Bachelor Thesis

Social Science Research Thesis- Geography

The influence of permeability, mixed land use and population density on number of crimes in Geneva, Switzerland

Mathilde Mirlesse
Student number: 63030234
Email: m.s.mirlesse@students.uu.nl

Spring Semester
Utrecht, 2020

Supervisor:
Hannah Roberts
Department of Human Geography and Spatial Planning

Abstract:

Crime strategies are rarely incorporated into sustainable development strategies, yet it is a crucial aspect for the wellbeing of a city. Previous research has focused on factors such as permeability, mixed land use and population density as predictors of crime, yet this has never been done in the context of Geneva Switzerland. This paper aims to fill this gap in the literature by investigating the relationship between these variables and crime. It also looks at how well they predict different categories of crime, namely attacks on life, theft, attacks on freedom, sexual offenses and others. This research takes the form of an ecological study using open secondary data provided by different governmental agencies in Geneva. We conducted several multiple linear regressions, examining the relationship between crime and permeability, population density and mixed land use, while adjusting for variables. We found that mixed land and population density indeed have a relationship with crime, however permeability did not. This provides us with crucial information that will help future urban architects and crime experts work together on future developments.

Table of Contents

1. Introduction……4

2. Literature Review……6
2.1 Crime rates in cities……6
2.2 Theories on the relationship between the environment and crime……7
2.3 Environmental design and crime……8
2.4 Permeability……10
2.5 Population density……11
2.6 Mixed land use……13
2.7 Study aims……14

3. Methods……15
3.1 Study design……15
3.2 Study region……15
3.3 Data……17
3.3.1 Outcome……17
3.3.2 Predictors……17
3.3.3 Controls……18
3.4 Statistical analysis……19

4. Results……20
4.1 Descriptive statistics……20
4.2 Main model……20
4.3 Attack on life……21
4.4 Theft……22
4.5 Attack on freedom……22
4.6 Sexual offenses……22
4.7 Others……23

5. Discussion……24
5.1 Main findings about crime……24
5.2 Findings in context……25
5.3 Strengths and limitations……26
5.4 Policy implications……27
5.5 Conclusion……27

References……28

1. Introduction

Historically cities were always meant to be places of safety and security, bringing us key resources to survive; today this definition has changed (Cozens et al, 2008). All cities in the world, no matter how large or small, no matter where they are located and no matter who lives in them, have crime. Eliminating all types of crime from an area is close to impossible, so the focus needs to be on how we can lower crime rates whilst maintaining an ordinary lifestyle. Ever since the early 1900s, our population has undergone a dramatic increase, going from 2.6 billion people in 1950, to 7.7 billion currently, and it is still expected to rise (UN, 2019). Not only is there a growth in population worldwide, but there is also an increasing trend in the amount of people moving from the periphery to core regions. Today around half of the world's population lives in cities, and this is expected to rise to 68% by 2050 (UN, 2018). Globalization has allowed transport and communication networks to expand, enabling us to travel faster and further than ever before at a low cost. As a result, cities are being put under enormous pressure. There is a huge influx of people arriving in core areas, which were not built to sustain such numbers. This has forced governments to adapt and expand urban infrastructures to increase the capacity of living. In recent years, issues such as overpopulation and climate change have re-centred approaches of city development towards more sustainable programs.

When discussing the sustainable development of cities, the most frequent topics mentioned concern the environment, such as expanding green spaces, reducing traffic in city centres and improving waste management (UNEP, 2017). The United Nations Environmental Program, for example, puts its focus on resource efficient, clean, green and healthy cities (UNEP, 2017). It is rare that crime reduction and perceived safety by the population features amongst top concerns. This is quite striking because besides basic human necessities, such as food, water and shelter; safety is a central component of a healthy and prosperous life. Therefore, we must adopt a new definition of a sustainable city which includes safety in its definition. Dr. Paul Cozens states that a "sustainable community must be one that is defined as safe, perceives itself to be safe and is widely considered by others to be safe" (Cozens, 2007). Sustainability should no longer solely revolve around 'being green', but it must incorporate measures of crime and safety as well (Cozens, 2007).

There are certain aspects in a city which will act as crime attractors, generators and detractors (Kinney et al, 2008). A crime attractor is for example, a place that is well known for providing criminal opportunity, such as a market for theft. A crime generator is for example, a place that gathers many people together, such as a mall or theatre. Finally, a crime detractor is a place that does not provide many opportunities to commit crime or for example that is located next to a police station. The city's built environment will greatly influence where these opportunities for crime can be found and where fewer crime occurs. Factors such as schools, stores and parks may have an influence on the density and types of crime (Kinney et al, 2008). In addition, criminals, just as anyone else, adopt a routine of where they will reoffend, and rarely will they stray from this. We must determine why they commit the crimes they do in certain locations as to break the vicious cycle of crime (Kinney et. al, 2008).

The goal of this paper is to identify in what ways the physical environment influences crime rates, so that when redesigning cities for sustainability, crime reduction can be incorporated in the urban development plans. The focus will be on the city of Geneva, Switzerland which will act as a case study to provide concrete evidence and answers to the research question. Three variables will be used to investigate crime, *permeability*, *mixed land use* and *population density*. These are taken from the theoretical framework of Crime Prevention Through Environmental Design (CPTED), which will be discussed further on. Research on *permeability*, *population density* and *mixed land use* is very polarized, which is why this paper will aim to bring some clarity to the subject. Some believe that increasing *permeability*, *population density* and *mixed land use* will lead to a decrease in crime rates (Jacobs, 1961), whilst others believe the opposite (Newman, 1970s). Finding an answer to the research question is crucial because people are moving to cities at an unprecedented rate, and the former will constantly need to adapt and change to sustain such populations. It is important for environmental planners and crime experts to communicate freely on this matter and work together to create sustainable communities all the meanwhile decreasing crime rates.

The following sections will provide information that will aid in finding an answer to the research question. Section 1 will look into the theoretical background, section 2 will showcase the methods used in data collection, section 3 will report the results and findings from the analyses and finally section 4 will discuss the results, draw some conclusions and suggest ideas and improvements for future research.

2. Literature Review

In order to uncover a research question, it is important first and foremost to have a clear overview of the literature and research that has already been published. This theoretical framework will first look into crime rates within cities. Then it will focus on the different theories that are used to predict crime. In the following section there will be an introduction to the framework that serves as a basis for the research conducted in the paper and each variable will be discussed separately: *permeability*, *population density* and *mixed land use*. The final section will highlight the gap in the research and end with the research question and aims.

2.1 Crime rates in cities

Criminal behaviour consists of any behaviour that breaks the law (Bartol, 2016). Studying crime and its push and pull factors is crucial because it poses a huge cost to society. It has a huge economic impact, for example in the UK, the British Chambers of Commerce estimated the cost of crime to UK businesses to be around £12.6bn a year (Design Council, 2008). It impacts people psychologically if they are the victim of a crime, whether it is being held at gunpoint or being a victim of fraud, it can have long lasting impacts. This also influences the social norms of a society. If there is gang violence within an area, the community is less likely to be welcoming.

