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SQUARES FOR CO-PRESENCE:

The influence of urban form on the intensity and diversity of people co-present in 12 squares in Gothenburg

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ABSTRACT

Increasing residential segregation in cities gives public spaces a more important role in solidarity processes, bringing people together, supporting movement, co-presence and co-awareness. Local squares thus have the greatest significance providing an arena for social interplay as people become co-present. Earlier studies showed that high spatial integration plays an important role for the mix of locals and non-locals besides aspects relating to population density and land use.

The purpose of this paper is to reach a better understanding whether also more local properties that characterize a square influence co-presence. Further, more squares are added to represent a broader spectrum of neighbourhoods which will help us understand whether network integration is important in all types of neighbourhoods. Thirdly, this study will help to inform whether earlier findings by Legeby in Stockholm, Södertälje and Gothenburg can be confirmed which allows us to generalize these findings.

The amount of people co-present in squares and the share of non-local visitors are studied as two indicators (or aspects) of co-presence. The empirical data was collected through observation including snapshots and interviews. The number of people present in the public squares was noted and the interviews were used to measure the share of non-locals. The spatial analysis includes besides integration and betweenness, an analysis of density (both population and building density) and land uses accessible from the squares within various radii. Also, geometric characteristics such as size, shape and enclosure of the squares are included in the study.

The result shows different patterns of co-presence in the 12 studied squares, especially if we distinguish squares in the most central area of Gothenburg with squares located at a longer distance from the city centre. Some findings confirm earlier findings and allow us to generalize the findings as other findings seem not to be relevant in all cities. Further, pure geometric properties of squares do not show strong correlations with co-presence. We can thus conclude that the local design intervention of squares cannot promote co-presence very well without the support of urban structure.

KEYWORDS

Co-presence, public squares, urban form, space syntax, segregation in public space

1. INTRODUCTION

In many European cities the history of massive post-war housing expansion has left a legacy of notoriously segregated suburbs. The problems related to segregation and exclusion in Swedish cities are currently being discussed "to an extent not experienced before" (Legeby et al. 2015, p. 239). This is reflected in policy documents, municipal budgets and Comprehensive Development Plans. However, the situation is more complex with some suburbs suffering social problems much more than others (Vaughan 2005; Vaughan and Arbaci 2011).

Earlier studies have shown that public space has an important role to play as it can contribute in a positive way to solidarity processes, bringing people together, supporting movement, co-presence and co-awareness (Hanson 2000, Hanson & Zako, 2007; Legeby 2013; Netto, 2016). Public space is thus not only urban design elements important for enabling travel between destinations, but has an important role to play in providing a social arena for social interplay (Olsson 1998; Gothenburg Comprehensive plan 2009). The routines of day-to-day life result in social interaction and cultural exchange including the negotiations of views and norms (Giddens 1984; Zukin 1995) and can potentially contribute to overcoming social exclusion (Legeby 2013; Young 1996).

Architecture and urban design are seen in this debate as playing a central role for counteracting segregation, confirmed by formulations found in policy documents. But how do we know what kind of design principles lead to less segregation? Earlier studies highlight the importance of urban space which frames and supports everyday life in the city such as streets, squares and parks (Hanson & Hillier 1987; Vaughan, 2005; Hanson & Zako, 2007). With whom we potentially share the street and what resources are within easy access as we perform our day-to-day routines, it is argued, is of utmost importance for matters related to social exclusion (Vaughan 2015). Earlier studies of squares and centres in Stockholm and Södertälje (Sweden) show that specific configurational properties have great impact on the pattern of co-presence, both in terms of the amount of people present in public space and the inflow of non-locals (Legeby & Marcus, 2011; Legeby, 2013). The latter is argued to be as an indicator of diversity as people coming from different parts of the city and becoming co-present at the square/centre in question. More specifically, it is found that segregation of public space, a limited spatial reach and an uneven distribution of spatial centrality, appears not to favour exchange between neighbourhoods or access to urban resources across the city – findings that are highly critical for the urban segregation issue (Al Gatam 2012; Legeby, 2013, p. ii; Legeby et al., 2015).

A study in Gothenburg (Legeby et al., 2015) showed similar patterns, but no statistical analysis was carried out at that stage and the 9 squares studied were all located in neighbourhoods developed following modernistic planning ideals. Further, the variables studied did not include other variables that might be of importance such as the working population and access to different kinds of services (e.g. shops, restaurants, amenities), which was found to be important in Stockholm.

The central question for this paper is therefore not primarily whether spatial form influences co-presence, but merely how in more detail it does so and whether the findings in Stockholm, Södertälje and Gothenburg are similar so that we can start to generalize the findings to at least the Swedish context at large.

The study presented in this paper will therefore contribute to these earlier findings in two ways: firstly, by adding more squares representing a broader spectrum of neighbourhood types in Gothenburg (e.g. different typologies and different periods in history) and by adding all variables used in the earlier study in Stockholm, we can compare the results with the Stockholm case. Secondly, by adding some basic urban form characteristics of the squares themselves (e.g. size, enclosure and height of the surrounding buildings) that were not included in Stockholm and will give us insight whether the design of the square itself is of importance to co-presence or not. We find this important as it is a question that is highly relevant for architects and planners involved in the design of public space and the importance of such design features is argued by some to have a huge impact on the performance of, for instance, squares. As in the earlier studies (Legeby, 2013) two aspects of co-presence that are argued to influence the character of urban life and thus affects what kind of urban networks or solidarities may emerge are included. Firstly, ʹintensityʹ in public space measured as the average amount of people present at the square on weekdays and secondly, ʹdiversityʹ or mix of people measured as the share of non-locals using the median metric distance to the home addresses of the people present at a specific square. Statistical analysis is then used to establish to what extent the inflow of non-locals corresponds to certain other attributes.

In the following section, the method will be explained including a discussion about the selection of squares, how the observation study was conducted, which spatial variables are included and how these are measured. In the section that follows, the results of the statistical analysis, relating the observation to the spatial analysis, are presented and in the last section the findings are discussed.

2. METHODS

2.1 SELECTING SQUARES

For the selection of squares, we used four criteria to ensure a good spread in spatial characteristics in terms of population density, centrality, size and enclosure. The accessible population was measured as the number of people living within a 500 metre walking distance from the square. Centrality was measured using betweenness[1] at 2-kilometre radius which have the potential to support the active presence of people and the resultant urban economy (Remali et al. 2015). Enclosure was measured as the share of the perimeter of the square that was built upon. This will be explained in more detail in section 2.3[2]. The values of each indicator are divided into three groups by natural breaks and the range of each group is shown in table 1. Putting the criteria of four indicators and squares into a selection matrix, we ensured to select different types of squares. As a result, 12 squares were selected (see figure 1). Besides three squares in the neighbourhoods Friskväderstorget in Norra Biskopsgården (1950s), Kyrkbytorget in Kyrkbyn (1950s) and Komettorget in Bergsjön (1960s) that were also included in an earlier study in Gothenburg (Legeby et al., 2015), 9 other squares were selected: Gustav Adolfs Torg (inner city, 17th century), Lilla Torget (inner city, 17th century), Masthuggstorget in Masthugget (mid-18th century), Kaggeledstorget in Torpa (1940s), Doktor Fries Torg in Guldheden (1950s), Radiotorget in Järnbrott (1950s), Trätorget in Björkekärr (1950s), and Brotorget and Johan Sannes Torg in Sannegården (2000-).

