



Reading the changing dynamic of urban social distances during the COVID-19 pandemic via Twitter

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ABSTRACT



The socio-spatial density of cities creates a critical setting for the spread of viral infections. Urban public space provides a ground for people to interact with others outside of their immediate social network. Interaction with weak or absent social ties is critical in the spread of the pandemic, as it represents a connection with strangers. Accordingly, non-pharmaceutical urban measures often aim to limit these interactions as a means for mitigating the spread of COVID-19. This paper explores the effects of these control measures, comparing the mean distances between geotagged tweets within an eight-month timeframe in the city of Kyrenia, Cyprus. Furthermore, the paper questions the lasting effects of these measures on the socio-spatial structure of the city. The results indicate that the mean distance between tweets increases during the full quarantine and goes down immediately after the restrictions are lifted, but it does not reach its pre-pandemic status. The outcome also shows the localisation of activities during the outbreak which necessitates further elaboration on the relationship between newly emerged social norms and urban space.

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Introduction

Cities are fundamentally social constructs that have been continually shaped and reshaped through people's interactions (Jacobs 1961). The field of urban sociology aims at building a framework which addresses the interconnected relationships between social interactions and spatial forms of cities (Simmel 1950a). Social interactions – as one of the quintessential elements of cities – are dynamic forms that might change according to emerging circumstances. The COVID-19 outbreak

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represents a moment in which the spatial forms of social interactions became subject to change. Mitigating the spread of the pandemic by minimising the possibility of unnecessary social interaction was one of the most effective and globally adopted measures. Learning from the COVID-19 outbreak and how it has affected the everyday life of cities is critical, as it provides a framework for potential future outbreaks in a rapidly urbanising world (Acuto 2020).

Non-pharmaceutical preventive measures happen in two often inseparable domains, namely, the state restrictions such as curfew and quarantine, and the self-governing socio-spatial behavioural changes. Both quarantine and social distancing are effective well-tested preventive measures against the spread of viral infections in urban areas (Wilder-Smith and Freedman 2020). While the self-regulating changes in terms of collective behavioural norms can be approached from numerous angles (Bavel et al. 2020), the emerging effects of these changes on urban space require more research for a better understanding of the future of cities after the COVID-19 pandemic (Salama 2020). Viral infections are closely associated with the proximal dimension of social interactions as one needs to come into physical contact with the carrier. Therefore, the structure of people's social networks seems to play a significant role in how the infection spreads through the population (Kuchler et al. 2020). This paper looks at the changing nature of social ties and their proximal properties in relation to urban space. A viral outbreak redefines the role of people, the majority of whom are considered strangers to one another in public space. As one's survival instinct associates strangers with the probability of disease, so might the positive role of the stranger be overlooked due to these extenuating circumstances.

City, pandemic, and social ties

Pandemics have a multidimensional relationship with the structure of cities, affecting the socio-economical (Bell et al. 2009), physical (Martin et al. 2020), socio-cultural (Renzaho 2020), psychological (Cao et al. 2020), and behavioural (Bavel et al. 2020) realms. This study focuses on how the current pandemic affects the socio-spatial network of cities, as this seems to be a critical and often understudied part of the narrative (Salama 2020; van Lent et al. 2017).

The possibility of forming weak social ties is at the foundation of [urban] social networks (Granovetter 1973), and the stranger – as the representation of the 'absent tie' – is the blank node that might form a

