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Rethinking Socio-Spatial Context Effects**

Petrovic, Ana; Manley, David; van Ham, Maarten

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Ana Petrović

Delft University of Technology

David Manley

University of Bristol

Maarten van Ham

Delft University of Technology and IZA

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ABSTRACT

Freedom from the Tyranny of Neighbourhood: Rethinking Socio-Spatial Context Effects

Theory behind neighbourhood effects suggests that different geographies and scales affect individual outcomes. We argue that neighbourhood effects research needs to break away from the tyranny of neighbourhood and consider alternative ways to measure the wider socio-spatial context of people, placing individuals at the centre of the approach. We review theoretical and empirical approaches to place and space from a multitude of disciplines and the geographical scopes of neighbourhood effects mechanisms. Ultimately, we suggest ways in which micro-geographic data can be used to operationalise socio-spatial context for neighbourhood effects, where data pragmatism should be supplanted by a theory-driven data exploration.

JEL Classification: I30, J60, P46, R23

Keywords: neighbourhood effects, socio-spatial context, micro-geographic data, bespoke neighbourhoods, spatial scale

Corresponding author:

Ana Petrović
OTB – Research for the Built Environment
Faculty of Architecture and the Built Environment
Delft University of Technology
P.O. Box 5043
2600 GA Delft
The Netherlands
E-mail: a.petrovic@tudelft.nl

1. Introduction

Current research on neighbourhood effects¹ is inconclusive with regard to the strength and importance of the effects, as well as identifying the underlying causal mechanisms (see Van Ham, Manley, Bailey, Simpson, & Maclennan, 2012). The literature often highlights a number of methodological challenges for quantitative neighbourhood effects research, including the non-random selection of people into neighbourhoods and endogeneity of neighbourhood characteristics, which are major obstacles in determining the causal relationships between neighbourhood characteristics and individual outcomes (see Manski, 1993). This paper focusses on another important challenge of research into neighbourhood effects, which has been given surprisingly little attention: the definition of *neighbourhood* (Galster, 2001; Lupton, 2003; Taylor, 2012; Van Ham & Manley, 2012).

Initial investigations into neighbourhood effects focused on ethnographic research, observing life in certain deprived neighbourhoods, and the effects that living in these neighbourhoods had on people and social structures (see, for instance, Wacquant & Wilson, 1989; Wilson, 1987)². However, although the neighbourhood was the starting point of enquiry, the focus was on the socio-spatial structures in local communities rather than the neighbourhood. Since late 1990s and 2000s, with the increasing availability of micro data and computing power, quantitative methods were used in neighbourhood effects research, modelling the effect of living in deprived neighbourhoods on individual outcomes (see, for instance, studies analysing data collected within the Moving to Opportunity (MTO) program, which was conducted in 1990s). Where ethnographic research generally focussed on a specific neighbourhood with a name and local reputation, quantitative research needed geocoded microdata linked to the characteristics of a multitude of local neighbourhoods. As a result, most quantitative studies which link individuals with their neighbourhood use a data-driven definition of neighbourhood, namely the administrative neighbourhood boundaries which are readily available in the data. Administrative neighbourhood, which may not appropriately reflect the residential neighbourhood at all – is often the only aspect of the socio-spatial context of people which is recorded in data. This is no surprise as administrative neighbourhoods are used for the delivery of policy and the collection of data based upon the political and social needs of the state, rather than based on underlying social processes that administrative units are said to delineate (Manley, Flowerdew, & Steel, 2006).

The pragmatism required by quantitative researchers in the adoption of administrative neighbourhoods means that the very nature of quantitative research on neighbourhood effects is to a big extent data-driven, and not driven by theoretical considerations. The single spatial entity cannot adequately capture all relevant characteristics of the socio-spatial context which might influence people (Galster, 2001; Nicotera, 2007; Raudenbush & Sampson, 1999). Yet, we study the effects of neighbourhoods through these entities because administrative neighbourhoods are available in our data. Of course, this problem is not exclusive to neighbourhood effects research: Across the social sciences, complex phenomena have been studied using unrealistic or simplifying assumptions about human behaviour and the urban environment, because of the lack of appropriate data and analytic tools (Kwan, 2000). Indeed a reduction from the complexity of the real world is required in order to say something

¹ Whilst there are a vast variety of definitions for neighbourhood effects, for the purposes of the paper that follows we are assuming that they represent the independent effects of residential neighbourhood characteristics on individual outcomes.

² Although early scholars investigating neighbourhood effects also used quantitative data (Lewis, 1966), this was still an emerging approach in the predominantly anthropological and ethnographic research.

meaningful (Epstein, 2008; Miller & Page, 2009). If we start from theory, it becomes clearer that many assumed causal mechanisms studied under the rubric flag of ‘a neighbourhood effect’ actually reflect effects from a multiple of contexts with different temporal and spatial scopes. Crucially, the residential administrative neighbourhood is only one of these scopes (see Galster, 2012; Sampson, Morenoff, & Gannon-Rowley, 2002 for details on the mechanisms of neighbourhood effects).

The literature finds itself, therefore, at a juncture, and we propose a thought experiment: Rather than being driven by data availability, what if we start with the theory and specify the data required from that perspective? Moreover, since the quantitative research on neighbourhood effects indisputably depends on secondary data, once we have thought through the data requirements, how can research benefit from the increasing availability of micro-geographic data? With the richer spatial data, quantitative studies have started to consider a larger number of spatial scales, which shed new light on multiple spatial contexts which affect people (Andersson & Musterd, 2010). Furthermore, alternative approaches to zonation, particularly in the form of bespoke neighbourhoods (or egohoods), centred around each person, have emerged (Buck, 2001; Johnston et al., 2000; MacAllister et al., 2001; Propper et al., 2005). So far, micro-geographic data have made it possible to move away from fixed administrative neighbourhood boundaries, i.e. discrete partitioning of space, to the bespoke multi-scale spatial contexts (see Andersson & Malmberg, 2014).

Within the context of a thought experiment, this paper discusses how micro-geographic data can be used to operationalise socio-spatial contexts within the theoretical framework of neighbourhood effects. We discuss three conceptual issues, starting with the most fundamental one, namely how place and space have traditionally been conceptualised in different disciplines studying neighbourhood effects. We then focus on theoretical neighbourhood effects mechanisms and their relevant geographies (Galster, 2012). This leads to hypotheses on idealised spatial units for testing specific contextual effects. To operationalise these spatial units, we need to know more about the nature of spatial data and how to use them to explore social processes, which is the third conceptual issue discussed. Building on these three *conceptual issues* (concepts of place and space, geography of neighbourhood effects mechanisms, and the nature of spatial data), the second part of the paper deals with the *operationalisation* of socio-spatial context in quantitative empirical studies of neighbourhood effects. We review selected studies which use different approaches to the geography of neighbourhood effects, ranging from fixed bounded administrative neighbourhoods toward a multi-scale representation of the socio-spatial context (Andersson & Malmberg, 2014; Petrović, van Ham, & Manley, 2018). Ultimately, we discuss how micro-geographic data can further improve the neighbourhood effects research.

2. Modifiable geographies of neighbourhood effects

2.1. Concepts of place and space

Place and space have historically played different roles in research in various disciplines dealing with neighbourhood effects, such as geography, sociology, criminology, economy or health studies. For instance, the study of how place relates to health has integrated knowledge from epidemiology, geography and sociology (see, for instance, Cummins, Curtis, Diez-Roux, & Macintyre, 2007; Curtis & Rees Jones, 1998; Diez-Roux, 1998). The notion of place in health geography reflects the specific social and physical attributes of particular spaces and moves us beyond the Euclidean notion of space as a dimension in which phenomena are

distributed. Therefore, space is *where* the location is, and place is *what* that location is (Tunstall, Shaw, & Dorling, 2004). Debates on place in health geography draw attention to distinct characteristics of places, notably at the small scale, as well as to the relations between the spatial and the social.