It is important to note that crime patterns diverge between cities, and within cities, the location of crime may differ as well. The way a city is built will determine how different urban spaces are used and what types of people visit them (Kinney, 2008). This is an essential factor when looking at crime because the layout of the city can determine spaces as being higher or lower crime areas. Therefore, in order to investigate crime in cities, it is critical to look at the geography of crime. There needs to be a focus on where and when certain types of crime take place and how environmental factors provide opportunities for, or deter offenders. It is also necessary to look into individuals' habits and way of thinking in order to anticipate where offenses may occur. Most individuals follow a weekly routine, whether it is going to work, school or shopping areas and this provides a general framework of where crime may be concentrated (Kinney, 2008). Just like 'regular' people, criminals tend to follow a routine, known as the routine activity theory, which will be discussed later on.

When taking a broader view of our society, we see that over the years people have come to realise that wealth is not the only necessary aspect of living a 'good' life. There has been an increase in awareness of other factors such as the social, political and environmental setting (Pacione, 2003). The aforementioned factors now determine what it means to live a safe and healthy life. A central component to this is the person-environment relationship, which looks into how both individuals and the urban environment interact to influence quality of life (Pacione, 2003). The larger the coherence between the two, the higher the quality of life, and

inversely. Fear of crime has a huge impact on the person-environment relationship, and it is a growing problem (Pacione, 2003).

In order to tackle this issue and improve quality of life, decisions on how to ensure feelings of safety need to be taken before any city development projects even begin. The aim of any sustainable development project is to provide a built environment where the varying needs of its inhabitants are met on a social, economic and environmental level (Pacione, 2003). However, when discussing sustainable developments strategies, crime and safety are generally mentioned implicitly. Oftentimes there are no clear explicit measures put in place (Cozens, 2010). As a result, officials may not see it as a priority, or these can be overlooked and therefore not included in the project. This may damage the person-environment relationship, which is crucial to a safe and healthy environment. From this we see that it is hugely important to uphold and maintain this relationship, because if urban dwellers feel safe where they live, they are more likely to make use of the facilities which are provided to them, creating a positive ecosystem. It should therefore be in the interest of cities to develop environments that ensure feelings of safety to promote health.

2.2 Theories on the relationship between the environment and crime

In order to grasp the globality of crime within a city, it is important to understand what factors predict crime and the theories that accompany them. This will allow us to narrow our focus when trying to investigate crime and modifying the urban environment.

Different urban environments prompt different types of offenses, according to Kinney (2008). He states that the general pattern of crime can be observed following the 'power law', whereby certain areas will have a large concentration of crime whilst others may have none. This will depend on the facilities and activities that are available to the population and the way that the land is used. This is where crime attractors, detractors and generators, which were mentioned previously, come into play. Depending on how the land is used, this will determine which types and degree of crime occur in certain areas. A certain type of land use, such as malls or city centres, may be seen as crime attractors because since there are many people, there are more opportunities to offend. On the other hand, it can also be seen as a detractor because there are more "eyes on the streets" to deter crime. Knowing this allows us to anticipate potential crime prone areas and therefore gives the opportunity for city architects to adapt their buildings and modify them where necessary in the early planning stages. With this information, CCTVs could be placed in strategic points or systems of facial recognition to deter crime in these urban attractors.

Another theory looks into ways in which the environment or a situation can facilitate crime (Cozens, 2010). There are four ways in which this can be done. The environment can *prompt* criminal behaviour, whilst social factors *pressure* individuals to commit crimes. A certain situation may weaken moral constraints and therefore *permit* offending. Finally, a current

moment can *provoke* someone to act out. These four actions: prompt, pressure, permit and provoke, are crucial push factors when it comes to breaking the law, according to Cozens. Knowing what pushes someone to act is essential because this could allow the government or environmental planners to remove these situations from the urban environment. The first facilitator is the environment according to Cozens. Therefore, if we ensure that this initial level does not prompt criminal behaviour (e.g. by installing CCTVs, or increasing police presence), then the chain is stopped at the start.

The next two theories come from the wider branch of situational crime prevention theory and aim to look at how criminal activity is influenced by situational factors in the everyday life of regular people and who adopt normal movements (Brantingham and Brantingham, 1991). Cornish and Clarke (1986), argue for the rational choice theory. This framework characterizes criminals as rational individuals. They make decisions and choices based on circumstances, whilst assessing the costs and benefits of the situation. They may be prompted by their environment and potential offenders will then evaluate the risks versus the rewards before acting (Cozens, 2011). As a result, the level of crime within an area indicates the opportunity that is given by this environment. Having this knowledge allows us to anticipate how an offender may perceive a situation and gives us the opportunity to stop or deter offenders before the cycle even begins.

Cohen and Felson (1979) argue for the routine activity theory. It is a place-based explanation of crime, where essentially several factors must come together in order for the offense to occur. There must be a motivated offender, an appropriate victim and an absent guardian. When these all coincide, criminal opportunity arises. As mentioned previously, offenders are individuals of habit and therefore develop what is called an 'awareness space'. This is characterized by the places and routes an offender follows, which then make up his perimeter of offending. If we are able to determine where this awareness space is, we have the potential to reduce or eliminate it. In addition, if we remove a factor from the equation, such as an absent guardian, we would be able to reduce criminal activity, for example by adding more police presence. By understanding the mindset of offenders, we are able to adopt more efficient preventative measures.

It is important to incorporate all the theories mentioned above when conducting research into crime and cities because they each take on a different approach, whether it be psychological, situational or spatial. We will now move on to examining the general framework which creates the basis of this paper's research.

2.3 Environmental design and crime

Over the years, there have been numerous strategies put in place in an attempt to reduce crime. Some frameworks focus on situational factors, others focus on changing offender behaviour (Levi, 2004). In recent years, a new form of crime prevention has spread globally: Crime

Prevention Through Environmental Design (CPTED). CPTED was first coined in 1971 by Ray Jeffrey (Clarke, 2009). The framework argues that criminal opportunities can be prevented and quality of life improved, through the modification of the built environment.