weak tie and take part in the flow of information. Weak social ties are critical in the flow of information throughout social networks (Granovetter 1973; Granovetter 1983). Weak ties represent the possibility of interaction with social actors that are outside of one's everyday circles. According to Granovetter (1983), one's weak-tie relations (acquaintances) are less likely to be closely associated with each other. Thus, weak ties present the possibility of communication between smaller social groups consisting of stronger ties. It could be argued that in terms of a viral pandemic in urban areas, weak social ties can potentially become the links that facilitate the spread of viral infections – similar to the flow of information. Block et al. (2020) have shown that reducing one's number of contacts and remaining in one's social bubble can reduce the risk of becoming infected with COVID-19. The public space of a city is the host of weak social ties and absent ties. A weak tie might constitute as a handshake, a nod, a smile of recognition, or a small-talk. Furthermore, even the absent tie does not always constitute an absolute lack of connection (Felder 2020). Citizens might feel a familiarity with one another due to common values and customs. Simply residing in a city establishes invisible bonds with other citizens. Urban public space provides a space for interaction among different factions of society (Gehl 2011). Public space can be considered as a place in which citizens become part of a larger group by interacting with weak and absent ties. In this light, state interventions (like quarantine) are an attempt to minimise the possibility of one's interaction with weak and/or absent ties. These preventative measures aim to restrict the spatiality of urban social networks, which in return, would minimise proximal contact between different groups. It could be argued that identifying and isolating strong ties is not challenging to implement as a preventative measure; however, interaction with strangers adds a degree of randomness that makes it difficult for systematic isolation strategies.

Socio-spatial distance and urban proximity

Social distance has been a part of urban sociological discourse since it was introduced by Hall (1966). These distances represent different levels of comfort zones that people have when interacting with others according to the strength of their relationship. Proximal relations might be affected by significant events, such as the 2020 pandemic, thus rendering new preferences in spatial representations of social networks. For Hall (1963) the extent of these changes in personal space can affect

architecture and urban space. There is a case to be made for the connection between the different distances presented by Hall (1966), and the significance of different ties elaborated by Granovetter (1973); namely, that the intimate and personal distances are often associated with strong ties, social distance with weak ties, and public distance with absent ties. The preventative measures accompanying the COVID-19 pandemic have changed how Proxemics is rendered within the everyday life of the city. The governmental restrictions have tried to minimise interactions by limiting the presence of the public, on the other hand, the new social norms seem to have moved towards the inflation of personal space. The previously potential weak tie has hence become a stranger whom must be avoided as much as possible.

Here, the stranger is not defined by its ignorance towards an established pattern of behaviour, but rather by an emerging pattern that identifies everybody as a potential stranger. The impact of changing patterns in society extends the 'stranger's habitual system of relevance' into the fabric of everyday life, disregarding the weak and some strong social ties (Schuetz 1944). Attraction to strangers – similar to that of weak ties – rests in the new qualities that it imports from outside into a close group (Simmel 1950b). The value of these qualities, in this case, is being undermined by the pandemic, which has pushed for the elimination of unnecessary contact. In urban studies, the stranger can be interpreted both as a weak or absent tie. During a pandemic, the conception of 'stranger' assumes a more negative undertone as that stranger could cause harm to the strong ties which people hold most dear.

Karakayali (2009) recognises five conceptualisations of the stranger, namely as a 'competitor', 'ally', 'symbol of otherness', 'saviour', and 'ambivalent figure'. However, a pandemic could create emerging forms of being a stranger that might constitute itself in different ways. For instance, Jones (2002) has shown how during the Winnipeg influenza epidemic, new social interactions were established that disregarded previous socio-cultural and gender-based norms. On the contrary, fear might reinforce the conception of the stranger as a 'symbol of otherness', as it becomes associated with the possibility of becoming infected. Bigon (2012) argues that the spread of infectious diseases in west Africa has caused segregation and despair. Hoffman (2016) has highlighted the spread of violence under such circumstances. A pandemic can amplify both positive and harmful behaviours in a social network (Bavel et al. 2020). Furthermore, in the information age, the stranger is no longer limited to spatial confines, with social media making the necessity of

presence in urban space non-essential in forming interactions. The resulting interaction with a stranger is, in this case, often similar to real space – by assuming the form of an external observer – and in turn, expands the extent of the socio-spatial urban structure and becomes an emerging part thereof (Terkenli 2005).

Urban public spaces become significant as they are the major container of weak and absent ties, and those ties are critical in the spread of viral diseases that spread via close contact. In an urban setting, low proximity between social actors is a natural side-effect of increasing density in cities, and in return, it seems to be associated with the spread of the pandemic (Stier et al. 2020).¹ In this regard, the urban form has shown to be influential in the spread of COVID-19 in various ways – for example, access to open spaces (Liu 2020). Evidently, the transmission of COVID-19 requires close contact between individuals, hence, it has a strong proximal dimension.

