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The neighbourhood

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13. The neighbourhood: where Wilson, Schelling and Hägerstrand meet

Ana Petrović, Maarten van Ham and David Manley

Introduction

There is a longstanding interest in the causes and consequences of socio-spatial inequalities in cities. A large literature has emerged on so-called neighbourhood effects, which seeks to understand how living in neighbourhoods of concentrated poverty affects a range of individual outcomes, such as health, income, education and general wellbeing (Galster, 2012). The literature on neighbourhood effects has developed rapidly in the last three decades. It is now common practice that studies of neighbourhood effects use geocoded longitudinal individual-level data and employ a variety of (often econometric) approaches in an attempt to reduce bias from non-random sorting into neighbourhoods (Knies et al. 2021). Studies of neighbourhood effects have also increasingly looked to incorporate more personal geographic contexts replacing ‘off the shelf’ administrative units with bespoke neighbourhoods (Johnston et al., 2005; Andersson & Malmberg, 2014; Petrović et al. 2022). The most common example of bespoke neighbourhoods are egohoods – neighbourhoods placing everyone at the centre of their own personal residential space (Hipp & Boessen, 2013). More recently, multiscale approaches have been used, whereby neighbourhood characteristics are measured at multiple scales of bespoke neighbourhoods (Petrović et al., 2022). It has been argued that for both theoretical and empirical reasons, the term ‘neighbourhood effects’ should be replaced by the more encompassing term ‘spatial context effects’, as many of the assumed spatial effects are not confined to residential neighbourhoods and the contestable meaning of neighbourhood distracts (Petrović et al. 2019).

Despite the substantial advances that have been made in defining and measuring the spatial context of individuals, we argue that to further our understanding of spatial context effects it is necessary to go much further. Today

multiscale bespoke neighbourhoods, where an individual is in the centre of multiple spatial units at a range of spatial scales (Petrović et al. 2018), represent the most advanced achievement in delineating neighbourhoods. However, such bespoke egohoods are what we term ‘directionally blind’: they are effectively circular entities – buffers – around an individual’s place of residence, for which we calculate a range of socio-economic or demographic characteristics (see also Stülpnagel et al. 2019). We then assume that the socio-economic context of this potential activity space is relevant for a range of individual outcomes in all directions and intensities. However, in reality, the spatial life of an individual is far from circular: some places will be visited frequently while other locations in the circle may never be visited. Of course, it is not just the surroundings of the residential neighbourhood that can be relevant; other daily locations such as the workplace, school or leisure sites may be meaningful spatial contexts which can be taken into account. Finally, neighbourhood characteristics in neighbourhood effects research (regardless of the type of spatial units) are often measured only at one point in time, while the spatial context can change over time.

Within these advances there remain substantial issues that still need to be addressed. For instance, to better understand socio-spatial inequalities it is crucial to understand why people end up in certain neighbourhoods (sorting), and what the effects are of living in different neighbourhood types for individual outcomes (spatial context effects). Measures of spatial context should be multiscale, asymmetric, multidomain and temporal, and to do so brings us to three literatures all addressing socio-spatial inequalities and which we want to build on more explicitly, as they provide insights into the same spatial puzzle. We start with Wilson (1987), one of the founding researchers in the neighbourhood effects literature, and propose extending the conceptual framework to also incorporate the literature evolving from the work of Schelling (1971) and Hägerstrand (1982). Schelling’s contribution here is through the model he developed to understand the dynamics of segregation (Schelling, 1971). His model demonstrates that even when individuals exhibit only mild *homophily* – preference to live among similar people – high levels of urban segregation can result. Hägerstrand’s space-time geography contributes the idea of space-time paths of people, including multiple domains of their life, such as work or leisure (Hägerstrand, 1982).

While each of these strands of literature provides useful insights into socio-spatial inequalities in their own right, together they can help us develop an approach to better understand spatial context effects. We know from literature derived from Schelling’s work that spatial sorting into residential contexts and other sites is important and ongoing, but there is substantial

heterogeneity in the way the sorting process works for different individuals and it cannot be captured by one simple model. Literature inspired by Hägerstrand has provided valuable insight into people's daily and lifetime space-time paths that drive individual differences in sorting, but which largely misses the spatial context effects on individual outcomes. The (quantitative) literature derived from Wilson on neighbourhood effects addresses the effect of space, but is often spatially muted as it does not take into account processes of spatial sorting and multiple activity sites. To better understand the effect of socio-spatial inequalities on people, individual space-time paths need to be put into the framework of *neighbourhood* effects to fully address spatial *context* effects.