CPTED is based on 6 essential principles: 'territoriality', 'surveillance', 'access control', 'image', 'activity program support' and 'target hardening' (Levaid, 2012). 'Territoriality' promotes the division of space into what is considered as "mine" or "yours" (Seung Lee, 2016). It gives a sense of ownership to individuals of their own land and promotes a certain guardianship of the individuals towards their community. 'Surveillance' relies on natural (e.g. by the people), formal (e.g. by the police) and semi-formal (e.g. with CCTV) ways of surveilling crime (Seung Lee, 2016). Jane Jacob, an urban activist in the 1960s, argued strongly for the concept of natural surveillance, stating that having "eyes on the streets" reduces criminal activity and creates a safer environment because individuals are under constant watch (Seung Lee, 2016). 'Access control' refers simply to the fact that it should be made difficult for criminals to have access to areas where they could commit crimes, this can be done through using symbolic or real barriers Seung Lee, 2016). 'Image' refers to the aesthetics of the urban space, whether the area is well maintained or whether it appears to be run down. This can be compared to the broken window theory proposed by Wilson and Kelling in 1982, which states that visible signs of antisocial behaviour and disorder, such as a broken window or graffiti on the walls, will encourage criminal behaviour. Therefore, maintaining a positive image is needed in order to deter crime. 'Activity program support' focuses on encouraging legitimate users to utilise urban space such as a mixture of both young and old, men and women and providing an environment where safe activities can be conducted. Finally, 'target hardening' aims to have strong physical security and design that deters potential criminals, for example by putting in place gates and locks (Levaid, 2012). In order to utilise the CPTED framework correctly, it is necessary to have substantial knowledge of crime, where it occurs and why (Cozens, 2010). Simply understanding CPTED is not enough, one must also understand the spatial and temporal dynamics that occur within a city (Cozens, 2010). In addition, CPTED must be incorporated at all levels: socially, politically and economically, and it must incorporate distinct types and levels of crime as well (Cozens, 2010).

It is important to note that this framework is the product of ideas of two pioneers in the field: Jane Jacobs and Oscar Newman. In order to assess the validity of the CPTED model, we must first question the foundations from which it was built, which is why this paper will investigate both Jacobs' and Newman's ideas in depth. Both individuals agree that natural or informal surveillance plays a big role in crime reduction but on opposite sides of the scale.

In her book "The Death and Life of Great American Cities" published in 1961, Jacobs argued that a constant use of public space leads to a continuous system of surveillance by the public, which in turn discourages criminal activity (Sohn, 2015). These include design features within the urban environment that allows for direct observation and interaction of city-dwellers within their community (Brown, 2008). This can be done through architectural features by adding balconies or large courtyards between buildings or encouraging the use of outdoor communal

spaces. This in turn increases neighbourhood responsibility and ownership from its residents. She therefore argues that by building a *permeable* environment, encouraging *mixed land use* and a high *population density*, this would increase neighbourhood security.

On the other hand, Newman proposes a contrasting theory; that of 'defensible space'. Defensible space refers to space that is seen by individuals as their own and one which they can defend, also known as territoriality. This sentiment of ownership can be promoted by using real or symbolic territorial displays (Schneider, 2005). Newman argues that high *population density*, a *permeable* environment and *mixed land use* leads to a decrease in this perception of territoriality and an increase in criminal activity (Schneider, 2005). This is because the three factors mentioned before (*permeability*, *population density* and *mixed land use*), create a higher flow of people, so residents will be less able to recognize who is an intruder into this space or not (Sohn, 2015). The residents lose the sense of control over their community. Cozens (2002), presents four levels to Newman's defensible space theory, depending on the degree of fear of crime. The first is 'defensible space' which is what Newman discusses and is mentioned above. The second is 'undefended space', proposed by Merry, 1981, and refers to space that is not actively defended due to fear of crime. The third is 'offensible space', proposed by Atlas, 1991, and concerns space defended by others, such as drug dealers or gangs. Finally, the fourth and highest on the scale of fear of crime is 'indefensible space', which is where local residents are incapable of defending this space (Cozens, 2002).

We see that there are two very contrasting views when it comes to the three factors: *permeability*, *population density* and *mixed land use*. These are justified in the theory, but they will now be discussed individually in an attempt to apply these theoretical frameworks into practice.

2.4 Permeability

The first variable to be discussed is that of environment *permeability*, more specifically looking into street *permeability*. We discussed previously that there are two opposing theoretical frameworks on the matter. On the one hand, Jacobs argues for a more permeable environment which leads to more 'eyes on the streets' and results in a decrease in criminality. On the other there is Newman, who argues for less permeable streets because this makes the neighbourhood more defensible amongst residents. We will now look into research and examples in an attempt to examine both sides with more concrete evidence.

First, we must understand what exactly is meant by *permeability* in the context of criminality. It can be interpreted in many ways; however, this paper will focus on the physical configuration of the neighbourhood. *Permeability* of the physical urban environment focuses on how street networks impact traffic and pedestrian movement, which is what this paper will mainly be focusing on (Johnson 2009). Street networks are crucial in determining *permeability* because

the way they are configured will determine who uses them, how frequently, at what times and for what purposes (Johnson, 2009).

Now that we have established what defines a permeable environment, we must determine in what ways this impacts criminal behaviour. A study by Yue (2018), looked into the impacts of street *permeability* on crime rates in Wuhan, China. As opposed to most studies who state that street *permeability* either increases or reduces crime, Yue found that there is a complex relationship between the two. Streets with higher local *permeability* indicate lower crime rates because they are used by local residents and this allows for strangers to be easily spotted amongst the routine of the local city-dwellers. This seems to discourage strangers from committing crimes in the area, which is in accordance with Newman's defensible space theory. On the other hand, streets with higher non-local *permeability* are shown to have higher crime rates because there are more strangers present within the area and this decreases the ownership of the land. It becomes unknown who is meant to watch over the neighbourhood. Yue found that the unemployment rate negatively impacted crime rate. She also identified that the distance of a place to a CCTV was negatively correlated with criminal offenses. It is also important to note that in accordance to Yue's research, Mayhew (1979) found that factors such as dark corridors, elevators and easily accessible apartments promoted crime, whilst on the other hand well lit, smaller, walk-up apartments were less prone to criminal activity.

Another study by Hillier (2005), investigated crime rate as a result of street connectivity in a London borough. He found that the more dwellings lie on a street within a residential neighbourhood, the safer these homes are from being robbed or burgled. This result seems to go against Newman's theory of defensible space because it appears that the more individuals there are within an area, the less crime prone the area.

A further study by Sohn (2018), examined street *permeability* and the influence of crime in Seattle, USA. They found that improving street *permeability* increased safety in the neighbourhood. This is due to the increased presence of individuals on the street who uphold natural surveillance of the area.

From the studies discussed above, it would seem that the research is in favour of Jacob's 'eyes on the streets' model where an increase in *permeability* acts as a deterrent to crime and goes against Newman's theory of defensible space where less permeable streets discourages criminal activity.

2.5 Population Density

Population density refers to the amount of people that live within an area can be found by dividing the number of people by the size of the area. Once again coming back to Jacobs and Newman's opposing views it must be determined which one is more efficient in reducing crime.

A study by Li (2000), used a geographic information system (GIS) to conduct a spatial analysis in Texas. They obtained crime data from police records and compared it to *population density* taken from the Texan government. By creating an overlay of maps, they were able to conduct statistical analyses to determine whether *population density* positively or negatively impacts crime rates. They did not find any significant correlation between the two, which indicates that perhaps there is no effect of population on crime rates. They also looked into social factors and found that high crime rates were associated with high levels of poverty and unemployment areas.