The conventional concept of place in health geography distinguishes between context as a measure of social environment and composition as an individual level factor (Pickett & Pearl, 2001). This distinction has advanced the theory of health geography, supporting the relevance of place for individual health and the distinction between individual and contextual level effects (Diez Roux, 2002; Duncan, Jones, & Moon, 1998). The relational approach questions the strict distinction made between place as ‘context’ and people as ‘composition’, because the characteristics of people and the contexts they live in are interrelated (Cummins et al., 2007; Macintyre, Ellaway, & Cummins, 2002). Authors such as Bernard et al. (2007); Curtis and Rees Jones (1998) reference Giddens’ (1984) structuration theory when rethinking place as a specific geographical setting in which social relations take place. The mutual relationship between social structures and people’s behaviour suggests that specific neighbourhood structures could have a strong influence on individuals, but also that an individual’s behaviour contributes to shaping neighbourhood structures (Bernard et al., 2007). This approach, therefore, intensified the importance of the relationship between spatial and social.

The relationship between place and social processes opens the question how to spatially capture those processes, and which tools to propose to operationalise neighbourhoods. Although emphasising social connections, some authors have proposed the neighbourhood as a ‘geographically bound unit’ (Chaskin, 1995). In contrast, others have worked with the neighbourhood as a fuzzy concept not strictly defined as a single spatial entity, based on the relational perspectives to places in human geography. For example, Massey (1994) conceptualises neighbourhood as a set of overlapping social networks, which can have various spatial extents. This contrasts sharply with traditional notions of neighbourhood (place) as a ‘bounded’ area where definition in terms of the placement of boundaries was relatively easy. Because social processes are not strictly bounded in space, neighbourhoods are fuzzy entities (Altman, 1994) which are difficult to define and difficult to operationalise. If deployed correctly, the operationalisation of fuzzy neighbourhoods should take into account social networks and integrate *objectively* measured local area characteristics with *subjective* information gained from the residents in the places being defined.

Besides fuzzy boundaries, another emphasis in views of fuzzy neighbourhood is on *overlapping* areas as opposed to mutually exclusive discrete units. Neighbourhoods imbricate not only because of social, but also organisational, political and economic processes (Logan & Molotch, 2007). The overlapping of community³ boundaries implies that residents do not see the city as divided into mutually exclusive local areas (Hunter, 1974). Within the neighbourhood effects literature, this concept of areas surrounding each individual (or a very small base area), with overlapping boundaries, has been formulised as ‘bespoke neighbourhoods’ or ‘egocentric neighbourhoods’ in the research of voting behaviour (Buck, 2001; Johnston et al., 2000; MacAllister et al., 2001), as well as ‘egohoods’ in the research of criminal behaviour (Hipp & Boessen, 2013). This is an important conceptual turn, given the fact that the investigation into the spatial aspects of crime has a very long tradition, but using non-overlapping units with well (administratively) defined boundaries (Weisburd, Bruinsma,

³ Distinguishing between the terms community and neighbourhood (Hunter, 1974; Sampson, 2004) is not crucial for this work, particularly given the emphasis on the social dimension of neighbourhood, although we acknowledge in other settings the distinction is important.

& Bernasco, 2009). Along with voting and criminal behaviour, the concept of bespoke neighbourhood can be linked with other individual outcomes.

Ever since bespoke neighbourhood have been introduced, their spatial scale has remained an intriguing issue. Crucial for determining which spatial scales are relevant is what aspect of the socio-spatial context we are interested in, because people simultaneously belong to multiple neighbourhoods defined in different ways. The fuzziness of space, therefore, is bi-directional. It arises not only from the overlapping *individual* contexts of multiple people, but also from the fact that individuals may belong to *multiple neighbourhood scales* as well. Different aspects of geographic context and their variation across multiple scales compose the so-called spatial opportunity structure, which depicts reality more truthfully than a single geographic context (Galster & Sharkey, 2017).

Different disciplines are focussed on different spatial scales in different periods: While health geography has focussed on smaller scales from the development of the concept of place, criminology has gradually moved from larger to micro scales. After a long period of studying crime at the regional and city levels in the 19th century (for a historical overview, see Weisburd, Bernasco, & Bruinsma, 2008), mid-20th century Chicago sociologists shifted the analysis of crime to neighbourhoods and communities, particularly by introducing the concept of social disorganisation (see Park, 1967; Thomas, 1966). In the following decades, criminologists remained interested in the role of neighbourhoods and communities in the development of crime (Brantingham & Brantingham, 1981) and specifically the effect of social cohesion within communities (Sampson & Raudenbush, 1999). Theoretical interest continued towards even smaller spatial scales, in other words specific locations within neighbourhoods (Eck & Weisburd, 2015), through the introduction of the ‘routine activities’ perspective (Cohen & Felson, 1979) as well as the ‘crime pattern theory’, where place is explicitly taken into account as a ‘backcloth’ of human behaviour (Brantingham & Brantingham, 1993).

Lupton (2003) has identified three key issues in conceptualising the spatial context in the neighbourhood effects research: the complex relationships between places and people who live in them; the issue of neighbourhood boundaries, and; the relationship of one neighbourhoods to another. While the former two have been illustrated in the discussions above on relational geographies and overlapping areas, the latter can be illustrated by the notion of spatial spillovers. Most neighbourhood effects studies investigate within-neighbourhood effects, or more simply the effect of the neighbourhood in which someone is located on individual outcomes. By contrast spillovers effects between neighbourhoods have, so far, received less attention than the corresponding concept of spillovers in economics (Dietz, 2002). Although the term ‘neighbourhood’ is usually associated with a bounded area, the interest in spillover characteristics of neighbourhoods suggests that the spatial context is much more complex than just an independent coexistence of adjacent neighbourhoods.

In addition to the spatial relationships, another dimension of complexity is the relationship between space and time. Both space and time are multi-scalar, and both are crucial for measuring exposure to context. However, even in disciplines like epidemiology, where place has long been recognised as essential, space-time relations have been underexplored (Auchincloss, Gebreab, Mair, & Diez Roux, 2012). Two main temporal perspectives of exposure to spatial context deserve more attention when studying contextual effects. The first one is the heterogeneity of places which people are exposed to during their daily space-time paths (Hägerstrand, 1970), including the residential, but also school, work and other environments. The second one are ‘spatial times’ (Massey, 2005) which incorporate

influences of different places on an individual during their life-course – a sequence of neighbourhoods which form an individual neighbourhood history (Hedman, Manley, Van Ham, & Östh, 2015). Full understanding of neighbourhood effects should include multiple spatial and temporal domains as well as linkages and interactions between them (see van Ham & Tammaru, 2016 for the domains approach to ethnic segregation). Underlying mechanisms are very diverse, but if we know what mechanism we examine, we can hypothesise about its spatial and temporal scope.

2.2. Mechanisms of neighbourhood effects and their spatial scope

Neighbourhood effects encompass a variety of impacts which an individual's environment may exert on different aspects of personal life course, such as health, education or socio-economic status. Dependent on the outcome under study, some spatial processes and mechanisms may be more relevant and as a result some spatial contexts will be more important than others. Synthesising the multitude of potential processes, Galster (2012) formulated a list of potential mechanisms of neighbourhood effects, grouped in four categories, namely social-interactive, environmental, geographical, and institutional mechanisms.

