The diverse pathways of social inequality transmission in the neighbourhood

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The diverse pathways of social inequality transmission in the neighbourhood

Dissertation

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chair of the Board for Doctorates
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by

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Summary

This thesis moves beyond the standard treatments of neighbourhood in the research on spatially transmitted inequality, and more specifically in the field of neighbourhood effects studies. Since the late 1980s, a substantial range of quantitative studies have investigated neighbourhood effects in different cities across the world, with different populations and outcome variables. Researchers have developed models relying on mechanisms of neighbourhood characteristics influencing the socioeconomic situation of an individual, with a particular focus on spatially concentrated poverty. This focus has been shared by policymakers and wider public perceptions, leading to policies aimed particularly at deprived neighbourhoods, such as social mix. However, many of these policy interventions have proved ineffectual or even detrimental, while socioeconomic segregation in Western cities keeps growing. The difficulties with translating the research on neighbourhoods into successful anti-segregation policies do not necessarily mean that the concept of neighbourhood effects itself is misguided, but could instead point to applications of this concept and interpretations of the observed effects being overly simplistic.

While neighbourhood effects research has contributed many valuable insights, the literature has often been to treat the neighbourhood as a mere setting, ignoring its own importance. The neighbourhood can be analysed as a place that people choose, which can change over time, and which can be differently perceived by different people. This thesis shows how quantitative neighbourhood studies can illuminate social research and policy by focusing on processes that are often overlooked, but which are crucial to social inequality transmission. Such an approach leads to a more nuanced view of that transmission than “living among poor people leads to more poverty”.

In order to explore the under-researched elements of sociospatial inequality transmission in neighbourhoods, four research questions are explored in four chapters describing empirical research. Firstly, Chapter 2 investigates to what extent are neighbourhood effects observed while controlling for explicitly modelled neighbourhood selection in three different Dutch cities: Amsterdam, Utrecht and Rotterdam. Chapter 3 moves to compare the effects of the different temporal operationalisations of individuals’ neighbourhood histories**,** timing, accumulation, duration and sequencing of exposure to neighbourhood poverty, on educational

attainment. Chapter 4 explores if, in the Dutch context, the effect of spatially concentrated affluence on educational attainment is stronger than that of poverty. Finally, Chapter 5 addresses the underlying, but often implicit, assumption of the previous models observing the effects of aggregated socioeconomic neighbourhood characteristics on individuals by studying how the individual perceptions of sociospatial variables such as the share of poor or foreign background neighbours differ from measurements based on register data, and what predicts these differences.

In all the empirical chapters of this PhD thesis, statistical regression models are used to analyse data from the Statistics Netherlands Social Statistical Database (SSD). The SSD is a population register that covers the entire population of the Netherlands and includes detailed statistics on individual and household characteristics, including income, education, country of origin, and geographic location. In Chapter 2, the individual SSD data is merged with neighbourhood-level variables from the publicly available Statistics Netherlands dataset *Kerncijfers Wijken en Buurten* and in Chapter 5 with survey data from the LISS panel. Such a quantitatively based approach, common in the field of neighbourhood effects studies, has been criticized for oversimplifying the complex realities of neighbourhood life and supporting policy approaches that overemphasize simple indicators of deprivation. However, quantitative research is valuable as a confirmation of generalized societal trends, and can contribute to a fuller understanding of social processes, also in the context of policy interventions. This thesis comprises statistical models inspired by qualitative studies and takes into account difficult to operationalise phenomena such as the difference between register data and individual perceptions.

The thesis also addresses the issue of determining the boundaries of the studied neighbourhoods, which has long been a challenge in urban research. Chapter 2 of the study uses administrative neighbourhoods, acknowledging that their borders are not entirely representative of the social space, but instead follow historical customs and local traditions. In Chapters 3 and 4, bespoke neighbourhoods are created with the Equipop software, which is used to identify the ratio of 200 nearest neighbouring households falling into the low or high income categories. Chapter 5 includes a different type of bespoke neighbourhood – a perceived neighbourhood – which is based on a self-defined area that a respondent can reach within a ten-minute walk from their home. Chapters 3-5 of this thesis demonstrate the versatility of the SSD geocoded grid data in creating bespoke neighbourhoods.

The results of this PhD thesis provide a nuanced view of the transmission of social inequality. Chapter 2 examines how, controlling for neighbourhood selection affects, neighbourhood effects influence individual income in Amsterdam, Utrecht, and

Rotterdam. The study finds that controlling for selection reduces neighbourhood effects compared to when only individual characteristics are controlled for, and provides insight into the differing patterns of neighbourhood selection and effects in Dutch regional housing markets. Chapter 3 focuses on the effects of exposure to neighbourhood poverty on educational attainment and operationalises four dimensions of that exposure: accumulation, duration, timing, and sequencing. It shows that the strength of the observed relationship between neighbourhood poverty and educational attainment is dependent on how exposure is measured and conceptualized, and highlights the importance of choosing the temporal aspects of individual neighbourhood histories based on the theoretical scope of a study. Chapter 4 finds that in the Netherlands, the positive effect of neighbourhood affluence on educational attainment is stronger than the negative effect of neighbourhood poverty. The chapter also explores the interactions between the educational level of parents and the neighbourhood context, and shows that parental higher education can act as a buffer against the effects of spatially concentrated poverty, although children from higher-educated households are still influenced by neighbourhood affluence. Chapter 5 addresses the discrepancy between the registered data-based measurements of neighbourhood characteristics, specifically the share of neighbours with foreign background and low income, and the individual perceptions of those characteristics by the inhabitants of the neighbourhood. These perceptions and registered data-based measures correlate, but not very strongly in the case of the percentage of low-income neighbours. The discrepancy between perceptions and register data-based measures varies based on individuals' characteristics; notably, individuals with lower trust in public institutions are likely to overestimate the ratios of their foreign background and low-income neighbours.

Methodologically, this PhD thesis has made several contributions, including improving on the modelling of neighbourhood selection and the influence of that selection on neighbourhood effects, and the creation of detailed operationalisations of different temporal aspects of exposure to neighbourhood characteristics. The recommendations for future research on inequality transmission in neighbourhoods are to take an interdisciplinary, mixed-methods approach and be conscious of its policy implications and theoretical influences. Connecting large-scale data-based studies with small-scale qualitative interviews could prove beneficial for the neighbourhood effects field and social science in general, despite the challenges related to data access and privacy.

The findings of the thesis confirm the validity of invoking the neighbourhood as a social setting that interacts with the micro and macro contexts, rather than simply as an aggregated characteristic that can be controlled for. The tendency to overlook certain aspects of the neighbourhood's role in social reality can be partly

explained by the fragmented nature of urban research and the different ontological assumptions and visions of various disciplines and traditions. Urban policies can be more effective when they both acknowledge these differences in assumptions and ideologies in research, and accept the complexity of mechanisms observed in urban settings. The role of researchers is to communicate the information on these mechanisms clearly without unnecessary simplifications. It is this inability to generalise the sociospatial processes happening in neighbourhoods as an easy to tell story is an important finding of this thesis. At the same time, the thesis shows that, in all its complexity, social inequality transmission does take place in neighbourhoods. The key takeaways for those researching and addressing urban inequalities are the need to take into account neighbourhood selection, different temporal aspects and individual perceptions, as well as to pay attention to spatially concentrated affluence, and not only poverty.

Samenvatting

Deze dissertatie gaat dieper in op de rol die gewoonlijk wordt toegeschreven aan buurten in het onderzoek naar ruimtelijke ongelijkheid, met name onderzoek op het terrein van buurteffecten. Sinds eind jaren tachtig is er veel onderzoek gedaan naar buurteffecten in verschillende steden over de hele wereld, voor verschillende populaties en met uiteenlopende resultaten. Op basis van het mechanisme dat buurtkenmerken van invloed zijn op de sociaal-economische situatie van een individu hebben onderzoekers modellen ontwikkeld, met name voor de ruimtelijke verdeling van armoede. Deze focus was ook gangbaar onder beleidsmakers en het grotere publiek, wat ertoe leidde dat het beleid zich vooral richtte op achtergestelde wijken, zoals beleid gericht op een sociale mix. Veel van deze beleidsinterventies blijken echter geen of zelfs een ongunstig effect te hebben, terwijl intussen de sociaal-economische segregatie in steden in het westen steeds verder toeneemt. Dat de vertaling van buurtonderzoek naar succesvol anti-segregatiebeleid problemen oplevert, betekent niet noodzakelijkerwijs dat er iets mankeert aan het concept buurteffecten. Het zou een aanwijzing kunnen zijn dat de toepassing van dit concept en de interpretatie van de waargenomen effecten te zeer werden versimpeld.

Het onderzoek naar buurteffecten heeft veel waardevolle kennis opgeleverd, maar in de literatuur werden buurten vaak voorgesteld als niet meer dan een omgeving, voorbijgaand aan de eigen betekenis die deze heeft. Een buurt kan worden gezien als een plek die mensen kiezen, die in de loop van de tijd verandert en die door verschillende mensen verschillend wordt ervaren. Dit promotieonderzoek toont aan hoe kwantitatieve buurtstudies kunnen bijdragen aan onderzoek en beleid door zich te focussen op processen die vaak over het hoofd worden gezien, maar die cruciaal zijn voor de overdracht van sociale ongelijkheid. Een dergelijke aanpak leidt tot een meer genuanceerde kijk op deze overdracht dan alleen “het wonen tussen arme mensen leidt tot meer armoede”.

In deze dissertatie worden in vier hoofdstukken vier onderzoeksvragen besproken voor empirisch onderzoek naar de onderbelichte factoren in het eerdere onderzoek naar sociaal-ruimtelijke overdracht van ongelijkheid in buurten. In hoofdstuk 2 wordt onderzocht in welke mate sprake is van buurteffecten wanneer rekening wordt gehouden met expliciet gemodelleerde buurtselectie in drie verschillende Nederlandse steden: Amsterdam, Utrecht en Rotterdam. In hoofdstuk 3 worden de effecten vergeleken die de verschillende wijzen van temporele operationalisatie van de

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geschiedenis, timing, accumulatie, duur en opeenvolging van individuen in een buurt hebben op onderwijsprestaties. In hoofdstuk 4 wordt onderzocht of in Nederland ruimtelijk geconcentreerde welvaart een groter effect heeft op onderwijsprestaties dan armoede. Tot slot wordt in hoofdstuk 5 de onderliggende, maar vaak impliciete aanname besproken van eerdere modellen wat betreft de effecten van het totaal aan sociaal-economische buurtkenmerken op individuen door te bestuderen hoe de individuele perceptie van sociaal-ruimtelijke variabelen, zoals het aantal buren dat in armoede leeft of van buitenlandse afkomst is, verschilt van de metingen op basis van registerdata, en hoe deze verschillen kunnen worden voorspeld.

In de empirische hoofdstukken van deze dissertatie worden statistische regressiemodellen toegepast voor de analyse van data uit het Sociaal Statistisch Bestand (SSB) van het Centraal Bureau voor de Statistiek (CBS). Het SSB is een bevolkingsregister voor de gehele Nederlandse bevolking en bevat onder meer gedetailleerde gegevens over individuen en huishoudens, zoals inkomen, opleiding, land van herkomst en geografische locatie. In hoofdstuk 2 worden de individuele SSB-data samengevoegd met variabelen op buurtniveau uit de openbare dataset *Kerncijfers Wijken en Buurten* van het CBS, en in hoofdstuk 5 met onderzoeksgegevens van het LISS panel. Deze kwantitatieve benadering, die gangbaar is in onderzoek naar buurteffecten, wordt vaak bekritiseerd vanwege de versimpelde voorstelling van de complexe realiteit van het buurtleven en het daarop gebaseerde beleid waarin te veel nadruk ligt op simpele armoede-indicatoren. Kwantitatief onderzoek is echter waardevol als bevestiging van algemene trends binnen de maatschappij en kan bijdragen aan een beter begrip van sociale processen, ook in de context van beleidsinterventies. Voor dit promotieonderzoek zijn statistische modellen toegepast die werden opgezet op basis van kwalitatief onderzoek. Daarnaast werd rekening gehouden met lastig te operationaliseren fenomenen als het verschil tussen registergegevens en individuele perceptie.

Daarnaast gaat deze dissertatie ook in op het vaststellen van de grenzen van de onderzochte buurten, wat vaak een probleem oplevert in onderzoek naar steden. In hoofdstuk 2 van dit onderzoek wordt gebruikgemaakt van administratieve buurten, waarbij wordt onderkend dat deze grenzen niet volledig representatief zijn voor de sociale ruimte, maar historische gewoonten en lokale tradities volgen. Voor hoofdstukken 3 en 4 werden buurten gecreëerd met Equipop-software, waarmee de verhouding werd vastgesteld van de tweehonderd meest nabije huishoudens in de buurt die in lage of hoge inkomenscategorieën vallen. In hoofdstuk 5 gaat het om een ander soort gecreëerde buurt (bestaand op basis van perceptie), die is gebaseerd op het door respondenten zelf aangewezen gebied dat zij binnen tien minuten te voet kunnen bereiken. In hoofdstukken 3 tot en met 5 wordt aangetoond hoe flexibel de geogecodeerde rasterdata van de SSB zijn voor het creëren van specifieke buurten.

De resultaten van dit promotieonderzoek leveren een genuanceerd beeld op over de overdracht van sociale ongelijkheid. In hoofdstuk 2 wordt besproken wat de invloed is van buurteffecten op het individuele inkomen in Amsterdam, Utrecht en Rotterdam, wanneer rekening wordt gehouden met de effecten van buurtselectie. Uit het onderzoek blijkt dat er, wanneer rekening wordt gehouden met selectie, minder sprake is van buurteffecten dan wanneer alleen rekening wordt gehouden met individuele kenmerken. Daarnaast biedt het inzicht in de verschillende patronen voor buurtselectie en effecten daarvan op de regionale Nederlandse woningmarkt. In hoofdstuk 3 wordt ingegaan op de effecten die de mate van blootstelling aan armoede in de buurt heeft op onderwijsprestaties. Deze blootstelling wordt op vier dimensies geoperationaliseerd: accumulatie, duur, timing en opeenvolging. Hieruit blijkt dat het verband tussen de waargenomen relatie tussen armoede in de buurt en onderwijsprestaties samenhangt met de wijze waarop de blootstelling wordt gemeten en geconceptualiseerd. Dit benadrukt hoe belangrijk de keuze is van de temporele aspecten van de geschiedenis van een individu in een buurt op basis van de theoretische reikwijdte van een onderzoek. In hoofdstuk 4 wordt geconcludeerd dat het positieve effect van welvaart in de buurt op onderwijsprestaties groter is dan het negatieve effect van armoede in de buurt. In het hoofdstuk wordt ook gekeken naar de interactie tussen het opleidingsniveau van ouders en de omstandigheden in de buurt. Hieruit blijkt dat een hogere opleiding van ouders een buffer kan zijn tegen de effecten van ruimtelijke armoede, maar dat kinderen in hoger opgeleide huishoudens wel beïnvloed worden door de welvaart in de buurt. In hoofdstuk 5 wordt ingegaan op de discrepantie tussen de metingen op basis van registergegevens over buurtkenmerken, met name het aantal buren met een buitenlandse achtergrond of een laag inkomen, en de individuele perceptie van die kenmerken door de buurtbewoners zelf. Er bestaat een correlatie tussen deze perceptie en de op registergegevens gebaseerde cijfers, maar die is niet erg groot wat betreft het percentage buren met een laag inkomen. De discrepantie tussen perceptie en de op registergegevens gebaseerde cijfers is afhankelijk van eigenschappen van individuen; vooral individuen met weinig vertrouwen in overheidsinstanties schatten vaak het aandeel van buren met een buitenlandse afkomst en laag inkomen te hoog in.

Op methodologisch vlak worden in deze dissertatie verschillende voorstellen gedaan, onder wat betreft een betere modellering van buurtselectie en de invloed van die selectie op buurteffecten, en een gedetailleerde operationalisering van verschillende temporele aspecten van de blootstelling aan buurtkenmerken. Voor toekomstig onderzoek naar buurtongelijkheid wordt een interdisciplinaire benadering aanbevolen met een combinatie van methoden, met aandacht voor de beleidsimplicaties en theoretische invloeden. Een combinatie van grootschalig databaseonderzoek en kleinschalige, kwalitatieve interviews zou zowel voor het onderzoek naar buurteffecten als de sociale wetenschap in het algemeen goede resultaten kunnen opleveren, ondanks de uitdagingen op het gebied van datatoegang en privacy.

Uit deze dissertatie blijkt dat het zinvol is om naar de buurt te kijken als een sociale omgeving waarin interactie is met de micro- en macrocontext, en niet slechts als een verzamelkenmerk dat als onderzoeksvariabele dient. De neiging om bepaalde aspecten van de rol van de buurt in de sociale werkelijkheid over het hoofd te zien kan ten dele worden verklaard door de gefragmenteerdheid van het onderzoek naar steden en de verschillende ontologische aannames en visies van verschillende disciplines en tradities. Stedelijk beleid kan effectiever worden wanneer het deze verschillende aannames en onderzoeksideologieën erkent en de complexiteit van stedelijke mechanismen accepteert. Voor wetenschappers is een rol weggelegd om duidelijk uit te leggen wat ze weten over deze mechanismen, zonder deze onnodig te versimpelen. Een belangrijke conclusie van deze dissertatie is dat het niet mogelijk is om de sociaal-ruimtelijke processen in buurten te generaliseren tot een simpel verhaal. Tegelijkertijd blijkt uit dit promotieonderzoek dat er in buurten wel degelijk complexe processen van overdracht van sociale ongelijkheid plaatsvinden. De belangrijkste conclusies voor mensen die ongelijkheid in steden onderzoeken en willen aanpakken is dat rekening moet worden gehouden met buurtselectie, verschillende temporele aspecten en individuele percepties, en dat daarnaast niet alleen aandacht moet worden besteed aan de ruimtelijke concentratie van armoede, maar ook aan die van welvaart.

1 Introduction

Ever since W.J. Wilson's book *The Truly Disadvantaged* (1987), a substantial range of studies have investigated the so-called neighbourhood effects in different cities across the world, with different populations and outcome variables. Wilson described the situation of the black residents of American inner cities, whose unemployment and poverty could, at least partially, be attributed to their spatial isolation both in terms of their distance from employment opportunities and middle class black families, who had moved out to the suburbs. Wilson claimed that the hard-working, middle class, families provide the necessary positive role models for their poorer neighbours. In the subsequent decades researchers developed models relying on similar mechanisms of neighbourhood poverty influencing the socioeconomic situation of an individual. Someone moving to a new neighbourhood is exposed to a new social environment, which can have positive (or negative) influences on their individual outcomes, compared to the effects of networks and resources available to them in their old neighbourhood (Galster, 2012).

Journalists and policymakers often refer to neighbourhood effects in the public discourse, assuming that spatially concentrated poverty and a high percentage of ethnic minorities in particular can have a negative effect on individual outcomes (Van Ham & Manley, 2012). One recent, extreme, example can be the Danish "ghetto" policies, including laws such as doubly harsh punishment of crimes in problematic neighbourhoods; such neighbourhoods are identified based on the proportion of foreign background inhabitants and poverty indicators (Seemann, 2021). Just as in case of the Dutch Rotterdam Act, forbidding poor households to move into certain neighbourhoods, statistics can be used to construct exceptional territories in need of decisive policies aimed at spatial deprivation (Uitermark et al., 2017). This is often justified as combatting negative neighbourhood effects. However, researchers studying such effects are far from a consensus, arguing that the amount of significant neighbourhood effects found in the literature could misrepresent the reality. This misrepresentation can be explained by a variety of factors, including publication bias in literature – papers with significant results are more likely to get published (Nieuwenhuis, 2016) – and selection bias present in the models: people choose neighbourhoods already inhabited by households with similar characteristics, and the observed "effect" of neighbourhood characteristics on individual outcomes includes the individual characteristics leading to neighbourhood selection in the first place (see Hedman & Van Ham, 2012 for an overview). In other words, the effect of

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neighbourhood poverty on its inhabitants' income could partly be caused by some people being too poor to live in a richer neighbourhood rather than any mechanisms in the neighbourhood itself.

Keeping in mind that several studies showed neighbourhood effects for adult employees after explicitly modelling neighbourhood selection (Ioannides & Zabel, 2008; Van Ham et al., 2018), the issue of selection bias highlights the fact that social inequality is spatially transmitted in diverse, often inconspicuous ways. Homophily (the notion that similarities attract) lies at the foundation of many friendships and romantic relationships in schools and workplaces, leading to an uneven distribution of social, cultural and economic capital within existing hierarchical socioeconomic and spatial structures (DiMaggio & Garip, 2012). In many physical spaces homophily processes themselves are less relevant, considering that privileged individuals self-select the places (such as private schools or sport clubs) they consider advantageous either for themselves or their offspring. The attraction of these expensive, exclusive spaces lies in the supposed elimination of traits associated with the less successful members of the society – their lack of motivation, unproductive or unhealthy lifestyles, delinquency – as much as in the perceived high quality of services provided. At the same time, getting to know other high status people enables people to benefit from shared skills and information (Bourdieu, 1986).

The same logic is followed by resourceful people while selecting a neighbourhood to live in. This, in turn, leads to spatial segregation, increasing in the recent years (Tammaru et al., 2014). Policymakers often worry about segregation – understandably, considering it goes against the popular meritocratic ideals of liberal democracies: children raised in disproportionally privileged or disadvantaged spaces do not have the same chances of succeeding in life, regardless of personal talent or effort. Because of these worries, proving that such segregation and its effects exist has been a central focus of the neighbourhood effects literature (Imbroscio, 2016). However, the scope of many studies is limited by underestimating the complexity of the neighbourhood itself and the way it is shaped by both the broader societal context and individual characteristics of its inhabitants. If one considers spatial concentrations of poverty, or ethnic minorities, in isolation, or has simplistic ideas about the effects that could arise from them, then the resulting policies are often supported not by evidence, but rather by appealing symbolism in public imagination. Examples are the already highlighted Danish ghetto laws, or social mix policies: in the case of already existing poor neighbourhoods, attracting middle class inhabitants through provision of new housing, for which the old housing has to be demolished and its inhabitants have to move elsewhere (Van Kempen & Bolt, 2009). This can negatively affect local social cohesion, while the unwanted homogenous poverty is

just moved to urban or suburban land with less value (Slater, 2013). But because of the appealing symbolism of decisively handling spatially concentrated deprivation, these policies keep being promoted and executed regardless of the lack of conclusive scientific evidence for their effectiveness (Kleinhans, 2004). Growing up in a "ghetto" or on the "wrong side of the tracks" is commonly seen as problematic. Yet to design policies which address urban segregation effectively we need to understand spatial transmission of inequality as a process more multifaceted than poor areas being neglected, and shaped both by the general mechanisms of social inequality and the actual location of the place of interest.

In the neighbourhood, people interact with others living close by, and these interactions can be studies as processes concerning some thousands local inhabitants and those who visit the neighbourhood. That situates the mechanisms of neighbourhood processes in an interesting middle position when it comes to the sociological micro-macro division – the micro-level being concerned with individuals and their immediate relationships, and macro with whole societies (Coleman, 1986). The neighbourhood is also in the middle of the spatial scale: between the individual households and larger cities, regions and countries. Despite often having unclear boundaries, neighbourhood can be seen as "a fundamental organising dimension of urban life" (Sampson, 2019, p. 7), persisting across historical eras and geographic locations. With the huge technological developments of the recent decades, it can be tempting to assume certain spacelesness, in which people are free from physical constraints of their neighbourhood because of online interactions and commuting possibilities. But at the same time, even in the relatively rich country of the Netherlands, city inhabitants have to deal with housing shortages and total restructuring of their neighbourhoods (Hochstenbach & Musterd, 2018) as well as their life outcomes being shaped by the education, facilities and social contacts in the neighbourhood (Boterman, 2012; Nieuwenhuis et al., 2015). People, especially those with fewer resources, create communities in their neighbourhoods (Völker et al., 2007). The recent Covid-19 pandemic was a stern reminder that even post-Space Age humans can become limited to and by their immediate physical environment (Bonomi Bezzo et al., 2021).

Rather than neglecting the effects of one's material location, social research should develop new approaches addressing how complex the dialectical interactions between space and social mechanisms can be. The key to effective policies lies in the neighbourhood itself, and more specifically in understanding its nature as a complex setting or even a sociospatial entity on its own: multifaceted, always changing and mediating "higher-order economic, political, and global forces" (Sampson, 2019, p. 21), as well as influencing and being influenced by its inhabitants. The complexity can be daunting: researchers have to keep in mind not only the differences between

countries or cities (Small & Feldman, 2012), but also between the neighbourhood inhabitants themselves. Whereas earlier neighbourhood effects studies wanted to find out whether these effects exist (Ellen & Turner, 1997), and it has been established that, in many cases, they do (Galster & Sharkey, 2017), the focus quickly moved to raising more questions like: when, where and for whom these effects matter (Sharkey & Faber, 2014). Is an observed effect true for all children, or only for boys, only for ethnic minorities, or only for children of single parent families? Why did their parents found themselves living in such a neighbourhood and what prevents them from leaving? What kind of people with what kind of careers create a disadvantageous neighbourhood? Is living in such a neighbourhood an issue for further achievements if a child has lived there for only few years? Do different children perceive their neighbourhoods in the same way? Such questions, and the desire to highlight the diverse pathways of social inequality transmission in the unique setting of a neighbourhood, inspired this PhD research. The following section explains the key theoretical concepts of this thesis, leading up to the formulation of the research aim and specific research questions for each of the chapters.

1.1 Theoretical framework: key concepts

1.1.1 Neighbourhood effects mechanisms

Neighbourhoods are usually thought of as places of a relatively low spatial scale, where people can directly interact. These interactions can be conceptualised as social-interactive neighbourhood effects mechanisms, next to those associated more with environmental factors such as pollution or the institutions and resources present in the neighbourhood (Galster, 2012). The social networks formed in neighbourhoods are theorised to aid spreading of social norms and sharing resources such as social and cultural capital (Lareau, 2011). The neighbourhood influence depends on exposure to its characteristics, and that exposure depends on factors such as the amount of time spent in the neighbourhood and social contacts among the neighbours (Sharkey & Faber, 2014). The influence on adults is therefore typically weaker than on children and teenagers, whose social networks are often limited to their neighbourhood. This is illustrated by the results of the Moving to Opportunity (MTO) quasi-experimental studies. The negligible results first disappointed

researchers, mostly economists expecting higher income and employment among the adults moving to a richer neighbourhood; only improvement in mental health was observed (DeLuca et al., 2012). The outcomes of MTO showed their full extent after many years, in longitudinal studies: the effects turned out to be substantial for children once they grew up and entered the labour market (Chetty et al., 2016).

Regardless, adults can adapt to their new residential locations by becoming more like their new neighbours by adopting their behaviours, aspirations and attitudes (social contagion), conforming to local social norms (collective socialisation) or accessing information and resources through their social networks (Galster, 2012). In terms of income, someone can find a better paid job through the neighbourhood social network or get a pay rise by behaving like their ambitious and hardworking neighbours. On the other hand, a person moving to an area with high unemployment and many low-skilled employees will more readily accept their own low salary (Pinkster, 2007). Additionally, environmental and safety-related characteristics of a neighbourhood, such as noise and deteriorated public infrastructure, could indirectly influence work performance of its inhabitants by raising their stress and anxiety levels (Bell et al., 1996). These place-based processes are regarded as potentially transmitting social inequalities both for children and adults (Lareau, 2011); the empirical chapters of this thesis explain in detail the neighbourhood mechanisms relevant for specific research questions.

1.1.2 Social inequality in the neighbourhood effects field

Despite the fact that social inequality is a key concept within the neighbourhood effects field, there is no standard approach to its conceptualisation. One could say that the lack of clarity about stratification within this field mirrors the variety of competing definitions of class and status within social sciences (Wright & Perrone, 1977). Wright (2009) outlines three main theoretical approaches within the sociology of class, social mobility and inequality: the individual-attributes approach (used in stratification research), opportunity hoarding (the Weberian approach) and mechanisms of domination and exploitation (the Marxist approach). The individual-attributes approach focuses on how people obtain resources that allow them to attain a certain occupation, and therefore a position within the social strata. These meritocratic resources (for example, education or motivation), next to attributes people are born with (sex, gender etc.) shape their chances in life. Missing from this approach is an analysis of the inequality between and the relational nature of the positions occupied by individuals. Starting with the assumption that access to the most prestigious positions tends to be strongly protected – or hoarded – by those on the top, the opportunity hoarding

or Weberian approach studies how the higher social strata distance themselves by setting up requirements based on economic, cultural and social capital, as well as more obvious, legal mechanisms of exclusion. An example from urban geography would be when local schools are only accessible to those living within a certain district – a geographically defined catchment area – which in turn only households with incomes above a certain level are able to afford. The domination and exploitation, or the Marxist, approach takes this analysis further, by asserting that those who restrict access to certain resources and positions can also "control the labour of another group to its own advantage" (Wright, 2009, p. 107). The main social division in this approach are the capitalists (who own the means of production) exploiting the workers (who are hired to work with these means of production), with other classes characterised by their relation to this main division (eg. managers who exercise much of the domination, but in the end are subjugated to capitalists themselves). Although it mostly focuses on workplace dynamics, this approach is present in urban studies research on the exploitations of tenants and ordinary homeowners by landlords and developers, and the pressure the latter can exert on government policies.

Researchers in the quantitative neighbourhood effects field usually mix elements of the stratification and Weberian approaches. The latter is popular partially because of the related, influential theories of economic, cultural and social capital as developed by Bourdieu (1986), which are often used to operationalise the transmission of social inequality in neighbourhood-based social networks (Lareau, 2011). The influence of the stratification approach manifests itself as a focus on (a lack of) social mobility and the idea that individuals' ultimate attained position is shaped by various attributes, many of them related to physical space.

Employing the concepts of cultural and social capital without fully adopting the opportunity hoarding approach associated with them may result in missing key pieces of the neighbourhood effects analysis. The positive influence of growing up in an affluent neighbourhood is not a serendipitous turn of fate; urban segregation is an outcome of conscious opportunity hoarding processes by those with the means to do so, even if households do not expect the macro level outcomes of their decisions (like in the Schelling ethnic segregation models), and the overwhelming majority of them are subjected to the whims of landlords and developers controlling the housing market. On the micro level, parents attach enormous value to the spatial environment of their offspring and contribute to making it even better (Toft & Ljunggren, 2016). Acknowledging that spatial transmission of poverty is not an isolated problem, but one reinforced by most resources being concentrated somewhere else, can help the neighbourhood effects field to move beyond the "poverty paradigm" and study social inequality more completely by investigating the role of affluent households and neighbourhoods (as this thesis does in Chapter 4).

1.1.3 Selection bias and neighbourhood selection

The research into selection bias in neighbourhood effects literature has been driven by the realisation that, without considering the structured selection of people into neighbourhoods, the supposed effects of neighbourhood characteristics such as average income on individual income could be just a result of reversed causality – in case of income, showing that richer people move into richer neighbourhoods (Ioannides & Zabel, 2008; Van Ham et al., 2018). While there have been many approaches to controlling for neighbourhood selection, for example by using fixed effects models (Jokela, 2015), the process of neighbourhood selection can be interesting in itself, with moving households having different spatial opportunity structures based on their resources and preferences.

Household income is not the only variable shaping the neighbourhood selection opportunity structure: while having a low income will greatly limit the choice set of neighbourhoods in which a household can reside, households can also express preferences for certain neighbourhoods based on their demographic and infrastructural characteristics. According to Hedman, Van Ham, and Manley (2011), "neighbourhoods which have a high proportion of children in their population are places where . . . families [with children] are most likely find a suitable dwelling, as well as being places which match parents preference to live in a child friendly neighbourhood" (p. 12). Such neighbourhoods will not only provide enough family-sized housing, but also enough schools, playgrounds, and kindergartens. Young, single people, on the other hand, may ignore these characteristics and choose a centrally located neighbourhood with vibrant nightlife, enough restaurants, and cultural venues. Equally, ethnic minority households might prefer to live closer to people with similar background, with local businesses and places of worship catering to their needs.

While preferences based on ethnicity, age and family structure influence individuals' choice regardless of their income, in practice all these characteristics are income-related. Neighbourhoods with many minority and young adult inhabitants will have a lower average income than those populated mainly by ethnic majority families, simply because these inhabitants earn less. Therefore, even seemingly income-unrelated choices result in people selecting into neighbourhood types which can influence their own income in a certain way (Hedman & Van Ham, 2012).