	Low	Medium	High
Accessible Population	<4463	4463-10090	≥10090
Betweenness	<13808	13808-66617	≥66617
Size	<1955m^2	1995-4317m^2	≥4317m^2
Enclosure	<0.37	0.37-0.56	≥0.56

Table 1. The values of the four selecting indicators: accessible population, betweenness, size and enclosure

[1] A measure of centrality developed by Freeman (1977). It analyses how often a segment is passed using the shortest paths between every point to all other points in the system within a certain radius.

[2] This paper is the result of a Master Thesis conducted at Chalmers University of Technology by Kailun Sun and more details can be found in the report ´Making Squares: a study of urban form and co-presence´.

Figure 1. The selection of squares

2.2 OBSERVATIONS

The empirical data contains two aspects of co-presence – 'intensity' and 'diversity' - and was collected through observation. Firstly, we counted people present at the square for a period of four minutes. These counts were repeated every hour for one day starting from 8:00 in the morning until 18:00 in the afternoon. These are then added up and divided by the total amount of counts during a day to arrive at the median momentary intensity.

The interviews were conducted to collect information about whom visits the square and why. Only one question of these interviews was used for this paper which is the question of the home address of the people visiting the square. The interviews were conducted on a weekday between 8:00 and 18:00, in between the counts that were done every half hour. Based on these home addresses we were able to measure the distance of the home address of the person visiting the square to the square in question. In this study 'locals' are defined as those living within 1000 meters of walking distance from the square. This distance is easy walkable (about 10-15 min) and has to do with how many of these neighborhoods are used, a kind of primary catchment area of the different neighbourhood centres and squares. Living further away increases the chance that residents will use another square/centre or another tram or bus stop. Besides, we used the median distance to these home addresses as a proxy for the mix of people co-present at the square where we don't have to make the somehow arbitrary choice of the 1 kilometre threshold for being local or non-local. We used interviews to collect the information about the home addresses of the visitors. The interviews were conducted in between observing the intensity, meaning that we have data for diversity from people interviewed on weekdays from 8:00-18:00. The information about the home addresses was analysed and the distance from the square to these addresses calculated. Some addresses are located really far away from the squares and these influence the average levels. We therefore used the median value which is not skewed so much by extremely large or small values, and so may give a better idea of a 'typical' value. This is also a way to deal with addresses located in positions not covered by the axial map.

2.3 SPATIAL ANALYSIS

The spatial analysis of the squares and its surroundings will be carried out in a way that acknowledges the city as an urban system that makes sense for where people are and how they move around. We distinguish four levels of spatial analysis: patterns of centrality using network analysis; patterns of population density including both residential population and working population; patterns of land use where we analysed the proximity to different kind of services; geometric characteristics of space from the scale of the local square to the scale of the neighbourhood.

The centrality analysis includes two network analyses of centrality, betweenness and integration from local to global scale. Analysing the spatial integration of a system defines how accessible each space (or its representation: the axial line) is from all other spaces (or axial lines) in the system (Hillier & Hanson 1984, Hillier 1996). In a way, it is a method used for describing how far away or how 'deep' each space is in the system, in relation to all others. Another way of measuring centrality is to analyse how many distance-minimising paths there are between every pair of segments. This is a way to identify important links connecting the spatial system is called betweenness.

Further, a series of attraction analysis were conducted including accessible population (residential and working population), accessible built density (measured as volume per area, m^3/m^2), network density (measured as street length per area, m/m^2), accessible services (amount of public amenities and food related services including cafes, groceries and restaurants[3]) and public transportation (amount of stops resp. amount of different lines). All were conducted at three scales of walking distance, that is, 500m, 1km and 2km, except for public transport (number of tram/bus lines but not number of stops) which was only calculated for a 500m radius. These analyses were done counting the amount of, for instance, restaurants, accessible within a distance of 500m using the street network. This means that the outcome depends both on the amount of restaurants (or any other attraction) and on the street layout. A grid-like pattern will give rather equal access in all directions and a tree-like street pattern tends to reduce the area one reaches, its spatial reach (Legeby, 2013) (see figure 2). This area one can reach (i.e. spatial reach) is a variable in the statistical analysis as well as it is used to calculate density in for instance accessible population density, accessible built density and accessible network density (Berghauser Pont & Marcus, 2014; Berghauser Pont & Haupt, 2010; Peponis et al., 2008).

[3] For public amenities the following land uses are included: libraries, sport facilities, leisure space, etc; for food services the following land uses are included: cafés, restaurants and groceries.

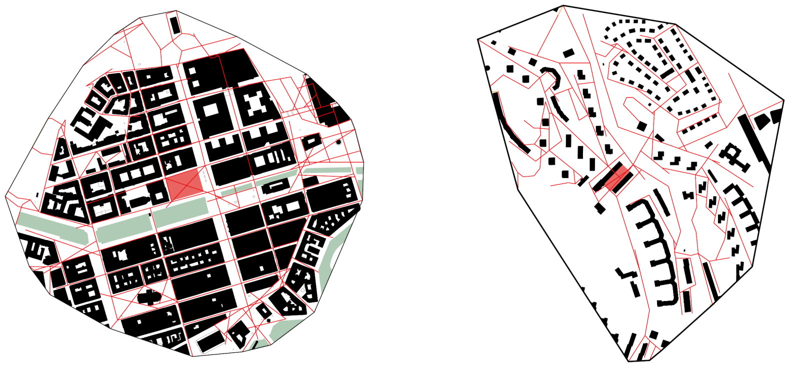

Figure 2. Spatial reach of two squares where the area is drawn using a convex hull based on the end points of the street segments reached within 500m walking distance

Thirdly, three more local urban form analyses were conducted including the size of the square, the enclosure of the square and the average height of the buildings that enclose the square. The size of the square was measured by drawing boundaries for each square, according to Gothenburg aerial map, excluding the adjacent streets. For enclosure, the polygon of the square was used in the measure of enclosure (see figure 3) where the length of the boundary that touched buildings is divided by the total length of the boundary. In cases of a setback, where the buildings do not directly front the square, but have for instance a street dividing them from the square, an offset was used; the offset is set until it cuts through main buildings. In this case, the percentage of the offset boundary cutting through buildings was counted. To capture the vertical dimension of the physical space at the square, the average building height was measured along the boundary of the square or the offset as explained earlier, weighted by the length of the shared perimeter.[4]

