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Resilient Rotterdam

Determining Potential Resilience of Neighborhoods Through Social Capital

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Introduction

When disaster strikes and hits a city it affects the various communities in it, although the extent to which each of them is affected varies greatly. In regard to disasters, a common phenomenon, that often does not receive much attention, is the difference in disaster response and recovery of the communities and where these differences stem from. During and after disasters, it can be observed that some neighborhoods would not only respond better to the immediate threats than others, but also show a faster recovery (Aldrich, 2010, 2012a, 2012b). An example of the former, are the often-observed immediate responses by next of kin and neighbors, who help evacuate or rescue immobilized elderlies much faster and sooner, than any international rescue mission could arrive on scene (Aldrich, 2010, 2012b; Aldrich & Meyer, 2015). Another example of this could be observed after the Kobe, Japan earthquake of 1993, where local citizens formed bucket brigades and looked for survivors (Aldrich, 2010) as well as during the 2011 earthquake, tsunami and nuclear meltdown, during which many of the elderly and infirm were saved by assistance from neighbors, friends and family (Aldrich, 2012b, Aldrich & Meyer, 2015). Similarly, there are several cases, showcasing fast recovery after disasters. After the 1993 earthquake in the Kobe region, 80% of its manufacturing and exports were restored back to pre-disaster levels within a year of the disaster. This could also be observed in Tamil Nadu in India, where after the severe damages of the 2004 Sumatra- Andaman earthquake, almost all schools were rebuilt and 75% of damaged houses repaired, within a year after the disaster (Aldrich, 2010). All these cases exemplify that some communities have a better response and faster recovery rate than others. Therefore, the question to ask, is how is it possible, that after a disaster some neighborhoods have recovered within a year, while others are still struggling?

To have some insight into these questions we use the example of a New Orleans neighborhood a year after hurricane ‘Katrina’. Many neighborhoods were left untouched and employment was lower than 2/3 of the pre-disaster state (Aldrich, 2010). Besides the infamous first response and handling right after the floods, much of the city was struggling to rebuild and recover. But there was an exception: The Village de l’est neighborhood in New Orleans. This predominantly Vietnamese neighborhood managed to respond and recover much faster than less damaged and richer neighborhoods (Aldrich & Meyer, 2015). As an explanation to this fast recovery was the theory that the high social capital within the neighborhood is the driving force for this recovery rates (Airriess, Li, Leong, Chen & Keith, 2008). From evacuation to relocation and recovery,

the interaction between co-ethnic social capital with church-centered institutionalized social capital was the driving force for all these developments (Airriess et al., 2008). This exemplified how through strong communal ties, real life help is synthesized and the advantage this can have.

When trying to understand local differences of disaster response and recovery, most approaches make use of the same few variables: damage, governance, socioeconomic status, and aid (Aldrich & Meyer, 2015). While all these are helpful and can provide some insights, most focus on external factors and do not consider interactions and relations of the population and how they may affect the response and rebuilding of a community. A new approach to local differences in disaster response and recovery, was put forward by Aldrich in 2012(b). Through his own experiences during the landfall of hurricane Katrina in New Orleans, Aldrich became inspired to investigate the mechanics of disaster resilience and recovery, and how the interactions with social capital could explain local differences between neighborhoods in their resilience and recovery (Aldrich, 2012b). Aldrich proposed that in order to achieve resilience, social capital needs to be considered.

The present study aims to reverse and operationalize social capital as a possible predictor of resilience and recovery. Since the suggestion to use social capital as part of pre-disaster planning (Aldrich & Meyer, 2015) only a handful of studies have attempted to do so (Kyne & Aldrich, 2019; Niehof & Kuipers, 2017). In a similar fashion, this study attempts to determine the potential resilience by means of social capital of each neighborhood in the city of Rotterdam, The Netherlands. For this, Aldrich's framework of combining social capital and resilience, will be applied to approximate social capital on a neighborhood level via publicly available data.

Based on Aldrich's body of work, the present study looks to determine the potential resilience profiles of the neighborhoods of Rotterdam. Trying to answer the research question:

How likely are Rotterdam's neighborhoods to be resilient, based on their social capital?

Academic and Societal Relevance

This study aims to further advance the concept of combining social capital with resilience, through the operationalization of Aldrich's findings (2012 and more) to employ social capital as a resilience factor. With the intention to establish social capital as part of resilience efforts, the focus is on two things: 1) The possibility to reliably and validly approximate social capital ranging from a neighborhood, to the entirety of a country and 2) make sure that these approximations can be made through the utilization of publicly available data. This study aims to advance these two central components of establishing social capital through showing the possibility to acquire reliable social capital scores through the use of publicly available data. Further, this study aims to advance the development of a standardization of this process. Following the insights offered by this, the study aims to advance the field of in-depth analysis of a city's resilience through utilizing social capital.

Lastly this study hopes to provide societal relevance from the possibility that through the analyzing and understanding of social capital scores, neighborhoods and cities might be able to increase their resilience through social capital. The findings of this study might be used to develop specific policies which could increase the overall quality of life within specific neighborhoods, if not the city. Further this study attempts to demonstrate a new way of assessing potential needs of neighborhoods and offer solutions to help with shortcomings, to ultimately, using all these measures to increase neighborhood resilience.

Thesis Outline

In the first chapter, the underlying theoretical framework will be highlighted. This includes the theory and history of social capital, as well as the different types thereof. In this, a particular focus is put on the contributions by Putnam, but also consists of other views on social capital. Further, the combination of social capital and resilience, as proposed by Aldrich (2012b) and the exact function of social capital will be introduced. In the second chapter the subject of the study, the city of Rotterdam, is introduced as well as the used measures to capture social capital. In addition, the used methods to compile, standardize and transform the data are shown. In the third chapter, the results of the transformed data are shown. It further substantiates the exact steps that are required, to transform the raw neighborhood scores into profiles that can highlight individual strengths and weaknesses. In the fourth chapter, the previously created profiles will

be used to judge the potential resilience of Rotterdam neighborhoods and make suggestions how to possibly increase resilience.

Chapter 1 - Theoretical Framework

This study aims to advance previous research (Aldrich & Kyne, 2019; Niehof & Kuipers, 2017) through replicating and extending these efforts to Rotterdam. To better understand the background of this study as well as the origins of the applied framework, the core concepts will be introduced. This will be done through an introduction into the writings of Putnam (1993, 1995, 2000). Further, the different types of social capital will be introduced and an overview of different views on social capital is given. Through this, we will move towards the connection of social capital and resilience as proposed by Aldrich (2010, 2012b).

Social Capital

Conceptually, social capital has a long history, given the complexity and vastness of the terminology, parts of the term's history and its synthesis will be explained ahead. Within this section, a selection of ideas and concepts is introduced as they allow for the comprehension of this topic.

The term *social capital* was first mentioned in the 1916 writings of Hanifan, where it described the quality of fellowship and social interactions within groups or families. Since then, the concept was adopted multiple times by other disciplines and in different decades (Bourdieu, 1983; Jacobs, 1961), but never became too popular.

Putman's Theory of Social Capital

The term and concept were ultimately popularized by Putnam, who introduced the term through an elaborate case study of Italian society (1993) followed by a second case study in the United States (1995; 2000). The basis for the Italian case studies (1993) are the differences in economic and societal development that can be observed in Italy between the North and south. Putnam (1993) argues, that since the governmental structures in both regions are identical, there needs to be an underlying reason for these differences- which he identified in the long-existing social structures that can be found in the north but are lacking in the south. He found, that the long tradition of guilds, clubs and community in the north paved the way for larger civic involvement, strong social ties and economic success. In contrast to the southern regions of Italy, being a rural and agricultural society with less communal ties and less social capital. He concludes, that while on paper all the local governments were the same, they varied in efficiency, and that this was determined through "longstanding traditions of civic engagement".

For this research, Putnam measured social capital/ civic engagement through several different proxies such as voter turnout, newspaper readership, membership in societies or clubs. He found that these measures were indicative of successful regions, rather than a result of the economic wealth of regions. Putnam (1993) concludes that the mechanism, through which social capital advances communities, is the increased strength of social networks. A strong social network improves coordination and communication while leading to collective actions.

In his 1995 follow-up essay 'Bowling Alone: Americas Declining Social Capital' (which was extended into the 2000 book *Bowling alone: The collapse and Revival of American Community)* Putnam applies the same logic to the United states. There, he focusses on what he perceives as a decline of social capital in a society that once pioneered it. He documents the decline in social capital through several metrics, such as membership in clubs and as hinted in the articles name, *bowling leagues.* The observation of Putnam was, that despite more Americans bowling than ever, the participation in bowling leagues steadily decreased. While more solo bowlers would go to the rinks, the large regular groups stayed away. This implies, that when the bowling leagues and weekly gatherings started declining, so did the connections between the people. When going to a bowling alley alone, the chance of getting acquainted with other players is a lot lower compared to attending a (local) league. More so, where bowling alleys might have worked as a meeting ground for new acquaintances, they are now representative of the isolation and lack thereof. Putnam concludes, that the social capital in the US has been slowly but steadily degrading and finds a number of reasons for this.

He mainly aims for societal changes, that despite their importance and merit, have significantly changed communities, such as women becoming full members of the workforce. As Putnam (1995) puts it, it is very plausible, that through this social revolution, the "…time and energy available for building social capital" had been reduced. Referring to the many of the previously maternal considered tasks, such as participating in Parent Teacher Associations and holding a position in a volunteer organization or group (e.g. The Red Cross). Membership, in these traditional 'female' organizations, had halved since the late 1960's (Putnam, 1995). More so, a similar effect to the same size could be observed a decade later for men's organization, which according to Putnam could be a chain-reaction triggered by the female liberation. As more tasks became available in the household, men now have less time to participate in organizations themselves. In addition to this, Putnam suggests that the increased mobility led to a decrease in social rootedness. What Putnam calls the 're-potting' hypothesis, describes how through

moving more frequently, people disrupt their roots while it takes a while to form new ones. Through the continuous moving, long established connections and networks seized existing. But Putnam does not only blame societal changes, he also focused on the changed demographics in the US since the 1960's. Putnam notes that a decrease in marriages and an increase in divorces, less children and lower real wages could have a negative effect on civic engagement. As it appears that married middle-class family were overall more connected within their community, the disappearance of such is problematic. More so, the changes in scale of the economy, from local to global and from small stores to large supermarkets also might play a role in a slow disconnect between neighbors and communities. To add to the sociological and demographic changes, Putnam names the 'technological transformation of leisure', mainly describing the change from communal activities towards more private and individualized. Previously, free time offered a good chance of building social capital which rapidly declined through the wide spread of television.

While being very vast in describing the extents of social capital and its decline, Putnam (1995) does little to show the effects of this reduction rather than give examples of dwindling memberships. And besides some statistics, much of the evidence of the decline seems anecdotal and to follow the desire to understand, how and why society has changed so much. In his conclusion, he suggests a few measures which require further research as to further stop the decline of social capital. Most notably, is the urge for the development of dimensions in which social capital can be distinguished. He argues for this, as social capital has a multitude of facet's which require separation. A specific focus should be put on the type of networks and what collective actions and social identities they inspire. Once these dimensions are identified, a pro-active approach towards the increase of social capital would be more feasible.

Types of social capital

As noted by Putnam (1995), social capital as a broad measure is not nuanced enough to cover all of its facet's. For this study, social capital will be separated into three types: Bonding, bridging and linking social capital. Two of these (bonding and bridging) were used by Putnam (2000) who found the typology useful while a third type (linking) was added by Woolcock (2000) and utilized by Aldrich (2010, 2012b).

Bonding social capital

The concept of Bonding social capital was first introduced through Gittel and Vidal (1998) who sought to differentiate further between different types of social capital. Bonding social capital describes the immediate connections of people with their surroundings. Close ties, like family, shared heritage, neighborhood, race, cultural background, or socioeconomic status that are based on shared traits. In this context, these similarities are often referred to as *homophily*[1], describing that the attraction lies in the similarity (Putnam, 2000). For this, Kyne & Aldrich (2019) note, that 'our closest friends and contacts often share our language, ethnicity, culture and class'. It is believed that it is the similarity of a group's members that leads to the building of a network (Putnam, 2000). Putnam (2000) attests Bonding social capital the ability of mobilizing solidarity. Which can be observed in the support that is generated in ethnic enclaves for less fortunate members. Bonding social capital can be understood as a sort of glue, that provides strong loyalty within groups but can at the same time lead to antagonism with outer-group members.

