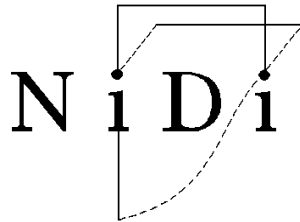Bart Sleutjes and Helga de Valk

Residential segregation patterns of migrant groups in Dutch cities: The role of scale

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Residential segregation patterns of migrant groups in
Dutch cities: the role of scale

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Abstract

Despite broad academic and societal attention for ethnic segregation and its presumed negative effects on e.g. personal life chances and social inclusion, there is no generally accepted standard for measuring segregation. This paper contributes to our understanding of residential segregation by taking an exploratory comparative design. We study and evaluate the three most commonly used indicators of ethnic segregation (i.e. the 'isolation index', 'entropy index' and 'dissimilarity index') and simultaneously analyze how they are manifested at different spatial scales and for different migrant origin groups. This allows us to assess to what extent these indicators result in indicating different segregation patterns. Simultaneously we study how levels of segregation differ across city-regions of different size, across different scale levels within them and for different migrant origin groups. The rich population register data on the Netherlands allow for this detailed analyses at the neighbourhood, municipality and city region levels. Our findings show that the three indices lead to different and sometimes contrasting segregation patterns. In general, segregation is weakest at the regional scale, but there is large variation at the neighbourhood level. Also clearly different patterns and levels of segregation exist between different migrant origins and across city-regions of different size.

Introduction

The urban diversity debate often focuses on the concentration of migrant groups in specific neighbourhoods. The combination of income inequality and large-scale international migration flows ensured policy attention for residential segregation (Malmberg *et al.*, 2011). Through 'neighbourhood effects', residential segregation is assumed to negatively affect, among others, the labour market chances, language abilities, social relations and integration of minority groups in society (Atkinson and Kintrea, 2001; Musterd *et al.*, 2003; Musterd and Andersson, 2005; Musterd, 2011). In addition, segregation is considered a threat to social inclusion and the welfare state in Europe and beyond (Lichter *et al.*, 2012; Andersson and Malmberg, 2014). The debate on ethnic segregation and the assumed neighbourhood effects resulting from it has flourished since Wilson's (1987) study on the largely mono-ethnic ghettos in the large metropolises of the United States. However, Western European studies have shown much lower levels of segregation than in the US context (Musterd and Van Kempen, 2009; Musterd, 2011).

Despite the large academic, societal and policy attention for residential segregation, there is no generally accepted standard for its measurement. There is first of all a large variety in measures, which, according to Massey and Denton (1988), measure more or less the same concepts. However, reliable comparisons of segregation patterns across different spatial entities and population categories are yet difficult. This is due to a lack of comparable data (Musterd and Van Kempen, 2009) and differences in administrative ward sizes across, but also within, countries (Malmberg *et al.*, 2011). In order to achieve full comparisons precisely defined measures that reflect the actual differences in residential patterns between different cities are much needed (Malmberg *et al.*, 2014).

Secondly, although previous studies suggest that the scale level at which segregation is measured is relevant, there is no clear consensus on the scale level at which segregation has the largest impact on individual outcomes. While some studies indicate that effects of the spatial context are strongest at the micro level, others stress that processes at the municipal or regional level may be more relevant, largely depending on the stage in the life cycle (Andersson and Musterd, 2010). Therefore, it is key to get a better understanding of the importance of scale levels for estimating patterns of residential segregation.

Finally, most Western European and US-based studies on residential segregation of migrants focus on the largest urban areas. Although these areas in most countries have the largest migrant communities, substantial numbers of migrants live in medium-sized and smaller municipalities. Some studies have suggested that strong levels of residential segregation also occur at the lower end of the urban hierarchy (Malmberg *et al.*, 2011). Comparing segregation levels between cities of different sizes might therefore offer a more complete view of ethnic segregation patterns, accounting for the specific dynamics of large metropolitan areas.

To fill the gap in our knowledge on these three points this paper contributes to the academic discussion on residential segregation by taking an multi-comparative design. We compare and evaluate the three most commonly used indicators of segregation -the isolation index, index of dissimilarity and entropy index- and simultaneously study how they are manifested at different spatial scales and for different migrant origins residing in cities in the Netherlands.

Four research questions are key in our work:

- *To what extent do different measures of segregation lead to different segregation patterns?*
- *To what extent is the level of ethnic segregation different across different scale levels?*
- *To what extent is the level of ethnic segregation different across cities of different size in the Netherlands?*

- *How and to what extent are there differences between different migrant categories with respect to segregation patterns across different scale levels?*

We take The Netherlands as a case study for three main reasons. First, The Netherlands can be seen as an example for other Western-European countries. The country has a long history as an immigration country and is home to different migrant groups of considerable size, which all have their own specific migration histories and spatial behaviour (Hartog and Zorlu, 2009). The main groups that can be distinguished are labour migrants, colonial migrants and western migrants, and this paper will compare the residential segregation levels of these different categories. Second, since a considerable number of these migrants settled in different parts of the country, we can study ethnic segregation in cities of different size. Third, the rich population register data on the Netherlands allows studying segregation levels and patterns for migrants of different origins and across different spatial entities. In this paper we use recent population register data from Statistics Netherlands for neighbourhoods, municipalities and city-regions. The data include information on the main categories of migrants based on country of origin and their shares in the population of the municipality as a whole and the neighbourhood units within them. Similar data are available at the city-region ('Stadsgewest') level, resulting in a rich and unique dataset suited for our multi-comparative analyses.

Although levels of segregation in Western-European cities are relatively low compared to the US context (Musterd and Van Kempen, 2009), the concentration of low-income groups and – especially— ethnic minorities in certain neighbourhoods is regarded problematic by policy-makers. Policies aimed at decreasing segregation often include urban regeneration programmes in which concentrations of social housing are replaced by a more diverse housing stock, or reforms in allocation systems for social rented dwellings (Van Kempen and Bolt, 2009; Galster, 2012). The main aim of such policies is to create socially mixed neighbourhoods, although the effectiveness of social mix policies has been strongly contested (Atkinson and Kintrea, 2001; Musterd *et al.*, 2003; Joseph *et al.*, 2007; Manley *et al.*, 2012). A more thorough understanding of segregation patterns for different migrant categories in cities of different size, and at different scale levels within them, may offer a better input for policies aiming at reducing segregation.

Ethnic segregation in the academic and policy debate
Segregation measures the distribution of groups across places (Massey and Denton, 1988), and is generally concerned with the under- or over-representation of either socio-economic or ethnic population categories in statistical spatial units, such as municipalities and neighbourhoods (Musterd and Ostendorf, 2009; Nijkamp and Poot, 2015). The concept 'ethnic segregation' deals specifically with the spatial separation of population categories based on countries of origin (Musterd, 2005). Neighbourhoods with a high concentration of migrants can either be mixed, with immigrants of diverse origins, or specialized, with a large concentration of one particular group (Hartog and Zorlu, 2009). Big differences in concentration patterns exist between the same migrant groups living in different European countries, but also between different cities within the same countries (Musterd and Van Kempen, 2009).

Causes and consequences of ethnic segregation in the European context
Rather than simply following class and income patterns, ethnic segregation results from a combination of choices and constraints (Massey and Denton,1998; Van Ham and Manley, 2009; Musterd and Van Kempen, 2009). An example of choice elements is ethnic minority members choosing to live among co-ethnics in the same neighbourhood, despite having better housing opportunities elsewhere, as was shown in a case study on the Pakistani community in the UK (Van

Ham and Clark, 2009). Historically grown migrant communities may reinforce concentrations of certain migrants in specific neighbourhoods (Zorlu and Latten, 2009; Van Ham and Manley, 2009). A recent study on non-western migrants in The Netherlands confirmed the important role of such own-group effects for neighbourhood selection, but also pointed at important differences between different migrant origins (Boschman and Van Ham, 2015). Examples of constraints that lead to the concentration of ethnic groups in certain neighbourhoods are restrictive housing allocation systems and welfare state mechanisms (Van Ham and Manley, 2009; Musterd and Van Kempen, 2009).