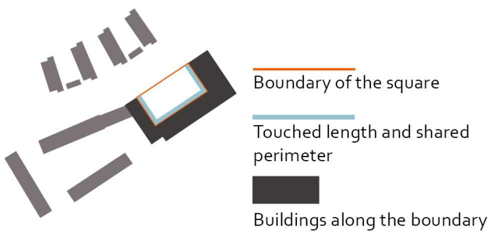

Figure 3. Local urban form analysis

2.4 DATA BASE AND MODEL

The network model used in the study is the hand-drawn axial map (and the segment map is derived from it). The axial map represents the pedestrian network, thus motorways and ferries are excluded. This is the same map as was used in the earlier study (Legeby et al., 2015). The geographical data as well as observation data of three squares, Friskväderstorget, Kyrkbytorget and Kommettorget, also come from the work of Legeby et al. (ibid). New observations were added in 2016. Most of data is on address level except

[4] GIS software MapInfo Pro. 15.0 and the Place Syntax Tool 2.10.7 are used for the spatial analysis.

for the population data, which is aggregated into cells of 100x100m. Analysis of building densities use data of building heights that were extracted from a laser dataset containing a Digital elevation model (DEM) and Digital surface model (DSM).[5] Then, DEM was subtracted from DSM to make a new surface model called Digital height model (DHM) which contains the real height values of the features on the ground. In the final step, building footprints were added and the average height value of each footprint was considered as the height of each buildings.[6]

2.5 STATISTICAL ANALYSIS

In the statistical analysis, we looked for correspondence between the observations (intensity and diversity of people co-present) and the spatial analysis of the 12 squares. Sometimes we divided the data in two groups; on the one hand squares in the city centre (Lilla Torget and Gustav Adolfs Torg) and on the other hand all other squares. We did this because the squares in the centre often stood out from the other squares. They had, in comparison to other squares, an extreme high diversity and intensity of co-presence as can be seen in figure 4. One can almost say that they represent another category, different from the other 10 squares which we from now on will refer to as non-CBD squares. This group should be studied separately from the squares in the centre (from now on referred to as CBD-squares) as some details of the trends in these non-central areas will be hidden because of the dominance of the CBD squares when looking at all of them at the same time. When discussing results, we will both discuss them for all squares and for the non-CBD squares separately.[7]

3. RESULTS

In the following section we will present the results of the observations of people counts (to measure momentary intensity) and the interviews (to measure the share of non-locals), the spatial analysis and the relation between these two. The results of the spatial analysis will be shown starting with the configurative properties, followed by the analysis of accessible population and amenities and lastly the very local geometric properties of the squares. In section 3.3 the relation between the spatial analysis and the amount of people being present at the squares (intensity) is discussed and in section 3.4 with the share of non-locals (indicating diversity).[8]

3.1 OBSERVATIONS

Gustav Adolfs Torg had the most visitors among all squares and Johan Sannes Torg got the least (see table 2). Further, the charts (figure 4) show very clear that two squares have many more visitors and a higher share of non-locals than all the other squares. These are the two central squares we referred to earlier as CBD squares: Gustav Adolfs Torg and Lilla Torget. Gustav Adolfs Torg had a median of 57 people visiting the square on our 4-minute counts. The average for all squares was 19. The share of non-locals is 93% which is very

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[5] Lantmäteriet (https://www.lantmateriet.se/); the average resolution used for the preparation is 2m.

[6] See Berghauser Pont et al., 2017 for extended description.

[7] In statistical analysis SPSS (IBM SPSS Statistics 22) is used.

[8] The overview of all correlation results can be found in appendix 2.

high in comparison to the average of 50%. We discussed these two groups of squares, CBD and non-CBD, already in section 2.4 where we proposed to look at the results of the statistical analysis for all squares and when excluding these two, what we called, CBD-squares.

Observation data

Square	Intensity	Diversity	
	Median of people co-present	Median Distance (m) (distance from home address to the square)	Share of non-locals (living out of 1km)
Brotorget	25	1 143	53%
Doktor Fries Torg	25	864	68%
Friskväderstorget	17	531	28%
Gustav Adolfs Torg	57	4 973	93%
Johan Sannes Torg	2	285	18%
Kaggeledstorget	10	633	45%
Komettorget	18	345	31%
Kyrkbytorget	4	627	39%
Lilla Torget	33	4 950	91%
Masthuggstorget	18	1 064	53%
Radiotorget	4	725	39%
Trätorget	11	742	34%

Table 2. Observations: intensity and diversity

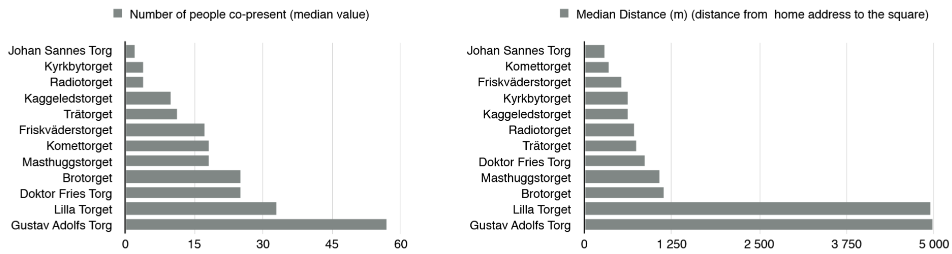

Figure 4Chars with results of intensity and diversity

Besides these values, it is also of interest to consult the maps where the locations of the home addresses are plotted and one can see how these are distributed. Figure 5 shows that for some squares such as Gustav Adolfs Torg, the red dots are spread out over large parts of the city. At Kaggeledstorget, on the other hand, most visitors live in the same or in adjacent neighbourhoods; the dots on the map are more concentrated. In other words, the latter is mainly used by locals and the average distance from home to square is short. If we now again look at the numbers (table 1), we see that 93% of the visitors at Gustav Adolfs Torg are not local (i.e. they live further than 1 km away from the square); Kaggeledstorget on the other hand, is more local, with only 45% non-locals. The lowest share of non-locals is found in Johan Sannes Torg, but here we only had very few people visiting the square which might have affected this outcome. In addition, it is possible to see that the river Göta älv seems to have a barrier effect at many squares as most visitors live at the same side of the river where the square is located. The two inner city squares being the exceptions.

Figure 5a. Maps with the distribution of home addresses (6 squares)