Social-interactive mechanisms include peer effects on an individual's behaviour and attitudes, local social norms, social networks, through which information are transmitted among neighbours, social cohesion and control, the relations between the residents with different socioeconomic statuses, etc. (Galster, 2012). Because of the requirement for contact and interaction, in the neighbourhood context these mechanisms must have a relatively local aspect, although understanding of social processes usually requires further, mostly qualitative, investigation of their spatial extent. The character of the immediate residential environment depends in many ways on the broader neighbourhood setting within the city. However, we can assume that peer group effects operate at the small spatial scale, such as several streets (Van Ham & Manley, 2012), and that residents feel more socially integrated on their own street block than in locations further away (Taylor & Brower, 1985).

In contrast to the social-interactive mechanisms, which affect people's behaviour, environmental mechanisms directly affect the mental and physical health and include exposure to violence, physical (public space quality, noise, etc.) and ecological (toxic) conditions of environment (Galster, 2012). Spatial scope of exposure to air and water pollutants is perhaps the most difficult to capture and hardly depends on any imposed boundaries. Particularly in large cities, the focus of investigating health impacts shifts from neighbourhood to city or even regional dimensions of air and water pollution, so that environmental burdens are increasingly displaced to greater scales (Sorensen & Okata, 2011). Indeed, with examples such as pollution accruing from ground water contamination, the flows under the ground may impact in a diverse set of locations. Conversely, the impact of contaminated land, often a factor in brown field building, may be highly localised and specific.

Geographic mechanisms refer to the neighbourhood's location relative to larger-scale political and economic structures rather than to the neighbourhood itself, and include spatial mismatch of neighbourhood residents on the one side and job opportunities on the other, as well as public services offered by local political jurisdictions (Galster, 2012). Macro-geographical context of neighbourhood, therefore, matters, but its actual spatial scale depends on the specific setting, e.g. urban form and the position of cities in regional and national structures. For example, spatial mismatch of jobs and workers was originally identified as an important

factor of unemployment of African-Americans (Kain, 1968). Although most authors used the spatial mismatch hypothesis to explain racial differences in unemployment in the United States (Holzer, 1991; Ihlanfeldt & Sjoquist, 1998), physical proximity to jobs is relevant in the European labour markets as well (Dujardin & Goffette-Nagot, 2005; Gobillon, Magnac, & Selod, 2011; Van Ham, Hooimeijer, & Mulder, 2001), but local conditions will determine the spatial scale of the mismatch in labour markets. Although useful assumptions can be made regarding the geographical scope of specific neighbourhood effect mechanisms, the scale at which they operate may vary between places as well as over time, and the same mechanism may operate at different scales in different geographical contexts (Manley et al., 2006; Van Ham & Manley, 2012).

Finally, institutional mechanisms involve actions by those typically not residing in the neighbourhood, but who nevertheless control important institutional resources located there. This group of mechanisms also includes following points of interface between neighbourhood residents and vital markets: stigmatization, physical conditions in the neighbourhood, local educational, healthcare and other institutions to which residents have access, and local market actors (Galster, 2012). Neighbourhood reputation and stigmatization is usually associated with well-known or even officially defined neighbourhoods, or areas with specific types of housing or ethnic background of residents. Other mechanisms, not only institutional, which relate to access or exposure to people, resources, or harms, can be better served by bespoke measures of neighbourhood characteristics rather than by officially defined neighbourhood boundaries.

Bespoke measures of neighbourhood characteristics are also supported by the argument that the response to neighbourhood effects differ for specific demographic or socioeconomic groups (Bernard et al., 2007; Chaskin, 1997; Galster, 2012; Small & Feldman, 2012). These groups may have different activity spaces (Dijst, 1999; Kwan, 1999) and different relations to the neighbourhood during their life course (Ellen & Turner, 1997; Forrest & Kearns, 2001; Lupton, 2003). Debates on neighbourhood effects often aim at comparing the effectiveness of individual-level and area-level policies and interventions for targeting social inequalities. However, strategies based on the interaction of 'kinds of individuals' with 'kinds of contexts' are likely to be more effective than the ones targeting either the individuals or the context (Wikström & Loeber, 2000). Spatial contexts for which social policies are designed are often invoked as an analytical frame of neighbourhood effects research. Neighbourhoods driven by policy are easy to define and to understand. However, neighbourhood effects mechanisms are largely not about the officially defined administrative neighbourhoods, but about a variety of spatial contexts contained within the spatial data.

2.3. The nature of spatial data and social processes

Researchers in the social sciences often have to use spatial units for which data are available rather than the ones that are more suitable for their research question. However, many social processes occur regardless of the administrative boundaries within which the data are normally collected (Jones, Manley, Johnston, Owen, & Charlton, forthcoming; Manley et al., 2006). The results of analyses depend on the spatial scale chosen, i.e. the size of spatial units, as well as on the precise delineation of the units at a single scale on the ground. This is referred to as the modifiable areal unit problem (MAUP; Manley, 2014; Openshaw, 1984; Openshaw & Taylor, 1979). Although mostly seen as a problem, notably a statistical problem, MAUP is also a resource, revealing geographic processes which the spatial analyst is challenged to identify and evaluate their importance from the spatial pattern observed (Manley et al., 2006).

While many spatial scales and zonation schemes are theoretically possible, study areas are not analogous to samples in statistics which are randomly drawn from the set of all possible study areas (Longley, Goodchild, Maguire, & Rhind, 1999). On the contrary, the neighbourhood is presented as a single conceptual entity rather than one of sequence of possibilities, and the structure of spatial data is further characterised by spatial autocorrelation, meaning that the value of an observation (area or point in space) is similar to or depends on the nearby observations (Tobler, 1970). Indeed, this is what makes spatial data ‘special’ (Anselin, 1989). For neighbourhood effects, which must by definition be spatial processes, the commonly used fixed effects model completely removes space, leaving neighbourhood as an isolated unit. Moreover, the use of an individual as their own control unit denies any group level effect, rendering the question meaningless. However, very existence of spatial autocorrelation in social and population data is a product of people’s mobility behaviour, residential location selection, resulting segregation and multiple contextual effects, and therefore not a nuisance, but a means to understand social processes. Even spatial statistics and econometrics often treat this spatial dependence as nuisance and something that should be corrected rather than theorised.

Spatial dependence has traditionally been used to delineate clusters as sets of spatial units forming an area where counts or rates are more similar than if the data were randomly distributed (Anselin, 1995; Haining, 2003). Pioneering work in spatial statistics included hot spot analysis and disease mapping in epidemiology and health geography, where small-area data have long been available (Cuzick & Elliott, 1992), as well as crime mapping in empirical research and practice of criminology (Weisburd & McEwen, 2015). While clustering reveals spatial concentrations of phenomena, various contextual characteristics which are relevant for the neighbourhood effects research will likely result in different clusters. Furthermore, spatial dependency does not occur everywhere at the same time or spatial scale or in the same way. Spatial heterogeneity is, therefore, the second ‘special’ feature of spatial data, which is reflected in the need to consider local characteristics of places, rather than universal generalities (Getis, 1999).

Both spatial autocorrelation and spatial heterogeneity are scale-dependent, as while smaller spatial units have their micro-characteristics, they are also simultaneously part of larger structures with macro characteristics. We can conceptualise two parts within the scale question. The first relates to the scale at which social structures exist and over which the processes operate and is known as the *phenomenon scale* (Montello, 2001). This contrasts with the second, the *analysis scale*, which relates to the size of the units at which these phenomena are empirically measured and analysed (Montello, 2001). Whilst it might seem trivial to suggest that analysis scale should correspond to the phenomenon scale from the research and policy perspective, often they do not correspond. Compared to the natural sciences, research regarding scale in social sciences has been less explicit and precise (Gibson, Ostrom, & Ahn, 2000). Matching the phenomenon and analysis spatial representation of social processes is associated with a high degree of uncertainty, as defined within the uncertain geographic context problem (UGCoP; Kwan, 2012).