Harries (2006), conducted a study in Baltimore, USA investigating crime rates and *population density*. He found that property crimes were positively correlated with *population density*, whilst homicides were negatively correlated. This goes to show that perhaps it is not a matter of the amount of people that influences criminality, but rather different population densities may encourage different types of crime. These findings cast doubts on Jacobs and Newman's radical views and leaves space to think that perhaps it is a combination of both that serves to determine high or low crime rates within a neighbourhood. It is possible that until a certain *population density* a certain type of crime may occur, and once this density increases, we may observe different patterns of crime. It also appears that the age of the population plays a role in the level of crime that can be found within a neighbourhood (Harries, 2006). Older populations may provide more natural surveillance during the day, because they are more likely to stay at home and be alert, compared to a younger working-class population which has to go to work during the day.

In addition, in a study on Shanghai, China conducted by Yin (2011), it would seem that within areas of high *population density,* there are hotspots where crime rates are higher than surrounding areas. These can be found in and around malls and recreational areas. As one moves further from these 'hotspots' crime rate decreases as well (Yin, 2011). Finally, a study by Omotor (2010) looked into the determinants of crime in Nigeria and found that an increase in *population density* significantly and low-income regions both increased crime rates. The above case studies confirm Newman's defensible space theory, whereby areas with fewer people lead to a decrease in criminal offenses.

Christens and Speer (2005), conducted similar research on *population density* and crime rates in Nashville, USA. They found significant evidence showing that an increase in density of individuals on the streets reduced rates of violent crime. In addition, in this study the *population density* was the most significant predictor of crime rates as opposed to other demographic characteristics. This confirms Jacobs (1961) theory of 'eyes on the streets' and suggests that more people are able to keep watch over the neighbourhood. However, it contradicts the findings of the previously mentioned study which found no correlation (Li, 2000) and or a positive correlation with property crimes (Harries 2006).

Overall, it would seem that research on *population density* and its influence on crime rates is very disputed. We can see however that there is more evidence showing that a high *population density* leads to an increase in crime, especially when looking at property crime, confirming Newman's defensible space theory. We can conclude that when investigating crime rates within cities we should look at *population density,* but it is also critical to look at other demographic factors which could influence the types and frequency of crime.

2.6 Mixed land use

Finally, the last factor to be discussed is that of *mixed land use* and whether this attracts or deters crime. In this paper, we will refer to *mixed land use* as heterogeneous areas of multifunctionality that can be used for a variety of purposes, anything from leisure to restoration to businesses.

Browning (2010), found some interesting results regarding *mixed land use* and crime rates in Northern American cities. According to him, up until a certain threshold, increasing the density of *mixed land use* also led to a corresponding increase in crime rates. However, above this threshold, increasing *mixed land use* led to no change in the number of offenses. Only for robbery was there a significant positive correlation with *mixed land use* throughout. This combines both Jacobs and Newman's views. Initially, we encounter the defensible space theory, whereby a less *mixed land use* seems to result in lower crime rates. However, once we reach a certain threshold, increasing *mixed land use*, will not result in an increase in crime because there will be a constant natural policing of the city-dwellers as stated by Jacobs (1961).

The study by Yue (2018) in Wuhan, China, confirms this initial statement of defensible space, stating that the number of commercial stores within a neighbourhood was positively correlated with criminal offenses. A further study by Shams (2012) examined the crime rates in relation to *population density* in Islam Abad and found that once again a higher density leads to a higher occurrence of offenses within the city. The study by Li (2000) found that in Texas, areas with *mixed land use* were more prone to crime simply because they provide offenders with more opportunities to commit crimes. In proximity to malls or recreational areas, cars may be stolen, and pickpocketing may be more prominent simply because there are more opportunities, compared to residential areas.

Wo (2019), considered eight different indices to measure *mixed land use* in Los Angeles, USA and investigated their impact on crime rates. When looking at the general effects of areas with more heterogeneity, they were found to have higher crime rates over a period of four years than other places.

From the research mentioned above, there seems to be an overwhelming amount of evidence pointing towards the fact that *mixed land use* is positively correlated with an increase in crime rate. This goes against Jacobs' theory, because by increasing *mixed land use*, more people will

be in the streets, however this leads to an increase in crime. The concept of natural surveillance does not seem to apply here.

2.7 Study aims

To date, there is no research which studies all three predictors mentioned above and their effect on crime in the city of Geneva. In addition to this, research that has been done is inconsistent in regard to the predictors. Thus, the current study will *aim to investigate the relationship between permeability, mixed land use and population density on the number of crimes in the different neighbourhoods in the canton of Geneva, Switzerland*. This paper will also explore the relationships across different crime sub-types, namely attacks on life, theft, attacks on freedom, sexual assaults and other crimes.

Our hypotheses are as follows:

H1: An increase in *permeability* leads to a decrease in crime rates
H2: More *population density* leads to an increase in crime rates
H3: *Mixed land use* leads to an increase in crime rates

3. Methods

The research methods and design are guided by the research question and the aim of this paper which is to investigate using quantitative methods the relationship between crime and our three factors, which are *permeability*, *mixed land use* and *population density*. Data was compiled to create our three indicators and then the relationship was investigated using the GIS software for geographical analyses ArcGIS Pro. Then, using SPSS, statistical analyses were conducted to obtain data to support the research design. First there will be a section to contextualize the study area. Following this, we will have the methods, which operationalize our variables. Finally, the analyses of our results are stated and separated according to type of crime.

3.1 Study design

This research takes the form of an ecological study that uses population data and statistics to conduct statistical analyses on different neighbourhoods within the canton of Geneva. It is a cross-sectional study as it takes data from a single point in time to study our variables of interest.

3.2 Study region

Over the years the population of Switzerland has increased drastically, going from 6'200'000 in 1970 to 8'500'000 in 2018 (Federal Bureau of Statistics, 2019). Of this population, the number of internationals has increased from 1'000'000 in 1970 to 2'500'000 in 2018, making up 25% of the local population currently (Federal Bureau of Statistics, 2019). Overall, crime in the whole of the country has steadily declined going from 375'000 offenses in 2009, to 291'000 in 2019 (SCC, 2019). The majority of offenses are committed in urban regions as opposed to the rest of the country (Swiss Info, 2019). The majority of prisoners in the country, around 71%, are foreigners. The majority comes from France (987), Portugal (455), Algeria (316) and Romania (271) out of a total of 7500 prisoners in 2018 (OFS, 2018).

This study focuses on Geneva. It is located in the east of Switzerland and can be considered an enclave as it is mostly surrounded by France. Around 80% of the population speaks French and the main foreign language is English, spoken by around 10% of the people. The canton of Geneva measures 282 km^2, with 40% of this being agricultural land and 30% being infrastructure (OFS, 2020). There is very low unemployment, only about 4%. Geneva is also home to one of the three headquarters of the United Nations since 1936, which makes it a very diverse and multicultural city (UNOG, 2019). It is home to 41 international organizations, 34'000 international civil servants and diplomats and more than 3'200 meetings annually (eda.admin.ch, 2020). Around 40% of the population is made up of foreign resident nationals (OFS, 2018). This makes it a very globalised city that is constantly adapting and developing.