Social distancing

Spatially-connected social networks represent a major way in which a viral disease moves through an urban area. The critical importance of understanding urban socio-spatial distances and how weak ties connect different groups of people comes from the fact that it provides a ground for efficient, quick, and targeted control scenarios (Glass et al. 2006). The importance of weak and absent ties is evident in the role of the Chinese Lunar New Year and how it increased the spread of infection (Chen et al. 2020). Accordingly, the effective policies regarding social distancing come either from changing social norms or from limiting activities in public spaces where the reduction of personal distance is inevitable. Besides the state control measures, social distancing is often an informal and effective form of control as the governing body cannot enforce peoples' distances from each other. However, the state can control the spatial structures that facilitate close social proximities (Acuto 2020). Moreover, urban planning can offer some policies for potential future pandemics; for instance, Liu (2020) has shown that in the areas with more open green parks, the rate of COVID-19 transmission is lower. These types of public spaces provide a natural buffer in which people can practice social distancing. Furthermore, people are

¹However, there is some debate on this as research on the topic is still in its embryonic stage (e.g. Hamidi et al. 2020).

highly motivated by the behaviour of other people in their social network, so informal social distancing as a preventive measure spreads through the network as a new norm (Bavel et al. 2020). It is critical to address the possibility of the lasting effects of these interventions on urban socio-spatial interactions; will urban socio-spatial interactions find a new normal or are the effects of the pandemic merely temporary?

Cases study

The current study uses geotagged Twitter data in the city of Kyrenia in Cyprus to provide a tangible reading about how the distances among citizens have been changed by the COVID-19 pandemic. The usage of geotagged Twitter data has precedent in the literature and has proven to represent an accurate image of urban socio-spatial interactions (Shelton et al. 2015; Arribas-Bel 2014). A previews study in Kyrenia has shown geotagged Twitter data to be a reliable indicator of urban points of interest and social activities (Iranmanesh and Alpar Atun 2020a). Here, the study used a very small section of ‘big data’ which was selected and monitored carefully. The following section explains the process of data collection and the data cleaning process.

Selection of Twitter handles

Citizens’ publicly-shared Twitter activities were monitored for a period of eight months in the city. Tweets were regularly collected from the permanent residence of Kyrenia using the NodeXL platform (Hansen et al. 2010). Data were collected following Twitter’s developer agreement and policy (Twitter 2020). The study followed ethical guidelines set forth by Townsend and Wallace (2016) and Rivers and Lewis (2014). Accordingly, only the publicly-shared data was collected and the Twitter handles remain anonymous in the analysis. The metadata that might have associated the results to individual Twitter handles were removed. Furthermore, the analysis only reported the aggregate of geotagged data to avoid identification of individual tweets. Previews studies have indicated the necessity of defining a set of parameters for the data collection and filtering processes when analysing tweets (Shelton et al. 2015; Lansley and Longley 2016). Accordingly, the study has set four parameters for including Twitter handles in the analysis.

- (1) Only Twitter handles that belong to a non-commercial personal account were selected.
- (2) The user must have had some geotagged metadata intact; this limited the number of potential users drastically as only 1-3% of all tweets include geotagged data (Kumar et al. 2014; Morstatter et al. 2013). Furthermore, despite the increase in the overall number of tweets during the pandemic, the number of geotagged tweets declined over the quarantine period because most of those tweets were tied to the public spaces (via chick-in) that were not functional anymore.
- (3) The study was looking for people who were using the urban public space to some extent, and so here, the handles which were only tweeting from a single residential block were eliminated.
- (4) The study aimed to find people who were actively using Twitter before, during, and after the first stage of quarantine, which further limited the number of potential candidates for the data collection process. In this case, out of 1364 personal handles which were using Twitter and had some geotagged data in the past year within the boundary of the city, only 64 met this condition.

Analysis

The geotagged data was separated onto eight monthly temporal slots. A heat map was produced for each month showing the main hubs of public activities. The heat map was produced using a Kernel Density Estimation with a bandwidth of 400 m (King et al. 2015). The heat map represents the radial density of observed data points on a smooth gradient (Figure 1).