1.1.4 Individuals' neighbourhood histories

In the first decades of the 21st century, several authors undertook the task of mapping neighbourhood histories of individuals. In Europe, Van Ham et al. (2014) analysed the neighbourhood histories and intergenerational transmission of poverty in Stockholm, Sweden. In the Netherlands, Kleinepier and Van Ham (2018) researched the effect of various childhood neighbourhood trajectories on teenage problem behaviour. In the US, Sampson & Sharkey (2008) observed the interplay between neighbourhood selection, racially shaped hierarchies, and socioeconomic inequality by following the moves of Chicago families for up to seven years. While these innovative studies show how past neighbourhood contexts can influence the chances of living in an affluent or deprived neighbourhood in the future, the link between neighbourhood histories and neighbourhood effects on individual outcomes is less clear. Still, considering the substantial number of studies showing significant effects of neighbourhoods on outcomes such as educational attainment, health, income and crime (see Galster & Sharkey, 2017, p. 21, for a comparison), the tendency for neighbourhood types to repeat throughout the life course suggests the presence of self-reinforcing, cyclical processes of spatial and socioeconomic inequality.

There is a difference between a neighbourhood history and a housing career of a person: an individual can move houses within the same neighbourhood, and each of these moves would be a step of the housing career, especially important if there is a change in the size of dwelling or tenure. An operationalisation of a neighbourhood history, however, can ignore not only moves within the same neighbourhood, but even within a certain neighbourhood type, for example if it is a move from one poor white neighbourhood to another.

1.1.5 The role of individual perceptions in quantitative urban research

Neighbourhood effects studies investigate the influence of aggregated neighbourhood characteristics, usually socioeconomic variables such as average income or share of ethnic minorities, on individual outcomes. Other studies focus on the individual perceptions of the neighbourhoods, related to subjective feelings and experiences. The studied concepts include perceptions of danger in the neighbourhood (Roosa et al., 2009), neighbours' friendliness (Munro & Lamont, 1985), or neighbourhood aesthetics (Mackenbach et al., 2016).

Still, even in the case of socioeconomic variables usually measured using register based data, individual perceptions can differ from those based on administrative measurements (Chiricos et al., 1997). It remains unclear from the literature how individual demographic and socioeconomic characteristics influence perception of neighbourhood characteristics, such as the share of inhabitants with migration background or poverty. The different ways in which different people may register or experience the commonly used register data variables are overlooked. For example, the positive influence of urban green space on health and wellbeing outcomes is widely studied but depends not only on the physical presence of urban green (which can be easily and numerically measured), but also on the ability of inhabitants to notice it and interact with it to allow any beneficial influence on their lives (K. Wilson et al., 2004).

Individuals are often inaccurate in their estimations, even in the context of large scale processes such as the poverty level in their entire country (Mysíková et al., 2019). At the neighbourhood scale, the likely absence of contact between different social groups living close by (Bolt & van Kempen, 2013) could contribute to that inaccuracy. Still, even the simple act of acknowledging the presence and assumed characteristics of a neighbour can form an "invisible" social tie (Felder, 2020), which can be sufficient to inform perceptions of neighbours. There are many studies investigating the mediating effect of more perceptual variables, such as neighbourhood disorder, on the objective measures of neighbourhood poverty (Haney, 2007). But, to my knowledge, none of them compare objectively measured and individually perceived neighbourhood poverty, and very few compare the perceived and measured presence of ethnic minorities in neighbourhoods (Hooghe & De Vroome, 2015; Van Assche et al., 2014, 2016).

1.2 Research aim and research questions

As the neighbourhood effects field developed, many researchers called for research considering the dynamic, cyclical and contextual nature of neighbourhoods and neighbourhood effects (Hedman, 2011; Sampson & Sharkey, 2008; Sharkey & Faber, 2014). People move, and the effects of their previous neighbourhoods still influence their choices, but the neighbourhoods themselves can also change: they become poorer or, more often in recent years, richer through gentrification (Hochstenbach & Musterd, 2018); the cities become more segregated (Tammaru

et al., 2014), with various consequences for the inhabitants. The housing market opportunities can become drastically different in a timespan of a generation (Hochstenbach, 2018). In more segregated cities, not only poverty, but also affluence of predominantly rich neighbourhoods shapes the life chances of children growing up in them (Toft & Ljunggren, 2016). Regardless of neighbourhood-level changes, neighbourhood histories of individuals tend to reinforce themselves: people who grew up in a poor neighbourhood are not only likely to experience its consequences, but also more likely to live in similar neighbourhoods in the future, controlling for individual achievement (Hedman et al., 2017). On top of this, neighbourhood effects are stronger for certain people, such as the part time employed and families with children (Galster et al., 2010). This can be partially caused by different people perceiving the same neighbourhoods in different ways (Bowling et al., 2006; Fagg et al., 2008). These new theoretical and methodological contributions lead to a complicated conceptual landscape of a field in which the original question, do neighbourhood effects exist, becomes too simplistic.

The aim of this PhD thesis is to explore the hidden pathways of social inequality transmission in the neighbourhood; or, in other words, to better understand how sociospatial inequality is reproduced in neighbourhoods with a specific focus on the under researched elements of this reproduction: neighbourhood selection (Chapter 2), individuals' neighbourhood histories (Chapter 3), spatial concentrations of affluence (Chapter 4) and individuals' sociospatial perceptions (Chapter 5). The significance of these elements becomes clear after one considers the neighbourhood itself and how it interacts with its inhabitants, instead of remaining in the simplified paradigm of concentrated disadvantage in the neighbourhood affecting its inhabitants.

Although touching on different concepts, the research questions in this thesis follow on from each other. Tammaru et al. (2021) developed the vicious circles of segregation approach to studying the spatial underpinnings of social inequalities, in which they note that new research on sociospatial inequalities beyond the place of residence and availability of detailed longitudinal data have allowed us to move from "photo-like" snapshots of urban segregation to a more complete "'video-like' following of people across time and space, connecting their behaviour in school, residential and work environments, and connecting family members, neighbours, school mates and co-workers with each other" (p. 67). I would argue that this "video-like" quality can apply to research on the home neighbourhood itself (the persisting importance of which is also noted by Tammaru et al.), especially if one considers the temporal aspects of the social processes of interest.

Interacting with a new neighbourhood context is always determined by one's previous socioeconomic status. While moving, people go through an often complex process of selection, in which they try to choose the best available housing and neighbourhood based on their preferences, and the resources and information available to them. This selection processes can explain much of what the researchers observe as the effects of the new neighbourhood – but can selection explain all these effects? And can these processes work differently in different cities? I focus on this question (research question 1) in Chapter 2. The alternative way of arriving in a neighbourhood, by being born in it, is also determined by one's parents' resources and choices. After that an individual is subjected to neighbourhood influences which can often change, and these changes across time can be operationalised in different ways by researchers. Chapter 3 compares how exposure to neighbourhood poverty over the entire childhood and early adulthood, operationalised in different ways – by accumulating the exposure, looking at different timing, duration and sequences of it – affects one's educational attainment at age 23 (research question 2). As described above, poverty tends to be the main focus of spatial inequality studies; but in the Dutch context, with relatively low poverty, but still growing segregation of rich and poor, could spatially concentrated affluence – related to more educational and cultural resources – have a stronger effect on educational attainment than poverty (research question 3)? Both this question and the possible interaction of neighbourhood context with the education of one's parents is studied in Chapter 4. All these studies use register data-based, assumingly objective measurements of socioeconomic neighbourhood characteristics. However, for certain effects, these measures can differ from how the same characteristics are perceived by individual, based on different individual traits. How perceived and measured characteristics differ and what can predict them (research question 4)? I answer that question in Chapter 5, assuming that the perceptions of socioeconomic characteristics, share of foreign background and low income neighbours, are themselves shaped by one's income and ethnic background. This is yet another "vicious circle", similar to how people with few resources would be limited in their neighbourhood selection and those more often exposed to neighbourhood poverty could experience negative effects on education; while, importantly, those in affluent settings could be influenced positively – but only if their or rather their parents' characteristics allowed them to live there in the first place. The focus of these chapters can be summarised in four research questions.

— **Research question 1:** To what extent are neighbourhood effects observed while controlling for explicitly modelled neighbourhood selection, in different Dutch cities? (Chapter 2)

- **Research question 2:** What are the effects of the timing, accumulation, duration and sequencing of exposure to neighbourhood poverty on educational attainment? (Chapter 3)

- **Research question 3:** In the Dutch context, is the effect of spatially concentrated affluence on educational attainment stronger than that of poverty? (Chapter 4)

- **Research question 4:** How do the individual perceptions of sociospatial variables such as the share of poor or foreign background neighbours differ from measurements based on register data, and what predicts these differences? (Chapter 5)

While neighbourhood characteristics can influence individual outcomes, these neighbourhoods are in turn influenced and, especially in the case of socioeconomic characteristics, ultimately formed by individual characteristics. In other words, the rich neighbourhood with good schools that positively influences one's educational attainment was first built and developed by previous inhabitants. The empirical chapters of this thesis are situated in different stages of that individual-neighbourhood dialectical relationship; Figure 1.1 is a schematic representation of that. Neighbourhood selection (Chapter 2) can be seen as situated within the influence of individual characteristics on that of the chosen neighbourhood, while individuals' neighbourhood histories (Chapter 3) are operationalisations of different temporal aspects of the neighbourhood characteristics' influence on individual outcome. Spatial concentrations of affluence (Chapter 4) and individuals' sociospatial perceptions (Chapter 5) are closely related both to the individual characteristics' effects on the neighbourhood characteristics and the opposite effect.

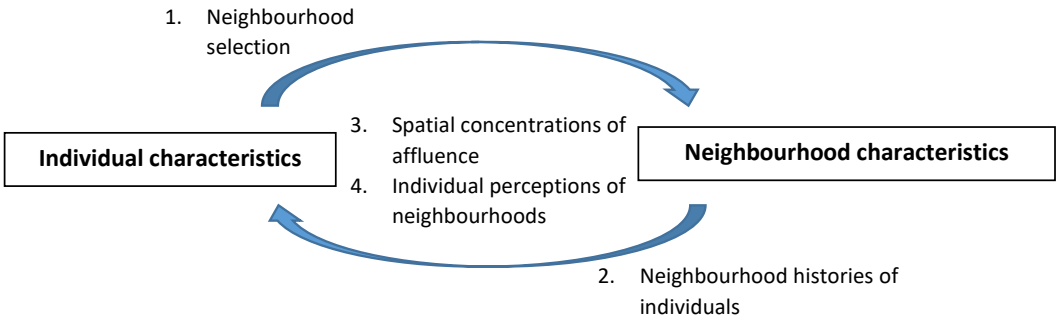

FIG. 1.1 The under researched elements of the sociospatial transmission of inequalities

1.3 Methods and data

1.3.1 Quantitative statistical analysis and GIS

In all chapters of this PhD thesis, I used statistical regression models of varying complexity. The strict quantitative approach of many, if not the majority of neighbourhood effects studies has been criticised for obscuring the complex realities of neighbourhood life, and therefore inspiring policy approaches which overemphasise simplistic indicators of deprivation and neglect important phenomena such as neighbourhood solidarity and cohesion (Slater, 2013). Critiques of the middle-range approach to social science (Boudon, 1991), typical for quantitative studies of social mobility within the larger social inequality studies field, are definitely needed and lead to fruitful contextualisations, such as including insights from theoretical and qualitative studies (also in this PhD project). But these critiques too often seem to discredit quantitative research, especially that comprising complex modelling, as per definition theoretically superficial. "Most troubling of all about these words is that *not a single Swede of any income category was interviewed* for the study" (italics from the original), writes Slater (2013, p. 279), about a study using regression to analyse neighbourhood effects with the assumption that information and attitudes on jobs spread through the local social networks (Galster, 2008). But while qualitative research provides crucial insight into individual motivations, generalised societal trends can only be confirmed by quantitative studies. Mistrusting quantitative research can also stem from associating statistics-based studies with positivist or modernist urban policy approaches, which have little care for the interest of oppressed social groups (Wyly, 2011); however, as Wyly argues with many convincing examples, quantitative urban research can be successfully used by researchers with very different views on urban policy and epistemology. Furthermore, policy interventions can always benefit from a fuller understanding of social processes on different levels, especially when situated in a unified framework which sees different research traditions as studying different aspects of the same social reality. In such a framework, qualitative studies proposing radical policies and exploratory quantitative studies can coexist despite their differing goals and visions of society (Wright, 2009).

Keeping these caveats in mind, statistical analysis of large geo-coded datasets is the logical analytical approach to answer the research questions posed in this thesis, which concern commonly occurring mechanisms, or averaged trends in

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the society. Whenever possible, the statistical models are inspired by qualitative studies and take into account individual perceptions (Chapter 5), through which some light is thrown into the "black box" of neighbourhood mechanisms studied using register data (Manley et al., 2013). Issues with the administrative data, such as changing neighbourhood names or borders, were also investigated using GIS (Geographic Information Systems) programmes, which also proved necessary for the construction of bespoke neighbourhoods in Chapter 5. In general, statistically modelling my data, which comprise the entire population of the Netherlands, allows me to formulate findings not only on specific neighbourhood settings, but on larger scale processes in different cities and the entire country.

1.3.2 Data sources

The data for the analyses presented in the following chapters are taken from the Statistics Netherlands (CBS) Social Statistical Database (SSD), also called microdata, which is a population register covering the entire population of the Netherlands from 1999 (with some datasets going as far back as 1995) until now (2022). The SSD datasets include detailed statistics on, among other characteristics, individual and household income, obtained education, country of origin and, crucially for my research, the geographic location of each person in the data on a 100x100m square grid. While maintained for administrative purposes, the database can be accessed by researchers after rigorous privacy requirements are met.

In Chapter 2, the individual SSD data are merged with neighbourhood-level variables from the publicly available Statistics Netherlands dataset *Kerncijfers Wijken en Buurten* (statistics about districts and neighbourhoods). In Chapter 3 and 4, all neighbourhood-level variables are created directly from the SSD individual datasets to obtain more accurate bespoke neighbourhoods. In Chapter 5, the Statistics Netherlands data are merged with survey data from LISS (Longitudinal Internet studies for the Social Sciences) panel administered by CentERdata (Tilburg University, The Netherlands), with a specific questionnaire on neighbourhood perceptions. The LISS panel is a representative sample of Dutch individuals who participate in monthly internet surveys. The panel is based on a true probability sample of households drawn from the population register (households that could not otherwise participate are provided with a computer and Internet connection). Next to the questionnaire on neighbourhood perceptions, specially designed by Heleen Janssen and Maarten van Ham, the study uses variables from other LISS datasets (Background Variables, Politics and Values, and Personality), choosing the waves which were closest to the time point of data collection for the neighbourhood

perceptions questionnaire (July 2020). The full documentation of the LISS panel can be found at www.lissdata.nl. Also in Chapter 5, a road map included in the Statistics Netherlands database (*Nationaal Wegen bestand*), which shows all named roads in the Netherlands, including footpaths, is used in QGIS to create bespoke neighbourhoods within a walking distance of 10 minutes (600 metres).

1.3.3 Administrative, bespoke and perceived neighbourhoods

Determining the boundaries of the studied neighbourhood has long been an important issue in neighbourhood based studies, with the most commonly available administrative neighbourhoods often criticised because of their often arbitrary size and shape. People living near the border of a neighbourhood could experience the effects of the surrounding neighbourhoods, which would not be included in the analysis. Despite this, administrative neighbourhoods can give insight into the contextual relationships and Chapter 2 of this study uses such neighbourhoods. This chapter deals with neighbourhood selection and people often see the possible neighbourhood destinations in terms of the administrative unit they belong to, which usually bears a name widely used to designate the area in the city (Permentier et al., 2008). Even though their borders might not seem entirely logical, administrative neighbourhoods often follow the historical customs in dividing the city into smaller areas, with local traditions making the areas recognisable to many inhabitants.

The increasing availability of rich data sources and methodological developments allow the creation of bespoke neighbourhoods, which are usually the best reflection of the actual surroundings of people in the analysis (Van Ham et al., 2014). In Chapters 3 and 4, such neighbourhoods are created based on the Statistics Netherlands microdata, using the Equipop software (Östh, 2014). Equipop identifies the number of nearest neighbours required to reach a specified threshold value – in the analyses in this thesis, 200 nearest households – and then calculates the ratio of a specified characteristic, for example the neighbouring households above or below certain income threshold. This approach can be used for analyses on larger regions with varying population densities, as long as that density, or the urban character of studied places, are controlled for. In some densely populated, highly urbanised areas, the threshold of the 200 nearest neighbours can be reached by not even leaving the central 100x100m grid square, while in the countryside the resulting bespoke neighbourhood could span substantially larger distances over many grid squares. Therefore, the number of neighbours in bespoke neighbourhoods should be chosen based on the geographical scope and focus of the study.

The final empirical chapter, Chapter 5, includes a different type of bespoke neighbourhoods – a perceived neighbourhood. This operationalisation is based on the LISS neighbourhood perceptions survey, in which the respondents were asked to think of their neighbourhood as of the area which they can reach within a ten minute walk from their home. Such a perceived neighbourhood might seem nebulous, which is typical for self-defined neighbourhoods. However, having one's home as the starting point can help with neighbourhood conceptualisation, which tends to be more accurate when starting with a core rather than its periphery (Minnery et al., 2009), with home taking over the role of commonly shared neighbourhood facilities in this case. Aiming to create the best possible match for these perceived neighbourhoods, in Chapter 5 I created bespoke neighbourhoods based on administrative data and comprising the area within an average ten minute walk, or 600m, from the survey respondent's home square. Because of this approach, GIS – more specifically the QGIS programme – was used instead of Equipop. As shown in these three chapters, the 100x100m geocoded grid data can be easily used for various kinds of bespoke neighbourhood creation.

1.4 Thesis outline

In this thesis, chapters 2 to 5 include four empirical studies answering the research questions listed above. Each chapter contains its own introduction and a theoretical background section, which reviews relevant academic literature. Chapter 2 models neighbourhood effects on individual income in three Dutch cities, while controlling for, also explicitly modelled, neighbourhood selection. It shows the highly structured processes of neighbourhood selection, how the neighbourhood effects diminish, but do not completely disappear after controlling for that selection, and how these processes are different in Utrecht, Amsterdam and Rotterdam. Chapter 3 operationalises four different temporal aspects of exposure to neighbourhood poverty, accumulation, duration, timing and sequencing. This chapter highlights the importance of careful, theoretically motivated choice of temporal operationalisations, as the effect of neighbourhood poverty on educational attainment differ for different operationalisations. Chapter 4 compares the effects of exposure to neighbourhood poverty and affluence, with the results supporting the idea that in the Netherlands, (lack of) exposure to spatially concentrated affluence can be more crucial for children's educational attainment than that to neighbourhood poverty. Chapter 5 investigates the mismatch between the measurements of

common socioeconomic variables, the share of low income and foreign background neighbours, created from register data and survey-based individual perceptions. The individual predictors of this mismatch, including institutional and generalised trust, are shown to be of influence.

Finally, chapter 6, the conclusions, reports the main research findings and reflects on them, as well as on the societal and academic relevance of the thesis. It discusses the ways in which new approaches to studying social inequality transmission in the neighbourhood, highlighting the cyclical nature of that transmission, can contribute to a fuller understanding of sociospatial effects both in research and policy. The chapter also considers the theoretical and methodological contributions of the thesis, as well as benefits and limitations of the data and methods used, ending with suggestions for future research.

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2 Modelling neighbourhood effects in three Dutch cities controlling for selection

Troost, A. A., Van Ham, M., & Janssen, H. J. (2022). **Modelling neighbourhood effects in three Dutch cities controlling for selection.** *Applied Spatial Analysis and Policy, 15*(2), 455-482.

ABSTRACT The non-random selection of people into neighbourhoods complicates the estimation of causal neighbourhood effects on individual outcomes. Measured neighbourhood effects could be the result of characteristics of the neighbourhood context, but they could also result from people selecting into neighbourhoods based on their preferences, income, and the availability of alternative housing. This paper examines how the neighbourhood effect on individual income is altered when geographic selection correction terms are added as controls, and how these results vary across three Dutch urban regions. We use a two-step approach in which we first model neighbourhood selection, and then include neighbourhood choice correction components in a model estimating neighbourhood effects on individual income. Using longitudinal register datasets for three major Dutch cities: Amsterdam, Utrecht and Rotterdam, and multilevel models, we analysed the effects for individuals who moved during a five-year period. We show that in all cities, the effect of average neighbourhood income on individual income becomes much smaller after controlling for explicitly modelled neighbourhood selection. This suggests that studies that do not control for neighbourhood selection most likely overestimate the size of

neighbourhood effects. For all models, the effects of neighbourhood income are strongest in Rotterdam, followed by Amsterdam and Utrecht.

2.1 Introduction

A major challenge in the field of neighbourhood effects is the estimation of contextual effects free of bias from the non-random selection of households into neighbourhoods. Neighbourhood effects are causal effects of the spatial context on individual outcomes, such as education, health or income (Galster & Sharkey, 2017). However, people do not randomly choose their residential neighbourhood, but generally select neighbourhoods inhabited by people with similar characteristics to themselves (Hedman et al., 2011). The observed "effect" of neighbourhood characteristics on individual outcomes is therefore at least partly the result of selective sorting of individuals into neighbourhoods (Hedman & van Ham, 2012).

The concern about selection bias is not new. Sampson (2008) traced it back to the early work of Jencks and Mayer (1990), who concluded that we do not know whether differences in outcomes result from neighbourhood factors, rather than just from selection into the neighbourhoods. Researchers developed several strategies to overcome selection bias in their research designs and statistical modelling approaches, such as: experimental, or quasi-experimental research designs (Katz et al., 2001; Leventhal & Brooks-Gunn, 2003; Sanbonmatsu et al., 2006); the use of instrumental variables (Hedman & Galster, 2013) or sibling data (Oreopoulos, 2003; Zick et al., 2013); or longitudinal data and fixed effects models (Boone-Heinonen et al., 2011; Jokela, 2015). Another approach explicitly models neighbourhood selection as a conditional logit regression, in which the probability of an individual choosing a neighbourhood based on individual, household and neighbourhood characteristics is estimated (Ioannides & Zabel, 2008). In a second step these predicted probabilities are turned into correction components, which are used as controls in a neighbourhood effects model for the same subjects. This method was applied and refined in a study of neighbourhood effects on individual income by Van Ham et al. (2018).

Because this two-step approach explicitly models neighbourhood selection, it can be used to provide insights about the influence of local selection mechanisms on neighbourhood effects, when it is applied to multiple cities. Small & Feldman (2012) argued that differences in neighbourhood effects between cities are often overlooked

in neighbourhood effects studies. The current study contributes to this discussion by arguing that dealing with selection bias can have varying results in different cities. We examine selection mechanisms and their influence on neighbourhood effects in three different Dutch urban regions (which from now on will be also referred to as cities): Utrecht, Amsterdam and Rotterdam. Using longitudinal and geo-coded register data, we first model neighbourhood selection, and then the effect of average neighbourhood income on individual income from work. We further develop the original two-step approach in several ways. Firstly, where previous studies only included individuals who moved within one particular year, which biases the sample towards "frequent movers" (Hansen & Gottschalk, 2006; Phinney, 2013), we included individuals who moved within a period of five years (2010 to 2014). Secondly, it is expected that moving to a higher income neighbourhood would lead to an *increase* in individual earned income. We therefore investigate neighbourhood effects on both income in a given year, and change in income. Finally, whereas Van Ham et al. (2018) used clustered standard errors to control for the clustering of individuals in neighbourhoods, we use a multilevel model, which is a more appropriate choice for modelling clustered data (Cheah, 2009; Jones, 1991), and gives us insight into the amount of variance explained by the predictors on neighbourhood level.

2.2 Literature review

2.2.1 Selection bias in the neighbourhood effects studies

Concerns about selection bias, or neighbourhood effects being overestimated due to the non-random structured selection of people into neighbourhoods, have long plagued the field of neighbourhood effects (Small & Feldman, 2012). In response to these concerns, different approaches were taken to take selection bias into account. Quasi-experimental designs were developed, such as the Moving to Opportunity scheme, beginning in 1994, in which low income American families could move out from high-poverty public housing to low-poverty middle class neighbourhoods (Leventhal & Brooks-Gunn, 2003). Oreopoulos (2003) took another approach by using data on public housing inhabitants from Toronto; he argued that they do not select their neighbourhoods themselves, which should minimise selection bias. Boone-Heinonen et al. (2011) noted that ideally observational designs should be

longitudinal, which allows for assessing changes in individual's characteristics in relation to changes in the neighbourhood. Cross-sectional studies often control for variables regarded as proxies for selection bias, and instrumental variables related to the proposed predictors, but not the outcomes (Zick et al., 2013). Such strategies, however, give little insight in the selection process itself, and in the case of self-reported preferences might even introduce additional bias (Boone-Heinonen et al., 2011).

But could there be *too much* focus on selection? Sampson (2012) observes that the function of individual choice remains a controversial matter: some researchers argue that "segregation and constraints of inequality override choice, in extreme case almost as if individuals are pawns in a predetermined game"; others "valorise choice to the point where it is said to undercut research efforts to investigate the effects of neighbourhood context" (p. 287). Such discussions hark back to the debate on the influence of socioeconomic structures vs individual agency on one's life outcomes. A few studies attempt to have the best of both worlds by modelling the effect of individual moving choices on the socioeconomic structure of neighbourhoods (Hedman et al., 2011; Sampson & Sharkey, 2008). Hedman et al. (2011) demonstrate that people move to neighbourhoods with inhabitants of income, ethnicity and family composition similar to their own, most often reproducing existing neighbourhood structures.

Ioannides and Zabel (2008) recognised the importance of explicitly modelling neighbourhood selection in their study of housing demand. They use a conditional logit model of selection from a set of 11 tracts (10 of them randomly selected from all US census tracts in the metropolitan area, plus the chosen tract of an individual). Subsequently, they deal with selection bias by deriving neighbourhood selection correction components from the first step, and including them in the models of housing demand. The results show that the neighbourhood effects became stronger after controlling for neighbourhood selection. In contrast, the results by Van Ham et al. (2018), who followed a very similar two-step strategy, show that the observed neighbourhood effects on individual income weaken after adding the neighbourhood selection controls. The different effects could be explained by the different dependent variables used in the two studies, as well as differences in their measurement of the neighbourhood context and different residential preferences of the American and Dutch households. Another explanation might be that Van Ham and colleagues used the full set of neighbourhoods, rather than a random subset like Ioannides and Zabel did. In any case, Ioannides and Zabel's paper introduces a convincing method of combining both the neighbourhood selection and effects processes in one modelling approach.

2.2.2 Neighbourhood selection

Over the life course people choose dwellings in different locations and neighbourhood types, each suited to their current preferences and resources, and closely related to major life events such as starting a family or retiring (Rossi, 1955). Because dwelling types are not randomly distributed over urban space, households tend to move to neighbourhoods with households similar to themselves, because they prefer to live in similar types of dwellings.

These trends can change over time; throughout the second half of the 20th century, Western middle class people used to move to the suburbs to raise their children in big dwellings and safe, sleepy neighbourhoods. Recently, more and more higher-educated couples refuse to forsake the inner city services and institutions once they have children (Boterman, 2012). Especially the mothers in dual-earner households benefit from the easy access to city resources Boterman & Bridge, 2015). The demand for inner city dwellings rises, spreading from the very city centre to the surrounding, previously undesirable neighbourhoods. Access to workplaces can also affect neighbourhood choice. Depending on the chosen mode of transportation, neighbourhoods located close to the highway or train station – or both – might be more attractive (Van Ham et al., 2001).

In their literature review on neighbourhood selection, Hedman et al. (2011) list empirical evidence confirming the position of income and ethnicity as the main drivers of neighbourhood choice and resulting patterns of segregation (see also Galster & Turner, 2019; Musterd, Van Gent, Das, & Latten, 2016). The choice-limiting effect of income is straightforward: low income households cannot afford to live in expensive neighbourhoods. Such “affordability constraints” can be accounted for by including dwelling value and household economic resources in the model (Bruch & Mare, 2012).

The effect of ethnicity is more complicated, also because ethnicity and income are strongly related. Many researchers, starting from the famous models by Schelling (1971), emphasise the importance of individual preferences with regard to the ethnicity of their neighbours in understanding neighbourhood choice, and the resulting patterns of segregation. While most minorities earn less than the ethnic majority, many of them have other economic, religious and cultural reasons for living close to each other (McAvay, 2018). Whereas an ethnic majority family most likely will move out of a poverty neighbourhood when they can afford it, an ethnic minority family which can afford to live in a more affluent, overwhelmingly native neighbourhood, might choose to remain in a neighbourhood with people from their own background to stay in touch with family and cultural traditions (Boschman & van Ham, 2015).

Next to preferences and affordability constraints, selection can be shaped by a limited access to information about neighbourhoods. Although such information is relatively easy to access in the Netherlands, movers might not consider the parts of the city they do not know well, and such knowledge is often closely related to the income- and ethnicity-based segregation (Krysan & Crowder, 2017). People's social networks are related to the places where they already live, and if these networks comprise, for example, high income individuals, it is likely that members of the network will share information mostly about higher income neighbourhoods.

2.2.3 Different cities, different neighbourhood processes

Studies of neighbourhood effects often overlook that both selection and neighbourhood effects can vary depending on local circumstances. For a long time, Chicago was seen as the prototype city to study neighbourhood effects (Small & Feldman, 2012). Key authors such as Wilson (1987) have claimed that various characteristics observed in Chicago, such as low density of local businesses and institutions in poor neighbourhoods, are representative for all US cities. However, Small and Feldman (2012) show that local establishment density in poor Chicago neighbourhoods is much lower than the averages for other American cities. Furthermore, Burdick-Will et al. (2011) found significant effects of the MTO experiment on children test scores in Chicago and Baltimore, but not in Los Angeles, Boston and New York. Because of such findings, Small and Feldman (2012) call for more neighbourhood effects studies with data collected from "average", middle-sized cities without unusually high crime or poverty levels. In Europe, Musterd, Galster, and Andersson (2012) also found that evidence of neighbourhood income mix effects on individual income varies between Swedish cities.

Because of the need for more heterogeneous research settings, and because of the importance of regional housing markets in understanding processes of neighbourhood selection, the current study focusses on three different urban regions in the Netherlands: Utrecht, Amsterdam and Rotterdam. Although all three cities are a part of the Randstad[1], this metropolitan area "has no institutional foundation and no formal powers of decision-making" (Stead & Meijers, 2015, p. 4), which

1 A polycentric metropolitan area in the western part of the Netherlands, comprising the four largest Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht), as well as multiple smaller cities and the less-densely populated, agricultural core (known as the Green Heart), totalling a population of around 7 million (Stead & Meijers, 2015)

leads to differences in local policies. Because of this and other, historical, reasons the three cities have developed differently. Utrecht has a far lower percentage of ethnic minorities (32%) compared to Amsterdam (50%) and Rotterdam (49%)[2]. Rotterdam has a higher share of households with a lower income and lower educational level compared to the other cities. This situation is related to the city's industrial past: even though now it has a university like Utrecht and Amsterdam (which has two), much of its labour market revolves around its port, the largest in Europe (Stead & Meijers, 2015). Amsterdam is a leading cultural and financial centre with a large number of both high- and low-income immigrants, as well as Dutch citizens with foreign roots. Utrecht has a similar labour market to Amsterdam, with an overrepresentation of high socio-economic status occupations. In Utrecht, ethnic minorities are concentrated in suburban districts, where most of the city's social housing is located; the overall percentage of social housing is also the lowest of the three cities (33% in 2015, compared to 45% in Rotterdam and 43% in Amsterdam[3]). Unlike in Utrecht, social housing is quite evenly spatially distributed in Amsterdam and Rotterdam. In Amsterdam this distribution is an effect of decades of housing policy which prioritised social mix on the neighbourhood level. Rotterdam also has a high percentage of social housing throughout the city, even after large scale urban restructuring since the 1990s.

These differences in local economies between the three cities are likely to affect the process through which households select into different types of neighbourhoods. Amsterdam and Utrecht are both known for their very high housing prices, and in these cities the middle income households are in a difficult situation, as they earn too much to qualify for social housing, but cannot afford to live in the most desirable neighbourhoods. As a result, income might be a stronger predictor of neighbourhood selection in Utrecht and Amsterdam compared to Rotterdam. Other personal characteristics, such as education and family composition, combined with local particularities, may also lead to differences in selection patterns between the cities, as well as to differences in the magnitude of neighbourhood effects.