A high spatial concentration of certain socio-cultural or ethnic groups is regarded undesirable, since it may cause or reinforce social exclusion and disadvantaged socio-economic positions of these groups (Nijkamp and Poot, 2015). At the individual level, segregation may hinder the access to better employment, education or housing (Ellen and Turner, 1997; Atkinson and Kintrea, 2001; Andersson and Musterd, 2010; Galster, 2012). Through socialization (collective norms, peers, role models), social networks, and exposure to violence and disorder, segregation is assumed to negatively affect local residents of these communities. At the macro level, segregation may generate isolated, inward-looking communities and obstruct the development of a cohesive society (Van Ham and Manley, 2009). Also stigmatization of residents in concentration neighbourhoods is often seen as a negative consequence of segregation (Wacquant, 1993; Permentier *et al.*, 2007).

However, the empirical evidence of neighbourhood effects is mixed, especially in the Western-European context, and the direction of causality is not always clear (Musterd and Andersson, 2005; Manley *et al.*, 2012). In particular, no evidence has been found for a linear relationship between housing mix and social mix, and living together in the same neighbourhood is not a guarantee for social interaction between different groups (MacAllister *et al.*, 2001; Musterd and Andersson, 2005). Furthermore, neighbourhood effects resulting from segregation may also be positive, since living among similar people may –at least in short-term— offer better labour market options, networking and matching (Pinkster, 2008; Cheshire, 2009).

Migration histories and ethnic segregation in The Netherlands
The Netherlands has been an immigration country since the 1960s, when 'guest workers' from especially rural parts of Morocco and Turkey were recruited and settled in the Netherlands (Van Tubergen, 2003). Although their residence was initially thought to be temporary, many stayed and were later followed by their families. However, the position on the labour market of especially the first generation of 'labour migrants' has been difficult, because of their recruitment into low level jobs, their limited level of education combined with language difficulties and a lack of integration programmes (Van Mol and De Valk, 2015). In the 1970s, the independence of the former colony of Surinam resulted in a large flow of Surinamese migrants to The Netherlands (Vermeulen and Penninx, 2000), followed by a smaller flow of migrants from the islands of the Dutch Antilles and Aruba. The socioeconomic position of these 'colonial migrants' is very diverse, but in general more favourable than that of labour migrants (Van der Werfhorst and Van Tubergen, 2007), also because of their command of the Dutch language upon arrival (Vermeulen and Penninx, 2000). Migration in the 1990s was dominated by asylum seekers, while over the past decades also an increasing number of western migrants settled in The Netherlands, due to the increasing internationalization of the economy and the growing number of multinational companies (Van Wissen and Heering, 2014; Van Mol and De Valk, 2015; Sleutjes and Musterd, forthcoming 2016). Currently, 21% of the Dutch population has a migrant background, including both migrants and their descendants (Statistics Netherlands, 2014) of which around half of have a western (mainly European) origin.

In the Dutch context, the large majority of immigrants lives in neighbourhoods where those of the same country make up less than 10% of the population (Hartog and Zorlu, 2009). Immigrants

show a large concentration in the western part of the country -the Randstad region-, which is even more marked than for the native population. Many non-western migrant groups show settlement patterns that differ from the native Dutch population as initial location choices upon arrival are often determined by the presence of co-ethnics and neighbourhood economic conditions (Zorlu and Mulder, 2008). Non-western immigrants show a concentration in the four largest cities (Bolt *et al.*, 2002). Segregation indices for ethnic groups have been mainly studied for these cities and are found to be largely stable over time, although the concentration of migrants has gradually shifted from inner-city districts towards post-war neighbourhoods since the 1990s and continuing today (Bolt *et al.*, 2002). Previous evidence has shown that Turkish and Moroccan migrants often live in the same neighbourhoods, whereas the Surinamese community can be found in areas with large shares of other non-western immigrants and -to a lesser extent- Antilleans. Concentration patterns of western migrants have not been studied thoroughly, but some first evidence suggests that non-western migrants are much more spatially concentrated than western migrants (Hartog and Zorlu, 2009).

The measurement of ethnic segregation
Segregation is measured in a variety of ways as is reflected in the twenty measures that Massey and Denton (1988) presented but that are all related to five concepts. First, 'evenness' measures the relative size of the group across geographical units. This aspect is most commonly measured via the 'index of dissimilarity', which was introduced by Duncan and Duncan (1955). The underlying theoretical argument is that conditions in the neighbourhood can influence individual outcomes, including educational outcomes (Andersson *et al.*, 2010). However, the index of dissimilarity is unsuitable for unraveling such relationships, since it is dependent on the size of the areas used in the calculations (Musterd and Van Kempen, 2009).

Second, 'exposure' indicates the degree of potential contact between members of different social groups within areal units. The 'isolation index' is the most common measure of exposure, which measures the chance that a random contact belongs to a certain group. Measures of isolation and exposure may offer more useful insights measures of evenness, since they can be more easily evaluated in terms of consequences. However, the isolation index increases with area size and is strongly dependent on general minority shares (Malmberg *et al.*, 2011).

Third, 'concentration' relates to the relative amount of physical space occupied by a given group. Concentration usually refers to geography or space, i.e. the extent to which a specifically defined population is unevenly dispersed across spatial units such as neighbourhoods or cities. Segregation then refers to the degree to which two or more groups defined by one attribute are distributed unequally across space. Fourth, 'centralization' measures the extent to which a given group is located near the centre of an urban area. Fifth, 'clustering' deals with the extent to which the distribution of a given group is in a contiguous way, for example in enclaves (Nijkamp and Poot, 2015).

Why scale matters for measuring segregation
Besides the way of measurement itself, also the way neighbourhoods are defined has a strong impact on segregation levels, its presumed consequences and policy implications. According to Andersson and Malmberg (2014), the mixed and limited quantitative evidence for neighbourhood effects on life chances at the individual level may be due to the way of measuring the neighbourhood context. They find that the effects of role models, norms and peer effects on educational attainment in 'individualized neighbourhoods' (with respectively 50, 100 and 400 neighbours) are three times greater than effects found in administrative neighbourhoods.

It is argued that different spatial scales provide different opportunities. Whereas neighbourhood effects are assumed to be strongest in the immediate surroundings of an individual, they likely become weaker as the size of the unit increases (Musterd, 2005; Andersson and Musterd, 2010). Segregation is expected to have different impacts according to the scale level at which it is measured, corresponding with social processes at different stages in the life-cycle. For example, social control as in adult monitoring influences pre-school children who play in local streets and playgrounds (Jacobs, 1961), whereas collective socialization and the influence of role models may operate at larger spatial scales. Institutional mechanisms encompass spatial scales as large as entire municipalities, depending on the availability and quality of healthcare, schools, universities and job centres (Ainsworth, 2002; Galster and Santiago, 2006).

Furthermore, although most policy and academic attention focuses on concentration patterns in the largest urban centres, there are good reasons to study segregation in smaller urban centres as well. Lichter *et al.* (2012) focused on the changing distribution of poverty across localities of different size in the United States. Their study found a growing number of poor places, with poverty rates over 20%, during the post-2000 period, both in metropolitan and non-metropolitan areas. Also in Europe, segregation is not restricted to the largest urban centres, but is manifested also in smaller municipalities. At the same time, large municipalities are not necessarily characterized by large-scale segregation (Malmberg *et al.*, 2011).