The initial spatial analyses in epidemiology and criminology were based on areal data, while for research questions related to neighbourhood effects the issues of ecological and atomistic fallacy became relevant. *Ecological fallacy* relates to drawing inferences at the individual level based on group (area) level data, whereas *atomistic fallacy* relates to identifying associations from individual-level data while ignoring area-level effects (Diez Roux, 2002; Haining, 2003). Therefore, the distinction between context and composition in health studies had not only theoretical (see Section 2.1.), but also a methodological role, which was

witnessed in the adoption of multilevel modelling, originally developed in education research, sociology, and demography. For neighbourhood effects research, both individual and multiple areal levels are crucial. Hierarchical structures of space, as applied in multi-level models, and spillovers captured by spatial weight matrices in spatial econometric models, are two basic ways to take spatial dependence into account. Both of them can be related to how social processes work. While recent studies on neighbourhood effects have been able to measure personal characteristics of people using individual level data, the representation of space has still been evolving, largely depending on the available data.

3. From neighbourhood effects to socio-spatial context research

3.1. From bounded neighbourhood towards multi-scale representation of the socio-spatial context

Geography must, almost by default, be one of the basic components of neighbourhood effects research. Yet, in quantitative research, the neighbourhood is often treated as an aspatial entity. Moreover, where a neighbourhood is given the conceptual space, it is treated more as a nuisance than as the fundamental tenant of the research question. Given the great volume of the neighbourhood effects research, few studies investigate how the effect of the MAUP may be on the outcomes of neighbourhood effect models, and even fewer explicitly base their definition of neighbourhood on theory. Data constraints are certainly one of the main reasons for the lack of attention to neighbourhood geography in empirical studies. The other reason is that there are other seemingly more pressing methodological concerns that have dominated thinking and so that for the sake of tackling those issues geography is given less attention. For example, Bauer, Fertig, and Vorell (2011) applied an instrumental variable approach to tackle the identification of causal neighbourhood effects, but then used postcode areas as proxies for neighbourhoods as sources of various mechanisms of neighbourhood effects on individual unemployment.

Opposing concepts of neighbourhood include ‘objective’ and perceived neighbourhoods, fixed and bespoke neighbourhoods, single-scale and multi-scale neighbourhoods, homogenous and heterogeneous neighbourhoods (see reviews by Chaix, Merlo, Evans, Leal, & Havard, 2009; Nicotera, 2007). Small-sample qualitative studies and large-sample quantitative studies fundamentally differ in measuring socio-spatial context. Qualitative small-sample studies are capable of revealing information that quantitative studies with a large number of observations are unable to produce, particularly with regard to people’s perception of their neighbourhood. Neighbourhood boundaries imposed by a researcher as an outsider neglect residents’ experience, which is relevant for some, but not all, individual outcomes. In contrast, quantitative large-sample studies use simplifying assumptions about neighbourhood size and boundaries, but yield more generalisable results, especially regarding ‘objectively’ measured neighbourhood characteristics.

In addition to qualitative methods, including discussion groups or interviews for surveying residents’ perception of the concept neighbourhood (Davidson, Mitchell, & Hunt, 2008), geographic information systems (GIS) are increasingly used (Coulton, Korbin, Chan, & Su, 2001; Lohmann & McMurrin, 2009). In the GIS-based methods, residents are asked to draw their individual view of neighbourhood boundaries on a map, which can be aggregated to compare how neighbourhoods are defined in both different settings and by different demographic groups. In the study conducted in low-income communities in 10 cities in the USA, Coulton, Jennings, and Chan (2013) found that neighbourhoods delineated from GIS

maps drawn by respondents are smaller than a typical census tract, but larger than those gained from residents' answers on an ordinal scale or qualitative questions.

The results of GIS-based studies are inconsistent regarding whether and which socio-demographic characteristics of individuals determine how people perceive their neighbourhoods (see, for instance, studies by Lee & Campbell, 1997; Orford & Leigh, 2014; Pebley & Sastry, 2009). This is certainly caused by the use of different methods, but also different settings in which the studies are conducted. Large-sample quantitative studies can also learn something from this, namely to more extensively consider various spatial settings and socio-demographic characteristics of individuals. Ethnographic heterogeneity has been gaining importance, but is still under-represented in quantitative studies of neighbourhood effects, where integrating qualitative (ethnographic) research could be immensely beneficial (Small & Feldman, 2012). Furthermore, as Chaix et al. (2009) notes, methods used to delineate *perceived* neighbourhoods can also be used for *objectively experienced* neighbourhoods, which, given that contextual (neighbourhood) effects rely on interactions and exposure, may be more informative to understand individual outcomes. Recent methods for detecting objectively experienced neighbourhoods use location-aware technologies such as GPS and mobile phone tracking to find people's activity spaces (Ahas, Silm, Järv, Saluveer, & Tiru, 2010; Chaix et al., 2013). While these methods have relaxed spatial and temporal constraints and successfully integrated space and time (Shaw, 2010), they have also intensified ethical issues in data collection.

When data on activity spaces are not available, empirical studies which acknowledge the importance of multiple spatial contexts, compare spatial units at multiple spatial scales. However, they usually restrict their analysis to two levels of administrative units or, more recently, through the implementation of bespoke neighbourhoods. The main contributions of these studies are that they demonstrate the scale effect as well as that they point out the constraints of the absence of small-area data, which would more appropriately represent the local contexts. For example, Prouse, Ramos, Grant, and Radice (2014) in their study on income inequality in Halifax, Nova Scotia (Canada), criticised the coarse scale of the census tracts (CT) as a predominant proxy for neighbourhoods and suggested that in smaller cities dissemination areas⁴ (DA) are more useful. A further purpose of comparing different scales is to identify what effects operate at which scales or whether the same effect operates simultaneously at more than one spatial scale, usually by comparing neighbourhoods with regions. In the study on neighbourhood effects on school dropout rates among Australian teenagers, Overman (2000) found that a high proportion of vocationally trained adults had the opposite effect at the two examined spatial scales. This was interpreted as a result of two different processes operating at different scales: larger labour market demands at the regional scale and informational networks at the local scale.

Apart from administrative units, neighbourhood effects studies are increasingly compare different spatial scales by aggregating the smallest available units to higher spatial levels using the bespoke neighbourhood approach (Bolster et al., 2007; Stein, 2014; Veldhuizen, Musterd, Dijkshoorn, & Kunst, 2015). One of the main benefits of the bespoke neighbourhood concept is that it tackles the fact that people living on the edge of the neighbourhood might associate themselves with or be more affected by the adjacent neighbourhood. However, exploring spatial scale of bespoke neighbourhoods also has a great

⁴ The DAs are administrative units defined within census tracts, whose boundaries follow distinctive features such as roads or waterways and encompass 400 to 700 people, forming variously sized areas with different population densities (Prouse et al., 2014).

potential to advance our understanding of the wider spatial context of neighbourhood effects. So far, few studies have considered neighbourhood as being a part of a wider spatial context within which they are imbedded (Graif, Arcaya, & Diez Roux, 2016) or the influence of 'neighbouring neighbourhoods' (Bolster et al., 2007).