2 https://opendata.cbs.nl/statline/

3 https://opendata.cbs.nl/statline/

2.2.4 Neighbourhood effects on income and income change

Many empirical studies have investigated neighbourhood effects on individual income (see Galster & Sharkey, 2017, p. 21, for an overview). The evidence suggests that the neighbourhood influence in adulthood is weaker than the influence experienced in childhood, when social networks are more often limited to the neighbourhood and major career choices are yet to be made (Galster & Sharkey, 2017). Still, adults can become more similar to their neighbours through the social-interactive mechanisms of adapting to their behaviours, aspirations and attitudes, conforming to local social norms or accessing information and resources through their social networks (Galster, 2012). With regards to income, someone can find a better paid job through the neighbourhood social network. On the other hand, a person living in an area with a high level of unemployment and many low-skilled employees will more readily accept her own low salary (Sari, 2012). Pinkster (2007, 2014) investigated these mechanisms in her qualitative studies of a high-poverty neighbourhood in the Hague, Transvaal-Noord. She found that the local dense social networks did help with finding a low-skilled job, but the availability of such jobs discouraged the immigrant neighbourhood inhabitants from pursuing further education, learning Dutch and familiarising themselves with the formal job market. This illustrates how the information and contacts in the neighbourhood can influence individuals' income.

For employed household heads moving to a new neighbourhood, a change in their income can be caused primarily by the aforementioned social mechanisms, but also by a number of other neighbourhood characteristics. In their study of the influence of neighbourhood social mix on Stockholm's inhabitants' income, Galster et al. (2016) describe the potential influence of local crime levels, institutional resources and job accessibility, widely studied in the literature. Neighbourhood average income tends to be a good proxy for these characteristics because of local self-reinforcing processes of spatial inequality – for example, well-connected neighbourhoods tend to have more expensive dwellings, which attracts richer inhabitants, who further profit from the easy access to jobs and services (Toft & Ljunggren, 2016). Such processes correspond to theories of the Matthew effect (Merton, 1968) and cumulative disadvantage (Sampson & Laub, 1997). A move to an affluent neighbourhood should therefore expose an individual to many beneficial resources, regardless of her previous socioeconomic status. It can also inspire an aspirational attitude of trying to „keep up" with the richer neighbours, encountered at local establishments and events.

2.2.5 Current study

Following Ioannides and Zabel (2008) and Van Ham et al. (2018), we first explicitly model neighbourhood selection and then use the predicted probabilities from this model to construct correction components, which we use as control for neighbourhood selection in the second modelling step: the neighbourhood effects models. We hypothesise that the correction components, which control for individual characteristics as well as neighbourhood selection, will reduce the selection bias present in the observed neighbourhood effect more accurately than the individual characteristics variables. In other words, we expect that the influence of neighbourhood income on individual income becomes smaller after including personal characteristics, and further diminishes after controlling for selection bias by using correction components.

Crucially, we model neighbourhood selection and effects with data from Utrecht, Amsterdam and Rotterdam. We expect that the degree to which the effects in the final models are affected by controlling for neighbourhood selection will be different in the three cities. That is because the neighbourhood selection controls reflect important differences between local housing markets, which can limit individuals' choice to various degree, based on e.g. the availability of social housing or family-sized dwellings. However, there can be also other unobserved neighbourhood-related, city-level factors which explain the differences between the three cities. For example, effects from differing regional policies affecting the local economy.

To make the relationships between the observed and unobserved factors in the models clearer, we have drawn a diagram showing these relationships (Figure 2.1). In the selection models, individuals (i) have the observed and unobserved personal characteristics affecting neighbourhood selection (PNoi, PNui), which relate to the characteristics of the neighbourhoods (j) they choose (NSj). In the neighbourhood effects models, the chosen neighbourhood can then have an influence on the final outcome, individual income (Oij), with their characteristics (NOij), which might not be entirely accounted for by the variables in the selection models. At the same time, individuals have other characteristics which affect Oij, also observed and unobserved (POoi and POui), in the neighbourhood effects model. Some of them (such as previous income or education) can overlap with the observed and unobserved personal characteristics affecting selection (PNoi and PNui), but not all of them will and those that do might not overlap entirely. Similarly, the neighbourhood characteristics (NOij) which influence individual income (Oij) are not necessarily the same which have led to choosing that neighbourhood (NSj). In our approach, we account for the bias caused by the statistical relationship between personal characteristics and neighbourhood selection criteria (PNi and NSj) by including the correction components based on

the selection models in the neighbourhood effects models. Because of possible differences between the (especially unobserved) personal characteristics affecting selection (PNi) and individual income (POi), as well as neighbourhood characteristics relevant to selection (NSj) and individual income (NOij), which can be also subjected to city-wide trends, we cannot say that these correction components cover all the city-level differences. Still, they should reflect many of these differences because of the wide range of variables used in both sets of models.

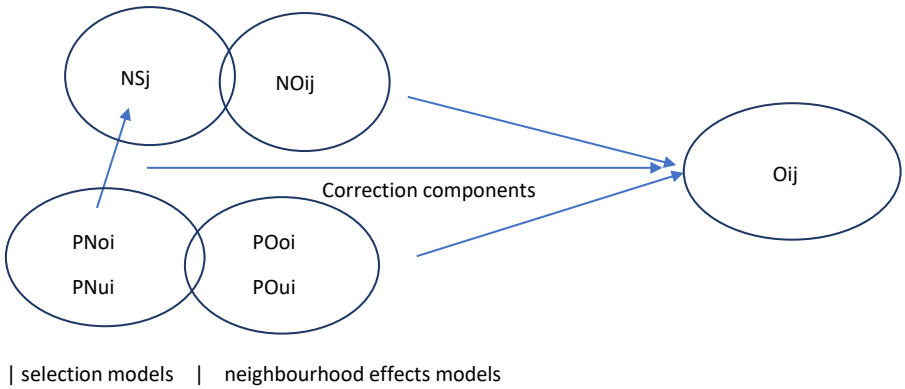

FIG. 2.1 Relationships between the observed and unobserved variables on neighbourhood and individual level

2.3 Data & methods

2.3.1 Sample and data

We used data from the Netherlands Social Statistical Database (SSD), a population registry including individual level, geo-coded longitudinal data for the entire population of the Netherlands from 1999 onwards. These data are merged with register-based publicly available neighbourhood-level data from Statistics Netherlands. We selected household heads with income from work in 2015 who moved between 2010 and 2014. This resulted in a final dataset containing 54,045 individuals in Utrecht, 84,935 in Amsterdam and 59,681 in Rotterdam, which corresponds to the different population sizes of these cities. We included both people moving within the city, and people moving in from other parts of the Netherlands. We only included household heads in our sample because including multiple earners from the same family would complicate the data structure, and second earners in the Netherlands, especially mothers, very often work part-time (Endendijk et al., 2018), which is not accounted for in the available income variables. Still, the sample consists of 40% women in Amsterdam and around 37% in both Rotterdam and Utrecht.

We included data of movers from multiple years to increase the external validity of our study. Only the last move is included, regardless of whether someone moved a year or five years before; we then control for time in our models. The previous studies have only used moves from one year (Ioannides & Zabel, 2008; van Ham et al., 2018), which can lead to an overrepresentation of recent movers, such as foreign-born, single and young people (Hansen & Gottschalk, 2006; Hedman et al., 2011). People who moved outside of the studied cities are not in the dataset, whereas people who moved into the cities are included. The spatial units we use are the municipalities' administrative neighbourhoods, which are likely to resemble neighbourhoods as people know them. Permentier et al. (2008, p. 840) conducted a survey in which the inhabitants of Utrecht asked to name their neighbourhood either gave the same (81.5%) or a similar (14%) name to the official name of the administrative area. This suggests that, in Dutch cities, people identify their neighbourhood similarly to the official administrative names (although the spatial bounds they have in mind might not map exactly onto the administrative borders). On average, there are 144 individuals from our sample per neighbourhood in the Utrecht region, 298 in Amsterdam and 195 in Rotterdam (for the total population, the average

is 1812 individuals per neighbourhood in Utrecht, 1403 in Amsterdam and 1331 in Rotterdam). We used the urban regions of Utrecht, Amsterdam and Rotterdam, which include the main city, but also surrounding municipalities, representing regional housing markets (see the appendix for a list of included municipalities).

2.3.2 Analytical approach and variables

Our modelling approach has two steps. It is akin to the Heckman 2-step solution overcoming selection bias (Mroz, 1987; Winship & Mare, 1992). We first estimate neighbourhood selection with a conditional logit model, in which we model the probability that an individual chooses a particular neighbourhood from the complete choice set of all neighbourhoods in the city (i.e. Utrecht, Amsterdam or Rotterdam) and its surrounding suburbs. Because of the properties of the conditional logit model, individual characteristics can only be included as interactions with neighbourhood characteristics. Based on these interactions we estimate linear probabilities of an individual choosing each neighbourhood in the choice set. These, in turn, are converted into correction terms by using a technique similar to the Inverse Mills Ratios, following Van Ham et al. (2018) and Ioannides and Zabel (2008). Because many neighbourhoods are similar on particular characteristics, and people tend to choose their neighbourhoods in a very structured way, we observe high levels of collinearity between the correction terms. Therefore, instead of keeping hundreds of correction terms, we reduce them to a smaller set of correction terms using Principal Component Analysis (for a more detailed description, see Van Ham et al., 2018). These components reflect the probabilities that types of households select types of neighbourhoods.

In the selection model we included neighbourhood-level variables (average dwelling value, number of restaurants within 3 km, distance to train station, distance to highway access lane, share of dwellings built after 2000, share of non-Western minorities, share of social housing, share of private rental, share of single person households and share of households with children), as well as individual-level variables (age, ethnic background, family composition, household income and education level). We included these characteristics for the year when the individual moved (2010-2014), except for educational level for which we included obtained educational level in 2015. Education level is measured by four dummy variables indicating “lower educated” for people with unfinished secondary education, “middle educated” for those with a secondary or practical vocational (*mbo*) degree and “higher educated” for people with a bachelor or higher degree (*wo* or *hbo*), and “missing” for those with missing information on their educational level (25%). Migration background

is represented in the model by two dummy variables: “Western migrant origin” and “non-Western migrant origin”, which identify individuals with at least one parent born abroad. “Western countries”, according to the Statistics Netherlands definition, include all European and Northern American countries plus Japan, Australia and Indonesia.

In the second modelling step we model neighbourhood effects. We regressed individual earned income in 2015 (log-transformed) on neighbourhood and individual characteristics by estimating a multilevel model with individuals at level 1 nested in neighbourhoods at level 2. In Model 1 we included average neighbourhood income as a predictor at neighbourhood level. In Model 2 we added individual characteristics to the model. Model 3 includes the variables from the previous models plus the neighbourhood types correction components, which reflect the possibility of each person selecting a particular type of neighbourhood. Consequently, in Model 3 we directly control for neighbourhood selection. The differences in neighbourhood effects between Model 2 and Model 3 indicate to what extent neighbourhood effects might be overestimated when not explicitly controlling for selection. The importance of using a multilevel model for our data is confirmed by the results of the null-models (in the Appendix), showing the amount of variance in individual income on individual and neighbourhood level. The intraclass correlation indicates that approximately 19% of the variance in individual income in Utrecht, 15% in Amsterdam and 18% in Rotterdam is on the neighbourhood level. Therefore, it is important to use multilevel modelling in order to correctly estimate standard errors. Furthermore, we can observe if and how unexplained variance on the neighbourhood level diminishes after including new predictors in the model.

In the neighbourhood effects models, the neighbourhood level variable is average neighbourhood income. The same individual characteristics as in the selection models are included, but with values taken from the 2015 datasets and with age in years instead of three age categories. We also included the number of months an individual has been living in the neighbourhood, to control for variation in exposure to neighbourhood conditions. The dependent variable is the logarithm of income from work in 2015. In order to directly model income change, in an additional set of models we included the logarithm of income in the year the individual moved to the neighbourhood. Furthermore, to check whether the differences in the neighbourhood average income coefficient size between the different cities are significant, we used formal tests for comparing the coefficients across models using different samples, described in detail by Paternoster et al. (1998)[4].

4 $$Z = \frac{b_1 - b_2}{\sqrt{SE_{b_1}^2 + SE_{b_2}^2}}$$

TABLE 2.1 Descriptive statistics of the neighbourhood and individual level variables used in the selection models

	Utrecht				Amsterdam				Rotterdam			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
Neighbourhood characteristics												
Average dwelling value (in 1000 Euros)	252.44	96.77	*	*	243.9	93.27	*	*	168.95	65.82	*	*
Restaurants within 3 km	81.42	99.36	0	638.8	317.37	383.78	0	1259.1	106.25	120.11	1.9	405.5
Distance to train station (km)	2.88	2.55	.3	13.1	2.79	1.89	.4	9.4	2.85	2.15	.2	10.9
Distance to highway access lane (km)	1.86	.76	.1	6.6	1.85	.90	.2	4.4	1.92	.86	.1	4.9
Share of dwellings built >2000	17.45	29.71	0	100	14.41	22.27	0	100	14.66	23.12	0	100
Share of non-Western minorities	15.76	13.07	0	78	28.15	18.69	0	78	30.40	18.67	0	80
Share of social housing	31.01	21.47	0	100	40.63	20.86	0	100	41.45	21.56	0	100
Share of private rental	15.23	10.88	0	94	23.62	16.04	0	100	17.35	12.48	0	100
Share of singles	41.37	16.1	10	96	49.14	13.67	8	94	43.98	12.74	0	93
Share of households with children	32.55	13.04	0	72	28.49	11.58	1	68	30.98	10.73	0	70
Individual characteristics												
Age <25	.08		0	1	.07		0	1	.11		0	1
25-65	.92		0	1	.93		0	1	.89		0	1
>65	.0004		0	1	.0005		0	1	.0006		0	1
Ethnicity Native Dutch	.77		0	1	.56		0	1	.57		0	1
Western migrant origin	.11		0	1	.20		0	1	.15		0	1
non-Western migrant origin	.12		0	1	.24		0	1	.28		0	1
Family type Single	.38		0	1	.48		0	1	.43		0	1
Couple	.29		0	1	.26		0	1	.25		0	1
Couple with children	.25		0	1	.17		0	1	.21		0	1
Other family type	.08		0	1	.09		0	1	.11		0	1
Gross household income (in 10,000 euro)	2.56	1.22	*	*	2.56	1.8	*	*	2.31	1.19	*	*
Educational level Low	.07		0	1	.08		0	1	.12		0	1
Middle	.22		0	1	.20		0	1	.30		0	1
Higher	.48		0	1	.46		0	1	.34		0	1
Education missing	.23		0	1	.26		0	1	.24		0	1

**We are not able to show minimum and maximum due to Statistics Netherlands disclosure restrictions. In the Utrecht urban region, we analysed 54,045 individuals in 375 neighbourhoods; in Amsterdam, 84,935 in 285; and in Rotterdam, 59,681 in 306.*

TABLE 2.2 Descriptive statistics of the neighbourhood and individual level variables used in the effect models

	Utrecht				Amsterdam				Rotterdam			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
Log income in 2015	10.71	.55	*	*	10.71	.67	*	*	10.58	.59	*	*
Average neighbourhood income (in 10,000 euro)	3.45	.83	*	*	3.44	1	*	*	2.99	.75	*	*
Log income in the year of move	10.62	.49	*	*	10.62	.6	*	*	10.5	.52	*	*
Native Dutch	.77		0	1	.55		0	1	.57		0	1
Non-Western migrant origin	.12		0	1	.24		0	1	.28		0	1
Western migrant origin	.11		0	1	.20		0	1	.15		0	1
Single	.38		0	1	.48		0	1	.43		0	1
Couple	.26		0	1	.26		0	1	.24		0	1
Couple with children	.34		0	1	.25		0	1	.29		0	1
Other family type	.09		0	1	.10		0	1	.12		0	1
Age	38.39	10.29	18	85	37.15	9.31	18	90	37.7	10.1	18	85
Lower educated	.07		0	1	.08		0	1	.12		0	1
Middle educated	.22		0	1	.20		0	1	.30		0	1
Higher educated	.48		0	1	.46		0	1	.34		0	1
Education missing	.23		0	12	.26		0	1	.24		0	1
Female	.36		0	1	.40		0	1	.37		0	1
Months since move	39.67	17.82	12	71	36.4	17.67	12	71	38.78	18.24	12	71

**We are not able to show minimum and maximum due to Statistics Netherlands disclosure restrictions.*

2.4 Results

2.4.1 Selection models

The results from the first step of our approach, the conditional logit model (in the appendix), show the effects of the interactions between individual and neighbourhood level characteristics in predicting neighbourhood choice. Most of the coefficients are significant, revealing the structured selection of types of individuals into types of neighbourhoods. For example, couples with children are more likely to select neighbourhoods with already a high share of such household type. The results also indicate that ethnic minorities are more likely to move to neighbourhoods with a high share of people with a non-Western background. This effect is strongest in Amsterdam, followed by Rotterdam and then Utrecht. Whereas higher educated

individuals in Utrecht and Amsterdam are more likely to select a neighbourhood with a larger share of ethnic minorities, in Rotterdam they are less likely to select this type of neighbourhood. Higher educated individuals are less likely to select a neighbourhood with a large share of social housing in Utrecht, but more likely in Amsterdam, and in Rotterdam we do not find an effect. Individuals with a non-Western migration background are less likely to select a neighbourhood with a high share of social housing in Amsterdam and Rotterdam, but not in Utrecht. Higher educated people select neighbourhoods with a high number of restaurants, a high share of singles, and a shorter distance to the train station, thus likely located in the city centre. Age differences between moving patterns in the three cities also emerge: for example, people below the age of 25 are more likely than 25-65 year old people to choose a neighbourhood with a high share of households with children in Rotterdam, but less likely to do so in Amsterdam, and the interaction is non-significant in Utrecht. These results of the selection model show that there are important differences in the determinants of neighbourhood choice between the three cities. This subsequently translates into the correction terms, which will be included in the neighbourhood effects model in the next step. Furthermore, the model fit differs between the three cities, with the Pseudo R-squared of 0.079 for Utrecht, 0.07 for Rotterdam and the lowest 0.057 for Amsterdam. These statistics suggest that the extent to which our model explains the selection is the biggest in Utrecht, even though one has to be cautious while comparing the Pseudo R-squared of models ran on different datasets.

2.4.2 Effect models: income

Tables 2.3-2.5 present the results of the multilevel models predicting individual income from work. In Model 1 we find a positive statistically significant effect of neighbourhood income for all cities, meaning that the higher the neighbourhood average income, the higher individual income a few years after the move. However, the magnitude of the effect differs between the cities, with a significantly stronger neighbourhood effect in Rotterdam compared to Utrecht and Amsterdam[5]. This contradicts our expectation that there are no differences in the strength of neighbourhood effects between the three cities. A €10,000 difference in average neighbourhood income is related to a 24% difference in individual income in Utrecht, a 27% difference in Amsterdam, and a 32% difference in Rotterdam.

5 The effect of neighbourhood average income in Model 1 is significantly larger in Rotterdam compared to Amsterdam ($Z = \frac{.238 - .279}{\sqrt{.007^2 + .009^2}} = -3.60$). The effect is not significantly different between Amsterdam and Utrecht ($Z = \frac{.238 - .218}{\sqrt{.007^2 + .008^2}} = 1.88$).

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In Model 2 we included individual characteristics in addition to the average neighbourhood income. In all three cities the effect of average neighbourhood income on individual income drops in size. In Utrecht the effect of average neighbourhood income drops by 42%, in Amsterdam by 33% and in Rotterdam by 44%. The effects of individual characteristics are similar across all three cities: all effects are statistically significant ($p < 0.001$) and show that ethnic minority members have a lower income, while couples, older and higher educated individuals have a higher income. The residual variances at neighbourhood and individual level are significantly reduced in Model 2 compared to Model 1, indicating that the individual characteristics not only explain differences between individuals but also between neighbourhoods in individual income.

In Model 3 we added the correction components derived from the previous modelling step in order to control for neighbourhood selection. As we expected, the effect of average neighbourhood income became even smaller than in Model 2. The reduction in effect size between Model 2 and Model 3 is 53% in Utrecht, 52% in Amsterdam and 48% in Rotterdam. These findings indicate that neighbourhood effects on individual income are overestimated to a large degree when the model does not explicitly control for the non-random selection of neighbourhoods by households. The effects of average neighbourhood income remain, however, positive and statistically significant. The exponentiated coefficients from the final model show that in Utrecht a €10,000 difference in average neighbourhood income is related to a 6% difference in individual income in Utrecht, a 8% difference in Amsterdam, and a 9% difference in Rotterdam (on average after 3 years after the move). The neighbourhood effect is significantly weaker in Utrecht compared to Amsterdam and Rotterdam[6].

Although the effects of the correction components cannot be interpreted unambiguously, and are therefore not reported, Model 3 shows that residential selection plays an important role. A large part of the neighbourhood effect found in Model 1 is the result of residential selection. Although the inclusion of individual characteristics in Model 2 corrected for a part for this selection, the inclusion of the correction components in Model 3 controlled for selection to a larger extent. For all three cities, the residual variances of individual income on the individual level are smaller in Model 3 than in Model 2, showing that the correction components, which were created using interactions between individual and neighbourhood characteristics, explain additional variance in individual income.

6 The effect of average neighbourhood income in Model 3 does not significantly differ between Amsterdam and Rotterdam ($z = \frac{.079 - .089}{\sqrt{.004^2 + .004^2}} = -1.76$); however, it is significantly weaker in Utrecht compared to Amsterdam ($z = \frac{.079 - .061}{\sqrt{.004^2 + .003^2}} = 3.6$), and therefore also Rotterdam.

TABLE 2.3 Neighbourhood effects on income: Utrecht

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.218***	(0.008)	1.244	0.131***	(0.004)	1.140	0.061***	(0.003)	1.063
Non-Western minority				-0.117***	(0.006)	0.890	1.359***	(0.048)	3.892
Western minority				-0.071***	(0.006)	0.931	0.269***	(0.013)	1.309
Couple				0.108***	(0.005)	1.114	0.054***	(0.006)	1.055
Couple with children				0.158***	(0.005)	1.171	-0.003	(0.007)	0.997
Other family type				-0.061***	(0.008)	0.941	0.101***	(0.009)	1.106
Age				0.057***	(0.002)	1.059	0.010***	(0.002)	1.010
Age squared				-0.001***	(0.000)	0.999	-0.000***	(0.000)	1.000
Middle educated				0.237***	(0.008)	1.267	1.180***	(0.021)	3.254
Higher educated				0.584***	(0.008)	1.793	0.756***	(0.030)	2.130
Education missing				0.342***	(0.009)	1.408	0.932***	(0.022)	2.540
Female				-0.195***	(0.004)	0.823	-0.136***	(0.004)	0.873
Months since move				0.001***	(0.000)	1.001	-0.001*	(0.000)	0.999
Correction components included	NO			NO			YES		
Constant	9.952***	(0.028)		8.496***	(0.036)		9.287***	(0.042)	
Residual variance at neighbourhood level	0.013***	(0.001)		0.003***	(0.000)		0.001***	(0.000)	
Residual variance at individual level	0.259***	(0.001)		0.196***	(0.001)		0.148***	(0.000)	
N	54045			54045			54045		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

TABLE 2.4 Neighbourhood effects on income: Amsterdam

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.238***	(0.007)	1.269	0.166***	(0.005)	1.181	0.079***	(0.004)	1.082
Non-Western minority				-0.142***	(0.005)	0.868	1.796***	(0.035)	6.025
Western minority				-0.032***	(0.005)	0.969	0.315***	(0.012)	1.370
Couple				0.127***	(0.005)	1.135	0.049***	(0.005)	1.050
Couple with children				0.188***	(0.005)	1.207	0.058***	(0.006)	1.060
Other family type				-0.047***	(0.007)	0.954	-0.008	(0.008)	0.992
Age				0.077***	(0.002)	1.080	0.011***	(0.002)	1.011
Age squared				-0.001***	(0.000)	0.999	-0.000***	(0.000)	1.000
Middle educated				0.269***	(0.008)	1.309	1.152***	(0.026)	3.165
Higher educated				0.605***	(0.008)	1.831	1.034***	(0.032)	2.812
Education missing				0.446***	(0.008)	1.562	0.809***	(0.018)	2.246
Female				-0.185***	(0.004)	0.831	-0.129***	(0.004)	0.879
Months since move				0.000	(0.000)	1.000	-0.003***	(0.000)	0.997
Correction components included	NO			NO			YES		
Constant	9.871***	(0.025)		7.995***	(0.039)		8.939***	(0.046)	
Residual variance at neighbourhood level	0.009***	(0.001)		0.004***	(0.000)		0.002***	(0.000)	
Residual variance at individual level	0.389***	(0.001)		0.315***	(0.001)		0.230***	(0.001)	
N	84935			84935			84935		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

TABLE 2.5 Neighbourhood effects on income: Rotterdam

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.279***	(0.009)	1.322	0.167***	(0.006)	1.182	0.089***	(0.004)	1.093
Non-Western minority				-0.119***	(0.005)	0.888	1.316***	(0.047)	3.728
Western minority				-0.115***	(0.006)	0.891	1.299***	(0.032)	3.666
Couple				0.086***	(0.005)	1.090	0.043***	(0.006)	1.044
Couple with children				0.109***	(0.005)	1.115	0.044***	(0.007)	1.045
Other family type				-0.058***	(0.007)	0.944	-0.085***	(0.008)	0.919
Age				0.048***	(0.002)	1.049	-0.003	(0.002)	0.997
Age squared				-0.000***	(0.000)	1.000	0.000	(0.000)	1.000
Middle educated				0.203***	(0.007)	1.225	-0.008	(0.017)	0.992
Higher educated				0.527***	(0.007)	1.694	-0.745***	(0.023)	0.475
Education missing				0.315***	(0.007)	1.370	-0.093***	(0.017)	0.911
Female				-0.218***	(0.004)	0.804	-0.178***	(0.004)	0.837
Months since move				0.001***	(0.000)	1.001	0.002***	(0.000)	1.002
Correction components included	NO			NO			YES		
Constant	9.739***	(0.028)		8.688***	(0.037)		10.046***	(0.038)	
Residual variance at neighbourhood level	0.009***	(0.001)		0.003***	(0.000)		0.001***	(0.000)	
Residual variance at individual level	0.298***	(0.001)		0.237***	(0.001)		0.191***	(0.001)	
N	59681			59681			59681		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

2.4.3 Effect models: income change

In addition to the previous analyses of individual income, we provide additional analyses of income *change* between the year of move and 2015 directly (Tables 2.6-2.8). Analysing income change could be seen as a more robust approach to causality, although it is not without problems. In the following models, we keep individual income in 2015 as the dependent variable and include in the models the individual income in the year of move as one of the independent variables. As could be expected, previous income is by far the most important predictor of current income. However, our predictor of interest, the average neighbourhood income, is still significant and follows a similar pattern as in the previous models. The effect of neighbourhood income becomes smaller after including individual characteristics (Model 2) and then even smaller when controlling for selection by including the correction components (Model 3), confirming our predictions. The reduction in effect size in Utrecht between Model 1 and 2 is 15%, and between Model 2 and 3 10%. The reduction is 8% and 17% in Amsterdam and 29% and 12% in Rotterdam respectively. Although the reduction in the effect size between Model 2 and 3 is strongest in Amsterdam, the reduction in Utrecht is similar to the reduction for Rotterdam. The exponentiated coefficients from the final model indicate that a one-unit (€10,000) difference in average neighbourhood income is related to a 1% increase in individual income in Utrecht, a 2% increase in Amsterdam, and a 2.2% increase in Rotterdam. The neighbourhood effect is significantly stronger in Amsterdam and Rotterdam compared to Utrecht[7]. We realise that this average income increase is small, yet while interpreting the results one has to remember that our models only include those who have recently moved, and that the time of exposure to their new neighbourhood is relatively short, so large effects cannot be expected.

All other variables follow similar patterns to those in the income models of the previous section, except for the effect of age, which becomes negative (older people's salary is less likely to increase) and months since move, which have a small positive effect on income change in all the models. Also having a partner and children has a negative effect, suggesting that people at this stage of their household careers are less likely to see their income positively change.

7 The effect of average neighbourhood income on change in individual income (Model 3) is significantly stronger in Utrecht compared to Amsterdam ($z = \frac{.020 - .010}{\sqrt{.002^2 + .002^2}} = 3.53$) and not significantly different between Amsterdam and Rotterdam ($z = \frac{.020 - .022}{\sqrt{.002^2 + .002^2}} = -0.71$ -0.71).

TABLE 2.6 Neighbourhood effects on income change: Utrecht

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.013***	(0.002)	1.013	0.011***	(0.002)	1.011	0.010***	(0.002)	1.010
Log income in the year of move	0.963***	(0.003)	2.620	0.935***	(0.003)	2.547	0.923***	(0.004)	2.517
Non-Western minority				-0.021***	(0.004)	0.979	-0.017	(0.033)	0.983
Western minority				-0.018***	(0.004)	0.982	-0.014	(0.009)	0.986
Couple				0.005	(0.003)	1.005	-0.002	(0.004)	0.998
Couple with children				-0.007*	(0.003)	0.993	-0.040***	(0.005)	0.961
Other family type				0.006	(0.005)	1.006	-0.008	(0.006)	0.992
Age				-0.001	(0.001)	0.999	-0.003*	(0.001)	0.997
Age squared				-0.000	(0.000)	1.000	0.000	(0.000)	1.000
Middle educated				0.039***	(0.005)	1.040	0.061***	(0.015)	1.063
Higher educated				0.103***	(0.005)	1.108	0.121***	(0.021)	1.129
Education missing				0.051***	(0.005)	1.052	0.062***	(0.015)	1.064
Female				-0.045***	(0.003)	0.956	-0.044***	(0.003)	0.957
Months since move				0.002***	(0.000)	1.002	0.001***	(0.000)	1.001
Correction components included	NO			NO			YES		
Constant	0.435***	(0.026)		0.648***	(0.032)		0.876***	(0.043)	
Residual variance at neighbourhood level	0.000***	(0.000)		0.000***	(0.000)		0.000***	(0.000)	
Residual variance at individual level	0.071***	(0.000)		0.068***	(0.000)		0.068***	(0.000)	
N	54045			54045			54045		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

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TABLE 2.7 Neighbourhood effects on income change: Amsterdam

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.026***	(0.002)	1.026	0.024***	(0.002)	1.024	0.020***	(0.002)	1.020
Log income in the year of move	0.908***	(0.002)	2.479	0.884***	(0.003)	2.421	0.837***	(0.003)	2.309
Non-Western minority				-0.029***	(0.003)	0.971	0.003	(0.028)	1.003
Western minority				-0.022***	(0.003)	0.978	-0.031***	(0.009)	0.969
Couple				0.020***	(0.003)	1.020	0.021***	(0.004)	1.021
Couple with children				0.013***	(0.003)	1.013	-0.009	(0.005)	0.991
Other family type				0.002	(0.005)	1.002	-0.013*	(0.006)	0.987
Age				-0.002	(0.001)	0.998	-0.006***	(0.001)	0.994
Age squared				-0.000	(0.000)	1.000	0.000*	(0.000)	1.000
Middle educated				0.059***	(0.005)	1.061	0.170***	(0.020)	1.185
Higher educated				0.147***	(0.005)	1.158	0.255***	(0.024)	1.290
Education missing				0.084***	(0.005)	1.088	0.152***	(0.014)	1.164
Female				-0.053***	(0.003)	0.948	-0.054***	(0.003)	0.947
Months since move				0.003***	(0.000)	1.003	0.001***	(0.000)	1.001
Correction components included	NO			NO			YES		
Constant	0.974***	(0.024)		1.144***	(0.030)		1.712***	(0.044)	
Residual variance at neighbourhood level	0.001***	(0.000)		0.000***	(0.000)		0.000***	(0.000)	
Residual variance at individual level	0.136***	(0.000)		0.131***	(0.000)		0.130***	(0.000)	
N	84935			84935			84935		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

TABLE 2.8 Neighbourhood effects on income change: Rotterdam

	Model 1			Model 2			Model 3		
	B	SE	Exp.	B	SE	Exp.	B	SE	Exp.
Average neighbourhood income (in 10,000 euro)	0.034***	(0.003)	1.035	0.025***	(0.002)	1.025	0.022***	(0.002)	1.022
Log income in the year of move	0.903***	(0.003)	2.467	0.868***	(0.003)	2.382	0.838***	(0.004)	2.312
Non-Western minority				-0.023***	(0.003)	0.977	0.180***	(0.035)	1.197
Western minority				-0.031***	(0.004)	0.969	0.172***	(0.024)	1.188
Couple				0.009*	(0.004)	1.009	0.001	(0.004)	1.001
Couple with children				-0.008*	(0.004)	0.992	-0.029***	(0.005)	0.971
Other family type				-0.004	(0.005)	0.996	-0.018**	(0.006)	0.982
Age				-0.004***	(0.001)	0.996	-0.007***	(0.001)	0.993
Age squared				0.000**	(0.000)	1.000	0.000***	(0.000)	1.000
Middle educated				0.043***	(0.005)	1.044	0.006	(0.013)	1.006
Higher educated				0.133***	(0.005)	1.142	-0.011	(0.018)	0.989
Education missing				0.057***	(0.005)	1.059	0.005	(0.012)	1.005
Female				-0.062***	(0.003)	0.940	-0.062***	(0.003)	0.940
Months since move				0.002***	(0.000)	1.002	0.002***	(0.000)	1.002
Correction components included	NO			NO			YES		
Constant	0.990***	(0.029)		1.372***	(0.035)		1.767***	(0.046)	
Residual variance at neighbourhood level	0.000***	(0.000)		0.000***	(0.000)		0.000***	(0.000)	
Residual variance at individual level	0.111***	(0.000)		0.106***	(0.000)		0.105***	(0.000)	
N	59681			59681			59681		

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

2.5 Conclusions & discussion

This study examined how the modelled neighbourhood effect on individual income is altered when controlling for neighbourhood selection, and how these results vary across three Dutch urban regions. Using multilevel models we have estimated neighbourhood effects on income and income change, while controlling for neighbourhood selection correction components. We found that a higher neighbourhood average income was related to a higher individual income, even after controlling for individual characteristics or neighbourhood selection in the form of correction components. The neighbourhood effect becomes even smaller after controlling for selection than after controlling for individual characteristics, which suggests that without taking selection into account, researchers can overestimate neighbourhood effects. The remaining neighbourhood effect is a much smaller, but also a more robust measure of contextual effects on individual income.

