

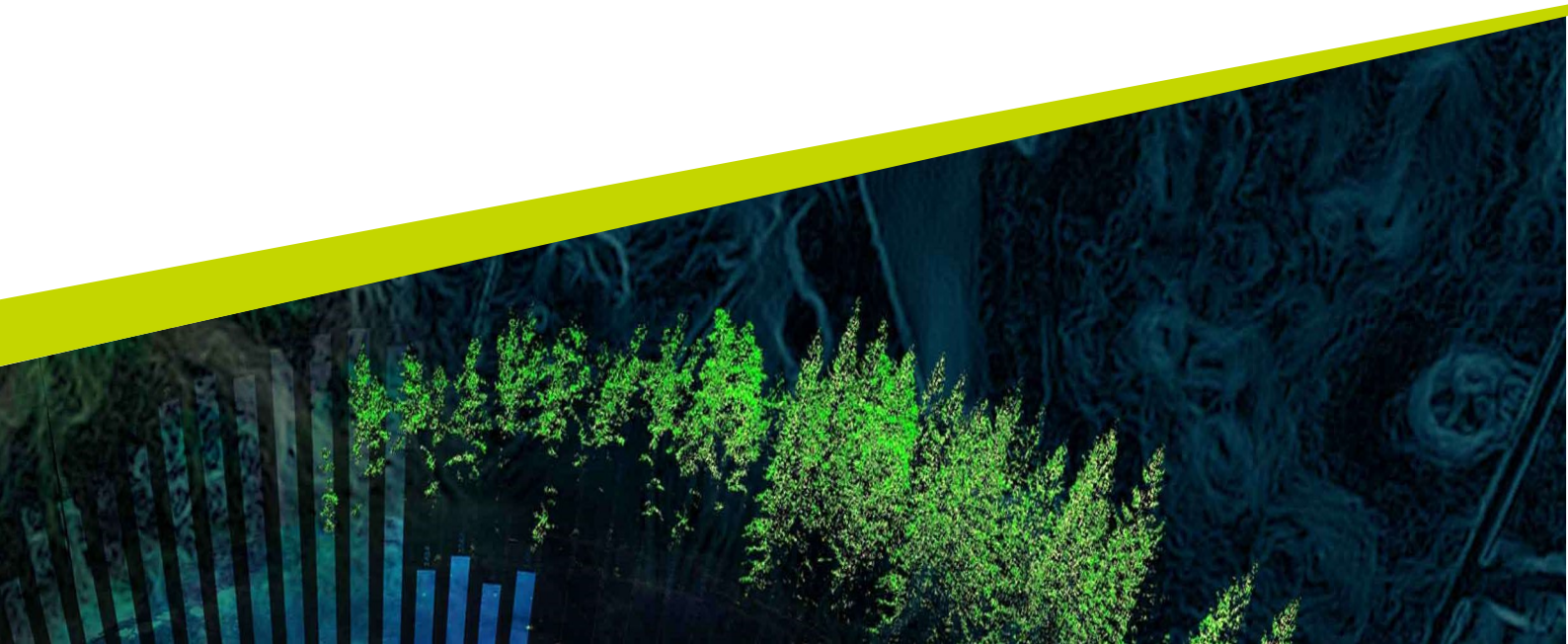


Bridging space syntax and social capital

a participatory approach to analysing the potential of Light Rail Transit to reconfigure spatialised social segregation in Gottsunda

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Abstract

The geographic separation of population groups can perpetuate social inequalities in reaching socio-economic opportunity and can exacerbate social exclusivity. Gottsunda, an area in Uppsala, has experienced historically reinforced spatialised social segregation by concentrating groups with foreign-born and low socio-economic backgrounds within the same neighbourhood. The Uppsala municipality has proposed a light rail transit (LRT) project, which is planned to include Gottsunda. This thesis project will look at the potential of this LRT addition to reconfigure socio-spatial segregation in Gottsunda by analysing changes in the public transport network and mobility behaviour using space syntax and social capital concepts. Space syntax is currently the dominant method of spatially determining segregation, although social capital has the potential to contextualise more complex dynamics driving social segregation. These two methods are also scrutinised based on how they construct complementary findings. By adopting spatial GIS analysis, interviewing people living or working in Gottsunda, and by undertaking participatory mapping exercises, the current state of spatialised social segregation in Gottsunda and the potential for LRT to reconfigure it are determined.

High social cohesion currently limits bridging opportunities for population groups living in Gottsunda, resulting in a reinforced division between the neighbourhood and the rest of the city. A strong neighbourhood identity and concentrations of people with similar socio-economic backgrounds, risking homophily, are not balanced by the relatively well-integrated public transport network in the neighbourhood. The LRT introduction has the potential of bridging communities and facilitating co-presence of dissimilar population groups due to improved integration and the potential for inter-city travel. The LRT line does not address non-spatial barriers to integration, however, such as the affordability of public transport and a lack of ownership of lower-income groups in urban decision-making. Investments in public transport affordability, cultural activity diversification, and policies promoting socially inclusive participation are central to overcoming spatialised social segregation. This study also demonstrates that space syntax can complement social capital in understanding spatialised social segregation, although it cannot account for social complexities and non-spatial barriers to accessibility, such as homophily and affordability. Both concepts can spatially or socially contextualise each other but new methods are needed to investigate missing conceptual links to account for the complexities of spatialised social segregation.

Keywords: public transport, spatialised social segregation, social capital, space syntax, participatory mapping, co-presence

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Abbreviations

DeSO	Demografiska statistikområden
GIS	Geographical Information Systems
LRT	Light Rail Transit
PT	Public transport
TIG	Transit-induced gentrification
TOD	Transit-oriented development

Popular science summary

Social segregation, the unequal access to benefitting from socio-economic opportunity, can be reinforced by the geographical separation of population groups. Population groups may be concentrated in neighbourhoods with less reachable employment, education, or public transport, which can perpetuate social inequalities and exclude other groups from parts of a city. Gottsunda, a neighbourhood in Uppsala, is subject to a historical pattern of concentrating population groups with foreign-born and low-income households.

A proposed light rail transit project will include Gottsunda, which may counter urban segregation. This thesis aims to examine how the addition of the light rail line can reconfigure the social and spatial integration in Gottsunda. It does so through a multi-method approach. First, the current state of social segregation is studied through interviews and mapping exercises with people living or working in Gottsunda. Second, spatial segregation will be quantified using spatial network analysis to determine the integration of streets in the public transport network before and after the introduction of the light rail line. Comparing the social and spatial aspects of segregation determines the integrative qualities of public transport but also shows overlap and shortcomings between the two methods of analysing segregation.

The findings from this data collection process indicate that concentrated social connections within similar geographic or socio-economic boundaries reinforce segregation in Gottsunda, which limits opportunities for certain population groups. The integrative capacity of the public transport network cannot balance out the strong neighbourhood identity and social connections within similar population groups. While the introduction of the light rail transit system has some potential to bridge different groups and facilitate coexistence by improving integration and enabling intercity travel, the project overlooks barriers that cannot be solved in spatial urban planning, such as the affordability of public transportation and a lack of community involvement in urban decision-making. Current decision-making processes in the community risk leaving out the participation of lower-income groups, making it a critical issue that urban planners must address. To counteract processes of social and spatial segregation, this thesis suggests that it is crucial to invest in affordable transportation, diversify cultural activities and to implement policies that promote participation and socio-economic inclusivity. This study demonstrates how spatial analysis can be complemented by social integration analysis, although contextualised information requires balancing both methods. Additional research methods are necessary to explore the missing links and account for the complexities of social segregation based on spatial factors.

1. Introduction

Spatialised social segregation, the unequal spatial distribution of various population groups, can substantially hinder groups from accessing goods and services (Cruz-Sandoval *et al.*, 2020). Public transport (PT) plays a major role in constituting spatial integration, i.e., the interaction of opportunity between areas, which correlates with social groups' capabilities to reach socio-economic opportunities, such as employment, education, and social connections (Derakhti & Baeten, 2020). Its capabilities of fostering integration can be crucial in reaching goals 10 and 11 (reduced inequalities and sustainable cities and communities, respectively) of the UN's Sustainable Development Goals, as they explicitly focus on reducing inequalities in reaching urban goods and services through resource-efficient transport. The ability to provide access to socio-economic opportunities has a pivotal role in reaching social and environmental sustainability in urban spaces.

Swedish cities belong to the most segregated urban areas in Europe (Thörn & Thörn, 2018). The Million Programme, an urban expansion project in the 1960s that relied heavily on functional separation, has been noted as the origin of many neighbourhoods currently facing processes of segregation (Koch *et al.*, 2019). Gottsunda, a neighbourhood in Uppsala, is one of those Million Programme neighbourhoods. Uppsala Municipality has proposed a light rail transit (LRT) line to improve its PT network (Uppsala Kommun & Uppsala Region, 2021). Although the construction mainly aims to enhance the capacity of the PT network to anticipate population growth, the suggested line distinctly includes a line and stops in Gottsunda, implying it could impact the spatial integration of the neighbourhood.

Many studies have addressed the spatially integrative capacity of transit-oriented development (TOD), i.e., a planning strategy aiming for compact and mixed land-use with high walking and PT accessibility, by focusing on how urban form influences human behaviour (Legeby, 2010; Morales *et al.*, 2019; Derakhti & Baeten, 2020). This spatially deterministic view is often claimed to be too reductionist for interpreting complex urban systems, which is why authors advocate for adopting more contextual, social, and participatory tools (Schnell *et al.*, 2015; Pafka *et al.*, 2018; Yao *et al.*, 2019). Issues like neighbourhood identity, co-presence potential, and gentrification may be predicted using spatial methods but need to be socio-spatially considered when analysing the integrative capabilities of TOD in a neighbourhood (Marcus & Legeby, 2012; Tehrani *et al.*, 2019; Derakhti

& Beaten, 2020). Similarly, the impacts of integration are not only spatial but involve social neighbourhood dynamics, an issue within and between communities.

1.1 Research Objectives

The potential of the LRT line to affect socio-spatial inequalities was explored by analysing the differences in the PT network and people's before and after the project's induction. This was done by adopting a qualitative interview study to determine social capital and with spatially deterministic analysis relating to space syntax. This mixed methods approach enabled scrutinising the potential of socio-spatial participatory integration research to complement traditional urban network analysis to further analysis on spatialised social segregation. This twofold objective allows for the following research question and sub-questions to be central to this thesis:

What is the potential of public light rail transit to reconfigure spatialised social segregation within and between neighbourhoods?

1. How can changes in the public transport network alter Gottsunda's socio-spatial integration and how will this change mobility behaviour?
2. How can traditional spatially deterministic analysis of be complemented by social participatory research to better understand the complexity of spatialised social segregation?

As the focus of this study is on Gottsunda, other neighbourhoods in Uppsala will be considered, be it to a lesser degree. Also, the study focuses on PT, which allows the study to fixate less on other modalities contributing to the urban mobility network, like active and private motorised vehicular transport, and other elements in the built environment, like urban green space and architectural features. As the LRT line has not been realised at the time of writing, the prospect of changes of the future PT network and human behaviour will be anticipated but cannot be fully ascertained.

The background in chapter 2 will delve deeper into understanding spatialised social segregation and theories of integration and mobility. Chapter 3 will focus on how space syntax and social capital are operationalised to gather data, which will be followed by findings presented in chapter 4. Chapter 5 will discuss the implications of these findings related to major theories and main takeaway points will be presented as conclusions in chapter 6.

2. Background

2.1 Spatialised Social Segregation

Urban segregation is a complex issue that is affected by social and spatial inequalities. Segregation structurally reinforces these social and spatial inequalities and can hinder social integration within and between neighbourhoods (Morales *et al.*, 2019). Social integration, considered the opposite of segregation, reduces inequalities in reaching socio-economic opportunities and social connections, and realises a shared sense of connectedness of dissimilar population groups (Schnell *et al.*, 2015). Traditionally, segregation has been analysed by mapping and analysing the spatial distribution of various socio-economic groups, based on income, ethnic background, or forms of tenancy (Vaughan & Arbaci, 2011; Morales *et al.*, 2019). Analysis becomes more complex if we want to account for the inherent complexity of socio-spatial segregation, however.

The spatial inequalities of reaching opportunities in urban segregation ensure that social integration becomes a matter of equal accessibility. Accessibility is determined by the interaction of location-based land-use and utility-based ways of reachability (Geurs & van Wee, 2004). Essentially, accessibility is determined by the spatially distributive supply and the needs-based demand of destination-based opportunities, such as employment, commercial, and social activities. The differences in proximity to urban opportunities create disparities among different social groups (Bittencourt *et al.*, 2021). Groups with higher socio-economic status tend to have better accessibility to jobs and social opportunities. This uneven distribution of resources reinforces the spatial intensification of marginalised communities (Legeby, 2009). This way, a lack of socio-economic opportunities can be perpetuated in historically socio-spatially segregated areas.

A major strategy to counteract spatialised segregation is to develop the potential of co-presence within a certain urban space. Co-presence takes place when people from different population groups are present at the same time and space (Legeby, 2013). The intentional design of urban spaces can foster social interaction based on a diversity of destinations. This can break down physical and social barriers between communities and can therefore have a pivotal role in fostering social integration. Co-presence is accommodated by diversity and temporal coexistence,

which are heavily related to mobility routines, such as reaching workplaces or leisure activities (Li *et al.*, 2022). Social exposure to different groups is the foundation of countering social fragmentation and connecting certain groups more with global society (Morales *et al.*, 2019). Public spaces, which are openly accessible areas without any major barriers to all population groups, are particularly important for co-presence. These spaces, such as roads, squares, and parks, allow for spontaneous contact and for population groups to meet (Gehl, 2011). Similarly, behaviour in public spaces can express and shape collective neighbourhood identities (Dixon *et al.*, 2022). A lack of opportunities of interacting in public spaces adds to spatialised segregation within urban areas, as it reinforces unequal access to social exposure (Rokem & Vaughan, 2019). The provision of public spaces and their potential of fostering co-presence can, therefore, mitigate processes of spatialised social segregation.

PT is inherently linked to accessibility, co-presence, and segregation. Accessibility depends on transportation, as it determines how easily the distance between origin and destination can be bridged (Geurs & van Wee, 2004). PT can increase accessibility by lowering the barrier to reaching socio-economic opportunities. Distributing spatial accessibility is especially constructive for providing the means of reaching these opportunities for lower-income population groups, if PT is affordable (Guzman & Oviedo, 2018). The affordability of transport generally constitutes non-spatial barriers to accessibility to mobility and to reaching opportunities. PT infrastructure contributes to bridging barriers established by land-use that currently constrains the potential for co-presence (Rokem & Vaughan, 2019). PT itself can be considered a public space where co-presence can occur, widening its potential for social exposure (Currie & Stanley, 2006). Therefore, comprehensive PT infrastructure is crucial for establishing inclusive and integrated cities by creating co-presence and equitable access to socio-economic opportunities.

2.2 Socio-spatial segregation in Sweden/Uppsala

Sweden has struggled with segregation in urban areas significantly compared to other European countries. Thörn & Thörn (2018) link this development with the Million Programme housing plan (Miljonprogrammet), which entailed the construction of a million dwellings over a 10-year period. Although the program focused on a variety of housing types, many neighbourhoods during this program currently experience the highest amount of ethnic and economic segregation in Sweden. After relative neglect of public investment in recent decades, higher-income groups have slowly left these areas for station communities and urban centres, concentrating lower-income groups within these neighbourhoods (Tunström *et al.*, 2016). Dwellings in these areas have been renovated in recent

years, which increased the risks of decreasing affordability of areas which are currently mainly inhabited by lower-income groups. Increased laissez-faire housing policies have enabled private actors to intensify business activity and to increase housing prices in certain areas, making dwellings less affordable (Thörn & Thörn, 2018). Flourishing urban centres attract new investors and higher-income dwellers, which threatens lower-income groups to be displaced to segregated neighbourhoods. Arguably, a combination of these phenomena has shaped the socio-spatial inequalities in Swedish cities.