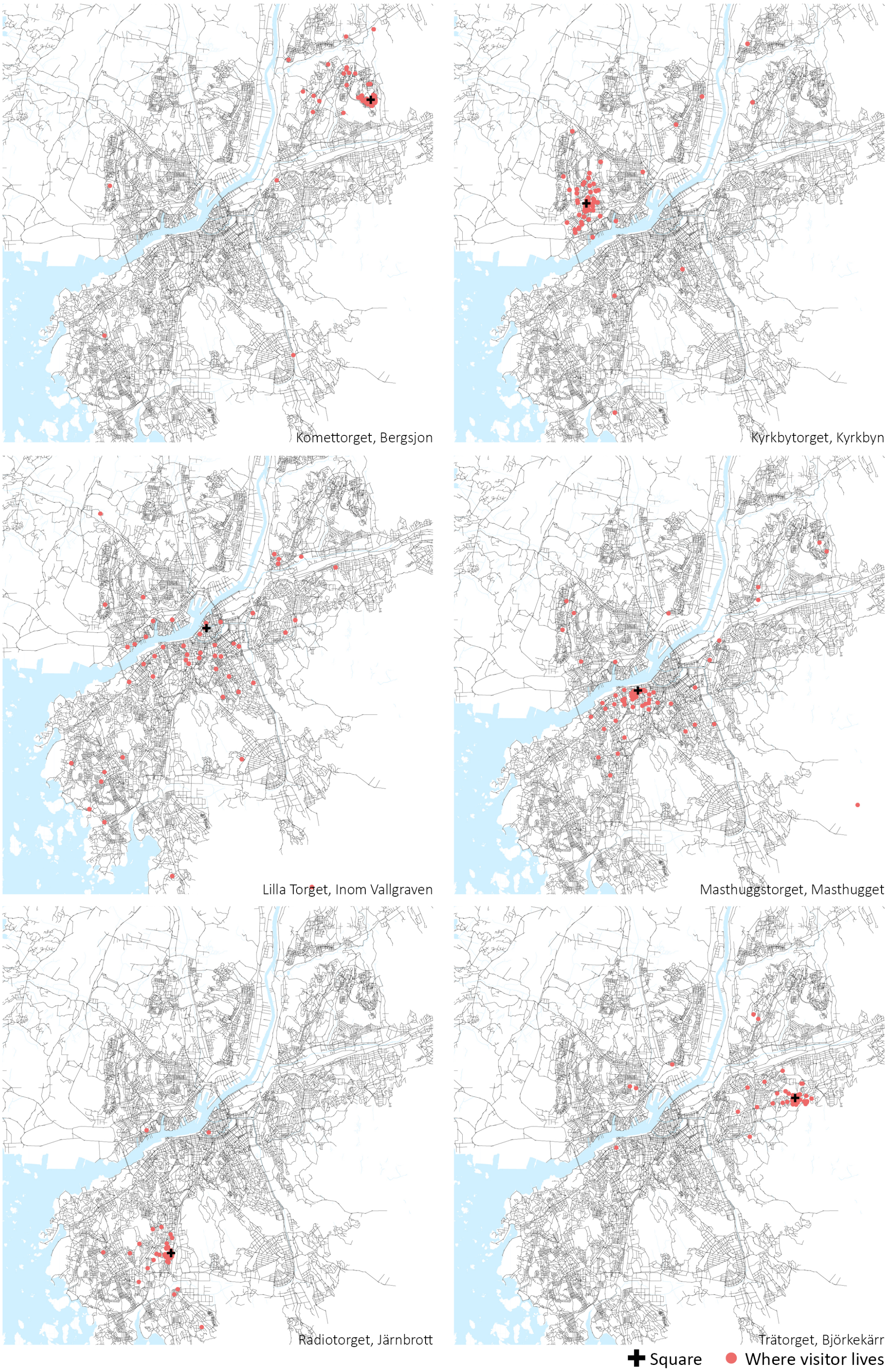

Figure 5b. Maps with the distribution of home addresses (6 squares)

3.2 SPATIAL ANALYSIS

Configurative properties

Integration and betweenness are two measures that describe the configurative properties as well as centrality in cities, properties that have proven to be of great importance for different kinds of processes taking place in cities, not least social processes that are at the core of this paper. The 12 squares studied are located in neighbourhoods with different centralities. The neighbourhoods in the north, for instance Bergsjön where Komettorget is located, are less integrated compared to the neighbourhoods in the south of the Göta River (see figure 6a). When looking at betweenness, we can see that the neighbourhoods in the north are more fragmented with 'islands' of higher betweenness values instead of a continuous path as we see in the south (figure 6b).

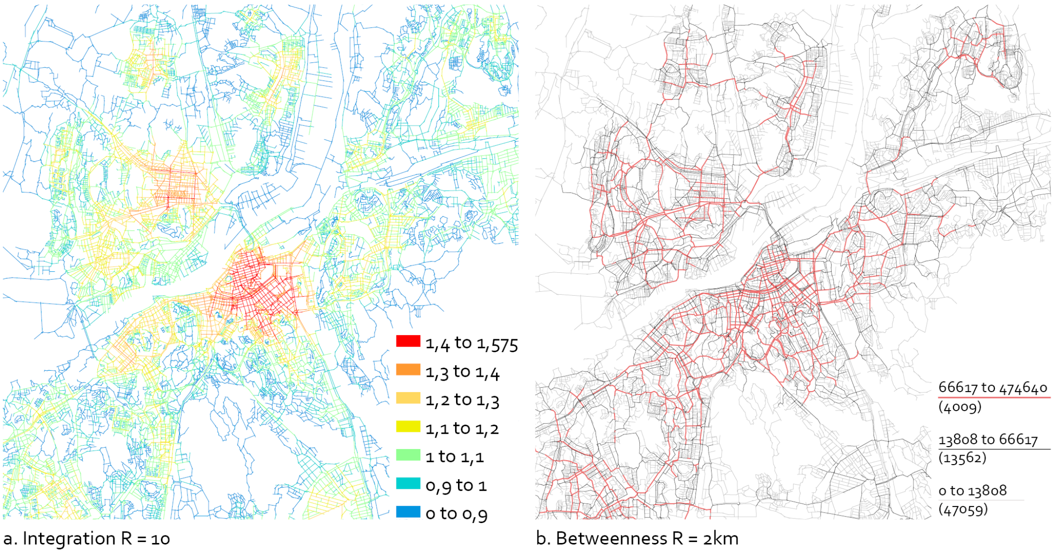

Figure 6. Integration and betweenness maps

Population densities

The areas surrounding the squares cover low, medium and high-density areas, both in terms of accessible working and residential population. If we look at the population accessible within a radius of 500m walking distance, most squares in the modernist neighbourhoods have a rather low working population. The two CBD squares are located in neighbourhoods with a very high working population, but a low residential density (see figure 7a). The highest working population within 500m walking distance is found around Gustav Adolfs Torg with almost 25.000 persons and the least around Johan Sannes Torg with only 150 jobs. Accessible residential populations spreads from 1.379 to 5.144 persons within the same radius of 500m.