The selection model used provide insight into the patterns of neighbourhood selection in three Dutch cities' regional housing markets, with slight local differences and repeated patterns of structured self-sorting, largely in line with the previous studies on the topic. The differences found could provide inspiration to future studies. For example, higher educated individuals tend to select neighbourhoods with a higher percentage of people with non-Western migrant background in Amsterdam and Utrecht, but not Rotterdam; the possible explanations could relate to different forms of gentrification in these cities, which might lead to different types of neighbourhoods seen as desirable. The selection models also show evidence for difference in preferences based on predictors such as education level, rather than just on earnings (Jansen, 2012; Pinkster & van Kempen, 2002), with higher educated people preferring centrally-located, busy neighbourhoods regardless of household income.

We found clear differences between the three cities in the effects models: the weakest neighbourhood effects can be observed in Utrecht, which also has the highest percentage of native Dutch individuals in our sample, and the strongest in Rotterdam, which has a high percentage of ethnic minorities, just like Amsterdam, but a lower percentage of higher- and middle educated people and a lower average income. This is consistent with the theories of lower-income people being, on average, more vulnerable to negative neighbourhood effects, as they have fewer resources to isolate themselves from the neighbourhood context (Galster et al., 2016); as well as with the studies showing stronger effects in poorer cities (Burdick-Will et al., 2011). However, these results contradict our predictions, based

on the assumption that ethnicity and income are to a large extent controlled for in our models. It is possible that stronger effects in Amsterdam and Rotterdam are caused by the influence of general city population, not only the movers included in the model; additionally, difficult to measure characteristics, such as the density of social ties in an average neighbourhood or local policies promoting social cohesion, may be at play.

We also observed differences in the effects of local context-dependent selection mechanisms on modelling neighbourhood effects. In the case of the income models, the reduction in the neighbourhood effect after controlling for selection in Utrecht and Amsterdam was more pronounced than in Rotterdam. This suggests that incorporating neighbourhood selection in neighbourhood effects models might be especially important in higher income cities, in which the competitive nature of the housing market leads to particularly structured selection processes and conscious decisions of the movers. One of the explanations could be that affluent parents support the housing careers of their offspring through social reproduction strategies and the intergenerational transfer of resources (Hochstenbach & Boterman, 2017; Galster & Wessel, 2019), and such strategies are more likely to be employed in richer regions, where a dwelling in the right location is a particularly important investment. However, it is important to note that there might be other explanations for the differences in the attenuation of the effect between the cities, such as differing neighbourhood effect magnitudes because of, for example, local economic conditions which were not captured by the variables in the models. Also, in the income change models it is the reduction in the effect size in Utrecht which was weaker than that in Rotterdam and especially Amsterdam. Future studies could explore these differences further, comparing data from more diverse cities.

Despite the very high quality of the data at our disposal, there are several limitations to our approach. While our models capture neighbourhood selection, some selection might still remain unmeasured, posing a challenge for future research. There might be unobserved variables which could contribute to a better fit of the model, such as more detailed sociocultural predictions, possibly interacting with education (van Gent et al., 2019). Furthermore, people's preferences and therefore neighbourhood selection could be influenced by their prior residential experiences (Bruch & Mare, 2012; Hochstenbach & Boterman, 2017; van Ham et al., 2014). Including neighbourhood histories could be a next step for future research, as it is beyond the scope of this paper. Another limitation of our approach is that we model neighbourhood effects only for the first couple of years after the move of employed household heads. Especially the short time period might have caused the small sizes of observed effects; this small effect could build over time. We limited our sample to people who moved recently to ensure that we have adequate data from the time

of move; but through the use of data reaching further back in time, future studies might be able to compare the neighbourhood selection and neighbourhood effects models for recent "movers" and those who have lived in the neighbourhood for a longer time. Future studies could also use our approach to analyse neighbourhood effects on other outcome measures, such as health or employment, for other groups of people, such as the unemployed and second earners, and for those spending more time at home as they are likely more susceptible to neighbourhood effects (Galster et al., 2016). Also interactions of neighbourhood characteristics with individual characteristics, such as ethnic background, could be tested, following earlier European research (Andersson et al., 2014; Musterd et al., 2008); and the neighbourhood effects on different ethnic and gender groups could be compared (Galster et al., 2010). Using a predictor based on income groups or share of poor neighbours could also prove more accurate than using average income, and has shown interesting results in past studies (Galster et al., 2010; Galster & Turner, 2019). If suitable data becomes available, research could include more information on past neighbourhood histories, modelling the influence of local social interactions since childhood and placing adult episodes in a longer time context. In our study we observed that people are, on average, influenced by the income level of the neighbourhood they move into as adults; however, extending the longitudinal analysis and the model to investigate how not one, but many such episodes shape life outcomes, would lead to a better understanding of spatial inequality both for scientists and policymakers. Our method could be also compared with models using instrumental variables and fixed effects, based on the same dataset (Galster & Hedman, 2013). Also, a transnational study using the same methods with data from different countries could be helpful, since there is evidence from Sweden that when taking selection into account, neighbourhood effect may show to be stronger (Hedman & Galster, 2013).

Concluding, we believe that our research contributes to better understanding of spatial socioeconomic mechanisms. By modelling neighbourhood selection and neighbourhood effects for multiple cities, we shed some light on the locally diverse neighbourhood processes, observing the strongest influence of average neighbourhood income in the relatively poor port city of Rotterdam. Most importantly, we show that the effect of average neighbourhood income on individual income becomes much smaller after controlling for explicitly modelled neighbourhood selection. This suggests that studies that do not control for neighbourhood selection may overestimate the size of neighbourhood effects, and could serve as an inspiration for researchers and policymakers to see residential selection as an integral part of any socio-spatial investigation.

Conflict of interest statement

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript.

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Appendix

TABLE 2.9 Null models – multilevel effects models

	Utrecht		Amsterdam		Rotterdam	
	B	SE	B	SE	B	SE
Log income in 2015						
Constant	10.733***	0.014	10.695***	0.016	10.645***	0.016
Variance at neighbourhood level	0.059***	0.003	0.067***	0.003	0.066***	0.003
Variance at individual level	0.258***	0.001	0.389***	0.001	0.298***	0.001
N	54045		84935		59681	
Intraclass correlation	0.186		0.147		0.181	

** p < 0.05, ** p < 0.01, *** p < 0.001*

TABLE 2.10 Selection models – conditional logit

	Utrecht		Amsterdam		Rotterdam	
	B	SE	B	SE	B	SE
Interactions						
Average dwelling value with…						
Non-Western	-0.003***	0.000	-0.000**	0.000	-0.002***	0.000
Western	-0.000	0.000	0.002***	0.000	-0.002***	0.000
Couple	-0.003***	0.000	-0.001***	0.000	-0.002***	0.000
Couple with children	-0.001***	0.000	0.000**	0.000	0.000	0.000
Other family	-0.002***	0.000	-0.001**	0.000	-0.001**	0.000
<25	-0.003***	0.000	-0.001***	0.000	-0.005***	0.000
>65	0.006**	0.002	0.000	0.002	0.003	0.003
Gross family income	0.001***	0.000	0.001***	0.000	0.001***	0.000
Middle educated	-0.006***	0.000	-0.005***	0.000	-0.008***	0.000
Higher educated	-0.003***	0.000	-0.002***	0.000	-0.002***	0.000
Education missing	-0.005***	0.000	-0.002***	0.000	-0.006***	0.000
# of restaurants within 3 km with…						
Non-Western	-0.000*	0.000	-0.000*	0.000	-0.001***	0.000
Western	0.001***	0.000	0.000***	0.000	-0.000*	0.000
Couple	0.000	0.000	-0.000***	0.000	-0.001***	0.000
Couple with children	-0.003***	0.000	-0.001***	0.000	-0.004***	0.000
Other family	-0.002***	0.000	-0.001***	0.000	-0.002***	0.000
<25	-0.001***	0.000	0.000	0.000	-0.001***	0.000
>65	-0.004	0.004	-0.001	0.001	-0.004	0.003
Gross family income	-0.000	0.000	0.000***	0.000	0.000***	0.000
Middle educated	-0.002***	0.000	0.001***	0.000	0.002***	0.000
Higher educated	0.003***	0.000	0.002***	0.000	0.006***	0.000
Education missing	-0.001***	0.000	0.001***	0.000	0.002***	0.000
Distance to train station with…						
Non-Western	-0.033***	0.006	0.094***	0.005	0.038***	0.005
Western	-0.032***	0.006	0.002	0.006	0.031***	0.007
Couple	0.018***	0.005	-0.003	0.005	0.020***	0.006
Couple with children	-0.021***	0.005	0.060***	0.006	0.009	0.005
Other family	0.018**	0.006	-0.003	0.007	0.013	0.007
<25	0.019**	0.007	-0.009	0.008	0.043***	0.007
>65	0.125	0.083	0.102	0.087	-0.052	0.088
Gross family income	-0.011***	0.002	-0.005**	0.001	-0.001	0.002
Middle educated	-0.018***	0.005	0.006	0.006	0.060***	0.006
Higher educated	-0.094***	0.005	-0.021***	0.005	-0.008	0.006
Education missing	-0.045***	0.005	0.031***	0.006	0.029***	0.006

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TABLE 2.10 Selection models – conditional logit

	Utrecht		Amsterdam		Rotterdam	
	B	SE	B	SE	B	SE
Interactions						
Distance to highway access lane with…						
Non-Western	-0.020	0.019	0.150***	0.010	0.110***	0.011
Western	0.001	0.017	0.070***	0.012	0.129***	0.013
Couple	0.010	0.013	-0.004	0.011	-0.002	0.012
Couple with children	-0.039**	0.013	-0.065***	0.013	-0.035**	0.013
Other family	-0.019	0.019	0.014	0.016	-0.046**	0.016
<25	-0.036	0.021	0.027	0.017	-0.022	0.016
>65	-0.112	0.258	0.133	0.193	0.086	0.214
Gross family income	-0.014***	0.004	0.000	0.003	-0.018***	0.004
Middle educated	0.118***	0.015	-0.048***	0.013	-0.104***	0.013
Higher educated	0.141***	0.014	-0.102***	0.011	-0.176***	0.014
Education missing	0.112***	0.015	-0.067***	0.013	-0.072***	0.014
% of houses build after 2000 with…						
Non-Western	0.008***	0.000	-0.002***	0.000	0.000	0.001
Western	-0.001	0.001	-0.002***	0.000	-0.006***	0.001
Couple	0.001*	0.000	0.002***	0.000	0.002***	0.001
Couple with children	-0.005***	0.000	0.001*	0.000	0.001	0.000
Other family	-0.003***	0.001	0.001	0.001	0.000	0.001
<25	-0.004***	0.001	0.000	0.001	-0.002**	0.001
>65	-0.026	0.019	-0.007	0.007	-0.001	0.007
Gross family income	0.001***	0.000	0.001***	0.000	0.001***	0.000
Middle educated	-0.002***	0.000	0.003***	0.001	-0.000	0.001
Higher educated	0.003***	0.000	0.001**	0.000	0.002***	0.000
Education missing	-0.004***	0.001	0.001*	0.001	0.002***	0.001
% of non-Western minorities with…						
Non-Western	0.037***	0.001	0.054***	0.001	0.042***	0.001
Western	0.017***	0.001	0.019***	0.001	0.027***	0.001
Couple	0.002	0.001	-0.004***	0.001	0.001	0.001
Couple with children	-0.007***	0.001	-0.008***	0.001	0.001	0.001
Other family	-0.011***	0.002	-0.005***	0.001	-0.004**	0.001
<25	-0.001	0.002	0.005***	0.001	0.004**	0.001
>65	0.046*	0.023	0.001	0.014	0.004	0.016
Gross family income	-0.003***	0.000	-0.003***	0.000	-0.002***	0.000
Middle educated	0.005***	0.001	0.006***	0.001	-0.008***	0.001
Higher educated	0.009***	0.001	0.008***	0.001	-0.014***	0.001
Education missing	-0.001	0.002	0.005***	0.001	-0.012***	0.001

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TABLE 2.10 Selection models – conditional logit

	Utrecht		Amsterdam		Rotterdam	
	B	SE	B	SE	B	SE
Interactions						
% of social housing with…						
Non-Western	0.001	0.001	-0.008***	0.001	-0.004***	0.001
Western	-0.006***	0.001	0.003***	0.001	-0.011***	0.001
Couple	-0.001	0.001	-0.001	0.001	-0.000	0.001
Couple with children	0.006***	0.001	-0.001	0.001	0.003***	0.001
Other family	0.011***	0.001	0.003**	0.001	0.006***	0.001
<25	-0.001	0.001	-0.003*	0.001	-0.006***	0.001
>65	-0.016	0.019	-0.008	0.014	0.024*	0.011
Gross family income	-0.000	0.000	0.002***	0.000	0.002***	0.000
Middle educated	-0.006***	0.001	0.005***	0.001	-0.002	0.001
Higher educated	-0.013***	0.001	0.015***	0.001	-0.001	0.001
Education missing	-0.008***	0.001	0.004***	0.001	-0.001	0.001
% of private rental with…						
Non-Western	0.007***	0.002	-0.007***	0.001	0.004**	0.001
Western	-0.004*	0.002	0.007***	0.001	0.010***	0.002
Couple	0.004**	0.001	0.000	0.001	-0.002	0.001
Couple with children	0.014***	0.002	0.001	0.001	-0.008***	0.002
Other family	0.007**	0.002	0.000	0.002	-0.000	0.002
<25	0.000	0.002	-0.001	0.002	-0.008***	0.002
>65	-0.017	0.025	-0.008	0.018	0.029	0.020
Gross family income	0.001**	0.000	0.002***	0.000	0.002***	0.000
Middle educated	-0.006***	0.002	-0.001	0.001	-0.000	0.001
Higher educated	-0.018***	0.001	0.016***	0.001	0.006***	0.001
Education missing	-0.005**	0.002	0.003*	0.001	-0.000	0.002
Share of single households with…						
Non-Western	-0.010**	0.003	-0.013***	0.002	0.011***	0.003
Western	0.019***	0.003	0.001	0.003	0.019***	0.003
Couple	-0.020***	0.002	-0.003	0.003	-0.016***	0.003
Couple with children	-0.023***	0.003	0.016***	0.003	-0.012***	0.003
Other family	-0.010**	0.004	0.015***	0.004	0.007*	0.004
<25	0.013***	0.004	-0.012**	0.004	0.024***	0.004
>65	0.018	0.047	0.071	0.039	-0.056	0.035
Gross family income	0.002***	0.001	0.006***	0.001	0.004***	0.001
Middle educated	0.011***	0.003	-0.002	0.003	0.007*	0.003
Higher educated	0.041***	0.002	0.021***	0.003	0.020***	0.003
Education missing	0.006*	0.003	0.007*	0.003	-0.001	0.003

>>>

TABLE 2.10 Selection models – conditional logit

	Utrecht		Amsterdam		Rotterdam	
	B	SE	B	SE	B	SE
Interactions						
Share of households with children with…						
Non-Western	-0.014***	0.004	-0.030***	0.003	-0.002	0.003
Western	0.009*	0.004	-0.007*	0.003	0.011***	0.003
Couple	0.004	0.003	0.011***	0.003	-0.007*	0.003
Couple with children	0.028***	0.003	0.045***	0.003	0.006*	0.003
Other family	0.022***	0.004	0.037***	0.004	0.015***	0.004
<25	0.007	0.004	-0.016***	0.005	0.015***	0.004
>65	-0.068	0.057	0.065	0.051	-0.062*	0.031
Gross family income	0.004***	0.001	0.006***	0.001	0.003**	0.001
Middle educated	0.001	0.003	0.008*	0.003	0.001	0.003
Higher educated	0.017***	0.003	0.028***	0.003	0.017***	0.003
Education missing	0.002	0.003	0.006	0.003	-0.006*	0.003
N	18964228		22458629		17117680	

** p < 0.05, ** p < 0.01, *** p < 0.001*

Full list of municipalities included from each city

- *Utrecht:* Utrecht, Bunnik, De Bilt, Houten, Ijsselstein, Nieuwegein, Stichtse Vecht (exists since 2011, before: Breukelen, Loenen, Maarssen), Vianen, Zeist
- *Amsterdam:* Amsterdam, Amstelveen, Diemen, Haarlemmermeer, Landsmeer, Oostzaan, Ouder-Amstel, Weesp, Zaanstad
- *Rotterdam:* Rotterdam, Albrandswaard, Barendrecht, Bernisse (joined with Spijkenisse in 2015 to create Nissewaard), Capelle aan den Ijssel, Pijnacker-Nootdorp, Schiedam, Spijkenisse, Vlaardingen

Creation of the correction components

First, we predict probabilities of each neighbourhood being selected by each individual using the estimates of the conditional logit model, with the Stata command “predict”. Then, we create the correction components, using the following formula (standard normal distribution probability function divided by cumulative distribution function) based on the Inverse Mills Ratios used in the Heckman two-stage regression model (REF Heckman, Demography), where “x” are the predicted probabilities from conditional logit:

$$IMR = \frac{\frac{1}{\sqrt{2\pi}} e^{-x^2/2}}{\int_{-\infty}^{a} f(x)dx}$$

TOC

3 Neighbourhood histories and educational attainment

The role of accumulation, duration, timing and sequencing of exposure to poverty

Troost, A. A., Janssen, H. J., & Van Ham, M. (2022). **Neighbourhood histories and educational attainment: The role of accumulation, duration, timing and sequencing of exposure to poverty.** *Urban Studies, 60*(4), 655-672.

ABSTRACT Studies of neighbourhood effects increasingly research the neighbourhood histories of individuals. It is difficult to compare the outcomes of these studies as they all use different datasets, conceptualizations and operationalisations of neighbourhood characteristics and outcome variables. This paper contributes to the literature by studying educational attainment and comparing the effects of the timing, accumulation, duration and sequencing of exposure to neighbourhood poverty. We use longitudinal register data to study the population of children born in the Netherlands in 1995 and follow them until the age of 23. Our findings show that it is important to separate the early adult years (age 18-22) when constructing individual histories of exposure to neighbourhood poverty. We find that the effect of exposure to neighbourhood deprivation on educational attainment during adolescence is slightly stronger than the effect of exposure during childhood.

We conclude that the observed relationship between neighbourhood poverty and educational attainment depends on how exposure to the neighbourhood effect is conceptualized and measured; choosing just one dimension could lead to under- or overestimation of the importance of exposure to neighbourhood poverty.

3.1 Introduction

The idea that the social status and performance of individuals is influenced by their spatial context has been researched within social sciences for many decades (see Wirth, 1938). Many studies have examined neighbourhood effects on socio-economic outcomes, including educational achievement (eg. E. K. Andersson et al., 2019; E. Andersson & Subramanian, 2006; Nieuwenhuis & Hooimeijer, 2016; Sykes & Musterd, 2011). Neighbourhood effects theory places great emphasis on the importance of time. Wilson (1987) suggested that not just the current neighbourhood, but also the neighbourhood history of an individual might be important to understand neighbourhood effects. Generally it is assumed that the longer someone is exposed to poor neighbourhood conditions, the more detrimental the effects will be on individual outcomes (Galster, 2012). This also applies to the social-interactive effects of the neighbourhood on educational achievement. Extracurricular activities, use of language and interpersonal attitudes typical for the neighbourhood can strongly influence one's graduation prospects, and that influence, transmitted by mechanisms such as role models and the social norms of peer groups, grows with time (Lareau, 2011). Richer and better educated neighbours not only promote ambitious social attitudes, but also invest in local community initiatives (Leventhal & Brooks-Gunn, 2003; Sykes & Kuyper, 2009). The lack of such resources in poorer neighbourhoods can be more influential the longer an individual lives in them.

Despite these insights, many studies have used point-in-time operationalisations of neighbourhood conditions, largely because of a lack of information on the neighbourhood histories of individuals in available data. Due to new developments in the availability of longitudinal data, there is now a growing literature on neighbourhood effects which takes the duration of exposure to deprived neighbourhoods into account (see Hedman et al., 2013; Musterd et al., 2012; Sharkey, 2008).

The ways in which neighbourhood histories of individuals can matter for individual outcomes are complex. Aspects like the accumulation, duration, timing, and sequencing of exposure to neighbourhood characteristics of interest could provide crucial information about the relationship between place and individual outcomes such as educational achievement or health (Pearce, 2018). People are born in a neighbourhood with certain characteristics, and over time the neighbourhood context can change because someone moves to a different type of neighbourhood, or because the neighbourhood context they live in changes. Sometimes the effect of early neighbourhood influence becomes apparent after many years (Glass & Bilal, 2016). Making neighbourhood histories operational from longitudinal data can be challenging (Van Ham et al., 2014), as many decisions need to be made on operationalising deprivation and the neighbourhood itself, on whether only changes due to residential moves are taken into account, or also in-situ changes in the neighbourhood.

Previous studies have made several aspects of neighbourhood histories operational. The effects of timing have been studied by health researchers, focusing on exposure at different ages or development periods of children and adults (Cherrie et al., 2018; Pearce et al., 2018). Other research considered the accumulation of exposure to neighbourhood characteristics within the studied period (Hystad et al., 2013). More socially and economically oriented urban studies focused on the timing of exposure (Chetty et al., 2016), and the influence of the sequencing of neighbourhood deprivation on neighbourhood poverty in adulthood (Van Ham et al., 2014) and problem behaviour in adolescence (Kleinepier & Van Ham, 2018). In the studies on the spatial effects on education, researchers have focused on the effects in different stages of childhood development (Brooks-Gunn et al., 1993; Leventhal & Brooks-Gunn, 2003), as well as the duration of exposure (Nieuwenhuis et al., 2021).

Although there is now a wealth of research on the effects of neighbourhood histories on individual outcomes, it is difficult to compare the outcomes of these studies as they all use different datasets, conceptualizations and operationalisations of neighbourhood characteristics and outcome variables. This makes it hard to assess the relative importance of different temporal aspects of exposure to neighbourhood deprivation.

The main research question of this study is in what way neighbourhood poverty is related to educational attainment. We contribute to the literature by investigating four different temporal conceptualizations of individuals' exposure to neighbourhood poverty: accumulation, duration, timing and sequencing. We use geo-coded longitudinal register data from the Netherlands to study the population of children born in the Netherlands in 1995 and follow them until age 23. By comparing the different approaches modelled on the same data, we can investigate whether they

result in different observed effects, what these differences are and what they can teach us about the temporal dimensions of exposure to neighbourhood poverty from childhood to early adulthood.

3.2 Theory and literature

3.2.1 Neighbourhood context and educational attainment

The idea of spatial life-paths has been widely studied since the end of 1980s in the neighbourhood effects field (Hagerstrand, 1982). Some of the studied neighbourhood effects, mostly falling into what Galster (2012) calls "institutional mechanisms" category (related to distance from and quality of schools and other institutions), obviously constrain the paths an individual might take. The neighbouhood can be far away from relevant workplaces, or have no amenities like healthy food shops or libraries; the local schools can also receive less funding and attract fewer highly qualified teachers (Otero et al., 2021), which is especially problematic in the Netherlands because of a shortage of teachers (Den Brok et al., 2017). However, many neighbourhood effects are related to the "social-interactive mechanisms": how the neighbours influence each other. To see social interactions as creating possible constraints, powerful enough to shape future life-paths, one can use Bourdieu's concept of habitus (Bourdieu, 1977): the way people perceive the world and their possible paths within it is shaped by their socioeconomic background, partially through imitating others during their socialisation. For example, technically in a country with free higher education it is possible for every young person to attend university; but someone who does not know anyone with a university degree growing up will not see it as a real option, and will not follow this path. A disruption of such an individual's habitus, for example a friendly neighbour who wants to attend university and suggests studying together, is needed to add attending a university as a possible space on the life-path. Lareau (2011) describes how the habitus of a social class influences young people's attitude to institutions, by teaching them how to interact with certain types of people (affluent children are taught by their extracurricular activities how to talk to unknown adults in formalised settings) and institutions (the poorer parents don't show assertiveness while dealing with authorities).

The spatially determined class-related processes can play a role in the eventual educational attainment, over and above the role of parental education and occupation (E. K. Andersson & Malmberg, 2015). Both the resulting theoretical models and the empirical investigation of these influences are complicated by all of these factors being related to each other: the local school often acts as the spatial nexus where people get to know their neighbours (pupils and their families), and the quality of the school as well as the green areas and sport facilities in the neighbourhood depends on the level of financial investment the local community has to offer. Richer neighbourhoods tend to have better quality schools (better test results, a higher teacher per student ratio) and other education-related facilities, like libraries (Hastings, 2009). Furthermore, with a larger percentage of higher educated people in the neighbourhood there is also a bigger chance that a child makes acquaintance with such people, whether they are parents of their classmates, local entrepreneurs or volunteers. Because of these interlinkages, the average socioeconomic status (SES) of a neighbourhood often acts as a proxy for its more specific characteristics (Custers, 2019).

Children can be influenced by the neighbourhood through their parents who might follow the example of other local parents by signing up their children for structured activities, or allow them to spend their free time in an unstructured way (Lareau, 2011). While having a large amount of unstructured free time and spontaneous play, which is typical for poorer children, has advantages (such as developing creativity), in general the formalised extracurricular activities popular among affluent children lead to the development of skills more useful in the education system. The common attitutes in the neighbourhood can influence children even without parental mediation: for example, skipping school may be unnoticed in places where people do not attach much value to education (Nieuwenhuis et al., 2015). Fewer social ties and weaker institutions in poorer neighbourhoods can also lead to less effective supervision and inability to enforce social norms related to education; in general, the social expectations of educational achievement are less clear in disadvantaged neighbourhoods because of the greater heterogeneity of cultural approaches to schooling (Harding, 2011).

Many neighbourhood effects studies claim that the effects on children are the strongest, since they are exposed to the neighbourhood environment during the crucial developmental phases of their lives, and are more likely than adults to befriend their same-aged neighbours (Nieuwenhuis et al., 2015). Education remains one of the most important factors in intergenerational social mobility, and it is the key link between the neighbourhood characteristics experienced in childhood and outcomes later in life (Toft & Ljunggren, 2016). However, the contextual effects experienced by individuals are often even more complicated than the already intricate

context of a single neighbourhood: families move around and neighbourhoods change over time. Because of that, it is important to compare the effects of the accumulation, duration, timing and sequencing of exposure to neighbourhood poverty.

3.2.2 Exposure to neighbourhood poverty over time (accumulation and duration)

Whether the accumulation (being exposed to a particularly high level of a variable of interest) or duration (living in a certain neighbourhood for a long time) is more important depends on the predictor and outcome. In the case of neighbourhood poverty and educational attainment, duration might be crucial since education-related habits and behaviours need to be developed and sustained over many years (Galster, 2012). Nieuwenhuis et al. (2021) and Wodtke et al. (2011) provide evidence for a longer duration of exposure to poverty having an influence on education, while in the same context a shorter duration does not. On the other hand, in a rich country like the Netherlands, average and even slightly poorer than average neighbourhoods can often still provide a motivating, peaceful learning environment, so it might be that the neighbourhood effects can only be observed for individuals exposed to a relatively extreme accumulation of poverty.

These theoretical considerations lead to opposing hypotheses: we could expect that the accumulation of exposure to neighbourhood poverty will predict the educational outcomes better than the duration of exposure, but the opposite could also be true.

3.2.3 Exposure at different stages of development (timing)

The idea of timing entails that exposure to neighbourhood poverty is more influential during certain periods, such as early childhood or, conversely, adolescence. According to Guo (1998), exposure during earlier childhood is more important for developing cognitive ability than during adolescence, but when it comes to the actual educational achievements, the exposure during adolescence is more influential. On the other hand, Chetty et al. (2016) observed that only children who were younger than 12 at the time of move to an affluent neighbourhood experienced the positive effects of the move, as evidenced by their higher educational attainment in early adulthood (measured by college attendance) and higher earnings compared to the control group (the children who remained in impoverished neighbourhoods). Still, Casciano and Massey (2012) find positive indirect effects of moving to an affluent

neighbourhood on school results for teenagers aged 12 to 18. Also, Brooks-Gunn et al. (1993) and Leventhal and Brooks-Gunn (2003) observe signigicant effects of neighbourhood poverty for both young children and adolescents. Similarly, Nieuwenhuis and Hooimeijer (2016) report no significant differences between age groups in their meta-analysis of studies analysing the influence of neighbourhood poverty on education.

For the Netherlands it can be expected that exposure to neighbourhood poverty before the age of 12 is more decisive for the eventual educational attainment than exposure at later stages, since the Dutch schooling system is highly stratified with early tracking. Already at the age of 12 students are allocated into educational tracks: *vwo*, preparing them for studies at a research university (*wo*), *havo*, which leads to a more vocation-oriented university of applied sciences (*hbo*), and *mavo*, which ends with a vocational secondary degree (*mbo*). Although it is possible to move between these different tracks, in practice most pupils stay in their designated track[8]. As children form their academic habits during early childhood, any setbacks experienced during that period can lead to major difficulties later on, regardless of tracking outcome at age 12. Still, it can also be argued that exposure to neighbourhood poverty during adolescence is more important for educational attainment. Kleinepier and van Ham (2018) show that adolescence might be a particularly important period for neighbourhood influence. According to their findings, children exposed to neighbourhood deprivation only during adolescence are even more likely to drop out of school than those exposed to deprivation throughout their entire childhood. During the adolescent years, peers become more important, and can influence one's attitudes and behaviours (Guo, 1998). Both neighbourhood effects on education for children below 12 (Kuyvenhoven & Boterman, 2021) and teenagers (Nieuwenhuis et al., 2021) have been observed in the European context.

Therefore, also here we could formulate opposing hypotheses, as there are arguments for both early childhood and adolescence being the most crucial period of neighbourhood poverty exposure.