Akin to many Swedish cities, Uppsala has had a major transformation during the Million Program (Miljonprogrammet), where areas like Gottsunda, Gränby and Flogsta saw major construction. All three areas are currently showing signs of spatialised social segregation and are described as ‘utsatta områden’ (vulnerable areas) by the national police (Koch *et al.*, 2019). Gottsunda is representative of the so-called SCAFT planning principle, which relies heavily on spatial function and mobility separation, having its own economic centre around which clusters of green spaces and housing are occupied. As seen in figure 1, Gottsunda is experiencing lower average incomes, as well as some of the highest ratios of foreign-born individuals compared to the overall population. Similarly, Gränby and Flogsta (see figure 1) exhibit higher foreign-born ratios, which shows that the Million Program concentrated people with similar socio-economic backgrounds in these neighbourhoods. Gottsunda, despite having relatively extensive coverage of PT opportunities, is still poorly connected to more central economic centres and has few public spaces where people from different socio-economic backgrounds can meet (Legeby & Feng, 2022). An exclusion to access certain parts of the city can hinder economic progress within a neighbourhood’s population.

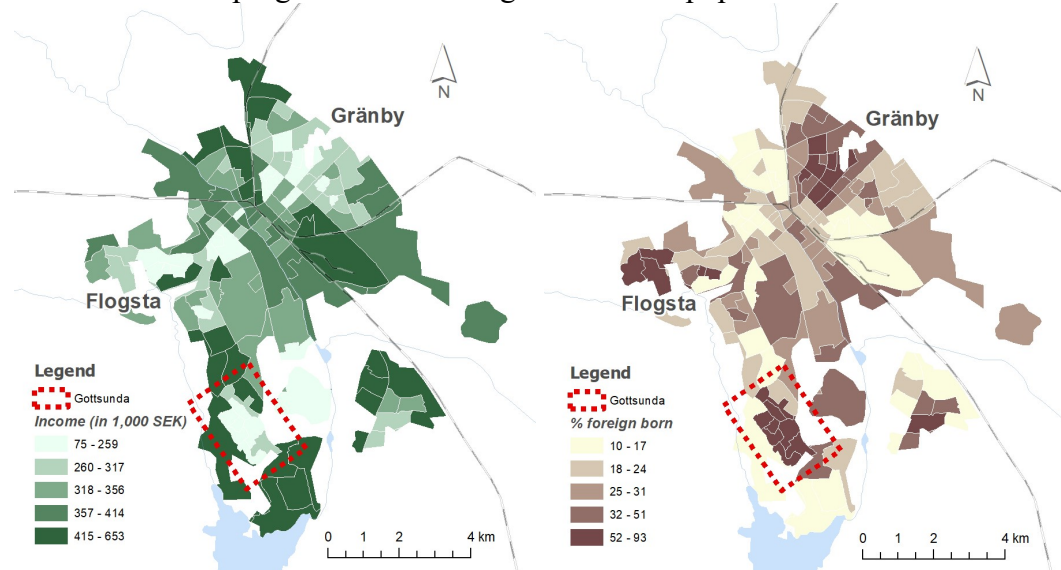


Figure 1. Mean total earned income per neighbourhood in Uppsala (left) and %foreign born to overall population per neighbourhood in Uppsala (right).

Uppsala Municipality has proposed a light rail transit (LRT) addition to the PT network to account for projected population growth and to reduce car dependency and, subsequently, reduce greenhouse gas emissions (Uppsala Kommun & Region Uppsala, 2021). This line is planned to be completed in 2029. LRT is a passenger urban transport mode that has similar characteristics to a tram but does not necessarily have to traverse on tracks in public streets. The line will be constructed largely alongside sections of the existing motorised vehicular transport network (black in figure 2), although some lines will be constructed completely from the ground up (red in figure 2), providing new between-neighbourhood connections. The proposed route notably includes Gottsunda (see figure 2) rather than including the northern part of the city. The municipality, region, and the Swedish Transport Administration have made a preliminary decision to start the construction process of the line under the condition that state-allocated funds will co-finance the project (Uppsala Kommun, 2021). The 2022 municipal election has changed political support for the project, however, which might result in a referendum acting as a final decision in 2024 (UNT, 2023).

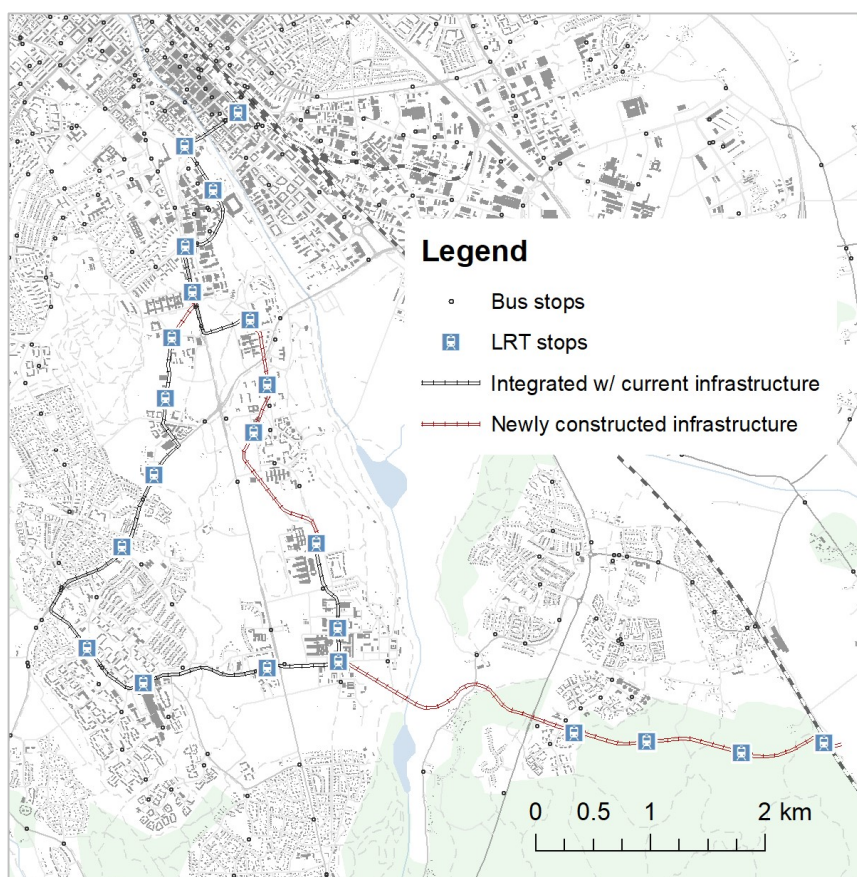


Figure 2. Spatial outline of the proposed LRT line and stops in Uppsala. Note: lines in red will be constructed from the ground up, whereas other lines will be integrated into the current transport infrastructure.

2.3 Determining Segregation through Urban Fabric

Predicting impacts of transport extensions in urban planning is often associated with a deterministic or probabilistic view of the relation between human behaviour and urban fabric, the spatial and physical characteristics of an urban area. This view of mutual constructiveness between society and space acknowledges that the configuration of a street network is related to movement patterns, which are in turn determined by the integration and connectivity of urban fabric (Hillier & Hanson, 1984). Similarly, social perceptions are shaped by the urban fabric but social actors living and traversing through physical space in turn influence the urban fabric. The interdependent relation between the urban fabric and human behaviour can be explained by Lefebvre's (1996) notion of how 'rhythms of the city', i.e., one's habitual activities in the physical environment are enabled by urban space and movement networks. These rhythms enable or constrain people and groups to meet spontaneously because of similar movement routines. Barriers to mobility risk invalidate these rhythms and disallow opportunities for people to organically cross paths (Legeby, 2010). By considering these barriers, a spatially deterministic view connects social inequalities and co-presence potential to the urban fabric.

2.3.1 Space Syntax

Space syntax is a set of theories and techniques based on this spatially deterministic mindset that enables network analysis of urban infrastructure. Transport networks are based on street distribution and symmetry, which define how integrated a street is within a network and can be visualised in cartographic representation (Hillier & Hanson, 1984; Yamu *et al.*, 2021). Although the relation between land-use and movement patterns is determined by mathematical modelling, empirical evidence has supported the predictive capacity of the integration of streets and the intensity of movement in certain areas (Hillier & Vaughan, 2007). This approach illustrates how spatialised social segregation is produced and reproduced by urban fabric by illustrating one's movement potential, inequalities in accessibility, and the possibilities of co-presence (Legeby, 2009). By determining co-presence through movement patterns, space syntax can help in understanding the dynamics of spatialised social segregation.

Space syntax quantifies and visualises to-movement and through-movement to determine how integrated a road network system is. To-movement refers to the potential to reach a destination from all other points within a system, whereas through-movement refers to how likely it is for one to pass through certain spaces in the urban fabric (Hillier & Hanson, 1984; Yamu *et al.*, 2021). This can be done for the infrastructural network of each type of transport modality, i.e., the means to travel, e.g., car, PT, or active transport. Through-movement implies how often a road segment is expected to be used by people travelling through them compared

to other roads. Angular choice is a metric that determines through-movement, which is integral to visualising how important a street is in providing integration and connectivity (Yamu *et al.*, 2021). Although these metrics leave out information to consider a complex mobility system, axial integration and angular choice are the most common metrics to illustrate to-movement and through-movement in mobility networks.

2.3.2 Social Capital

Space syntax and spatially deterministic analysis can be suitable for simplifying movement potential in networks but lacks contextual information to determine social phenomena like spatialised social segregation (Vaughan & Arbaci, 2011; Pafka *et al.*, 2018). To consider social context, a multi-dimensional approach is needed to represent the complexity of mobility behaviour and reaching socio-economic opportunity in urban systems (Andersen, 2003; Vaughan & Arbaci, 2011). Marcus & Legeby (2012) echo this notion by stating that considering urban space as a complex system is well established within academia but is infrequently accounted for in practice. Individual mobility behaviour, which is driven by complex feelings of at-homeness and identity, highlights the complexity of understanding co-presence potential and underlines the importance of including social facets in integrated segregation metrics (Dixon *et al.*, 2012; Schnell *et al.*, 2015). An appropriate approach to relating space syntax metrics to the overtly social topic of residential segregation, therefore, requires human-centric complementary information to represent actors affected by urban planning.

Neighbourhood identity, accessibility, and social integration are part of the overarching concept of social capital. The term ‘social capital’ was coined by Bourdieu (1986) who aimed to quantify the potential of societal resources to institutionalise relations within and between social groups. In socio-spatial studies, social capital is seen as the enabling factor of a society or a sub-section of a society to function effectively through networks and relationships of people to accommodate a common purpose (Claridge, 2018). Although it is not straightforward to quantify, it is fundamental for building a community and shared values of a neighbourhood. It enables collective action built on communal trust and cooperation and can therefore counter social segregation.

Theories of the societal embeddedness of social ties *within*, *between*, and *across* groups have been constructed since the 1970s. Granovetter (1970) specifically focused on this triality in understanding social networks. Building on Granovetter and Bourdieu, Aldrich (2012) popularised the distinction of *bonding*, *bridging*, and *linking* being the main determinants for creating social capital. *Bonding* refers to connections within a group with similar demographic characteristics, whereas *bridging* refers to relations between communities. *Linking* could be seen as a type

of *bridging* that connects more abstract barriers between ‘vertical networks’ (Claridge, 2018), i.e., between citizens and formal institutions or between groups with differing socio-economic status. This triality of *bonding*, *bridging*, and *linking* will be the main way to deconstruct social capital in this research paper.

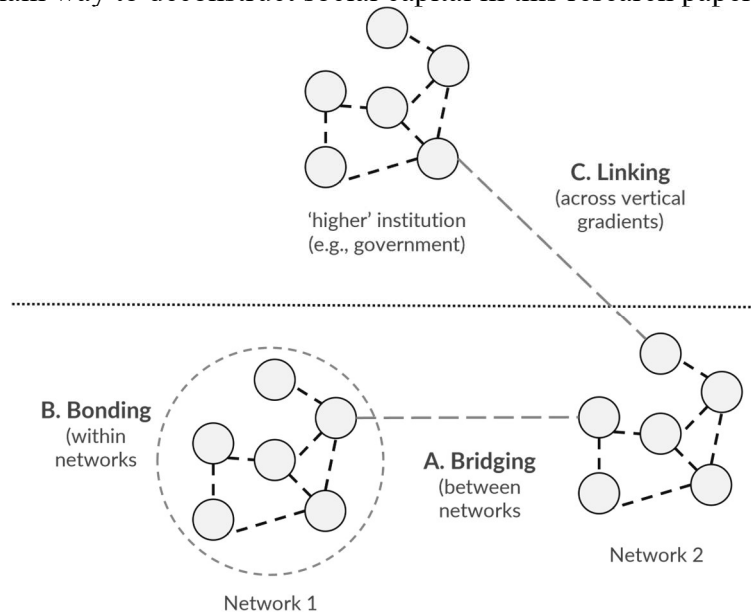


Figure 3. Social capital and the relation between bonding, bridging, and linking (Aldrich, 2012).

Bonding and *bridging* are the most commonly adopted measures for determining social capital in PT studies (Gray, 2006; Marcus & Legeby, 2012; Tahlyan *et al.*, 2022). *Bonding* is based on the homogeneity of groups in terms of demographic characteristics and shared values (Patulny & Svendsen, 2007). *Bonding* constitutes neighbourhood identity, which is fostered by within-group cohesion, trust, and a sense of belonging. It mainly fulfils social functions such as social connectedness and satisfaction with living in a certain place (Claridge, 2018). *Bridging*, on the other hand, refers to the ability to connect different population groups and is most directly linked to spatial functions, like the accessibility and reachability of socio-economic opportunities. *Bridging* is connected to segregation, as it constitutes the potential of groups to overcome barriers that would otherwise reinforce spatial inequalities (Legeby, 2013).

Bonding and *bridging* constitute the likelihood of co-presence to occur, as they influence one’s routine mobility behaviour and the possibilities of reaching certain places (Marcus & Legeby, 2012). Co-presence connects space syntax theories to social capital theories, as it links individuals’ spatial and social conditions. Understanding a neighbourhood’s social capital by determining co-presence potential with space syntax, therefore, help to understand processes of spatialised social segregation in a neighbourhood.

Bonding and *bridging* tend to counteract each other. A lack of *bridging* keeps people within similar population groups, thus reinforcing *bonding*. Excessive

bonding prevents people from seeking inclusive shared spaces, which inhibits *bridging* and co-presence to occur. This concentration of similar socio-spatial social groupings is a process referred to as homophily and can be detrimental to an area's integrative capacity (Neal, 2015; Xu *et al.*, 2019). Homophily promotes physical and social fragmentation of certain social groups if *bonding* is strengthened without being balanced by *bridging* (Morales *et al.*, 2019). Similarly, socially exclusionary place identities, like zoning areas for specific population groups or commercial activities, can restrict people, who are otherwise equally spatially proximate, from reaching public spaces, which reinstates processes of homophily (Dixon *et al.*, 2022). Overall, communities with diverse community identities, as well as high *bonding* and *bridging* social capital, have lower socio-spatial segregation.

2.3.3 Interplay between Light Rail Transit, space syntax, & social capital

The ability of PT to enable co-presence is directly associated with social capital, space syntax, and spatialised social segregation. PT facilitates social integration by bridging population groups with improved accessibility (Neal, 2015). It connects the urban fabric to behavioural relations, as co-presence is the most visible result of exercising one's mobility routines (Marcus & Legeby, 2013). The spatial integration of PT networks, which can be determined by space syntax analysis, can therefore be a determinant of constituting *bridging* opportunities between neighbourhoods. More nuanced and abstract *bonding* dynamics are harder to determine with spatial metrics alone. PT, TOD, and mobility networks are claimed to be enablers for various socio-economic benefits in disadvantaged communities, like greater communal trust, improved social networks, and higher incomes (Currie & Stanley, 2006). PT-induced accessibility is often seen as a pivotal strategy for mitigating residential segregation within a neighbourhood by bridging accessibility gaps in reaching other communities or general goods and services (Gray *et al.*, 2006; Kaplan *et al.*, 2014; Derakhti & Baeten, 2020). Improving mobility generally tends to reduce the risk of social exclusion by increasing activity in public spaces and generally improving societal participation (Derakhti & Baeten, 2020). PT-induced mobility, therefore, has a pivotal position in enabling urban regenerative processes by equalising access to services and diminishing the accessibility-based opportunity gaps among people with different socio-economic backgrounds.