Undoubtedly, 'heavy' data approaches provide a future for spatial analysis as more and more data become available which can be geocoded and linked with other data. However, using such rich data needs direction, and therefore it requires a solid foundation in theory. This theory needs to merge different, and at present largely disconnected, strands of literature. Using detailed geocoded data and space-time diaries, spatial analysis needs to move from single-scale neighbourhoods, and further develop multiscale bespoke spatial contexts into 'multidomain, directionally sensitive, bespoke spatial contexts'. The necessary elements to achieve this already exist. This chapter suggests how to merge insights from different fields, to advance our understanding of socio-spatial inequalities and the ways in which the ambient social matters for individuals. We present the neighbourhood where William Julius Wilson, Thomas Schelling and Torsten Hägerstrand meet. The synergy of these classic, but rarely explicitly combined, approaches will lead to establishing a new field of spatial analysis for social inequities (SASI).

State of the art

Much of the literature on urban neighbourhood effects is inspired by Wilson's research (1987) that was ethnographic, longitudinal and experimental in nature. In his approach, Wilson sought to explore the effect of neighbourhood, putting emphasis on the *effect* rather than on the *neighbourhood* itself, with the consequence that 'time' played an important role in his assessment of the impact of place, and time has remained critical in our exploration of exposure to contextual influences. Although the original neighbourhood effects literature used qualitative research methods, quantitative research has become prevalent in the field. The time element of neighbourhood effects is now captured in many studies by using quantitative longitudinal data and approaches. As

geocoded data became more readily available, it became possible to quantitatively model the effect of neighbourhoods on people's lives. But, to do this, we needed to first define neighbourhood. At present, most of the neighbourhood effects research uses existing administrative spatial units to define neighbourhoods, which are often the only (and simplest) option. And because most data only include information on residential neighbourhoods (such as census data or register data), research often focuses on the effects of the residential context only, disregarding other important domains in life such as work and schools (see Park & Kwan, 2018 for an exception). The above-mentioned concept of the egohood arose as a reaction to this use of administrative residential context as the 'default'. To further develop this concept, we argue that the spatial aspects need to be given as much attention as time: if people change places over time, then how we conceptualise place is critical.

If we start from the idea that space is equally important for neighbourhood effects research as time, we can characterise the current literature as taking one of three main approaches to space. The first, and most traditional, approach is to use single-scale administrative units, which often have no suitable alternatives. In many countries, the characteristics of the residential neighbourhood context (from censuses or population registers) are only available for standard geographical reporting units. Therefore, much research on neighbourhood effects uses a single-scale administrative neighbourhood, or two scales of administrative neighbourhoods if those exist in the data, to represent the residential context. Studies of neighbourhood effects increasingly focus on identifying causal effects by controlling for selection bias (see Bauer et al. 2011), but this has often been at the expense of the conceptualisation and operationalisation of space. Specifically, the contextual effects literature assumes that there are causal processes operating at a level (or levels) beyond the individual, but if the level included in an analysis does not correspond with the level(s) of the process then it is possible it will be mis-estimated, conflated with the lowest level present, or missed entirely.

The second approach to space adopts a multiscale approach (Bolster et al., 2007; Andersson & Malmberg, 2014; Petrović et al., 2022). For these studies researchers had access to highly detailed geocoded longitudinal data, which are available in an increasing number of countries and often for full populations. Often the data record people's residential context for each year in the study period and, crucially, this residential context is delineated at multiple spatial scales, or starts from very small spatial building blocks which can be aggregated. These studies therefore have a very detailed approach to space and spatial scale – a huge advantage. A critical contribution of the multiscale approach is that it shows how dramatically an individual spatial context can