Within the given timeframe, February represents the regular everyday life of the city; Kyrenia's harbour which is the core of its public life can be easily identified. Secondary public cores of the city are also vibrant and visible via geotagged tweets. As the spread of COVID-19 became evident, some measures were taken in early March and all public gatherings and educational activities were suspended on the 10th. The rapid decline of urban public activities is evident here, but the location of the main cores remains the same. April showcases the state of full quarantine. All non-essential shops and services were closed down, and movements were regulated to minimise the spread of COVID-19. Here, the returned tweets from public spaces disappear in most parts, and some local residential centres show more tweets as the residents' movements became

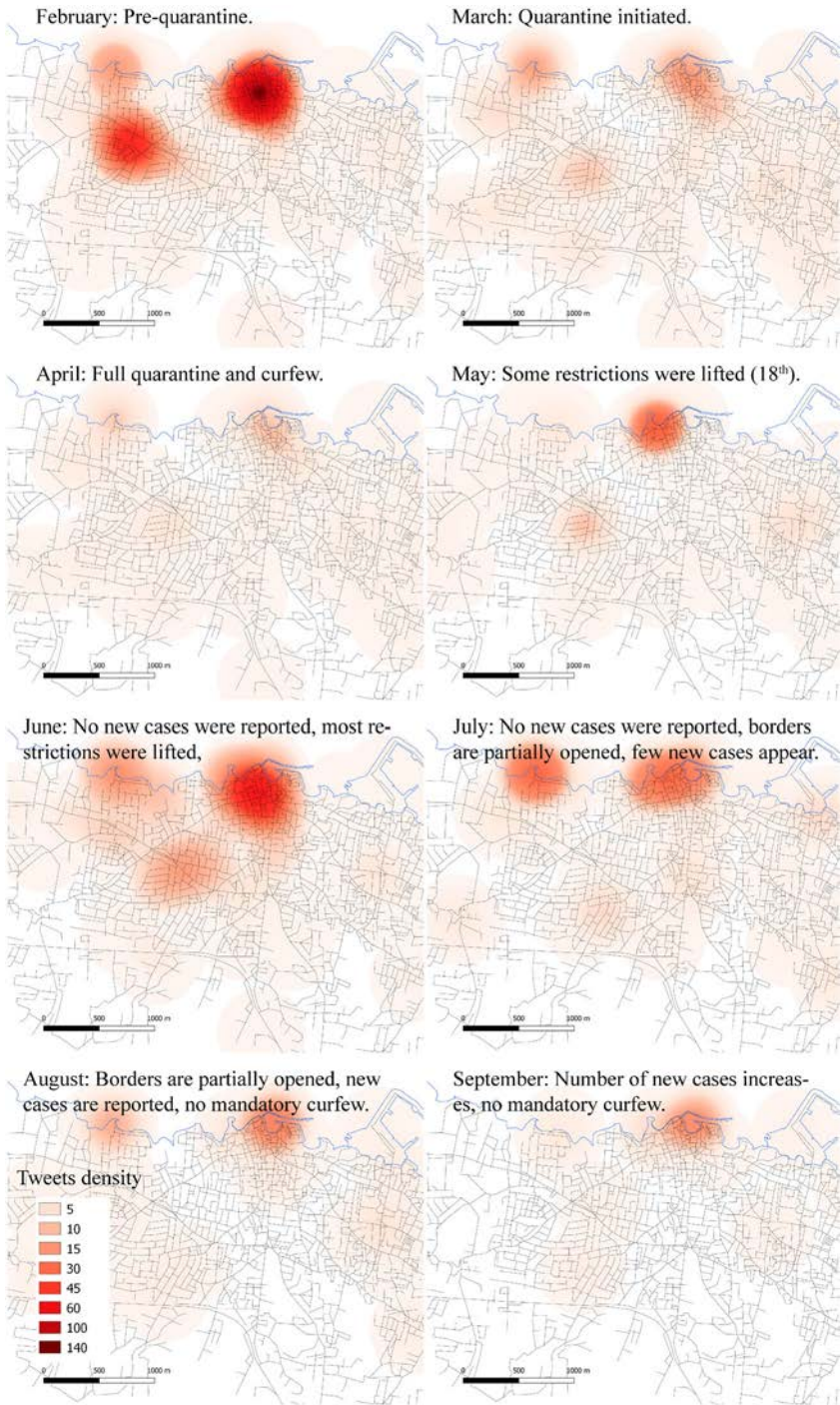


Figure 1. The heat map of observed geotagged tweets over the course of eight months.