Increased connectivity by PT improvement poses a paradoxical effect on livelihood affordability. It has the possibility of making transportation more affordable for lower-income groups, as reliance on private vehicular transport and car ownership decreases barriers to accessibility, resulting in greater *bridging* potential (Dehrakhti & Baeten, 2020). Street networks prioritising cars generally undermine social connections and, therefore, impose on *bonding* and *bridging* (Gray *et al.*, 2006). TOD can therefore equalise accessibility and *bridging* if PT

affordability is adequately considered (Currie & Stanley, 2008). Contrastingly, proximity to rail stations positively correlates with higher property values, which decreases housing affordability for lower-income residents, which can alter *bonding* due to neighbourhood change (Dawkins & Moeckel, 2016). However, Padeiro *et al.* (2019) found that housing prices are more directly influenced by the built environment and policy rather than just PT accessibility. These complex dynamics between affordability and accessibility make it difficult to determine a direct relation, though it does signify how transit provision can inherently build or impose on *bonding* capital.

TOD occasionally neglects the needs of the local population, which limits the socio-economic integration of a neighbourhood (Derakhti & Baeten, 2020). The strong relation between TOD and improved mobility and the risk of increased spatialised segregation are heightened due to transit-induced gentrification (TIG). This process takes shape by displacement; a process where middle-to-higher income gentrifiers increasingly move into an area, which causes housing to become increasingly unaffordable, making it harder for lower-income inhabitants to live in (Rérat & Lees, 2011). This process could be relatively long-term—even intergenerational—if it is based on imposed moving-in opportunities but could be more rapid when involving higher rent prices or construction of higher-income dwellings. LRT has specifically been linked to TIG, making it an unwelcome by-product of enhanced accessibility (Tehrani *et al.*, 2019). A lack of public spaces can increase homophily in gentrifying places, due to the lack of *bridging* capabilities between groups with varying socio-economic backgrounds. Furthermore, it can harm a sense of belonging, which harms a community's *bonding* social capital. In conclusion, existing research suggests that PT and TOD have a complicated relation with social capital. Although its initial improvements in *bridging* can foster co-presence, its potential to advance processes of gentrification can limit *bonding* capital and limits accessibility to opportunities.

2.3.4 Participatory Planning & Mapping

Out of the three components of social capital, *linking* is discussed the least in literature. The *linking* of vertical networks can be vital for social cohesion within urban areas (Poortinga, 2012). As it is often characterised as political participation, local participatory planning and decision-making increase *linking* in neighbourhoods. This effect reinforces both *bridging* and *linking* capital, as people with better access to voluntary associations and dissimilar population groups tend to organise themselves and are more involved in local decision-making processes (Teorell, 2003). *Linking* can address power relations in neighbourhood planning, which can also result in *bonding*, as community engagement improves (Menzel *et al.*, 2013). The full relation between participation and institutional trust is not fully

understood, though *linking* and the quality of participation are heavily reliant on initial trust.

Nevertheless, citizen participation can be pivotal in addressing power structures and in improving socio-spatial integration. Who is given access to socio-economic opportunities due to spatial configuration is inherently a question of the distribution of power within a city, as relative accessibility of one population group comes at the expense of that of another (Koch *et al.*, 2019). Although this signifies differences in bargaining power between population groups, participation tends to address the role of citizens in decision-making to planners and policymakers (Carmona, 2010). The amount of control citizens have over decision-making fundamentally determines the degree of citizen participation in urban planning. Arnstein (1969) distinguishes participation into three groups: non-participation, tokenism, and citizen power. Non-participation is one-way communication from planner to citizen, whereas informing and consultation involve citizen's input into decision-making. These 'tokenism' measures are still insufficient in delegating legitimate power to local populations, which is addressed in citizen power. A higher degree of citizen participation accounts for localised decision-making based on a better understanding of local wants and needs. Ways of involving citizens in urban planning have traditionally involved community meetings or opinionated surveys (Hanzl, 2007). The increase in applicability and citizen knowledge of information technologies offer new opportunities to digitally involve citizens in decision-making.

Participatory mapping provides an approach to linking spatial determinism and citizen participation to determine the social capital of a neighbourhood. Simply put, participatory mapping is a research tool to present and analyse data that is linked to a geographical location (Aditya, 2010). It engages people in particular issues using a plethora of mapping methods to help community involvement, local democracy, and political awareness in a neighbourhood (Chambers, 2017). Participatory GIS, where information from participatory processes is cartographically visualised and analysed through GIS (geographic information systems) software, highlights the potential of integrating classically top-down approaches of GIS-based decision-making with bottom-up local knowledge from participation (Chambers, 2017). Participatory GIS users to have highly specialised knowledge, which can be a barrier to participation. Visual mapping processes are generally underapplied in the analysis of segregated areas (Espito De Vita *et al.*, 2016). Mainly, they are used to identify barriers and visual control points, which can hinder *bridging* potential. Participatory mapping can be used to represent actors affected by urban planning decisions and allows for the adoption of deliberative planning (Vaughan & Arbaci, 2011). Aditya (2010) mainly recognises three ways in which participatory mapping can facilitate discussion in community participation. First, it helps to spatially reference opinions on a map. Secondly, it can facilitate data collection to help

understand others' spatial behaviour by visualising access by map-based annotations. Lastly, it has the potential to be used as a decision-making support, which can help decisionmakers in contextual problem-solving. The role of participatory mapping can result in two-way communication and in relatively high levels of participation. (Arnstein, 1969; Hanzl, 2007). It does not address the direct involvement of citizens to have power over decision-making, although it can be aligned with power delegation for enhanced citizen participation. Through participatory mapping, the role of communities to align planning with their collective values and clarity on deliberative outcomes is a main driver for *bonding* and *linking* capacities.

3. Methods

As socio-spatial segregation and human behaviour are complex issues, a mixed methods research design is used to quantitatively and qualitatively account for real-world complexity (Creswell & Creswell, 2017). Mixed methods are not often used in spatial behavioural analysis but are vital to converge findings from urban fabric and human experience to solidify patterns in human urban behaviour. Furthermore, it is essential to mix methods to quasi-experimentally determine how traditional space syntax analysis can be complemented with participatory data contriving social capital. The geographic focus of the research topic accommodates a case study, which in this instance is the city of Uppsala with an emphasis on Gottsunda.

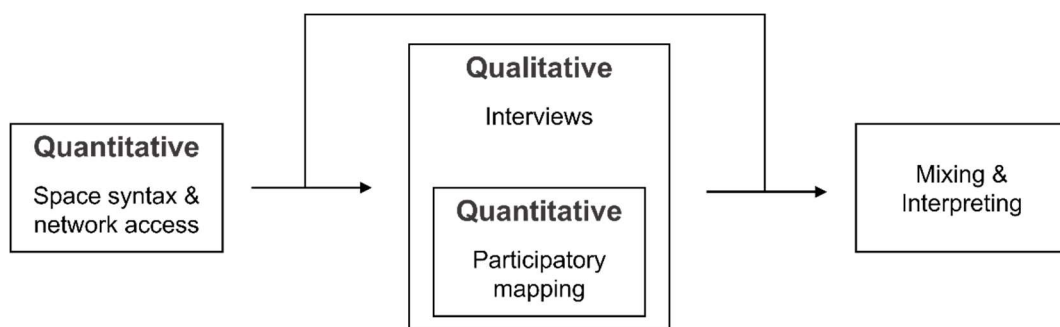


Figure 4. Research design & workflow.

The main design of data collection and analysis is linked to the triality of *bonding*, *bridging*, and *linking* concepts of social capital. *Bridging* is mainly determined by quantitative methods, whereas *bonding* and *linking* capital are dominantly associated with qualitative methods (Patulny & Svendsen, 2007). This distinction shaped the structure of the research design, but the broadness of qualitative information entailed some overlap across all social capital concepts. In practical terms, the first major research phase determined *bridging* by determining integration through spatial configuration of the local PT network before and after the LRT line inclusion with GIS analysis. This was followed up by case-specific information to contextualise the quantitative spatial findings with qualitative participatory findings. This phase mainly determined *bonding* and *linking* potential and pitfalls. The distinction between these phases is explanatory and sequential, as the second qualitative phase interprets quantitative information from the first phase

(Creswell & Creswell, 2017). The second phase was more concurrent and embedded, as qualitative and quantitative data were collected in parallel processes of interviewing and participatory mapping, which were analysed simultaneously. This allows for complimentary but different data on the same topic to interrelate and validate findings. In all phases, both quantitative and qualitative had equal weighing in analysis and were mixed by connecting findings from various sources to theorise on social capital potential. An illustrative workflow of this research design is visualised in figure 4.

3.1 Spatial analysis: integration of the public transport network

The first major part of the research involved determining spatial segregation and *bridging* capital by analysing the local PT network in Uppsala before and after the LRT introduction. This means that the bus and LRT networks were included but regional rail was excluded from analysis. This part followed Legeby's (2010) method of spatially determining segregation, which includes assessing a network's integration, accessibility, and observable characteristics. Integration entails quantifying the to-movement and through-movement with space syntax analysis. Accessibility included proximity to PT stations with service area analysis. Observations, in this case, were not possible, as the full effects of LRT are future-dependent. Interviews, discussed in the next section, substituted observational data.

3.1.1 Data collection

Data collection for spatial analysis only included secondary data, which was transformed using GIS software. Data from Lantmäteriet ('General map', 'Property map Built-up areas', and 'Property map Transport networks') were downloaded using the Geodata Extraction Tool. These were obtained as complete shapefiles, which could be used directly in GIS software. Data from SCB were extracted as tabular files containing demographic statistics, which were spatially joined with DeSO (Demografiska statistikområden) polygons representing neighbourhoods. This data was not subjected to any transformation and can be found in the literature review. Tabular files were also extracted from Trafiklab's GTFS Regional API, which contained coordinates (using SWEREF 99 projection) representing lines and stops covering PT in Uppsala Län (UL). Data representing the most recent edition of the proposed LRT line (as of February 2023) was obtained with the help of Uppsala Kommun and GisGruppen, who consult the municipality with geo-analysis of the LRT. Polyline representing the course of the proposed LRT line were acquired as complete shapefiles, whereas the proposed stops were determined by considering the line as visualised in Uppsala Kommun's (2021) conditional

decision report and georeferencing street segments or buildings with coordinates of Lantmäteriet’s files. An overview of all geographic data is visualised in table 1.

Table 1. Data sources and uses relevant for this research project.

Data source	Type of data
Lantmäteriet	Land use, buildings, pedestrian road network
SCB	Income and %foreign born + DeSO (Demografiska statistikområden)
Traffiklab	API to collect current PT routes (bus/train lines/stops)
GisGruppen	Proposed LRT lines
Uppsala Kommun	Map to determine LRT stops

3.1.2 Data analysis

Spatial integration was determined by determining to-movement and through-movement by quantifying axial integration and angular choice of axes and segments of Uppsala’s PT network (Legeby, 2010; Yamu *et al.*, 2021). Both measures were calculated and visualised using the spatial analysis program depthMapX. This was done for both the lines representing the current PT network, including bus lines, and the future network, which includes the proposed LRT line. Tabular files containing values of axial integration and angular choice were joined in GIS software with the according shapefiles to visualise them on thematic maps.

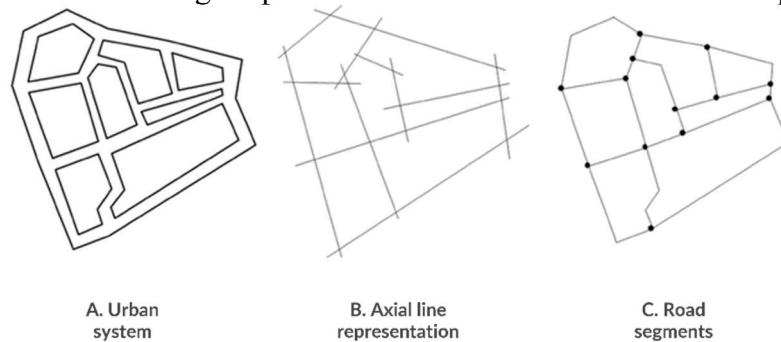


Figure 5: Differences between realistic (A), axial (B) and segment (C) representation of a road network (Özbil, 2013).

To-movement is determined by transforming infrastructural networks into ‘graphs’, where roads are reconstructed into axes (see figure 5). Axial integration is determined by the number of axes one needs to travel through from a starting point to all other axes within a system (Pafka *et al.*, 2020). This is calculated for each axis and compared relative to all other axes’ values. Therefore, the greater the number of axes traversed through, the lower the integration values become. The process of calculating axial integration is visualised in figure 6. Through-movement considers streets as complete segments rather than axes, which requires breaking down lines into street intersections, as is seen in figure 5 (van Nes & Yamu, 2021). Angular choice is calculated by quantifying how often a street segment falls on the shortest

path between all pairs of segments within a selected distance (van Nes & Yamu, 2021). It was calculated using a 5,000m radius to account for city-wide network configuration. This metric shows how likely one is to pass through a PT segment when accounting for all origin and destination combinations.

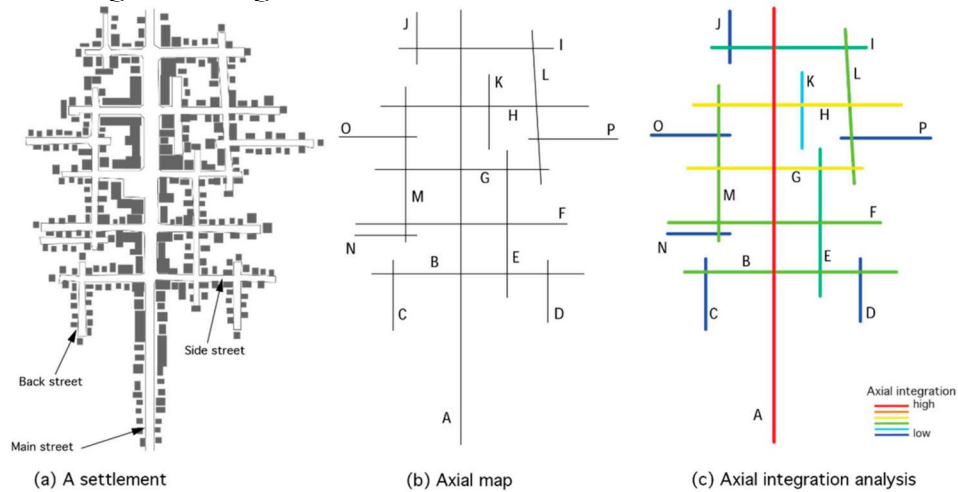


Figure 6. Deconstructing urban space into axial lines for integration analysis (Yamu et al., 2021).

As PT is the only variable determinant for accessibility, proximity to PT stops was quantified using service area analysis for assessing Gottsunda’s accessibility. This involved determining a region that encompasses accessible streets from a certain point rather than opting for a direct Euclidean buffer zone. For this instance, the walking distance from each PT stop before and after the inclusion of the LRT line was analysed. There is no single agreed-upon threshold for determining pedestrian accessibility, but 400m is most used by public planning institutions (Daniels & Mulley, 2013). This metric, plus a 50% deviation below and above this threshold, was used to visualise accessibility to PT stations, where the maximum range roughly equates to 10 minutes of walking. Only so-called ‘parent stations’ were considered for each point, which means that bus stations that are relatively close but facilitate lines going in different directions were considered as one single point. This was done as not to clutter the analysis and to smoothen the visualisation of the results. The two resulting layers, including the before and after scenarios, were symbolised with different colours to visually separate temporal differences.

3.2 Interviews and participatory mapping

3.2.1 Data collection

The second major phase of the research project aligns with the research objective of how participatory methods can complement space syntax analysis. During this

phase, contextualised information was gathered and corroborated with semi-structured qualitative interviews to better determine how PT behaviour relates to social capital. The interviews were held with individuals to discuss current and future individual behaviour of PT usage and their perceptions of neighbourhood identity and change. Interview topics followed the three pillars of social capital and included topics discussed in indicator-based transport studies on social capital by Poortinga (2012), Derakhti & Beaten (2019), and Tahlyan *et al.* (2022). To fit the aim of this research project, these topics and categories were altered into attitudinal measures, personal networks, access to resources, gentrification, and civic engagement. Most of these categories included a mapping exercise to gather spatial data related to the topics discussed. The main categories, their relevance to social capital, and subsequent mapping questions are presented in table 2.