Several of the surrounding regions of France are what are called “banlieues”. This is a term to describe the suburbs of France that are poorer, have high unemployment and generally are notorious for having higher incidences of crime (Peralva, 2005). In an attempt to discourage criminals from travelling across borders to commit crimes, a Swiss law was passed in 2009 in collaboration with the French police. The aim of this law is to allow officers to follow or make arrests on foreign ground. For example, if there is a car chase in Swiss territory and the offender decides to cross the border, the Swiss police officer is allowed to enter French grounds and continue to follow the offender to make an arrest. This promotes collaboration between the two countries in an attempt to reduce crimes across borders.

Crime rates in Geneva have remained stable with no significant decrease over time (OFS, 2018). However, there have been fluctuations in the types of crimes committed. For example, there was a 31% increase in domestic violence between 2017 and 2018 in the canton (ge.ch, 2019) and a 6% decrease in thefts (Swiss Info, 2019). In 2018, Geneva was the second canton with the most offenses per 1000 inhabitants, with 101 offenses (Swiss Info, 2018).

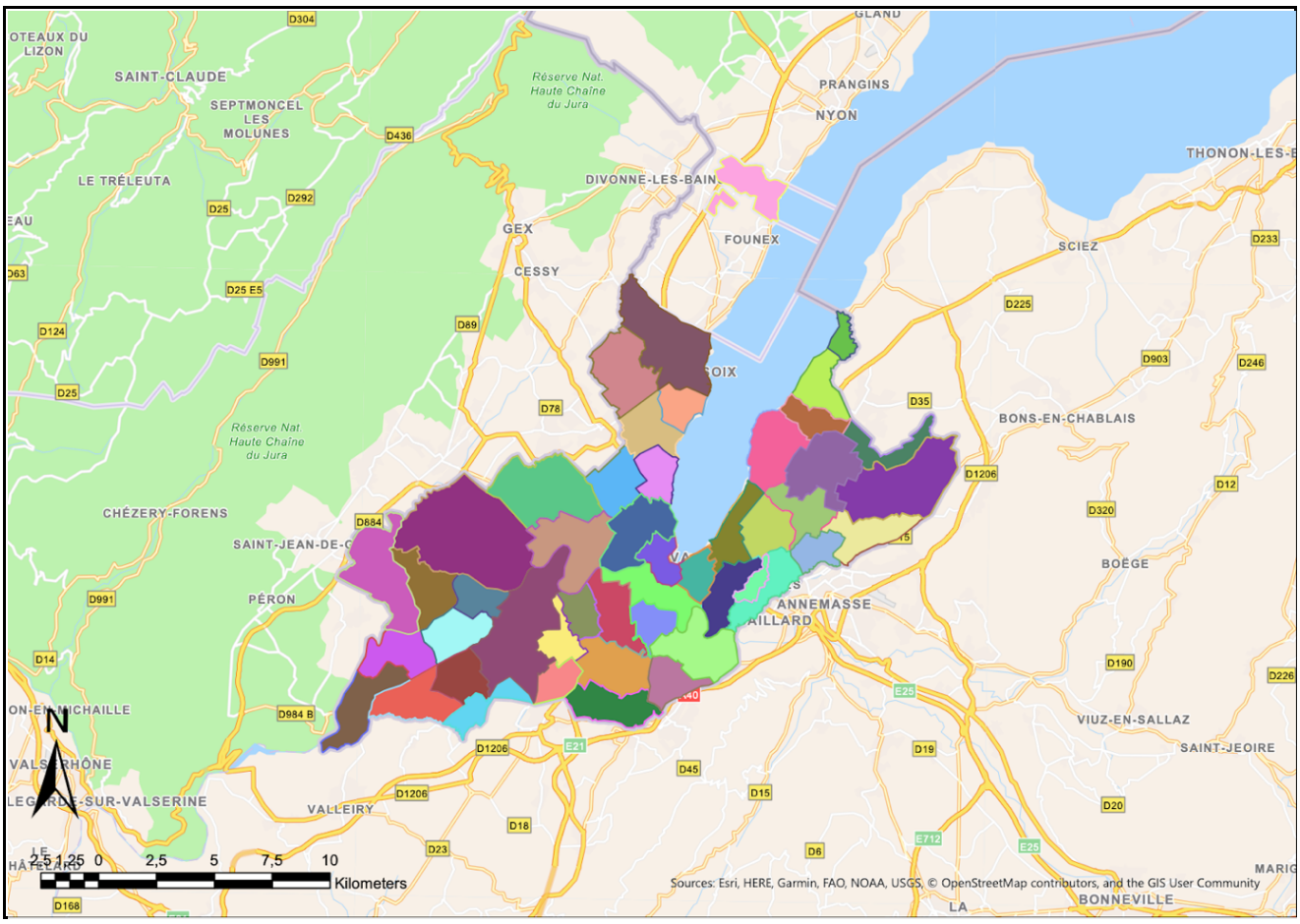

Figure 1. Map of the municipalities of Geneva

3.3 Data

Geneva as a canton follows the open data policy which means that all non-confidential information is made available to the public. Therefore, our data were derived from open sources. We collected these from sources for every municipality in Geneva (n=45).

The outcome or dependent variable is crime rate (per year) and our predictors or independent variables are *permeability*, *population density*, and *mixed land use*. Several databases were used to compose each predictor, which will be discussed below. Finally, we had some control variables to increase the internal validity of the research.

3.3.1 Outcome

Two reports of crime data were obtained from the collaborative reports of the federal office, 'Office Federal de la Statistique' (OFS) and the police forces, 'Police Genève', to form our crime data. All information is from 2018, which is the most updated data there is. The first report consists of demographic data to do with crime, such as age, gender in relation to the types of crime. The second data set focused more on decomposing the exact type of crime that occurred across different municipalities. This data is taken from the OFS and separates crime into five categories: "attacks on life", which consists of homicides, physical assault; "theft", which includes robberies and fraud; "attacks on freedom", such as kidnapping, or threats; "sexual assaults", such as rape and "others" which includes arson and money laundering. These crimes have been placed in five categories because they are subject to the same or similar laws.

3.3.2 Predictors

Several data sets were used in order to compose three indices of *permeability, population density* and *mixed land use*. The data were obtained from three main sources. All are freely available to the public. The first is the government database 'Services Industriels de Genève' (SITG), the second is the 'Office Cantonal de la Statistique' (OCSTAT), which is a database concerning the canton of Geneva, and finally the OFS, which provides statistics for Switzerland as a whole.

Permeability

In order to assess *permeability* of each communality, three data sets were chosen and are summarised in table 1. 'Pedestrian' refers to the length of pedestrian areas and includes both paths and pedestrian roads. This variable measures the walkability of the neighbourhood, to determine if people are encouraged to be in the streets and therefore increases "eyes on the streets" (Jacobs, 1961). 'Train stations' maps the different locations across the canton of train stations and differentiates between regional and inter-regional lines. These indicate points of commute and public transport which once again helps us to determine the *permeability* of the

municipality. Finally, 'roads' considers all roads that pass through the canton. This gives us information on how well connected the neighbourhood is throughout.