8 https://www.cbs.nl/nl-nl/publicatie/2020/49/jaarrapport-2020-landelijke-jeugdmonitor (pp. 50-54)

3.2.4 Improving or deteriorating neighbourhood conditions (sequencing)

Some studies suggested that the sequence of exposure to neighbourhood poverty can affect the strength and results of neighbourhood influence (Goldsmith et al., 2017). It could matter whether an individual is exposed to consistent affluence or deprivation, or whether the neighbourhood conditions are improving or deteriorating over time, because they move to a different neighbourhood (or the neighbourhood itself changes) at some point in their lives (Kleinepier & Van Ham, 2018).

As mentioned above, both childhood and adolescence can be the periods of vulnerability to certain neighbourhood effects; the idea behind the significance of sequencing is that by growing up in a certain type of neighbourhood since early childhood its inhabitants learn to be resilient to its negative aspects (see Galster, 2012, about the neighbourhood effect "dosage"). Therefore, a move to a poorer neighbourhood can leave a child vulnerable to local behaviours and social norms, such as the greater tolerance of delinquency or dropping out of school in order to quickly access low-income jobs. On the other hand, a move to a richer neighbourhood might leave a child alienated, unable to access neighbourhoods' facilities and social networks because of the lack of skills and local gatekeeping. This is because of the phenomenon of relative deprivation (Galster, 2012), which has been studied in the Dutch context by Nieuwenhuis et al. (2017), who found that moving to a richer neighburhood "was related to increased levels of depression, social phobia, aggression, and conflict with fathers and mothers" (p. 1891). To sum up, rising neighbourhood sequences (poor to less poor neighbourhoods) could potentially result in both better or worse educational outcomes.

3.3 Data & methods

We used individual level, longitudinal geo-coded register data from the Statistics Netherlands' Social Statistical Database (SSD), which covers the entire population of the Netherlands. We have identified 149,558 individuals born in 1995 without gaps in their neighbourhood histories between 1995 and 2017, when they are around 22 years old, and without missing information on other variables (except for parental education).

3.3.1 Education level

Our dependent variable is the level of education obtained at age 23. For individuals who were still following education in the final year of observation, we have measured the level of education that they were following at that time. Education level is measured in years officially needed to reach that level, with an extra year added for research universities (*wo*) to distinguish them from universities of applied science (*hbo*). The minimum is 2 years for unfinished primary education, and maximum is the 23 years needed to obtain a doctoral degree (only 10 such cases), with the mean 16,5 years.

3.3.2 Contextual poverty

Contextual poverty is measured as a ratio and based on the Eurostat definition of the at-risk-of-poverty rate, which is defined as the share of households with an equivalised disposable household income below the at-risk-of-poverty threshold, which is set at 60% of the national median equivalised disposable income[9]. Even though in our data the detailed household income goes back only to 2003, we are able to trace people's residential location back to 1995. For the years 1995-2002, we created measures of contextual poverty using income data from 2003. It is important to stress that the (1995 born) individuals' residential location does change every year also for the years 1995-2002: only we use the 2003 poverty ratio of the neighbourhood they are in. This means for creating the poverty ratio in years 1995-2002, we use the household income and the neighbourhood composition of households as they were in 2003. As neighbourhoods themselves transform less dynamically than households (because of career changes, marriages, separations etc.), using the 2003 neighbourhood incomes gives an accurate approximation of the neighbourhood income situation in earlier years

The geocoded data shows where each person lived at a spatial resolution of 100x100 m squares. We created bespoke measures of neighbourhood poverty including the 200 nearest neighbouring households using Equipop, a specialized software-program for the calculation of the k-nearest neighbours (Östh et al., 2014). Equipop calculates the proportion of the k-nearest neighbours that meet user-set criteria. Based on this, a ratio of the neighbours meeting a criterion within

9 https://ec.europa.eu/eurostat/web/products-datasets/product?code=tessi014

the 200-households bespoke neighbourhoods is calculated for each year of an individual's life. These ratios are the building blocks of our neighbourhood history variables, which are described in more detail below. The 200 nearest neighbours method should lead to more accurate measurements both in densely and sparsely populated areas, which is important in this study, since we use the data from the whole country. Furthermore, as most of our predictors are based on social interaction, it is appropriate to focus on people rather than space while operationalising the variables. The method also allows for setting a custom income criterion, which we adjusted for the median income in each year: households with an income below 60% of median household income were classified as at-risk-of-poverty ("poor"). If an individual scores 0,15, for example, on their 2005 neighbourhood poverty variable, this means that in 2005, 15% of the 200 nearest households was poor.

We chose the nearest 200 households to reflect a social space in which people are likely to meet each other and interact with each other. The scale of spatial research should be chosen according to the theoretical assumptions of the study (Petrović et al., 2018), and in our case we focus on relatively small-scale, social-interactive neighbourhood effects which would happen in neighbourhoods of about 200 households.

3.3.3 Operationalisation of time effects

In our study, the *accumulation* of neighbourhood poverty is measured by adding up the poverty rate over the years divided by the number of years. We calculated the accumulation over two different periods: from birth to age 17 and from birth to age 23. The first period ends with the likely move out of the parental home around the age of 18; the second period is the longest we could capture with the available data. *Duration* of exposure to neighbourhood poverty is measured by adding up the years in which an individual lived in the top 20% neighbourhoods with the highest poverty rates. Duration of exposure to poverty was measured for the same time periods as accumulation: from birth to age 17 and from birth to age 23. *Timing* of exposure to neighbourhood poverty is measured by adding up the poverty rate in three different developmental periods: childhood (ages 0 to 12), adolescence (13 to 17), and young adulthood (18 to 22). *Sequencing* of exposure to neighbourhood poverty was measured by eleven trajectories. As a first step, all neighbourhoods were divided into top, middle and bottom. The top consists of the top 20% of neighbourhoods with the lowest poverty rate (the least poor neighbourhoods), the bottom consists of the bottom 20% of neighbourhoods

with the highest poverty rate (most poor), and the middle consists of the 60% in the middle. Knowing in which type of neighbourhood an individual lived per year, we constructed 11 different sequences: three trajectories that indicate that the individual lived constantly (at least 15 years) in either a low, medium or high poverty neighbourhood, six trajectories that indicate that the neighbourhood poverty rate changed over time (e.g. moving from a poor to a medium poor neighbourhood), one trajectory indicating that the individual lived in all three types of neighbourhoods (at least 2 years in each of the categories), and one trajectory indicating frequent moves of the individual between neighbourhood categories, classified as "other". The six sequences that indicate change over time – low to medium poverty, medium to low, medium to high, high to medium, high to low and low to high – were identified as neighbourhood histories which first had an uninterrupted period of at least 3, at most 15 years in one category and then such a period in the other (e.g, "low to medium" indicates a period of 3-15 years in low poverty neighbourhoods, and subsequently 3-15 years in medium poverty neighbourhoods). Our classification of these categories is quite strict, not allowing even for one year in a different category for each of these periods (that would classify the sequence as "other", or "constant" in case there is still an at least 15 years long uninterrupted period in one of the categories). Our approach to classifying sequences is motivated by its clarity; a similar manual classification approach to "residential mobility biographies" has been used by Coulter and van Ham (2013).

3.3.4 Control variables

As control variables we included an individual's gender (female or male) and their migration background, which can be native Dutch (both parents born in the Netherlands), Western or non-Western[10]. Parental characteristics are controlled for by household income, measured in 2003, 2007 and 2011, and parental education level (low, middle, high and data separate category when this variable is missing, in 28% of cases). The highest educational level achieved by any of the two parents is recorded on this variable. We also included the contextual level of urbanity measured as address density on the municipal level. It is based on the proportion of years between 1999 and 2017 (for which the address density data was available) an individual has lived in an urban environment.

10 "Western countries", according to the Statistics Netherlands definition, include all European and Northern American countries plus Japan, Australia and Indonesia (for historical reasons).

TABLE 3.1 Descriptive statistics of the variables

	Mean / %	SD	Min	Max
Education level (in years needed to obtain)	16.49	1.62	2	23
Accumulation (age 0 – 22)	0.14	0.08	0.01	0.80
Accumulation (age 0 – 17)	0.11	0.07	0.01	0.85
Accumulation (age 0 – 12)	0.11	0.07	0.01	0.86
Accumulation (age 13 - 17)	0.12	0.09	0.01	0.89
Accumulation (age 18 – 22)	0.21	0.15	0.01	0.99
Total exposure in years until 2012	3.57	5.89	0	18
Total exposure in years until 2017	4.56	6.67	0	23
Constant low poverty	6.4		0	1
Constant medium poverty	38.2		0	1
Constant high poverty	10.8		0	1
Low to medium poverty	3		0	1
Medium to low poverty	1.9		0	1
Medium to high poverty	2.2		0	1
High to medium poverty	2.2		0	1
High to low poverty	0.1		0	1
Low to high poverty	0.1		0	1
Other sequences	30.3		0	1
Varied sequences	4.8		0	1
Urbanity	0.77	0.41	0	1
Female	49	0.50	0	1
Household income (2003, in 10,000 euros)	1.88	1.14	*	*
Household income (2007, in 10,000 euros)	2.30	1.55	*	*
Household income (2011, in 10,000 euros)	2.74	1.77	*	*
Native Dutch	81		0	1
Western	5		0	1
Non-Western	14		0	1
Low educated parents	11		0	1
Middle educated parents	27		0	1
High educated parents	33		0	1
Parental education missing	28		0	1

N = 149,558

** We are not able to show minimum and maximum due to Statistics Netherlands disclosure restrictions.*

3.3.5 Analytical approach

We estimate a series of linear regression models with educational level at age 23 as the dependent variable. All models are estimated on the same sample of 149,558 individuals, and contain the same control variables. We run separate models for accumulation, duration, timing, and sequencing of exposure to neighborhood poverty and compare their results.

It can be difficult to compare the effect of sequencing to the effects of other time dimensions, such as timing of exposure, because of the different operationalisation of the predictor required to construct them (simple categories, such as bottom, middle, and top are needed to keep the sequence types from getting too complex). Still, by running the sequence analysis on the same dataset, we can determine whether sequencing provides new insights into how contextual effects work or largely repeats the findings already present in the simpler timing, accumulation and duration models.

Given the nested structure of our data, the use of multilevel modelling appears logical. However, there are two reasons why we have not used this type of models. Firstly, individuals are nested in neighbourhoods which can change every year. Therefore, the complex hierarchical structure inhibits model convergence. This is further exacerbated by the second reason, whereby there is no strict hierarchy because of the multiple membership of individuals in the bespoke neighbourhoods (the neighbourhoods are overlapping with each other). Furthermore, because of bespoke neighbourhoods which are constructed for each individual every year, and only including people born in 1995 in the sample, a large number of individuals are “nested” alone or with just one other person in their neighbourhood (73,367; 49%), which is another obstacle to estimating a hierarchical fixed effects structure.

3.4 Results

3.4.1 Accumulation of exposure to neighbourhood poverty

TABLE 3.2 Effects of accumulation of exposure to neighbourhood deprivation on educational level

	Model 1 (age 0 – 22)		Model 2 (age 0 – 17)	
	B	SE	B	SE
Accumulation of exposure to neighborhood poverty (age 0 – 22)	0.560***	(0.056)		
Accumulation of exposure to neighborhood poverty (age 0 – 17)			-1.941***	(0.060)
Urbanity	0.402***	(0.010)	0.451***	(0.010)
Female	0.310***	(0.008)	0.311***	(0.008)
Household income (2003)	0.109***	(0.004)	0.101***	(0.004)
Household income (2007)	0.076***	(0.003)	0.073***	(0.003)
Household income (2011)	0.065***	(0.003)	0.060***	(0.003)
Western	0.020	(0.017)	0.067***	(0.017)
Non-Western	-0.054***	(0.013)	0.138***	(0.013)
Middle educated parents	0.478***	(0.014)	0.426***	(0.014)
High educated parents	1.348***	(0.014)	1.281***	(0.014)
Parental education missing	0.746***	(0.014)	0.672***	(0.014)
Constant	14.624***	(0.017)	14.944***	(0.017)
R^2	0.171		0.176	

N = 149,558; standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.00*

The first model (Table 3.2) presents the accumulation model which includes the average exposure to neighbourhood poverty from birth to age 22 (Model 1), and from birth to age 17 (Model 2). Surprisingly, the effect of accumulated exposure to neighbourhood poverty for the whole period is positive and significant (b = 0.560, p < 0.001, beta = 0.028), meaning that the higher the rate of neighbourhood poverty an individual was exposed to over the years, the higher their individual educational attainment. This contradicts findings from previous literature. However, when we run the model on the childhood years only – from age 0 to 17 – we see that the effect is negative and significant (b = -1.941, p < 0.001, beta = -0.084). The different outcomes by these two models can be explained by the exposure to neighbourhood poverty during the last few years, from age 18 to 22. Exposure during this period is

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positively related to obtained education and biases the accumulation effect for the complete period, from age 0 to 22 (see the section on timing models).

The control variables have the expected effects, with females having a slightly higher level of education level than males, non-Western ethnic minorities having a slightly lower educational level compared to native Dutch individuals, and with household income and parental education being positively related to education level. The share of years spent living in an urban setting also has a significant positive effect, consistent with an easier access to multiple types of schools and high skilled white collar jobs being more prevalent, and therefore seen as the norm, in cities.

3.4.2 Duration of exposure to neighbourhood poverty

TABLE 3.3 Effects of duration of exposure to neighbourhood deprivation on educational level

	Model 1 (age 0 – 22)		Model 2 (age 0 – 17)	
	B	SE	B	SE
Duration of exposure to neighbourhood poverty in years (age 0 – 22)	-0.007***	(0.001)		
Duration of exposure to neighbourhood poverty in years (age 0 – 17)			-0.023***	(0.001)
Urbanity	0.438***	(0.010)	0.460***	(0.010)
Female	0.312***	(0.008)	0.310***	(0.008)
Household income (2003)	0.106***	(0.004)	0.102***	(0.004)
Household income (2007)	0.075***	(0.003)	0.073***	(0.003)
Household income (2011)	0.063***	(0.003)	0.060***	(0.003)
Western	0.042*	(0.017)	0.066***	(0.017)
Non-Western	0.036**	(0.013)	0.132***	(0.013)
Middle educated parents	0.454***	(0.014)	0.430***	(0.014)
High educated parents	1.323***	(0.014)	1.287***	(0.014)
Parental education missing	0.712***	(0.014)	0.678***	(0.014)
Constant	14.725***	(0.016)	14.792***	(0.016)
R^2	0.171		0.176	

N = 149,558; standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

Table 3.3 presents the results from the duration models, which include the number of years in which an individual lived in the top 20% of neighbourhoods with the highest poverty rates. We estimated two separate models, one examining the effect of the duration of exposure between birth and age 22, and the other between birth

and age 17. Contrary to the findings from the accumulation model (Table 2), the effects of the duration of exposure to neighbourhood poverty are both negative and significant (b = -0.023, $p < 0.001$, beta = -.084 and b = -0.007, $p < 0.001$, beta =-.029). The effect for the model of ages 0-22 is smaller than in the 0-17 model; however, it does not change its direction as is the case for the accumulation model of the same time range. A possible explanation is that the accumulation model is more sensitive to extreme poverty rates than the duration model, which is based on the number of years in top 20% poorest neighbourhoods.

3.4.3 Timing of exposure to neighbourhood poverty

In the next sets of models (Table 3.4) we examined the effect of timing of exposure to neighbourhood poverty, in order to examine whether exposure at certain ages is more strongly related to obtained educational level compared to other periods. We estimated the effect of exposure to neighbourhood poverty during childhood (age 0 – 12), adolescence (age 13 – 17), and early adulthood (age 18 – 22) when children start moving out of the parental home. The results from the models show that the effect of exposure during childhood and adolescence is negatively related to obtained educational level (b = -1.790, $p < 0.001$, beta = -.077, and b = -1.593, $p < 0.001$, beta = -.089 respectively). The difference in the effects of exposure during childhood and adolescence is small, but statistically significant; exposure during adolescence is slightly stronger negatively related to education attainment.

Exposure to neighbourhood poverty during early adulthood, on the other hand, is positively related to obtained educational level (b = 2.032, $p < 0.001$, beta = 0.188). This positive effect can be explained by the fact that at these ages, individuals are likely to move out of the parental home into city centres and student housing to follow higher education, where the proportion of low-income households is high. More importantly, this different effect for exposure to poverty during early adulthood explains the small positive effect we found in the accumulation model (ages 0-23). Including these last four years changes the effect so that the negative influence of exposure to poverty in childhood can no longer be detected.

When it comes to migration background, we find that individuals with a non-Western migration background have a higher educational level compared to individuals without a migration background in the models including neighbourhood poverty from age 0 to 17. In models including neighbourhood poverty from age 18 to 22, however, we find an effect in the opposite direction, indicating that individuals with a non-Western migration background have a lower educational level. This might be related to different residential

trends for non-Western minorities, such as living with their parents for a longer time (De Valk & Liefbroer, 2007). Controlling for the variables such as parental income, education and urban environment could explain while the often observed negative influence of having an immigrant background is not always present in our models.

TABLE 3.4 Effects of timing of exposure to neighbourhood deprivation on educational level

	Model 1 (age 0 – 12)		Model 2 (age 13 - 17)		Model 3 (age 18 – 22)	
	B	SE	B	SE	B	SE
Exposure to neighborhood poverty (age 0 – 12)	-1.790***	(0.061)				
Exposure to neighborhood poverty (age 13 - 17)			-1.593***	(0.049)		
Exposure to neighborhood poverty (age 18 – 22)					2.032***	(0.027)
Share of urban	0.446***	(0.010)	0.452***	(0.010)	0.243***	(0.010)
Female	0.311***	(0.008)	0.311***	(0.008)	0.277***	(0.008)
Household income (2003)	0.102***	(0.004)	0.102***	(0.004)	0.105***	(0.004)
Household income (2007)	0.073***	(0.003)	0.073***	(0.003)	0.070***	(0.003)
Household income (2011)	0.061***	(0.003)	0.059***	(0.003)	0.064***	(0.003)
Western	0.063***	(0.017)	0.063***	(0.017)	-0.005	(0.017)
Non-Western	0.123***	(0.013)	0.119***	(0.013)	-0.143***	(0.012)
Middle educated parents	0.432***	(0.014)	0.427***	(0.014)	0.511***	(0.014)
High educated parents	1.290***	(0.014)	1.281***	(0.014)	1.305***	(0.014)
Parental education missing	0.681***	(0.014)	0.673***	(0.014)	0.790***	(0.014)
Constant	14.916***	(0.017)	14.918***	(0.017)	14.440***	(0.016)
R^2	0.175		0.176		0.201	

N = 149,558; standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

3.4.4 Trajectories of exposure to neighbourhood poverty

Finally, the sequencing model (Table 3.5) not only takes into account the duration of exposure to neighbourhood poverty, but also whether the level of neighbourhood poverty was stable over time, improving or deteriorating. Based on the findings from the previous models, we measured the trajectories from birth to age 17. We present three models differing in the reference trajectory: constant in medium poverty (Model 1), constant in high poverty (Model 2), and constant in low poverty (Model 3). The findings from Model 1 show that individuals who consistently lived in neighbourhoods with the highest poverty rates have a lower educational level compared to individuals who lived consistently in moderately and low poverty neighbourhoods (on average 0.3 and 0.5 years lower respectively).

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Individuals for whom the neighbourhood context improved over time have on average higher educational levels. Individuals for whom the neighbourhood context changed from high poverty to medium or low levels of poverty are on average 0.1 and 0.5 years respectively higher educated than those who lived constantly in neighbourhoods with high poverty levels. Those who move from medium to low poverty neighbourhoods are on average 0.1 year higher educated than those who lived in medium poverty neighbourhoods constantly.

Those individuals for whom the neighbourhood poverty rate increased over time have on average lower educational levels. Individuals who lived in low poverty neighbourhoods and moved to medium poverty neighbourhoods are on average 0.1 years lower educated than those who remained in low poverty neighbourhoods. Changing conditions from low to high poverty, however, has a stronger negative effect. Individuals who experience this change are on average 0.2 years lower educated than those in constant low poverty neighbourhoods. Interestingly, moving from medium neighbourhood poverty to the high poverty neighbourhoods has a stronger effect. Those who experience this change are on average 0.3 years lower educated than those who remain in neighbourhoods with moderate poverty levels. Both other sequences and varied sequences, characterised by a high number of moves, have a negative effect on educational attainment compared to constant medium ($b = -0.041$, $p < 0.001$ and $b = -0.200$, $p < 0.001$ respectively).

Finally, when comparing all of the models (Tables 2 – 4), we see that the explained variance (R-squared) is similar – around 17-18% - across all models - except for the third one of the timing models (influence of neighbourhood poverty at ages 18 – 22, R-squared at 20%).

TABLE 3.5 Effects of different trajectories of exposure to neighbourhood poverty on educational level

	Model 1 Ref = medium poverty		Model 2 Ref = high poverty		Model 3 Ref = low poverty	
	B	SE	B	SE	B	SE
Constant low poverty	0.144***	(0.016)	0.407***	(0.020)		
Constant high poverty	-0.263***	(0.014)			-0.407***	(0.020)
Constant medium			0.263***	(0.014)	-0.144***	(0.016)
Low to medium poverty	0.017	(0.023)	0.280***	(0.026)	-0.127***	(0.027)
Medium to low poverty	0.138***	(0.028)	0.401***	(0.030)	-0.006	(0.031)
Medium to high poverty	-0.268***	(0.026)	-0.005	(0.028)	-0.412***	(0.030)
High to medium poverty	-0.171***	(0.026)	0.092**	(0.028)	-0.315***	(0.030)
High to low poverty	0.181	(0.123)	0.445***	(0.123)	0.038	(0.123)
Low to high poverty	-0.082	(0.118)	0.182	(0.119)	-0.225	(0.119)
Other sequences	-0.041***	(0.009)	0.223***	(0.015)	-0.184***	(0.017)
Varied sequences	-0.200***	(0.019)	0.063**	(0.022)	-0.344***	(0.023)
Share of urban	0.445***	(0.010)	0.445***	(0.010)	0.445***	(0.010)
Female	0.311***	(0.008)	0.311***	(0.008)	0.311***	(0.008)
Household income (2003)	0.104***	(0.004)	0.104***	(0.004)	0.104***	(0.004)
Household income (2007)	0.074***	(0.003)	0.074***	(0.003)	0.074***	(0.003)
Household income (2011)	0.062***	(0.003)	0.062***	(0.003)	0.062***	(0.003)
Western	0.055**	(0.017)	0.055**	(0.017)	0.055**	(0.017)
Non-Western	0.082***	(0.013)	0.082***	(0.013)	0.082***	(0.013)
Middle educated parents	0.443***	(0.014)	0.443***	(0.014)	0.443***	(0.014)
High educated parents	1.306***	(0.014)	1.306***	(0.014)	1.306***	(0.014)
Parental education missing	0.694***	(0.014)	0.694***	(0.014)	0.694***	(0.014)
Constant	14.754***	(0.016)	14.490***	(0.020)	14.897***	(0.022)
R^2	0.174		0.174		0.174	

N = 149,558; standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

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3.5 Conclusions & discussion

The aim of this study was to come to a better understanding of the relationship between exposure to neighbourhood poverty and educational attainment. We have conceptualized four dimensions of exposure to neighbourhood poverty – accumulation, duration, timing and sequencing – and estimated their effects on educational attainment. Using register data from the Netherlands, we studied the population of children born in 1995, and followed them until age 23. Our findings show that the observed relationship between neighbourhood poverty and educational attainment depends on how exposure to the neighbourhood effects is conceptualized and measured.

We found that it is important to separate exposure in early adult years (age 18-22) from exposure in earlier childhood years. The effect of exposure to neighbourhood poverty during these years was positively related to educational attainment, whereas exposure up to the age of 17 was negatively related. This can be explained by these early adult years representing a very different stage in the life course during which individuals move out of the parental home towards city centres and student housing, where the proportion of households with a low income is higher – especially if their move is related to enrolling into higher education. Including these years in a measure of exposure to poverty from birth to age 23 distorted the results with a type of selection bias, caused by students selecting into neighbourhoods with their peers and other inhabitants of cheap housing. This bias was stronger in the accumulation model than in the duration model, which is less sensitive to extreme values. Researchers have to avoid the temptation of including generalised measures of as many years as possible, considering these years can span different stages of the life course, and test the influence of various theoretically implicated time periods. That is true even though the cumulative effect of exposure at ages 0 to 17 was stronger than that of ages 0-12 or 13-17, which is similar to the findings of studies of other spatial effects over time (Musterd et al., 2012).

With regard to the timing of exposure to neighbourhood poverty at different stages of development, we find that exposure during adolescence is slightly stronger related to educational attainment than exposure during childhood. There are multiple explanations for this effect, mainly related to the influence of parents diminishing as adolescents strive for more independence, while the influence of (local) peer groups increasing during adolescence (Janssen et al., 2016; Smetana et al., 2006). Both of these time periods being influential confirms the findings from earlier studies (Kuyvenhoven & Boterman, 2021; Nieuwenhuis et al., 2021).

The sequencing model highlights the importance of not only cumulative exposure to neighbourhood poverty, but also whether the neighbourhood conditions are improving or deteriorating. We find that individuals with improving conditions reached a higher educational level compared to those who remained in neighbourhoods with the highest poverty rates. In case of the most varied sequences, the effect is almost as big as constantly living in the poorest neighbourhoods. This points to the distinctive role of volatile moving histories. Future research could study this type of trajectories, which have proven influential in other studies (Coulter & Van Ham, 2013); as well as investigate moving within the same neighbourhood categories – something that could be another influential dimension of neighbourhood histories because of the resulting breakage of social ties.

A possible limitation of our study is that in addition to the neighbourhood context, the school context plays an important role when it comes to educational attainment. Previous research has, however, indicated that the effect of school can be a mediating factor in the neighbourhood effect on educational achievement in the Netherlands (Sykes & Musterd, 2011). Moreover, neighbourhoods have been theorised as encompassing the school context in similar studies (Toft and Ljunggren, 2016); even though there is no strict catchment area policy in the Netherlands, in most cases it is the easiest to sign up for a local school and private schools are not popular (Boterman, 2012). Another possible shortcoming is that we have focused on neighbourhood poverty only. Other characteristics could play an important role for educational attainment, such as neighbourhood employment and education level. We chose for a single measure of poverty, which is to some extent necessitated by the complex predictors in the study. Comparing the effects at different spatial scales could also lead to more insights – for example, duration of exposure being more important than accumulation at larger scales, because at that level local institutions could matter more than personal contacts and one needs more time to be affected by their quality.

In conclusion, our findings show that the observed relationship between neighbourhood poverty and educational attainment depends on how exposure to neighbourhood poverty is conceptualized and measured, as well as on the life course stage of the studied individuals. While it cannot be said that one of the dimensions – accumulation, timing, duration or sequencing – is more important than the others, researchers should carefully choose an approach that fits their theoretical interests, and preferably test different operationalisations and compare their outcomes. The main message of our study is that choosing just one dimension or operationalization may lead to the underestimation or overestimation of the importance of exposure to neighbourhood poverty.

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4 Neighbourhood effects on educational attainment

What matters more: exposure to poverty or exposure to affluence?

Troost, A. A., Van Ham, M., & Manley, D. J. (2023). **Neighbourhood effects on educational attainment. What matters more: exposure to poverty or exposure to affluence?** *PLOS One, 18*(3), e0281928.

ABSTRACT Neighbourhood effects studies typically investigate the negative effects on individual outcomes of living in areas with concentrated poverty. The literature rarely pays attention to the potential beneficial effects of living in areas with concentrated affluence. This poverty paradigm might hinder our understanding of spatial context effects. Our paper uses individual geocoded data from the Netherlands to compare the effects of exposure to neighbourhood affluence and poverty on educational attainment within the same statistical models. Using bespoke neighbourhoods, we create individual neighbourhood histories which allow us to distinguish exposure effects from early childhood and adolescence. We follow an entire cohort born in 1995 and we measure their educational level in 2018. The results show that, in the Netherlands, neighbourhood affluence has a stronger effect on educational attainment than neighbourhood poverty for all the time periods studied. Additionally, interactions with parental education indicate that children with higher educated parents are not affected by neighbourhood poverty. These results highlight the need for more studies on the effects of concentrated affluence and can inspire anti-segregation policies.

4.1 Introduction

The current interest in the economic impacts of neighbourhood effects was ignited by W.J. Wilson's book *The Truly Disadvantaged* (1987). The field has been dominated by a "poverty paradigm" ever since (Sampson, 2012) as studies on a wide range of individual outcomes focussed almost exclusively on the presumed negative effects of living in poverty concentration neighbourhoods. The research focus on poorer neighbourhoods is understandable, as these are the places where a variety of problems accumulate and restrict individual life chances. Moreover, poor neighbourhoods are highly relevant from the perspective of public policy interventions aimed at reducing poverty and related problems. However, focusing solely on the negative effects of spatially concentrated poverty may hinder our understanding of the role of spatial context effects in individual life courses. Studying the effects of living in areas with concentrated affluence could help us to better understand how inequalities arise. After all, the Matthew effect suggests that not only do the "poor get poorer", but also that the "rich get richer" (Merton, 1968).

Few studies have specifically investigated the effects of living in affluent neighbourhoods on individual outcomes (Toft & Ljunggren, 2016), despite repeated calls to do so since the 1990s (Danziger, 1996; Kawachi & Kennedy, 1997). The lack of literature on concentrated affluence is even more striking given the influential position of affluent households: the choices of the wealthy largely shape patterns of socio-economic segregation in cities, as higher income households can use their resources to select the best residential locations in a city (Troost et al., 2021). By using their wealth, richer residents are able to (re)produce spatial inequalities, including the inequalities arising from both positive and negative neighbourhood effects (Van Ham et al., 2018).

To ameliorate negative neighbourhood effects, policy has often focused on the social renewal of poor neighbourhoods through relocating poor and introducing more affluent households – a policy without substantial empirical support (Van Kempen & Bolt, 2009). The need to focus on tackling concentrated poverty while neglecting the spatial concentration of richer households has likely contributed to that limited policy approach (Slater, 2013). Ultimately, the overwhelming focus on "fixing" poverty could, in part, be the result of researchers adopting theories based on individual social actors' attributes rather than on a more dynamic view of society, in which upper social classes manage their resources through mechanisms of exploitation and exclusion (see the overview of social inequality theories in Wright, 2009).

There is a small number of studies that have demonstrated the significant influence of elite or affluent spatial contexts on various life outcomes in Europe (Andersson & Malmberg, 2018; I. Gordon & Monastiriotis, 2006; Kauppinen, 2007; Toft, 2018a, 2018b; Toft & Ljunggren, 2016) and in North America (Browning & Cagney, 2003; Pebley & Sastry, 2003; Wen et al., 2003). Amongst the important findings from these papers is that well-off and more highly educated neighbours can transfer their social and cultural capital through shared social networks formed within the neighbourhood. This is of particular importance for children's educational outcomes, considering that richer and more highly educated neighbours not only promote ambitious social attitudes (attending university to access high paying jobs as a norm), as well as invest in local community initiatives out of interest in the wellbeing of their own offspring (Sykes & Kuyper, 2009). Wealthier residents are likely to set higher standards for extracurricular activities for local children, spending time and resources on activities related to sport or culture. Through participating in such activities, children and teenagers not only expand their objective skills and knowledge, but also learn social codes which can be important for accessing affluent settings (Friedman & Laurison, 2020). Evidence from the Netherlands also suggests that homogenous high-income neighbourhoods exhibit more local solidarity behaviours than poorer or mixed-income neighbourhoods (Völker et al., 2007).

This study investigates the effects of exposure to neighbourhood affluence and neighbourhood poverty on educational attainment, using data from the Netherlands. Although by international standards Dutch cities are only moderately economically segregated, there is evidence of growing socioeconomic inequality in recent years (Hochstenbach & Musterd, 2018), as well as isolated elite spatial contexts, created by rich households seeking to further accumulate their capital (Hochstenbach, 2018). Moreover, the Dutch educational system is highly stratified and shows a growing dependency on students' socioeconomic background (Van den Broek et al., 2017). In our study we use longitudinal register data, which enable us to follow the 1995 birth cohort and construct neighbourhood histories from birth to age 18, and measure educational outcomes at age 23. We study the effects of exposure to affluence and poverty at different stages of development: early childhood (ages 0 to 12), adolescence (13 to 17) and the entire childhood (0 to 17). The measures of neighbourhood poverty and affluence are created from bespoke neighbourhoods based on the nearest 200 households. Following earlier studies (Sykes & Kuyper, 2009), we also test if the exposure to the neighbourhood context (both affluence and poverty) is different for children with different parental levels of education. We find that, in all models, neighbourhood affluence has a stronger effect on educational attainment than neighbourhood poverty. Additionally, interactions with parental education indicate that children with higher educated parents are not affected by neighbourhood poverty.