Methodology and data

Calculation of segregation indices

Most previous studies focused on one or –at most- two indices of segregation. Given the specific drawbacks of each indicator, including three indicators in one analysis and comparing their subsequent patterns of segregation potentially gives a more complete picture of segregation patterns in one specific context. Therefore, ethnic segregation will be assessed in this paper via three indicators: the 'isolation index', the 'dissimilarity index' and the 'entropy index'.

The isolation index reflects the probability that a minority person is exposed only to other members of the same minority. The values sum to 1 and higher values indicate higher levels of segregation. The following formula measures the isolation index:

$$\sum_{i=1}^{n}\left[\left(\frac{x_i}{X}\right)\left(\frac{x_i}{t_i}\right)\right]$$

, where xi is the minority population of area i, X is the total minority population, and ti is the total population of area i (Iceland *et al.*, 2000).

The index of dissimilarity (Duncan and Duncan, 1975) is a measure of evenness. It indicates which share of the group's population in each neighbourhood would have to move in order to get an equal share as the city overall (Nijkamp and Poot, 2015). The index ranges from 0 (complete integration) to 1 (complete segregation), and is measured by the following formula:

$$\frac{\sum_{i=1}^{n}\left[t_i\left|(p_i - P)\right|\right]}{[2TP(1 - P)]}$$

, where ti is the total population of area i, pi is the proportion of area i's population that is minority, P is the proportion of the municipality's population that is minority and T is the total population (Iceland *et al.*, 2000).

A third measure, the entropy index, controls for the degree of sorting and indicates whether high levels of isolation are explained by a high overall share of minorities, rather than by a stronger spatial concentration. It measures entropy, or the weighted average deviation of each areal unit from the metropolitan area's racial and ethnic diversity. The index varies between 0 (when there is only one group) and a maximum of 1 when all groups have an equal number of members (Malmberg *et al.*, 2011; Nijkamp and Poot, 2015), and is measured by the following formula:

$$\sum_{i=1}^{n}\left[\frac{t_i(E-E_i)}{ET}\right]$$

, where t_i is the total population of area i,

$$E_i = p_i \ln\left(\frac{1}{p_i}\right) + (1-p_i)\ln\left(\frac{1}{1-p_i}\right) \qquad E = P\ln\left(\frac{1}{P}\right) + (1-P)\ln\left(\frac{1}{1-P}\right)$$

, and T is the total population (Iceland *et al.*, 2000).

Data

The paper uses the most recent available population register data from Statistics Netherlands (StatLine) for 2014. Through the StatLine online portal, several aggregate statistics on The Netherlands and all its spatial entities (provinces, city-regions, municipalities and neighbourhoods) are available. These data cover topics ranging from population composition to welfare, health, economy and infrastructure. We gathered data on the total population size and the size of several migrant categories (covering the four main origins of non-western migrants, Turkish, Moroccan, Surinamese and Antilleans, as well as other non-western and western migrants). Western migrants include all migrants from Europe (excluding Turkey), North-America, Oceania, Indonesia and Japan. The Indonesian migrants are mainly migrants from the former colony of 'Nederlands Indië' and their descendants. Non-western migrants include migrants from Turkey, Asia (excluding Indonesia and Japan), Africa and Latin-America. Subsequently, based on shared migration histories (as discussed above), we combined the Turkish and Moroccan migrants into the 'labour migrants' group and the Surinamese and Antillean migrants into the 'colonial migrants' group. In the Dutch context, migrant origin in the Dutch context is determined by the country of birth of the person and his or her parents. A person is counted as a member of a certain minority if he or she is born in another country (first generation migrants), or if at least one parent is born outside The Netherlands (second generation migrants). In case both parents are born outside The Netherlands, the country of birth of the mother determines the migrant origin.

We included four cities in our analyses, the two largest highly urbanized cities in the western part and two medium sized municipalities in the central and south of the country: Amsterdam (810,935 inhabitants), Rotterdam (618,355 inhabitants), Utrecht (328,165 inhabitants) and Eindhoven (220,920 inhabitants). By including these four contexts we can see whether segregation patterns differ according to city size and region, compare different types of economies, and for each type a large and a medium-sized city. Amsterdam and Utrecht both have an economy dominated by business services, while Rotterdam and Eindhoven have a strong industrial profile. Rotterdam is the major port of The Netherlands and Eindhoven is specialized in electronic manufacturing. Furthermore the comparison between Amsterdam and Eindhoven is interesting because of the regions' strong international focus. Amsterdam is the main financial and business services hub of the Netherlands and the region is home to many transnational companies. Eindhoven is the country's main high-tech region ('Brainport') and the regional business sector has actively focused on attracting foreign technical talent.

Besides looking at the municipality level, we conducted separate analyses for all neighbourhoods in the four cities (the neighbourhood level) and for the city-regions they are part of (the regional level). The neighbourhoods are comparable with boroughs in larger European cities, range widely in size and consist of smaller districts. For each of these districts an index score was calculated, relative to the total neighbourhood population, and the sum of all scores for districts makes up the index score for the neighbourhood. In turn, for each neighbourhood, an index score relative to the total municipality population was calculated, and the sum of these scores makes up the index score for the municipalities. The city-regions consist of the core city and a small number of surrounding municipalities. The index score for the region is made up by the sum of all index scores at the municipality level (relative to the total regional population). Patterns of segregation are subsequently mapped through a GIS-analysis.

Results

Ethnic segregation patterns: differences across scale levels and cities of different size

Comparing the index scores at three scale levels, the city-region, the municipality and the neighbourhood level, we find that scores generally increase as the spatial scale becomes smaller (see Table 1 in appendix). In other words, ethnic segregation is more pronounced at the neighbourhood level than at the city and regional level.

Isolation index scores are generally somewhat higher at the municipality level than at the city-regional level, whereas at least some neighbourhoods have higher scores than the municipality-level. This pattern is the same for all four city-regions. Thus, the chance that migrant group members encounter only their own co-ethnics is largest at the neighbourhood level. However, scores vary strongly between different neighbourhoods within the same city. While some neighbourhoods are characterized by very strong ethnic segregation, other districts have only modest concentrations of migrants.

Interestingly, the analysis of the index of dissimilarity scores shows different patterns: We find that the distribution of migrant groups is sometimes more uneven at the city-regional level than at the municipality level and even the neighbourhood level. Table 2 in the appendix shows that within each city-region, the core city has by far the highest score for each indicator, mostly followed at a large distance by the directly adjacent suburban municipalities and some 'new towns' further away.

Regarding entropy index scores the analyses show that at the city-regional level they are somewhat lower than at the municipality level. There seems to be a link between city-size and ethnic diversity. The Amsterdam region, the largest of the four, has the highest entropy index score (0.41) while the smallest region, Eindhoven, has the lowest (0.30). Entropy index scores at the neighbourhood level are not strongly different between the four cities. Intra-city differences are largest in Utrecht: there are neighbourhoods with the lowest entropy scores of all four cities (Noordoost, 0.28, Vleuten-De Meern, 0.29), whereas other neighbourhoods have scores comparable to areas in Amsterdam or Rotterdam (Zuidwest, 0.41, and Overvecht, 0.41). In this respect, Utrecht seems to be the most segregated city of the four. In Amsterdam, the entropy index for different neighbourhoods ranges from 0.37 (Zuidoost) to 0.44 (West). Neighbourhoods in Amsterdam are thus to a large degree similar in terms of ethnic diversity and there are no neighbourhoods that are completely dominated by one group. The outcomes for Rotterdam are largely similar. All districts range from 0.37 (Prins Alexander) to 0.45 (Centrum); only the village of Hoek van Holland has an entropy index score way lower than the rest of the municipality (0.21).