Table 1. Predictability of the post-pandemic heat maps and the pre-pandemic month of February.

		Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.
Feb.	Correlation coefficient (R)	0.54**	0.54**	0.40**	0.86**	0.86**	0.44*	0.44*
	Coefficient of determination (R ²)	0.292	0.292	0.167	0.740	0.743	0.198	0.199

**Results are significant at the 0.01 level. *results are significant at the 0.05 level.

more localised. As the number of reported cases decreased and reached zero in May, some of the restrictions were lifted. The heat map shows the return of activities to the main urban cores, but many other localised hubs remained active. As the country became a COVID-free zone in June, most of the restrictions were lifted and the city resumed the majority of its functions. Some restrictions like the usage of masks in public indoor functions and the ban on large public gatherings remained in place. June's heat map shows a 74% similarity with that of February in Kyrenia ($R^2=0.74$). It must be noted that Kyrenia is a tourist hub, and therefore the livelihood of its core had not fully recovered, as the international borders remained closed in June. Although the collected data includes locals and not tourists, many spaces available for public functions in Kyrenia, such as hotel lobbies, are regularly used by the residents of the city as well. Table 1 shows the predictability of the post-pandemic timeslots via the pre-pandemic month of February. The results show that immediately after the borders were partially opened and new cases started to appear, the predictability of geotagged tweets via February dropped to 19% for August and September.

Furthermore, the study measured the mean distance between the observed tweets during the timeframe of the study (Figure 2). The mean value represents the average distance between the geotagged activities of the users and can be utilised as a tool for understanding the dynamics of social distances. Here, the target group is small, due to the strict parameters of the methodology and the data collection process, therefore, the outcomes might display some biases. The results show that the mean distance increased significantly after the quarantine was initiated. This was caused by the elimination of public spaces from the everyday life of the city. In this case, the mean distance between the geotagged tweets increases rapidly starting in March and reaches its maximum in April. The distance starts to come down immediately after the restrictions were lifted and the number of new COVID-19 cases dropped to zero in May and June.² As of June, the mean distance remained slightly higher than where it was in February. Furthermore,



Figure 2. The mean distances between geotagged tweets and the reported number of COVID-19 cases according to the local Ministry of Health.

the study addresses the mean distance in terms of the new COVID-19 cases in the region. The mean distance seems to be in harmony with the number of new cases – albeit with a slight delay. These numbers are reported by the local media and seem to be affecting how people use urban spaces. Nevertheless, as [Figure 2](#) indicates, during the second wave of the virus, the mean distance does not go much higher than the first wave. Two speculations can be made on this. First, people are not as afraid of the pandemic as they were initially and the pandemic is becoming a new normal in everyday life of the city. Second, there is a limit to how much the mean distance can stretch within an urban setting which is directly related to its spatial properties such as density or the distribution of urban amenities.

Discussion and conclusion

Jacobs (1961) described the city as a problem of ‘organized complexity’, where emerging phenomena get adapted into the system until it reaches a new balance. A public health crisis is an emerging layer of complexity that cannot be understood outside the sphere of the built environment (Colomina 2008). Mitigating the effects of public health crises requires emerging innovations that need to address those complexities (Bell et al. 2009). Public space provides the grounds for interaction and the formation of weak and absent ties. It provides spatial opportunities for connection between different parts of the network that are not strongly connected. It is also a platform that makes interaction with strangers

²Data retrieved from the TRNC Ministry of Health, accessed 30th September 2020, <https://saglik.gov.ct.tr/> Haberler