Bridging

Bridging social capital is a concept, that is focused on looking outward of the community. Where bonding is based on similarities, bridging connects individuals on a less intimate level and works as an extension of one's personal network. As such, it can be seen as a person's weaker ties that connect them with people of other ethnicity or occupational background (world health report, 2000). Bridging social capital is associated with attending churches, service groups, being a member in sports clubs or organizations like the boy/girl scouts. (Aldrich, 2012; Putnam, 2000). Bridging social capital often results out of the usage of shared spaces in which interactions occur that usually would not happen (Aldrich & Meyer, 2015; Kyne & Aldrich, 2019). Through these interactions, the personal networks (bonding social capital) are connecting, leading to much larger reach as a result. Bridging networks work well for the linkage of external assets and spread of information. It also is helpful in finding help, which the immediate circle cannot provide. According to Putnam (2000) Bridging social capital is more helpful when trying to find jobs as it leads to opportunities outside of a persons established circle.

[1] Due to the connotation of the word with homosexuality, this term will further be referred to as *homogeneity* to avoid confusion.

Linking

Linking social capital is a later addition to the forms of social capital by Woolcock (2000). It was introduced to extend social capital through a vertical dimension. The focus of linking social capital, is describing the connections (links) that members of communities have to people with influence in formal institutions, such as the municipality, banks or the police (Gillis, Shoup & Sicat, 2001; Woolcock, 2000). Linking social capital was added, as to acknowledge the importance of a connection between communities and their police, municipality, or politicians. The reason for adding a new type of social are the limits that bonding and bridging social capital will eventually run into. Connections of linking social capital are helpful to facilitate immediate help and communicate the most urgent needs. Usually these ties result out of participation of individuals within local government or through continuous interactions with representatives (Kyne & Aldrich, 2019).

The Dark Sides of Social capital according to Putnam

After the success of his 1995 article and with the publication of his 2000 book, Putnam changed several of his outlooks on social capital. Most importantly, he ventured into the potential dark sides of social capital. Where in previous writings, social capital was a purely positive concept which could explain social problems (1995) or economic disparities (1993) this changed. Bonding social capital can lead to several caveats. One of them being, through the strong influences of groups that are homogenous, diversity is not encouraged. Further, the overly reliance on bonding social capital can lead to a lack of social mobility. For example, when looking for a job, bridging social capital allows for better chances to advance (Putnam, 2000). Strong social capital of a community can further prove problematic for outsiders. When it comes to joining a community, strong ties within a community might not allow for new people to join. This could lead to people being left out of the communal advantages (Putnam, 2000).

Other Theories of Social Capital

Communitarian view

The communitarian view was held by Fukuyama (1995, 1997) and Putnam (1993, 1995) during the beginning of his exploration of social capital. In this view social capital is connected to the amount of organizations, clubs or groups that exist in each region. It is assumed, that the more of these institutions exist, the higher is the social capital. While this belief is also found in other views, the communitarian view separates itself through the assumption that social capital is

inherently good. They further assume that social capital is the more of it there is, the better and that it always has a positive effect on a community. These effects can either be economically (Putnam, 1993) or socially (Putnam, 1995). The communitarian view has advanced the analysis of poverty through identifying the importance of social ties in overcoming strains, as noted by Dordick (1997) noted, that the 'poor' still have something to lose, each other.

Through all these positive outlooks, proponents (Putnam 1993, 1995) of this view overlook the possible downsides of social capital. Those can be observed in isolated communities or groups that work against the collective interests of society, for example in *ghettos, gangs* or local *organized crime groups*. Especially structures of organized crime might offer many of the perks which come with social capital, despite having a negative effect overall. Further, the view does not consider the possible exclusion, discrimination and inequality within communities that can result out of a heightened social capital. Especially the hindering effects that result from community pressures and old traditions show, that there can be downsides (Narayan & Shah, 1999). This can be observed in many rural, close tied communities that are hardly accessible to outsiders and progressive ideas stifle. Notably, with the 2000 publication of his book *Bowling Alone*, Putnam changes his views on the extent of social capital. He now separates social capital into different types and focuses on some of the negative effects, that social capital can have.

Networks view

The networks view (Burt 1992, 1997, 1998; Portes, 1998; Portes & Sensenbrenner, 1993) attempts to account for both the up and down sides of social capital and points to the importance of both horizontal and vertical connections between communities, individuals and organizations. While highlighting the importance of connective ties within a community, the network view acknowledges limitations of social capital. This is done through the separation of social capital into bonding and bridging, describing intra- and intergroup connection. This separation is important, as this view considers the limits of each type of social capital. In an example, Woolcock and Narayan (2000), mention small business loans in poor communities. When starting small businesses mostly rely on bonding social capital through providing services to their immediate surroundings. But this (bonding social capital) eventually reaches a limit and new customers need to be found. This is, where through bridging social capital, the customer base can be expanded, and emerging entrepreneurs get to advance. Ultimately, this

example illustrates the possibilities of rising out of poverty through utilizing both forms of social capital available.

Social capital in this view, is approached in a more balanced approach, while it can offer new economic opportunities to members of the community, these same claims can swing into obligations and commitment, which can have negative economic consequences. Additionally, a stronger separation of the sources and consequences of social capital is proposed, which aims at the possible losers of high social capital. While in the communitarian view the focus lies on the advantages of social capital, the networks view embraces the possibility that these might come at an expense. While this view succeeds in explaining developments and acknowledges both up and down sides of social capital it falls short when considering the larger economic and social effects that come from social groups. Through mainly considering the effects of social capital on the involved groups, a larger view is not possible. As such, proponents of network view do not believe in measuring social capital on a larger scale such as on the societal or national level (Portes, 1998). As within this view, benefits of group activity are usually only considered for directly involved members rather than for society or the community at large (Woolcock & Narayan, 2000). Further, the networks view does not allow for the incorporation of institutions at the societal level and their ability to shape communities. While acknowledging possible negative effects of repressive policy, the positive aspects of good community relations to the institutions are widely ignored (Woolcock & Narayan, 2000). This means, that this view and understanding of social capital do not go far enough, as their focus is too close on the networking facet.

The institutional view

Where the communitarian & network views were very reliant on the individual and communities' influences on social capital, this is turned around in the institutional view. Both the communitarian and networks view treat social capital as in independent variable, that will influence the individuals and communities (Woolcock & Narayan, 2000). Within the institutional view, social capital is a dependent variable, that arises out of the quality of institutions that is above them (North, 1990; Woolcock & Narayan, 2000). Proponents of the institutional view (Knack & Keefer, 1995, 1997; Skocpol, 1995) argue, that community networks are mainly a product of its political environment. Rather than arguing for the absence of regulations, the institutional view promotes the idea that societies rise to the level that they are encouraged (Skocpol, 1995).

As such, the ability of social groups to form and advance can only succeed if it is enabled by institutions. Within this view, government social capital is of utmost importance for the advance of society and the creation of sustainable structures. These structures in turn, lead to more stable countries and societies. So, while other views propagate a ground-up approach in their views, the institutional view propagates a top-down model. This views wide scope, is its biggest weakness: through focusing on large and often slow measures, it falls behind on the small interactions that happen within society on the daily. While it might hold true, that in a failed or corrupt state, social capital builds a lot slower than in other countries, this theory loses focus of the individuals in the countries that do not have the ability to keep waiting for improved policy.

Aldrich's theory on the Effects of Social Capital

Within Putnam's writings, social capital was a concept that was determined through participation in society and allowed for understanding economic (1993) and societal (1995, 2000) developments of regions or countries. In the same spirit, other researchers were looking at other possibilities to work with social capital and link its effects to new fields.
Areas where social capital has been extended to, include public health where Szreter and Woolcock (2004) found a connection between eroding social capital and reduced life expectancies. Others, like Aldrich (2010, 2012a, 2012b) ventured into disaster research and investigated why some regions recovered faster after disasters than others.

Aldrich (2010, 2012a, 2012b) mentions that social capital may be used to determine crisis preparedness and resilience. The theory is based on the findings by Aldrich (2012b) about the possible link in between social capital and improved crisis response and recovery. Aldrich drive to develop a theory on social capital came as a consequence of his personal experiences with Hurricane Katrina in 2005, since he could observe the effects of social capital on crisis response firsthand. Because of this, Aldrich investigated past disasters, the process of recovery and the possible effect of social capital, and the results of this analysis were published in the 2012 book *Building resilience: Social capital in post-disaster recovery*. In this book, Aldrich elaborates on the concept of social capital as a driving force for explaining a phenomenon: after disasters, some regions recover faster than others. His theory for this, is that social capital moderates a faster and more efficient response during a disaster and helps with recovery. Data and evidence for this theory is taken from his fieldwork in regions that experienced disasters. Aldrich

(2012b) used interviews to gather direct reports of the immediate responses of victims as well as recovery efforts. Through the analysis of archival data, such as participation on elections etc. he was able to approximate a score of social capital. What Aldrich found, was that regions, that scored higher on measures of social capital had a better immediate response during disaster as well as a faster recovery after disaster.

According to Aldrich (2012b), the informal & formal ties that come with a high social capital are the reason for this effect. As such, the social capital, and the network of inhabitants in regions it represents determines its response and recovery. The way this works, is that through each of the three different types of social capital (*bonding, bridging and linking*), a different aspect of response or recovery is facilitated. Generally speaking, *bonding social capital* is the first resource, individuals can count on in case of a disaster (Aldrich & Meyer, 2015). Bonding social capital helps with receiving warnings, preparations, supplies immediate aid and helps with the first recovery (Hawkins & Maurer, 2010). This holds especially true for family or next of kin, which frequently serve as the first line of help and assistance (Aldrich & Meyer, 2015). It was shown that bonding social capital reduces the chances for individuals to seek out aid from organizations during disasters (Haines, Hurlbert & Beggs, 1996). It also was discovered, that during the Earthquake, Tsunami and nuclear Meltdown in 2011 in Japan, many first responders were either family or neighbors which helped with the evacuation (Aldrich & Meyer, 2015). In contrast, a lack of bonding social capital is shown to slow first response. In a study of the 1995 heat wave in Chicago, Klinenberg (2003) found, that isolated, elderly individuals were most likely to die and not be discovered for days when their bonding was low, this held especially true for poor members of the African American community. In contrast, elderlies of the similarly poor Hispanic community, with higher social capital, were less likely to die and not be discovered. While bonding social capital is often the first resource of help, it certainly can not cover all needs in times of distress. And while bonding social capital is the most attainable resource for a quick response, research shows, that *bridging social capital* influences recovery (Aldrich & Meyer, 2014).

Just as in societal and economic scenarios, bridging social capital offers a chance to obtain resources that cannot be provided by the immediate network (Aldrich & Meyer, 2014). With its thinner connections and further reaches, it has the potential to provide access to information and services, that can help with recovery in the long run (Hawkins & Maurer, 2010). Examples of this include friendships and connections that span through race and socioeconomic status or

community. These are often facilitated by institutions such as churches, which in case of a disaster are able to organize aid. Further, it was shown, that members of social groups received more help after hurricane Andrew (Haines, Hurlbert & Beggs, 1996). *Linking social capital*, is especially important when a community needs help that both bridging and bonding social capital cannot help with anymore. In cases like this, it is important to have a link to an institution or higher-up, which can send the needed help. The importance of this could be observed in Tamil Nadu after the 2004 tsunami and earthquake, during which many coastal towns were flooded. Aldrich (2012b) discovered, that the towns that had previously interacted with a community representative were able to organize recovery efforts.

If social capital promotes recovery, then there is no need to wait for a disaster to show which communities are more vulnerable than others. Even more so, there should be an aim to find out what can be learned from communities with stronger ties. Considering the proposed connection between resilience and social capital, it should be possible to use social capital to assess potential resilience. In this light, this study aims to shed light on the feasibility and the importance of investigating social capital *before* a crisis or disaster occurs. Through the use of social capital scores, defense- and emergency plans can be more precise and focused on the specific needs and account for potential strengths of specific neighborhoods or cities. In addition, to the determined needs and qualities of each neighborhood can inspire resilience related actions before the occurrence of disasters. As such, the social capital scores of each neighborhood can be used to determine potential weaknesses and allow for pre-emptive measures.

Chapter 2 - Method and Data

In this chapter, the used measures to capture social capital as well as their background are introduced. To gain a better understanding of the subject of the study, a short overview of the city of Rotterdam is given stating the most relevant facts. Ultimately, the used formula to standardize and transform the neighborhood measures is elaborated on as to allow for replicability.