The lack of appropriate data sometimes leads to questionable conclusions that the MAUP or geography in general are irrelevant for individual outcomes. For example, Brännström (2005) found effects of neither census areas nor parishes on individual income and receipt of social assistance in Sweden. As pointed out by Andersson and Musterd (2010), both of these spatial units are fairly heterogeneous and might obscure processes that in fact occur at smaller scales. Using smaller scales was made possible by the availability of micro-geographic data, which do not constrain the researcher to the smallest available administrative units, but put a wider variety of scaling and zonation ways into practice. A few studies were conducted using the Swedish socio-economic data aggregated to 100 by 100m grid cells. Andersson and Musterd (2010) investigated the impact of area characteristics on individual income employing two types of areas (bespoke neighbourhoods and statistical units) at different spatial scales, using the following theoretical reasoning: 100 by 100m grid cells represent individuals' immediate surroundings, where most of social interactions take place; municipalities represent the level at which many decisions relevant to people's socio-economic status are made; Small Area Market Statistics (SAMS) units (comprised of 400 to 800 people) represent an intermediate scale, at which urban districts for state interventions against segregation are identified. Besides finding the effect of spatial contexts on individual outcome, the authors pointed out that the impact of different contextual variables is more prominent at some scales and less so at others. More detailed findings on the effect of specific contextual variables were achieved by using only the micro-geographic data and aggregating them at a larger number of scales (Östh, Clark, & Malmberg, 2014; Östh, Malmberg, & Andersson, 2014). So, the micro-geographic data made it possible for the neighbourhood effects research to move from predefined (administrative) units to spatial contexts which are both individualised and multi-scalar.

3.2. The role of micro-geographic data in future contextual effects research

Quantitative research depends on synchronised availability of good-quality data, well-formulated hypotheses which can be expressed in mathematical terms, analytic tools and techniques, and technology to facilitate the analysis (Haining, 2003). Formulating hypotheses should be a crucial initial step, ideally the main determinant in the choice of appropriate spatial data. In neighbourhood effects research, guidance is provided by the theoretical approaches to the mechanisms of neighbourhood effects, where, for example, social mechanisms generally differ from institutional mechanisms in both spatial scale and zonation schemes. Exploring spatial patterns in the data can help researchers to formulate clearer hypotheses with regards to how specific processes operate in various geographic settings, i.e. different cities or even parts of cities. Micro-geographic data, therefore, can be used to create alternative spatial units for testing, but also developing theoretical approaches to neighbourhood effects.

Analytic tools and techniques in the neighbourhood effects research usually treat spatial units as any other variables represented in tabular form and analysed using standard statistical methods. Micro-geographic data draw more attention of social scientists to the ways they represent and analyse spatial data and the need to more effectively integrate spatial analysis in their research. In terms of statistics, three basic ways of dealing with spatial data include using regular statistics methods and ignoring spatial dependence; acknowledging that spatial

dependence exists and trying to remove it to justify the use of aspatial methods; and taking spatial autocorrelation explicitly into account and trying to explain it from a theoretical perspective. The latter is what the neighbourhood effects research can benefit from the most.

Furthermore, the potentials of GIS have been utilised in the social sciences to a lesser extent than in physical geography and related natural sciences, although the spatial dimension is no less important for social than for natural processes. Particularly, GIS has not been sufficiently reconciled with the neighbourhood studies. Maps can be found already in early stages of many areas of social science, but many disciplines got away from these roots for the sake of developing other methodologies (Steinberg & Steinberg, 2005). Current trends in data science, specifically the increasing availability of geocoded micro-data, make mapping particularly important and useful, because visualisation can help to get insight into the complex spatio-temporal patterns. An exceptional example of using mapping to put the theory of neighbourhood effects into practice is the work of Knaap (2017), who mapped the spatial opportunity structure to better link the geography of opportunity with the mechanisms of neighbourhood effects. Thinking in layers is the fundamental feature of GIS. GIS expresses geography as a series of layers, where each layer captures something unique, but often correlated with other layers. This is also how the spatial opportunity structure is organised, namely as a series of unique, but to some extent related characteristics, such as ethnic and income compositions (see Galster & Sharkey, 2017).

Using micro-geographic data, (potential) exposure to socio-spatial context for each individual can be more adequately represented with exposure surfaces in a moving windows style at multiple spatial scales than fixed spatial units. For example, if a small area where an individual lives is surrounded by a larger area with markedly different characteristics, in traditional conceptualisations of space and scale this could be masked when aggregated into a larger areal unit. However with the moving window this does not happen (Jones et al., forthcoming). The richer the data, the more various are methods for delineating exposure areas, including Euclidean distance, road network distance, population size, travel time or cost. Exposure surfaces in a moving window style can also move as beyond discrete-space modelling. Both multi-level and spatial econometric modelling corresponds with theoretical guidelines regarding multiple neighbourhood membership or spillovers between neighbourhoods, which should be utilised more extensively in the neighbourhood effects research. However, very small areas, close to exact geographic coordinates, also offer possibilities for continuous-space modelling. The continuous treatment of space should reveal more information on the spatial distribution of outcomes and the scale of spatial variations, whereas measuring area characteristics at the level of neighbourhood in its traditional, bounded sense might severely underestimate the effect of context as a more complex spatio-temporal category (Cummins et al., 2007).

The finer the spatial data, the greater the locational precision, which makes it easier to follow individual residential histories and exposure to socio-spatial context over time. For many individual outcomes duration of exposure to different places is very important, and so is the relative importance of various spatial contexts, for example residential neighbourhood and school for education outcomes, or place of residence and workplace for labour market or health outcomes. Therefore, micro-geographic data also improve the connection between time and space: We can adapt spatial scale to the temporal scope we are interested in, for example by using micro-locations for exposures on daily space-time paths, or larger scales for long-term exposure to poverty.

The theory of underlying processes should be given equal attention as the analytic tools and techniques. For example, spatial econometrics models developed both faster than and separately from the theoretical explanations of spatial processes which drive the spatial dependence and which were supposedly captured by the modelled. Arbitrary definitions of spatial weight matrices with no underlying understanding of distance, interaction or association (Getis, 1999) are still an issue in the spatial statistics and econometrics. In addition, alternative spatial units would possibly change the spatial dependence structure which is modelled using predefined administrative units. While conventional definitions of neighbourhoods (typically administrative units) precisely define neighbourhood boundaries, and the location of an individual within the area is unknown, micro-geographic data reveal the location of an individual more precisely, while the boundaries of their *multiple* neighbourhoods are fuzzier.

Micro-geographic data tightly link between people and socio-spatial context. Bespoke neighbourhoods are increasingly used in the neighbourhood effects research, with two prevailing types, namely distance and population based bespoke neighbourhoods. Population based bespoke neighbourhoods (nearest neighbour approach) can be ideally constructed from geographical coordinates for each individual, because even small area aggregates make it impossible to closely determine specific number of neighbours. Using micro-scale grid cells, small increments in distance can be more clearly applied than small increments in population, because grid cells themselves are created based on distance. Irregularly shaped spatial units are more challenging for delineating both distance and population based bespoke neighbourhoods, depending on the way the basic units were created. Smaller basic units are more manipulatable, which not necessarily gives a 'real' gain, but if implemented correctly, the gain can be way beyond the technical and reveal spatial patterns. Although larger base units may appear less problematic, they can obscure 'social cliffs' and 'social cleavages' which may exist within these spatial units and can be relevant even at larger scales. Uncovering these marked socio-spatial changes is particularly relevant for the neighbourhood effects research, where micro locations and local changes in exposure are often at the core of the theory, but in the empirical research have often been represented by some kind of proxy.

In any case, the choice between specific techniques for delineating bespoke neighbourhoods is not just a technical issue, and the theoretical reasoning behind this choice deserves more attention. On the one hand, some institutions or services are closely based on rationales which include the population served and are therefore closer to the number of people, justifying the nearest neighbour approach. On the other hand, the area over which these people are distributed should certainly be considered, as distance largely determines accessibility and exposure. For example, direct residential environments and exposure to first neighbours are normally associated with short distances regardless of the number of neighbours, although the density of neighbourhood can also affect social processes. Furthermore, since the same number of people can be distributed over very different areas, only population size is not sufficient to characterise large scale contexts. Distance, in combination with urban form and city size offers valuable insight into the urban setting. The relationship between distance and population probably represents the characteristics of urban space most comprehensively, but the research aim should be decisive for choosing distance, population or both.