change as the spatial scale of analysis changes. For example, as an individual walks just a few hundred metres away from their front door, down their street and into the wider neighbourhood and then city space, the types of people, spaces and groups that they can come across often alter substantially. However, this approach also offers scope for further improvements because it simplifies space in general, ignoring the exact contours of people's specific activity spaces. Multiscale spatial contexts are often represented by circles around a residential location, and even at various spatial scales, this approach is directionally blind. Such an approach does not take into account how people actually use space and when they use it. Operationalisations of egohoods are fundamentally akin to potential activity spaces (Hägerstrand, 1982), which offer little relation with how people actually use urban space. In reality, an individual's actual activity spaces may be more oriented to a specific direction and not equally in all directions – they may exhibit preferences or desires to head in certain directions within the neighbourhood over other directions. Or, there may be social frontiers which they seek to avoid even when they are not visible (Dean et al. 2012). This then impacts our understanding of the context to which people are actually exposed. Furthermore, different people are not equally exposed to all parts of their surroundings, even at the same spatial scale. Instead, people are likely to be more intensively and more often exposed to specific directions of their socio-spatial environment.

The third approach to space explicitly incorporates contextual space from each individual, creating not only bespoke contextual spaces but also individualised neighbourhoods in size, shape and direction. Often, and in contrast to the examples above, these approaches are limited to smaller datasets: they are time-consuming and highly detailed. For example, individuals' bespoke neighbourhoods can be developed by asking a sample of people either to draw their neighbourhood on a map, or to describe their actual activity spaces (see, for example, Coulton, Jennings & Chan, 2013). While this technique of delineating neighbourhoods allows for a more nuanced neighbourhood to be developed beyond that of the administrative unit or the buffer, the collection routines mean it is only possible to apply it on a relatively small sample of people. Individual collection would not be feasible for large-scale population surveys or on full populations, which are needed for detailed research on spatial context effects. However, a large-scale 'big data' approach to generating individualised bespoke neighbourhoods has been explored in the literature by using mobile phone data (see, for example, Ahas et al. 2010). By creating individualised actual activity spaces of people, these studies have also made a move towards including multiple domains (residential, school, work, etc.) of life in spatial context effects research. Moving towards more individualised neighbourhoods also requires researchers to take into account natural and built

boundaries in space, even for larger datasets (Lund, 2018). Such techniques are still in their initial development phases because they require substantial computational power.

All three approaches to space have focused on a specific aspect of making space operational for the study of neighbourhood effects. And while all models have to, by necessity, provide some simplifications of the real world, we are calling on the literature to consider more carefully how to operationalise space in such a way that it best represents actual activity spaces and not potential activity spaces. If the question is to unpick the impact of spatial context on individual life outcomes, then the spatial container into which context is developed and measured is likely to be one of the more important elements to represent in its fullness. The spatial pathways that individuals follow are highly complex and convoluted. Moreover, even when the complexity of residential context is given sufficient attention, a question remains whether this is the only relevant context and how to capture other domains of life and people's activity spaces. Finally, to really make progress, we need individualised spatial context based on real activity spaces, not just for small samples of people but for full populations. For this, we need strong theoretical foundations that require a synergy from different strands of literature, and that needs to go hand in hand with data developments.

Moving forward: the synergy of Wilson, Schelling and Hägerstrand

To fully realise Wilson's ideas around the influence of neighbourhood requires dynamic, multiscale, multidomain and multidirectional operationalisations of spatial contexts, based on the legacies of Torsten Hägerstrand and Thomas Schelling. To us, the approaches of Schelling and Hägerstrand are complementary, together operationalising the neighbourhoods, or better spatial contexts, needed to measure spatial context effects.

In his influential work on the dynamics of segregation, Schelling (1971) used early agent-based models (ABMs), and explained how people's even mild preferences can result in segregated residential patterns. Underlying these models is the idea that individuals prefer to live close to other individuals who are similar, and over time this simple (and often mild) preference can result in high segregation levels which in turn lead to segregated neighbourhood structures. Although the Schelling models are associated with the literature on segregation, his work is perhaps more tightly connected with the neigh-

bourhood effects literature than is acknowledged at present. Schelling was probably the first to construct egohoods: using a checkerboard simulated city, he assumed that the characteristics of the people in the surrounding cells would influence the residential behaviour of the people in the central cell. It has been argued by Sampson (2012) that this non-random residential mobility behaviour of people is, in fact, a neighbourhood effect in itself. Schelling therefore basically used *egohoods* to understand *neighbourhood effects*. In his model this egohood is dynamic as the characteristics of the egohood change as people move around. One's spatial context changes through others' mobility behaviours. And one also influences the spatial context of others through their own mobility behaviour.

