define this movement as a translation of one's territoriality to another location, which indeed doesn't always imply being physically in motion, but can just as well be mediated through various devices. Because virtual space remains a dimension of space, linked to the others (Arora 2012). It responds to the same problems of presence and absence, of representation, of affirmation of one's territoriality, be it in a conference call, on social media feeds, in government data, on e-commerce and delivery platforms etc.
- 45 Even within its virtual dimension, space remains tamed and handled with greater ease by those who already possess some capital: those who can afford the cost of mediating technologies of information and communication, who possess the skills to use them, who have the proper codes of virtual communication, and overall those who possess a "locational knowledge" (Foresman and Luscombe 2017) that allows them to be aware of their presence in space and adapt their strategies to take greater advantage of it.
- 46 Borrowing the notion of "symbolic capital" from Pierre Bourdieu, one could possibly see a misrecognition of mobility privilege (Mace 2017), with a lockdown mainly designed in accordance with mobile urban classes whose capital grants them a stronger visibility in decision-making spheres. An archetypal vision of a dematerialized society might have, consciously or not, been used as a referential for "normality," while the characteristic informality ruling the survival economy might have, as the term suggests, remained largely absent from formal planning. A similar tendency can be observed in large infrastructural policies that tend to favor the wealthier and highly-educated urban classes (Kennedy et al. 2011). One can even wonder if the trending notion of "resilience," consistently promoted in international organizations (Reghezza-Zitt et al. 2012), or a romanticized version of a certain "culture of chaos," often used to refer to the Indian population, has not been resorted to in order to partly exempt the authorities from further planning.
- 47 Despite various hacks and endeavors, for people on the margins of the accumulation economy, mobility is structurally limited because of a strong dependency on physical circulation, because they have few resources ready to hand and lesser means to travel. But this disadvantage becomes even more pronounced when their particular circulation pattern remains neglected in the space of policy making, but also in the digital space as seen in this paper.

Conclusion

- 48 The study of the first lockdown in Delhi's region discloses the various avatars of a differentiated experience across different social groups. This assessment doesn't come to contradict the terrible time the whole population went through, nor does it take a stance regarding epidemiological factors, but emphasizes those additional damages emerging from the COVID-19 pandemic and questions the applicability of this hurried lockdown.
- 49 The main entry explored here is the one leading to different relations to movement and mediating devices resulting in mobility inequalities at the sub-urban scale. The high economic and social capital of some populations, particularly those located in the urban centers, may have allowed them greater adaptability to the movement constraints. Job stability and technological skills might allow them to maintain a presence, even if it is a virtual one, in the social space. In some cases, accessing information in an efficient way, and travelling with greater ease, they were even able to relocate temporarily to a more comfortable setting. In contrast, the peripheral areas characterized by the persistence of agricultural labor, also showing a younger population, with a higher proportion of women, seem to have needed to keep the movement flows active. One can infer a greater dependency on on-site presence, mainly due to physical labor and no guaranteed continuation in wages, associated with economic precariousness that leaves no flexibility with regard to unpaid leaves. Even though broadly shown by the data, the paper is not suggesting that this center *versus* periphery readout is enough to understand the spatial configuration of this situation. First, informality is present all over the country, and is a factor of vulnerability to such measures anywhere. Second, the internal migrant classes, also present in central areas of Delhi, were put under a lot of pressure when trying to get back to their "original" locations. This effect, possibly echoing caste networks, becomes visible only in a second phase, a few months after the lockdown implementation, showing probable difficulties in getting back. These populations also potentially reinforced the movement volumes observed in some peripheral areas.
- 50 It seems legitimate to think that the pandemic did act as a revealer, but also as a catalyst of pre-existing spatial dynamics. The picture that emerged from the data analysis includes the shadow of spatial fragmentation and segregating practices that might have found an opportune terrain in the sanitary situation. As far as the dataset goes in time, a more positive way of seeing things could suggest that people are reevaluating their relation to proximity and commitment to their surrounding areas at the same time. The whole notion of centrality is also questioned, with former urban hubs being less physically occupied, while their hegemony might remain through virtual and symbolic dimensions. Without making any hasty or peremptory conclusion, of the kind that brought some to announce the death of the cities in the post-COVID era, I would suggest that this demonstration would need to be complemented by long-term observations of the same kind, and with qualitative data that could reflect some ground-based narratives.
- 51 This leads to the comment that digital data remains a land to be conquered for some underprivileged populations. Responsibility also falls to the providers to address the hurdles limiting the accessibility of their platforms. An instrument of governance and power for those who produce and exploit it, the study shows at the same time that a

large and well-structured dataset can also be an impressive proxy to decipher spatial practices. Undeniably a thought provoking tool, with potential for contention of inequalities, it appears that movement data would benefit from improved representativity, particularly for women, rural, aged and overall economically challenged populations.