Table 1. GIS data used to measure permeability

Dataset	Data type	Attributes	Source
Pedestrian	Polyline	Length of pedestrian network	SITG
Train stations	Point shape	Number of train stations	SITG
Roads	Polyline	Length of road segments	SITG

Population density

Population density was measured using data from the OCSTAT, which gives us this statistic on for each municipality. This was chosen because it reflects *population density* best and gives us additional information if necessary. It is measured by giving us the number of people per square kilometre in each municipality for the year 2018.

Mixed land use

Mixed land use was measured by compiling three different GIS datasets. The first 'public facilities' refers to the amount of facilities open to the public, such as museums, libraries, sports centres, schools, etc… This indicates areas that host a variety of people on a daily basis and for different purposes within the same municipality. 'Mixed land' refers to heavily used public facilities, such as malls or recreational areas. This illustrates *mixed land use* but on a wider scale, high density areas. Finally, 'Green areas' measure the total area that is taken up by parks or forests, which is a useful indicator of how land is used within each area. These three datasets were chosen to illustrate the diversity of the space in question, and its layout.

Table 2. GIS data used to measure mixed land use

Dataset	Data type	Attributes	Source
Public facilities	Point shape	Number of public attributes (e.g. museums)	SITG
Green areas	Polygon	Total area of green spaces	SITG
Mixed land	Point shape	Number of areas of frequent use (e.g. malls)	SITG

3.3.3 Control variables

Unemployment levels, foreign population levels and police stations are three control variables that are included in the model. Data for unemployment rates and the proportion of foreign population for each municipality was gathered from OCSTAT. High unemployment levels are

associated with an increase in criminality (Alves, 2018), so it is important to take note of this when conducting the analysis. In addition, the foreign population is used as a control to assess to see whether areas with higher populations of expatriates experience more crime, to ensure this does not act as a confounding variable. The number of police stations was found in the SITG database. This is a useful statistic to include because we would assume that there are fewer crimes near police stations as there is a higher risk of getting caught.

3.4. Statistical analysis

All GIS datasets were inputted into ArcGIS Pro to conduct geographical analyses. The map of Geneva was divided amongst its 45 municipalities so that all analyses would occur within each of them. The 'Summarize Within' tool was used to calculate the amount of points, the total length of lines and areas of polygons in the canton.

Then the data was inputted into SPSS to conduct further analyses on our results. All polyline and polygon data were converted into a ratio of the land area to facilitate comparison between the municipalities. The study area was originally mapped as having 48 different municipalities simply because the one called 'Geneva' was split into 4 smaller areas. However, for the purpose of this study their data was compiled to make one larger area. This is because OCSTAT classifies this as such. Genève Petit Saconnex, Genève Cité, Genève Eaux Vives and Genève-Plainpalais are simply named Genève in our dataset. Length of road and length of pedestrian walkways were standardized to obtain data per square kilometre. Their data measured in kilometres was divided by the area of the municipality to obtain comparable data that can be analysed further on.

The aim was to test our dependent variable 'number of crimes' against our multiple predictors: *permeability*, *population density* and *mixed land use*. First, a multiple linear regression was conducted to assess how the total number of crimes was influenced by our different predictors, whilst controlling for unemployment levels, proportion of foreign population and number of police stations. Separate multiple linear regressions were also conducted for each sub-type of crime to determine how well our variables predict them. Types of crime considered were: 'life threatening', 'theft and burglary', 'attack on freedom', 'sexual offenses' and 'other'.

4. Results

4.1 Descriptive statistics

Table 3 shows the means and standard deviations for our variables. The average number of crimes (dependent variable) occurring within the canton per year was 1092. The average *population density* was 1810 people per square kilometre. When looking at Pearson correlations between our dependent variable and the predictors, we see that all except two predictors are significantly correlated to crime rates. These non-significant variables are pedestrian path density (p= .42) and green spaces (p=.24). In addition, the remaining significant predictors are all strongly positively correlated to crime with coefficients above .68. The variable 'percentage of foreign population' and the predictor 'road density' still have positive correlations but lower coefficients of .42 and .51 respectively.

Variables	Mean	Standard Dev.
Overall crime	1092.24	3857.451
Attacks on life	48.40	170.35
Theft	814.29	2954.70
Attacks on freedom	121.31	357.40
Sexual assaults	12.00	43.14
Others	97.34	337.27
Train stations	.49	.87
Pedestrian Density	2,64	2.12
Road Density	7.67	2.33
Public equipment	31.36	52.97
Green areas	.71	1.01
Mixed land facilities	2.71	9.36
Population density	1810.24	2649.48
% of foreign population	28.91	9.26
unemployment	214.12	674.68
police stations	.38	1.39

Table 3: Descriptive statistics for the dependent and independent variables

4.2 Main model

The multiple linear regression of the overall crime model is significant, $F(10,34)= 933.33$, $p<.001$. The R^2 value tells us that our variables jointly explain 99.6% of the variability in overall crime levels, which is a large effect. When looking more closely at the predictors, two are significant at predicting overall crime: mixed land, (B= .31, p=.003) and *population density*, (B= -.11 p<.001). Unemployment rate too was significant (B= .80, p<.001). By looking at the

regression coefficients of our three significant variables we see that mixed land and unemployment are positively correlated with overall crime whilst *population density* is negatively correlated with overall crime. A one unit increase in mixed land leads to 128.12 more crimes and an increase of 1km^2 in *population density* leads to -.16 crimes.

Variables	Overall crime			Attacks on life			Theft			Attacks on freedom			Sexual offenses			Others		
	b	SE	beta	b	SE	beta	b	SE	beta	b	SE	beta	b	SE	beta	b	SE	beta
police stations	193.25	140.49	.07	13.76***	5.77	.11	137.81	112.05	.07	3.33	12.20	.012	-2.03	1.62	-.07	41.61***	18.11	.17
mixed land facil.	128.12***	39.51	.31	4.28***	1.62	.24	98.22***	31.51	.31	11.71***	3.43	.31	1.99***	.46	.43	12.15***	5.11	.34
road dens.	12.25	33.96	.01	.85	1.39	.01	10.02	27.08	.01	.37	2.95	.01	-.52	.39	-.03	1.52	4.32	.01
% of foreign pop.	7.75	7.18	.02	.38	.30	.02	5.74	5.73	.02	.57	.62	.02	.08	.08	.02	.99	.91	.03
unemployment	4.59***	.89	.80	.28***	.04	.90	3.62***	.71	.83	.30***	.08	.56	.06***	.01	.86	.40***	.11	.81
pedes. dens.	3.77	20.20	.01	.74	.83	.01	1.09	16.12	.01	-.25	1.75	-.01	.25	.23	.01	2.12	2.62	.01
pop. dens.	-.16***	.04	-.11	-.01***	.00	-.11	-.13***	.03	-.12	-.01***	.01	-.06	-.01***	.01	-.08	-.01***	.01	-.11
public equip.	-6.53	7.97	-.09	-.54	.33	-.17	-5.65	6.36	-.10	1.23	.69	.18	-.13	.09	-.16	-1.56	1.05	-.25
green areas	-79.98	47.15	-.02	-.89	1.94	-.01	60.54	37.60	-.02	-6.56	4.10	-.02	-1.02	.55	-.02	-10.91	6.00	-.03
train stations	-152.64	88.72	-.03	-3.78	3.64	-.02	-129.92	70.76	-.04	-12.26	7.71	-.03	-.74	1.03	-.02	-5.35	11.42	-.01