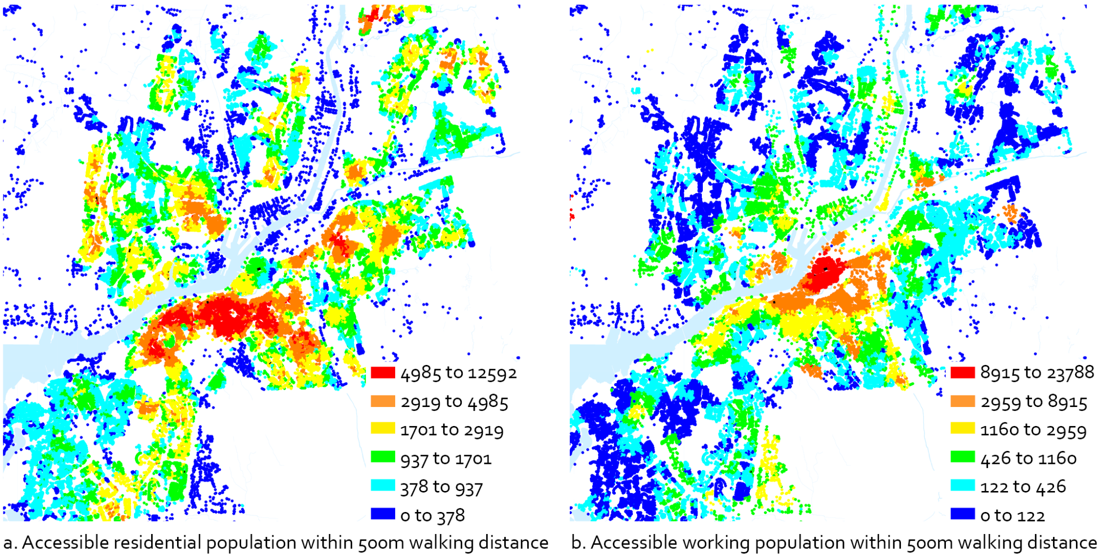

Figure 7. Accessible population in Gothenburg

Proximity to services

CBD squares have access to a much higher amounts of services than the other squares. The non-CBD squares with low numbers of accessible service usually have public transport, public amenities and food service, but only few of each; they have a grocery, a café/bakery, a bus/tram stop, some public amenity, etc., and offer the basic setup for daily life. The biggest variation in the amount of accessible services between squares is found when analysing accessible food services; the difference can be more than 10-fold.

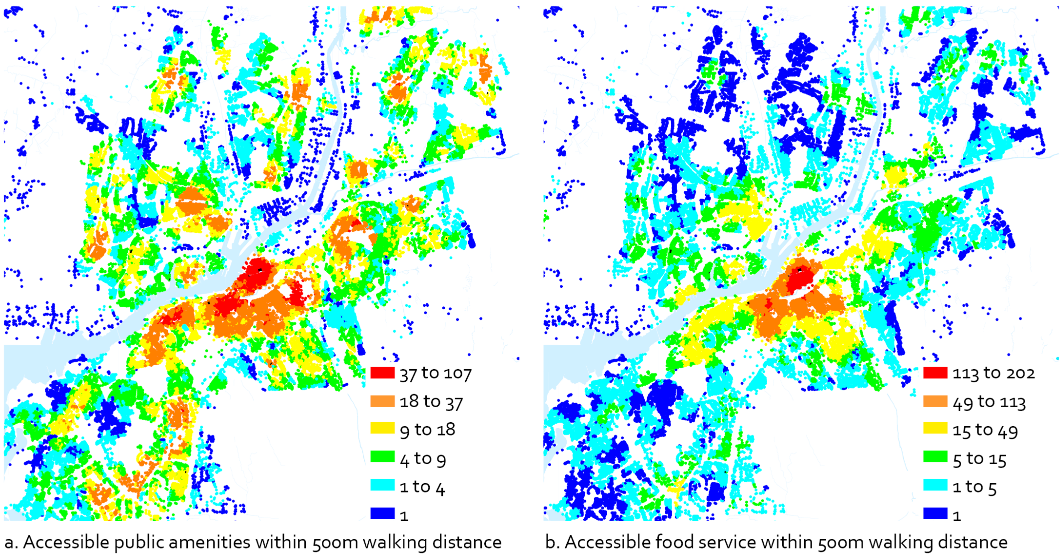

Figure 8. Accessible public amenities and accessible food service

Geometric characteristics of the squares and its surroundings

The built density, measured as volume density, is highly correlated with total population density, but does not distinguish between working and residential population as we will soon see, is of importance. The difference in network density relates directly to the area of reach. Both are higher in the more central areas than in the areas with a more tree-like setup dominant in the suburbs.

3.3 RELATION BETWEEN THE SPATIAL PROPERTIES AND INTENSITY

Configurative properties

The strongest correlation between integration and the amount of people is found at the R4, 6 and 10 and less on both very local (R2) and global scales (R14 and higher) . By taking out the CBD-squares from the analysis, however, no correlation is found. Integration, it seems, is mostly an indicator for the centrality of the squares and explains the difference between the centre and suburbs, but it does not explain the differences between the squares located outside of the city centre (i.e. the non-CBD squares). The correlation between the amount of people and betweenness is found significant at radii 1km and 2km when all squares are included. Here, the correlation is stronger ($r = 0,81$) when the CBD-squares are excluded, at least at radius 1km. In other words, betweenness shows a strong relation with the amount of people both in the non-central areas and when all squares are included; betweenness thus seems to be important for squares in order to be used intensely.

Population densities

A strong correlation is found between population density and the amount of visitors counted at the 12 squares. Noticeably, it is the working population that seems to play an important role, as we did not find correlations when looking at only the residential population. Highest correlations are found at the most local scale, radius 500m ($r = 0,86$). This confirms earlier findings by Legeby (2013) in Stockholm and Södertälje (2010). However, by taking out the two CBD-squares, none of the variables are significant anymore. The huge variation in working population in the city with very high numbers in the centre and very low in the rest of the city can be the reason for these results.

Proximity to services

The correlations with the amount of service found in proximity of the squares are strong when all squares are included. Without CBD-squares, however, no significant correlations are found. This corresponds to the findings we discussed earlier when looking at population density. The presence of many services and high population density seem important for the amount of people using the squares, but differences in the amount of people counted at the non-CBD squares cannot be explained by population density nor by the amount of services found in the vicinity of these squares.

Geometric characteristics of the squares and its surroundings

A higher spatial reach, higher built density and network density on a local scale (radius 500m) is important for the amount of people counted when all squares are included. However, again, as we discussed so many times earlier, when excluding the CBD-squares, no correlations are found. When it comes to the size of squares and enclosure, this is not important at all; not when all squares are included and not when we reduce it to the 10 non-CBD squares.

3.4 RELATION BETWEEN THE SPATIAL PROPERTIES AND DIVERSITY

Configurative properties

Strong correlations are found between integration and diversity for all squares throughout all scales, measured both as share of non-locals and measured as median distance to home address. By taking out the CBD-squares, no correlations are found. For betweenness we find correlations for radius 1km and 2km, but most significant results are found for 2km using the share of non-locals. This result is even found when only looking at the 10 non-CBD squares. In other words, the connections between adjacent neighbourhoods is important in the design of squares if the goal is to have a higher share of non-locals present at these squares. Further, as we discussed in section 3.3 also for the amount of people, betweenness showed a high correlation. Betweenness at 1km and 2km scale thus seem to play an important role in the discussion on co-presence. We will return to this shortly.

Population densities

Population density shows very high correlations with the share of non-locals when all squares are included, and again, as we have seen earlier, the working population is giving higher correlations. The results without the CBD-squares show only correlations at the 2km radius and surprisingly, the residential populations gives the highest correlation ($r = 0{,}65$) when correlating with the share of non-locals. Working population correlates but with a low level of significance (p-value at the 0,1 level). When we, instead of share of non-locals, correlate the median distance to home addresses with population density, the working population gives the highest correlation ($r = 0{,}61$), but again with a low p-value. We might thus conclude that a higher share of non-locals is related to population density in general, but that working population has an important role to play and only increasing the residential population is not enough. In other words, we find here an indication for the importance of mixed neighbourhoods.