As shown by previous research (Kyne & Aldrich, 2019; Niehof & Kuipers, 2017), it is possible to determine scores of social capital through the evaluation of publicly available data as proxies. Like these past studies, this study will utilize existing public data, such as census data or surveys, regarding subjective measures on life in neighborhoods/ city. Using this data as proxies for social capital, the aim is to approximate a social capital measure for each neighborhood. The values of each neighborhood will be compared through using a statistical software (IBM SPPS, Microsoft Excel) and computed into overall scores for each neighborhood. Once data is collected on all neighborhoods, profiles will be created to discuss the neighborhoods. These profiles will address the different distribution and concentration of social capital and the implications in the neighborhoods. Also, the profiles will be the foundation for specialized recommendations, what measures could be taken to improve.

Scope of the Study

The Subject of this study is the city of Rotterdam. Rotterdam is in the Province of South Holland and part of the metropolitan region of Randstad. With the official population as of January 1st, 2020 being 650597 registered citizens and it's 324 km2 size, Rotterdam is the second largest city in the Netherlands[2]. In addition to this, the city features Europe's largest cargo port, the Port of Rotterdam. With 10.9%[3] of the population below the poverty line, Rotterdam is the poorest city of the Netherlands, as well as the most industrial (Van den Berg, 2012) and the most diverse city[2] in the Netherlands. In regard to its demographics, more than

[2] Demographic data retrieved from www.onderzoek010.nl (July 20th, 2020)
[3] Derived from 'Sociaal en Cultureel Planbureau', https://digitaal.scp.nl/armoedeinkaart2019/waar-wonen-de-armen-in-nederland/ (July 20th 2020)

one third of Rotterdam's population (38,92%[4]) have a non-western background compared to a national average of 11%. In order to tackle some of the problems of the city, the municipality is working on improving the city and increase quality of life (Van den Berg, 2012).

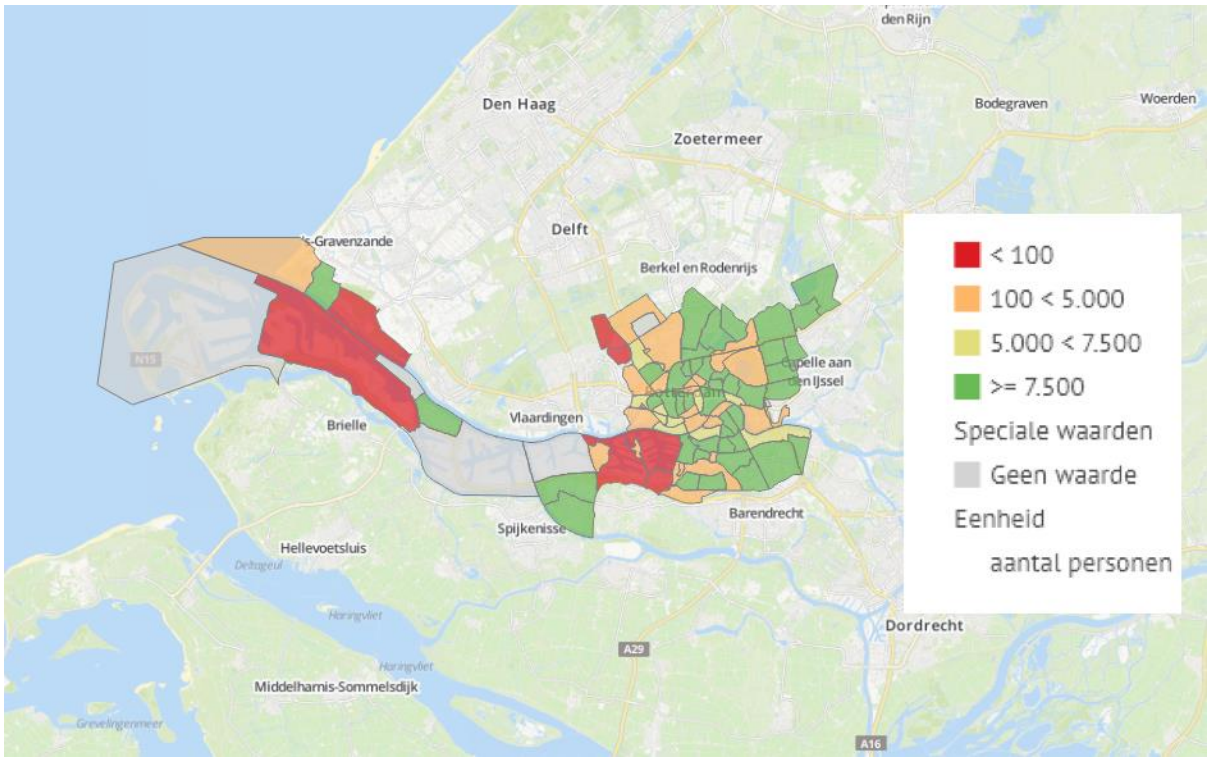

Figure 1. *Rotterdam neighborhoods; Population per neighborhood as of 01.2020.*
Source: www.Onderzoek010.nl

With the declared goals to tackle the city's poverty and crime, the municipality is slowly re-shaping the city. Central to this is the intention to have the lower income population relocate to other municipalities (Van den Berg, 2012). The declared desired new residents for the city are YUPP's an acronym for young urban professional parents, preferably dual-earning (Van den Berg, 2012). As a result of this measures, the city has been extending some efforts into the development of neighborhoods. On the one side through deliberately reducing social and affordable housing and on the other side through the development of new real-estate that is marketed to young families (Van den Berg, 2012). In addition to these measures, the largest University in the city, Erasmus University, has grown substantially in the past 5 years. When there were 23.990 students enrolled in the university in 2015, this number increased to 29.558

[4] Demographic data retrieved from www.onderzoek010.nl (July 20th, 2020)

in 2019[5]. This is mainly due to an increase in international students which are joining English language bachelors and masters programs. Through this, more students are moving to the city which has led to observable effects on the housing market[6]. Overall, it can be said, that Rotterdam is an everchanging city, which slowly tries to free itself from its industrial character and re-invent itself.

Data

Following the notion, that all data should be sourced from publicly available sources, all used data comes from two of the city's websites that are specialized in compiling data and making it accessible. These two websites are *www.onderzoek010.nl* and *www.wijkprofiel.rotterdam.nl.* The data used in this study, was exclusively sourced and compiled through these statistic outlet portals. The city of Rotterdam employs 2 separate systems, which at times complement each other. As such, Onderzoek010.nl offers an overview on most of the city's statistics which allows comparison between neighborhoods, boroughs and allows for comparison to other Dutch cities. The portal summarizes most findings and studies that were done for the purpose of reports such as the state of the youth. It allows the user to access many different data which can be displayed just as the user wants. Unfortunately, this portal is limited by the reports and studies the city commissions. After contacting the city's statistician office, I was pointed to the Website *Wijkprofiel.nl*. This website is managed by a third-party research company, that is tasked by the city to research differences between neighborhoods and score them. The topics of this research circle around the Physical, Safety and Personal experience in each neighborhood. The results of this are then presented in profiles. While the end product between this research and our own differ, there is a certain overlap between the data that is used. After an ongoing exchange of emails, a complete summary of their used data and results was handed over to me. The neighborhood profiles that are created for this study, are based upon data from both outlets.

Despite Rotterdam having 91 neighborhoods altogether, collecting data on all of them is not possible. This is in part due to the large size of the port and the city limits following the Nieuwe

[5] https://www.erasmusmagazine.nl/2019/10/23/opnieuw-stijgt-het-aantal-studenten-aan-de-eur/ .Retrieved on July 20th, 2020.
[6] https://www.erasmusmagazine.nl/en/2019/10/04/no-end-in-sight-to-the-student-housing-shortage-in-rotterdam/ .Retrieved July 20th, 2020.

Waterweg to the Sea. Due to this, there are several neighborhoods with populations ranging from 0 to 64. This also applies to the neighborhood of 'Kralingse Bos', which is in the north-end of the city. As the name indicates, this district is mainly a forest with the city's largest lake and functions as a park for the locals. As such, this park has an official population of 109 and there are no meaningful statistics on it. Other areas this applies to, is the neighborhood of Europort with a population of 2 or Emmshaven with 17 registered citizens. Other times, for some of the city's larger neighborhoods no data was found for all of the variables. In these cases, the decision was made to remove those neighborhoods. While it limits the study's results, it allows for more coherence. Due to this reasoning these neighborhoods were left out. Other neighborhoods that were removed due to incomplete datasets were: Charlois, Groot Ijsselmonde Nord & Zuid, Kralingen Oost & Bos, Oud Mathnesse, Witte Dorp, Nieuwe Werk and Dijkzigt. A complete overview of the analyzed neighborhoods and their population can be found table 1.

Table 1. Population as of January 1st, 2020 – Neighborhoods of Rotterdam

Neighborhood	Population	Neighborhood	Population	Neighborhood	Population
Afrikaanderwijk	8272	Terbregge	3442	Tussendijken	7362
Agniesebuurt	4231	Lombardijen	14240	Vondelingenplaat*	0
Bedrijvenpark Noord_West*	4	Maasvlakte*	0	Vreewijk	14576
Bedrijventerrein Schieveen*	0	Middelland	11992	Waalhaven*	2
Bergpolder	8200	Molenlaankwartier	8249	Waalhaven Zuid*	12
Beverwaard	12262	Nesselande	12780	Wielewaal	402
Blijdorp*	10454	Nieuw Crooswijk	3435	Witte Dorp*	593
Blijdorpsepolder*	169	Nieuw Mathenesse*	632	Zestienhoven*	3514
Bloemhof	14241	Nieuwe Werk*	2086	Zevenkamp	16094
Bospolder	7127	Nieuwe Westen	19517	Zuiderpark	1275
Botlek*	0	Noord Kethel*	65	Zuidplein	1302
Carnisse	11753	Noordereiland	3362	Zuidwijk	13906
Charlois Zuidrand*	450	Noordzeeweg*	0		
Cool	5664	Ommoord	25721	**Total Population**	**650597**
CS Kwartier	1026	Oosterflank	10580	**Total Population Selection**	**568404**
De Esch	4621	Oud Charlois	13846		
Delfshaven	7165	Oud Crooswijk	8166		
Dijkzigt*	710	Oud IJsselmonde	5992		
Dorp*	7912	Oud Mathenesse*	7196		
Eemhaven*	17	Oude Noorden	17034		
Europoort*	2	Oude Westen	9613		
Feijenoord	7604	Overschie	6845		
Groot Ijsselmonde*	28846	Pendrecht	12229		
Heijplaat	1604	Pernis	4886		
Het Lage Land	10989	Prinsenland	9824		
Hillegersberg Noord	7922	Provenierswijk	4688		
Hillegersberg Zuid	8058	Rijnpoort*	64		
Hillesluis	12035	Rivium*	0		
Hoogvliet Noord	12848	Rozenburg	12511		
Hoogvliet Zuid	22333	Rubroek	8294		
Katendrecht	5596	s Gravenland	8302		
Kleinpolder	8056	Schiebroek	17059		
Kop van Zuid	2753	Schiemond	5390		
Kop van Zuid - Entrepot	8100	Schieveen*	337		
Kralingen West	16060	Spaanse Polder	101		
Kralingen Oost*	8203	Spangen*	10432		
Kralingse Bos*	109	Stadsdriehoek	16940		
Kralingseveer	1636	Strand en Duin	2402		
Landzicht*	384	Struisenburg	5578		
Liskwartier	7703	Tarwewijk	12610		

Neighborhoods marked with asterisk (*) were removed from the dataset due to lack of data

As a result of incoherent data, a total of 63 neighborhoods were selected for the analysis. In terms of population, this covers data of 568404 of the city's 650597 inhabitants. While a full scope of all the city's neighborhoods would have been preferred, the city's unique composition made this hard. It can therefore be assumed, that enough of the city's population and neighborhoods is represented through this analysis.

As established by previous research (Kyne & Aldrich, 2019; Niehof & Kuipers, 2017), social capital will be captured in three types. For each of these types, a selection for proxies was made. It is important to point out, that this selection is in no way exhaustive and is only capable of showing facets of each type. Given the explorative nature of the study with the aim to compare individual neighborhoods, being selective on the measures is imperative. Since Rotterdam is comprised of a total of 91 neighborhoods, 63 of which we are analyzing, it was decided to limit the measures for each dimension of social capital. This is, so to limit the amount of vast data that otherwise would occur because of attempting to use as many measures as possible. The selection for which measures were used will be elaborated on in the respective section.