*** = $p < .001$
* = $p < .05$

Table 4: Regression coefficients both standardized (beta) and unstandardized (b) of the multiple linear regression models

Variables	Overall crime	Attacks on life	Theft	Attacks on freedom	Sexual offenses	Others
Sig.	<.001	<.001	<.001	<.001	<.001	<.001
R square	.996	.997	.996	.996	.996	.992
std. error estimate	264.37	10.86	210.85	22.96	3.05	33.63
df	10, 34	10, 34	10, 34	10, 34	10, 34	10, 34
F	933.34	1079.88	860.67	1062.66	874.93	429.21

Table 5: Model fit for all dependent variables

4.3 Attack on life

The mean of life-threatening crimes was 49 per year for the whole canton of Geneva. Once again when looking at the relationships between our variables, we see that all but two, pedestrian roads (p=.44) and green spaces (p=2.70), have significant associations with life threatening crimes. All significant variables have a strong positive correlation to crime apart from the percentage of foreign population with a coefficient of .43. The multiple linear regression model is significant $F(10, 34)= 1079.81$, $p<.001$. The R^2 value tells us that the variables jointly explain 99.7% of the variability in life threatening crimes, which is a large

effect. Three predictors have a significant power to predict this type of crime: mixed land, (B=.24, p=.012), *population density* (B=-.11, p<.001) and police stations, (B=.11, p=.023). The control variable unemployment was also significant (B=.90, p<.001). The regression coefficients show that for every unit increase in mixed land, every additional km^2 in *population density* and every unit increase in police stations, there is a 4.28, -.01 and 13.76 change respectively in life threatening crimes.

4.4 Theft

The average of theft crimes was 814 per year in the county of Geneva. As for the previous type of crime, both pedestrian paths (p=.42) and green spaces (p=.24) do not have significant correlations with theft. However, the predictors which are significant have a strong positive correlation with theft. The multiple linear regression analysis with theft as a dependent variable is significant F(10,34)= 860.67, p<.001. The variables jointly explain 99.6% of the variability in theft, which is a large effect. There are two significant predictors, the same as in the general model: mixed land (B=.31, p=.004) and *population density* (B=-.12, p<.001). These can successfully predict theft crimes. The control variable unemployment was also significant (B=.83, p<.001). The regression coefficients show that with every unit increase in mixed land there are 98.22 more theft crimes and for an increase in a km^2 of *population density* there is a -.13 decrease in theft.

4.5 Attack on freedom

On average we observed 121 crimes against freedom, such as kidnapping or serious threats, per year in Geneva. As for previous crimes, both pedestrian paths (p=.42) and green spaces (p=.24) have non-significant correlations with attacks on freedom, whilst the other variables are strongly positively correlated. The overall model is significant F(10, 34)= 1062.66, p<.001, which suggests good predictive power. The variables jointly explain 99.7% of the variability in crimes against freedom, which is a large effect. There are two predictors that explain these crimes: mixed land (B=.31, p= .002) and *population density* (B=-.06, p= .03). Once again, the control variable unemployment was also significant (B=.56, p= .001). If we look at the intensity of the prediction, we see that for every unit increase in mixed land there is an 11.71 increase in crimes against freedom and for a km^2 increase in *population density* there is a -.01 decrease in crime.

4.6 Sexual offenses

In the canton of Geneva there was an average of 12 sexual crimes a year which is the lowest figure of all crime types so far. There are only two non-significant correlations which are pedestrian paths (p=.46) and green areas (p=.27). All the other variables are significant and

strongly positively correlated, which allows us to then study their relationship. The overall model is once again significant F(10, 34)= 874.93, p<.001. The variables jointly explain 99.5% of the variability in the model, which is a strong effect. Two predictors, following previous patterns, predict sexual offenses: mixed land (B=.43, p<.001) and *population density* (B=-.08, p= .008). For every unit increase in mixed land, there is a 2.00 increase in sexual offenses and for a km^2 increase in *population density* there is a decrease of -.001 in crime.

4.7 Others

Finally, the last remaining category is all the other crimes which do not fit in the four other categories and include arson and money laundering. On average there were 97 of these crimes occurring in the canton of Geneva each year. As with all other crimes only two correlations are non-significant pedestrian paths (p=.43) and green areas (p=.21). The overall model is significant F(10, 34)= 429.21, p<.001. The variables jointly explain 99% of the variability in the model, which is a strong effect. This category of crime has three significant predictors: mixed land (B=.34, p=.02), *population density* (B=-.11, p= .007) and police stations (B=.17, p= .03). The control variable unemployment was also significant (B=.81, p= .001). For every unit increase in mixed land there is a 12.15 increase in other crimes. For every km^2 increase in *population density*, there is a -.01 decrease in other crimes and finally for every increase in police stations there is 41.61 increase in other crimes.

5. Discussion

5.1 Main findings about crime

Using open data from the government and canton of Geneva, our aim was to answer the research question "how does *permeability*, *mixed land use* and *population density* impact crime rates in the canton of Geneva?". The canton of Geneva was divided into 45 municipalities and data was collected for all of them. Several multiple linear regressions were conducted with the independent variables being *permeability* (i.e. train stations, pedestrian paths, roads), *population density* and *mixed land use* (i.e. public facilities, green areas, mixed land), and the dependent variable varying according to the type of crime.

The main findings from the multiple linear regression of overall crime show us that **crime is associated with the two main predictors, which are mixed land and *population density*.** The other two variables that were used to measure *mixed land use* (i.e. green spaces and public facilities) were not significant. **Permeability did not have a significant relationship with crime.** If we look at the individual coefficients, we see that mixed land has the greatest impact on overall crime and leads to the highest increase in crimes for every additional mixed land facility. To answer our research question, we see that mixed land and *population density* have a positive and negative relationship with crime, respectively.

If we focus on the different types of crimes, we see a recurrent pattern. **Even though different crimes have different attractors and detractors (Kinney, 2008), we find that the same two variables consistently predict them: mixed land and *population density*. The control variable unemployment also had a significant impact.**

In the case of 'attacks on life' and 'other' crimes, the effect size is largest for police stations. Even though this is a predictive relationship, we must not consider it a causal relationship. It is possible that due to an increase in attacks on life, more police stations were then placed in the neighbourhood. It does not necessarily mean that new police stations result in an increase in crime rates. **For all other crime types, we see that mixed land has the largest effect size** when it comes to predicting attacks on freedom, sexual assaults and thefts. **For all categories of crimes, *population density* was negatively associated with offenses**. This suggests that an increase in population is associated with a decrease in all crime. Unemployment, which was used as a control variable, also seems to greatly impact crime, whereby an increase in unemployment leads to an increase in crimes.