(absent ties) possible. The contact between individuals with weak ties and absent ties is critical in the structural flow of information in the city, and a similar assumption can be made regarding the flow of an infectious disease. Accordingly, non-pharmaceutical measures such as quarantines, curfews, and social distancing all try to minimise the spatial contact between different parts of the social network. The localisation of social interactions in cities could reduce the spread of the viral disease, furthermore, strong local cores provide more practical opportunities for halting the spread of the disease if one local community becomes infected. The practical implementation of this finding emphasises the necessity of providing accessible local amenities for all parts of the city. Similar findings have been reported by Mehta (2020) indicating the critical necessity of local neighbourhood public spaces for having a resilient city that can withstand future similar outbreaks. This approach is not only beneficial for preventing the effects of the pandemic but for the city as a whole because it minimises unnecessary intercity travels while it strengthens the local urban communities. The desire to take part in public spaces of the city is a significant force that might reduce the temporary effects of COVID-19 restrictions.

This study used geotagged Twitter data as a representation of socio-spatial interactions with the city, monitoring the data across an eight-month period in the city of Kyrenia. The results show the direct effect of the non-pharmaceutical measures on the observed mean distance between the socio-spatial geotagged interactions via Twitter. However, although the observed distance starts to decrease as soon as the restrictions are lifted, they do not reach pre-quarantine distance. The distance increased rapidly immediately after the borders were re-opened and new cases of COVID-19 emerged, but the mean distance between geotagged tweets did not increase in relation to the number of newly reported cases. It could be argued that people's fear of the virus has become a less dominant factor and also that they are adapting to the new reality. The findings suggest that the desire to take part in public space is an intrinsic quality that – given enough time – can supersede the restrictions emerged from the COVID-19 pandemic.

Furthermore, it seems that there is a limit to how far these distances can stretch across an urban area. It should be noted that, in general, although the number of interactions via Twitter have increased during the quarantine, the geotagged tweets that represent a spatial connection with urban spaces have decreased (Iranmanesh and Alpar Atun 2020b). Future studies are needed to explore a longer timeframe to produce a

clearer answer regarding the longer-lasting effects – if any – of the COVID-19 pandemic.

The case study was selected on the bases of previous studies showing the reliability of Twitter data in showing socio-spatial interactions in the city of Kyrenia (Iranmanesh and Alpar Atun 2020a). The limited scope of this study cannot provide a reading into the socio-cultural aspects of the distance. For instance, Sjödin et al. (2020) have argued that the socio-cultural differences between Chinese and Italian communities might have had a significant effect on the respective countries' spread and control strategies for the outbreak. Accordingly, the degree in which the finding of this study can be generalised must be approached by taking contextual factors into account. Furthermore, the current study does not indicate that Twitter users are a homogeneous sample of the entire population; moreover, Twitter data, in general, might have intrinsic biases (Stephens and Poorthuis 2015). Nevertheless, Twitter data can provide unprecedented insight into the everyday life of the city when collecting other data types become impractical or unsafe.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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References

- Acuto, M. (2020) 'COVID-19: Lessons for an urban(izing) world', *One Earth* 2(4): 317–319.