4.2 Theoretical background

4.2.1 The spatial influence of affluence

The neighbourhood context can influence educational outcomes of a child, similarly to the effect of parental and school factors, with which neighbourhood factors often interact (Andersson & Malmberg, 2018). The literature focusses mostly on social mechanisms (Galster, 2012) in the neighbourhood, including social interactions, which are based on physical proximity. The benefits of affluence for the quality of the built environment and facilities such as libraries, or schools, are clear – richer parents will have more resources to invest in their community, which they first carefully chose according to their preferences (Hastings, 2009). However, the social networks formed in the neighbourhood, which can be of high importance for children's future (Toft, 2018a; Toft & Ljunggren, 2016), are also affected by the wealth of local inhabitants.

Much of the neighbourhood effects literature uses the theory of resource transmission through local networks, which in turn is based on Bourdieu's concepts of social and cultural capital (Bourdieu, 1986). By knowing certain types of people (social capital), individuals gain access to valuable information about schools or jobs, as well as adopt certain habits and ways of expression which lead to being accepted by those in charge of school or job admission (cultural capital). Yet even when individuals are in possession of these skills and attitudes, these paths may remain untrodden if, for example, they do not perceive attending a university as a realistic option for their future. These socially inspired possibilities are covered by the concept of habitus (Bourdieu, 1977). The life choices individuals make must fit in within their habitus, which is formed by those with whom they are interacting (Bourdieu & Passeron, 1990). As individuals imitate others during their socialisation, the way they perceive the world and their place within it is shaped by their socioeconomic background. The habitus of a social class influences children's attitude to institutions (Lareau, 2011): the poorer parents, family members and classmates are unable to mobilise the same degree of social and cultural capital while dealing with authorities as richer ones.

Households reproduce neighbourhood characteristics by choosing neighbourhoods with people who are like themselves, and this is partly driven by their choice of housing and the neighbourhoods in which it is available (Hedman et al., 2011). Even if they are not consciously aware of social mechanisms, resourceful parents are likely to choose a neighbourhood as affluent as possible and contribute to preserving or enhancing that

status (Toft & Ljunggren, 2016). Such behaviour is rationalised as a desire to provide their children with a safe environment and protect from possible disorder in other neighbourhoods rather than to seek the positive effect of affluent ones (Boterman, 2012). For children, a safe environment is important because they spend time with their peers outside both in early childhood and in adolescence, playing sports and games. Unsupervised play outside is less prevalent among richer children, but still present (Stuij, 2015). For a child from a poorer household, becoming part of a social network with children from more affluent households can result in peer effects overriding the educational and vocational preferences of their own parents (Toft & Ljunggren, 2016). Shared behaviours, such as studying together (potentially supervised or assisted by higher educated parents) or refraining from skipping class, contribute further to educational success. Parents themselves may also be affected by the parenting attitudes in the neighbourhood (Sykes & Kuyper, 2009). Neighbourhood networks are often connected to other networks, for example when local children are encouraged to join clubs playing higher status sports such as field hockey or tennis (Stuij, 2015). Ultimately, a transmission of resources takes place in richer neighbourhoods, and children from poorer households can benefit from residing in such places.

4.2.2 Neighbourhood poverty in European context

Poorer neighbourhoods are not only deprived of resources, but also must deal with a wide range of consequences of poverty, including higher crime rates or the social isolation of migrant groups. Many studies of neighbourhood context influencing educational attainment from the US have focused on such spatial disorder, with participants expressing the stress caused by presence of organised crime or drug trade (DeLuca et al., 2012; Sharkey, 2018). However, these issues are less prevalent in the more egalitarian European societies (Kauppinen, 2008), with higher government spending on welfare (Le Galès & Zagrodzki, 2006). There are also differences between Northern American and European urban planning, with European cities being more “urban” – denser, with well-developed public transit networks – while many American cities are characterised by extensive, car-oriented, suburbs (Le Galès & Zagrodzki, 2006). Even if Western European cities have also experienced suburbanisation during the last decades (P. Gordon & Cox, 2012), their more compact nature should result in lower spatial isolation experienced by their inhabitants. Furthermore, cities in the US have been expanding due to international migration, a phenomenon which remains much slower in Western Europe (Le Galès & Zagrodzki, 2006). The large influx of new inhabitants from abroad may make social cohesion in American cities more difficult to achieve.

These differences between European and American cities might be a reason for caution in using US studies as inspiration for research on European data. The strong focus on poverty could be one of such trends. Even if American authors have long been calling for a greater focus on affluence (Danziger, 1996; Kawachi & Kennedy, 1997), most of the US research and public attention goes to deprived neighbourhoods (Sampson, 2012). Based on the practical reality of relatively egalitarian Western European cities, we assume that in the Netherlands, the lack of higher educated, affluent neighbours could be more important than the overall impact of poverty. This assumption is further supported by the few studies from European countries which show that the influence of neighbourhood affluence on various outcomes can be stronger than that of neighbourhood poverty (I. Gordon & Monastiriotis, 2006; Kauppinen, 2007).

While comparing the effects of affluence and poverty, it is important to highlight that one is not simply the inverse of the other. As already discussed, poverty is often associated with crime and isolation of minority groups (DeLuca et al., 2012; Sharkey, 2018). Furthermore, the accumulation of different types of capital characteristic for affluence could progress at very different rates than the negative effects of poverty, which can also accumulate (for example, having debts can lead to difficulties in finding an affordable mortgage). There are studies which not only show that the effect of one could be stronger than the other, but also that there can be a significant effect of concentrated affluence on health while concentrated poverty has no effect at all (Wen et al., 2003). Affluence and poverty can also interact differently with individual characteristics. This lack of symmetry is an argument for including them both in empirical models, as well as measuring them as distinct and separate factors to capture all of their influence. There are also theoretical reasons for studying poverty together with affluence, while using the Weberian-inspired conceptualisations of social and cultural capital, on which we elaborate in the next section.

4.2.3 Conceptualising social inequality

This paper addresses the issue of the poverty paradigm in the literature by specifically paying attention to spatially concentrated affluence. Understanding social inequality is central in research on neighbourhood effects, as social inequality is both their cause and consequence. It is, therefore, surprising that there has been relatively little attention paid to the theorising and conceptualising social inequality itself within the field, even in the studies which do include measures of affluence. In the following sections we argue for the need of studying not only the effects of poverty, but also affluence, arising from the theories of inequality used (sometimes only implicitly) in the field.

Most of the quantitative neighbourhood effects research, including the papers discussed in the sections above, fits well into the so-called middle-range sociology, a scientific scope advocated by scientists such as Merton (1949) and Boudon (1991). Middle-range sociology is situated between the grand theories and pure empiricism, with theories focused on specific aspects of social life, instead of the whole society; it aims to identify the same social mechanisms in different situations (Hedström & Udehn, 2009). Middle-range social research papers focus on answering specific research questions based on, most often, quantitative methods such as statistical models or experiments (Ultee et al., 2009). Studies of neighbourhood effects often investigate specific mechanisms (Galster, 2012), related to the effect of some form of segregation and therefore social inequality in urban space. The strict paper structure characteristic for the middle-range social studies usually does not allow for extensive theoretical commentary about inequality. Nevertheless, the concepts used in these papers are based on a variety of competing approaches to class, status and inequality (for an early overview see Wright & Perrone, 1977), even if these inspirations are not immediately visible.

To understand why researchers tend to overlook the spatial effects of affluence, it is important to highlight some of the traditions in studies of social inequalities and how they relate to the neighbourhood effects field. Wright (2009) outlines three main theoretical approaches within the sociology of class, social mobility and inequality: the individual-attributes approach (used in stratification research), opportunity hoarding (the Weberian approach), and mechanisms of domination and exploitation (the Marxist approach).

The individual-attributes approach focuses on how people obtain resources that allow them to attain a certain occupation, and therefore a position within the social strata. These meritocratic resources (for example, education or motivation), combined with attributes people are born with, shape their chances in life. The opportunity hoarding approach begins with the assumption that access to the most prestigious positions tends to be strongly protected – or hoarded – by those already having access. This Weberian approach studies how individuals in the higher social strata distance themselves by setting up requirements based on economic, cultural and social capital, as well as legal mechanisms of exclusion. One example, from urban geography, is when a good school is only accessible to those living in a certain district, and house prices in that area are sufficiently high that only affluent households can afford to live there. The third approach evolves around mechanisms of domination and exploitation. This Marxist approach takes the analysis further, by asserting that those who restrict access to certain resources and positions can also "control the labour of another group to its own advantage" (Wright, 2009, p. 107). This approach is present in urban studies research on the exploitations of tenants and ordinary homeowners by landlords and developers, and the pressure the latter can exert on government policies.

4.2.4 Social inequality and neighbourhood effects

Quantitative studies on neighbourhood effects usually mix elements of the individual-attributes and opportunity hoarding approaches. The individual-attributes approach manifests itself as focus on social mobility and the idea that the position an individual ultimately attains is shaped by a bundle of attributes, many of them related to physical space. This approach has the advantage that it is relatively easy to translate into statistical models. However, because of the high level of methodological sophistication in time and space-variant predictors, researchers often reduce their most important status-related neighbourhood characteristic(s) to a single proxy variable which captures the spatial context of an individual.

One approach for measuring the affluence of a spatial context is using income (Custers, 2019). Using categorical measures, or grouping neighbourhood inhabitants by their income level, often fits the research design better than using average income. Authors tend to follow the tradition of the field by focusing on poverty (choosing to create categories based on the percentage of poor households, etc.), which leads to the relatively lower number of studies on affluence (Toft & Ljunggren, 2016). From the perspective of the individual-attributes approach, this focus on poverty can be justified because there is no assumed relationship between poverty and affluence. As such, "eliminating poverty by improving the relevant attributes of the poor—their education, cultural level, human capital—would in no way harm the affluent" (Wright, 2009, p. 107). By contrast, "in the case of opportunity hoarding, the rich are rich in part because the poor are poor, and the things the rich do to maintain their wealth contribute to the disadvantages faced by poor people." It therefore follows that "moves to eliminate poverty by removing the mechanisms of exclusion would potentially undermine the advantages of the affluent".

One could argue that a discussion on whether societal well-being can be improved without substantially limiting the choices or wealth of upper strata is not immediately relevant to more exploratory neighbourhood effects research. However, many neighbourhood studies still implicitly use opportunity hoarding theories to explain the mechanisms under investigation. Maybe the most important examples are the already discussed concepts of cultural and social capital as developed by Bourdieu (1986). Bourdieu argues that social phenomena such as cultural norms are employed by upper classes to limit the access to their resources. Therefore, researching poverty in isolation disregards, potentially, the most influential part of the picture: the affluent social actors who possess the cultural, social, and economic capital. There are also theories focusing on the spread of disorder associated with capital deficiency, such as the broken windows theory (O'Brien et al., 2019). It could still be illuminating to frame the commonly studied neighbourhood effects

mechanisms in terms of the presence of various forms of capital, rather than a lack of it. Those studies investigating the effect of affluence often omit discussion of the wider implications of focussing on the effect of poverty in research. In addition to developing more methodologically sophisticated operationalisations of the current variables, quantitative neighbourhood effects researchers could deepen their assumptions and conclusions by grounding them in sociological theory. This is one of the goals of the current paper, although there are still interesting steps to be taken, such as questioning not only the poverty paradigm, but also the meritocracy paradigm (Imbroscio, 2016) as well as expanding the conceptualisations of social class (Custers & Engbersen, 2022).

4.2.5 Current study

Studies of neighbourhood effects on educational attainment (and in a broader sense all spatial effects studies) should investigate not only the effect of neighbourhood poverty, but also the effects of concentrated affluence. We argued that a better understanding of affluence is crucial for the neighbourhood effects mechanisms driven by various forms of capital. We use household income as a measure of poverty and affluence, which is highly correlated to other, more intangible, characteristics such as social cohesion (Galster, 2008). Income also serves as a proxy of resources available to neighbourhood inhabitants. Using income allows us to construct detailed individual neighbourhood histories and investigate the effects of different periods of exposure. We also create bespoke neighbourhoods, which reflect local spatial ties better than neighbourhoods based on administrative borders.

Following the literature review, we expect that the positive effect of exposure to affluent neighbours on education attainment will be stronger than the negative effect of exposure to poorer neighbours. We also expect differences between the effects of exposure to contextual poverty and affluence at different developmental stages, but it is not clear from previous work which period of influence will have the greatest impact. For instance, early years childhood exposure could be more influential for educational attainment than later exposures because of values and beliefs formed during the early years. Young children also experience less disruption from changing the neighbourhood environment (Chetty et al., 2016). However, adolescents have greater freedom from their household and spend more time with their peers away from the parental control, and therefore exposures during adolescence could be more important.

In recent years the focus of neighbourhood effects research has shifted somewhat from "do neighbourhood effects exist?" to "for whom" do they matter (Sharkey & Faber, 2014). In the case of children, social background could prevent them from interacting with poorer or richer neighbours (Toft & Ljunggren, 2016). Parents can explicitly limit children's interactions or simply not create any opportunities to play or socialise with children in other groups. On the other hand, children of higher educated parents may be more likely to believe in the importance of education regardless of their peer contacts in the neighbourhood. Given these propositions, we test for interactions between the exposure to neighbourhood affluence or poverty and parental education.

4.3 Data & methods

For our empirical analysis we used individual level, geo-coded longitudinal register data from the Statistics Netherland's Social Statistical Database (SSD), which covers the entire population of the Netherlands. We selected 140,338 individuals born in 1995 who also had complete neighbourhood histories between 1995 and 2017, when they are around 22 years old, and without missing information on the variables of interest (except for parental education, which has a large percentage of missing values). For our dependent variable, education level, we measured the level of education attained by age 23 and translated this in the number of years someone would normally need to achieve that level. We added an extra year for those who studied at research universities (*wo*) to distinguish them from universities of applied science (*hbo*). The resulting variable ranges from the minimum of 2 years for unfinished primary education, to a maximum of 23 years required to obtain a doctoral degree, with the mean 16.5 years. For individuals who were still following education in the final year of observation, the level of education that they were following at that time is registered.

The data underlying our results cannot be shared publicly as they are a part of the confidential Statistics Netherlands data. Statistics Netherlands is legally responsible for consent related to data use and they have approved our project. CBS is bound by the European General Data Protection Regulation (GDPR). In addition, CBS adheres to the privacy stipulations in the Statistics Netherlands Act, the European Statistics Code of Practice, and its own Code of conduct (Statistics Netherlands, 2022).

4.3.1 Contextual affluence and poverty

Contextual poverty is measured as a ratio and based on the Eurostat definition of the at-risk-of-poverty rate, which is the share of households with an equivalised disposable household income below 60% of the national median equivalised disposable income. The threshold for contextual affluence is set at 150% of that median, resulting in a similar percentage of the population above this threshold as the percentage of households under the poverty threshold. Even though in our data the detailed household income extends back to 2003, we have sufficient spatial information to people's residential histories all the way back to 1995, a further 8 years. To overcome the lack of neighbourhood income data pre-2003 we used the averaged neighbourhood income data from 2003 for all years between 1995 and 2002. Although neighbourhood characteristics change over time, using the 2003 data for earlier years is the only way to include the longer time period, which is crucial for our purposes (see Meen et al., 2012 on the static nature of neighbourhood positions).

The geocoded nature of our data gives us information on the residential location for each individual at a spatial resolution of 100x100m grid squares. Using this information, we have created bespoke measures of neighbourhood affluence and poverty for each year using Equipop (Östh et al., 2014). Equipop calculates the proportion of the *k*-nearest neighbours that meet user-set criteria, in our case a ratio of the neighbours meeting the poverty or affluence criterion within the 200 nearest households for each year of an individual's life. These ratios are the building blocks of our neighbourhood history variables, which are described in more detail below. We adjusted the income criterion for the median income in each year: households with an income above 150% of median household income that year were classified as affluent, and those with an income below 60% of median as poor. If, for example, an individual scores 0.15 for their 2005 neighbourhood affluence ratio, this means that in 2005, 15% of the 200 nearest households were regarded as affluent.

By constraining our neighbourhoods to the 200 nearest households, we are able to standardize measures both in densely and sparsely populated areas, important in this study, since we use the data from the whole country. Furthermore, as most of our predictors are based on social interaction, it is appropriate to focus on people rather than space while operationalising the variables.

The scale of spatial research should be chosen according to the theoretical assumptions of the study (Petrović et al., 2018), and in our case we focus on relatively small-scale, social-interactive neighbourhood effects which would happen in neighbourhoods of about 200 households. This size should reflect a social

space where people are likely to interact with each other, which, according to the assumptions of this study, assists in acquiring the skills and resources relevant for an individual's educational attainment.

4.3.2 Exposure to neighbourhood affluence and poverty

We measure exposure to neighbourhood affluence and poverty by combining annual affluence/poverty ratios during different developmental periods: early childhood (ages 0 to 12), adolescence (13 to 17), and the entire childhood (0 to 17): we add up the yearly ratios and divide them by the number of years. The affluence and poverty variables in each period are only weakly correlated (correlation of -.45 for all three periods). We do not include measures of neighbourhood exposure after the age of 17; running models until the age of 23 in an earlier study has shown that young adults have very particular neighbourhood experiences (Troost et al., 2022). Many of them leave the parental home around the age 18, moving to cheap student accommodation in often low-income neighbourhoods. That creates a positive effect of having many poor neighbours on attained education, but as the education is rather the cause than the result in such a case, we decided to include only neighbourhood histories up to and including age 17.

4.3.3 Control variables

The control variables in this study include an individual's sex (female or male) and their ethnicity, which is coded as native Dutch (both parents born in the Netherlands), Western migrant or a non-Western migrant background (Western countries, according to the Statistics Netherlands definition, are all European and Northern American countries along with Japan, Australia and Indonesia). Additionally, an individual's household context is represented by their household income measured in 2007, when the individual being observed would have been twelve years old, the age by which mothers are likely to have re-joined the labour market, and a variable recording parental education level (lower, middle, higher or missing). The latter variable is constructed by recording the highest education level achieved by either of the (up to) two parents. Parents with missing information on their education are kept in the data as a separate category because of their large number (11% missing) and an overrepresentation of migrants in this category. A control variable at the municipality level is the level of urbanicity, based on the proportion of years between 1999 and 2017 (for which the address density data was

available) an individual has lived in an urban environment. To control for the density of social interactions at a lower level, we also included interval distance, measured by Equipop in kilometres necessary to reach the 200 nearest neighbours. The descriptive statistics of all variables can be found in Table 4.1.

TABLE 4.1 Descriptive statistics

	Mean / %	SD	min	max
Education level (in years)	16.482	1.609	2	23
Exposure to neighbourhood affluence (age 0 – 17)	.163	.101	.000	.820
Exposure to neighbourhood affluence (age 0 – 12)	.163	.101	.000	.831
Exposure to neighbourhood affluence (age 13 – 17)	.163	.111	.000	.802
Exposure to neighbourhood poverty (age 0 – 17)	.114	.072	.014	.848
Exposure to neighbourhood poverty (age 0 – 12)	.111	.071	.008	.860
Exposure to neighbourhood poverty (age 13 – 17)	.122	.087	.009	.892
Female	49%		0	1
Household income (2007, in 10,000 euros)	2.298	1.546	*	*
Household income (in 10k euros, median centered)	.287	1.546	*	*
Western	.052	.221	0	1
Non-Western	.133	.341	0	1
Native Dutch	.815	.388	0	1
Parental education	1.780	.979	0	3
Lower parental education	28%		0	1
Middle parental education	33%		0	1
Higher parental education	28%		0	1
Parental education missing	11%		0	1
Urbanicity	.771	.414	0	1
Equipop distance (in km)	0.213	0.282	0	7.288

N=140,338

** Removed because of Statistics Netherlands privacy regulations.*

4.3.4 Analytical approach

We estimated a series of linear regression models with educational level at age 23 as the dependent variable. All models are estimated on the same sample of 140,338 individuals, and contain the same control variables. Given the nested structure of our data, the use of multilevel modelling appears logical. However, there are two reasons why we have not used this type of models. Firstly, individuals

are nested in neighbourhoods and these can change each year requiring multiple hierarchies which creates a complex structure inhibiting model convergence. This is further exacerbated by the second reason, whereby there is no strict hierarchy because of the multiple membership of individuals in the bespoke neighbourhoods (the neighbourhoods are overlapping with each other). Furthermore, because of bespoke neighbourhoods which are constructed for each individual every year, and only including people born in 1995 in the sample, a large number of individuals are nested alone in their neighbourhood (71,016; 50.60%), which is a further complication in estimating a hierarchical fixed effects structure.

The spatial variables contribute to around 3% difference in R-squared. The initial model without spatial variables explained around 15% (for detailed coefficients, see the Appendix), increasing to 16% when the urbanicity control was added, to 18% with all spatial variables included. This is the magnitude of difference that can be expected from similar variables in sociological models. Additionally, including the spatial variables diminishes the effects of other variables in the model, such as family income, which means the spatial variables contribute to the underlying causal structures. VIF values were unproblematic, therefore there are no issues with multicollinearity in the models (see the Appendix for exact VIF values).

4.4 Results

4.4.1 Exposure to neighbourhood affluence and poverty

Table 4.2 presents the effects of exposure to neighbourhood affluence and poverty over time on educational level (measured in years) at age 23. In the case of affluence, the effects of exposure during the entire childhood (ages 0 to 17) and early years (0 – 12) are both positive and similar in size ($b = 2.138$, $p < 0.001$, beta = 0.133 and $b = 2.119$, $p < 0.001$, beta = 0.132, respectively). The effect of exposure to affluence during adolescence remains positive, but is smaller ($b = 1.733$, $p < 0.001$, beta = 0.118). Compared to early childhood ($b = -0.827$, $p < 0.001$, beta = -0.036), the negative effect of exposure to poverty is slightly stronger when taking into account the whole childhood ($b = -0.989$, $p < 0.001$, beta = -0.043), and the effect during adolescence ($b = -0.925$, $p < 0.001$, beta = -0.052) is the strongest,

when looking at the standardised beta coefficient. The most important finding for this paper is the comparison between the effects of affluence and poverty. The modelling results show that exposure to affluent neighbours has a stronger overall effect on educational attainment for all three time periods than exposure to poverty, confirming our hypothesis.

Most of the control variables have the expected effects, with women having a slightly higher levels of education level than men, and with higher parental household income and education being positively related to educational attainment. A surprising effect is that, in our models, Western and non-Western ethnic minorities have a slightly higher educational levels compared to native Dutch individuals. However, our models control both for parental household income and parental education level, which explains much of the negative influence of belonging to a minority ethnic background observed in other studies. In total, each of the models explains almost 18% of the variance in educational attainment.

TABLE 4.2 Effects of exposure to neighbourhood affluence and poverty in childhood and adolescence on educational level at age 23

	(1) Exposure age 0 – 17		(2) Exposure age 0 – 12		(3) Exposure age 13 – 17	
	b	SE	b	SE	b	SE
Exposure to neighbourhood affluence	2.138***	(0.048)	2.119***	(0.047)	1.733***	(0.044)
Exposure to neighbourhood poverty	-0.98[9]***	(0.066)	-0.827***	(0.066)	-0.925***	(0.055)
Female	0.309***	(0.008)	0.310***	(0.008)	0.309***	(0.008)
Household income (in 10k euros, median centered)	0.110***	(0.003)	0.113***	(0.003)	0.114***	(0.003)
Western (ref. native Dutch)	0.047**	(0.018)	0.045*	(0.018)	0.042*	(0.018)
Non-Western	0.130***	(0.013)	0.119***	(0.013)	0.099***	(0.013)
Middle parental education (ref. lower educated)	0.437***	(0.014)	0.443***	(0.014)	0.441***	(0.014)
Higher parental education	1.258***	(0.014)	1.269***	(0.014)	1.274***	(0.014)
Parental education missing	0.677***	(0.014)	0.686***	(0.014)	0.686***	(0.014)
Urbanicity	0.325***	(0.011)	0.325***	(0.011)	0.330***	(0.011)
Equipop distance	-0.250***	(0.015)	-0.238***	(0.015)	-0.267***	(0.015)
Constant	15.122***	(0.019)	15.094***	(0.019)	15.183***	(0.018)
R^2	0.181		0.180		0.179	

N=140,338; standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

4.4.2 Interactions with parental education

The effects of exposure to neighbourhood affluence and poverty remain significant in the models which include interactions between these neighbourhood factors and parental education, ranging from lower parental education (reference category), through middle, to higher education, and also including the sizable group of parents whose education level is missing from the data. In the model with interactions with neighbourhood poverty we additionally include the exposure to neighbourhood affluence as a control variable, and vice versa (for detailed results, see the Appendix). For ease of interpretation, we present the results of the interaction terms visually. Figure 4.1 shows the slopes of the interactions from both models. In the model with the interactions with neighbourhood poverty, children from households with at least one higher educated parent do not appear to be affected by the proportion of poor households in their bespoke neighbourhood. Children of either middle or lower educated parents are negatively impacted, although the severity of the impact is differential. When the proportion of poor neighbours is low then it is the children of lowest educated who are most at risk; the experienced effects are similar for children from lower and middle educated families at the highest proportion of poor neighbours.

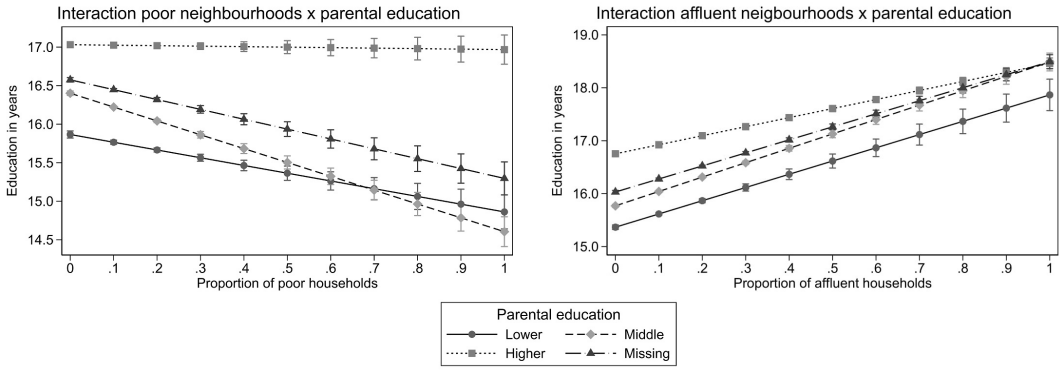

FIG. 4.1 Interactions between the ratio of poor or affluent neighbours and the parental education

In the model with the interactions with neighbourhood affluence, all interaction slopes are positive, although the slope of the interaction between higher parental education and neighbourhood affluence is slightly flatter. This implies that again, children with at least one higher educated parent are less susceptible to their neighbours' influence on educational attainment, compared to those with lower educated parents. However, this difference is less pronounced in the case of exposure to affluent neighbourhoods than to poor ones.

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4.5 Conclusions & discussion

In this paper we have compared the effects of exposure to neighbourhood affluence and neighbourhood poverty during different stages of childhood on educational attainment. We argued that there are theoretical reasons to believe that exposure to affluence may actually be more important as a predictor of educational attainment than exposure to poverty, because of the crucial influence of interacting with higher educated people on one's resources, skills and educational aspirations; and, in the Dutch context, because of the lack of extreme concentrated poverty. Confirming this empirically, our results show that neighbourhood affluence has a stronger effect on educational attainment than neighbourhood poverty in the Netherlands. This is consistently the case across different time periods – from early childhood (ages 0 – 12), adolescence (13 – 17) – as well as for the entire childhood (0 – 17). According to our models the neighbourhood effects during different time periods are similar when it comes to magnitude, direction, and significance. Interestingly, the effect of exposure to poverty during the entire childhood period is stronger than that of shorter periods, which contrasts with previous results from the US (Chetty et al., 2016) and the Netherlands (Kleinepier & Van Ham, 2018).

We considered the educational level of parents to explore whether children from higher or lower educated parents are influenced differently by the neighbourhood. This is in line with earlier works, arguing that neighbourhood effects may not be the same for everybody within the neighbourhood, and that the heterogeneity of individual backgrounds might be important for their transmission (Sharkey & Faber, 2014). The interactions between the effects of neighbourhood affluence or poverty and parental education level show that children with at least one higher educated parent are not impacted by neighbourhood poverty. We therefore consider higher education to be a buffer against negative neighbourhood contexts. However, children with higher educated parents are still influenced by neighbourhood context when that context is set in affluence, although their gains are not as great as those experience by children living in households with lower levels of parental education.

Most importantly, our results highlight how spatially concentrated affluence contributes to the reproduction of socioeconomic inequalities, as the effect of neighbourhood affluence on educational attainment is stronger than that of neighbourhood poverty. It seems that, in this sense, neighbourhood effects in the Netherlands are similar to those observed in the UK (I. Gordon & Monastiriotis, 2006) and Finland (Kauppinen, 2007). Our results, specifically the effect of spatially concentrated affluence being stronger than that of poverty,

support our initial idea that it is often the *lack of resources* – the cultural and economic capital of richer neighbours - in poor and middle-income neighbourhoods that is the problem, not the theorised negative effects of poverty itself. Again, in the Dutch context, crime and teenage delinquency are at relatively low levels compared to the United States, where much of the previous literature is set. Social interactions with resourceful neighbours and peers do seem to play an important role in forming children's ambitions, as well as in sharing knowledge and forming attitudes that support them. Additionally, children with at least parent with a higher level of education were less susceptible to neighbourhood influences, especially when living in poor neighbourhoods, which suggests that parental resources have a buffering role, compensating for the local lack of capital. Such children were also less affected in affluent neighbourhoods, but they still benefitted from the neighbourhood context. This implies that neighbourhood resources can have an added effect regardless of family background.

One potential possible limitation of this study is that we have measured neighbourhood resources only taking into account household income. While the use of this relatively simple variable allows for a sophisticated operationalisation of neighbourhood histories at across time periods it does not necessarily capture all important dimensions of resources. Future work could try to include other dimensions of capital and inequality to investigate the effects of living near elite, rather than just affluent, social groups. The sequences of moving from more to less affluent neighbourhoods, and vice versa, could also be studied, as we did in an earlier paper focusing on the different temporal aspects of exposure to neighbourhood poverty (Troost et al., 2022). Future studies should also include the role of the school context (Cordes et al., 2016), with a direct measure of it. Lack of the school context is a possible limitation of this study; however, the effect of schools can be a mediating factor in the neighbourhood effect on educational achievement in the Netherlands (Sykes & Musterd, 2011). And finally, when longer time series become available, future studies could measure educational attainment at an older age, which may provide more accurate information on obtained diplomas and final qualifications as well as the impacts of returning to education in later adulthood.

In the introduction we observed that neighbourhood effects research is trapped in the poverty paradigm, and as a consequence focusses predominantly on the negative effects of living in poor neighbourhoods. Our study serves as an inspiration for both research and policy focused on the spatial transmission and segregation of affluence. The positive effect of growing up in an affluent neighbourhood is not a serendipitous turn of fate; urban segregation is an outcome of opportunity hoarding processes by those with the means to do so, even if people do not expect the macro level outcomes of their decisions (as in, for example, the Schelling ethnic

segregation models: Schelling, 1971), and the overwhelming majority of households are subjected to the whims of landlords and developers controlling the housing market. By studying the effects of living in both affluent and poor environments, we have painted a fuller picture in which urban segregation is not just driven by the sociospatial transmission of deprivation, but also by most resources being concentrated in affluent neighbourhoods.

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Appendix

TABLE 4.3 The basic model without spatial variables.

	(1) Exposure age 0 – 17	
	b	SE
Female	0.325***	(0.008)
Household income (in 10k euros, median centered)	0.158***	(0.003)
Western (ref. native Dutch)	0.071***	(0.018)
Non-Western	0.047***	(0.012)
Middle parental education (ref. lower educated)	0.491***	(0.014)
Higher parental education	1.476***	(0.014)
Parental education missing	0.784***	(0.014)
Constant	15.430***	(0.013)
R^2	0.150	

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

TABLE 4.4 VIF values.