It is also important to note that out of the 10 municipalities with the most proportion of crime, the majority was found in proximity to the French borders. This suggests that the closeness to the 'banlieues' could be one of the reasons for such an effect on crime.

5.2 Findings in context

Permeability

Two theoretical frameworks were discussed in regard to *permeability,* that of Newman's defensible space theory, and that of Jacob's 'eyes on the streets' theory. Both Hillier (2005) and Sohn (2018) conducted studies which provided evidence in favour of Jacobs theory, stating that increasing *permeability* and connectivity leads to a reduction in crime because the neighbourhood environment becomes defensible space. Johnson (2009) also places a clear emphasis on the importance of connectivity throughout the urban space. They show that well connected streets lead to more people using those streets and therefore natural surveillance develops throughout. However, we see in our results that none of the variables used to measure *permeability* (i.e. train stations, pedestrian paths and roads), are statistically significant when predicting crime. This suggests that *permeability* in our model is not a good predictor of crime in the city of Geneva. In addition, pedestrian walkways have no significant correlation with any crime type. Therefore, our results are not aligned with these theories

Population density

In the literature, we looked at Newman's versus Jacob's theories in an attempt to determine how *population density* impacted crime. Li (2000) found no relationship between *population density* and crime. Harries (2006) argued that it is not *population density* that influences crime, but the demographics of this population that does. Instead of the amount of people by square kilometre, he stated that age, income and ethnicity have a higher predictive power. Finally, Christens and Speer (2005), found that a higher *population density* leads to a decrease in violent crimes but an increase in petty crimes. Following Jacobs' theory, we would assume that the more people there are the less crimes there should be because of this natural surveillance phenomena. This is exactly what was found in the study, *population density* and crime are inversely related. This provides evidence for Jacobs' theory, that the more people there are within an area, the less crime there will be because this discourages criminals from acting as they are being watched at all times. Our results align with Jacobs' theory and not with Li's theory, who suggests there is no relationship. Further research needs to be conducted in order to support Harries theory; that it is not only a matter of density but also a matter of demographics. As for Christens and Speer, we do see this to a small extent. *Population density* seems to have a bigger negative correlation with theft than with violent crimes, which supports their research.

Mixed land use

The research on *mixed land use* overwhelmingly showed that an increase in this variable leads to an increase in crime rates. Of the three datasets used to measure *mixed land use*, only the variable mixed land showed a significant relationship to crime. Browning (2010) offered the idea that up until a certain threshold, *mixed land use* leads to an increase in crime and once it is reached, anything above that no longer has any impact on crime. This evidence is backed up by studies from Yue (2018), Shams (2012), Li (2000) and Wo (2019). They all state that *mixed*

land use strongly predicts crime, whether it be in Shanghai, Baltimore, Texas or Nigeria, this finding seems to be recurrent. Our research found evidence that mixed land has a strong positive relationship with all types of crime, which is aligned with the previously mentioned research. Not only did mixed land predict crime, but it also had the most impact, meaning for every additional mixed land facility, there was a large increase in all types of crimes. This contradicts Jacobs' theory because more facilities should lead to more people using these facilities (more eyes on the streets) and therefore it should result in a higher natural surveillance. In addition, it would be expected that more facilities increase theft because it provides more opportunities to commit crime. However, it is surprising that it also increases violent crimes and not only petty crimes, which is not consistent with Browning's (2010) findings.

5.3 Strengths and limitations

In order to reflect on the research, we will now consider the strengths and limitations of this research. This study provided evidence showing how the three chosen variables influence different types of crime within the region of Geneva. It helps us to determine the general pattern that is occurring. In addition, we were able to cover the whole canton of Geneva using open secondary data which has the advantage of giving an overall view of the current situation, with recent data.

However, there are a few methodological downfalls to which this paper is subjected. Firstly, crime statistics may be unreliable. They may not be representative of the actual crime occurring within an area as they only include reported crimes, where the individual is caught by the police. Therefore, unreported crimes are not included in our data. This will also depend on the type of crime. For example, a theft is more likely to be reported than a sexual assault (Bureau of Justice Statistics, 2018). It also may depend on the culture of people living in a certain district because there can be stigma against reporting certain crimes. Another limitation is that crime data was presented in the form of numbers per commune and the exact location of each incident was not disclosed to the public. This made it impossible to conduct specific spatial analyses, such as proximity analysis. This would have allowed us to deepen the research and also determine where different types of crimes occur in different urban locations. Finally, by conducting multiple linear regressions on our datasets, we were able to establish a predictive relationship between predictor, outcome and control variables. From this however, we are not able to establish a causal relationship.

Future research could focus on deepening the analysis by investigating how different types of facilities influence different categories of crime, or also looking at the demographics of the population rather than simply the density. In order to get an overall view of the crime that is taking place, it is not only important to look at the statistics recorded by the police and government but also to investigate the feeling of safety amongst the population (Cozen, 2010). It is possible that statistics reflect low crime rates but that people do not feel at ease within their

urban environment. Therefore, this factor could be assessed with a qualitative research using a survey in each neighbourhood to determine whether the statistics reflect the feelings of the population.

5.4 Policy implications

There are several policy implications that emerge from this research. This study shows that there is a clear relationship between all types of crimes and mixed land. It also shows that there is a negative relationship between *population density* and crime and finally that unemployment plays a large predictive role in crime. These three factors need to be taken into consideration in urban planning for future developments. Knowing that *mixed land use* strongly predicts crime, is something that needs to be considered by urban architects when developing new districts and neighbourhoods. If for example there is an area which already has high levels of crime, perhaps adding new businesses and stores is not the best development strategy. As a result of people migrating to cities at an unprecedented rate, these will need to constantly adapt and change in order to sustain such populations. Only by implementing crime strategies into sustainable development projects can we tackle this problem hands on. It is also important for environmental planners and crime experts to work closely together in order to create sustainable communities while decreasing crime rates.

5.5 Conclusion

The initial aim of this paper was to investigate in what ways the physical environment influences crime rates, so that when redesigning cities for sustainability, crime reduction can be incorporated in the urban development plans. After conducting thorough research into three predictor variables: *permeability*, *mixed land use* and *population density*, we are able to say that within the city of Geneva, only mixed land and *population density* have a significant relationship with crime. *Permeability* showed no significant relationship with crime. Then, by conducting deeper analyses on different types of crimes, we can conclude that mixed land has the strongest relationship with all types of crimes and *population density* has an inverse relationship with crime. Eliminating crime from a large city is close to impossible, however it is important to try to reduce it as much as we can. It is not only important to target overall crime, but crime specific strategies also need to be put in place. In order for a city to be sustainable it is important to keep in mind that crime prevention strategies should be actively implemented in future developments. As mentioned earlier, a "sustainable community must be one that is defined as safe, perceives itself to be safe and is widely considered by others to be safe" (Cozens, 2007). Now that we have established the factors that attract and deter crime in the physical environment, it is important to integrate this knowledge in future developments and further investigate factors that influence perceived safety by the population.

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