Proximity to services

The same trends are found when the share of non-locals is correlated with the proximity and access to public amenities, public transport and food services; strong correlations when all squares are included and none when the CBD-squares are excluded; except for public transport. The amount of public transport stops shows a high correlation when using the share of non-locals ($r = 0{,}81$) and moderate when using the median distance to home addresses ($r = 0{,}63$). The amount of cafés, restaurants and grocery stores (i.e. food services) shows a correlation ($r = 0{,}56$), but with a low significance (only at the 0,10 level) and any conclusion would therefore be highly suggestive. That public transport might play an important role for the share of non-locals is not so surprising and can be related to betweenness where in both cases infrastructure allows for people to visit the area. The presence of public transport allows people from far away to visit the squares and is thus an effective ´door´ to enter the square from neighbourhoods elsewhere in the city.

Geometric characteristics of the squares and its surroundings

Spatial reach is important at radius 500m and a general high volume and network density seems important at all scales. When excluding CBD squares, only accessible volume density at 2km walking distance shows a correlation, but weak and with low significance. However, this confirms our findings for the population densities discussed earlier. When it comes to the size of squares and enclosure, no correlations are found. We can thus conclude that for the share of non-locals, the geometric characteristics do not play a role of importance. This does, however, not say that these characteristics are unimportant. They might be highly relevant for the experience when visiting the square, but this is not the question this paper tries to answer.

4. DISCUSSION AND CONCLUSIONS

From the results of the statistical analysis, we see clearly different patterns of co-presence in the 12 studied squares in Gothenburg. Firstly, the clear difference between the CBD and the non-CBD squares. This is by no means a surprising finding, but for practice and not least for politicians working with urban planning and design, it can be good to be aware of the fact that what you have in the most central areas cannot easily be copied to peripheral areas with less centrality and less density. Adding only density, we have seen, will not do the job. It is the combination of both, that makes central areas and squares crowded. However, when it comes to the amount of non-locals, we found a strong correlation with betweenness at 2km radius. This means that squares that are not so intensely used, still can have a diversity of people visiting them, that is, both local and non-local visitors. In design terms, this means that we need to design the relations between neighbourhoods so that people pass a square in neighbourhood X when moving from neighbourhood Y, via X to Z. This is an important finding as it can in a positive way contribute to solidarity processes, bringing people together (Hanson 2000; Hanson & Zako 2007; Legeby 2013), social interaction and cultural exchange including the negotiations of views and norms (Giddens 1984; Zukin 1995) and can potentially contribute to overcoming social exclusion (Legeby 2013; Young 1996). These findings correspond to the conclusions from the earlier study in Stockholm, Södertälje and Gothenburg allowing us to generalize these findings, at least for Swedish cities.

For all other variables, the huge variation between CBD and non-CBD squares are dominating the more nuanced variations between the non-CBD squares. CBD squares have a much higher centrality (in terms of integration), much higher number of people working, higher network densities, many more amenities, and all this overshadows so to speak the minor variations of these variables in the non-CBD squares. This is the reason these squares were analysed separately.

When analysing the non-CBD squares, only few variables seem to be of importance. For the intensity of people, it is only betweenness at a radius of 1km that correlates. For diversity we found only three important variables (that correlate): betweenness (radius 2km), population density (within walking distance 2km) and the number of public transport stops (walking distance 1km). Thus we can try to conclude that for squares located in less central areas (areas with relative low integration values), betweenness is the key to activate squares. In other words, the importance of spatial conditions is more clearly seen here than in the city, and in order to get a less segregated square, we need to put more emphasis on the configurational design of the square, or, in other words, we need to better connect neighbourhoods to promote through movement. Adding more shops and attractions would probably not change so much and we could even go so far as to say that when spatial interventions are successful, it becomes more probable that new shops will occur as a result of an increase in people visiting the square.

A surprising result is that the amount of accessible jobs (i.e. working population) that was shown to be important in Stockholm and Södertälje when correlated to the share of non-locals does not show similar strong results in Gothenburg. The correlation found in Gothenburg is modest, but with a rather low level of significance. Accessible residential population, though, shows a stronger correlation. This is something that should be looked in more closely in the future.

The pure geometric properties and especially the very local ones such as size of the squares and enclosure did not correlate at all with intensity nor diversity. We can thus conclude that without the support of urban structure, the design of the squares itself cannot drive a more diverse inflow neither have impact on the amount of people present. Instead, we should improve the configurative properties and sometimes dare to invest outside of the square when we want to create a square that can attract larger numbers of non-locals to contribute to solidarity processes and potentially contribute to overcoming social exclusion. This does not imply that the design of the square itself is not important, but this cannot make them more crowded nor more diverse.

The conclusions presented here are based on the empirical data that were collected on weekdays, from 8 o'clock to 18 o'clock. During this time of day, most people show up in public space when they commute to work, have lunch, have coffee break and go home from work. However, the pattern of co-presence on weekends, if we would have the empirical data on weekends, might change the results considering the different purpose and destination of journeys and the flexible time people have to go out in public space during weekends.

Further, it should be stated again that this study is based on only 12 squares, or 10 squares when excluded the two CBD-squares. This is a rather small amount of samples for the correlation analysis. In other words, the reliability of the result relies on the selection of few squares. For the results that confirm earlier findings in Stockholm, Södertälje and Gothenburg, we can be confident that the results are robust. However, those that show discrepancies need to be interpreted cautiously.

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APPENDIX 1

Spatial anlaysis

No.	Square Name	Intensity	Diversity		Integration								
		Median	Median distance (m)	Share of non-locals	R2	R4	R6	R10	R14	R16	R30	R50	R80
A	Brotorget	25	1143	53%	3,832	2,280	1,670	1,116	0,871	0,805	0,494	0,368	0,299
B	Doktor Fries Torg	25	864	68%	3,214	1,821	1,408	1,032	0,825	0,782	0,531	0,359	0,281
C	Friskväderstorget	17	531	28%	4,343	2,351	1,731	1,118	0,897	0,805	0,538	0,324	0,256
D	Gustav Adolfs Torg	57	4973	93%	5,618	2,984	2,273	1,532	1,111	1,000	0,598	0,418	0,338
E	Johan Sannes Torg	2	285	18%	5,000	2,243	1,633	1,088	0,845	0,788	0,497	0,368	0,298
F	Kaggeledstorget	10	633	45%	2,979	1,850	1,476	1,071	0,841	0,757	0,496	0,342	0,269
G	Komettorget	18	345	31%	4,314	1,962	1,354	0,990	0,816	0,733	0,433	0,305	0,216
H	Kyrkbytorget	4	627	39%	4,343	2,349	1,685	1,187	0,972	0,914	0,534	0,353	0,286
I	Lilla Torget	33	4950	91%	5,612	2,990	2,341	1,561	1,147	1,045	0,609	0,420	0,336
J	Masthuggstorget	18	1064	53%	4,614	2,519	1,818	1,375	1,134	1,032	0,603	0,414	0,329
K	Radiotorget	4	725	39%	2,844	1,855	1,413	1,072	0,856	0,782	0,490	0,378	0,271
L	Trätorget	11	742	34%	2,238	1,496	1,256	0,969	0,761	0,693	0,461	0,319	0,237