Method

When trying to approximate social capital scores, there are different ways to determine it. For this research, with the aim to use publicly available sources, social capital on the neighborhood level will be assumed through several proxies. When trying to find social capital scores we will rely on several different determinants that allow an approximation of social capital. The used statistics aim to represent cognitive measures of social capital, such as through the perception of the neighborhood and the satisfaction of living with neighbors. Further, this study uses behavioral measures of social capital by utilizing statistics that measure these aspects. For example, through the participation in voluntary work or attendance of religious services. Once these measures are collected, they are standardized and transformed so that a comprehensive profile can be created for each neighborhood. These profiles are based on the three types of social capital and how the neighborhood has scored in each type.

Bonding Social Capital

Bonding social capital is mainly influenced by homogeneity, shared interests, and connections to people within proximity (Putnam, 2000; Aldrich, 2012b, Aldrich & Meyer, 2015). The used proxies for bonding social capital, represent some of the core principles that are behind this

type of social capital. To approximate a score of Bonding social capital, the following measures were picked as proxies: The percentage of inhabitants of a neighborhood, that 1) have weekly contact with their neighbors and 2) have weekly contact with other persons within their neighborhood and 3) the percentage of people that feel connected to their neighborhood. A list of the used proxies can be found in table 2.

These measures were chosen, as they capture perceived quality of life and the connections of inhabitants with their close neighbors and other members within their community (Kyne & Aldrich, 2019, Niehof & Kuipers, 2017). The measure of weekly contacts with other people in the neighborhood was added to have a better perception of the connections within the whole area. While there is somewhat of a redundancy with the measure of weekly contacts with neighbors, this offers a good possibility to double-check this measure. Through the extension of connections, this further allows for measuring connections of individuals in their whole neighborhood. A test of correlation further showed a significant connection (r= .872, sig = 0.000) which indicates a strong relation of the two measures and that they represent the same measure.

Table 2. Used measures for capturing bonding social capital

Measure	Social Capital	Justification
Weekly contact with neighbors	Bonding	Putnam, 2000
Weekly contacts with people in the neighborhood	Bonding	Putnam, 2000
Feeling connected to the neighborhood	Bonding	Niehof & Kuipers, 2017

Bridging social capital

Bridging social capital has a wider focus and is aimed at the connection's residents have with other residents that differ in class, social background or area (Putnam, 2000). Since this cannot be directly measured, the used proxies for it are focused on voluntary activities, participation in cultural events and the coexistence of ethnicities within the neighborhood (Kyne & Aldrich, 2019; Niehof & Kuipers, 2017).

To capture the social connections the percentage of volunteers, attendees of religious events, attendees to hobby clubs and visitors of cultural events are used (Aldrich, 2012b; Aldrich & Meyer, 2015; Kyne & Aldrich, 2019; Niehof & Kuipers, 2017; Putnam, 2000). All these measures can capture the interactions between citizens. During these gatherings, networks are extended into new circles and acquaintances are made. Through this, the weaker ties of inhabitants with other people, that are not explicitly in their neighborhood, can be observed

(Putnam, 2000). Further, the indication if different ethnical groups are getting along, captures the very core of bridging social capital are the ties in between people and groups stronger than their heritage. This allows for a judgement if the connections within the neighborhood are solely based on homogeneity. The exactly used statistics can be found in Table 3 with their justification.

Table 3. Used measures for capturing bridging social capital

Measure	Social capital	Justification
Volunteering	Bridging	Norris et al. (2008)
Visits to cultural events	Bridging	Perkins & Long, 2002; Wandserman, 2000
Ethnical groups are getting along in my neighborhood	Bridging	Niehof & Kuipers, 2017
Visits to religious events	Bridging	Chamlee-Wright (2010)
Visits to hobby clubs	Bridging	Perkins & Long, 2002; Wandserman, 2000

Linking social capital

Given the complex nature of linking social capital, finding determinants is not as straightforward. Linking social capital captures the vertical links between the local population and their local authorities or representatives (Woolcock, 2000; Aldrich, 2012b). Rather than just ties, linking social capital is about the local population being able to rely on their representatives, and local authorities. These unique ties are not captured easily, so measuring these ties needs a specific set of proxies. The used proxies follow the principal of capturing parts of the population's opinion and connection to their local governments. Through using the available data on election participation, the interest in politics can be inferred (Aldrich, 2012b). Further, the data on trust in both the municipality & Local commission can in addition help to contrast these outcomes. Used measures can be found in Table4.

Table 4. Used measures to capture Linking social capital

Measure	Type of Social Cap.	Justification
Election participation	Linking	Aldrich, 2012
Trust in the Municipality	Linking	Niehof, 2017
Trust in the local administration	Linking	Niehof, 2017

Standardization of data

The aim of this study is the determination of potential resilience of neighborhoods through (public) statistics. For this, every neighborhood will receive a score on 3 types of social capital as well as an overall social capital score. These scores will then be used as a basis for prediction

of resilience. With all the used data being percentages, they cannot be used as determinants outright. To achieve comparable scores, these percentages require a standardization and transformation beforehand.

All of the used data comes from the city's survey's and is recorded in percentages. These percentages indicate what part of a neighborhoods surveyed population agrees with statements or sees them applicable to themselves. When using percentages, the logical maximum values are 100% and 0%. Under this assumption, the percentages could be transformed easily through using cut-off points based on the natural minimum or maximum values. But since these extreme values are only seldomly achieved, a formula will be used to allow for a standardization that accurately depicts the scores and allows for comparison. This is also to ensure, that measures with less range can show a meaningful value. For this reason, every used statistic will be converted individually.

For the standardization and conversion of scores, an established approach (Niehof & Kuipers, 2017) is used. First, for each statistic, the mean, median and standard deviation are calculated through statistical software. The values are standardized through a formula to determine the categories and their cut-off values for each variable. Once the cut-off points are determined, they can be used to transform the percentage score to a categorical number.

The formula utilizes the median score and standard deviation of each measure. The decision to use the median instead of the mean is based on the discovery of several outliers while scanning the raw data. Due to this, it was decided to rely upon the Median instead of the mean (Niehof & Kuipers, 2017) for the standardization. When a variable has outliers, its median can be a better indicator of the overall tendencies of the dataset. Since the mean is calculated through the dividing the sum of all values through the number of values, values that are multiple times larger or smaller than other values can have a skewing effect on the mean. Relying solely on the mean can be quite misleading, therefore the median can be used to achieve a more balanced overview. Rather than relying on the sum of all variables divided by the number of cases, the median marks the middle of a dataset. It marks the point, between two halves of the dataset of the same size. Through using the value that falls exactly in the middle, the median is less prone to skewness than the mean. The standard deviation is a representation of the dispersion and variation of values that the variable is made up off. A lower standard deviation indicates that

most values fall close to the mean, while a high standard deviation indicates that the values are spread out further from the mean.

The standardization formula utilizes the median score and standard deviation of each measure. To determine the baseline scores, half a standard deviation is added or subtracted to determine the category called ‘moderate’. If a percentage value falls in between these points, it can be labeled as ‘average’. In written form, this looks like this:

The upper cut-off point for ‘moderate score’= Median + standard dev. * 0.5

The lower cut-off point for ‘moderate score’= Median – standard dev. * 0.5

So, if a neighborhood has a median percentage of **60%**, with a standard deviation of **5** the formula would look as follows:

$$60 + (5*0,5) = 62,5$$

$$60 – (5*0,5) = 57,5$$

With this example, the range for the category ‘moderate’ is:

$$62,5 – 57,5.$$

For the category, ‘below moderate’, a similar formula was used: From the lowest result that would fall into the ‘moderate’ category, the standard deviation is once again subtracted:

$$57,5 – 5 = 52,5$$

With this example, the ‘below moderate’ category ranges from:

$$57,5 – 52,5.$$

Similarly, the category ‘above moderate’ is calculated using the highest value of the ‘moderate’ category and adding the standard deviation:

$$62,5 + 5 = 67,5$$

With this example, the ‘above moderate’ category ranges from:

$$67, 5 – 62,5.$$

In addition to this, there further are scores that are ‘far above moderate and ‘far below moderate’. For these ‘far above’ scores, all values are included that are higher or lower than the ‘above moderate’ and ‘below moderate’ cut-off points.

With this example, the category ‘far above moderate’ is any value higher than:

$$67,5.$$

Similarly, the category ‘far below moderate’ is comprised of every score below:

$$52, 5.$$

Chapter 3 - Results and Scores

Within the result section, the used statistics and steps will be highlighted. First, the overall results of the selection of neighborhoods are shown, utilizing these descriptive statistics, the cut-off points are shown. Based on this transformation, the social capital scores for all analyzed neighborhoods will be shown. Based on these scores, profiles are created that highlight the individual strengths and weaknesses of each neighborhood.

Descriptive statistics

When looking at the descriptive statistics, a picture of the selected neighborhoods is sketched and coming together. Based on these results, some observations on the analyzed neighborhoods can be made. It can be seen, that on average, 50% of the local population has weekly contacts with their neighbors and on average, 23% of residents are active as volunteers. The whole extent of the descriptive statistics can be found in Table 5.

Table 5. Descriptive statistics for the used measures

Concept	Study Indicator	N	Mean	Median	Std. Dev.	Min	Max
Bonding							
Weekly contact with neighbors	Bewoners met wekelijkse burencontacten [%] [2018]	63	50,71%	52,00%	9,48%	27,00%	69,00%
Weekly contact with people in neighborhood	Bewoners met wekelijkse contacten met overige buurtgenoten [%] [2018]	63	28,00%	29,00%	7,33%	12,00%	44,00%
Connection to neighborhood	Zich verbonden te voelen met buurt [%] [2018]	63	56,33%	54,00%	11,73%	34,00%	87,00%
Bridging							
Active volunteers	Bewoners dat actief is als vrijwilliger [%] [2018]	63	23,40%	23,00%	4,73%	15,00%	38,00%
Ethnical groups get along	% bewoners dat zegt dat de omgang tussen etnische groepen in de buurt goed is	63	43,21%	44,00%	8,44%	25,00%	60,00%
Religious gatherings	% bewoners dat maandelijks levensbeschouwelijke of religieuze bijeenkomsten bezoekt	63	16,65%	16,00%	6,94%	5,00%	38,00%
Bridging							
Cultural visits	% bewoners dat maandelijks culturele voorzieningen bezoekt	63	15,21%	15,00%	4,62%	2,00%	25,00%
Attendance of hobby clubs	% bewoners dat maandelijks een hobbyclub of vereniging bezoekt	63	23,44%	23,00%	6,23%	11,00%	39,00%
Linking							
Participation communal elections 2018	Opkomst Gemeente Verkiezingen [%] [2018]	63	45,84%	45,10%	11,94%	26,00%	75,00%
Trust in local government	% bewoners dat zegt vertrouwen te hebben in gebiedsbestuur	63	47,77%	48,00%	7,27%	22,00%	62,00%
Trust in municipal government	% bewoners dat zegt vertrouwen in gemeentebestuur te hebben	63	56,27%	58,00%	9,60%	23,00%	73,00%

Cut Off Points

Following the calculations of means, medians and standard deviation, the values were standardized. Given that all these measures are based on percentages, they required a transformation which would allow for comparison and calculation of a score. As described, the values were standardized through the addition/ subtraction of the standard deviation to find out which category the percentage would fall into. The exact cut-off points, as well the median and standard deviation that were used to determine them, can be found in Table 6.

Table 6. Cut off points for standardization

Variable	**Far above moderate (5)**	**Above moderate (4)**	**Moderate (3)**	**Below moderate (4)**	**Far below moderate (5)**	**Median**	**Std. Dev.**
Bonding							
Weekly contact with neighbors	> 66,22%	66,22% - 56,74%	56,74% - 47,26%	47,26% - 37,78%	< 37,78%	52%	9,48%
Weekly contact with people in neighborhood	>40%	40% - 32,67	32,67% - 25,34%	25,34% - 18,01%	<18,01%	29%	7,33%
Connection to neighborhood	> 71,6%	71,6% - 59,87%	59,87% - 48,14%	48,14% - 36,41%	< 36,41%	54%	11,73%
Bridging							
Active volunteers	> 32,1%	32,1% - 27,37%	27,37% - 22,64%	22,64% - 17,9%	< 17,9%	23%	4,73%
Ethnical groups get along	> 56,66%	56,66% - 48,22%	48,22% - 39,78%	39,78%- 31,34%	< 31,34%	44%	8,44%
Religious gatherings	> 26,41%	26,41% - 19,47%	19,47% - 12,53%	12,53% - 5,59%	< 5,59%	16%	6,94%
Cultural visits	> 21,93%	21,93% - 17,31%	17,31% - 12,69%	12,69% - 8,07%	< 8,07%	15%	4,62%
Attendance of hobby clubs	> 32,35%	32,35% - 26,12%	26,12% - 19,89%	18,89%- 13,65%	< 13,65%	23%	6,23%
Linking							
Election participation 2018	>63,01%	63,01% - 51,07%	51,07% - 39,13%	39,13%- 27,19%	< 27,19%	45,10%	11,94%
Trust in gebieds bestuur	> 58,89%	58,89% - 51,63%	51,63% - 44,37%	44,37% - 37,11%	< 37,11%	48%	7,26%
Trust in Gemeente bestuur	> 72,35%	72,35% - 62,76%	62,76% - 53,21%	53,21% - 43,62%	< 43,62%	58%	9,59%

Using these ratios, each of these categories was given a value, between 1-5. Since these assigned values stem from a process that used the median values and standard deviations, the score of a neighborhood is more than just an indication how good or bad a neighborhood scored objectively, but of its state compared to the other neighborhoods. This helps counter the assumption of a 100% maximum or 0% minimum, values that in this data-set never occurred

(see Table 5). If a measure had less variance and a smaller range, this was represented within the cut-off points through utilizing the standard deviation.