Table 2. Outline of topics discussed in the interview, including categories, relevance to social capital, and participatory mapping exercises.

<i>Category</i>	<i>Social capital</i>	<i>Mapping exercises</i>
Attitudinal measures	Bonding	-
Personal network	Bonding/bridging	If you go to any community group, where are they located?
Access to resources	Bridging	Where do you go to work?
Gentrification	Bonding/bridging	Where do you think LRT will attract more business or raise property values?
Civic engagement	Bridging/linking	[if disagreed with the LRT proposal] What part of the proposed LRT line do you disagree with? Where would you place the LRT line if you could decide?

The interviews were based on an interview guide with more specific topics for each category. This was done to ensure a balanced flow, as the categories were structured starting with more personal experiences, which steadily flowed to more global topics. Following this interview guide ensured all relevant topics were discussed and for information to be more consistent in analysis. Firstly, people’s attitude towards the neighbourhood identity of Gottsunda was discussed, including feelings of at-homeness. While talking about trust and interactions with neighbours, personal network-related topics were complemented with homophily potential and access to social relations. Community involvement is related both to people’s social networks and access to resources, including work and public spaces. This category was mainly centred around the potential of co-presence by talking about participants’ current usage of PT and potential changes in accessing work and leisure after introducing LRT. Values attached to PT and current travel behaviour took most of the time of the interviews, as people introduced much anecdotal evidence of experiences with PT. After the LRT introduction, its gentrification

potentials, such as changes in neighbourhood identity and concerns of housing affordability, were discussed. Finally, people's knowledge of and agreement with the LRT project, as well as the possibilities of participation were discussed. For each category, question phrasings such as "describe the scenario of..." were used for participants to shape their narratives. Although each interview roughly followed a categorical structure, participants were encouraged to bring up topics that were not defined in this guide. The interviews varied in length, depending on concepts brought up by interviewees, ranging from 30 to 60 minutes. A full copy of the interview guide, including topics per category and related prompts and mapping exercises, is visualised in appendix A.

The mapping exercises covered various topics discussed during the interview. These were considerably more structured questions, as these quantitative data required uniformity to be valid. These exercises involved physical maps with only essential information symbolised for this research project, such as basic land-use outlines, buildings, PT and walkable infrastructure, as well as the proposed LRT line. The maps containing space syntax and network accessibility were intentionally not shown to prevent bias and to not rely on specialised knowledge from participants. Maps for the before and after scenarios were designed and printed on 3 major scales: city-wide, focus on the LRT line, and focus on Gottsunda. Participants were asked to draw on these maps based on questions presented in table 3. This method was deemed most suitable, as physical maps give participants the freedom to express their opinion and require less specialised knowledge than digital methods (Aditya, 2010). Physical mapping makes it accessible for participants to draw more complex polylines to express spatial information, whereas software-based methods mainly focus on points and lines. The maps containing info about the built environment and the LRT line facilitated the interviews, e.g., in discussing topics of individual travel behaviour, as spatial patterns could be pointed to and discussed accordingly.

The aim of the interview was not to focus on representativeness but to invite individuals to discuss their individual relation to the integration in Gottsunda and PT behaviour, which contrived subjectivist findings of perceptions and behaviour. This motivated an information-oriented selection of interviewees. All interviewees either lived in or were employed in cultural organisations in Gottsunda. To achieve certain representation among participants, I aimed for variety in age and gender and for a variety of foreign-born and Swedish-born participants. Due to the research project's sequential outline and limited time frame, pragmatism influenced the contacting process. I started by contacting my own contacts of people living in Gottsunda and snowballed from there. Similarly, the people contacted at various local cultural institutions were asked if they knew someone interested in participating in the study. Ultimately, seven participants were involved in the interviewing process. Their demographics are shown in an overview in table 3.

Table 3. Demographics of interviewees.

Reside or culturally involved in Gottsunda?		Sex	Age		Foreign-born / Swedish-born		
Reside	5	Male	2	0-29	2	Foreign-born	4
Involved	2	Female	5	30-49	3	Swedish-born	3
				50+	2		

The interviews were held face-to-face in public spaces in Gottsunda, including a café and a library, and in participants’ offices. All interviews were recorded, but notes were taken during the interviews to check the interview guide and note unexpected topics. After each conversation, non-transcribable features such as the location and the flow of conversation were annotated. Ethical treatment of the data collected was ensured according to Brinkmann’s (2013) conditions, meaning that the consequences of data handling were mentioned in the invitation and informed consent was ensured by starting the interview with what (demographic) information would be used and how quotes would be anonymised for confidentiality. Also, the participants could opt to not include certain data after the interview.

3.2.2 Data Analysis

Analysing qualitative data from the interviews was centred around transcribing the recordings and codifying themes. Coding software was used to transcribe the recordings but required some analogue adjustments for digital error and to include verbatim transcription, such as laughter, hums, and pauses. Major themes were coded in an abductive approach: overarching categories and their association with social capital concepts (see table 2) were pre-constructed codes, but interviewees’ own input established new codes (Charmaz *et al.*, 2012). After transcribing, information from all interviews was compiled in a mind map to form tentative categories, which were trimmed down into major overarching concepts. Relating concepts from the interview to social capital concepts contextualised information to the case of Gottsunda. Corroborating or contrasting these concepts with secondary research generalised trends from the findings.

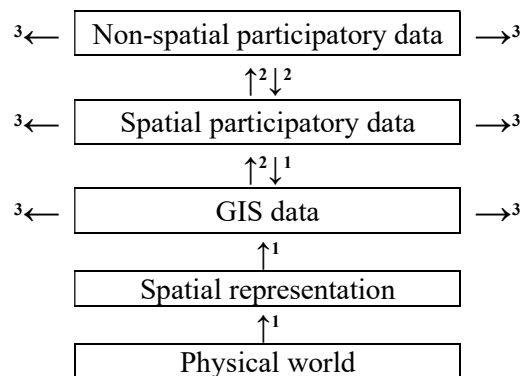


Figure 7. Flow of information during exploring (1), explaining (2), & predicting (3).

Information from the mapping exercises was analysed according to Fagerholm *et al.*'s (2020) explore-explain-predict workflow for interpreting participatory spatial data and relating them to non-spatial participatory data and spatial representation of the physical world. First, data was explored by internally validating the spatial correctness of locations during the interview. The input from the mapping exercises was georeferenced in GIS software by relating points to the reference maps. Lines were simply presented as they were on the participant's maps but points were complemented with buffers and were represented slightly transparent, so overlap between respondents could be seen. Data stemming from different mapping questions were symbolised and layered differently. These layers were then explored by overlay analysis, which is where multiple inputs are overlapped to create a general overview. From here, patterns of clustering and spatial association with other layers were visually identified. This was done with all bi-variate combinations of all layers stemming from the participatory mapping questions, as well as the space syntax and network accessibility layers from prior analyses. This allowed for a better understanding of the relation between participatory data and other spatial data sources. To contextualise these overlaps, trends were corroborated and validated with non-spatial data from the interviews. Furthermore, major findings were compared with each other, as well as with how other authors have dealt with these topics. Figure 7 gives an overview of this analytical process.

4. Findings

4.1 Space Syntax

4.1.1 Axial Integration

Firstly, space syntax analysis quantified the to-movement of the Uppsala PT network. Figure 8 shows the axial integration before (a) and after (b) the LRT inclusion. The distribution of the values of integration is symbolised according to Jenks' natural breaks classification of all values in the before scenario. The same percentual thresholds are used in the after scenario to illustrate the equal relative distribution of values of the lines to show changes in axial integration. The highest integration values are visualised in red, moderate in yellow, and the lowest in blue. In both the before and after scenarios, the centre of Uppsala has the highest cluster of roads showing the highest integration. Gottsunda, south of the red cluster, shows low-to-moderate integration values in the before scenario and moderate-to-high integration values in the after scenario. In the after scenario (right in figure 8), the clustering of highly integrated lines in the city centre is generally distributed more southwards. The line that follows the LRT line is continuously showing values symbolised as yellow or red, signifying moderate to high integration. Some areas in the south also shift from lower to moderate integration, whereas some areas in the central north shift marginally from high to moderate integration.

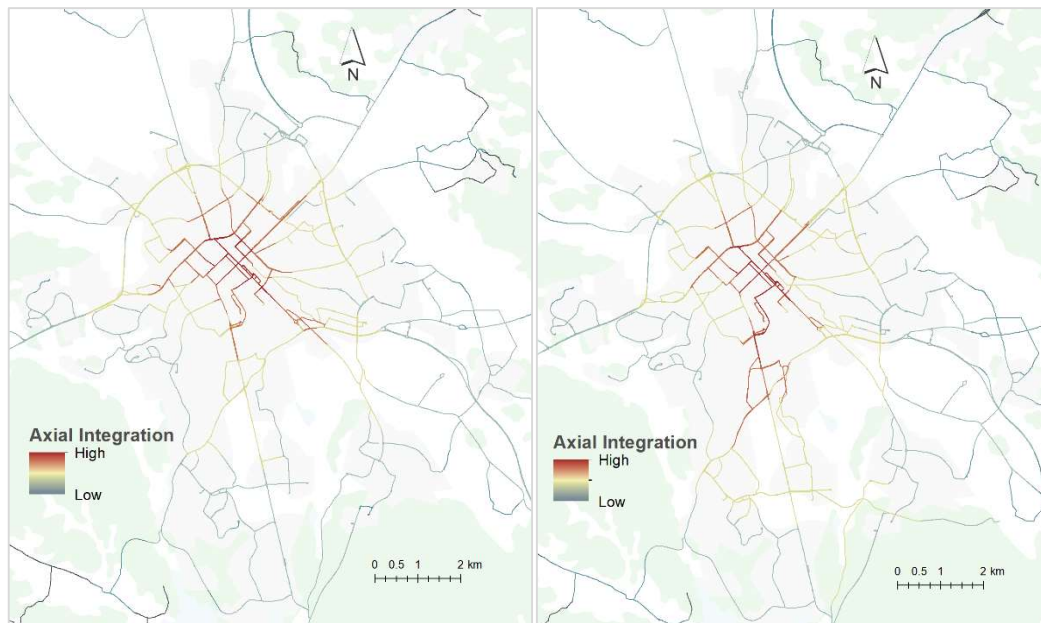


Figure 8. Axial integration of Uppsala's local PT network before (left) and after (right) the LRT inclusion.

4.1.2 Segment Analysis

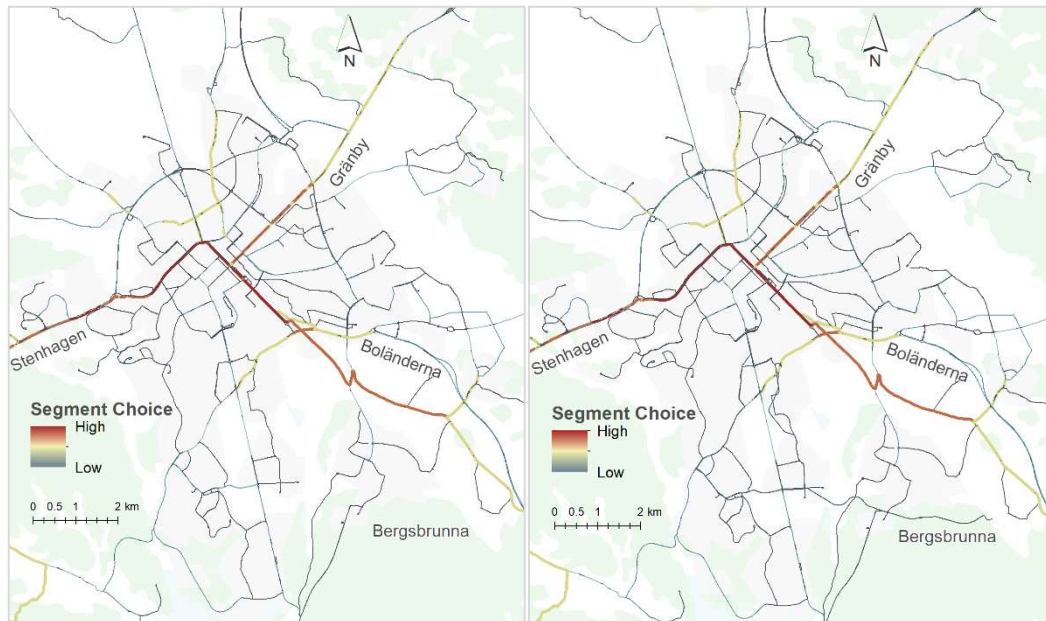


Figure 9. Angular choice of Uppsala's local PT network before (left) and after (right) the LRT inclusion.

As for the through-movement, the angular choice of segments in the Uppsala local PT network was calculated for the before and after scenarios, which are visualised in figure 9. Figure 10 shows the same metrics resulting from analysing the angular choice of Uppsala's PT network including the regional train line to Stockholm. Segment lines were symbolised with a similar blue-yellow-red scale, where the lowest choice values are blue and the highest are red. The distribution of values was broken down in equal breaks to highlight high values, as the vast majority are low in choice. The highest values, shown in red and yellow, are visualised as thicker segments to contrast more with the rest of the network. For the local PT network, no changes in angular choice are visible after the LRT inclusion. There is still a high choice visible for a bus line going from the centre to Stenhagen in the west, Boländerna in the southeast, and Gränby in the northeast. This is approximately also where the moderately high segments are located. One line, perpendicular to the line to Boländerna, stands out as being higher. In the PT network including regional transport, this line is showing more angular choice after the LRT inclusion (right in figure 10), as it partially follows the course of the LRT line. The rest of the LRT line does not show similarly high values. Segments to Stenhagen and Gränby still have high values in the before scenario with regional transport, although the segment to Gränby decreases in the after scenario. Both the before and after scenarios including regional transport show high angular choice to the south-east, but follow slightly different lines. Including the regional rail also shows some differences in moderate choice values in the central north. Overall, the regional rail

inclusion in the PT network shows more variation in angular choice than focusing on just the local PT network. This illustrates that the likelihood of street segments passing through with PT will not change much when only considering bus and LRT, but can entail some differences when regional rail is considered.

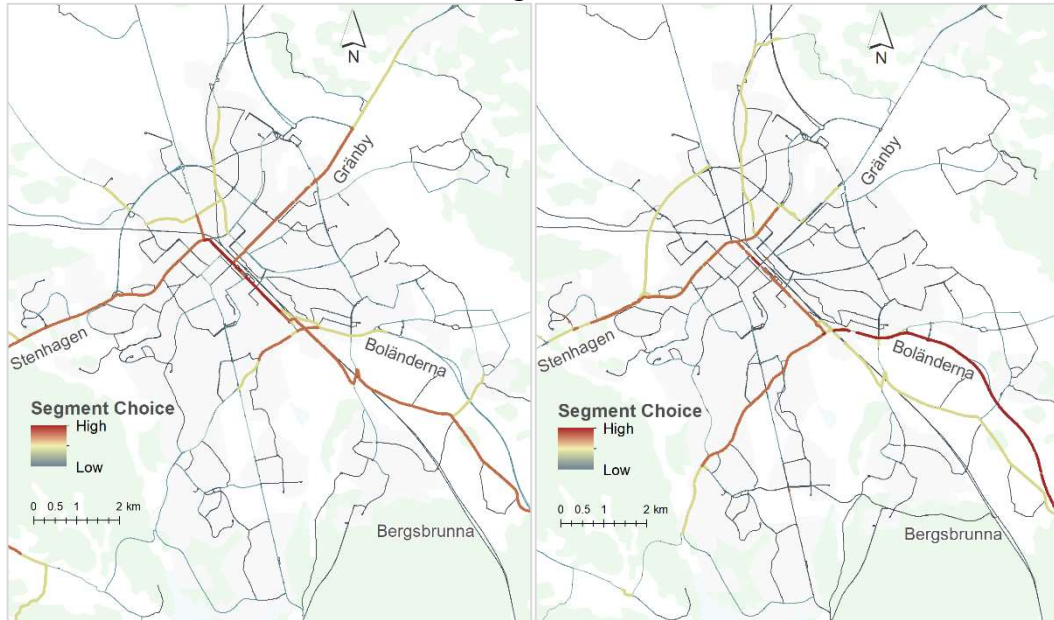


Figure 10. Angular choice of Uppsala's regional PT network before (left) and after (right) the LRT inclusion.