Regardless of the metrics (e.g. distance, population counts, travel time) used to delineate bespoke neighbourhoods, the smaller the scale, the more 'bespoke' are the neighbourhoods, and the bigger the scale, the more 'shared' and overlapping are the neighbourhoods. Multi-scale bespoke neighbourhood perspective, therefore, draws attention to both local peculiarities

and extreme contextual conditions on the one hand and large-scale shared contexts on the other hand, which is what the theory of neighbourhood effects mechanisms asks for.

4. Conclusions

The theory of neighbourhood effects mechanisms points out that administrative divisions cannot adequately capture all the social, economic and other relevant processes, while the spatial data analysis, notably the modifiable areal unit problem, suggests that neighbourhoods can be defined in vastly different ways. The concepts of place within the theoretical framework of neighbourhood effects and adequate spatial data are prerequisites for the meaningful operationalisation of neighbourhoods. A parallel between theorising place and space and the availability of spatial data can be drawn in the geography of health and criminology, where the spatial data were quite rich and the concept of place was given more attention comparing to other disciplines within the neighbourhood effects research.

Reviewing empirical studies shows that spatial scale is gaining greater attention in the neighbourhood effects research. Many of the studies that have invoked scale as an important research question have explored it in a limited manner – often only using a couple of scales at most. Nevertheless, their contribution is significant in the sense that they provide evidence of the scalar nature of the effects being explored and highlight that scale is a critical methodological issue in the neighbourhood effect research. The literature on neighbourhood effects includes debates as to which spatial scale is the most appropriate for testing neighbourhood effects. Customised solutions for different mechanisms, different geographical settings as well as different socio-demographic groups require much more empirical investigation, but the theory suggests that this is a critical development to advance our understanding of context. Theories regarding neighbourhood effects suggest plausible spatial contexts in which specific mechanisms can operate. This should be complemented by exploring spatial patterns in the data, particularly with regard to specific geographic settings, as well as by (ethnographic) research regarding different socio-demographic groups. In doing so, the grounding for neighbourhood effects research increases as does our knowledge about phenomenon scale. Together, this can then inform analysis scale. The role of micro-geographic data is then to better link the phenomenon and the analysis scale, as well as to give attention to both micro-locations and large-scale urban, institutional and economic structures.

Along with using multiple scales, the concept of bespoke neighbourhoods has enabled researchers to alter how they specify the local residential environment. Neighbourhood effects research will continue to move from the notion of bounded neighbourhood to the notion of the bespoke multi-scale contexts. Since many social, economic and cultural processes spread beyond artificially (and administratively) defined boundaries, more fuzzy concepts of neighbourhood can be used to examine specific contextual characteristics. Using micro-geographic data, neighbourhood effects research can give more attention to location, distance and exposure, spatial dependence and heterogeneity, taking into account multiple neighbourhood membership. The main goal should be to design zonation systems that are less arbitrary and that would capture the relevant processes more accurately than the pre-defined administrative areas. Micro-geographic data move us from the bounded spatial units to the continuous space, in which neighbourhoods are much fuzzier than is normally assumed, and where contextual effects should be investigated rather than ‘neighbourhood’ effects.

Using standard administrative units was long a defining feature of the neighbourhood effects research. This is understandable as most datasets only allow specific geographies to be used.

In this paper, we built on the insights of previous conceptual and empirical work and we want to raise spatial awareness and integrate knowledge from various disciplines, particularly because spatial data are becoming more detailed and more accessible to researchers. Increasingly available micro-geographic data can help social scientists to better understand socio-spatial context and arrive at clearer conclusions about contextual effects. The variety of spatial contexts that are possible to study using micro-geographic data should not only remain alternative ways of operationalisation of neighbourhoods. Instead, they should become a paradigm of the spatial contextual research. Where the neighbourhood effects literature argues for more attention to the definition of neighbourhood, we even go one step further, and argue that in order for neighbourhood effects research to move on, we need to break away from the tyranny of neighbourhood, and consider the effects of the broader socio-spatial context of people.

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References

- Ahas, R., Silm, S., Järv, O., Saluveer, E., & Tiru, M. (2010). Using mobile positioning data to model locations meaningful to users of mobile phones. *Journal of urban technology*, 17(1), 3-27.
- Altman, D. (1994). Fuzzy set theoretic approaches for handling imprecision in spatial analysis. *International journal of geographical information systems*, 8(3), 271-289.
- Andersson, E. K., & Malmberg, B. (2014). Contextual effects on educational attainment in individualised, scalable neighbourhoods: Differences across gender and social class. *Urban Studies*, 0042098014542487.
- Andersson, R., & Musterd, S. (2010). What scale matters? Exploring the relationships between individuals' social position, neighbourhood context and the scale of neighbourhood. *Geografiska Annaler: Series B, Human Geography*, 92(1), 23-43.
- Anselin, L. (1989). What is Special About Spatial Data? Alternative Perspectives on Spatial Data Analysis (89-4).
- Anselin, L. (1995). Local indicators of spatial association—LISA. *Geographical analysis*, 27(2), 93-115.
- Auchincloss, A. H., Gebreab, S. Y., Mair, C., & Diez Roux, A. V. (2012). A review of spatial methods in epidemiology, 2000–2010. *Annual review of public health*, 33, 107-122.

- Bauer, T. K., Fertig, M., & Vorell, M. (2011). *Neighborhood effects and individual unemployment: Ruhr Economic Papers*.
- Bernard, P., Charafeddine, R., Frohlich, K. L., Daniel, M., Kestens, Y., & Potvin, L. (2007). Health inequalities and place: a theoretical conception of neighbourhood. *Social science & medicine*, 65(9), 1839-1852.
- Bolster, A., Burgess, S., Johnston, R., Jones, K., Propper, C., & Sarker, R. (2007). Neighbourhoods, households and income dynamics: a semi-parametric investigation of neighbourhood effects. *Journal of Economic Geography*, 7(1), 1-38.
- Brännström, L. (2005). Does neighbourhood origin matter? A longitudinal multilevel assessment of neighbourhood effects on income and receipt of social assistance in a Stockholm birth cohort. *Housing, Theory and Society*, 22(4), 169-195.
- Brantingham, P. J., & Brantingham, P. L. (1981). *Environmental criminology*: Sage Publications Beverly Hills, CA.
- Brantingham, P. L., & Brantingham, P. L. (1993). Environment, routine and situation: Toward a pattern theory of crime. *Advances in criminological theory*, 5(2), 259-294.
- Buck, N. (2001). Identifying neighbourhood effects on social exclusion. *Urban Studies*, 38(12), 2251-2275.
- Chaix, B., Meline, J., Duncan, S., Merrien, C., Karusisi, N., Perchoux, C., . . . Kestens, Y. (2013). GPS tracking in neighborhood and health studies: a step forward for environmental exposure assessment, a step backward for causal inference? *Health & place*, 21, 46-51.
- Chaix, B., Merlo, J., Evans, D., Leal, C., & Havard, S. (2009). Neighbourhoods in eco-epidemiologic research: delimiting personal exposure areas. A response to Riva, Gauvin, Apparicio and Brodeur. *Social science & medicine*, 69(9), 1306-1310.
- Chaskin, R. J. (1995). *Defining neighborhood: History, theory, and practice*: Chapin Hall Center for Children at the University of Chicago.
- Chaskin, R. J. (1997). Perspectives on neighborhood and community: a review of the literature. *The Social Service Review*, 521-547.
- Cohen, L. E., & Felson, M. (1979). Social change and crime rate trends: A routine activity approach. *American Sociological Review*, 588-608.
- Coulton, C. J., Jennings, M. Z., & Chan, T. (2013). How big is my neighborhood? Individual and contextual effects on perceptions of neighborhood scale. *American journal of community psychology*, 51(1-2), 140-150.
- Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: a methodological note. *American journal of community psychology*, 29(2), 371-383.
- Cummins, S., Curtis, S., Diez-Roux, A. V., & Macintyre, S. (2007). Understanding and representing 'place' in health research: a relational approach. *Social science & medicine*, 65(9), 1825-1838.
- Curtis, S., & Rees Jones, I. (1998). Is there a place for geography in the analysis of health inequality? *Sociology of health & illness*, 20(5), 645-672.
- Cuzick, J., & Elliott, P. (1992). Small-area studies: purpose and methods. In P. Elliott, J. Cuzick, D. English & R. Stern (Eds.), *Geographical and Environmental Epidemiology: methods for small-area studies* (pp. 14-21).
- Davidson, R., Mitchell, R., & Hunt, K. (2008). Location, location, location: The role of experience of disadvantage in lay perceptions of area inequalities in health. *Health & place*, 14(2), 167-181.
- Dietz, R. D. (2002). The estimation of neighborhood effects in the social sciences: An interdisciplinary approach. *Social Science Research*, 31(4), 539-575.