Ethnic segregation patterns: differences between western and non-western migrants

Comparing the index scores of western and non-western migrants, we find that segregation rates for western migrants are in general much lower than those for non-western migrants. This

concerns both the isolation index and the index of dissimilarity, and occurs at all spatial scale levels. At the municipality and regional level, according to the isolation index scores, non-western migrants have the highest probability of meeting each other in the two largest cities: Rotterdam (0.43) and Amsterdam (0.41). The scores for the medium-sized cities Utrecht (0.28) and Eindhoven (0.19) are considerably lower. For western migrants, the difference between large and medium-sized cities is less clear-cut. In Amsterdam, western migrants have the highest probability of meeting only their own co-ethnics (isolation index score of 0.17), and also the separate neighbourhoods of the city have higher scores than those in the other three cities. Amsterdam is followed by Eindhoven, with an isolation index score for western migrants of 0.14, higher than Rotterdam and Utrecht.

Figure 1: Isolation index scores for western migrants, in (clockwise) Amsterdam, Rotterdam, Eindhoven and Utrecht
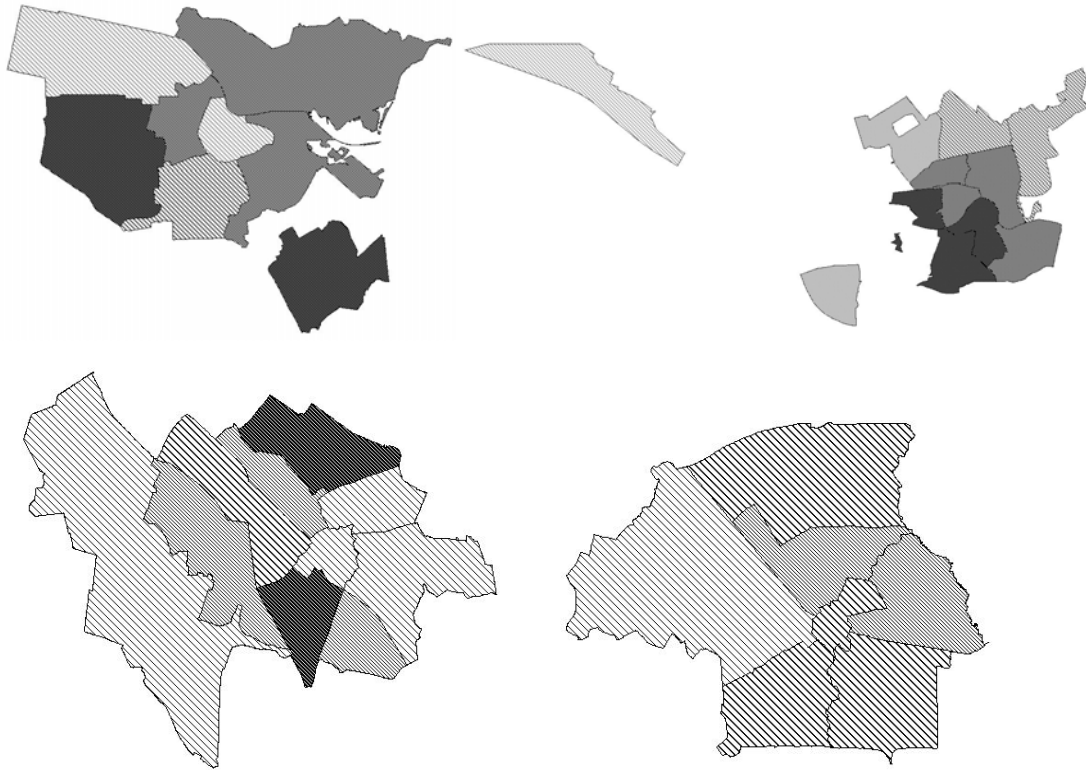
Figure 2: Isolation index scores for non-western migrants, in (clockwise) Amsterdam, Rotterdam, Eindhoven and Utrecht

A second finding is that western and non-western migrants settle in different neighbourhoods. Figures 1 and 2 illustrate these differences clearly: In Amsterdam, following the isolation index, non-western migrants are especially concentrated in the neighbourhoods 'Zuidoost' (southeast, 0.67), 'Nieuw-West' (western part, outside the ring road, 0.53) and 'Noord' (north, 0.44) (see Table 1 in appendix and Figure 2). These areas are characterized by a relatively peripheral location, a lower socio-economic status and a predominantly postwar housing stock. 'Zuidoost' is the main concentration area of Surinamese and Antillean migrants, which together account for 36% of the neighbourhood's population. Within this neighbourhood, index scores for non-western migrants are especially high in the highrise-dominated 'Bijlmer' district and in 'Holendrecht/Reigersbos'. 'Nieuw-West' is the main concentration area of Moroccan and Turkish migrants, together accounting for 34% of the area's population. Particularly the districts 'Kolenkit' and 'Landlust', close to the ring road, show large concentrations of non-western migrants. Within 'Noord', the concentrations appear to be limited to the older districts 'Volewijck' and 'IJplein', closest to the city centre, and the post-war highrise district 'Nieuwendam-Noord'. Also the neighbourhoods 'West' (0.38) and 'Oost' (east, 0.37), surrounding the inner-city, have scores that are much higher than the two most affluent districts 'Centrum' (city centre) and 'Zuid' (south). Thus, non-western migrants are well-represented in all but two neighbourhoods, which are also the areas with the highest socio-economic status.

Compared to the isolation index scores for non-western migrants, the scores for western migrants are relatively low (see Table 1). This indicates that western migrants are more equally dispersed across the city than non-western migrants. Only the districts 'Centrum' (0.25), 'Zuid' (0.22) and to a lesser degree 'West' (0.18) show relatively large concentrations of western migrants. These are the most centrally located neighbourhoods with a higher socio-economic status, some of which

have undergone processes of gentrification over the past two decades. Figure 1 also illustrates a large concentration of western migrants in the central, southern and inner-western part of the city. In the inner-city, the largest concentrations are found in the gentrified 'Jordaan' district, the 'Grachtengordel-Zuid' (canal belt) and the 'Nieuwmarktbuurt'. In Zuid, western migrants are most likely to meet each other in 'Museumkwartier', near the concert hall and the main art museums, in the gentrified nineteenth century district 'De Pijp', but also in the postwar 'Buitenveldert-West' area, near the South Axis business district. Thus, western migrants have the highest isolation index scores in the inner city and in the neighbourhoods with the highest socio-economic status: 'Zuid' and West. Non-western migrants, however, show large concentrations in all districts but the inner city and 'Zuid'. Only 'West' has large concentrations of both groups.

In Rotterdam the picture is less clear-cut as in Amsterdam (Table 1). According to the isolation index scores, non-western migrants are strongly concentrated in certain neighbourhoods, whereas the western migrants are more equally spread across the city. Non-western migrants are especially likely to encounter their own co-ethnics in 'Feijenoord' (0.63), 'Delfshaven' (0.60) and 'Charlois' (0.49). These districts are located south and west of the inner-city, and have a lower socio-economic status. The more affluent peripheral districts 'Hillegersberg-Schiebroek' (north, 0.21) and 'Prins-Alexander' (east, 0.24) have the lowest isolation index scores for non-western migrants. Figure 2 illustrates that non-western migrants are found in all areas, apart from the far northern neighbourhoods and the remote village of 'Hoek van Holland'.

Unlike in Amsterdam, western migrants in Rotterdam are also often found in neighbourhoods where non-western migrants are overrepresented. In fact, in their main concentration area, 'Rotterdam Centrum' (the inner city), the index score for non-western migrants is much higher (0.44) than that of western migrants (0.17). But also in some sections of 'Charlois', 'Kralingen-Crooswijk' and 'Noord' (north), relatively strong concentrations of both western and non-western migrants can be found. Still, western migrants (Figure 1) seem to be more selective in their settlement patterns than the non-western population (Figure 2): there is a clear axis running from the inner city and its surrounding neighbourhoods to the southwestern part of the city.