4.1.3 Accessibility

Access to PT stops is the last result of the GIS analysis. Figure 11 shows radii of 200-, 400-, and 600-meters walking distance to existing stops in red and to new stops in blue. The frame is zoomed in on the course of the LRT line rather than the entire city, as this is where all the changes occur. Individual buildings are also visualised underneath these radii to visualise if they fall under any of the PT stop service areas. The concentration of accessibility to stops before the LRT inclusion is highest in the city centre, or north-west in figure 11. Not many areas have new opportunities for accessibility after the LRT inclusion. Most notably, the area in the southeast, where 4 LRT stations are planned, has a considerable increase in accessibility. Other than that, an area in the centre-west of the map is more accessible after the LRT inclusion.

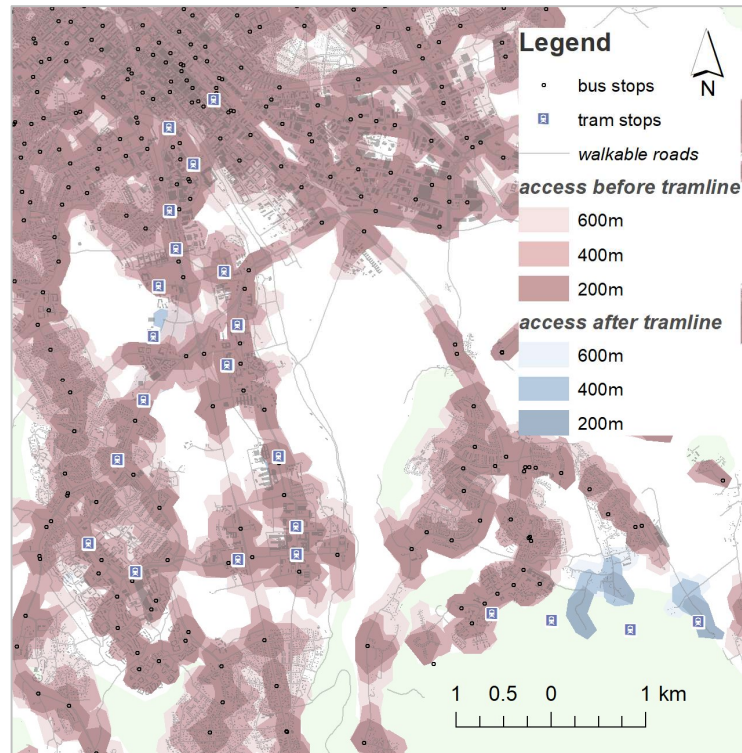


Figure 11. Access to PT stations within 200m-400m-600m walking distance. Note: red exemplifies access to current infrastructure, whereas blue shows new access after LRT stations.

4.2 Interview Data

Findings from the interviews are presented per category. As these topics are presented as codes, interpretations of their meaning and relevance to other codes are briefly discussed but are not corroborated with secondary literature or quantitative data from the GIS. This will follow in the discussion section. A conscious effort was made to include topics that were brought up by the participants that were not foreseen by the interview guide, which mostly involved political topics such as privatisation and PT affordability. The comprehensiveness of these findings remains bound to what is either discussed or left in.

4.2.1 At-homeness

General attitudes of at-homeness in the Gottsunda were mixed. Some people praised Gottsunda for its socio-environmental conditions, whereas others highlight common “problem neighbourhood” attitudes, like poor socio-economic standards and a general lack of safety. One participant shared a nuanced notion that represents the general response of participants to their feelings towards Gottsunda well:

“I think the majority is really proud of his community. But, of course, there are people who are struggling to find another place to live [and] they don’t want their kids to grow up with the

other kids living in Gottsunda and try to have a career moving away from Gottsunda. So, [...] you have the community that have been living here since they started to build the apartments here like in the 70s and they are still here because they love Gottsunda [...] Currently, the main part of people moving to Gottsunda is people who have not been standing in the queue to get an apartment long enough to get an apartment central in Uppsala and [...] people who have newly come to Sweden [...], this has always been the first place you're living and then you might stay, but you might get integrated into education and a career and then you find somewhere [to live]. So, you succeed to raise the level of education and employment, but then they move, and you start all over again. So, it's quite rare that the ones with real estate are moving to Gottsunda, but they might stay.”

There is a lot to unpack from this quote, but mainly, it shows that the social cohesiveness among people living here for a while is rather strong, but that people generally move to more central areas in Uppsala once their socio-economic status improves. This is echoed by other respondents who argue that they currently live in Gottsunda because of the relatively high share of rental apartments and that “[Gottsunda] was the only option because apartments [elsewhere] are so expensive”. Two out of the five people interviewed who lived in Gottsunda also noted that they wish to move closer to central Uppsala. It is also interesting to note that four out of the five people living in Gottsunda were foreign-born, whereas interviewees who worked but did not live in Gottsunda are Swedish.

Major themes discussed why people do not think fondly of Gottsunda is that the area visibly reflects low socio-economic standards, which connects to Gottsunda feeling detached from Uppsala and people having feelings of not feeling safe in the neighbourhood:

“the situation in Gottsunda is completely different [from the rest of Uppsala] with the highest rate of unemployment, the highest rate of people living on social welfare, the highest rate of people not graduating from high school, and so on and so on. And that affects everyday society.”

Partially, this makes people think lowly of Gottsunda and some are worried about their safety, triggered by occasional news articles of violence or because “groups of young men [...] feeling threatening if you don’t know them”, though one participant also feels unsafe in the city centre. Nevertheless, the topic of safety, influencing at-homeness, was unprompted and brought up by more than half of the participants.

The lower socio-economic levels also cause many interviewees to view Gottsunda as separate from Uppsala. Some even say that Gottsunda is akin to the “ghetto of Uppsala”. One interviewee prompted: “here we are always talking about Gottsundabo [people living in Gottsunda] instead of Uppsalabo [people living in Uppsala]”, whereas they perceive people in similarly lower socio-economic areas elsewhere to be considered as part of that city rather than the neighbourhood. Part of this distinction is related to “Miljonprogrammet buildings” looking different

from architecture in other parts of the city. People note that the city centre radiates more historic and affluent values than Gottsunda, where buildings are called “really awful”. This distinction was sometimes positive, making people feel “closer to Gottsunda instead of Uppsala”, sometimes called a problem. They expressed interest in my research topic because it is “super necessary for things to change”, whereas someone else notes “I think that [people] are proud to live in Gottsunda [rather than] living in Uppsala. But [...] you have to somehow find people to be proud of living in Uppsala”. People extended on feeling included in Gottsunda by talking about social inclusivity and the apparent social “warmth” of people living in the area. These people dismissed most of Gottsunda’s negative reputation:

“as an outsider, you hear so many bad things. And then, because of my expectations, they were so low when I got this lovely experience instead. [...] people are so lovely.”

“There are, of course, some problems, but compared to how many people [are] living here, it’s not exceptional in my point of view.”

These feelings are reciprocated by statements as “everyone seems to know everyone”, “the community feeling”, and “the [social] warmth is so nice”, but it being “quite cold [if] you’re outside [the community]”. This sentiment also correlated with participants who mention being socially included in Gottsunda to not mention feelings of unsafety. These people were also more likely to note positive feelings of nature connectedness and were less critical of the architecture.

Furthermore, it was common for interviewees to compare Gottsunda to other areas where they used to live, either in Uppsala or outside of Sweden. People that lived in other areas in Uppsala mentioned that they “would not really interact with people [compared to Gottsunda]”. This was noted for areas in central Uppsala and Ultuna, also south of the city. Some people also added that Gottsunda feels “a lot more similar to where [they] grew up”, adding that the area is “a lot more international, so it feels like [they] stick out less”. This sentiment was given by three out of the four foreign-born interviewees. So, social cohesion and international character were noted as increasing feelings of at-homeness in Gottsunda.

4.2.2 Personal Relations

Besides people’s general outlook on their social connectedness within the area, people talked about their personal relations in the city. People seemed to have rich social lives within Gottsunda and, to a lesser extent, in the south and west side of the city. Respondents with the most concentrated social circles either live with their friends or partially centre their social life around those connections, some have family in Gottsunda. Only one person did not know anyone in Gottsunda besides their housemates, and people expressed that “both friends and colleagues [mainly live] in the city centre or even outside Uppsala”. Contrastingly, interviewees did

not have many connections north and east of the city centre: “no one [I know] lives north-east of the central station, so there is no need to travel further than that”. Two respondents noted exceptions, having friends in Gränby; another area shaped by Miljonprogrammet in the north-east part of the city.

As for social circles centred around community groups, all but one respondent goes to at least one community group. This varied from social gatherings to sports-related organisations; the latter being the most popular destination. The distribution of locations is relatively even between the city centre and Gottsunda (see figure 12). For Gottsunda, Gottsunda Centrum seems to be where most of the community activities take place:

“there are lots of activities that are, like, oriented towards the community, like they have a förskola [preschool], they have a time at the library for women to come and practise Swedish and there is an international hour [...] in the Culture House for people to participate in”

Gottsunda Centrum is often praised for connecting the neighbourhood. One respondent noted practising sports, going to the library, practising Swedish, being involved in the preschool, and going to the theatre, all within the same establishment. Other people go to other recreational groups, like dancing and an orchestra in the city centre. Overall, the location of visited community groups seems to be diverse but there is a tendency of centralising in Gottsunda.

4.2.3 Access to Resources

Besides social relations, people access other destinations. Gottsunda Centrum is again mentioned to be pivotal in its ability to provide access to resources, such as supermarkets, cafes, clothing stores, health services, etc. Therefore, people do not feel compelled to go beyond Gottsunda to satisfy these needs: “I would barely leave; I have all my needs kind of met here”. The concentration of functions this building provides was also why one participant went there for shopping when they did not live in Gottsunda. One interviewee did mention that she misses some amenities and, therefore, needs to go to the city centre. Access to the centre was often high on their priorities, for a multitude of reasons, but generally, people were positive about Gottsunda’s connectedness with central Uppsala, especially compared to places where they lived before moving to Gottsunda.

People noted access to urban green to be partially a need to be met by travel but also something that establishes the neighbourhood identity of Gottsunda. Every respondent was, unprompted, positive to the integration of vegetation and waterbodies into the landscape:

“[Gottsunda] is a beautiful place with a great scenery. [...] you have lake Mälaren and you have the forest and stadsskogen [an urban forest] all so close to you” “it’s a very forest-y area”

It shows that this integration not only allows satisfaction of accessibility to green but also that closeness to nature is part of feeling connected to the neighbourhood. Some even noted that this is one of the main aspects they would miss if they would leave Gottsunda.

People were less enthusiastic about the accessibility to cultural resources. Besides some positive remarks on an art gallery and theatre in Gottsunda Centrum, people mainly go to the city centre or to Stockholm, which is roughly an hour away by train from Uppsala, to fulfil cultural needs. Some respondents went into specifics such as architecture, museums, and performance venues being lacking in Gottsunda and being more prevalent in the city centre, making them feel like tourists when travelling to the city centre. The cultural activities that occur in the city were mainly criticised for being expensive and inaccessible for people living in Gottsunda:

“How do you make the city more attractive to the ones living in Gottsunda? [...] I think distance in kilometres is not the biggest problem. It’s like the distance in your mind. [...] I think you have to make the city more relevant for everyone in Uppsala, not only the middle class and the higher high middle class to be represented in [...] sports to music to culture. You have to do something different [...] you are not represented at the art museum, city theatre, or the concert house. You have to do a lot more than that to make the city relevant for visiting.”

This quote exemplified a lot of frustration expressed by some participants, who have a demand for cultural resources but cannot access them. This access is not imposed merely because of distance, but because of other barriers, such as cost or infrequency of events. Some expressed the desire to have more cultural resources near to them to fulfil the needs of recreation, whereas others were content with the current situation.

Work was the main reason to use PT. All employed respondents living in Gottsunda worked outside Gottsunda (see figure 12). Most of these locations are concentrated around the city centre, whereas one person works in Ultuna, which is also in the south of Uppsala. The respondent working in Ultuna marked most positively to being connected to work from Gottsunda, as it is “only six minutes by bus”. People working in central Uppsala also tend to be relatively positive about access to work, as “it is only one [bus-]line to the city”. All people either always or mostly use PT to go to work, but active modes of transport are also mentioned.

4.2.4 Current transport behaviour

People’s social relations, recreation, nature, commercial activities, and work are all somewhat differently located, and the modes for reaching these destinations differ much. People tend to walk to commercial resources and nature. Recreation and social relations are most divisive in terms of modality, as the destination could either be in the city centre or in Gottsunda. Depending on the proximity, people either walk, bike, or use PT to reach these destinations. Work is dominantly

accessed by PT or bike. The common denominator for biking is dependent on the season and more unpredictable weather conditions: “Sometimes, when it’s raining, you simply don’t want to bike”. Similarly, most people note that they don’t use the bike during the winter and mainly mention snowstorms hindering “the option to substitute public transport for biking, but preferably I don’t want to use my car as well”. Even though only one of the participants noted being an environmentalist, this sentiment of not wanting to use the car was shared by a lot of participants living in Gottsunda: “I don’t feel like I need a car”. Notably, people that work in Gottsunda but live near the centre mention that they mostly use their car to commute. For inter-city travel, which mainly concerns Stockholm, the interviewees always use PT.

Furthermore, the proximity of Gottsunda to the city centre seems the maximum distance for biking, as people call Gränby, north-east of the centre, “too far to bike [and] too annoying to take public transport to”. Biking is seen as an expression of personal freedom and neighbourhood identity and makes them feel connected to Gottsunda and Uppsala, because “there are bike roads everywhere, it’s amazing”. Nevertheless, all participants who use active modes of transport mention using PT “at least once a week”. Using PT, rather than active modalities, is mainly driven by convenience and weather protection: “[public transport] is really just a little comfort thing [...] to travel more easily between places”. Furthermore, people tend to use the bus less if they perceive taking PT as too much of a hassle. This point is reached rather quickly, as participants frequently expressed dissatisfaction with having to transfer between bus lines. People commonly found that it is simply easier to walk for longer than they would be comfortable with than crossing bus lines, as it is mentioned to be slightly faster. Overall, people’s frequency of taking PT varies from “once a week”, “five to ten times a month”, to “nearly every day”.

People generally have positive feelings towards PT. The interviewees often relate PT, including buses and trams, with areas they grew up in, which are often bigger cities abroad, making it part of their personal identity. On the other hand, someone calls time spent on PT “wasted time”, as time between activities, such as recreation and work. Contrarily, two other participants noted that PT allows them to “do some work, I can read, whatever [...] I’m not the one controlling [the bus] so I guess it is saving me a lot of time”. Furthermore, the possibility of spontaneously meeting acquaintances and “seeing the same people on your daily trip” are social values that people link to PT. The general feelings and values people associate with PT are positive. When talking about people’s experiences with using the bus, interviewees were more critical of the current system.

The distinction between people's appreciation and dislike for the current bus system is largely dependent on the accessibility of destinations, as the connectivity of the current bus network is often positively linked to travel to the city centre and is even noted to be part of Gottsunda’s neighbourhood identity, especially Gottsunda Centrum having “so many lines [...] going to the centre, which are

fantastic”. All but one seem content with the time it takes them to reach the city centre, but travel to other areas is shed in a more negative light:

“Direct lines to the north [of the city] don’t seem to be a thing in Gottsunda. You either have to travel to Rosendal [south of the centre] or through Ultuna [south, but east of Gottsunda]”

People found the north of the city harder to reach because of transferring bus lines and it taking too long to get there. Other areas that are noted to be less connected from Gottsunda are Boländerna and Sävja, which are both east of the city. Boländerna, where land use is prominently allocated to industry, is mentioned as something people wish they had better access to. This entails both the south-north and an east-west divide in PT connectivity. The former is mainly supported by “having to transfer bus lines [...] which is more difficult than it should be” and the latter seemingly being shaped by the river: “the Fyris [river] seems like a kind of border between [parts of] the city. Not just to Sävja but even the part behind the train station already seems further away”.