- Diez-Roux, A. V. (1998). Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *American journal of public health*, 88(2), 216-222.
- Diez Roux, A. (2002). A glossary for multilevel analysis. *Journal of Epidemiology & Community Health*, 56(8), 588-594.
- Dijst, M. (1999). Two-earner families and their action spaces: A case study of two Dutch communities. *GeoJournal*, 48(3), 195-206.
- Dujardin, C., & Goffette-Nagot, F. (2005). Neighborhood effects, public housing and unemployment in France.
- Duncan, C., Jones, K., & Moon, G. (1998). Context, composition and heterogeneity: using multilevel models in health research. *Social science & medicine*, 46(1), 97-117.
- Eck, J. E., & Weisburd, D. L. (2015). Crime places in crime theory *Crime and Place: Crime Prevention Studies*, 4 (pp. 1-33).
- Ellen, I. G., & Turner, M. A. (1997). Does neighborhood matter? Assessing recent evidence. *Housing Policy Debate*, 8(4), 833-866.
- Epstein, J. M. (2008). Why model? *Journal of Artificial Societies and Social Simulation*, 11(4), 12.
- Forrest, R., & Kearns, A. (2001). Social cohesion, social capital and the neighbourhood. *Urban Studies*, 38(12), 2125-2143.
- Galster, G. (2001). On the nature of neighbourhood. *Urban Studies*, 38(12), 2111-2124.
- Galster, G., & Sharkey, P. (2017). Spatial foundations of inequality: A conceptual model and empirical overview. *RSF*.
- Galster, G. C. (2012). The mechanism(s) of neighbourhood effects: Theory, evidence, and policy implications. In M. van Ham, D. Manley, N. Bailey, L. Simpson & D. Maclennan (Eds.), *Neighbourhood effects research: New perspectives* (pp. 23-56): Springer.
- Getis, A. (1999). Spatial statistics. In P. A. Longley, M. Goodchild, D. J. Maguire & D. W. Rhind (Eds.), *Geographical Information Systems: Principles and Technical Issues*.
- Gibson, C. C., Ostrom, E., & Ahn, T.-K. (2000). The concept of scale and the human dimensions of global change: a survey. *Ecological economics*, 32(2), 217-239.
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*: Univ of California Press.
- Gobillon, L., Magnac, T., & Selod, H. (2011). The effect of location on finding a job in the Paris region. *Journal of Applied Econometrics*, 26(7), 1079-1112.
- Graif, C., Arcaya, M. C., & Diez Roux, A. V. (2016). Moving to opportunity and mental health: Exploring the spatial context of neighborhood effects. *Social science & medicine*, 162, 50-58.
- Hägerstrand, T. (1970). What about people in regional science? *Papers in regional science*, 24(1), 7-24.
- Haining, R. P. (2003). *Spatial data analysis*: Cambridge University Press Cambridge.
- Hedman, L., Manley, D., Van Ham, M., & Östh, J. (2015). Cumulative exposure to disadvantage and the intergenerational transmission of neighbourhood effects. *Journal of Economic Geography*, 15(1), 195-215.
- Hipp, J. R., & Boessen, A. (2013). Egohoods as waves washing across the city: a new measure of "neighborhoods". *Criminology*, 51(2), 287-327.
- Holzer, H. J. (1991). The spatial mismatch hypothesis: What has the evidence shown? *Urban Studies*, 28(1), 105-122.

- Hunter, A. (1974). *Symbolic communities: The persistence and change of Chicago's local communities*: University of Chicago Press.
- Ihlanfeldt, K. R., & Sjoquist, D. L. (1998). The spatial mismatch hypothesis: a review of recent studies and their implications for welfare reform. *Housing Policy Debate*, 9(4), 849-892.
- Johnston, R., Pattie, C., Dorling, D., MacAllister, I., Tunstall, H., & Rossiter, D. (2000). The neighbourhood effect and voting in England and Wales: real or imagined? *British Elections & Parties Review*, 10(1), 47-63.
- Jones, K., Manley, D., Johnston, R., Owen, D., & Charlton, C. (forthcoming). Modelling residential segregation as unevenness and clustering: a multilevel modelling approach incorporating spatial dependence and tackling the MAUP. *Environment and Planning B*.
- Kain, J. F. (1968). Housing segregation, negro employment, and metropolitan decentralization. *The Quarterly Journal of Economics*, 175-197.
- Knaap, E. (2017). The Cartography of Opportunity: Spatial Data Science for Equitable Urban Policy. *Housing Policy Debate*, 1-28.
- Kwan, M.-P. (1999). Gender, the home-work link, and space-time patterns of nonemployment activities. *Economic Geography*, 75(4), 370-394.
- Kwan, M.-P. (2000). Analysis of human spatial behavior in a GIS environment: Recent developments and future prospects. *Journal of Geographical systems*, 2(1), 85-90.
- Kwan, M.-P. (2012). The uncertain geographic context problem. *Annals of the Association of American Geographers*, 102(5), 958-968.
- Lee, B. A., & Campbell, K. E. (1997). Common ground? Urban neighborhoods as survey respondents see them. *Social science quarterly*, 922-936.
- Lewis, O. (1966). The culture of poverty. *Scientific American*, 215(4), 19-25.
- Logan, J. R., & Molotch, H. (2007). *Urban fortunes: The political economy of place*: Univ of California Press.
- Lohmann, A., & McMurrin, G. (2009). Resident-defined neighborhood mapping: Using GIS to analyze phenomenological neighborhoods. *Journal of prevention & intervention in the community*, 37(1), 66-81.
- Longley, P., Goodchild, M., Maguire, D., & Rhind, D. (1999). *Geographical Information Systems- Volume 1: Principles and Technical Issues; Volume 2: Management Issues and Applications*: New York, John Wiley & Sons.
- Lupton, R. (2003). Neighbourhood effects: can we measure them and does it matter? *LSE STICERD Research Paper No. CASE073*.
- MacAllister, I., Johnston, R. J., Pattie, C. J., Tunstall, H., Dorling, D. F., & Rossiter, D. J. (2001). Class dealignment and the neighbourhood effect: Miller revisited. *British journal of political science*, 31(01), 41-59.
- Macintyre, S., Ellaway, A., & Cummins, S. (2002). Place effects on health: how can we conceptualise, operationalise and measure them? *Social science & medicine*, 55(1), 125-139.
- Manley, D. (2014). Scale, Aggregation, and the Modifiable Areal Unit Problem. In M. Fischer & P. Nijkamp (Eds.), *Handbook of Regional Science* (pp. 1157-1171). Berlin, Heidelberg: Springer.
- Manley, D., Flowerdew, R., & Steel, D. (2006). Scales, levels and processes: Studying spatial patterns of British census variables. *Computers, environment and urban systems*, 30(2), 143-160.
- Manski, C. F. (1993). Identification of endogenous social effects: The reflection problem. *The review of economic studies*, 60(3), 531-542.
- Massey, D. (2005). *For space*: Sage.