Social Capital Scores

Once the score categories were created and the percentages transformed to values, this allowed for the calculation of social capital scores. Similar to past research (Kyne & Aldrich, 2019) these scores can then be used as indicators, how well each neighborhood performed on each type of social capital.

Transformation to a comparable scale

To capture social capital in its 3 types, a number of different variables were utilized. Given the differences in variety and availability, there is a varying number of variables per type of social capital. Due to this, simply adding the scores is not possible. This could lead to misleading results where the sum is influenced by a good or bad performance in one type of social capital. These simple additions of scores, can be found in the table as 'raw score' for each of the 3 types of social capital, as well as for the total score. To avoid this, the raw-scores were transformed to a 10-point scale. Depending on the number of variables, this was done by dividing the raw-scores by $1/10^{th}$ of the highest possible sum. These transformed scores for each type of social capital as well as for the total score, can be found as 'Transformed score' in table 7.

For example, in the case of Afrikaanderwijk (See table 7.), the sum of standardized scores was 9 for bonding-, 17 for bridging- and 8 for linking social capital. The raw sum of these three variables is 34. But due to the higher number of proxies for bridging social capital, this sum does not allow for any conclusion. To allow for this, the scores need be transformed so to be indicative of the scoring. For Bonding and Linking, which each contain 3 proxies, the highest possible score would be 15. This means that the raw sum needs to be divided by 1,5 to transform it to a 10-point scale. For Bridging, which contains 5 proxies, the highest possible score is 25. Therefore, the raw-score for bridging needs to be divided by 2,5. These calculations for the transformed score look as follows:

Bonding: 9 / 1,5 = 6
Bridging: 17 / 2,5 = 6,8
Linking: 8 / 1,5 = 5,3

This leads to total social capital score for Afrikaanderwijk:

$$6 + 6{,}8 + 5{,}3 = 18{,}14$$

This example shows the advantage of this process. On the first look, the raw bridging score is twice as high as the bonding and linking scores. This could lead to the assumption, that the neighborhoods bridging social capital score is very good. But after transforming and controlling for the weight of the variable it becomes apparent that the three scores are rather similar. All of the transformed scores as well as the total can be found in Table 7.

Table 7. Social capital scores for all neighborhoods separated into three types of social capital

Neighborhoods	Bonding			Bridging			Linking			Total Scores		
	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score linking	Raw Sum	Transformed Score (SUM)	Z-score
Afrikaanderwijk	9,00	6,00	-0,01	17,00	6,80	0,96	8,00	5,33	-0,29	34,00	18,13	0,14
Agniesebuurt	7,00	4,67	-0,79	16,00	6,40	0,52	9,00	6,00	0,10	32,00	17,07	-0,24
Bergpolder	5,00	3,33	-1,58	16,00	6,40	0,52	10,00	6,67	0,48	31,00	16,40	-0,47
Beverwaard	10,00	6,67	0,39	15,00	6,00	0,08	7,00	4,67	-0,67	32,00	17,33	-0,14
Bloemhof	9,00	6,00	-0,01	11,00	4,40	-1,67	7,00	4,67	-0,67	27,00	15,07	-0,93
Bospolder	9,00	6,00	-0,01	17,00	6,80	0,96	11,00	7,33	0,87	37,00	20,13	0,83
Carnisse	5,00	3,33	-1,58	12,00	4,80	-1,23	5,00	3,33	-1,44	22,00	11,47	-2,18
Cool	5,00	3,33	-1,58	15,00	6,00	0,08	9,00	6,00	0,10	29,00	15,33	-0,84
CS Kwartier	5,00	3,33	-1,58	13,00	5,20	-0,79	4,00	2,67	-1,82	22,00	11,20	-2,27
De Esch	8,00	5,33	-0,40	18,00	7,20	1,40	8,00	5,33	-0,29	34,00	17,87	0,04
Delfshaven	6,00	4,00	-1,19	20,00	8,00	2,27	8,00	5,33	-0,29	34,00	17,33	-0,14
Feijenoord	6,00	4,00	-1,19	15,00	6,00	0,08	5,00	3,33	-1,44	26,00	13,33	-1,53
Heijplaat	11,00	7,33	0,78	14,00	5,60	-0,35	8,00	5,33	-0,29	33,00	18,27	0,18
Het Lage Land	8,00	5,33	-0,40	17,00	6,80	0,96	10,00	6,67	0,48	35,00	18,80	0,37
Hillegersberg Noord	12,00	8,00	1,18	20,00	8,00	2,27	13,00	8,67	1,63	45,00	24,67	2,41
Hillegersberg Zuid	12,00	8,00	1,18	19,00	7,60	1,83	13,00	8,67	1,63	44,00	24,27	2,27
Hillesluis	8,00	5,33	-0,40	13,00	5,20	-0,79	5,00	3,33	-1,44	26,00	13,87	-1,35
Hoogvliet Noord	11,00	7,33	0,78	16,00	6,40	0,52	6,00	4,00	-1,06	33,00	17,73	0,00
Hoogvliet Zuid	11,00	7,33	0,78	17,00	6,80	0,96	8,00	5,33	-0,29	36,00	19,47	0,60
Katendrecht	11,00	7,33	0,78	14,00	5,60	-0,35	9,00	6,00	0,10	34,00	18,93	0,41
Kleinpolder	9,00	6,00	-0,01	14,00	5,60	-0,35	7,00	4,67	-0,67	30,00	16,27	-0,51
Kop van Zuid	4,00	2,67	-1,98	12,00	4,80	-1,23	12,00	8,00	1,25	28,00	15,47	-0,79

Neighborhoods	Bonding			Bridging			Linking			Total Scores		
	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed Score (Sum)	Z-score
Kralingen West	8,00	5,33	-0,40	14,00	5,60	-0,35	11,00	7,33	1,63	33,00	18,27	0,18
Kralingseveer	14,00	9,33	1,96	16,00	6,40	0,52	6,00	4,00	-1,06	36,00	19,73	0,69
Liskwartier	10,00	6,67	0,39	15,00	6,00	0,08	14,00	9,33	2,02	39,00	22,00	1,48
Lombardijen	9,00	6,00	-0,01	13,00	5,20	-0,79	8,00	5,33	-0,29	30,00	16,53	-0,42
Middelland	8,00	5,33	-0,40	15,00	6,00	0,08	11,00	7,33	0,87	34,00	18,67	0,32
Molenlaankwartier	12,00	8,00	1,18	15,00	6,00	0,08	15,00	10,00	2,40	42,00	24,00	2,17
Nesselande	12,00	8,00	1,18	18,00	7,20	1,40	10,00	6,67	0,48	40,00	21,87	1,43
Nieuw Crooswijk	7,00	4,67	-0,79	15,00	6,00	0,08	11,00	7,33	0,87	33,00	18,00	0,09
Nieuwe Westen	9,00	6,00	-0,01	16,00	6,40	0,52	9,00	6,00	0,10	34,00	18,40	0,23
Noordereiland	10,00	6,67	0,39	16,00	6,40	0,52	7,00	4,67	-0,67	33,00	17,73	0,00
Ommoord	10,00	6,67	0,39	16,00	6,40	0,52	10,00	6,67	0,48	36,00	19,73	0,69
Oosterflank	8,00	5,33	-0,40	13,00	5,20	-0,79	7,00	4,67	-0,67	28,00	15,20	-0,88
Oud Charlois	9,00	6,00	-0,01	13,00	5,20	-0,79	7,00	4,67	-0,67	29,00	15,87	-0,65
Oud Crooswijk	7,00	4,67	-0,79	14,00	5,60	-0,35	7,00	4,67	-0,67	28,00	14,93	-0,98
Oud IJsselmonde	10,00	6,67	0,39	16,00	6,40	0,52	8,00	5,33	-0,29	34,00	18,40	0,23
Oude Noorden	8,00	5,33	-0,40	15,00	6,00	0,08	7,00	4,67	-0,67	30,00	16,00	-0,61
Oude Westen	9,00	6,00	-0,01	19,00	7,60	1,83	8,00	5,33	-0,29	36,00	18,93	0,41
Overschie	10,00	6,67	0,39	15,00	6,00	0,08	9,00	6,00	0,10	34,00	18,67	0,32
Pendrecht	10,00	6,67	0,39	16,00	6,40	0,52	6,00	4,00	-1,06	32,00	17,07	-0,24
Pernis	14,00	9,33	1,96	15,00	6,00	0,08	8,00	5,33	-0,29	37,00	20,67	1,02
Prinsenland	11,00	7,33	0,78	14,00	5,60	-0,35	10,00	6,67	0,48	35,00	19,60	0,65
Provenierswijk	7,00	4,67	-0,79	13,00	5,20	-0,79	11,00	7,33	0,87	31,00	17,20	-0,19
Rozenburg	12,00	8,00	1,18	11,00	4,40	-1,67	8,00	5,33	-0,29	31,00	17,73	0,00

Neighborhoods	Bonding			Bridging			Linking			Total Scores		
	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed score	Z-score	Raw Sum	Transformed Score (Sum)	Z-score
Rubroek	6,00	4,00	-1,19	15,00	6,00	0,08	11,00	7,33	0,87	32,00	17,33	-0,14
s Gravenland	10,00	6,67	0,39	16,00	6,40	0,52	10,00	6,67	0,48	36,00	19,73	0,69
Schiebroek	12,00	8,00	1,18	17,00	6,80	0,96	12,00	8,00	1,25	41,00	22,80	1,76
Schiemond	8,00	5,33	-0,40	14,00	5,60	-0,35	11,00	7,33	0,87	33,00	18,27	0,18
Spangen	9,00	6,00	-0,01	13,00	5,20	-0,79	10,00	6,67	0,48	32,00	17,87	0,04
Stadsdriehoek	6,00	4,00	-1,19	14,00	5,60	-0,35	12,00	8,00	1,25	32,00	17,60	-0,05
Strand en Duin	13,00	8,67	1,57	16,00	6,40	0,52	3,00	2,00	-2,21	32,00	17,07	-0,24
Struisenburg	4,00	2,67	-1,98	14,00	5,60	-0,35	10,00	6,67	0,48	28,00	14,93	-0,98
Tarwewijk	9,00	6,00	-0,01	14,00	5,60	-0,35	8,00	5,33	-0,29	31,00	16,93	-0,28
Terbregge	14,00	9,33	1,96	20,00	8,00	2,27	12,00	8,00	1,25	46,00	25,33	2,64
Tussendijken	8,00	5,33	-0,40	12,00	4,80	-1,23	10,00	6,67	0,48	30,00	16,80	-0,33
Vreewijk	9,00	6,00	-0,01	10,00	4,00	-2,10	7,00	4,67	-0,67	26,00	14,67	-1,07
Wielewaal	14,00	9,33	1,96	11,00	4,40	-1,67	2,00	1,33	-2,59	27,00	15,07	-0,93
Zevenkamp	9,00	6,00	-0,01	13,00	5,20	-0,79	8,00	5,33	-0,29	30,00	16,53	-0,42
Zuiderpark	10,00	6,67	0,39	13,00	5,20	-0,79	7,00	4,67	-0,67	30,00	16,53	-0,42
Zuidplein	4,00	2,67	-1,98	11,00	4,40	-1,67	8,00	5,33	-0,29	23,00	12,40	-1,86
Zuidwijk	9,00	6,00	-0,01	13,00	5,20	-0,79	7,00	4,67	-0,67	29,00	15,87	-0,65

The calculated social capital scores, including the scores for each type of social capital can be found in table 7. While no neighborhood received a full score, several of them came close.