Besides connectivity, the frequency of when buses arrive, and the total capacity also spark people’s dissatisfaction with the current PT system. One notes “there are too many stops [...]” it goes every 10 minutes and there are not many people inside”, though others find frequency and capacity to be more lacking:

“I would say a lot of things can be improved, but I am also satisfied to a point. They need to be more frequent the buses because it's always very crowded. And they didn't change the frequency of the buses after COVID-19, in spite of it being still crowded”

Notions about buses “being full” or “only going once an hour and when you miss it, you’re just stranded” are mentioned by three of the five interviewees living in Gottsunda. The lack of capacity is also mentioned as a reason why people sometimes use the car, even though they wish they didn’t. Furthermore, the infrequency of buses past midnight is noted by the interviewees: “I feel like it works well until midnight, and then it just draws out”. Noted, it was only mentioned by two people, who were the youngest participants, but it seemed the specific topic was important to them as it was unprompted. People do not wish to travel by active modalities, i.e., walking and biking, during night-time. The overall desire for more frequent buses was complemented by a desire for more capacity in PT, although this came up considerably less often. Particularly, “on the way back [from work], it is super packed [...] sometimes you feel better to not get on board”.

Somewhat related to frequency, people wish for more reliable PT alternatives during bad weather conditions, fewer disruptions in operability, and better information when lines do fall out. One participant noted these sentiments:

“whenever the weather is a little bit worse and the buses get cancelled, it's very bad with the information on their application, they give either no information at all or part of the information. Just last week I was trying to get to work when it was a snowstorm. And on their app, it said

that bus lines and specific bus lines with specific numbers are being cancelled and another bus lines are still going as usual and the one I'm taking [...] was still going and I stood by the bushålpplats [bus station] for 25 minutes and nothing came and I had to go back home and we had to take the car [...] apparently they changed the route, so I was really, really angry”

Even though it was not explicitly part of the interview guide, every single participant brought up affordability, as put by one interviewee: “I would use public transport more if it wasn’t this expensive”. This notion was widespread, and it stops people from taking the bus for short trips, which was exemplified by people not “taking it to go to Norby, which would just be a few minutes by bus but probably 20 if I would walk”. The city uses a zonal system, where every part of the inner city, including Gottsunda, can be accessed with the same price. Monthly tickets exist, which save money with frequent usage but “it’s not cheap, it’s expensive. It’s more expensive than the one in Stockholm and the one in Stockholm covers a much larger area, so I don’t think that makes any sense. Respondents note the high prices exclude people from lower socio-economic backgrounds being included in the city:

“if they live downtown, they never visit the institutions that the municipality is trying to integrate them in, like the museum up in the castle or the UKK, or the city theatre and so on... To connect the community for real, you have to consider that some people are never going to pay this much”

This is echoed by someone calling affordability a bigger issue than connectivity: “You can have the best infrastructure in the world, but if you can’t afford a ticket, you can’t find the benefits of taking public transportation”. One participant suggests Uppsala to follow a system that has been tried in Germany, where every PT modality is included in the same monthly ticket, as well as being relatively cheap:

“Imagine if you could have 1 ticket valid for take yourself from Gottsunda to maybe Knivsta or Stockholm or up north [...] of course it would cost a lot, but the environment would gain so much. And I also think that it enables people to move from areas like Gottsunda. [...] I think the state and the municipality would actually save money [by saving money on] the damage of criminality and everything that comes with it if you’re really low down on the social scale”

Two participants linked the inoperability and high prices to the privatisation of the PT network, directing it to UL and Gamla Uppsala bus, both Uppsala-based bus companies, but also to SJ, the national train operator. Besides the noted inefficiency and lacking responsibility of having multiple companies running the same system, one participant noted:

“When SJ [...] was one company running the trains to all Sweden, they could afford to take a train into service long before you needed to take the train in the service because they had that system so they could have them. They had a lot of trains [...] Now, it’s a private company, they have to run them until they are maybe broken [...] You had people working to clear the rails from leaves and snow and so on because that was a system in Sweden [...] But now the

train is stopped because of lives or if it's snowing [...] it's not new that it snows in Sweden. But now the trains are not managed to run effectively but to be profitable for an entrepreneur”

This respondent also noted that public procurement ensures that the lowest bidder is often the one that is accepted to run these state-supported services that determine the operability, as “the cheapest one is probably not the best quality. And this affects trains, buses, everything” whereas they would rather see this focus shift to local employment and environmental consideration.

The LRT line was called inherently political. Someone noted that “some parties are very reluctant to invest in good public transport”, relating it to a lot of the aforementioned issues. Another participant adds that the LRT line is the brainchild of Miljöpartiet (the Green party) and Socialdemokraterna (social democrats) and that it is, therefore, safe to assume that it will be carried out as long as they are in office. It illustrates that LRT, as well as PT in general, is a highly political topic that is acknowledged to impact the current PT systems.

4.2.5 Changes in transport behaviour

Participants were either reluctant at first or immediately approving of the LRT introduction. People mentioned it might increase the connectivity of the PT network in areas. Partially, people were glad that it seems to connect the city centre to Gottsunda and vice versa. When asked about whether they would use LRT, “If it's faster, why not”. Though no one expressed excitement about the addition, every interviewee stated that they would opt for LRT rather than the bus if it was either faster, had better capacity, or cost the same or less than PT currently does. People said that “it wouldn't change that much in terms of where I go to”. People that work, but don't live, in Gottsunda, said that they might change modality: “right now, the most convenient way to go [from the centre to Gottsunda] is by car. But in a couple of years, if I still work in Gottsunda, then I might take the spårvagn [tram]”. Once again, people mainly stressed affordability to be a main determinant of whether they would use LRT. Other than that, participants mentioned that it could be more reliable in the winter than buses, as it would be more fit to deal with snow.

Participants were generally enthusiastic about the increased reachability LRT could entail in Bergsbrunna, the south-eastern extension of the current PT network. Partially because it connects the city to inter-urban transport and partially because it connects the southeast and southwest parts of the city by having a new bridge over the river. It was noted to have a positive impact on the inter-city connectivity between Gottsunda and Stockholm: “If I have to go to Stockholm, I have to go all the way to the centre first [...] if I would travel to Stockholm pretty much every single day and then it would be convenient to go through Bergsbrunna”. Though not everyone expects to be travelling to Stockholm daily, most people still brought up the benefits of being more connected to Stockholm or to the airport in Arlanda,

which is roughly in between Uppsala and Stockholm. Bridging the southern east-west divide is desired as “there is no bus that connects the two sides of Uppsala on the South side”. This extension is mentioned to have the most drastic impact on where people move to, rather than how people move to current destinations.

Although it was not touched upon extensively, people also believed LRT both positively and negatively affect social integration. People mainly noted that “maybe I would see some other faces during my daily trip to work”, extending upon the notion that the interviewee felt familiar with people they encountered a lot on PT but otherwise had no connection to. Another said:

“the politics of taking public transport of, like, respectability and visibility of minorities [could change] it could be a big deal if people on the tram talk on the phone or listen to music, which is frowned upon in northern parts of the city [which] could lead to more friction”

This quote exemplifies how multiple people believe LRT will entail more contact with people from varying neighbourhoods, with different outcomes.

4.2.6 Changes in the neighbourhood

In terms of how LRT could change Gottsunda, people were equally nuanced in their expectations, mentioning both negative and positive scenarios. Positively, people expected the added connectivity could attract new people moving to Gottsunda. This feeling was expected for short-term visits, as people mention “trams feel touristy. If [Gottsunda] manages to be relevant [in terms of culture], I assume a lot of people could come here”. Another interviewee said it could “make Gottsunda a lot more socially popular” due to better accessibility. People also foresee a more diverse mix of people with different socio-economic backgrounds to be permanently living in Gottsunda:

“back [in the day], we had a saying that we have a public school that everyone went to. I mean, the professor’s son went to the same class as the cleaning person’s kids and everyone played with each other and grew up with each other too [...] Nowadays, if you’re wealthy or living in a wealthy area, you put your kids in special schools because of the new school system and if you live in Gottsunda [...] it’s convenient to put your kids in Gottsundaskolan [a local school] A more mixed and equal society is always better. And that’s not my point of view, that’s science. It’s better for community”

Participants believe it could lead LRT to be a connector for mixing society. Mostly, however, interviewees focused on attracting people to Gottsunda for short stays. Gottsunda. Some even mention that it could be the next Södermalm, an area in Stockholm that underwent a cultural revival that is partially prompted to be desirable, as “it is in these kinds of areas [where] the interest in culture is taking place”. Becoming “the next Södermalm” also has its downsides, however.

Interviewees also noted the threats of gentrification it could lead to: “Nowadays, no one can afford to live [in Södermalm] besides really wealthy people. God forbid this will happen in Gottsunda as well”. Other interviewees also mentioned it could “intensity current processes of gentrification”.

Another person noted that LRT “could be a lot quieter than the buses are right now”, which they linked to increased housing prices around roads where buses currently pass through. Areas that have established infrastructure, such as bus stations and open spaces, and are planned to have an LRT station constructed (see figure 12) are mentioned to be threatened by gentrification: “They could become some sort of ‘hubs’ that feel more ‘urban’ [...] I suppose it doesn’t have to be a bad thing, but there’s a lot of people just living next to these stations. I could see some businesses or whatever taking up that space”.

Bergsbrunna and Sävja, both east of the river and close to newly constructed LRT stations, are mentioned to be subject to processes of gentrification (see figure 12). Interviewees often mention that there is “nothing currently happening here” and “if they don’t build new fancy houses [...] all the way to Bergsbrunna, why would they have a new train station”. Similarly, this process of attracting higher-income people could be strengthened by “allow[ing] people to live near nature, which attracts higher-income people”. Generally, people link the locations where new LRT stations are planned with gentrification.

4.3 Participation

Figure 12 shows the accumulation of all respondents’ participatory GIS input. The dots represent where people work, go to community groups, and expect gentrification. These dots have a slightly larger radius for better visibility and to determine their broader impact. The additional lines, illustrated in blue, illustrate where people wish to add LRT lines. The line in red visualises the part of the LRT line that is currently planned but critiqued by some participants.

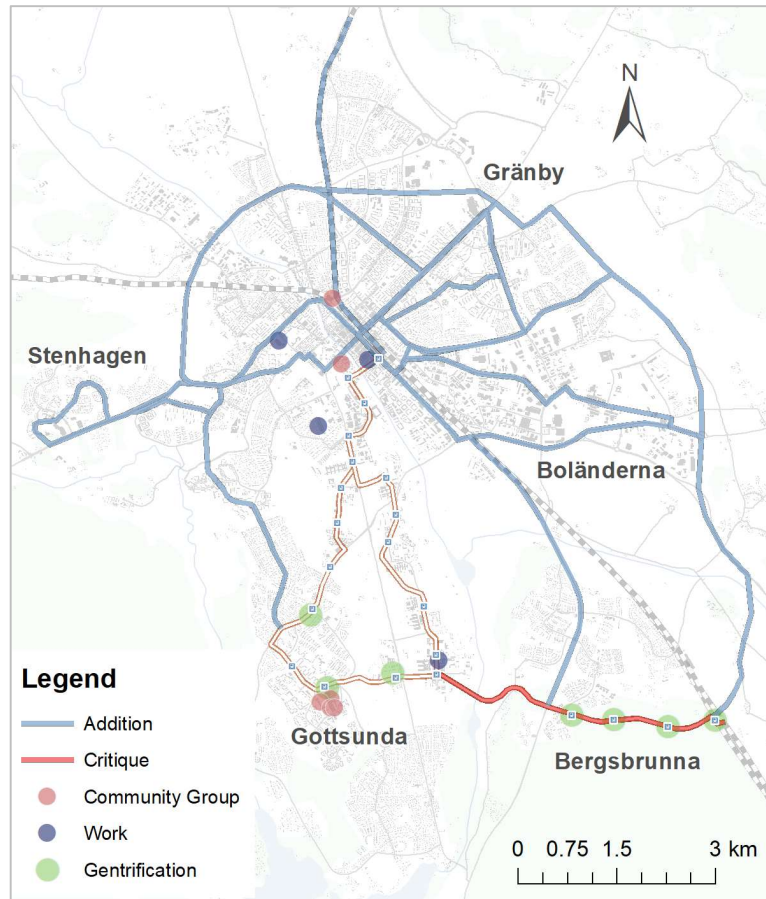


Figure 12. Collection of all participatory GIS spatial input.

4.3.1 Civic Engagement

Three out of five participants living in Gottsunda had not heard about the LRT. Besides the people having “heard of it for the first time [during the interview]”, others mentioned that they know of it because of friends or through the political party Moderaterna who advocated: “nej till spårvagn [no to the tramline]”. These people also noticed that “the kommun [municipality] has tried to change the outlook of the area and make it less of a ‘poor’ area”, noting urban renewal of houses, infrastructure investment, and striving for the area to not be a “problemområde [problem area] anymore”. They also note that they can easily see why LRT is in-line with these ambitions. People couldn’t recall seeing information about this on bulletin boards or through (e-)mail. All respondents living in Gottsunda noted that they would not know how to be involved in decision-making. Both participants who are employed in cultural organisations in Gottsunda knew most about the project and were surprised by the lack of knowledge from other participants:

“You would think [people know about the tramline], because the municipality has invested a lot of money to give people the information, but still. It’s so many people that you don’t reach, for example, [people] might have been living in Sweden for five years and you find out that

they're lacking so much knowledge of basic things that you kind of [assume] that they will know this. So, to enable them to take in the information like this well, some of them might know but the majority didn't know."

They further noted people with lower socio-economic status are less involved in decision-making:

"We had a big meeting in [the community centre] maybe six months ago. It was so many people in that room raising their voice against all these plans. Not one person from central Gottsunda renting their apartment, so it was like two 250 people from the surroundings from the villas and Valsåtra and Södra Gottsunda and maybe Bergsbrunna as well, I don't know. But you can see that there's a lot of people who are against it [...] and their voices are really strong, and I think that there are people who are positive, but you don't hear their voices so much"

The tendency of wealthier people to be more involved with decision-making is echoed by another participant, who noted that it could be because "they are afraid that if you build more houses [...] the value of their house will be lower". The quote also illustrates the apparent inability of some people to raise their voices, which was also noted by another interviewee, who prompted that the reasons could be "it's hard to express your opinion if it's not negative [because] it could be hostile to be vocal about it" and "If you were positive, you have already taken in the information and you [...] don't have to go to a meeting". People also note that Gottsunda residents could just have other things on their minds. This relates to both simply being too busy or struggling with "permits for citizenship [...] problems in school [...] can't find a job", noting that people need to experience some level of comfort before they start participating in communal decision-making.

Respondents were generally open to being more involved in decision-making and would like to see more participation by Gottsunda citizens. The extent to which differed, however. On one end, someone noted "I'm not the kind of person who would participate in this public stuff", noting that participation is related to one's identity. They were open to a referendum taking place to measure people's approval of LRT. Some mention referenda can imply simply being "more informed [...] and more integrated into the decision-making process". Three out of seven respondents suggested democratic voting on decision-making but leaving strategic decision-making to urban planners or environmental scientists: "I don't have so much information about how different lines could affect in a different way. I would keep that to the experts". Someone noted that "more information could be beneficial [...] like building a small model to visualise everything" could raise awareness of LRT impacts. Interviewees advocated for a more active approach to decision-making. One suggested gathering ideas and doing participatory exercises like this interview as input for decision-makers "to account better [for] current environmental and accessibility needs". Others noted a continuous form of appraisal, exemplified by an app or a polling station in public places where people can vote on the general outline or specifics of a project. The main reasons stated for a more participatory

decision-making process were representing people in Gottsunda and connecting people from different parts of the city in the decision-making process.

Particular critiques against the LRT concerned the cost and environmental impact of the PT extension to Bergsbrunna. In terms of expense: “I think this would cost very much before it is in place, and they could use that money for improving the already established bus system”. This notion was shared by another participant, who noted that they would prioritise connecting other parts of the city. Other participants also noted that the extension to Bergsbrunna will entail constructing a new line, which requires forests to be cut and wildlife to be disrupted. Practical suggestions for LRT critiquing the line to Bergsbrunna relate to cost efficiency and environmental protection. Someone mentioned, “Get rid of most of these stations [...] I see the point in the train station but why build tram places where no one lives?”. Another person, aiming at environmental protection, mentions the LRT line and the bridge over the Fyris river to preferably not going through forests or farmland and suggesting natural pathways over or under the line to connect ecosystems. Similarly, another person notes “They could just make it a tunnelbana [metro]” to ensure there are no barriers between ecosystems.