- Massey, D. B. (1994). *Space, place, and gender*: U of Minnesota Press.
- Miller, J. H., & Page, S. E. (2009). *Complex adaptive systems: an introduction to computational models of social life: an introduction to computational models of social life*: Princeton university press.
- Montello, D. R. (2001). Scale in geography. In N. J. Smelser & B. Baltes (Eds.), *International Encyclopedia of the Social and Behavioral Sciences* (pp. 13501-13504). Oxford: Elsevier.
- Nicotera, N. (2007). Measuring neighborhood: A conundrum for human services researchers and practitioners. *American journal of community psychology*, 40(1-2), 26-51.
- Openshaw, S. (1984). The modifiable areal unit problem, CATMOG 38. *Geo Abstracts, Norwich*.
- Openshaw, S., & Taylor, P. J. (1979). A million or so correlation coefficients: three experiments on the modifiable areal unit problem. *Statistical applications in the spatial sciences*, 21, 127-144.
- Orford, S., & Leigh, C. (2014). The relationship between self-reported definitions of urban neighbourhood and respondent characteristics: a study of Cardiff, UK. *Urban Studies*, 51(9), 1891-1908.
- Östh, J., Clark, W. A. V., & Malmberg, B. (2014). Measuring the Scale of Segregation Using k-Nearest Neighbor Aggregates. *Geographical analysis*, 47(1), 34-49.
- Östh, J., Malmberg, B., & Andersson, E. (2014). Analysing segregation with individualized neighbourhoods defined by population size.
- Overman, H. G. (2000). *Neighbourhood effects in small neighbourhoods*: Centre for Economic Performance, London School of Economics and Political Science.
- Park, R. (1967). The City: Suggestions for the Investigation of Human Behaviour in the Urban Environment. In R. E. Park & E. W. Burgess (Eds.), *The city: Suggestions for the investigation of human behaviour in the urban environment* (pp. 1-46). Chicago: The University of Chicago Press.
- Pebley, A. R., & Sastry, N. (2009). Our place: perceived neighborhood size and names in Los Angeles. *Los Angeles: California Center for Population Research, University of California*.
- Petrović, A., van Ham, M., & Manley, D. (2018). Multiscale Measures of Population: Within-and between-City Variation in Exposure to the Sociospatial Context. *Annals of the American Association of Geographers*, 1-18.
- Pickett, K. E., & Pearl, M. (2001). Multilevel analyses of neighbourhood socioeconomic context and health outcomes: a critical review. *Journal of epidemiology and community health*, 55(2), 111-122.
- Propper, C., Jones, K., Bolster, A., Burgess, S., Johnston, R., & Sarker, R. (2005). Local neighbourhood and mental health: evidence from the UK. *Social science & medicine*, 61(10), 2065-2083.
- Prouse, V., Ramos, H., Grant, J. L., & Radice, M. (2014). How and when Scale Matters: The Modifiable Areal Unit Problem and Income Inequality in Halifax. *Canadian Journal of Urban Research*, 23(1), 61-82.
- Raudenbush, S. W., & Sampson, R. J. (1999). Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociological methodology*, 29(1), 1-41.
- Sampson, R. (2004). Neighbourhood and community. *Juncture*, 11(2), 106-113.
- Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing "neighborhood effects": Social processes and new directions in research. *Annual review of sociology*, 443-478.
- Sampson, R. J., & Raudenbush, S. W. (1999). Systematic social observation of public spaces: A new look at disorder in urban neighborhoods. *American journal of sociology*, 105(3), 603-651.

- Shaw, S. (2010). *Time Geography: Its Past, Present, and Future*. Paper presented at the AAG Meeting, Washington, DC.
- Small, M. L., & Feldman, J. (2012). Ethnographic evidence, heterogeneity, and neighbourhood effects after moving to opportunity *Neighbourhood effects research: New perspectives* (pp. 57-77): Springer.
- Sorensen, A., & Okata, J. (2011). Introduction: Megacities, Urban Form, and Sustainability *Megacities* (pp. 1-12): Springer.
- Stein, R. E. (2014). Neighborhood Scale and Collective Efficacy: Does Size Matter? *Sociology Compass*, 8(2), 119-128.
- Steinberg, S. J., & Steinberg, S. L. (2005). Geographic information systems for the social sciences: investigating space and place: Sage Publications.
- Taylor, R. B. (2012). Defining neighborhoods in space and time. *Cityscape*, 225-230.
- Taylor, R. B., & Brower, S. (1985). Home and near-home territories. In I. Altman & C. M. Werner (Eds.), *Home environments* (pp. 183-212): Springer.
- Thomas, W. I. (1966). Social disorganization and social reorganization. *On social organization and social personality: Selected papers*, 3-11.
- Tobler, W. R. (1970). A computer movie simulating urban growth in the Detroit region. *Economic Geography*, 46(sup1), 234-240.
- Tunstall, H. V., Shaw, M., & Dorling, D. (2004). Places and health. *Journal of Epidemiology & Community Health*, 58(1), 6-10.
- Van Ham, M., Hooimeijer, P., & Mulder, C. H. (2001). Urban form and job access: disparate realities in the Randstad. *Tijdschrift voor economische en sociale geografie*, 92(2), 231-246.
- Van Ham, M., & Manley, D. (2012). Neighbourhood Effects Research at a Crossroads: Ten Challenges for Future Research (discussion paper). *IZA Discussion Paper 6793*.
- Van Ham, M., Manley, D., Bailey, N., Simpson, L., & Maclennan, D. (2012). *Neighbourhood effects research: new perspectives*: Springer.
- van Ham, M., & Tammaru, T. (2016). New perspectives on ethnic segregation over time and space. A domains approach. *Urban Geography*, 37(7), 953-962.
- Veldhuizen, E. M., Musterd, S., Dijkshoorn, H., & Kunst, A. E. (2015). Association between self-rated health and the ethnic composition of the residential environment of six ethnic groups in Amsterdam. *International journal of environmental research and public health*, 12(11), 14382-14399.
- Wacquant, L. J., & Wilson, W. J. (1989). The cost of racial and class exclusion in the inner city. *The Annals of the American Academy of Political and Social Science*, 501(1), 8-25.
- Weisburd, D., Bernasco, W., & Bruinsma, G. (2008). *Putting crime in its place*: Springer.
- Weisburd, D., Bruinsma, G. J., & Bernasco, W. (2009). Units of analysis in geographic criminology: Historical development, critical issues, and open questions. In D. Weisburd, W. Bernasco & G. J. Bruinsma (Eds.), *Putting crime in its place* (pp. 3-31): Springer.
- Weisburd, D. L., & McEwen, T. (2015). Introduction: Crime mapping and crime prevention.
- Wikström, P.-O. H., & Loeber, R. (2000). Do disadvantaged neighborhoods cause well-adjusted children to become adolescent delinquents? A study of male juvenile serious offending, individual risk and protective factors, and neighborhood context. *Criminology*, 38(4), 1109-1142.
- Wilson, W. J. (1987). *The truly disadvantaged: The inner city, the underclass, and social policy*: Chicago: University of Chicago Press.