Our findings for the isolation index indicate that Utrecht to a large degree resembles Amsterdam. Western migrants predominantly live in the inner-city and the districts with a higher socio-economic status: 'Oost' (east, 0.18), 'Noordwest' (northwest) and 'West'. Non-western migrants are hardly found in these districts, but predominantly congregate in the district with a lower socio-economic status: 'Zuidwest' (southwest, 0.55) -especially the 'Kanaleneiland' district-, 'Overvecht' (0.50) and to a somewhat lesser degree 'Zuid' (south, 0.33). Figures 1 and 2 show that western migrants are mainly concentrated in the eastern part of the city, while non-western migrants are overrepresented in the northern and southern parts.

Eindhoven, the smallest of the four cities, does not have any neighbourhoods where concentrations of non-western migrants are as high as in the other cities. Even the area with the strongest concentration, 'Woensel-Zuid', has an isolation index of only 0.27. In fact the concentration of non-western migrants is hardly more pronounced than that of western migrants. The isolation index for western migrants is highest in the inner-city (0.20), but the scores in the other districts are only slightly lower. Based on the isolation index, Eindhoven is the least segregated city of the four, both for western and non-western migrants as also becomes clear in Figures 1 and 2.

An interesting finding is that the isolation index and the index of dissimilarity show different patterns of ethnic segregation, although the differences between western and non-western migrants are consistent. For non-western migrants, the lowest index of dissimilarity score is found in the smallest city, Eindhoven (0.12). However, Rotterdam (0.30) and Utrecht (0.29) have a more uneven distribution of non-western migrants than Amsterdam (0.26).

Figure 3: Index of Dissimilarity scores for non-western migrants, in (clockwise) Amsterdam, Rotterdam, Eindhoven and Utrecht

Looking at differences within cities, Figure 3 illustrates the segregation patterns based on the index of dissimilarity, taking non-western migrants as an example. Comparing these patterns to the ones in Figure 2, it becomes clear that neighbourhoods that score high on one segregation indicator, can score low on another. For example, in Rotterdam the isolation index indicated a strong concentration of non-western migrants in the southern part of the city and to a lesser degree in and around the inner-city. However, the index of dissimilarity shows an axis running from northwest, through the inner city, to the middle-southern part of the city. Also in Eindhoven, which had no districts with high isolation index scores, there are districts with relatively high levels of segregation according to the index of dissimilarity, particularly in the far north and the southern districts.

The Amsterdam neighbourhoods all have similar index scores for the non-western group, between 0.24 and 0.30. The only two areas with a somewhat lower score are the most expensive districts of the city: 'Centrum' and 'Zuid'. The index of dissimilarity of western migrants is generally lower, and nowhere higher than 0.17 ('Zuidoost'), which indicates that western migrants are fairly well dispersed across the city according to this index.

Also in Rotterdam, western migrants appear to be dispersed fairly across the city based on the index of dissimilarity. Only in Feijenoord (0.23) and Charlois (0.21), more than 20% of this group has to move in order to get an even distribution. The index of dissimilarity for non-western migrants differs strongly between the city's different neighbourhoods: The lowest scores are found in the surrounding villages and in the edge-urban districts of 'Prins Alexander' and 'IJsselmonde'.

Especially the districts 'Feijenoord' (0.39), 'Overschie' (0.38), 'Noord' (0.32) and 'Centrum' (0.32) have relatively high scores on the index of dissimilarity, which indicates an uneven distribution of non-western migrants in these districts.

Based on the index of dissimilarity, the city of Utrecht is characterized by low levels of segregation of western migrants and high levels of segregation of non-western migrants. Especially 'Zuidwest' (e.g. 'Kanaleneiland') has a high index score (0.52): more than half of the district's non-western migrants should move in order to get a distribution in line with the city's average. Also 'Zuid', and the 'Nieuw-Hoograven Zuid' section in particular, has a relatively high index score (0.35). The suburban area 'Leidsche Rijn' and the more affluent districts 'Oost' and 'Noordoost' have the lowest index scores. Western migrants appear to be more equally dispersed across the city, but slightly higher index scores can be observed for 'Zuidwest', both in the 'Rivierenwijk' and the 'Kanaleneiland' districts, and in 'Oost', where a relatively strong concentration is found near the university campus.

Eindhoven has only moderate levels of segregation for western migrants, based on the index of dissimilarity: in no district, the index score is higher than 0.11. However, in contrast to the findings related to exposure, there seems to be more unevenness with respect to non-western migrants. The differences in index scores are larger than in Amsterdam, but slightly smaller than in Rotterdam and Utrecht. The strongest concentration of non-western migrants is found in 'Woensel-Noord', where 31% of the non-western migrants should move in order to obtain the same population distribution as the city's average. Also 'Stratum' (0.28) and 'Gestel' (0.25) have relatively high index scores, while 'Centrum' (0.14) and 'Strijp' (0.11) have scores below those of other neighbourhoods (see Table 1 in appendix).

Ethnic segregation patterns: differences between non-western group

Within the group of migrants of non-western origin, there are large differences in the concentration patterns of 'colonial' and 'labour' migrants. Figures 4 to 7 illustrate these differences. Foremost, these groups are much more often found in the two largest cities, Amsterdam and Rotterdam, than in the two smaller cities (see Table 1 in appendix). But also within these cities, colonial migrants and labour migrants appear to concentrate in different districts. Colonial migrants are strongly overrepresented in 'Amsterdam Zuidoost' (southeast) where, the chance is 39% that a Surinamese or Antillean migrant will meet only migrants of the same origin in the neighbourhood. The isolation index scores for labour migrants closely resemble those of non-western migrants in general, except for the 'Amsterdam Zuidoost' district, where this group is hardly found. Especially in the western part of the city, there is a strong concentration of labour migrants (see Figure 4).
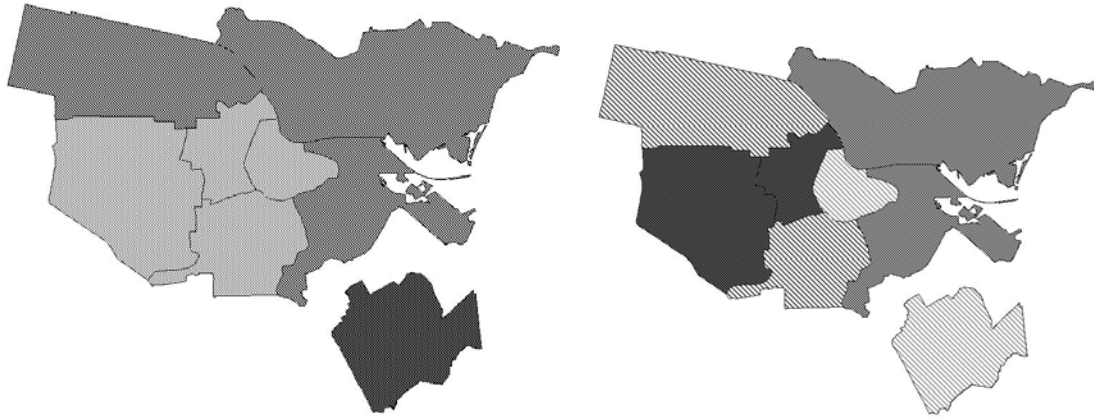
Figure 4: Isolation index scores for colonial migrants (left) and labour migrants (right) in Amsterdam
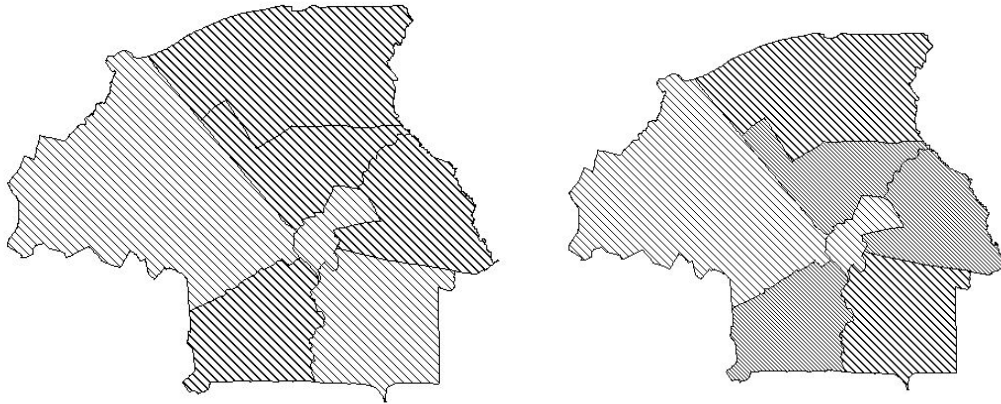