	(1) Exposure age 0 – 17		(2) Exposure age 0 – 12		(3) Exposure age 13 – 17	
	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
Exposure to neighbourhood affluence	1.56	0.640902	1.52	0.657647	1.55	0.643576
Exposure to neighbourhood poverty	1.52	0.659378	1.47	0.678045	1.49	0.671022
Female	1.00	0.998209	1.00	0.998211	1.00	0.998206
Household income (in 10k euros, median centered)	1.20	0.832869	1.19	0.840395	1.20	0.833727
Western (ref. native Dutch)	1.02	0.982759	1.02	0.982980	1.02	0.983712
Non-Western	1.33	0.751932	1.32	0.754751	1.29	0.778015
Middle parental education (ref. lower educated)	2.64	0.379063	2.64	0.379423	2.64	0.379347
Higher parental education	3.07	0.326180	3.06	0.326984	3.05	0.327461
Parental education missing	2.80	0.357685	2.79	0.358420	2.79	0.358343
Urbanicity	1.25	0.797803	1.25	0.801308	1.25	0.798701
Equipop distance	1.19	0.840852	1.19	0.841416	1.19	0.840197
Mean VIF	1.69		1.68		1.68	

TABLE 4.5 Interactions between the exposure to neighbourhood poverty and affluence with parental education.

	(1) Interactions with neighbourhood poverty		(2) Interactions with neighbourhood affluence	
Exposure to neighbourhood poverty (age 0 – 17)	-1.005***	(0.132)	-0.890***	(0.067)
Exposure to neighbourhood affluence (age 0 – 17)	2.134***	(0.048)	2.500***	(0.170)
Interaction effects parental education and neighbourhood poverty (ref. is lower educater parents)				
Middle edu parents x proportion poor households	-0.792***	(0.163)		
High edu parents x proportion poor households	0.941***	(0.164)		
Parental edu missing x proportion poor households	-0.275	(0.171)		
Interaction effects parental education and neighbourhood affluence (ref. is lower educated parents)				
Middle edu parents x proportion affluent households			0.219	(0.187)
High edu parents x proportion affluent households			-0.791***	(0.177)
Parent edu missing x proportion affluent households			-0.037	(0.182)
Urbanicity	0.328***	(0.011)	0.322***	(0.011)
Equipop distance	-0.250***	(0.015)	-0.261***	(0.015)
Female	0.309***	(0.008)	0.403***	(0.025)
Household income centered	0.110***	(0.003)	1.387***	(0.025)
Western	0.047**	(0.018)	0.665***	(0.026)
Non-Western	0.147***	(0.013)	0.403***	(0.025)

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TABLE 4.5 Interactions between the exposure to neighbourhood poverty and affluence with parental education.

	(1) Interactions with neighbourhood poverty		(2) Interactions with neighbourhood affluence	
Middle educated parents	0.536***	(0.028)	0.403***	(0.025)
Higher educated parents	1.166***	(0.027)	1.387***	(0.025)
Parental education missing	0.710***	(0.027)	0.665***	(0.026)
Constant	15.116***	(0.026)	15.072***	(0.027)
R^2	0.182		0.182	

Standard errors in parentheses
** p < 0.05, ** p < 0.01, *** p < 0.001*

5 Do you see it how I see it?

Differences in neighbourhood perceptions predicted by individuals' socioeconomic characteristics and attitudes

Chapter 5: Troost, A. A., Manley, D. J. & Van Ham, M. **Do you see it how I see it? Differences in neighbourhood perceptions predicted by individuals' socioeconomic characteristics and attitudes** (submitted for publication)

ABSTRACT For the study of neighbourhood effects, researchers often use register data-based measures of neighbourhood characteristics. However, the causal mechanisms explaining such neffects might be based on the perception of neighbourhood characteristics, rather than the objectively measured characteristics. The mismatch between the objective measures and subjective perceptions is likely influenced by individuals' characteristics and attitudes. This paper investigates the mismatch in the measured percentage of low-income and foreign background neighbours and the perceptions of these neighbourhood characteristics. We use a unique Dutch neighbourhood perceptions survey merged with population register data to create neighbourhoods coinciding with the areas the respondents were asked to consider. The perceptions and register data-based measures correlate, although not strongly for the percentage of low-income neighbours. Older age and greater social embeddedness lead to underestimation of both characteristics, and higher household income to underestimation of the share of low-income neighbours. Higher education also leads to underestimation, but after controlling for individual institutional trust it becomes less significant to the perceived percentage of foreign background neighbours, and insignificant to the perceived percentage of low-income neighbours. Individuals with lower institutional trust are likely to overestimate both

the percentages of their foreign background and low-income neighbours; in the case of low income, the same can be said for generalised trust.

Our results could explain inconclusive results of neighbourhood studies using register-based variables, and suggest that urban research should benefit from augmenting administrative datasets with surveys and interviews highlighting feelings and values.

5.1 Introduction

A central feature of the quantitative neighbourhood effects literature is that the neighbourhood context is often measured objectively using spatially aggregated census or register data. These objective characteristics are assumed to have an effect on neighbourhood residents. However, it might be that the *perceptions* of the neighbourhood context, instead of the objective measures, explain contextual influence (Fagg et al., 2008). Studies have shown that the effects of individual perceptions of the spatial context can differ from those based on administrative measurements (Chiricos et al., 1997). It remains unclear from the literature how individual demographic and socioeconomic characteristics influence perception of neighbourhood characteristics, such as the share of inhabitants with migration background or poverty.

Studies using variables based on individual perceptions of the spatial context have focused primarily on feelings, emotions or opinions seen as being experienced "subjectively". These concepts include perceptions of danger (Roosa et al., 2009), neighbours' friendliness (Munro and Lamont, 1985), or aesthetics (Mackenbach et al., 2016); while researchers using supposedly objective variables choose characteristics such as neighbourhood average income (Van Ham et al., 2018) or percentage of neighbourhood green spaces (Pearce et al., 2018). This difference in approach is further reinforced because even though it is possible to numerically express neighbourhood friendliness, beauty or safety, register and census data do not include such indicators and consequently, it has been difficult to connect the subjective measures with objective data. Moreover, the different ways in which different people may experience or perceive neighbourhood characteristics are overlooked. For example, the positive influence of urban green space on health and wellbeing outcomes is widely studied but depends not only on the physical presence

of urban green (which can be easily and numerically measured), but also on the ability of inhabitants to notice it and interact with it (which can be more difficult to gauge) in order to allow any beneficial influence on their lives (Wilson et al., 2004).

Most studies using variables such as neighbourhood deprivation or percentage of migrants assume that register data-based measurements are sufficiently accurate for capturing the causal effect of these neighbourhood characteristics on individuals. However, people are often inaccurate in their estimations of area characteristics, even in the context of large scale processes such as the poverty level in their entire country (Mysíková et al., 2019). At the neighbourhood scale, the likely absence of contact between different social groups living close by (Bolt & van Kempen, 2013) could contribute to that inaccuracy. Still, even the simple act of acknowledging the presence and assumed characteristics of a neighbour can form an "invisible" social tie between people (Felder, 2020), which can be sufficient to inform perceptions of neighbours. There are many studies investigating the mediating effect of more perceptual variables, such as neighbourhood disorder, on the objective measures of neighbourhood poverty (Haney, 2007). But to our knowledge there are no studies directly comparing objectively measured and individually perceived neighbourhood poverty, and very few comparing the perceived and measured presence of ethnic minorities in neighbourhoods (Hooghe & De Vroome, 2015; Van Assche et al., 2014, 2016).

Given that there is an extensive literature exploring the potential influence of neighbourhood characteristics - such as poverty or ethnic diversity - on people's lives, the way in which this influence is mediated by individual perceptions, and how that mediation differs across social groups, could be crucial in enabling a better understanding of the results and implications of neighbourhood research. This paper contributes to the literature by studying how the objective neighbourhood characteristics from register data – the share of people with a foreign background and the share of people with low income – and the perceptions of those characteristics by inhabitants of the neighbourhood differ. We study the influence of several individual level predictors, including gender, household income, ethnic background and social embeddedness in the neighbourhood on that mismatch. Particular attention is paid to the measures of institutional and generalised trust, which can influence one's perceptions of the socioeconomic situation of the neighbourhood.

We use data from LISS (Longitudinal Internet studies for the Social Sciences) panel, including a unique neighbourhood perceptions survey collected in 2020, and the Statistics Netherlands geocoded microdata based on administrative registers. With these data, we create bespoke neighbourhoods based on a 10 minutes walking

distance, conceptualised to coincide with the area the respondents of the LISS survey could consider as the extent of their neighbourhood. Within the survey the respondents are asked specifically to assess the percentage of the neighbourhood population who are poor and the percentage of inhabitants who are of foreign background within their 10-minute-walk neighbourhood. As a result, the data offer a unique opportunity to compare these popular social science variables, as captured by governmental registers, with inhabitants' own perceptions. We believe that developing a fuller understanding of the predictors of the discrepancy between individual perceptions and measures from administrative sources is relevant not only for urban research, but also for social science research in general.

5.2 Theoretical background

5.2.1 Individual perceptions in neighbourhood effects research

The existing body of work on neighbourhood perceptions has largely focused on subjective characteristics such as aesthetics or social atmosphere of the neighbourhood (Bowling & Stafford, 2007; Drukker & van Os, 2003; Kamphuis et al., 2010; Mackenbach et al., 2016). Several studies investigated the opinions of inhabitants about their local amenities, including green spaces and playgrounds (Bailey et al., 2014; Hoehner et al., 2005; Munro & Lamont, 1985). Other researchers have studied feelings of safety and social cohesion in the neighbourhood (Bowling et al., 2006; Jones & Dantzler, 2021; Munro & Lamont, 1985; Semyonov et al., 2012). Another group of studies focused on the neighbourhood reputation, pointing out that there are differences between how the inhabitants perceive their neighbourhood and how it is seen by outsiders (Permentier et al., 2008).

Next to investigating the effect of the perceptions themselves on individual outcomes, these studies also sought to establish the relationship between inhabitants' perceptions and the objectively measured variables such as neighbourhood socioeconomic status. For example, Haney (2007) tested the "broken windows" theory by investigating the roles that perceptions of neighbourhood disorder and objective neighbourhood poverty could have in influencing individual self-esteem. Haney's results indicate that much of the impact

of neighbourhood poverty (as measured by the proportion of people in respondent's census block below the US poverty line) on self-esteem is mediated by the perceived neighbourhood disorder. This is not surprising, as the measure of disorder – based on an amalgamation of issues including the quality of city services (such as garbage collection), housing and property upkeep, and crime and vandalism – is broad, and encapsulates the symptoms of neighbourhood poverty an individual will directly perceive. Key socioeconomic variables, such as neighbourhood income, employment, or education level, are often conceptualised as proxies encompassing a wide range of associated mechanisms – to the degree that some authors would describe the processes in neighbourhoods as obscured by the "black box" of neighbourhood effects (Van Ham & Manley, 2012). Using survey data based on individual perceptions of neighbourhood characteristics is, therefore, an attempt to cast some light into that box.

At the same time, and as a consequence of their role as proxies, there have been few studies looking specifically at individual perceptions of neighbourhood socioeconomic characteristics such as neighbourhood poverty or the percentage of ethnic minorities. These objective, also called archival (Roosa et al., 2009), variables are constructed from quantitative data such as administrative registers and usually require the definition of categories, such as country of origin, or scales, such as for income. Often these measures are seen as strictly defined – even though criticism of their rigidity can be easily formulated. For example, the previous[11] Statistics Netherlands criteria used to identify people of non-Dutch origin divided them into Western (according to the definition, this included individuals from European and Northern American countries plus Japan, Australia and Indonesia) or non-Western (the rest of the world). This choice, like many necessitated by the nature of quantitative analysis, is to some extent arbitrary (why is Japan Western but South Korea is not?), although it reflects colonial and trading histories. Ethnic categories detailed at the level of country of birth still omit many within-country differences (Jennissen et al., 2018). The crux here is that measuring a trait such as ethnicity necessitates creating groups, and these groups are usually imperfect representations of the diversity of belonging and identity.

When it comes to income, which is often used as a proxy of socioeconomic status, many researchers highlight that a complete measure of socioeconomic resources should include not only the amount of money an employer pays but also individual

11 From 2022, a new categorisation focusing more on the country of birth and continents was introduced (https://www.cbs.nl/nl-nl/dossier/dossier-asiel-migratie-en-integratie/heroverweging-indeling-westerse-en-niet-westerse-migratieachtergrond).

wealth and relations to processes of production, as well as education, occupation and, more generally, social and cultural capital (Savage, 2015). Looking more at social class than at income as a solitary measure could lead to a fuller image of neighbourhood affluence or deprivation (Custers & Engbersen, 2021). But, class itself can be considered as nebulous, not corresponding directly to individual experience and is not immutable across people, time, or places (Wright, 2009).

Despite these issues, most studies accept the validity of numerically measured economic and ethnic composition variables. But how much of these quantified sociospatial situations translates directly to people's perception of their neighbourhood? And how is this "translation" influenced by various characteristics of people – eg. their education, which can supposedly increase their social awareness? Our two predictors of interest, neighbourhood poverty and percentage of neighbours with foreign background, operate quite differently: the first is usually used as a proxy, while the second measure is often presented as very directly affecting inhabitants of a neighbourhood (even if mediated through actual social interaction). Because of these differences we discuss the measures separately.

5.2.2 Perceptions of poverty

In social science research, subjective poverty has been approached in multiple ways ranging from openly political approaches, in which the consciousness of one's working class belonging is a prerequisite of system-changing action (Wright, 2009), to psychologised approaches equating broadly understood poverty with lack of life satisfaction or even lack of happiness (Praag & Ferrer-i-Carbonell, 2008). What unites these approaches, even if for some poverty is a concrete material situation and for others a feeling, is the relationality of poverty: except for those absolutely penniless or undeniably rich, one can only be poor in comparison with a personal situation from the past or the current situation of someone else. This idea has inspired many studies on relative deprivation, also in the neighbourhood effects field. These studies test the assumption that being richer compared to one's neighbourhood has its own advantages, and vice versa, being relatively poorer breeds disadvantage. The reason behind any apparent disadvantage could be the psychological distress – manifested through feelings of shame and guilt – caused by the comparisons between oneself and one's neighbours. The evidence for the relative deprivation theory in the neighbourhood context remains inconclusive, with some studies supporting it (Bacqué et al., 2014; McCulloch, 2001), and others not finding significant effects (Knies et al., 2007; Stafford & Marmot, 2003).

People do not develop their perceptions in isolation, removed from external influences. Opinions are strongly influenced by the media, education and politics, often controlled by people whose interests align more closely with the general obfuscation of social inequality rather than seeking to promote accurate knowledge. There have been detailed analyses of such processes, mostly by theorists studying the Marxist concept of false class consciousness (Fuchs, 2021) – people acting against their socioeconomic interests because of the cultural and social propaganda of the capitalist class. Even if we look at the single measure of individual income, and not the entire concept of social class, the subjective idea of having low income can be substantially influenced by cultural signifiers of wealth (Bourdieu, 1986). Someone with objectively low income can see themselves as richer if they can afford fashionable clothes considered high quality according to their vision of culture (cultural capital); on the other hand, someone objectively affluent can feel poor if they compare their current life situation, in which they cannot afford fancy restaurant dinners or luxury holidays, to something they know as the norm from their past, friends' stories or media representations. The comparison effect can happen on a scale as large as entire countries: for instance, Mysíková et al. (2019) show how Slovakians considered themselves to be poorer than Czechs even years after the initial economic differences between the two countries diminished.

The complicated processes of people trying to determine their economic position in relation to what they know from the media, their workplaces, and their own past experiences point to how difficult it is to gauge the situation of others in their neighbourhood. The lack of clarity when it comes to the economic standing of one's neighbourhood could explain the inconclusive results of the neighbourhood effects studies investigating relative deprivation: two people, relatively rich compared to their neighbourhoods according to their exact income and wealth, might have very different perceptions of their neighbours and therefore their experience of relative deprivation will differ. Social contacts in the neighbourhood can aid accurate (or alternatively reinforce inaccurate) perceptions; although one could argue that for assessing a large number of neighbours, the "invisible ties" – knowing of someone's presence without necessarily *knowing* them personally (Felder, 2020) – are more important. These fleeting, everyday encounters could be seeing one's neighbours driving expensive cars or staying home all day because of unemployment.
One's education and cultural awareness may also help with correctly estimating neighbourhood affluence or poverty, and avoiding the mental traps of prejudices: for example, assuming that a relatively low quality of housing upkeep is indicative of neighbourhood poverty, when in reality the central location of the neighbourhood in the city causes high rents and therefore necessitates higher incomes from the inhabitants. At the same time, political beliefs and worldview can influence the way people interpret the information they access through their education. In the final

section of this theoretical background, we elaborate on what kind of demographic characteristics, skills and behaviours we expect to influence the perceptions of neighbourhood poverty.

5.2.3 Perceptions of foreign origin neighbours

Because of the substantial public and academic interest in migration, the presence of ethnic minorities in neighbourhoods has been widely researched. Some of the earliest neighbourhood studies and models have focused on the exclusion (Liebow, 2003) and segregation processes (Schelling, 1971) experienced by black inhabitants of large American cities. In European research, people of immigrant background are cast in a similar role to the minority racial groups in the US. In the Dutch context, many of them, originating mostly from Turkey and Morocco, are the descendants of the so-called "guest workers" from the 1960s and 1970s whose supposed temporariness contributed to the low socioeconomic position of their families in the following decades. The two other big immigrant groups hail from Suriname and the Antilles, former Dutch colonies. In addition, the expansion of the European Union brought with it a new wave of immigrants from Eastern Europe, who have so far been overlooked in neighbourhood research, potentially because they initially settled in smaller cities and rural areas rather than the largest urban conurbations.

The presumed characteristics of the main migrant groups – low income, working in occupations with low prestige and low job security, and a greater propensity for crime and delinquency than the majority population – are so widely implied in neighbourhood research that papers often control for "immigrant presence" in the neighbourhood without motivating the underlying mechanisms. While qualitative studies do show evidence for immigrant social networks discouraging their members from seeking prestigious career paths in Dutch society, mostly by providing them with low-income jobs (Pinkster, 2007), in many quantitative models the effect of the share of immigrant background inhabitants disappears when other variables like income and share of social housing are controlled for (Van Ham et al., 2018). Outside of the studies predicting economic and educational outcomes of neighbourhood ethnic diversity, researchers have investigated its possible influence on social cohesion (Tolsma et al., 2009), neighbourhood inhabitants' political views (Janssen et al., 2019) and feelings of safety (Jacobs et al., 2017).

While we can assume that the presence of ethnic minorities is more of a proxy in neighbourhood effects related to income and education (Harris, 1999) – because of phenomena such as low-income migrant job networks or language difficulties

experienced at schools – their presence can have a very direct effect in studies on social cohesion, neighbourhood atmosphere and reputation, and political views. That effect has been hypothesised to be either positive or negative, confirming or debunking the biases people tend to develop about immigrant groups (Janssen et al., 2019). The size of the outgroup – in this case, the percentage of foreign background neighbours as perceived by someone from the ethnic majority – has also been researched, with results suggesting it can be either threatening (Semyonov et al., 2012) or, contrastingly, lead to positive opinions on the outgroup, possibly because of more opportunities for interaction (Wagner et al., 2006). For these processes, the perceived share of foreign origin neighbours is of crucial importance.

In a study using Belgian municipality-level data, Hooghe & De Vroome (2015) show that, in general, people show a tendency to overestimate the presence of non-nationals. A study by Chiricos et al. (1997) shows that black, but especially white people greatly overestimate the proportion of black neighbours in their surroundings. The tendency described by Hooghe & De Vroome is further influenced by respondent's individual characteristics such as age, gender, and TV watching habits – pointing to the important role of these predictors, on which we elaborate further in the next section.

5.2.4 Individual predictors of neighbourhood perception bias

Developing a greater understanding about the relationship between perceptions and objective measures of neighbourhood characteristics is highly relevant for key issues in urban research: the "black box" of mechanisms between the neighbourhood level variables such as income and individual outcomes; the acknowledgment of one's socioeconomic and cultural position relative to that of other neighbours; and the assessment of the actual presence of migrants, who are commonly seen as influential for city communities. Whether or not perceptions match register data, an individual's perception of their neighbourhood is a crucial moderator for many socio-spatial processes. If strong discrepancies exist, knowing what individual characteristics predict them can help with interpreting sometimes puzzling results of neighbourhood effects studies.

In our paper, we start with the basic demographic characteristics - gender, income, education, and ethnic background – as well as social embeddedness in the neighbourhood. The role of the last variable is to check whether actual social contacts in the neighbourhood make the perceptions of it more comparable with official statistics. Even though the link seems logical, the search for a relationship between embeddedness and neighbourhood effects has proven inconclusive (Miltenburg, 2015).

Among the emotion-related characteristic relevant for neighbourhood perceptions, trusting other people and institutions can play a crucial role when it comes to neighbours' foreign background (associated with "otherness") or seeing local households as struggling to make ends meet. Several studies investigated the effect of neighbourhood exposure to ethnic minorities (Gundelach & Freitag, 2014; Kokkonen et al., 2014) and deprivation (Wang et al., 2017) on social trust. This influence can have a dialectical character, as trusting people might underestimate local deprivation, and low trust in institutions can go in pair with overestimating local poverty and the presence of ethnic minorities. Janssen et al. (2019) note that dissatisfaction with political institutions can predict voting for anti-immigrant parties, but it is not related to register-data-measured presence of ethnic minorities at the neighbourhood level; it could be that in this case, people's perceptions of their surroundings, influenced by their political mistrust, are more important than the objective measures of neighbourhood diversity. Van Assche et al. (2014, 2016) use both objective and perceived diversity measures in their studies. The detailed investigation into the relationship between these measures and individuals' authoritarianism suggests that highly authoritarian people are more likely to have an accurate estimate of the proportion of ethnic minorities, possibly because of their 'vigilance' when it comes to immigrant groups (Van Assche et al., 2016). Because of these various findings in the literature, we include two measures of trust as predictors in our study. A measure of institutional trust, based on people's confidence in institutions such as the Dutch government and the police, and groups such as politicians, aims to capture respondents' satisfaction with the public sphere, which could be highly relevant for their perceptions of the socioeconomic situation of their neighbourhoods. To complete that measure with a control for personal values and attitudes, we also include generalised trust – how likely the individuals are to expect good intentions from people beyond their friends and family members (Kwon, 2019).

The survey we use asked respondents about how many of their neighbours struggle to make ends meet based on income, but even this specific question can trigger very different associations with poverty and "struggling", based on knowledge and life experience. Low-income individuals can project their own experiences on the characteristics of the whole neighbourhood (Kamphuis et al., 2010). Similarly, while asked about "foreign origin", the respondents might not recognise its symptoms if they are less vigilant about people's appearance and behaviours being different (Van Assche et al., 2016). We can assume that having a higher level of education leads to more accurate perceptions; however, the diversity perceptions model of Hooghe & De Vroome (2015) actually points to gender and age being more important than education, with women and older people more likely to estimate a high percentage of non-Belgians.

Although it is straightforward to say that we assess people's perceptions on their accuracy by comparing them to official statistics, these statistics are also to some extent only an approximation of reality, as highlighted above. This study is therefore an investigation into the relationship between two scientific representations of reality, a more constructivist and a more positivist one. Because of this, and because of very few studies on this topic, we are exploratory in our approach.

5.3 Data & methods

For our empirical analysis we use a combination of the Statistics Netherlands longitudinal, geo-coded microdata from the Social Statistical Database (SSD), which covers the entire population of the Netherlands, and LISS (Longitudinal Internet studies for the Social Sciences) panel administered by CentERdata (Tilburg University, The Netherlands), with a specific questionnaire on neighbourhood perceptions. The LISS panel is a representative sample of Dutch individuals who participate in monthly internet surveys. The panel is based on a true probability sample of households drawn from the population register (households that could not otherwise participate are provided with a computer and internet connection). We include all the 2,663 individuals who responded to the LISS neighbourhood perceptions questionnaire and match them with their geographic location in the SSD. Some individuals had to be omitted from the final analyses for various reasons, including the Statistics Netherlands privacy limitations, being in the dataset together with their partner (which creates another, unwanted level in the structure of our data; at the same time, there were too few such respondents to include such level), and having missing values on the variables of interest. Therefore, the dataset we use for the final models comprises 1,800 respondents. We also added variables from other LISS datasets (Background Variables, Politics and Values, and Personality), choosing the waves which were closest to the moment of data collection for the neighbourhood perceptions questionnaire (July 2020). The full documentation of the LISS panel can be found at www.lissdata.nl.

5.3.1 Main variables

The two dependent variables we use, the *perceived percentage of foreign background neighbours* and the *perceived percentage of low-income neighbours*, are based on questions from the LISS neighbourhood perceptions questionnaire. The questionnaire starts with "This questionnaire is about your neighbourhood. By 'your neighbourhood' we mean the area around your home, which can be reached on foot in about 10 minutes.". The relevant questions are "What do you estimate, what percentage of the residents of your neighbourhood are of foreign origin?" and "What do you estimate, what percentage of the residents of your neighbourhood struggle to make ends meet from their monthly income?", with answers ranging from 0%, 10%... to 100%.

Closely related to these dependent variables are the two key predictors, *register data percentage of foreign background neighbours* and *register data percentage of low-income neighbours*, which we constructed making them correspond to the perception variables from the LISS survey as closely as possible. Firstly, we matched the respondents to their 100x100m grid squares in the Statistics Netherlands microdata. Then, using a dataset (*Nationaal Wegen bestand*) which shows all named roads in the Netherlands, including footpaths, we created bespoke neighbourhoods, based on the area that the respondents can reach within 10 minutes (distance of 600m), starting in their home square. From microdata, we created the percentages of foreign background (at least one parent or the person themselves born abroad) and low income (households with an equivalised disposable household income below 60% of the national median equivalised disposable income, based on the Eurostat definition of the at-risk-of-poverty rate) neighbours per square, and then aggregated these percentages (weighted by the covered square area) for each bespoke neighbourhood.

We measure the *institutional trust* of a respondent with a scale variable, based on the nine answers from the LISS Politics and Values Core Study, Wave 13, in which respondents had to rate their trust in the following institutions, groups and organisations on a 10-point scale: Dutch government, Dutch parliament, the legal system, the police, politicians, political parties, European Parliament, United Nations, and the media (Cronbach's alpha: 0.94). For *generalised trust*, we use a variable from the LISS Personality Core Study, Wave 12, containing the answers to the question "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people?", recorded on a 10-point scale (from 1, "You can't be too careful", to 10, "Most people can be trusted").

5.3.2 Control variables

The control variables in the models include individual *gender* (female or male), *education* (expressed in years needed to achieve the education level) and ethnicity, coded as *native Dutch* (i.e. both parents born in the Netherlands) or not, to reflect the binary nature of the "foreign background neighbours" variables. Additionally, *household income* is represented by standardised household income measured at the start of 2020. To control for the urban character of the neighbourhood we included a spatial control variable *urbanicity*, based on address density per km^2 (in five categories from "less than 500" to "2,500 or more"). We also include a measure of individuals' *social embeddedness* in the neighbourhood to assess how likely people were to be familiar with their neighbours. This was based on six questions from the LISS such as knowing local residents by name or visiting them (Cronbach's alpha: 0.78; for the list of questions, see Appendix). The descriptive statistics of all variables can be found in Table 5.1.

TABLE 5.1 Descriptive statistics.

	Mean	SD	Min	Max
Perceived % foreign background neighbours	2.202	1.841	0	100
% of foreign background in bespoke neighbourhoods	0.226	0.143	0	0.842
Perceived % low income neighbours	2.196	1.902	0	100
% of low income in bespoke neighbourhoods	0.119	0.078	0	0.499
Urbanicity	1.932	1.415	0	4
Social embeddedness	2.611	0.755	1	4.667
Gender (female)	0.517	0.500	0	1
Household income (in 1000 euro)	33.270	13.741	*	*
Native Dutch	0.816	0.388	0	1
Age: 18 – 34	0.137	0.344	0	1
Age: 35 – 64	0.483	0.500	0	1
Age: 65+	0.380	0.486	0	1
Age	56.504	16.894	18	95
Education (in years)	15.424	2.583	8	19
Institutional trust	5.713	1.776	0	9.556
Generalised trust	6.120	2.253	0	10

** Minimum and maximum removed because of the Statistics Netherlands privacy restrictions.*

5.3.3 Analytical approach

Because of the ordinal nature of our dependent variables, we use ordered logit regression for our models. Even though the ten possible answers are numerically spaced at equal intervals, it is difficult to assume how the respondents interpreted them – for example, the "0%" answer could be interpreted as exactly zero neighbours of foreign background, or low income, but also a "0%-5%" category, considering the next possible answers are 10% and 20%. Therefore, we consider it appropriate to treat the variable as ordinal. Ordered logit is also intuitive to interpret, as a linear function is estimated of the independent variables and a set of cut points, which represent an underlying score (Van Ham & Manley, 2009). The probability of a respondent's answer belonging to each category can be calculated by filling in the regression equation for each individual, with the most likely answer identified as the one with the highest probability. Because the perception of the percentage of foreign or low-income neighbours are the dependent variables, and the register data variables for the percentage of foreign and low income neighbours are included in their relevant models, the effects of other variables show either under- (negative coefficients) or overestimation (positive coefficients) of the "objective" situation in individual perceptions.

5.4 Results

Before reporting the results of the regression models, we explore the correlations between the key variables. The correlation between the perceived percentage of foreign neighbours and that percentage based on register data is 0.61, relatively high for human behaviour-related variables, and positive. The correlation between the perceived percentage of low-income neighbours and that percentage as derived from register data is much smaller at 0.38. That suggests that people are better able to accurately assess the presence of foreign background neighbours than the percentage of low-income neighbours, as already implied by the less direct effects of the latter (see theoretical background). Also interesting are that the correlations between the two perception-based variables, and the register data-based ones. There is a positive and relatively strong correlation between the former (perception-based percentages of foreign background and low-income neighbours), 0.55, and an even stronger positive one for the latter (register data-based percentages of foreign background and low-income neighbours), 0.64. People's perceptions of the

percentage of neighbours in questions are thus likely based on similar predictors, and possibly the fact that in the Netherlands, many people with foreign background live in neighbourhoods with many low-income households.

5.4.1 Foreign background neighbours models

In Table 5.2, models 1a, 2a and 3a predict the ten categories of the percentage of foreign background neighbours, as perceived by the individuals in our dataset, while thinking about their 10-minute-walk neighbourhoods. Model 1a is the basic model, while model 2a adds the institutional trust variable; 3a includes both the institutional and generalised trust. As expected, in all three models the relationship with the percentage of foreign background neighbours based on register data is strong and positive. Because of the presence of that variable in the model, the other effects point to the relative over- or underestimation of the percentage of foreign background neighbours because of individuals' characteristics or opinions. The urbanicity of the neighbourhood is an exception; its effect is positive, as could be expected, considering that most people with an immigrant background in the Netherlands live in cities (Greft et al., 2016).

When it comes to individual level variables, people socially embedded in their neighbourhoods, those in older age groups and higher educated tend to underestimate the percentage of foreign background neighbours in all the models. Being female or native Dutch is not significant in the models, and household income is only slightly significant, with higher individual income leading to an underestimation of the foreign background neighbours percentage, in Model 1a. In Model 2a, it turns out that having higher trust in institutions also leads to underestimating the percentage of foreign neighbours; adding this variable also lowers the significance of education's effect. Generalised trust in people, added in Model 3a, is not significant on its own, but it does lower the significance of the effects of institutional trust and social embeddedness.

5.4.2 Low income neighbours models

Models 1b, 2b and 3b in Table 5.2 predict the ten categories of the percentage of low-income neighbours, as perceived by the individuals in the dataset, considering their 10-minute-walk neighbourhoods. The institutional trust and generalised trust variables are added to Models 2b and 3b in the same way as in Models 2a and 3a, described in the foreign background neighbours section above. Again, in all three models the relationship with the percentage of low-income neighbours based on

register data is strong and positive. Urbanicity of the neighbourhood is also once again a positive and significant predictor in all the models, as most low-income neighbourhood in the Netherlands are situated in urban areas.

TABLE 5.2 Ordered logit regression models predicting the perceived neighbourhood characteristics.