- Arribas-Bel, D. (2014) 'Accidental, open and everywhere: emerging data sources for the understanding of cities', *Applied Geography* 49: 45–53.
- Bavel, J. J. V., Baicker, K., Boggio, P. S., Capraro, V., Cichocka, A., Cikara, M., Crockett, M. J., Crum, A. J., Douglas, K. M., Druckman, J. N., Drury, J., Dube, O., Ellemers, N., Finkel, E. J., Fowler, J. H., Gelfand, M., Han, S., Haslam, S. A., Jetten, J., Kitayama, S., Mobbs, D., Napper, L. E., Packer, D. J., Pennycook, G., Peters, E., Petty, R. E., Rand, D. G., Reicher, S. D., Schnall, S., Shariff, A., Skitka, L. J., Smith, S. S., Sunstein, C. R., Tabri, N., Tucker, J. A., Linden, S. v. d., Lange, P. v., Weeden, K. A., Wohl, M. J. A., Zaki, J., Zion, S. R. and Willer, R. (2020) 'Using social and behavioural science to support COVID-19 pandemic response', *Nature Human Behaviour* 4(5): 460–471.
- Bell, D. M., Weisfuse, I. B., Hernandez-Avila, M., del Rio, C., Bustamante, X. and Rodier, G. (2009) 'Pandemic influenza as 21st century urban public health crisis', *Emerging Infectious Diseases* 15(12): 1963–1969.
- Bigon, L. (2012) 'A history of urban planning and infectious diseases: colonial Senegal in the early twentieth century', *Urban Studies Research* 2012: 1–12. doi:10.1155/2012/589758.
- Block, P., Hoffman, M., Raabe, I. J., Dowd, J. B., Rahal, C., Kashyap, R. and Mills, M. C. (2020) 'Social network-based distancing strategies to flatten the COVID-19 curve in a post-lockdown world', *Nature Human Behaviour* 4(6): 588–596.
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J. and Zheng, J. (2020) 'The psychological impact of the COVID-19 epidemic on college students in China', *Psychiatry Research* 287: 112934.
- Chen, S., Yang, J., Yang, W., Wang, C. and Bärnighausen, T. (2020) 'COVID-19 control in China during mass population movements at New Year', *Lancet (London, England)* 395(10226): 764–766.
- Colomina, B. (2008) *Skinless Architecture*, Professur Theorie und Geschichte der modernen Architektur.
- Felder, M. (2020) 'Strong, weak and invisible ties: a relational perspective on urban coexistence', *Sociology* 54(4): 675–692.
- Gehl, J. (2011) *Life Between Buildings: Using Public Space*, Washington, DC: Island press.
- Glass, R., Glass, L., Beyeler, W. and Min, H. (2006) 'Targeted social distancing design for pandemic influenza', *Emerging Infectious Diseases* 12(11): 1671–1681.
- Granovetter, M. (1983) 'The strength of weak ties: a network theory revisited', *Sociological Theory* 1: 201–233.
- Granovetter, M. (1973) 'The strength of weak ties', *American Journal of Sociology* 78(6): 1360–1380.
- Hall, E. T. (1963) 'A system for the notation of proxemic behavior', *American Anthropologist* 65(5): 1003–1026.
- Hall, E. T. (1966) *The Hidden Dimension*, Garden City, NY: Doubleday.
- Hamidi, S., Sabouri, S. and Ewing, R. (2020) 'Does density aggravate the COVID-19 pandemic?', *Journal of the American Planning Association* 86(4): 495–509. doi:10.1080/01944363.2020.1777891.
- Hansen, D., Shneiderman, B. and Smith, M. A. (2010) *Analyzing Social Media Networks with NodeXL: Insights from a Connected World*, Burlington: Morgan Kaufmann.