The Schelling work on segregation forms an inspiration for the neighbourhood effects literature through the emphasis it placed on the importance of individual residential dynamics in urban space. However, in its original conceptualisation, the Schelling model focuses only on the residential neighbourhood, and does not take into account other domains and individual space-time pathways. What is missing here, then, are the other critical domains of life, such as leisure and work, in a more individual perspective. That can be taken from Hägerstrand's because if we adopt his perspective then egohoods are not circular; they take the form of actual activity spaces.

In the context of the manifesto being put forward here, Hägerstrand's work already is multidomain, which also makes it multiscale, and through the inclusion of the time element (individuals passing through domains and scales throughout the hour, day, week ...) it is also longitudinal (Hägerstrand, 1982). Three defining features of Hägerstrand's work are: individual space-time paths, multidirectionality and multiple domains. These provide three pathways to complement and advance Schelling's work. Firstly, we should relate Schelling's model to the individual residential outcome rather than the composite contextual result. For example, even people from the same ethnic group who may have similar residential preferences in terms of ethnicity still differ in many ways. Secondly, egohoods are multidirectional and asymmetric. And thirdly, egohoods should not be limited to residential space, but also to other domains. Hägerstrand described the space-time paths that people followed, and through the collection of such data it is possible to delineate actual individual activity spaces. These activity spaces include multiple domains of people's life, such as the residential neighbourhood, school, work and leisure. Hägerstrand's domain approach is therefore at the same time multiscale and *multidirectional*, because people's actual activity spaces spread across space at various spatial scales and in various directions. This approach also includes a temporal dimension. Space-time paths include people's daily trajectories,

from home to work and other places, as well as yearly paths, from spending more time in the residential location to travelling to other places.

Combining the multidomain, multiscale and longitudinal elements of Hägerstrand with the urban dynamics of the Schelling model leads to a new approach to making spatial contexts operational. The model would then not only include the individual preference dynamics of segregation at the level of the city and neighbourhoods, generally assuming that people behave in the same way, but it would also include different kinds of individual dynamics – individual differences of people in their family background, residential preferences and structure of their life domains forming their daily and other temporal and spatial paths. The result: the dynamics still exist in space, but they also include the multitude of individual dynamics.

A foundation of the individual dynamic approach is an individual residential biography at multiple scales – a residential history which includes all spatial contexts where an individual lived, including multiple spatial scales around the residential location and the temporal changes of those spatial contexts that occur through the mobility of other people. *One* contextual measure – for example, the share of low-income people in *one's* residential location – can be measured at various spatial scales, from the immediate neighbourhood up to a regional urban context, and all that for multiple years. During those years, the composition of the residential area changes as people move around. Finally, a person may move multiple times over a longer period. Schelling's approach can explain much of the mechanisms behind this. Each of the neighbourhoods where this person lived has changed over time – in different ways at different spatial scales. For example, in the first residential location (neighbourhood) where the person lived, they did not have many low-income neighbours, but after they moved away from home there were more low-income people. In the second neighbourhood, the person had many more low-income neighbours already after walking a few hundred metres from their home, although the large-scale social environment did not change much compared to the first location. This is an example of a spatial residential biography, which includes sorting over time at multiple spatial scales.

Different scales would then represent a simplified version of the nested hierarchy of domains from Hägerstrand's work. If we apply Hägerstrand's approach more precisely, we can use actual activity spaces of people. Activity spaces and different domains of life from Hägerstrand's approach therefore represent the next ingredient of our synergy approach that already contains Schelling's residential egohoods and the dynamics of sorting into them. Various domains of life are tightly connected with different spatial scales, but do not exactly

confine to concentric circles around one's home. Instead, various life domains are expressed in people's space-time paths that can take different directions from an individual's home, forming their actual activity spaces. Activity spaces are rarely symmetric. People's activities are either generally more oriented to a certain direction around their home or specific activities are more oriented to specific directions. Taking this into account would bring the multiscale bespoke neighbourhoods to the next level – directionally sensitive multiscale bespoke contexts.