More commonly, people suggested the addition of lines or prioritising other areas than Bergsbrunna: “It would be much more interesting [for the line to go] to Stenhagen and Gränby and make it a whole Uppsala line, so you can go to the centre from every part of the city”. These lines are visualised in figure 12 in blue and go through other areas impacted by Miljonprogrammet. Four out of the total seven interviewees want to see Gränby connected more. Stenhagen, on the other hand, was noted by 2 participants. Another area that was mentioned that people wish to be connected by an LRT extension is Boländerna, the industrial area in the east of Uppsala, where two lines were drawn to. The most radical suggestion was an LRT ringway around the built-up area in Uppsala. The main reason noted for this request is “if you want to picture Uppsala as one city, you have to connect every part of the city [...] not just Gottsunda”. They also noted that “if I only have to use one ticket, I would never take my car [...] of course it’s a completely different investment [...] but if you could dream, that would be the ideal scenario”. The suggested drawn line is a ringway design that goes inwards in more populated areas, including Sävja (north of Bergsbrunna), Boländerna, Gränby, and Stenhagen. They also noted that it has the potential to go outwards for future city expansion.

5. Discussion

5.1 Bonding

5.1.1 Neighbourhood Identity & Gentrification

The ‘problem area’ narrative of Gottsunda was noted to define its neighbourhood identity. Gottsunda has a population group with relatively similar socio-economic backgrounds, largely consisting of foreign-born and low-income households (see figure 1). The interviewees’ notion that high earners move away from Gottsunda is echoed by Tunström *et al.* (2016), who note that social mobility away from Miljonprogrammet areas is common. These points are negatively reinforced by news outlets and feelings of unsafety, which diminish *bonding* capital (Forrest & Kearns, 2001). This narrative is associated with a perceived separation from Uppsala. The separation between neighbourhood and city could be explained by the relatively low axial integration of Gottsunda compared to other areas in the city with more prominent public cultural areas (see figure 8). This low *bridging* can heavily affect neighbourhood identity and *bonding* as well (Dixon *et al.*, 2022). The wish for an ‘Uppsala community’ could show that connectedness stretches beyond spatial exclusion but also involves attitudinal measures.

The separation of Uppsala and Gottsunda also implies a lack of cultural or architectural identity. Aesthetics and sensory access to unique architecture can improve at-homeness in a neighbourhood, which is currently mentioned to be lacking in Gottsunda (Montello, 2007). The 1960s design of public spaces, when Gottsunda was designed, generally negatively affect neighbourhood identity (Siláči & Vitková, 2017). On the other hand, urban green was often noted to define the identity of Gottsunda, which could indicate backed-up societal and personal benefits like stimulating a sense of belonging, collective wellbeing, and social engagement within the neighbourhood (Jennings & Bamkole, 2019).

Although the negative ‘problem area’ narrative was acknowledged, the interviewees recounted different experiences of living in Gottsunda. A strong neighbourhood identity and a shared sense of belonging caused interviewees to dismiss these negative expectations. Interviewees often mentioned seeing neighbours with similar international backgrounds, which would strengthen a sense

of at-homeness and belonging (Forrest & Kearns, 2001). To some extent, the high concentration of low-income and foreign-born demographics and rental apartments make Gottsunda a homogenous group, which could boost social cohesion and *bonding* capital (Vermeulen *et al.*, 2012; Claridge, 2018). This was also exemplified by the noted ‘warmth’ of people in the neighbourhood. Long-term citizens seemed to experience high social cohesion because they recounted strong feelings of inclusion and negated feelings of unsafety. This could indicate lacking social mobility within Gottsunda, although it does acknowledge the links between solidarity among groups with low wealth disparities (Forrest & Kearns, 2001). Low social mobility exemplifies how social segregation can be linked to spatial place attachment.

PT and connectedness to the city centre were noted to contrive neighbourhood identity. Although the axial integration of Gottsunda’s position in the PT network is low-to-moderate, figure 13 shows how PT in Gottsunda offers better reachability to a wider variety of destinations compared to communities in the north-east and north-west part of the city. Although this also covers *bridging*, the relatively strong neighbourhood identity, based on social cohesion, belonging, and at-homeness, can considerably strengthen *bonding* capital (Claridge, 2018). Areas with lower global axial integration usually tend to have higher *bonding* capital (Marcus & Legeby, 2012). The threat to *bonding* capital by the distinct separation between Gottsunda and Uppsala could, therefore, be balanced by a stronger neighbourhood identity of socio-economic similarity and spatial segregation.

Gentrification likely has limited potential to alter *bonding* and neighbourhood dynamics. No interviewee was weary of LRT leading to higher rents and cultural displacement, contrasting common notions of TIG (Dawkins & Moeckel, 2015, Derakhti & Beaten, 2020). The most apparent risks of gentrifying the area are based on ‘transport hubs’ around stations. These ‘hubs’, whose locations are approximated in figure 12, do describe a process of TIG, as areas around new stops tend to attract business activity and increase rent (Dawkins & Moeckel, 2015). This notion was more explicitly expressed for Bergsbrunna, where the line is newly constructed, and stations will provide considerable improvement in access to PT (see figure 11).

The cultural argument of ‘becoming the new Söder’ is a more prominent threat to gentrification in Gottsunda. A simultaneous expanse of cultural resources and increased axial integration after the LRT introduction (see figure 8), could attract more tourists and more high earners to move into the area, as the cultural expansion did in Södermalm in Stockholm (Franzén, 2005). Although a mixed society was desired by some interviewees, such development could threaten neighbourhood identity in Gottsunda and ultimately lower *bonding* capital (Tehrani *et al.*, 2019). Generally, the participants’ dismissal of gentrification in Gottsunda is linked with Padeiro *et al.* (2019), who suggest that gentrification is more associated with

existing local dynamics and housing policies than TOD. So, although gentrification can potentially limit *bonding* capital, its complex processes are difficult to determine.

5.1.2 Sociality and Co-presence

All respondents noted having rich social lives in or around Gottsunda. Besides Gottsunda, they also have social circles in Gränby and Stenhagen, where several participants mentioned they have social connections. These are areas with relatively high shares of foreign-born and low-income populations, like Gottsunda (see figure 1), and were mostly constructed during the Miljonprogrammet. Not only does this reinforce Miljonprogrammet areas being subject to higher spatialised social segregation, but it could also indicate that social relations are shaped relatively strongly by socio-economic status (Thörn & Thörn, 2018). This is in line with Xu *et al.* (2019), who note that people's status is more defining for social-network connections on the individual level, whereas spatial accessibility plays a more dominant role for groups. The negative relation between distance and contact intensity could also explain the respondents' tendency to have more social connections in the southwest and the centre of the city. Although the southwest is not highly integrated in the PT network according to axial integration (see figure 8), it is still spatially proximate to Gottsunda with either pedestrian or PT modes (see figure 13). This shows that the southwest part of the city is reachable within 20 minutes of travel. Accessibility is a major part of a network's integration, which could negate relatively low axial integration and explain which areas are more connected to Gottsunda, rather than the entire urban area of Uppsala (Legeby, 2010). The centralisation of social networks can result in spatialised or in socio-economic grounds for homophily (Newman & Dale, 2007; Xu *et al.*, 2019). This can limit Gottsunda from pairing *bridging* with *bonding* capital, as people are less likely to feel connected with other neighbourhoods of the city or with people with dissimilar socio-economic status. Likewise, this focus on *bonding* without enabling *bridging* can hinder organic inter-community co-presence and can reinforce spatialised social segregation.

When looking at the participatory GIS representation of where people go to community groups (see figure 12), it becomes clear that activities take place in Gottsunda Centrum and the city centre. A similar centralisation of recreation is often noted in ethnically diverse neighbourhoods (Vermeulen *et al.*, 2012). Activity centralisation can close social groups and reinforce homophily in a neighbourhood (Patulny & Svendsen, 2007). This can result in condensed *bonding* capital without room for *bridging* capital to grow. Koch *et al.* (2019) also note that Gottsunda Centrum plays a large role in the neighbourhood's activity centralisation. The relatively high local integration ensures that people do not need to travel to other areas to satisfy community and recreational needs. Although these activities can be

vital for the co-presence of dissimilar population groups, it can strengthen the homophily of social groups based on geographic location, which could considerably hinder *bridging* to balance *bonding* capital. (Xu *et al.*, 2019). The increased axial integration after the LRT addition (see figure 8), however, can imply more capacity for people reaching diverse community groups.

People's social activities in non-proximate neighbourhoods, such as the city centre, Stenhagen, and Gränby, can still improve the potential of co-presence due to long-distance travel. The low axial integration of Gottsunda and the southwest section of the PT network, as well as the lack of accessibility in the north and east, can withhold people from traversing to various parts of the city (Legeby, 2010). This limits spatialised integration through co-presence, as long-distance activities improve chances for social interaction. Mobility between Gottsunda, Gränby, and Stenhagen can foster co-presence simply by *bridging* distances in PT (Zülfe *et al.*, 2021). PT lines with high angular choice, such as the segment in the city centre and the segment leading up to Gränby (see figure 9), can facilitate the co-presence of dissimilar population groups and create new group identities (Morales *et al.*, 2019; Xu *et al.*, 2019). A lack of varied destinations to reach social relations can, therefore, reinforce strong *bonding* without balancing *bridging* capital. The ability of buses to foster familiarity with strangers was also acknowledged by the interviewees, which could be enhanced by the LRT addition. The visibility of dissimilar population groups could lead to clashes in assimilation and can limit Gottsunda to become more socio-spatially integrated (Valdez, 2014). Determining the full relation between the *bridging* potential of LRT and city-wide *bonding* is, therefore, complicated.

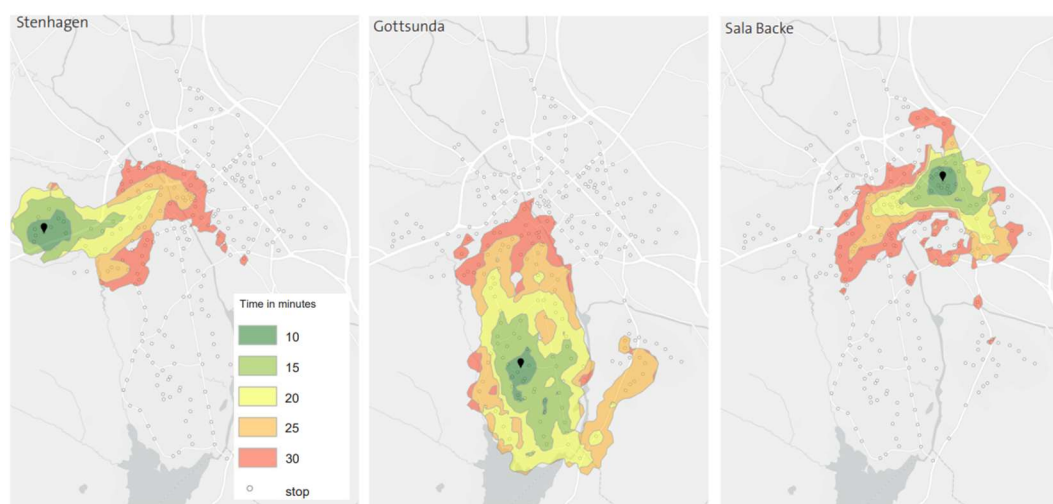


Figure 13. Network service area analysis, reachability with walking and PT in minutes (Legeby & Feng, 2022, p.98). Note: Gränby is slightly northeast of Sala Backe; the image on the right.

5.2 Bridging

People's choice of transport was based on a variety of determinants. Respondents opt for active modes of transport for short-to-moderate distances and PT of private motorised transport for longer distances. This is in line with common distinctions of transport choice, as distances over roughly 1 kilometre tend to be bridged by non-active modalities (Şimşekoğlu *et al.*, 2015). Active and public transport were also supported by more attitudinal values to modalities. Active modes were noted to be used because of bike infrastructure, which relates to accessibility (van Geurs & Wee, 2004). Ideals about exercise, flexibility, and low-emission transport also supported biking behaviour. Similarly, the convenience of PT and the lack of responsibility when traversing were noted to drive PT usage. Respondents were generally inclined to be averse to car use. This could be explained by the age of respondents, as older interviewees mentioned using the car more, which is generally the case (Şimşekoğlu *et al.*, 2015). Car use also risks inadaptability to PT, even if better connectivity is provided. These attitudinal motivators are aligned with general transport choice priorities.

Habits and attitudes toward modalities ultimately decide commuting routines. This is complemented by respondents' modal choice or destinations not changing much after the introduction of the LRT line, although it could substitute bus usage. This aversion to change could also be explained by little change in angular choice in segments within the local PT network (see figure 9), which makes it unlikely for existing bus- or LRT lines to be used more after the LRT introduction (van Nes & Yamu, 2021). People were, however, satisfied by the connectivity of the current PT network, especially toward the city centre. This is echoed by the relatively large PT reach from Gottsunda (see figure 13) and the moderate-to-high axial integration of Gottsunda after the LRT introduction (see figure 8). Improved integration and accessibility allow for enhanced opportunities where one can traverse to (Montello, 2007). These issues constitute positive *bridging* capital and ultimately are determined by accessibility.

5.2.1 Accessibility & Integration

Accessibility determines the *bridging* potential of a neighbourhood. This is dependent on the relation between location and destination, but also the integration and operability of a transport system and individual needs and constraints (van Geurs & Wee, 2004). Accessible destinations in urban space can be unnumerable but commonly consist of education, healthcare, employment, commercial services, transport, socio-cultural services, and urban green spaces (van der Ham, 2022). Education was not discussed much, but urban green was adequately met by surrounding forests and fields and contributed highly to *bonding* capital. The need for commercial and healthcare services was also adequately met by centralising

services in Gottsunda Centrum. Access to transport was similarly positively met by respondents, which corroborates with distances to PT stops (see figure 11) rarely being further away than 400 meters. The new LRT stops will not change access to PT much, though not much additional access is required by the respondents. These urban services were dominantly accessed by active modes of transport, such as walking and biking. The two remaining urban destinations, socio-cultural services and employment, are less one-dimensional, however.

Although people's socio-cultural destinations were mainly centred in Gottsunda Centrum, there was a strong desire for more cultural destinations. These destinations were either mentioned to be too far, in the city centre, not apparent at all, or too expensive. This is in line with van Geurs & Wee's (2004) land-use component of accessibility, which considers the amount and distribution of opportunities. If these resources are either too distant or not apparent at all, no amount of transport connectivity will be able to make this resource accessible. It could also imply a lack of public space, which would impose on co-presence potential with strangers (Schnell *et al.*, 2015). This lack of cultural resources implies a missed opportunity for both *bridging* and *bonding* capital, as it impedes on the ability to reach urban resources and it disallows for culture-based neighbourhood identity (Patulny *et al.*, 2007). If diverse activities do not exist, spatial integration is simply irrelevant to enhance accessibility and co-presence.

People's employment destinations are mainly localised in the centre of Uppsala but are slightly more dispersed (see figure 12). These destinations were mentioned to be relatively accessible. Respondents varied in modal choice for commuting, as biking, PT, and car use were mentioned to reach work. Employment-based transit is the most prominent routine travel behaviour and can therefore constitute recurring co-presence between dissimilar populations groups (Marcus & Legeby, 2013). Segments with high angular choice, such as the one in the city centre (see figure 9), have the potential to facilitate co-presence in PT (Legeby, 2010). Although choice will not change much after the light rail inclusion, the added axial integration could still improve the likelihood of people taking PT (see figure 8). This unchanged PT behaviour is also in-line with Gehl's (2011) distinction of destinations, which can either be necessary, optional, or social. Work typically falls under necessary destinations and will therefore not change much in the frequency of reaching this destination. Improved integration could still foster better *bridging* potential for optional and social destinations, however.