Table 8. Top 5 highest and lowest scoring neighborhoods in Rotterdam

Neighborhood	**Transformed Social Capital Score**
Terbregge	25,33
Hillegersberg Noord	24,67
Hillegersberg Zuid	24,27
Molenlaankwartier	24,00
Schiebroek	22,80
Hillesluis	4,62
Feijenoord	4,44
Zuidplein	4,13
Carnisse	3,82
CS Kwartier	3,73

The top scoring neighborhoods (Table 8) are exclusively part of the borough 'Hillegersberg-Schiebroek'. This Neighborhood is located in the north of Rotterdam and is distinctively disconnected from the rest of the city. As such, it is located between two 'lakes' (Bergse Voor & Achterplas). Due to this rather remote location, this neighborhood has become a sub-urban enclave which mainly attracts families & retirees due to the quiet location with city-like amenities. Hillegersberg-Schiebroek is an overall tight-knit community of middle-upper-class households. The fact, that all neighborhoods of this district scored well is indicative of the districts homogeneity. The lowest scoring neighborhood is C.S. Kwartier, which is a neighborhood that for the most part is made up of the central station and its neighboring buildings. C.S. Kwartier is for the most part a business district with high rising office towers and a few city center apartments. With the exception to C.S. Kwartier which is in the city center, all other low scoring neighborhoods are in the south-side of the city. The city's south-side is marked by its position south of the river Nieuwe Maas which separates the city.

While overall scores allow for a good overview of each neighborhood, basing a neighborhoods potential resilience on a single number is not sufficient. By glaring over the different influences each type of social capital has, much of the variation that makes each neighborhood unique, gets lost. Also, this does not allow for a comprehensive understanding, how each neighborhood scores and what are their respective strengths and weaknesses.

Creating Neighborhood Profiles With Z-scores

To facilitate the grouping of the neighborhoods, Z-scores are employed to further transform the values. Z-scores are a product of standardization and represents the location where a value falls within a normal distribution. For example, all Z-scores that fall between -1 and 1, represent 68% of the data. Due to this, they are the ideal tool for the grouping of the social capital types according to their respective performance for each neighborhood.

Based on the Z-scores that were calculated as part of the social capital index scores, the neighborhoods were grouped. Once the scores of social capital are transformed into Z-scores, it is possible to see if a neighborhood scores High, medium, or low- for each type of social capital. As mentioned, Z-scores follow the logic of a normal distribution. A Z-score indicates the number of data points that a value is away from its mean. At that, z-scores fall in between the range of -4 to 4. Through the value of the Z-score, one can indicate where in the distribution of data, a specific result fits. A z-score of 2, for example, indicates that this data point is higher than 95% of the rest of the data. For this categorizing and profiling of neighborhoods, cut-off points are formulated. The used cut-off points can be found in table 9 and the frequency of occurred profiles in table 10.

Table 9. Z-scores for the creation of profiles

Z-Score	Category
< -1	Low (lowest 16%)
-1 to 1	Medium (68% of the data)
> 1	High (highest 16%)

Table 10. Frequency of social capital profiles for the selected neighborhoods

Profile	Frequency	Percent	Profile	Frequency	Percent
H H H	3	4,8	L L M	1	1,6
H H M	1	1,6	L M H	1	1,6
H L L	1	1,6	L M L	2	3,2
H L M	1	1,6	L M M	4	6,3
H M H	2	3,2	M H M	2	3,2
H M L	2	3,2	M L M	3	4,8
H M M	1	1,6	M M H	2	3,2
L H M	1	1,6	M M L	3	4,8
L L H	1	1,6	M M M	31	49,2
L L L	1	1,6	**Total**	**63**	**100**

The analysis of indicators shows, that there are a total 19 individual profiles of the analyzed 63 neighborhoods. Most of the groups are occurring with a lower frequency, with a few exceptions. The exact distribution and groups can be seen in Table 10. As could be expected, the most frequently occurring group is one that includes neighborhoods with a 'medium' score in all three categories and is labeled as 'M M M' (triple M). This group occurred 31 times. The triple M profile was detected the most frequently. A triple M profile indicates, that the neighborhood scored medium on all three types of social capital. In numbers, this means that all three of the neighborhoods scores fell within the central 68%. This wide range also explains the frequency of the profiles, as the chance for all three measures to fall into this range is likely. Triple M profiles could be observed all over the city, which complicates any uniform statement about the profile.

Interestingly, only 1 and 3 neighborhoods, respectively, could be placed in triple L or triple H groups. In comparison to the triple M profile, both triple H and triple L are much less likely. They only occur when a neighborhood scores in the top or bottom 12% in all three types of social capital. The three profiles that scored triple H, are all located in close proximity in the neighborhood of Hillegersberg- Schiebroek. Not surprisingly, all three could also be found in the top 5 of overall social capital scores. The only neighborhood that scored a triple L is Carnisse, which is located in the south-side of the city in the district of Charlois. Out of the 63 analyzed neighborhoods, only Carnisse scored low on all three types of social capital. The remaining profiles are combinations of high, medium or low scores in one of the 3 types of social capital. Given, that a total of 27 groups would have been possible, the occurrence of 19 groups in total is fine.

Chapter 4 - Analysis and Discussion

The aim of this study is to determine potential resilience of Rotterdam Neighborhoods through using publicly available data. In the previous sections the process of this sketched out. Data was collected through the city's official statistical outlets and scanned for fitting measures that could capture social capital. Once selected, the measures were standardized and transformed to capture a neighborhoods individual performance. In addition, values were transformed once again to correct for an un-equal number of measures for each type of social capital and calculate an overall score for social capital. To make more precise predictions on potential resilience, the three scores for different types of social capital were used to create profiles. These profiles indicate how a neighborhood scores on each type of social capital. Through the use of these profiles, it is possible to make specific predictions on the potential resilience of each neighborhood. In this section, the selected profiles are introduced, judged on their potential resilience and recommendation are made that could lead to an increase of social capital. Further, a general remark towards potential risks for the city of Rotterdam is made and general policy recommendation that could increase social capital are introduced.

Profiles of Neighborhoods

After the analysis of each neighborhoods Z-scores on all types of social capital, a total of 19 combinations of high, medium and low social capital were found. While this is less than the possible amount of 29 profiles, those are still too many profiles to allow for a meaningful analysis. With this in mind, a selection of profiles was made. This selection includes neighborhoods which had high or low scores on all three types social capital. Further, neighborhoods will be highlighted that had contrasts. Contrasts, meaning that they had a high score on one type of social capital while having a low score on another. First, the selected profiles will be introduced, and their potential resilience rated. In addition, a number of suggestions will be made that reflect on the neighborhood profiles. What measures should be taken, to increase or maintain social capital and therefore improve upon resilience.

Triple H

A neighborhood that falls into the triple H profile is defined by a high score on all three types of social capital, bonding, birding, and linking. The high score in bonding social capital results out of a high feeling of connectedness to their neighborhood and a high percentage of the population indicating that they have regular meetings with their neighbors as well as other people within their neighborhood. Through this high score we can assume that people in this neighborhood feel they are part of their community and can relate to the people around them. A high score for bridging social capital means that the people within the neighborhood likely have ties into other communities and neighborhoods. The high score indicates, that people are more likely to have ties that reach out of their close circles. This is based on high scores on attendance for different, intercommunal clubs, events and gatherings. This includes cultural events, religious gatherings, and the attendance of hobby- and sport clubs. Unlike bonding, bridging social capital speaks to the connection of a neighborhood to "outsiders", meaning people from other neighborhoods, social status or heritage. To this speak the high scores on the perceived interactions of people of different ethnicities, which were rated high as well. Therefore, these high scores warrant the believe that people within this neighborhoods are having connections with people outside of their own neighborhood, community and close circles. Lastly a high score in linking social capital means that there is a high ability to connect and reach local representatives or people of power with the ability to help. Not only do these neighborhoods have high election participation, they also tend to have a high trust with their local representatives as well as regional and municipal governments.

In terms of potential resilience and speed of recovery, the high scores in social capital signify multiple things. A high score in bonding social capital indicates, that there could be a quick response (Aldrich, 2012b). Further, the members of these tightly knit neighborhoods can be expected to offer help and support within their neighborhood. This means, that in case of an emergency we expect there to be a fast and immediate relief response, driven by the community and supporting the community.

The high score in bridging social capital lets us hypothesize that these neighborhoods would be capable of mobilizing a higher amount of "outside" help (Aldrich & Meyer, 2015). Not only from the communities around but also through utilizing organically built connections. These connections are particularly relevant in terms of recovery, as they allow for a further reach to find specific help (Aldrich & Meyer, 2015). This is especially relevant when the amount of

relief that is supplied through bonding social capital reaches its limits. In terms of linking social capital, it is assumed that through these connections and links to higher authorities, these neighborhoods have an advantage when it comes to communicating needs and demanding help (Aldrich & Meyer, 2015). This includes all specific needs, that both bonding and bridging social capital are not capable of obtaining. Through this, the response and relief efforts can be adapted to the specific needs of the community and a speedy recovery is facilitated.

Out of the 63 analyzed neighborhoods in Rotterdam, 3 scored high in all 3 of the analyzed dimensions: Hillegersberg Nord, Hillegersberg Zuid and Terbregge**.** As could be expected, the neighborhoods that scored high on all three measures, are also on top of the list for the social capital index. It needs to be noted, that all of them belong to the same district, Hillegersberg-Schiebroek. The borough itself is located in the north of the city and is of a rather residential character. It is partly disconnected from the city center through a highway and train-tracks and two large lakes. As such, the calculated scores indicate, that the citizens are not only well connected within their neighborhood, but also have ties to other neighborhoods and local government. On the basis of these high scores the potential resilience is rated high and it is assumed that these neighborhoods would have a fast recovery.

To conclude we believe that the neighborhoods in Rotterdam who have scored triple H would have a higher resilience potential and a faster recovery than in other neighborhoods. Following the theory, these high scores of social capital would influence the availability of help within the immediate neighborhoods well as the willingness to help their surrounding neighbors (Aldrich, 2012a, 2012b). We can assume, that these neighborhoods are capable of organizing help that extends their immediate circles and therefore lead to a higher chance for recovery (Aldrich & Meyer, 2015). This also extends to the ability to organize larger means of aid and support through having good contacts to local authorities, which puts these neighborhoods at an advantage. Ultimately, we can assume that in case of an emergency people in this communities would know who to reach out to and contact in order to help themselves. Through this, these neighborhoods can be assumed to not only have more resources available for self-help, but also a heightened ability to demand and receive additional resources to deal with a disaster. When it comes to a neighborhood that scores high in all 3 types of social capital, there is little to no improvements that can be suggested. The focus of any resiliency measure should be to maintain this performance or improve it in any way possible.

Figure 2. *Triple H neighborhoods in Rotterdam.*
Source: www.Onderzoek010.nl

Table 11. Triple H Neighborhoods

Neighborhoods	Z-score Bonding	Z-score Bridging	Z-score linking	Profile
Hillegersberg Noord	**1,18**	**2,27**	**1,63**	H H H
Hillegersberg Zuid	**1,18**	**1,83**	**1,63**	H H H
Terbregge	**1,96**	**2,27**	**1,25**	H H H

Triple M

A triple M neighborhood is a neighborhood that has scored consistently moderate throughout all different types of social capital. This means in regards to bonding social capital, the population feels connected to their neighborhood and there is a moderate amount of relations and contact within the neighborhood. In regards to bridging social capital, it can be assumed that the inhabitants while having some connections to other neighborhoods or communities this is less prevalent than in the high scoring profiles. This means, that the participation in events and interactions are moderate. We therefore assume, that people in triple M neighborhoods are connected a good amount to other neighborhoods, communities, or social classes. Lastly in regard to linking social capital, we again assume a good amount of connections to local authorities. In general terms, these neighborhoods can be assumed to have a good sense of community within their neighborhoods and relations extending out of their community up to the levels of local representation.

In terms of resilience it can be expected that initial response of neighborhoods in this category would perform worse when compared to a triple H neighborhood, but better when compared to a neighborhood that scored low on all measures (Triple L) neighborhood. Considering recovery, these neighborhoods might be able to have a moderate speed of recovery, that despite being slower than a triple h neighborhood, it is likely to be faster than for a triple L neighborhood or a neighborhood that scored low on bridging and linking social capital. Due to the status of the middle, it must be considered that response and recovery can go both ways. Either, a strong response towards helping others and providing relief can be observed. This involves the potential of organizing help from outside the community and utilizing ties to call in specialized help. Or, the initial response, as well as the long-term efforts will show lacks. As the weaker ties both within and outside of the neighborhood will limit possible mobilization of aid and recovery.