No.	Betweenness							Local urban form		
	500m	1km	2km	3km	4km	5km	10km	Aare of square(m^2)	Enclosure	Building Height (m)
A	2 531	24 484	99 146	205 338	390 016	717 322	7 060 496	972,09	0,16	18,65
B	1 816	20 958	139 081	327 558	635 205	948 398	3 319 693	1528,80	0,72	10,74
C	1 293	11 196	88 053	181 396	266 970	532 473	2 919 850	3412,67	0,51	20,97
D	1 946	20 413	132 227	334 409	820 984	1 804 979	25 811 712	5992,26	0,46	12,77
E	1 626	8 530	46 590	142 261	274 879	517 880	5 390 028	868,02	0,32	13,12
F	965	7 559	32 363	61 152	101 717	127 773	611 310	803,39	0,68	9,64
G	2 898	18 531	42 822	51 324	65 744	82 810	179 032	1037,88	0,28	4,09
H	1 794	13 752	73 834	321 118	780 492	1 270 309	10 495 914	3903,71	0,43	10,34
I	2 037	13 998	88 634	255 161	475 134	827 787	6 702 697	878,99	0,46	18,25
J	2 922	19 055	135 949	816 033	2 679 993	5 724 079	48 769 192	3151,21	0,50	16,08
K	856	8 879	66 188	133 994	237 578	304 327	740 619	1402,97	0,50	5,39
L	996	4 847	18 636	45 998	64 640	96 576	371 627	603,42	0,68	8,78

No.	Area of reach (m2)			Volume density (m^3/m^2)			Population density (/ha.)			
	500m	1km	2km	500m	1km	2km	Residential 500m	Residential 1km	Residential 2km	Work 500m
A	404862,07	1636891,13	5791637,75	4,14	5,65	5,03	63,82	43,41	29,78	10,84
B	439328,20	1888799,65	7630255,58	8,56	7,72	6,83	64,67	51,89	67,94	6,67
C	444700,56	1859791,41	7436458,00	12,01	6,85	2,94	93,48	70,54	37,76	6,88
D	564251,64	1968385,69	8779722,00	51,27	22,91	12,18	25,95	28,70	50,62	417,40
E	452778,37	1692349,85	6007420,13	3,59	4,54	4,91	53,43	41,46	30,69	3,29
F	500524,33	1587226,13	6694492,25	4,03	3,26	2,92	49,81	39,96	33,78	7,29
G	472824,24	1401514,31	4594404,50	5,27	2,82	2,12	62,24	48,86	27,87	3,57
H	490953,44	2100499,63	8881023,50	3,81	2,56	2,72	41,43	33,66	36,51	3,03
I	541507,34	1776513,67	8321435,17	21,90	24,15	13,84	27,13	32,83	62,85	271,96
J	453036,23	1823597,31	6862329,63	23,55	19,41	14,82	113,55	120,75	83,55	109,17
K	434165,69	1829035,49	7171213,50	2,17	4,06	4,92	31,76	31,92	28,38	11,42
L	352150,82	1540225,00	6076562,50	9,85	4,86	1,81	66,25	39,50	23,36	5,20

No.	Population density (/ha.)					Network density			Public transportation			
	Work 1km	Work2km	Total 500m	Total 1km	Total 2km	500m	1km	2km	Stops 500m	Stops 1km	Stops 2km	Lines 500m
A	17,61	26,12	74,67	61,02	55,90	0,0228	0,0207	0,0190	2	8	25	5
B	23,55	33,94	71,34	75,44	101,88	0,0237	0,0204	0,0188	2	13	36	1
C	3,65	3,85	100,36	74,19	41,61	0,0271	0,0198	0,0161	2	4	16	5
D	232,23	98,90	443,35	260,93	149,52	0,0315	0,0277	0,0187	6	16	50	40
E	15,79	25,29	56,72	57,25	55,97	0,0209	0,0196	0,0196	1	6	24	4
F	6,87	14,24	57,10	46,83	48,02	0,0213	0,0196	0,0150	1	8	30	2
G	6,20	5,06	65,82	55,06	32,93	0,0250	0,0221	0,0155	2	6	20	5
H	5,16	10,37	43,55	38,81	46,88	0,0238	0,0209	0,0188	1	8	32	4
I	225,40	96,23	299,09	258,23	159,07	0,0279	0,0300	0,0201	4	13	47	31
J	58,75	66,93	222,72	179,50	150,48	0,0292	0,0247	0,0224	2	14	37	5
K	17,09	19,00	43,19	49,00	47,38	0,0206	0,0180	0,0151	2	9	25	4
L	3,12	10,63	71,45	42,62	33,99	0,0183	0,0133	0,0112	3	5	12	1

No.	Public amenities			Food service		
	500m	1km	2km	500m	1km	2km
A	4	30	77	5	39	91
B	19	43	176	8	29	283
C	15	34	115	6	14	33
D	94	152	401	162	327	782
E	3	19	82	5	28	95
F	22	38	132	8	20	49
G	18	45	77	3	7	13
H	11	28	131	7	17	91
I	97	165	399	105	339	813
J	35	112	378	58	193	608
K	10	35	158	4	12	60
L	9	21	55	4	8	15

APPENDIX 2

Correlations with 12 squares (including CBD squares)