Travel behaviour can change more considerably for inter-city travel because of the potential of Bergsbrunna to integrate the local and the regional PT network after the LRT introduction. The angular choice of the northern segments in the regional PT network shows different values (see figure 10), indicating an increased likelihood for people to traverse through these segments (Yamu *et al.*, 2021). Although the LRT addition is still relatively low in angular choice, the LRT line

north of Gottsunda shows considerably higher angular choice (see figure 10). This could be paired with inter-city travel, as was noted by various respondents to be the main factor of LRT to change travel behaviour. Currently, as seen in figure 13, PT reachability from Gottsunda is impeded by the river running in the middle of the city. This was identified as a main barrier and could harm spatial integration between the southern parts of the city (Lefebvre, 1996). The additional connectivity of inter-city travel, *bridging* the south of Gottsunda, and increased capacity will likely further improve *bridging* capital.

5.2.2 Obstructions to accessibility: inoperability & affordability

Major complaints of the PT system were aimed at fluctuating operability, capacity, and frequency. Although these are not inherently spatial attributes, they still constitute the accessibility of PT, as it affects travel time and reliability (van Geurs & Wee, 2004). The capacity during peak hours, night-time frequency, and less reliability during the winter, impose on accessibility. These aspects are expected to be addressed by the LRT addition, as it promises more capacity, frequency, and better weather independence than buses (Uppsala Kommun & Region Uppsala 2021). The lack of capacity and reliability can impede on *bridging* potential that would otherwise be constituted by PT, which could be resolved by the LRT addition (Currie & Stanley, 2008).

The affordability of the current PT system was most often critiqued. Affordability is a major component of accessibility and can therefore exacerbate inequalities in spatial opportunity. The unaffordability of a PT system disconnects the transport component between the individual component of accessibility, as it fails to meet the opportunity of the individual based on income and travel budget (van Geurs & Wee, 2004). The current cost of a ticket is often seen as too high and is not mentioned to decrease after the LRT addition, making it a barrier for lower-income groups for reaching opportunities. This policy-based measure has been noted to be detrimental to ridership among varying socio-economic groups (Guzman & Oviedo, 2018). Lower ridership due to the unaffordability of the PT network is often linked to lower co-presence potential, both in PT and in public places (Currie & Stanley, 2006; Gray *et al.*, 2006). This barrier, linked with the high cost of cultural destinations, lowers *bridging* capital, as it prohibits access to certain services. Distributing accessibility by investing in PT subsidies can reduce accessibility gaps between socio-economic groups (Guzman & Oviedo, 2018). This investment could, therefore, increase PT ridership, allow people to connect to more varied destinations, and ultimately improve *bridging* capital.

5.2.3 Mappings Needs for Accessibility

The future scenarios of LRT brought up by interviewees addressed participants' concerns and needs for further accessibility. The main critique against the line was raised with ecological concerns, relating to the *bonding* capital of the neighbourhood identity of areas outside of Gottsunda (Jennings & Bamkole, 2019). Although additions to the light rail line were mainly based on individual needs, the locations of where they with LRT to go can generalise some trends.

Stenhagen in the west, Gränby in the northeast, and Boländerna in the southeast were noted as locations for light rail extensions (see figure 12). These areas are currently too far to bike and relatively far with PT, as noted by participants and seen in figure 13. The reachability from Gottsunda is still considerably larger than Stenhagen and Gränby, however, which implies less accessibility-based spatial integration of these areas (Legeby, 2010), even though they have similar low-income and foreign-born demographics (see figure 1). Both Gränby and Stenhagen have segments leading to them with high angular choice leading to them (see figure 9), which could imply ample possibility of co-presence when travelling to these areas due to the increased likelihood of passing through these segments (Yamu et al., 2021). Stenhagen has particularly low axial integration, however (see figure 8), making it harder to reach. The mapped lines also point to distributive issues of accessibility, as these areas show less spatial integration than Gottsunda, making them inherently socio-spatially segregated (Koch *et al.*, 2019). The additional LRT lines could provide more spatial integration of these areas.

Boländerna is an area with relatively low current axial integration, despite its central location, and has some proximate paths with high angular choice (see figures 8 and 9). This implies it is currently not well spatially integrated, but it has some co-presence potential in PT travel can occur (Yamu et al., 2021). This area is mainly characterised by commercial activity, which could indicate that Gottsunda might be lacking access to commercial services, even though this was not addressed in the interviews (van Geurs & Wee, 2004). All the areas are included in the ringway suggestion, which has additional lines connecting the centre to the ringway in various directions, which mainly corresponds with the desire to distribute access across the city and to ensure connectivity to all neighbourhoods (Pereira *et al.*, 2017). This ambition for distributive equality for all neighbourhoods in Uppsala further notes that *bridging* capital is not only a concern for Gottsunda, but also for other spatially segregated areas in the city. The mapping exercises did show that deliberation by local populations without expert knowledge is also inherently participatory, enabling it to foster *linking* capital as well (Aditya, 2010).

5.3 Linking & Participation

Although respondents were mostly approving of the addition of the LRT line, hardly any of the Gottsunda residents had heard about the project or knew how to participate in decision-making. The municipality has organised community meetings and spent effort on providing information, however, illustrating a gap in reaching certain population groups within Uppsala and potentially a disconnect between the municipality and Gottsunda citizens. This is a common gap between professionals and laypersons and, ultimately, the powerful and powerless (Carmona, 2010). As mentioned by respondents, people with higher socio-economic status were more likely to attend community meetings to discuss the project. People with lower socio-economic status commonly have a lower sense of ownership in community planning; the degree to which groups see their ability to influence decisions and are affected by the outcomes of decision-making (Mullenbach *et al*, 2019). Even in low-income neighbourhoods, higher earners tend to show more ownership and participation in new developments, which could be the same for the light rail addition and the potential of neighbourhood change. Both institutional and socio-economic gaps are detrimental to *linking* capital, as it withholds people from participating equally in the neighbourhood (Poortinga, 2012). Some interviewees considered participation as an extension of one's personal or neighbourhood identity, making *linking* a *bonding* issue.

Participants suggested various methods of future participation to make Gottsunda more involved in decision-making and to improve its *linking* capital, ranging from more information to temporary or continuous input. The suggested improvements for participation follow various degrees of informing, consulting, or community power in citizen participation (Arnstein, 1969). Current practices could either be regarded as non-participative, informing, or consulting. Currently, the municipality has the ambition to inform and consult in terms of open access information and a referendum, but that information fails to reach parts of the Gottsunda public. Extra consultation in terms of contextualised information through public inquiry, like opinionated surveys and referenda, was suggested by some respondents, which can improve *linking* the municipality and citizens through informed consent in decision-making (Carmona, 2010). Some respondents also suggested using the outcomes of the participatory mapping exercises to influence planning decisions. This could also empower people to align community values to deliberative outcomes and, therefore, increase *linking* capital (Aditya, 2010). Although these scenarios are more participatory, these gradations of participation still do not involve delegating decision-making power to neighbourhoods (Hanzl, 2007). Power delegation could considerably improve Gottsunda's *linking* capital by enhancing citizen participation and ensuring accountability of decisions made. It would entail investment in time, cost, and effort from the planners' side, however, making it difficult to implement for the LRT line, which is to be completed in 2029.

Generally, *linking* social capital in Gottsunda is quite poor. The respondents' lack of knowledge and perceived inability to contribute can considerably lower interaction between groups and across institutions (Claridge, 2018). Likewise, these issues of distributional power can constitute spatialised social segregation, as groups with lower agency are centralised in the same neighbourhood (Koch *et al.*, 2019). A noted willingness to participate more suggest that people have some agency that is currently not exercised. *Linking* capital is often lower in areas where people with dissimilar socio-economic backgrounds do not meet each other often (Teorell, 2003). Arguably, it could be linked to the generally similar foreign-born and low-income profile of Gottsunda (see figure 1) and could be boosted by a relative lack of axial integration compared to other areas of the city (see figure 8). Similarly, a lack of *bridging* capital and subsequent low possibilities of being co-present with people in dissimilar socio-economic groups can impose on willingness to take up political action in a variety of voluntary associations (Valdez, 2014). *Linking* capital and participation constitute a reinforcing feedback loop, where people who feel having less agency also show less civic participation (Teorell, 2003). To counter this, civic associations could be more present and visible and people's power to participate could be made clearer. The felt lack of agency also relates to *bonding* and *bridging* capital, as groups with higher social cohesion tend to organise themselves more and participate in civic decision-making to a higher degree (Forrest & Kearns, 2001). Improving *linking* capital, therefore, is dependent on a neighbourhood with diverse and strong social capital, making it a complex issue to tackle.

5.4 Limitations & Future Directions

The large amount of data gathered for this research project allows for many future directions to be taken in PT-based research. In future research, this data could simply be complemented by more respondents for better representation. Widening the research topic to account for the complexity of segregation, such as housing policies, social reproduction, or the impact of other transport modes could be touched upon further. Some findings brought up by respondents had less relevance to this research question but could be explored further in terms of their significance to societal impact. A dominant critique against the LRT expansion was based on ecological concerns. Although concerns like these contribute to an area's *bonding* capacity and *linking* capital, the ecological implications of cutting parts of a forest to make way for urban expansion could be researched further. Furthermore, topics such as the privatisation of PT and its effects on operability and affordability were touched upon but could be explored further in much greater detail when focused on separately. The implications of PT subsidies and the noted central ticket could also be elaborated on further. Coincidentally, Miljöpartiet (2023), a Swedish political

party, suggested a cheap and central ticket ‘Sverigekoret’ a week after the last interview was held. At the time of writing, this has not become a reality yet, but it opens the possibility for analysis. Furthermore, the temporal constraints of this research project did not allow for ex-post assessment of the LRT impacts, due to it not being finished for supposedly another six-to-seven years.

Temporal constraints also create possibilities for additional space syntax analysis in future research. For example, each contribution by the participatory mapping exercises could be analysed with space syntax to check their impact on axial integration or angular choice in the PT network. Common issues discussed in the interviews, such as operability, bus transfers, multi-modality, waiting times, capacity, and frequency are also not accounted for in traditional space syntax analysis, as all axes or segments ultimately have the same weight in analysis. Developing new ways to integrate space syntax analysis with these dynamics could, therefore, be a point for further methodological improvement. Similarly, inter-city transport was noted as mainly changing angular choice within the Uppsala PT network. This topic, however, is inherently inter-spatial, as it involves integration with other cities and regional scales. Space syntax ultimately requires certain spatial boundaries accounting for a specific urban area (Yamu *et al.*, 2021). Finding ways to overcome these strict spatial limits could advance space syntax analysis.

6. Conclusion

6.1 Spatialised Social Segregation and changes in the public transport network

Gottsunda is currently showing signs of reinforcing dynamics of spatial and social segregation. The neighbourhood has historically concentrated foreign-born and low-income groups in the same geographic area. This has caused the neighbourhood to have a relatively bad reputation and has resulted in unequal access to opportunities. This similarity in population causes Gottsunda to have a strong neighbourhood identity and generally strong *bonding* capital.

This strong *bonding* capital can impede *bridging* capacity to reach dissimilar population groups. Homophily, therefore, could be a main cause for the perceived separation between Uppsala and Gottsunda. The *bridging* potential of reaching opportunities from Gottsunda with PT are not insignificant, however. The neighbourhood is relatively well integrated into the PT network and accessibility to urban services is mostly satisfactory. However, the lack of access to some parts of the city and low angular choice in the southwest PT network currently limit the co-presence potential for Gottsunda residents. By far the largest barrier is formed by the unaffordability of PT. For better *bridging* capital, activity distribution could be diversified by improving cultural resources, widening connectivity throughout the city, and considering PT subsidies for equitable PT accessibility.

The introduction of the LRT line can somewhat socio-spatially integrate Gottsunda. It can improve *bridging* capital by integrating the PT network more in Gottsunda's favour and by providing better reachability south of the city. The LRT line can also facilitate co-presence at stops and in wagons. The southern extension to Bergsbrunna and its relevance to inter-city travel –to Stockholm– will probably change people's travel behaviour the most. This will likely not be paired with major modal shifts, although the LRT line can substitute the current bus system, as it provides better capacity, frequency, and reliability. Some areas will still likely be inadequately accessible, however, such as Stenhagen or Gränby. Nonetheless, the LRT line does not address affordability, the largest barrier to accessibility.

Bonding capital is not expected to be altered much. Besides the small risk of TIG around station communities, LRT seems to imply little risk of gentrifying Gottsunda, although it could be magnified by cultural land-use improvements. The

LRT line will likely not increase *bridging* so considerably as to compensate for the high *bonding* capital, meaning that the LRT line can alter some dynamics of spatialised social segregation but will be less impactful than investment in affordability and cultural resource diversification.

Linking capital is currently lacking and the participation in urban planning decision-making of lower-income groups in Gottsunda is a big issue to be addressed by urban planners. Besides issues relating to *bonding* and *bridging* capital, the lack of *linking* can exacerbate issues of integration, as hierarchical inequalities of power are left unaddressed. This heightens the severity of affordability issues, which can inhibit people's agency to participate. Solving this through equitable transport policy, as well as focusing on mixing the area more through, e.g., land-use or housing policies, can reorganise power differences in Gottsunda that go beyond spatial integration. Furthermore, these policies, and improved *linking* capital, can heighten citizens' sense of ownership in Gottsunda and can result in enhanced agency for new developments. The municipality could explore possibilities to increase *linking* capital by raising people's awareness of their participatory ownership and by evaluating possibilities of socially inclusive transport policies.

6.2 Spatially deterministic integration analysis & social participatory research

Determining spatialised social segregation with space syntax and social capital has shown that the two concepts are partially complementary. Overlap between the concepts occurs, as angular choice can spatially predict co-presence on certain routes, which could improve *bonding* capital, and axial integration can predict *bonding* by providing access to cultural resources and social relations. The spatial attributes of space syntax relate much more to *bridging*, however. As spatialised social segregation is an issue of distributive access, it could visualise inequalities in integration in various areas. Space syntax alone is too reductionist to determining socio-spatial segregation, however, it is not able to account for social complexities and non-spatial accessibility, such as homophily and affordability, which inhibit spatial *bridging* potential. Space syntax mainly seems to spatially contextualise *bonding* capital and social capital can socially contextualise spatial *bridging* possibilities. *Linking* capital is harder to investigate using space syntax methods, but participatory mapping does enable further space syntax analysis.

Generally, social capital seems to be a more global concept where space syntax partially fits into, but neither social capital nor space syntax can fully determine socio-spatial integration based on people's relation to PT networks. For a better understanding of the complexities of spatialised social segregation, the combination of these two concepts and missing links needs to be researched further.

7. Bibliography

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Appendix A. Interview Guide

Attitude

Checklist	Prompts
At-homeness in Gottsunda	Why have you decided to live in Gottsunda?
Trust in neighbours	How do you describe what it's like to live in Gottsunda to people outside of Gottsunda?
Neighbourhood character	If you had to move, what would you miss the most from the neighbourhood?

Personal Relations

Checklist	Prompts
Homophily	How close do your friends/family live?
Access to social relations	How do you reach them? Are you active in a community group?

Access to Resources

Checklist	Prompts
Usage of PT	When did you last use public transport? For what, how did it go? Do you often use public transport?
Thoughts about the line	What do you think of the current bus lines?
Changes in PT behaviour	What are areas that you can't easily reach which you wish you could? <i>After mapping</i> , considering your A-to-B, do you think the line would help you in reaching people/work/groups? If this LRT line is implemented, how do you think it will change the way your everyday travel?
Mapping	If you go to organisations/clubs/religious groups, where are they?
Mapping	Where do you go to work?

Gentrification

Checklist	Prompts
Neighbourhood character	Do you think the introduction of the LRT line might change Gottsunda?
Property prices	
Mapping	Do you think the tramline will attract more business (where)?
Mapping	Do you think property values might increase in some areas

Civic engagement

Checklist	Prompts
Participation in decision-making	<p>Have you heard of the new tramline? How did you hear about it?</p> <p>Do you discuss it with your friends/neighbours? About what?</p> <p>Have you had a say in decision-making of this project? (would you like to, would you know how to, have you been contacted?)</p>
Agreeance with project	Do you agree with this proposed version of the LRT line?
Possibilities for participatory appraisal	Do you feel like the municipality needs to consider this kind of information in plans in general?
Mapping	Would you like to see an added bus/LRT stop added somewhere in Gottsunda?
Mapping	<i>If disagreed</i> , where would you put the LRT line?
Mapping	If you could draw your dream tramline for you and your community of this map, what would it look like? (explain choices they make)

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