- Hoffman, D. (2016) 'A crouching village: ebola and the empty gestures of quarantine in Monrovia', *City & Society* 28(2): 246–264.
- Iranmanesh, A. and Alpar Atun, R. (2020a) 'Reading the urban socio-spatial network through space syntax and geo-tagged Twitter data', *Journal of Urban Design* 25(6): 738–757.
- Iranmanesh, A. and Alpar Atun, R. (2020b) 'Restricted spatiality and the inflation of digital space, an urban perspective', *Space and Culture* 23(3): 320–328.
- Jacobs, J. (1961) *The Death and Life of Great American Cities*, New York: Vintage Books, Random hous.
- Jones, E. (2002) 'Contact across a diseased boundary: urban space and social interaction during Winnipeg's influenza epidemic, 1918-1919', *Journal of the Canadian Historical Association/Revue de la Société Historique du Canada* 13(1): 119–139.
- Karakayali, N. (2009) 'Social distance and Affective Orientations', *Sociological Forum* 24(3): 538–562.
- King, T. L., Thornton, L. E., Bentley, R. J., et al. (2015) 'The use of kernel density estimation to examine associations between neighborhood destination intensity and walking and physical activity', *PLoS one* 10(9): 1–16.
- Kuchler, T., Russel, D. and Stroebel, J. (2020) 'The Geographic Spread of COVID-19 Correlates with the Structure of Social Networks as Measured by Facebook', *National Bureau of Economic Research Working Paper Series No. 26990*.
- Kumar, S., Morstatter, F. and Liu, H. (2014) *Twitter Data Analytics*, New York: Springer.
- Lansley, G. and Longley, P. A. (2016) 'The geography of Twitter topics in London', *Computers, Environment and Urban Systems* 58: 85–96.
- Liu, L. (2020) 'Emerging study on the transmission of the Novel Coronavirus (COVID-19) from urban perspective: Evidence from China', *Cities* 103: 102759.
- Martin, M., Deas, I. and Hincks, S. (2020) *Temporary urban solutions help us deal with crisis—and can lead to radical shifts in city space (COVID-19)*. <https://theconversation.com/temporary-urban-solutions-help-us-deal-with-crisis-and-can-lead-to-radical-shifts-in-city-space-135248> [Accessed 20 Apr 2020].
- Mehta, V. (2020) 'The new proxemics: COVID-19, social distancing, and sociable space', *Journal of Urban Design* 25(6): 669–674.
- Morstatter, F., Pfeffer, J., Liu, H., and Carley, K. M. (2013) 'Is the sample good enough? Comparing data from Twitter's streaming API with Twitter's firehose', paper presented at the 7th International AAAI Conference on Weblogs and Social Media, Menlo Park, CA, July 8–11.
- Renzaho, A. (2020) 'The need for the right socio-economic and cultural fit in the COVID-19 Response in sub-Saharan Africa: examining demographic, economic political, health, and socio-cultural differentials in COVID-19 morbidity and mortality', *International Journal of Environmental Research and Public Health* 17(10): 3445.
- Rivers, C. and Lewis, B. (2014) 'Ethical research standards in a world of big data [version 2; peer review: 3 approved with reservations]', *F1000Research* 3(38): 1–15.
- Salama, A. (2020) 'Coronavirus questions that will not go away: interrogating urban and socio-spatial implications of COVID-19 measures [version 1; peer review: 3 approved]', *Emerald Open Research* 2: 1–14.

- Schuetz, A. (1944) 'The stranger: an essay in social psychology', *American Journal of Sociology* 49(6): 499–507.
- Shelton, T., Poorthuis, A. and Zook, M. (2015) 'Social media and the city: Rethinking urban socio-spatial inequality using user-generated geographic information', *Landscape and Urban Planning* 142: 198–211.
- Simmel, G. (1950a) *The Sociology of Georg Simmel*, New York: The Free Press.
- Simmel, G. (1950b) 'The stranger', *The Sociology of Georg Simmel* 402: 408.
- Sjödin, H., Wilder-Smith, A., Osman, S., Farooq, Z. and Rocklöv, J. (2020) 'Only strict quarantine measures can curb the coronavirus disease (COVID-19) outbreak in Italy, 2020', *Eurosurveillance* 25(13): 2000280.
- Stephens, M. and Poorthuis, A. (2015) 'Follow thy neighbor: Connecting the social and the spatial networks on Twitter', *Computers, Environment and Urban Systems* 53: 87–95.
- Stier, A., Berman, M. and Bettencourt, L. (2020) 'COVID-19 attack rate increases with city size', *Mansueto Institute for Urban Innovation Research Paper Forthcoming*.
- Terkenli, T. S. (2005) 'New landscape spatialities: the changing scales of function and symbolism', *Landscape and Urban Planning* 70(1): 165–176.
- Townsend, L. and Wallace, C. (2016) 'Social media research: A guide to ethics', *University of Aberdeen*.
- Twitter (2020) 'Developer Agreement and Policy', Available from: <https://developer.twitter.com/en/developer-terms/agreement-and-policy> [Accessed 15 September].
- van Lent, L. G., Sungur, H., Kunneman, F. A., van de Velde, B. and Das, E. (2017) 'Too far to care? measuring public attention and fear for Ebola using Twitter', *Journal of Medical Internet Research* 19(6): e193.
- Wilder-Smith, A. and Freedman, D. O. (2020) 'Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak', *Journal of Travel Medicine* 27(2): 1–4.