Correlations

		Integration									Betweenness						
		R2	R4	R6	R10	R14	R16	R30	R50	R80	500m	1km	2km	3km	4km	5km	10km
Intensity_median	Pearson Correlation	.520	,639*	,693*	,678*	.564	.531	.564	.510	.518	.359	,614*	,621*	.248	.171	.196	.344
	Sig. (2-tailed)	.083	.025	.013	.015	.056	.075	.056	.091	.085	.252	.034	.031	.436	.594	.542	.274
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Diversity_median distance	Pearson Correlation	,621*	,777**	,876**	,881**	,746**	,723**	,705*	,719**	,694*	.158	.286	.424	.204	.132	.147	.292
	Sig. (2-tailed)	.031	.003	.000	.000	.005	.008	.010	.008	.012	.625	.368	.169	.525	.683	.649	.356
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Share of non-locals	Pearson Correlation	.422	,627*	,728**	,781**	,686*	,686*	,717**	,724**	,697*	.242	.509	,642*	.365	.273	.264	.350
	Sig. (2-tailed)	.172	.029	.007	.003	.014	.014	.009	.008	.012	.449	.091	.024	.243	.390	.408	.264
	N	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Local urban form			Area of reach			Volume density		
		Area of square	Enclosure	Building height	500m	1km	2km	500m	1km	2km
Intensity_median	Pearson Correlation	.506	-.062	.324	.535	.198	.369	,860**	,759**	,614*
	Sig. (2-tailed)	.093	.849	.304	.073	.537	.238	.000	.004	.034
	N	12	12	12	12	12	12	12	12	12
Diversity_median distance	Pearson Correlation	.392	-.029	.323	,688*	.298	.572	,814**	,870**	,727**
	Sig. (2-tailed)	.207	.928	.306	.013	.346	.052	.001	.000	.007
	N	12	12	12	12	12	12	12	12	12
Share of non-locals	Pearson Correlation	.351	.138	.270	,602*	.359	,591*	,734**	,821**	,758**
	Sig. (2-tailed)	.264	.668	.397	.038	.252	.043	.007	.001	.004
	N	12	12	12	12	12	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Population density									Network density		
		Residential 500m	Residential 1km	Residential 2km	Work 500m	Work 1km	Work 2km	Total 500m	Total 1km	Total 2km	500m	1km	2km
Intensity_median	Pearson Correlation	-.224	-.089	.425	,856**	,818**	,768**	,866**	,800**	,698*	,742**	,697*	.297
	Sig. (2-tailed)	.483	.783	.168	.000	.001	.004	.000	.002	.012	.006	.012	.349
	N	12	12	12	12	12	12	12	12	12	12	12	12
Diversity_median distance	Pearson Correlation	-.510	-.273	.405	,955**	,988**	,904**	,911**	,917**	,785**	,652*	,797**	.332
	Sig. (2-tailed)	.090	.391	.191	.000	.000	.000	.000	.000	.003	.022	.002	.292
	N	12	12	12	12	12	12	12	12	12	12	12	12
Share of non-locals	Pearson Correlation	-.390	-.145	,609*	,836**	,871**	,873**	,810**	,837**	,843**	,627*	,758**	.416
	Sig. (2-tailed)	.211	.653	.035	.001	.000	.000	.001	.001	.001	.029	.004	.179
	N	12	12	12	12	12	12	12	12	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Public transportation				Public amenities			Food sercive		
		Number of stops 500m	Number of stops 1km	Number of stops 2km	Number of lines 500m	500m	1km	2km	500m	1km	2km
Intensity_median	Pearson Correlation	,883**	,686*	,671*	,837**	,806**	,768**	,668*	,846**	,774**	,751**
	Sig. (2-tailed)	.000	.014	.017	.001	.002	.004	.018	.001	.003	.005
	N	12	12	12	12	12	12	12	12	12	12
Diversity_median distance	Pearson Correlation	,881**	,702*	,796**	,970**	,964**	,907**	,810**	,938**	,938**	,876**
	Sig. (2-tailed)	.000	.011	.002	.000	.000	.000	.001	.000	.000	.000
	N	12	12	12	12	12	12	12	12	12	12
Share of non-locals	Pearson Correlation	,766**	,872**	,880**	,802**	,870**	,849**	,815**	,834**	,847**	,868**
	Sig. (2-tailed)	.004	.000	.000	.002	.000	.000	.001	.001	.001	.000
	N	12	12	12	12	12	12	12	12	12	12

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations with 10 squares (excluding CBD squares)

Correlations

		Integration									Betweenness						
		R2	R4	R6	R10	R14	R16	R30	R50	R80	500m	1km	2km	3km	4km	5km	10km
Intensity_median	Pearson Correlation	-.025	.063	.046	.010	.033	.023	.130	-.047	.006	.544	,779**	.596	.250	.190	.190	.150
	Sig. (2-tailed)	.945	.863	.901	.977	.928	.949	.720	.898	.987	.104	.008	.069	.487	.599	.598	.679
	N	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Diversity_median distance	Pearson Correlation	-.281	.124	.238	.439	.400	.419	.468	.567	.538	.256	.526	.624	.559	.529	.514	.494
	Sig. (2-tailed)	.432	.733	.508	.204	.252	.228	.173	.087	.108	.476	.119	.054	.093	.116	.129	.147
	N	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Share of non-locals	Pearson Correlation	-.315	-.056	.011	.232	.237	.288	.405	.414	.385	.259	.627	,703*	.482	.416	.371	.307
	Sig. (2-tailed)	.375	.878	.975	.519	.510	.419	.246	.234	.272	.470	.053	.023	.159	.232	.291	.388
	N	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Local urban form			Area of reach			Volume density		
		Area of square	Enclosure	Building height	500m	1km	2km	500m	1km	2km
Intensity_median	Pearson Correlation	-.039	-.056	.376	-.239	-.186	-.240	.372	.371	.273
	Sig. (2-tailed)	.914	.878	.285	.507	.608	.504	.289	.292	.445
	N	10	10	10	10	10	10	10	10	10
Diversity_median distance	Pearson Correlation	.103	.079	.367	-.375	.210	.186	.415	.562	.571
	Sig. (2-tailed)	.776	.829	.296	.286	.561	.607	.233	.091	.085
	N	10	10	10	10	10	10	10	10	10
Share of non-locals	Pearson Correlation	.050	.315	.085	-.034	.249	.277	.266	.412	.489
	Sig. (2-tailed)	.892	.375	.815	.925	.489	.438	.457	.237	.152
	N	10	10	10	10	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Population density								
		Residential 500m	Residential 1km	Residential 2km	Work 500m	Work 1km	Work 2km	Total 500m	Total 1km	Total 2km
Intensity_median	Pearson Correlation	.541	.391	.421	.198	.276	.269	.372	.365	.362
	Sig. (2-tailed)	.107	.263	.226	.583	.440	.452	.290	.300	.304
	N	10	10	10	10	10	10	10	10	10
Diversity_median distance	Pearson Correlation	.333	.373	.491	.519	.577	.614	.474	.475	.574
	Sig. (2-tailed)	.348	.288	.150	.124	.081	.059	.166	.165	.083
	N	10	10	10	10	10	10	10	10	10
Share of non-locals	Pearson Correlation	.168	.252	,640*	.333	.493	.541	.283	.363	.617
	Sig. (2-tailed)	.643	.483	.046	.347	.147	.106	.427	.303	.057
	N	10	10	10	10	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		Network density			Public transportation				Public amenities			Food sercive		
		500m	1km	2km	Stops 500m	Stops 1km	Stops 2km	Lines 500m	500m	1km	2km	500m	1km	2km
Intensity_median	Pearson Correlation	.446	.327	.206	.456	.322	.127	.028	.308	.330	.154	.183	.237	.314
	Sig. (2-tailed)	.196	.356	.569	.185	.365	.726	.938	.387	.351	.671	.612	.510	.376
	N	10	10	10	10	10	10	10	10	10	10	10	10	10
Diversity_median distance	Pearson Correlation	.189	.160	.315	.372	.631	.414	-.053	.270	.458	.489	.484	.540	.558
	Sig. (2-tailed)	.601	.659	.376	.289	.050	.234	.884	.451	.183	.152	.157	.107	.094
	N	10	10	10	10	10	10	10	10	10	10	10	10	10
Share of non-locals	Pearson Correlation	.223	.297	.335	.165	,813**	,680*	-.316	.443	.433	.488	.346	.372	.557
	Sig. (2-tailed)	.536	.405	.344	.649	.004	.031	.374	.200	.211	.153	.327	.289	.094
	N	10	10	10	10	10	10	10	10	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).