In regard to the neighborhoods in Rotterdam, Triple M was the by far largest profile group with a total of 31 profiles. This profiles performance is considered as *moderate.* For this group, the scores on all types of social, lied somewhere in the 68% between H and L. Due to this variety and vastness, no specific prediction can be made for the neighborhoods that fall within this group. Despite this, we expect these neighborhoods to have a better resilience as well as a better timely recovery than neighborhoods with a lower score. It needs to be considered that the cut off point for this profile was decided based on the z-scores, which includes scores that lied very

close to +1 or -1. This means that there might be neighborhoods that were close to falling into H or L. Due to this, the variety within these profiles is vast and neighborhoods that might have scored close to a double H or double L fell within this category. This is also the reason why a uniform statement on this profile has its limits. Similar to a prediction on a potential response, suggestions for these neighborhoods are stifled by the high number of cases.

Overall, these neighborhoods should focus on measures that increase bonding and bridging social capital, such as organizing neighborhood gathering or festivities (Aldrich & Meyer, 2015). Through this, the re-connection of entities within the neighborhood as well as the identification with the area can be facilitated (Oldenburg, 1999). In regards of linking social capital, an increased visibility of the administration and local authorities, including police and representatives could be helpful to increase these connections. As mentioned earlier the results differ vastly for each neighborhood, therefore local administrations could consider the unique actions for each neighborhood to base a decision of actions on.

Figure 3. *Triple M neighborhoods in Rotterdam.*
Source: www.Onderzoek010.nl

Table 12. Triple M Neighborhoods

Neighborhoods	Z-score Bonding	Z-score Bridging	Z-score linking	Profile
Afrikaanderwijk	-0,01	0,96	-0,29	M M M
Agniesebuurt	-0,79	0,52	0,10	M M M
Beverwaard	0,39	0,08	-0,67	M M M
Bospolder	-0,01	0,96	0,87	M M M
Heijplaat	0,78	-0,35	-0,29	M M M
Het Lage Land	-0,40	0,96	0,48	M M M
Hoogvliet Zuid	0,78	0,96	-0,29	M M M
Katendrecht	0,78	-0,35	0,10	M M M
Kleinpolder	-0,01	-0,35	-0,67	M M M
Kop van Zuid - Entre	-0,01	-0,79	0,87	M M M
Lombardijen	-0,01	-0,79	-0,29	M M M
Middelland	-0,40	0,08	0,87	M M M
Nieuw Crooswijk	-0,79	0,08	0,87	M M M
Nieuwe Westen	-0,01	0,52	0,10	M M M
Noordereiland	0,39	0,52	-0,67	M M M
Ommoord	0,39	0,52	0,48	M M M
Oosterflank	-0,40	-0,79	-0,67	M M M
Oud Charlois	-0,01	-0,79	-0,67	M M M
Oud Crooswijk	-0,79	-0,35	-0,67	M M M
Oud IJsselmonde	0,39	0,52	-0,29	M M M
Oude Noorden	-0,40	0,08	-0,67	M M M
Overschie	0,39	0,08	0,10	M M M
Prinsenland	0,78	-0,35	0,48	M M M
Provenierswijk	-0,79	-0,79	0,87	M M M
s Gravenland	0,39	0,52	0,48	M M M
Schiemond	-0,40	-0,35	0,87	M M M
Spangen	-0,01	-0,79	0,48	M M M
Tarwewijk	-0,01	-0,35	-0,29	M M M
Zevenkamp	-0,01	-0,79	-0,29	M M M
Zuiderpark	0,39	-0,79	-0,67	M M M
Zuidwijk	-0,01	-0,79	-0,67	M M M

Triple L

Different than the beforementioned categories, a triple L profile results out of a low score on all three types of social capital. For bonding social capital, this means that the population of the neighborhood has little connections between each other and does not identify with the neighborhood. But the lack of connections is not limited to within the neighborhood. In regard to bridging social capital this means that the inhabitants of the neighborhood neither have connections outside of their neighborhood. As participation in events and gatherings is very low, and the interactions of different ethnicities are not rated well. This low scores on both bonding and bridging and linking social capital signify that not only there is a low connection in within the neighborhood but also an extremely low connection to outside the neighborhood. Lastly in regard to linking social capital we can assume people have a low connection to representatives, authorities and local representatives. As such, the neighborhood overall has little connections both within and outside of it and neither is expected to have connections to a higher level.

What a triple L score profile means for a neighborhood, is that's it is very likely to have low resilience in case of a disaster. Based on the low score on bonding social capital, it is assumed, that the initial response in the neighborhood would be very slow and individualized (Aldrich, 2012b, Aldrich & Meyer, 2015). In regard to recovery, a similarly low performance is predicted: where there were no ties in between the neighborhood, no ties outside of it were detected. This leads to the assumption, that the mobilization of outside help will be slow, if occur at all (Aldrich & Meyer, 2015). The low score in linking social capital allows for the assumption that there will be no possibility to demand help from a higher position (Aldrich, 2012b). All in all, people in these neighborhoods would be less likely to help each other, to reach out for help from other neighborhoods. Further, besides being less likely to reach out for help from their surroundings, it must be assumed that there would be no awareness how to ask local representatives for aid.

In Rotterdam there was only 1 neighborhood performed this low, which is Carnisse. So, while the sole existence of such a low-performer is worrisome, it is not the common denominator throughout the city. The neighborhood of Carnisse is located far in the south of the city and is

a former working-class neighborhood that is slowly losing its population[7]. While parts of the city's southern neighborhoods have received help from a fund[8] to increase quality of life and social cohesion, Carnisse has not received any help yet[9]. For any neighborhood that fell or might fall into the triple L profile, the following suggestions are made. To increase bonding to the neighborhood, efforts are required that change the perception of the area for their own inhabitants. It needs to elevate itself as a place where people stay in connection with their job or due to cheap housing and aim to allow for it to become home. Similarly, efforts should be made that allow for interactions in between neighbors such a neighborhood gatherings or festivities. These festivities could aim to celebrate the diversity and differences of the people in the neighborhood and allow for a connection in a higher level (Aldrich & Meyer, 2015). Also, measures should be taken to facilitate the participation in clubs, gatherings and events that lead to the building of connections outside of the neighborhood (Brune & Bossert, 2009). And ultimately, the local authorities and representatives need to increase their visibility and approach the local population. A large amount of distrust in both the local as well as the municipal administration are a bad sign. Factoring in the lack of election participation, this neighborhood still has a long way to go.

All in all, the triple L neighborhood of Carnisse is expected to have a low resilience potential. Both the initial response as well as the long-term recovery are assumed to very likely occur very slowly, therefore to improve these, programs and actions need to be developed.

[7] "Carnisse aan vooravond stadsvernieuwing"- https://youtu.be/6p6tl4p2WRo (retrieved July 15th 2020)
[8] "Nationaal Programma Rotterdam Zuid (NPRZ)"- https://www.watdoetdegemeente.rotterdam.nl/begroting2020/paragrafen/nationaal-programma-rotte/ (Retrieved July 15th 2020)
[9] "Carnisse aan vooravond stadsvernieuwing"- https://youtu.be/6p6tl4p2WRo (retrieved July 15th 2020)

Figure 4. *Triple L neighborhoods in Rotterdam.*
Source: www.Onderzoek010.nl

Table 12. Triple L Neighborhoods

Neighborhoods	Z-score Bonding	Z-score Bridging	Z-score linking	Profile
Carnisse	**-1,58**	**-1,23**	**-1,44**	L L L

High Contrast Profiles

When looking at the profiles and results, we found that 28 neighborhoods in Rotterdam had large variations in their scores. It can be noted, that while half of the data set falls within the triple category, the other half is made up from individual cases. In these numerous profiles, we have found a number of neighborhoods that have different scores in their individual dimensions. For example, neighborhoods were found, that while scoring high on Bonding, they scored low on bridging and linking social capital. For this section, we try to aim for neighborhoods, that contain both a high as well as a low score. We decided for this, as it will allow to highlight individual strengths and weaknesses of each area and make individual suggestions. These suggestions could hopefully be used to increase social capital in these areas and ideally increase the long-term resilience potential.

As a total of 19 profiles were identified, a selection of cases needed to be made. In addition to the 3 triple profiles, we will showcase the variations of scores with a focus on the 'extreme', noteworthy cases. More important than on what basis an inclusion was made, are the terms that led to an exclusion: Generally speaking, the cases that contained at least one M and the other dimensions were identical, were excluded. Similarly, all cases with at least 2 dimensions categorized in M's were excluded, due to their closeness to the triple M group. Employing this criterion, the following profiles stood out and are introduced individually (Table 13.).

Table 13. Selected Neighborhoods with Contrast

Neighborhoods	Z-score Bonding	Z-score Bridging	Z-score linking	Profile
Wielewaal	**1,96**	**-1,67**	**-2,59**	H L L
Kop van Zuid	**-1,98**	**-1,23**	**1,25**	L L H
Stadsdriehoek	**-1,19**	**-0,35**	**1,25**	L M H

H L L – Wielewaal

The neighborhood of Wielewaal has a profile of High bonding but both low bridging and linking scores. The neighborhood of Wielewaal is located in the district of Charlois and located close to the neighborhood of Carnisse. At that, the area is similarly structured, and its population is mainly working class with migration background[10]. With a profile like this, we expect there to be strong bonds in between neighbors and inhabitants of the neighborhood. In regards of weaker ties to other neighborhoods or communities, there seems to be a lot less. Besides the absence of these ties, there is also low participations in events and clubs that could lead to new connections. Similarly, so, the low score in linking social capital indicates a large disconnect with the local and municipal regulators.

In regards of resilience, we expect a neighborhood like Wielewaal to perform initially well in case of a disaster. Due to the high local bonds among the neighborhood, we believe that in a first instance much of the necessary help could be provided by the closest environment (Aldrich & Meyer, 2015). Advantages that are associated with bridging and linking social capital, are less likely to be observed. Especially considering recovery or a longer lasting calamity, the immediate bonds between neighbors are much less efficient (Aldrich & Meyer, 2015). In these instances, it can be assumed that through the lack of potentially mobilizing outside help or demand specific aid, recovery would be hindered.

For this neighborhood we suggest activities that increase bridging and linking social capital and strengthen the bonding social capital. We recommend the facilitation of larger group gatherings, for example through neighborhood events that involve other neighborhoods (Aldrich & Meyer, 2015). Similarly, the existence of clubs in proximity needs to be revised. If there is a lack of events, clubs and gatherings, the sole introduction of such recreational opportunities could be helpful (Brune & Bossert, 2009). Similarly, the local representatives need to work on their visibility and work towards increasing the trust of the locals. Some of the suggestions are already in place. In September 2018, the municipality set up the 'Wielewaal Huis' which is a coordinated effort to increase social cohesion. This is done due the city's efforts to modernize the area and make the neighborhood more appealing. The goal is to

[10] Demographic information from: www.onderzoek010.nl (July 25th 2020)

increase the social cohesion of the area and allow for interactions between old and new inhabitants. [11]

In terms of resilience potential, we believe that Wielewaal will have an initially quick response but will have problems with recovery. Any measure to increase resilience of the neighborhood, should aim at improving both bridging and linking social capital.

Figure 5. *Selected High Contrast Neighborhoods.*
Source: www.Onderzoek010.nl

[11] https://wielewaalhuis.wixsite.com/wielewaalhuis - retrieved July 15th 2020.

L L H – Kop van Zuid

The neighborhood of Kop van Zuid scored Low on bonding and bridging with a high score on linking social capital. This unusual set-up could be caused by the unique character of this neighborhood: Kop van Zuid is one of the newest additions to the city and is a transformed former port area that marks the middle between the north and south of the city. As such, it is now a very sought-after and recognized area to live in. It features plenty of luxury high-rise apartment towers, that form the city's 'sky-line'. It can assume that due to the inorganic genesis of this area, many bonds with the neighborhood and neighbors are inhibited. The scores on the different types of social capital paint a picture of an area in which its population spends little time with people in close proximity and also does not feel connected to their neighborhood. More so, the connections of the inhabitants to other neighborhoods, are very low as well. The curious aspect about the neighborhood is the very high score in linking social capital. This indicates there is a high connection with representatives and local administration of the area.

Based on these scores we can infer the resilience potential of the neighborhood in case of a disaster. It can be assumed, that the neighborhood will lack communal help within and from outside, as the social capital that facilitates these, is not sufficiently found (Aldrich, 2012b). In regard to recovery, one could expect a heightened possibility, as through the high linking social capital, direct aid could be facilitated (Aldrich, 2012b). In terms of speed of recovery, it is hard to come to a conclusion, since through the likely lack of initial response as well as outside help, the state of the neighborhood at the time of recovery could be significantly worse. Due to this, we believe that a high score in linking social capital is not capable of mitigating the lack in bonding and bridging social capital.