- 52 The analysis was also constrained by the existing census categories. This in a way limits it to some broad observations on social groups whose existence might owe more to the categorization endeavors of the census, than to an actual ground-based homogeneity. Reflection could be initiated to understand how to increase their plasticity in response to the complex social and spatial intertwinings of Indian society.
- 53 The last outtake of this study is to reassert the need for a critical framework that guides the use of movement data and puts it in perspective. Under no circumstance should data be an end in itself. The endeavor here was two-fold: (1) relocating the raw data into a territorial dimension, by intersecting it with some socio-demographic factors and consideration for local contexts; (2) bringing an encompassing understanding of mobility, that takes into account the diversity of individual trajectories, the different strategies and arbitrations that initiate motion, and the various expressions of territoriality. I am humbly stating, in the continuation of this demonstration, that a better comprehension of mobility and its geographies would significantly help our societies to overcome such a crisis as that of COVID-19. In return, the meticulous study of such crises gives us a sharp and crude reflection of our inhabited landscapes.

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NOTES

1. The administrative division corresponding to the latest available Census of India (2011) was used.
2. The details of the code used for that article: https://github.com/SamuelBenkimoun/R_scripts/blob/master/SAMAJ_paper.R
3. <https://dataforgood.facebook.com/>
4. A new census release was scheduled for 2021, but got delayed because of the pandemic.
5. A set of variables with low collinearity were chosen. Variables are the following, at the sub-district level: P_06 = rate of the population under 6 years old; P_SC = rate of the population belonging to a scheduled caste; MAIN_HH/AL/CL/OT_P = rate of people involved in a household industry / in agriculture / cultivating / being other workers; MARGWORKERS = rate of marginal workers; RENTED = rate of people living on rent; w_eigen = weighted eigenvector centrality, measured through network computation in R; HINDUS/MUSLIMS = rate of Hindus/Muslims in the population; F_RATIO = female ratio in the population; DENSITY_c = the density of population; SCOOTER/CAR/COMP_INTERNET/MOBILE = rate of households equipped with a scooter/ a car/ a computer with internet / a mobile phone; HH_GCONDITION = rate of households in "good" condition; SIX_MORE_HH = households with six or more children; and P_LIT = rate of literacy. $\text{eccentricity/w(eighted)_page/degree/betwenness/w(eighted)_eigen(centrality)} = \text{centrality indicators computed through graph theory implementation on the movement networks.}$
6. Meaning a strong statistical interdependence between variables that may include redundancy, hence disrupting the explanatory power of individual indicators.
7. Cambridge Dictionary. "mobility." Consulted on 4th June 2022 (<https://dictionary.cambridge.org/fr/dictionnaire/anglais/mobility>).
8. The Census data mostly describes the inhabitants' characteristics in the given administrative unit, rather than what resources there are in the unit.
9. <https://thewire.in/communalism/delhi-riots-timeline>
10. The channel of access for the movement data at this resolution around Delhi was only opened from February 26, 2020, leaving us no other choice but to make do with this configuration.
11. We used the VIF (value inflation factor) to measure multicollinearity, with a maximum threshold of 10. <https://www.rdocumentation.org/packages/regclass/versions/1.6/topics/VIF>
12. <https://www.rdocumentation.org/packages/stats/versions/3.6.2/topics/AIC>
13. The eigenvector centrality measures the centrality of a geographic unit with respect to its own weight, and the weight of the other units it is connected with. The weight used here to measure the influence of a unit on the network is the total of incoming movements. https://igraph.org/r/doc/eigen_centrality.html
14. Roughly gathered in the "Other Workers" category of the census which gathers non-agricultural, non-household-industry and non-marginal workers.
15. <https://www.statista.com/statistics/268136/top-15-countries-based-on-number-of-facebook-users/>
16. Given the nearly 10-year gap between the two datasets, this figure is to be taken cautiously. The difference with the national figure of "1 account for 4 inhabitants" can mainly be attributed to people not allowing their phone location to be shared with the Facebook app, or owning more than one account. The dataset measures individual mobile devices.

17. Superior to 4 hours, since the location retained in the data is the one where the majority of the time has been spent during the 8-hour time slot.

18. The three slots are respectively 12:00 AM - 8:00 AM and 4:00 PM.

ABSTRACTS

The singular form that the response to COVID-19 took, namely a general lockdown on the scale of entire countries, combined with the recurrence of this health threat, leads us to draw concrete conclusions from this episode of strict movement restriction in Delhi and its region. To the multitude of works that have dealt with this subject, the present study brings an analysis based on the contribution of massive data from a major social network, Facebook, which informs and quantifies the evolution of population flows before and after the implementation of the containment measures. By analyzing the socio-demographic characteristics of the affected territories, mobility is relocated at the intersection of active renunciation to movement for some high capital populations, and constrained continuation of physical motion for others. This critical framework allows us to define mobility not as a simple synonym of movement, but as a capacity that constitutes the privilege of implementing one's strategies in the various dimensions of space. That privilege was made particularly visible by the crisis, but one can wonder if it has been properly recognized in decision-making spheres. After having articulated hypotheses on the territorial dynamics that fuel those inequalities, this study observes how the circulation networks are rebuilding and questions what can be said about the relations between area types. Finally, a reflection is engaged on the data's blind spots, and on how digitization may also alter, if not distort, the understanding of mobility.

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Keywords: mobility, digital, spatial dynamics, health, Delhi

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