Figure 5: Isolation index scores for colonial migrants (left) and labour migrants (right) in Rotterdam

Figure 6: Isolation index scores for colonial migrants (left) and labour migrants (right) in Utrecht

Figure 7: Isolation index scores for colonial migrants (left) and labour migrants (right) in Eindhoven

In Rotterdam, the former labour migrants seem to be more strongly spatially concentrated than the colonial migrants. Especially 'Feijenoord', 'Delfshaven' and 'Noord', directly surrounding the inner-city, have high concentrations of labour migrants. Colonial migrants have more concentration areas, but there is a clear congregation in the southern and western parts of the city and less concentration in the eastern and northern parts (see Figure 5). In Utrecht, no strong concentration of colonial migrants is found using the isolation index, while the concentration patterns of labour migrants closely resemble those of non-western migrants in general: especially the southern and northern districts show large concentrations (see Figure 6). Also in Eindhoven, colonial migrants do not show clear concentrations, whereas the isolation index scores of labour migrants are low compared to the other three cities (see Figure 7). The index scores for labour migrants are largely similar across the city; only the inner-city and Strijp have considerably lower isolation index scores.

The scores on the index of dissimilarity for labour migrants to a large degree overlap those for non-western migrants, in all four cities. For colonial migrants, a smaller number of districts has high scores on the index of dissimilarity, but interestingly these are not the same districts with a high isolation index score. Again, two indicators thus suggest different patterns of ethnic segregation.

Conclusions and discussion

The main aims of this paper were to analyze levels and patterns of segregation for different migrant groups by comparing different ways of measurement across spatial scale levels. The rich population data of Statistics Netherlands were used. Four contributions to the literature on ethnic segregation are made. First, given each indicator's specific strengths and weaknesses, three segregation measures were simultaneously analyzed and compared. Second, since social processes generally occur and have impacts at different spatial levels, the segregation indexes were calculated at three spatial scales: the city-regional, the municipality and the neighbourhood level. Third, the study was extended beyond the often analyzed metropolitan areas by comparing the two largest cities in The Netherlands (Amsterdam and Rotterdam) to two medium-sized cities in the central (Utrecht) and southern (Eindhoven) parts of the country. Fourth, we covered not only non-western migrants but also the increasingly important share of migrants of western origin.

Our analyses resulted in a number of important conclusions. First and foremost, for measuring segregation patterns, it clearly matters which indicator is used. The scores on the three different indexes used in this paper –the isolation, the dissimilarity and the entropy index- lead to different, and sometimes contrasting, segregation patterns in all four cities. For example, the same neighbourhoods

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can show low scores on the isolation index, but high scores on the index of dissimilarity. Relying on only one indicator of ethnic segregation might therefore result in misleading conclusions.

Having said this irrespective of the segregation measure used, all index scores showed moderate segregation levels in The Netherlands at most. Isolation index scores were also much lower if the group was more clearly bounded: the labour and colonial migrants generally have lower index scores than non-western migrants in general. These findings indicate, in line with previous studies on migrants in The Netherlands, that there are no concentration neighbourhoods where the population largely consists of only one group (Musterd and Van Kempen, 2009; Hartog and Zorlu, 2010). Still, the moderate entropy index scores indicate that in many urban neighbourhoods, and especially in the two largest cities, at least one of the three groups (native Dutch, non-western migrants or western migrants) is overrepresented. Thus, urban neighbourhoods in Dutch cities are not strongly segregated, but do show a large degree of ethnic diversity.

A second overarching conclusion is that ethnic segregation is manifested differently at various spatial scales. Segregation levels are in general lowest at the city-regional level and highest at the neighbourhood level. There is, however, a large variety between different neighbourhoods with respect to all three segregation measures. Some neighbourhoods have scores way above the score for the city overall, while other districts score even lower than the regional index score. These findings suggest on the one hand that the spatial scale level is indeed important to take into consideration for measuring segregation. On the other hand, segregation seems to be a highly localized phenomenon, with large differences across small distances.

Third, there are clear differences in segregation levels and patterns between western and non-western migrants. Non-western migrants show stronger levels of segregation than western migrants. Both for the isolation index and the index of dissimilarity, the differences between the highest and the lowest index scores are larger for non-western migrants than for western migrants. Even the highest index scores on the isolation index or the index of dissimilarity for western migrants are moderate compared to the highest index scores for non-western migrants. These findings suggest that the settlement patterns of western migrants more closely resemble the patterns of native Dutch population than the patterns of non-western migrants. A possible explanation for this could be the generally higher level of education and incomes of western migrants, compared to non-western migrants. In this respect, the western migrant group does not differ strongly from the native Dutch population. Furthermore most neighbourhoods in Amsterdam and Utrecht with high index scores for western migrants generally have low index scores for non-western migrants, and vice versa. Only in Rotterdam, both groups are found in the same districts. Generally, western migrants settle in the inner city or in neighbourhoods with a higher socio-economic status. Non-western migrants tend to concentrate in a larger number of areas, but generally less in districts with a high, and more in districts with a low socio-economic status. This pattern is clearly visible in Amsterdam and Utrecht, but much less in Rotterdam and Eindhoven but the concentration of western migrants in the inner-city was found in all four cities. With our data we cannot directly test the suggested explanations for these patterns. However, most likely differences in average income and migration backgrounds between the two groups help to explain this outcome. Most non-western migrants are either (descendants of) former guest labourers or refugees, and many of them are within the lower income strata. Western migrants, however, are more often high-educated and belong to the higher income groups. Many of them moved to The Netherlands for job opportunities or because of international relationships, a trend that has strengthened significantly since the opening of the EU's internal borders (see Van Mol and De Valk, 2015). Further analyses are needed to determine to what extent location choices of western migrants are reflecting (economic) opportunities only or are related to e.g. different networks and language knowledge.

Fourth, within the group of non-western migrants, there is a large difference in segregation patterns between former colonial and labour migrants. Colonial migrants have strong concentrations in the two largest cities, and much less in Utrecht and Eindhoven. Also, while the segregation patterns for labour migrants largely resemble those of non-western migrants in general, colonial migrants seem to settle in a small number of neighbourhoods only and often in other districts than labour migrants. These very specific concentrations in certain cities and specific neighbourhoods within them may be the result of existing ethnic networks and infrastructures in some of these districts. The Surinamese community in Amsterdam Zuidoost ('Bijlmermeer') is the best-known example of this in the Dutch context. Apart from choice mechanisms, also housing market mechanisms and the welfare state may determine why certain population groups end up in certain neighbourhoods (Van Ham and Manley, 2009; Musterd and Van Kempen, 2009).