For the neighborhood of Kop van Zuid, we recommend all the previously mentioned measures to increase both bonding and bridging social capital such as social activities and the creation of deliberate meeting spaced. This could lead to the creation a livelier neighborhood that allows for identification with its residents, facilitate neighborhood contacts and create meeting spaces which can be used as neutral grounds to interact (Oldenburg, 1999). As most residential houses in Kop van Zuid are High rises, the problem of anonymity is bigger than in smaller neighborhoods. Meeting points of neighbors on a usual day are the lobby of their building or the elevators. Both places, that do not facilitate interactions.

In conclusion, the neighborhood Kop van Zuid is less resilient than one might think when seeing the glossy high rises from a distance. Altogether, the inorganic creation of the neighborhood could have led to a lack of connections between the local residents, leading to potentially poor initial response which could carry over into the recovery.

L M H – Stadsdriehoek

A similarly extreme case is the neighborhood of Stadsdriehoek. This area is located quite literally in the middle of the city and includes many different student and expat houses as well as upper-class inner-city real estate. The social capital in this area is very much shaped by low bonding scores. There is little contact among neighbors and other members of the neighborhood as well as little connection felt between the inhabitants and their neighborhood. More than that, a medium score of bridging social capital indicates, that more than connections within the neighborhood, the inhabitants are active outside of their neighborhood. More so, the high score of linking social capital lets us assume that the inhabitants are well connected to their local representatives. In case of a disaster, we expect an area with this profile to perform initially bad, since there are little immediate contacts (Aldrich, 2012b; Aldrich & Meyer, 2015). But throughout a crisis, and especially during recovery, an area with this properties should be quick(er) to recover (Aldrich & Meyer, 2015). It needs to be considered, that the slow initial response might very well carry over to the recovery phase, as considered in Kop van Zuid.

The recommendation for this neighborhood is to work on the ties between the locals. Through targeted measures, as introduced previously, like neighborhood festivities and gatherings (Aldrich & Meyer, 2015). Other Measures could include the creation of meeting points for the local population, so that these ties could be facilitated (Oldenburg, 1999). In regards of bridging and linking social capital the neighborhood seems to be doing well.

In conclusion, we can assume that in terms of resilience for the neighborhood of Stadsdriehoek. In terms of initial response, we can predict a slow performance, which is likely to increase for the duration of the crisis. Especially through bridging and linking social capital, the recovery is likely to be facilitated.

Overall Suggestions for the City

While the profiles allow a good overview of the neighborhood's overall strengths and weaknesses, a blanket statement for the entire city is a lot harder to make. Throughout this study, two major threats to the city's social cohesion and capital were identified, 1) the city's development plans that are sacrificing living space for lower income citizens and replace it with real estate projects, 2) the large influx of students which can lead to the transformation of residential neighborhoods.

As mentioned previously, Rotterdam is an industrial city, that is slowly attempting to diversify its population. One of the main strategies is the appeal to a changed demographic through the creation of alternative industries (van den berg). While this strategy is sure to reduce the poverty within the city as it becomes less affordable for lower income citizens, it might come at the expense of established communities. As was shown in the profiles, popular and newly developed neighborhoods are lacking bonding and bridging social capital. With this in mind, the city should consider planning for measures that could increase social capital in this areas. While there several projects that target resilience and neighborhood cohesion, these are predominantly aimed at lower income neighborhoods or placed where new development projects are planned[12]. As a result of this study, the city should consider implementing some measures for the already developed and popular neighborhoods. In case of Kop van Zuid, which was developed from scratch in the last 20 years, the introduction of social activities and third spaces could lead to more interactions within the community. It is assumed, that through the rapid development of neighborhoods, the social cohesion and social capital is affected, which in turn might could lead to less communal resilience of neighborhoods.

When considering the social cohesion of the city and within neighborhoods, another risk factor is the influx of new inhabitants, especially those that are not planning to stay long-term. Through the increase of 5000 students in Rotterdam since 2015, much of the local housing market has tipped[13]. This is especially problematic for neighborhoods that still offer affordable housing and have a predominantly lower income population such as the southern

[12] www.gobotu.nl; wielewaalhuis.wixsite.com/wielewaalhuis . retrieved July 25th 2020.

[13] https://www.erasmusmagazine.nl/en/2019/10/04/no-end-in-sight-to-the-student-housing-shortage-in-rotterdam/ retrieved on July 20th 2020.

neighborhoods Feyenoord and Charlois. Given, that students often move to a city solely for the university and leave once their study is done, this could lead to serious problems in regards of bonding social capital. Also, the different lifestyle of students can lead to tensions within neighborhoods. As the long-term effects of such volatile moving behavior are beyond the scope of this study, we assume that through the transformation of former residential neighborhoods into student areas, a further decrease of social capital is likely. A solution for this would be a coordinated effort of the city and university to create new student housing to soften the effects on the housing market. Further, students could be incentivized through different measures to further interact with their neighborhood, such as through community currency and social activities that are aimed at the shared interests like a community garden.

Policy Recommendations for Increasing Social Capital

This section aims to introduce several policy recommendations which were used to increase social capital in the past. As shown by Aldrich (2012b), higher scores of social capitals can lead to an improved disaster response during, as well as a faster recovery after a disaster. Through higher social capital, communities are better capable of distributing and attracting resources that are necessary for response and recovery. To increase social capital, which could ultimately increase potential resilience, interventions are required that could facilitate these developments. Following, a few policy recommendations are introduced which are aimed at improving social capital at a neighborhood level.

An established way to increase social capital, is through the introduction of *time banking* and *community currency* (Lietaer, 2014). The core idea of these interventions is to provide incentives and rewards towards volunteering citizens. For example, for every hour of volunteering in a community facility like a school, volunteers receive a voucher for one ’hour of help’ or currency, which can be redeemed as local business. The intervention aims to create a ‘virtuous cycle’, which pulls in citizens that otherwise would not volunteer and facilitates them to serve in their neighborhood. In addition to increasing social capital, it was discovered that the introduction of a time banking system can lead to an increase in physical and mental health (Lasker et al., 2011).

Another measure is the introduction of *focus group meetings* and *social events (Aldrich & Meyer, 2015).* Through the organization of neighborhood based social activities, such as parades, festivities, fairs and town-house style discussions communal trust and social cohesion

can be increased (Aldrich, 2010). As these meetings and events facilitate the possibilities of neighbors to get to know each other and exchange their thoughts on topics of shared importance. It was shown that regular meetings of neighborhood-level group members developed led to higher trust in other participants (Brune & Bossert, 2009). Overall, there are plenty of different social activities that could increase neighborhood cohesion and social capital if they lead to an increase of interactions between neighbors. In Rotterdam, some neighborhoods have established their own programs that aim to facilitate neighborhood exchange for example in community centers and -gardens[14].

While a local population might be interested in the exchange with their neighbors, the physical layout of their neighborhood or housing units might not allow for it. To create and maintain social capital, neighborhoods require a careful planning of *community*- and *architectural structures.* The concept that is known as 'third places' (Oldenburg, 1999) describes areas that are of neither professional or private nature and allow for interactions between residents. These places can vary from public libraries to bars and coffee places as long as they facilitate interactions between residents. The creation of such spaces can be deliberately planned by the communities to cater to special interests of their residents. It was shown that in communities where residents felt connected to their space, crime rates lowered and bridging social capital increased (Newman, 1996, Aldrich & Meyer, 2015).

[14] www.gobotu.nl; wielewaalhuis.wixsite.com/wielewaalhuis . retrieved July 25th 2020

Conclusion

The aim of this study was to investigate the possibility to use publicly available data and use it to create scores of social capital in Rotterdam. As was shown by research (Aldrich, 2012b), social capital can have a significant impact on both disaster response as well as recovery. As such, the approximated social capital scores were used to predict potential resilience of Rotterdam neighborhoods. The research question was 'How likely are Rotterdam neighborhoods to be resilient based on their social capital? '

Following the history and development of social capital, the theoretical connection of social capital and resilience was shown. As shown by research, social capital can facilitate the recovery after and the response during a disaster. With social capital indicating the connections within and between local communities, its approximation allows for an inference on resilience. While past research has mainly focused on the analysis of past catastrophes and used social capital to explain disaster response and recovery, this study aimed to advance the subject of disaster preparedness. Following a number of similar studies, that relied on public data to determine social capital (Kyne & Aldrich, 2019) or use social capital to create resilience score cards (Niehof & Kuipers, 2017). This study utilized publicly available data to approximate social capital scores on the neighborhood level. Using these scores, this study was able to create profiles, based on the neighborhoods individual strengths and weaknesses.

The city of Rotterdam has a total of 91 neighborhoods, some of which are purely industrial areas with a small population. After correcting for population and availability of data, 63 neighborhoods were left which allowed for analysis. Overall, 11 measures were utilized, that are capable of capturing social capital in the selected neighborhoods. To better differentiate between the different types of social capital, the scores were separated into Bonding, Bridging and linking social capital. These types measure connections between inhabitants of an area (*bonding*) as well as connections to other neighborhoods (*bridging*) as well as to local representatives (*linking*). There were 3 measures for bonding social capital, 5 for bridging social capital and 3 for linking social capital. Based on the median scores of the selected neighborhoods, the data was standardized and transformed to allow for comparison. In the end, the scores were used to calculate an overall social capital score and 19 unique profiles were identified.

Further, a selection of profiles was closely investigated, and predictions were made on the potential resilience of these neighborhoods based on their strengths and weaknesses, based on their social capital scores. Three policy recommendations were introduced that could lead to an increase in social capital on the neighborhood level, which in turn could increase. These measures are the implementation of community currency, organization of social activities and modifying the architecture to allow for more interactions.

For the City of Rotterdam, in regards of social capital and communal resilience, a number of potential problems were identified. The city's strategy of transforming away from an industrial city and cater to a new demographic, could in the long run destroy organically grown networks. This is especially visible in popular neighborhoods like Stadsdriehoek and Kop van Zuid. Further, the ongoing growth of the university, in particular their English taught programs, will lead to an influx of students competing for affordable housing with the local population.

Overall, a statement of the city's resilience is hard to make as the different neighborhoods are very diverse. In terms of policy makers and local authorities, the individual scores that were created throughout this study, should allow for the implementation of specific, custom interventions.

Limitations & Future Research

Within this studies design, there are several limitations. Some of which are inherent to the approach, others can be addressed in further research.

1) Proxies

While one of the greatest strengths of this study is the use and reliance on publicly available data, this approach also brings some problems. Despite there being a sizable body of knowledge that links different demographic statistics to social capital, this extension of measurements to a separate concept is always risky. Given that statistics, like weekly contact to neighbors are primarily indicators of weekly contact with neighbors, assignment of an additional dimension is not always straight forward. This holds particularly true, when for the lack of specific statistics where relations were shown, only similar ones are available. In cases like this, only a handful of inaccurate choices can lead to a shift in results. A solution to this could be the use of correlation between variables that one is certain to capture social capital and other variables

one is uncertain of. If there is a strong relation one could assume that the unknown variable might be an indicator of the same type of social capital.

2) Standardization

While the process of standardizing the data through the median and standard deviation is a sound procedure, this can lead to a skewing in values. If, for example, the whole dataset is continuously scoring low on a measure, this process would still lead to some neighborhoods performing 'above moderate', despite there objectively being no 'good' results. With this in mind, it is important to sight the dataset in advance so to assure that none of the measures are particularly skewed positive or negative.

3) Selection of data/ dataset

While for this study there was sufficient data to find and utilize proxies, this will not hold true for every area, city or community one might want to investigate. While the reliance on already existing data is a formidable way to save time and money while still arriving at a meaningful conclusion, this assumes the existence of said data.

4) Sensitivity of the cut-off points for the profiles

For this study, a strict approach regarding the Z-scores for types of social capital was chosen. Only using the top and bottom 12% as basis for high or low scores was a choice to facilitate the discovery of more extreme cases. Given the large number of cases that are in the MMM category, and the variance of their individual scores, one could argue for setting less strict cut-off points. Through extending the bottom and top cut off points to cover each 20%, while the M category covers the remaining 60% of values, could lead to more nuanced findings.

Despite these limitations, this study gives a cross sectional indication on the state of social capital in Rotterdam. In terms of planning, the city would be wise to consider the results of this study and integrate social capital into their disaster approach. As shown through this study, considering social capital and its effects on resilience are an achievable addition to disaster planning, which could significantly increase the accuracy of predictions.

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