The spatial residential biography provides an empirical context of the synergy of Schelling's and Hägerstrand's approaches, because it combines sorting in space and over time. Schelling directly speaks about sorting into neighbourhoods. However, he defines a general model that applies to all the people in a city, while residential biographies can take vastly different forms. So, in addition to general models, there are also specific characteristics of people. The result of the synergy of Wilson's, Schelling's and Hägerstrand's work would then result in the multiscale and multidirectional spatial contexts and the corresponding residential biographies.

Future manifesto: spatial analysis for social inequalities

The conceptualisation of space in the neighbourhood effects literature is already advanced. This chapter has proposed the next step – moving from potential activity spaces to actual activity spaces, which can change through mobility dynamics of others. We have sketched a framework for this starting from William Julius Wilson's ideas on neighbourhood effects, and operationalising them with the help of the dynamic, multiscale, multidomain and multidirectional concepts introduced by Torsten Hägerstrand and Thomas Schelling. We emphasised that the literature needs to move towards measuring spatial context effects instead of neighbourhood effects, and needs to take into account both space and time equally.

The existence of multiple domains and multiple spatial scales of residential and other domain contexts suggests that the spatial context of an individual varies greatly over space and time. This variation largely determines the magnitude of spatial context effects. Failing to take this variation into account may significantly distort our understanding of spatial context effects. Space-time relationships will be one of the defining features of the future neighbourhood effects research. Combined approaches of sorting and activity spaces will result in a synergy approach. This theoretical approach can critically improve

the operationalisation of spatial context in neighbourhood effects research. The synergy approach starts from multiscale bespoke neighbourhoods – the most advanced, but still rather simplified conceptualisation of spatial contexts in neighbourhood effects research – and adds more complex space–time relationships. Adding and combining existing theories will bring the concept of bespoke multiscale neighbourhoods forward, so that they evolve into directionally sensitive multiscale bespoke contexts.

Taking into account all the complex space–time relationships, defining and analysing spatial contexts will require data-heavy foundations. This includes individual-level data with both temporal and spatial references. Having started from the initial single scale – the residential neighbourhood – future research will increasingly include multiple spatial contexts. Firstly, this includes *multiple scales* of the residential context. Secondly, it includes *multiple domains*, such as school, work or leisure, and the relevant spatial contexts. In both cases, bespoke neighbourhoods may not only be delineated in their simplest form – a circle, but more advanced spatial units created using GPS (the Global Positioning System) and mobile phones.

An important issue related to new data developments is the question of how to reconcile scientific curiosity and open science on the one hand and ethical norms and privacy on the other. Collecting very detailed data necessary to operationalise the directionally sensitive multiscale bespoke contexts, especially using mobile phones, opens many ethical concerns (de Montjoye et al., 2018). Collecting any data should be led by good scientific goals and transparency. Very sensitive data can justify the fact that they reveal large amounts of information about individuals only if they are collected and used for societal benefits.

The analysis of large and complex data also requires much computational power. In this regard it is crucial that modern technologies and data for spatial analysis get as much attention as theoretical approaches and models. Computational power should be used carefully – processing substantial arrays of data ought not to be the aim in and of itself. Instead, we should always be led by thoughtful considerations of spatial context. Thoughtful considerations start from strong and substantiated theoretical foundations, combining insights from a multitude of disciplines involved. Combining multiple theoretical approaches will also encourage using mixed empirical methods.

Finally, we cannot disregard the term ‘neighbourhood’, but the new spatial analysis for social inequalities (SASI) will give a new meaning to it. The neighbourhood will become an inseparable part of the *multidomain direc-*

tionally sensitive bespoke spatial contexts which will take into account all the complexity of how people end up in specific places and how their exposure to ambient social develops over time and space. Much of these are contained in the neighbourhood where Wilson, Schelling and Hägerstrand meet.

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