Finally, segregation levels and patterns also strongly differ across cities and regions of different size. The link between city-size and segregation levels is complex, however, since it is different according to the migrant origin and indicator under study. The largest cities -Amsterdam and Rotterdam- have higher index scores for non-western migrants than the two smaller cities, Utrecht and Eindhoven. For non-western migrants, concentration levels seem to increase with city-size, but for western migrants the picture is more complex. Concentrations are largest in Amsterdam, followed by Eindhoven, most likely explained by the economic profile of both regions (being main hubs for high-skilled employment and hosting many international companies). These potentially attract migrants with different characteristics resulting in different segregation patterns.

Looking at differences between the districts with the highest and the lowest index scores within the four cities, we can conclude that on the one hand differences in index scores between the neighbourhood level and higher spatial scales are large, while at the same time there are large differences between neighbourhoods in the same city. Intra-local differences are largest in Utrecht, which has districts with very high and very low index scores. Scores in the other three cities appear more consistent: relatively high in Amsterdam and Rotterdam, and in general low in Eindhoven.

Although our study has revealed some important conclusions, looking at administrative spatial entities (city-regions, municipalities and neighbourhoods) also has clear limitations (even though it is the conventional way of measuring segregation). Borders of predefined spatial units may run right through the areas that people consider 'their neighbourhood'. Besides, people living at the other side of an administrative neighbourhood, may live further away than people right across the border in an adjacent neighbourhood. Constructing individualized neighbourhoods of different sizes may be a next step to achieve more enhanced insights in the role of scale levels for segregation measurement. Our data did not allow for this type of analysis as personalized data were not available but future studies should aim for this. Another limitation is that only registered migrants could be included in the analysis. Covering also non-registered migrants may lead to different patterns of segregation, most likely especially for the non-western group. It would be an asset if future data collection efforts would also aim to cover unregistered migrants and describe the specific segregation patterns for this group of migrants. Finally, our study focused on the Netherlands only. Although this country is highly similar in terms of migrant histories and welfare arrangements to other north-western European countries, comparative country studies are needed to draw cross-national conclusions.

Despite these limitations our findings offer some useful building blocks for future research and policy. Foremost, given the large differences in scores between different indicators, a comparison of at least two measures of segregation is necessary in order to get a nuanced view of segregation levels and patterns. Drawing conclusions based on the outcomes of only one indicator may not tell the

full story of ethnic segregation in a city or neighbourhood and result in policies make the wrong assumptions, thus e.g. neglect districts in need.

Future studies should furthermore take note of the fact that the strongest segregation levels and patterns were found at the neighbourhood level. Additional analyses even showed that there is also large diversity in scores between the districts within these neighbourhoods. It is thus important to focus on spatial units that are as small as possible and that correspond closely to the social environment of residents. The earlier mentioned personalized neighbourhoods may be a useful tool for this in the future.

Lastly, although ethnic segregation is more pronounced in the largest metropolitan areas and among certain migrant origin groups, it is certainly not solely a big city phenomenon. More scientific and policy attention is warranted for an ethnically diverse population living in cities of different scales both in the Netherlands and across Europe.

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Table 1. Segregation indexes for various migrant groups; differences between three spatial scale levels

	Isolation western	ID western	Isolation non-western	ID non-western	Isolation colonial	ID colonial	Isolation labour	ID labour	Entropy
City region Amsterdam	**0,143**	**0,201**	**0,304**	**0,239**	**0,098**	**0,264**	**0,124**	**0,328**	**0,405**
Municipality of Amsterdam	**0,172**	**0,060**	**0,416**	**0,263**	**0,198**	**0,344**	**0,228**	**0,310**	**0,439**
Stadsdeel Centrum	0,244	0,060	0,154	0,140	0,051	0,194	0,038	0,243	0,403
Stadsdeel Westpoort	0,003	0,015	0,001	0,001	0,089	0,516	0,071	0,498	0,441
Stadsdeel West	0,182	0,028	0,376	0,252	0,069	0,212	0,261	0,376	0,436
Stadsdeel Nieuw-West	0,128	0,096	0,534	0,235	0,082	0,394	0,371	0,289	0,419
Stadsdeel Zuid	0,219	0,084	0,191	0,182	0,059	0,210	0,065	0,266	0,406
Stadsdeel Oost	0,157	0,063	0,374	0,276	0,089	0,216	0,201	0,374	0,430
Stadsdeel Noord	0,109	0,141	0,441	0,296	0,107	0,255	0,212	0,341	0,407
Stadsdeel Zuidoost	0,100	0,165	0,670	0,246	0,393	0,223	0,044	0,277	0,372
City region Rotterdam	**0,106**	**0,171**	**0,322**	**0,308**	**0,107**	**0,312**	**0,131**	**0,352**	**0,381**
Municipality of Rotterdam	**0,122**	**0,205**	**0,434**	**0,297**	**0,128**	**0,219**	**0,196**	**0,395**	**0,419**
Rotterdam Centrum	0,173	0,060	0,437	0,318	0,124	0,325	0,192	0,498	0,446
Delfshaven	0,130	0,093	0,603	0,192	0,142	0,128	0,313	0,274	0,408
Overschie	0,094	0,131	0,347	0,383	0,104	0,277	0,174	0,432	0,376
Noord	0,132	0,110	0,452	0,324	0,117	0,298	0,245	0,392	0,428
Hillegersberg-Schiebroek	0,120	0,024	0,215	0,285	0,056	0,227	0,100	0,440	0,341
Kralingen-Crooswijk	0,158	0,074	0,416	0,214	0,111	0,237	0,220	0,309	0,436
Feijenoord	0,109	0,226	0,633	0,387	0,161	0,299	0,365	0,476	0,396
IJsselmonde/ Pernis/ Spaanse Polder/ Rozenburg	0,094	0,047	0,364	0,138	0,181	0,265	0,114	0,286	0,386
Prins Alexander	0,095	0,074	0,237	0,140	0,112	0,175	0,050	0,147	0,363
Charlois	0,149	0,210	0,491	0,210	0,187	0,212	0,176	0,216	0,437
Hoogvliet	0,090	0,062	0,271	0,218	0,149	0,208	0,058	0,299	0,368
Hoek van Holland	0,076	0,018	0,044	0,045	0,020	0,004	0,032	0,497	0,205

City region Utrecht	**0,099**	**0,091**	**0,183**	**0,500**	**0,032**	**0,158**	**0,112**	**0,328**	**0,321**
Municipality of Utrecht	**0,108**	**0,083**	**0,284**	**0,289**	**0,039**	**0,175**	**0,210**	**0,378**	**0,367**
West	0,111	0,090	0,239	0,234	0,023	0,128	0,164	0,301	0,356
Noordwest	0,112	0,062	0,253	0,217	0,038	0,155	0,185	0,259	0,367
Overvecht	0,096	0,091	0,497	0,209	0,054	0,107	0,353	0,228	0,405
Noordoost	0,120	0,074	0,113	0,185	0,024	0,185	0,085	0,407	0,277
Oost	0,176	0,141	0,099	0,188	0,019	0,162	0,068	0,575	0,299
Binnenstad	0,151	0,050	0,122	0,209	0,023	0,095	0,053	0,475	0,308
Zuid	0,093	0,073	0,333	0,353	0,041	0,182	0,299	0,574	0,348
Zuidwest	0,093	0,162	0,545	0,528	0,036	0,282	0,473	0,589	0,409
Leidsche Rijn	0,102	0,034	0,289	0,153	0,061	0,106	0,164	0,228	0,376
Vleuten-De Meern	0,085	0,077	0,156	0,249	0,042	0,217	0,082	0,304	0,291
City region Eindhoven	**0,109**	**0,134**	**0,151**	**0,407**	**0,024**	**0,263**	**0,066**	**0,363**	**0,304**
Municipality of Eindhoven	**0,141**	**0,064**	**0,185**	**0,122**	**0,029**	**0,072**	**0,074**	**0,178**	**0,360**
Stadsdeel Centrum	0,203	0,057	0,214	0,141	0,016	0,098	0,019	0,171	0,403
Stadsdeel Stratum	0,136	0,109	0,189	0,280	0,031	0,245	0,109	0,432	0,335
Stadsdeel Tongelre	0,127	0,077	0,252	0,220	0,035	0,097	0,153	0,360	0,381
Stadsdeel Woensel-Zuid	0,153	0,110	0,270	0,194	0,042	0,187	0,131	0,246	0,401
Stadsdeel Woensel-Noord	0,114	0,076	0,207	0,309	0,035	0,218	0,114	0,422	0,341
Stadsdeel Strijp	0,139	0,079	0,154	0,108	0,030	0,142	0,044	0,162	0,342
Stadsdeel Gestel	0,143	0,076	0,219	0,256	0,034	0,240	0,115	0,374	0,374