	DV: perceived % foreign background neighbours						DV: perceived % low income neighbours					
	(1a)		(2a)		(3a)		(1b)		(2b)		(3b)	
Foreign bespoke nbh	8.325***	(0.427)	8.310***	(0.428)	8.349***	(0.428)						
Low income bespoke nbh							7.069***	(0.662)	7.067***	(0.659)	7.141***	(0.658)
Urbanicity	0.124**	(0.038)	0.133***	(0.038)	0.129***	(0.038)	0.108**	(0.034)	0.115***	(0.034)	0.112***	(0.034)
Social embeddedness	-0.242***	(0.063)	-0.222***	(0.063)	-0.206**	(0.064)	-0.258***	(0.062)	-0.220***	(0.062)	-0.187**	(0.062)
Female	0.135	(0.088)	0.162	(0.088)	0.158	(0.088)	0.090	(0.086)	0.131	(0.086)	0.128	(0.086)
Household income	-0.007*	(0.003)	-0.005	(0.003)	-0.005	(0.003)	-0.019***	(0.003)	-0.016***	(0.003)	-0.015***	(0.003)
Native Dutch	-0.199	(0.116)	-0.171	(0.116)	-0.149	(0.117)	-0.093	(0.115)	-0.038	(0.115)	0.004	(0.116)
Age (ref. 18 – 34)												
35 – 64	-0.631***	(0.137)	-0.677***	(0.137)	-0.684***	(0.137)	-0.159	(0.135)	-0.238	(0.135)	-0.234	(0.135)
65+	-1.034***	(0.149)	-1.040***	(0.149)	-1.027***	(0.149)	-0.635***	(0.146)	-0.636***	(0.146)	-0.597***	(0.147)
Education	-0.071***	(0.019)	-0.057**	(0.019)	-0.053**	(0.019)	-0.054**	(0.019)	-0.025	(0.019)	-0.015	(0.019)
Institutional trust			-0.125***	(0.027)	-0.109***	(0.028)			-0.212***	(0.026)	-0.182***	(0.027)
Generalised trust					-0.038	(0.022)					-0.076***	(0.022)
Cut 1 (10%)	-3.436***	(0.396)	-3.822***	(0.405)	-3.824***	(0.405)	-3.630***	(0.390)	-4.214***	(0.397)	-4.201***	(0.397)
Cut 2 (20%)	-0.859*	(0.388)	-1.232**	(0.396)	-1.233**	(0.396)	-1.639***	(0.384)	-2.188***	(0.390)	-2.169***	(0.390)
Cut 3 (30%)	0.207	(0.388)	-0.160	(0.395)	-0.159	(0.395)	-0.602	(0.382)	-1.123**	(0.387)	-1.101**	(0.388)
Cut 4 (40%)	1.337***	(0.389)	0.980*	(0.396)	0.982*	(0.396)	0.233	(0.382)	-0.263	(0.387)	-0.237	(0.387)
Cut 5 (50%)	2.149***	(0.393)	1.798***	(0.399)	1.802***	(0.399)	0.738	(0.383)	0.259	(0.387)	0.288	(0.387)
Cut 6 (60%)	2.928***	(0.398)	2.583***	(0.404)	2.588***	(0.404)	1.326***	(0.386)	0.864*	(0.389)	0.896*	(0.389)
Cut 7 (70%)	3.653***	(0.407)	3.316***	(0.412)	3.320***	(0.412)	2.004***	(0.392)	1.554***	(0.395)	1.588***	(0.396)
Cut 8 (80%)	4.828***	(0.435)	4.507***	(0.440)	4.514***	(0.440)	2.843***	(0.410)	2.403***	(0.413)	2.442***	(0.413)
Cut 9 (90%)	6.072***	(0.510)	5.773***	(0.514)	5.783***	(0.514)	4.326***	(0.503)	3.893***	(0.505)	3.937***	(0.505)
Cut 10 (100%)	7.721***	(0.813)	7.430***	(0.815)	7.445***	(0.815)	5.847***	(0.801)	5.415***	(0.803)	5.460***	(0.803)
Pseudo R^2	0.139		0.142		0.143		0.058		0.068		0.070	

*Standard errors in parentheses. N = 1,800. * p < 0.05, ** p < 0.01, *** p < 0.001*

The individual level variables largely repeat the patterns that can be found in the foreign background neighbours models (Models 1-3a), with being female and native Dutch having no significant effect on perceptions, and social embeddedness in the neighbourhood having a significant negative effect, suggesting that people with more social contacts in the neighbourhood tend to underestimate the percentage of low income households living there. The effect of the respondent's household income is significant and negative in all three models, 1-3b, again pointing towards underestimation – which can be explained by higher income people being less likely to notice or acknowledge their low income neighbours. Age also is not a significant predictor in the 35 – 64 category (compared to 18 – 34), suggesting only retirement age people tend to underestimate the percentage of low income households in their neighbourhood. The most interesting changes between the models occurred in the educational effects: in the first model (1b) the effects were significant and negative while after taking the negative, significant effect of institutional trust into account the effect of education becomes insignificant. Moreover, for the low income perception, the effect of generalised trust is also significant and negative. Higher educated people tend to underestimate how many low-income neighbours live around them, but much of this seems to be explained by their higher trust in public institutions and that, in turn, is partially, but not entirely, explained by higher trust in people in general. Conversely, those who mistrust institutions and other people overestimate the percentage of their neighbours struggling to make ends meet, consistently with their more pessimistic view of society.

5.5 Conclusions & discussion

In this paper, we have studied the mismatch between objectively measured neighbourhood characteristics – share of people with foreign background and low income – drawn from population registers and the survey-derived perceptions of those socioeconomic neighbourhood characteristics by inhabitants of the neighbourhood. As could be expected, we found that the perceptions- and register data-based measures correlate; surprisingly this was not very strongly in the case of the percentage of low-income neighbours. Investigating the predictors of this mismatch, we have found that older age and greater social embeddedness in the neighbourhood lead to an underestimation of both characteristics, and respondents with higher household income tend to underestimate how many of their neighbouring households struggle to make ends meet. Having a higher level of education also

leads to underestimation in the initial models, but then becomes less significant to the perceived percentage of foreign background neighbours, and insignificant to the perception of low-income neighbours after a measure of institutional trust is controlled for. It seems that individuals with lower trust in public institutions are likely to overestimate the ratios of their foreign background and low-income neighbours. In the case of low income, the same can be said for generalised trust – trust in people in general: the less trusting someone is, the higher the share of their neighbours they perceive to be struggling financially.

Our investigation into the individually perceived and administrative data-based socioeconomic neighbourhood characteristics has produced several insights relevant for researchers and policymakers. Firstly, and perhaps unsurprisingly, the perceptions and objectively measured characteristics can be very different. This is especially important for variables such as neighbourhood income-related poverty, often used as a proxy for crucial processes in the neighbourhood. Much of the poverty present in the neighbourhood affects its inhabitants very indirectly, possibly without being consciously perceived. Secondly, the extent of these differences, or mismatch, between perceptions and register data vary based on individuals' characteristics such as household income, age and social embeddedness in the neighbourhood. Some characteristics, such as education, can be influenced by emotional attitudes of an individual: trust in institutions or people in general. Many of these characteristics could remain unmeasured, while possibly playing a salient role in the neighbourhood effects mechanisms. Finally, our results seem to confirm that even in the case of social phenomena that can be numerically measured, like poverty with (lack of) money, their further effects on people are influenced by subjective emotions, as previously discussed in the literature (Praag & Ferrer-i-Carbonell, 2008). This implies that spatial effects research could benefit from more mixed-methods approaches and augmenting large register-based datasets with surveys and interviews highlighting feelings and values.

Future research could develop in several directions, including comparing the effects of perceived and register-based measures on the outcomes of interest (specifically which type of measure matters more for which outcomes, and with which predictors?), and further exploring the reasons for the mismatch we have observed. Even with the very detailed surveys we used, it is not totally clear why, for example, older people are likely to underestimate the percentage of foreign background neighbours. We can hypothesise that it is because of more interactions with people of immigrant background happening in the younger generations, or maybe simply because of more older people being native Dutch themselves and having social contacts with that ethnicity. Interviews with older inhabitants of neighbourhoods with varying ethnic diversity levels could shed some light on it. In a similar way future research

could explore the reasons for richer people underestimating the share of low-income households in their neighbourhoods – it could be the inability to see the signs of poverty or refusal to accept that there even is (much) poverty so close to home. Finally, the relationship with institutional trust deserves more attention, possibly with comparisons across countries where views on migration might not be as related to political dissatisfaction as they are in the Netherlands (Janssen et al., 2019).

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Appendix

Social embeddedness (questions from the LISS Neighbourhood perceptions questionnaire)

The following questions are about your contact with local residents.

Sub-questions:

- How many residents do you know by first name?
- How many local residents sometimes visit you?
- With how many local residents do you ever discuss something personal (e.g. your health, family or work)?
- How many local residents could you ask for help with small things (e.g. watering the plants) or to borrow something (e.g. tools)?
- How many relatives of yours live in your neighbourhood?
- How many neighbours have a key to your home?

Categories: **1** = 0 / **2** = 1-2 / **3** = 3-4 / **4** = 5-6 / **5**= 6 or more

TOC

6 Conclusions

The underlying approach I took in this thesis was to move beyond the standard treatments of the neighbourhood in the research on spatially transmitted inequality. Even though the neighbourhood effects field has produced many valuable contributions, the trend in social inequality research has often been to treat the neighbourhood, or more generally the spatial context, merely as a setting for interesting processes that must be controlled for or operationalised as simple spatial snapshots of socioeconomic characteristics. However, the neighbourhood itself is important, and can be expressed quantitatively as a place that people choose, that changes or can be exchanged over the years, and which can be differently perceived by different people (Sampson, 2019). Neighbourhood has often been reduced, in the popular imagination and to some extent in research, to being most significant as the deprived "ghetto" (Sampson, 2012), representing an amalgamation of sociospatial issues that have to be solved, or, quite often, done away with. This has led to the popularity of social mix policies, alternatively called state-led gentrification, even though empirical evidence of their success remains inconclusive (Van Kempen & Bolt, 2009). This thesis addresses the critiques of neighbourhood effects studies as too focused on simplistically operationalised poverty and therefore feeding superficial policy approaches (Slater, 2013). It shows how quantitative neighbourhood studies can still be illuminating to social research and policy by focusing on processes that are often overlooked, but which are crucial to social inequality transmission, and which lead to a more nuanced view of that transmission than "living among poor people leads to more poverty".

In order to explore the under researched elements of the sociospatial inequality transmission in neighbourhoods, in this thesis I answered four research questions, in four chapters, each of which consists of empirical research published as a paper or submitted for publication. Firstly, I investigated neighbourhood selection and the influence of that selection on neighbourhood effects itself; an interesting process which is often neglected as selection bias that needs to be controlled for (Chapter 2). Secondly, I developed a way to operationalise detailed neighbourhood histories of individuals, based on bespoke neighbourhoods, which capture four temporal aspects of exposure to the spatial context: accumulation, duration, timing, and sequencing (Chapter 3). I employed these operationalisations to further our understanding of the influence of such changing individual exposure to neighbourhood poverty on education achievement. Using the detailed timing of exposure operationalisation, in the next

chapter I studied the influence of neighbourhood affluence and poverty on educational attainment, motivated by the lack of research on spatially concentrated affluence and direct comparison of its effects to that of concentrated poverty (Chapter 4). Finally, the last empirical chapter investigates the process behind the variables used in previous chapters: how do neighbourhood participants perceive the socioeconomic characteristics of their neighbourhood, more specifically the share of low income and foreign background neighbours, and how these perceptions are shaped by individual demographic characteristics and attitudes (Chapter 5). In the following sections, I summarise the results of each of these chapters, reflect on them, describe the theoretical, as well as methodological contributions and reflect on the societal and academic relevance of the thesis. I then describe the benefits and limitations of the chosen approaches and suggest the future research that could continue the most promising lines of investigation from the current study. The last section of this thesis includes concluding remarks on my findings and the research process.

6.1 Summary of the research results

Starting with the issue of selection bias, concerning researchers in the neighbourhood effects field, **Chapter 2**, which was published in the journal *Applied Spatial Analysis and Policy*, examined how the modelled neighbourhood effect on individual income is altered when controlling for neighbourhood selection, and how these results vary across three Dutch urban regions. I started with conditional logit selection models and, based on the approach by Van Ham et al. (2018), created correction components from these models which could be then included in the neighbourhood effects models for the same individuals in Amsterdam, Utrecht and Rotterdam. Even after controlling for selection, I found that a higher neighbourhood average income was related to a higher individual income. However, the neighbourhood effect became smaller after controlling for selection compared with after controlling for individual characteristics alone, which suggests that without taking selection into account, researchers can overestimate neighbourhood effects. The selection models themselves provided insight into the patterns of neighbourhood selection in Dutch regional housing markets, with repeated patterns of structured self-sorting, largely in line with the previous studies on the topic (Hedman et al., 2011), and slight local differences. For example, higher educated individuals tend to select neighbourhoods with a higher percentage of people with non-Western migrant background in Amsterdam and Utrecht, but not Rotterdam; the possible explanations could relate

to different forms of gentrification in these cities, which might lead to different types of neighbourhoods seen as desirable. Both in the selection and in the effect models there were differences between the three cities, with the strongest influence of average neighbourhood income observed in the relatively poor Rotterdam, and the reduction in the neighbourhood effect after controlling for selection most pronounced in Amsterdam and Utrecht. This suggests that neighbourhood selection could be particularly structured in higher income cities with competitive housing markets, where social reproduction strategies and intergenerational transfer of resources play a larger role (Hochstenbach & Boterman, 2017); these same resources also influence how an individual is then affected by the neighbourhood context.

In **Chapter 3**, published as an article in *Urban Studies*, I conceptualized four dimensions of exposure to neighbourhood poverty – accumulation, duration, timing, and sequencing – and estimated their effects on educational attainment. Responding to the critiques of neighbourhood effects studies using point-in-time measures of the spatial context, I went even further and focused on the differences between different temporal aspects of individual neighbourhood histories, in which the bespoke neighbourhood of an individual could change every year. My findings, based on data on the Dutch population born in 1995 and followed until age 23, show that the observed relationship between neighbourhood poverty and educational attainment is dependent on how exposure to the neighbourhood effects is conceptualized and measured. In general, the effect of exposure to spatially concentrated poverty on education was negative; however, I found that it is important to separate exposure in early adult years (age 18–22) from exposure in childhood years. The effect of exposure to neighbourhood poverty during these years was positively related to educational attainment, most likely caused by students selecting into neighbourhoods with cheap housing, whereas exposure up to the age of 17 was negatively related. Including the early adulthood led to bias in the models, stronger in the accumulation model than in the duration model – which is less sensitive to extreme values, as it included only whether an individual was exposed to high neighbourhood poverty in a certain year, but not the precise ratio of poor neighbours. With regard to the timing of exposure to neighbourhood poverty at different stages of development, I found that exposure during adolescence is slightly more influential than exposure during childhood. Both of these time periods being influential confirms the findings from earlier studies (Kuyvenhoven & Boterman, 2021; Nieuwenhuis et al., 2021). In the sequencing models, I found that improving neighbourhood conditions lead to a higher educational attainment than remaining in poor neighbourhoods for all years; another argument against single point-in-time approaches. The most varied sequences, implying volatile moving histories, have an almost as big negative effect on education as constantly living in the poorest neighbourhoods. This points to the distinctive role of volatile moving

histories. The fact that all models, except for the ones including only late adulthood, explain the statistical effect to almost the same extent can be seen as a robustness check for all the detailed operationalisations.

In **Chapter 4**, published in *PLOS One*, I compared the effects of exposure to spatially concentrated affluence and poverty during different stages of childhood on educational attainment. Much of the neighbourhood effects field is focused on studying neighbourhood deprivation because of what Sampson calls the "poverty paradigm" (2012). Still, in this chapter I argued that there are theoretical reasons to believe that exposure to neighbourhood affluence may be more important as a predictor of educational attainment than exposure to neighbourhood poverty, because of the crucial influence of interacting with higher educated people on one's resources, skills and educational aspirations; even more so in the Dutch context, lacking extreme concentrated poverty. Confirming this empirically, I found that neighbourhood affluence has a stronger effect on educational attainment than neighbourhood poverty in the Netherlands across different time periods: early childhood (ages 0 – 12), adolescence (13 – 17) and the entire childhood (0 – 17). The effect of exposure to poverty during the entire childhood period was stronger than that of shorter periods. In my models, I controlled for the educational level of parents and studied its interactions with the neighbourhood context, to explore whether children from higher or lower educated parents are influenced differently. The interactions show that children with at least one higher educated parent are not impacted by neighbourhood poverty, implying that parental higher education can act as a buffer against the effects of spatial deprivation. However, children with higher educated parents are still influenced by neighbourhood affluence, although their gains are not as great as those experience by children from households with lower levels of parental education. In general, my results in this chapter support the initial idea that it is often the *lack of resources* in poor and middle income neighbourhoods that is the problem, not the theorised negative effects of poverty itself.

In the final empirical chapter, **Chapter 5**, submitted as an article for publication, I studied the mismatch between register data-based measurements of neighbourhood characteristics (such as those used in my previous studies) – share of people with foreign background and low income – and the perceptions of those socioeconomic neighbourhood characteristics by inhabitants of the neighbourhood. As predictors of that mismatch, next to individual characteristics such as household income, age and social embeddedness in the neighbourhood, I included measures of trust in institutions and people in general, because of the previously studied relationships between the neighbourhood ethnic diversity (Gundelach & Freitag, 2014; Kokkonen et al., 2014), deprivation (Wang et al., 2017) and social trust, as well as political attitudes and neighbourhood perceptions (Van Assche et al., 2016). I found that the perceptions-

and register data-based measures do correlate, but not very strongly in the case of the percentage of low-income neighbours. This shows that the perceptions and objectively measured characteristics can be very different, especially in the case variables often used as a proxy for crucial processes in the neighbourhood, such as neighbourhood poverty. The extent of these differences, or mismatch, between perceptions and register data vary based on individuals' characteristics. I have found that older age and greater social embeddedness in the neighbourhood lead to an underestimation of both share of foreign background and low income neighbours, and that respondents with higher household income tend to underestimate how many of their neighbouring households struggle to make ends meet. Being higher educated also lead to underestimation as observed in the initial models, but it became less significant to the perceived percentage of foreign background neighbours, and insignificant to the perception of low-income neighbours after I controlled for institutional trust. This suggests that individuals with lower trust in public institutions are likely to overestimate the ratios of their foreign background and low-income neighbours. In the case of low income, the same can be said for generalised trust – trust in people in general: the less trusting someone is, the higher the share of their neighbours they perceive to be struggling financially. In general, my findings in the chapter seem to confirm that even in the case of social phenomena that can be numerically measured, their further effects on people are influenced by subjective emotions.

6.2 Reflection: hidden pathways of sociospatial inequalities

This thesis is embedded in and a continuation of the neighbourhood effects literature. Many of its findings confirm the existence of the well-trodden paths in the subfield: the expected negative effects of exposure to neighbourhood poverty on individual outcomes were observed in the three empirical chapters testing them (Chapters 2–4). However, the aim of the thesis was exploring the hidden pathways of the social inequality transmission in the neighbourhood by studying its under researched elements. Therefore, the main finding is a range of statistically significant effects of highly structured sociospatial processes that are often given insufficient attention; their significance confirms that the processes happening on the neighbourhood level are complex and deserve careful consideration. This goes against the tendency in the popular discourse to focus on the simplicist idea

of deprived neighbourhoods as a problem that has to be done away with. The transmission of inequality in the neighbourhoods forms a link in a chain of other processes and should not be seen in isolation, as a static snapshot of a larger story, if it can be avoided. The vicious circles of segregation (Tammaru et al., 2021) are apparent both in the case of neighbourhood selection, shaped by not only people of similar economic status, but also ethnicity and education, opting to live close to each other (Chapter 2), and neighbourhood perceptions (and thus likely the effects of the perceived characteristics), influenced by individual socioeconomic characteristics and beliefs (Chapter 5). Modelling the different temporal aspects of individuals' neighbourhood histories (Chapter 3) suggests that effects might be more likely overlooked in some operationalisations than in others, as it was the case with the surprising early adulthood period being more significant in the accumulation model than in the more simply operationalised duration one. Finally, the role of spatially concentrated affluence, often overlooked in the field, proved to be bigger than that of poverty when it comes to educational attainment in the Dutch context (Chapter 4).

These results should encourage researchers to always consider the neighbourhood as a social setting that interacts with its micro and macro contexts in a complex way, rather than an aggregated characteristic that can be controlled for. This turn to complexity and focus on the neighbourhood itself has also been recently promoted by researchers with decades of experience in the neighbourhood effects field, such as Sampson (2019). Both theoretical contributions (Sharkey & Faber, 2014) and literature reviews (Galster & Sharkey, 2017) remind social scientists and policymakers that the existence of a particular neighbourhood effect should never be assumed, especially in new geographical settings. The findings of this thesis confirm the validity of this approach.

The tendency to overlook certain aspects of the neighbourhood's role in social reality can be at least partially explained by the interdisciplinary nature of urban research: sociologists tend to underestimate the geographical paradoxes, while geographers neglect sociological theories of inequality, political scientists focus on people and movements over their spatial setting and socioeconomic context, and so on. In the section on future research I outline some suggestions on how to remedy these divisions, just like throughout the thesis itself I aimed to show the complexities of neighbourhood's functions also by including inspirations from qualitative studies and social theory in my quantitative, empirically-focused research. However, the fragmented nature of research on urban inequalities is not caused purely by the differences in methodological approaches. Different disciplines and traditions approach the highly relevant for policy field of social studies with different ontological assumptions and therefore different visions of the roles of the researcher. The more politically oriented, almost exclusively qualitative, constructivist research

focuses on people affected by various market trends and policies, often arguing for political action against these policies. On the other hand, positivist, most often quantitative research, while often investigating politically sensitive issues, claims to be an objective investigation of social phenomena, avoiding explicit policy recommendations. Because of this divide, many subfields of neighbourhood research remain isolated from each other, and when they interact, these interactions tend to remain on the safe common ground of empirical findings.

While my research is more focused on understanding social reality than changing it through concrete policy recommendations, it would be impossible, or at least irresponsible, to ignore its implications to policymakers. In the following sections I reflect on the policy-related and academic contributions of this PhD thesis.

6.2.1 Societal relevance of the thesis

The neighbourhood effects field has been accused of providing quantitative – and thus difficult to dispute – evidence for often criticised policies such as state-led social mix in neighbourhoods (Slater, 2013). However, it is often the quantitative neighbourhood studies themselves which show these policies' ineffectiveness (Bolt & van Kempen, 2013; Kleinhans, 2004; Van Kempen & Bolt, 2009). In truth, the link between the specific findings of neighbourhood effects research and state policies seems tenuous. Without elaborating on the information loss in policy process, I do want to suggest it is because of the varied and often inconclusive results of the neighbourhood studies.

It might seem counterintuitive, therefore, for me to recommend even more complexity in neighbourhood effects research, as I do in the conclusions of my empirical chapters and the whole thesis. Still, the key to more effective policies can lie precisely in the observed complex mechanisms – as long as they are communicated and understood properly. The case of people's perceptions of the poverty of their neighbours being inaccurate suggests that effort and resources spent on social mix can better be directed somewhere else, to projects chosen together with local citizens, as the neighbourhood inhabitants not only might not form social ties with, but likely do not even notice the poverty or affluence rates in their neighbourhood reaching certain numerical goals. Similarly, while Chapter 2 has shown differences in neighbourhood selection and neighbourhood effects processes between Rotterdam, Amsterdam and Utrecht, policymakers should consider whether these differences are substantial enough to justify the current strong focus on poorer cities. In the end, significant processes of spatial inequality transmission have been

observed in all three cities. One should keep in mind the danger of more deprived areas in richer cities becoming neglected as resources are directly largely to the city areas seen as especially problematic, as is the case with the major National Programme Rotterdam South (Dol et al., 2019).

The strong effect of spatially concentrated affluence (in Chapter 4) has its own serious policy implications. It suggests that in order to prevent urban segregation, affecting the mobility and location of affluent households may be more effective than poor ones, especially because richer households are driving segregation processes (for detailed explanation, see Chapter 2). As mentioned before, urban policies tend to focus on supporting, but also often relocating the cities' poorest inhabitants – at least partially because it is simply easier to influence them, as they are often dependent on state welfare in form of social benefits and social housing. However, there are also political reasons for the focus to be shifted away from poorer citizens, as the constant interventions in their neighbourhood are met with more and more resistance (Hochstenbach, 2022). Still, without decisive policies the resistance of affluent citizens will always remain more effective because of their richer resources. As Sampson (2019) notes in a similar discussion of anti-segregation policies in the US relocating predominantly black citizens, "whites are rarely required to make sacrifices, let alone move, to achieve racial integration . . . And when they are, opposition is common" (p. 24). Yet the focus on minorities and disadvantaged groups in urban restructuring policies can contribute to feelings of dissatisfaction with the neighbourhood and neighbourhood stigmatisation as only those from "unwanted" groups are expected to relocate and mix with desirable, proper neighbourhood populations.

6.2.2 Theoretical and methodological contributions

This PhD thesis has made several theoretical contributions to the neighbourhood effects field. Firstly, it argued for the need of detailed temporal operationalisations of the neighbourhood histories of individuals, based on the life course research (Chapter 3). Secondly, it contextualised the way social inequality is studied in the neighbourhood effects field and showed how this approach to social inequality could have caused the role of neighbourhood affluence being overlooked in the field (Chapter 4). The thesis also drew attention to the observable differences between cities that are similar within the same country, when it comes both to neighbourhood selection and neighbourhood effects (Chapter 2), and highlighted the importance and possibility of differences between individual perceptions and objective measures of common neighbourhood context variables (Chapter 5). In general, the PhD research drew attention to the varied and inconspicuous pathways of spatial transmission of social inequality.

Methodologically, the contribution from Chapter 2 expands on the method of studying neighbourhood selection, and the influence of that selection on neighbourhood effects, developed by Ioannides & Zabel (2008) and Van Ham et al. (2018). I do that by including multiple years of people moving, using a multilevel neighbourhood effects model and looking at the effects on change in income, in addition to income itself. In Chapters 3 & 4 I create detailed operationalisations of different temporal aspects of exposure to neighbourhood poverty. The thesis also features a range of different neighbourhood boundaries operationalisations; among them, the bespoke neighbourhoods corresponding to the perceived neighbourhoods in Chapter 5 offer a straightforward method to study the difference between register data-based neighbourhood measures and individual perceptions.

6.2.3 Methodological benefits and limitations of the study

As explored in the introduction, choosing a quantitative over a qualitative research approach shapes the character of any study. The benefits of the quantitative, mostly register data-based approach in this thesis, include being able to construct detailed, longitudinal neighbourhood context predictors (especially in Chapters 3 and 4) and apply methodological approaches requiring complex statistical models (Chapter 2). Combining these data with the LISS panel allowed for a unique investigation of the relationship between subjective perception variables and objective administrative measures in Paper 5. At the same time, quantitative and especially register-based data offer only a very limited insight into people's motivations and feelings about their neighbourhoods and related choices.

Because of the limited scope of scientific journal articles, researchers often have to compromise on their methodological choices, as article length limits make it difficult to include a large number of tests and methods in one study. In all studies I looked only at a single spatial scale, although I always strived to choose one most conceptually accurate for the studied research question.

6.2.4 Looking forward to future research

Future research could explore the findings of this thesis, continuing the research line further in many different directions. Oveall, I hope this study will inspire more interdisciplinary, mixed-methods approaches, as well as neighbourhood effects studies more conscious of their policy implications and clearer on their theoretical

influences. For instance, sociology, and specifically the fields of class, power and social inequality studies, have rich traditions which could be acknowledged more, and potentially with interesting results, by the often very geographically focused urban research. Well structured, interdisciplinary studies can be based on existing frameworks combining these different traditions, such as the class analysis framework by Wright (2015).

When it comes to more specific research suggestions, the effect of spatially concentrated affluence being stronger than that of poverty in the case of educational attainment should be tested for other individual outcomes. Affluence being so influential for education is already a major finding, but that relationship holding for more key socioeconomic indicators would imply a necessary shift of focus in the Western European urban policy and research. Furthermore, the study of neighbourhood perceptions seems very promising, with the existing and possibly new survey data being able to illuminate how the commonly studied neighbourhood characteristics actually affect individuals living in the neighbourhoods. This subfield of studies could be particularly inspirational to interdisciplinary, mixed-methods approaches, with qualitative and quantitative research being conducted in response to the same research questions and with researchers from different backgrounds closely collaborating with each other.

While writing this thesis, I often appreciated being able to refer to qualitative studies conducted in the Dutch context such as those of Pinkster (2007, 2014). Future research can respond to the challenge of connecting studies conducted using large-scale register-based data, such as this thesis, to small-scale interviews concerning the same neighbourhoods and ultimately the same people. While many obstacles related to data access and issues such as privacy can deter researchers from establishing these links, ultimately they could prove extremely beneficial for the neighbourhood effects field and social science in general.

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Curriculum vitae

Agata Troost was born in Warsaw, Poland, in 1993. She moved to the Netherlands in 2012 to study at University College Utrecht, where she majored in social science with tracks in sociology, human geography and political science. In 2014, she spent six months on exchange at the University of California, Los Angeles, following courses on social networks, public opinion, communication science and film theory. In the summer of 2014 she completed journalism internships at Gazeta Wyborcza and Res Publica Nowa magazine in Warsaw. In 2015 she obtained her Bachelor of Arts degree, with a thesis on the polarisation and radicalisation of online discourse (supervised by prof. dr. F. Maiolo). Also in 2015, she attended the Visegrad School of Political Studies, organised by the European Academy of Diplomacy in Warsaw.

In 2017 Agata graduated from the research master programme Sociology and Social Research at Utrecht University with a Master of Science degree. She wrote a thesis on the early applications of big data in sociological research (supervised by prof. dr. M. van Assen). During the second year of the programme, she completed an internship at the Center for Big Data Statistics of Statistics Netherlands (Centraal Bureau voor de Statistiek, CBS). As a part of the master programme, she completed elective courses at University of Amsterdam (in policy oriented research) and She also worked as a student assistant and then, from summer 2017 until the beginning of 2018, as a junior researcher at Utrecht University with prof. dr. M. van Leeuwen, focusing on research related to HISCO (Historical international Standard Classification of Occupations) and international organisation studies.

During her PhD, which started in March 2018, Agata taught bachelor courses in English and Dutch and supervised bachelor students in writing papers. She presented at multiple international conferences, including the European Network for Housing Research (2018, 2019, 2020), European Sociological Association (2019), ESA Urban Sociology Research Network (2021), European Social Science History Conference (2021) and European Consortium for Sociological Research (2022) conferences. She also gave invited talks at the Perspectives on Housing and Inequality event (Utrecht University, February 2022), the Study Day on Transnational Social Movement Organisations (Utrecht University, September 2022) and the Warfare and Welfare workshop (The German Historical Institute in Rome, December 2022). As a part of her doctoral education, she took part in, among other courses, the Geonatura GIS training project, multiple qualitative methods courses, and a Norwegian PhD substance course on Explorations in Class, Power and Inequality coordinated by NTNU – Trondheim.

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23#10

The diverse pathways of social inequality transmission in the neighbourhood

Agata Troost

This PhD thesis aims to move beyond the standard treatments of neighbourhoods in research on spatially transmitted inequality. The research questions explored in the four empirical chapters of the thesis delve into under-researched elements of sociospatial inequality transmission in neighbourhoods. The thesis uses statistical models to analyse register and survey data, and relies on different operationalisations of neighbourhoods: administrative and bespoke. Chapter 2 finds that controlling for selection reduces neighbourhood effects compared to when only individual characteristics are controlled for, and provides insight into the differing patterns of neighbourhood selection and effects in Dutch regional housing markets. Chapter 3 shows that the strength of the observed relationship between neighbourhood poverty and educational attainment is dependent on how exposure is measured and conceptualized, and highlights the importance of choosing the temporal aspects of individual neighbourhood histories based on the theoretical scope of a study. Chapter 4 finds that in the Netherlands, the positive effect of neighbourhood affluence on educational attainment is stronger than the negative effect of neighbourhood poverty. Chapter 5 addresses the discrepancy between the registered data-based measurements of neighbourhood characteristics, specifically the share of neighbours with foreign background and low income, and the individual perceptions of those characteristics by the inhabitants of the neighbourhood. The findings of the thesis confirm the validity of treating the neighbourhood as a social setting that interacts with the micro and macro contexts, rather than simply as an aggregated characteristic which can be controlled for.

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