Table 2. Segregation indexes for various migrant groups; differences between municipalities within the same city-region

	Isolation W	Isolation NW	Isolation Col	Isolation Lab	ID W abs	ID NW	ID Col	ID Lab	Entropy
City region Amsterdam	**0,143**	**0,304**	**0,098**	**0,124**	**0,201**	**0,239**	**0,264**	**0,328**	**0,405**
Almere	0,009	0,039	0,029	0,004	0,017	0,003	0,040	0,028	0,388
Amstelveen	0,014	0,007	0,001	0,000	0,009	0,011	0,016	0,023	0,397
Amsterdam	0,097	0,230	0,060	0,108	0,092	0,117	0,090	0,164	0,438
Diemen	0,002	0,004	0,002	0,001	0,000	0,000	0,002	0,004	0,405
Haarlemmermeer	0,008	0,006	0,002	0,001	0,023	0,036	0,037	0,042	0,311
Landsmeer	0,000	0,000	0,000	0,000	0,003	0,004	0,004	0,005	0,216
Muiden	0,000	0,000	0,000	0,000	0,001	0,002	0,002	0,003	0,246
Oostzaan	0,000	0,000	0,000	0,000	0,003	0,004	0,004	0,004	0,188
Ouder-Amstel	0,001	0,000	0,000	0,000	0,002	0,004	0,004	0,005	0,297
Purmerend	0,003	0,004	0,002	0,000	0,016	0,018	0,015	0,025	0,310
Waterland	0,000	0,000	0,000	0,000	0,005	0,007	0,008	0,008	0,185
Wormerland	0,000	0,000	0,000	0,000	0,005	0,006	0,007	0,007	0,193
Zaanstad	0,006	0,013	0,002	0,010	0,024	0,024	0,034	0,009	0,337
Zeevang	0,000	0,000	0,000	0,000	0,002	0,003	0,003	0,003	0,180
City region Rotterdam	**0,106**	**0,322**	**0,107**	**0,131**	**0,171**	**0,308**	**0,312**	**0,352**	**0,381**
Albrandswaard	0,001	0,001	0,001	0,000	0,006	0,009	0,007	0,011	0,262
Barendrecht	0,002	0,003	0,001	0,001	0,010	0,015	0,013	0,016	0,286
Bernisse	0,000	0,000	0,000	0,000	0,005	0,007	0,007	0,008	0,148
Brielle	0,001	0,000	0,000	0,000	0,004	0,009	0,009	0,009	0,197
Capelle aan den IJssel	0,007	0,010	0,007	0,001	0,000	0,008	0,003	0,022	0,363
Hellevoetsluis	0,003	0,001	0,000	0,000	0,007	0,017	0,016	0,018	0,252
Krimpen aan den IJssel	0,001	0,000	0,000	0,000	0,008	0,014	0,014	0,015	0,212
Maassluis	0,002	0,003	0,000	0,003	0,006	0,007	0,010	0,002	0,315
Nederlek	0,000	0,000	0,000	0,000	0,005	0,008	0,008	0,008	0,154
Ridderkerk	0,002	0,001	0,000	0,000	0,011	0,019	0,020	0,020	0,245
Rotterdam	0,069	0,272	0,090	0,109	0,084	0,153	0,153	0,165	0,418
Schiedam	0,007	0,018	0,003	0,011	0,002	0,001	0,010	0,011	0,386
Spijkenisse	0,005	0,005	0,004	0,000	0,009	0,020	0,012	0,031	0,309
Vlaardingen	0,004	0,008	0,001	0,005	0,010	0,014	0,021	0,007	0,328
Westvoorne	0,001	0,000	0,000	0,000	0,004	0,008	0,008	0,008	0,172

City region Utrecht	0,099	0,183	0,032	0,112	0,091	0,500	0,158	0,328	0,321
De Bilt	0,006	0,002	0,000	0,000	0,004	0,059	0,024	0,028	0,239
Bunnik	0,001	0,000	0,000	0,000	0,005	0,024	0,009	0,012	0,190
Houten	0,004	0,002	0,001	0,000	0,016	0,071	0,017	0,037	0,215
Nieuwegein	0,009	0,012	0,007	0,002	0,000	0,053	0,030	0,023	0,311
Stichtse Vecht	0,008	0,004	0,002	0,001	0,010	0,085	0,015	0,042	0,247
Utrecht (gemeente)	0,058	0,149	0,017	0,102	0,046	0,113	0,045	0,164	0,362
IJsselstein	0,003	0,005	0,002	0,002	0,009	0,037	0,004	0,012	0,268
Zeist	0,009	0,010	0,002	0,005	0,002	0,059	0,013	0,010	0,300
City region Eindhoven	**0,109**	**0,151**	**0,024**	**0,066**	**0,134**	**0,407**	**0,263**	**0,363**	**0,304**
Best	0,004	0,002	0,000	0,001	0,014	0,059	0,023	0,018	0,217
Eindhoven	0,083	0,143	0,022	0,065	0,074	0,070	0,148	0,206	0,362
Geldrop-Mierlo	0,007	0,003	0,001	0,001	0,013	0,075	0,018	0,030	0,236
Nuenen, Gerwen en Nederwetten	0,004	0,000	0,000	0,000	0,010	0,056	0,023	0,029	0,185
Son en Breugel	0,002	0,000	0,000	0,000	0,008	0,039	0,015	0,020	0,185
Valkenswaard	0,006	0,001	0,000	0,000	0,011	0,071	0,025	0,039	0,202
Waalre	0,004	0,001	0,000	0,000	0,004	0,037	0,011	0,021	0,221

Despite broad academic and societal attention for ethnic segregation and its presumed negative effects on e.g. personal life chances and social inclusion, there is no generally accepted standard for measuring segregation. This paper contributes to our understanding of residential segregation by taking an exploratory comparative design. We study and evaluate the three most commonly used indicators of ethnic segregation (i.e. the 'isolation index', 'entropy index' and 'dissimilarity index') and simultaneously analyze how they are manifested at different spatial scales and for different migrant origin groups. This allows us to assess to what extent these indicators result in indicating different segregation patterns. Simultaneously we study how levels of segregation differ across city-regions of different size, across different scale levels within them and for different migrant origin groups. The rich population register data on the Netherlands allow for this detailed analyses at the neighbourhood, municipality and city region levels. Our findings show that the three indices lead to different and sometimes contrasting segregation patterns. In general, segregation is weakest at the regional scale, but there is large variation at the neighbourhood level. Also clearly different patterns and levels of segregation exist between different migrant origins and across city-regions of different size.