



## ABSTRACT

In this research, the role of spatial crime analysis in urban planning is discussed by investigating the areas surrounding urban crime scenes as well as the cultural, religious, and ethnic background of delinquents by using geospatial technologies, e.g. Geographic Information Systems (GIS). The results of an indicator based analysis of young delinquents in terms of their social, environmental, and economic environment will lead to conceptualizing, testing, and evaluating new concepts for crime prevention in urban areas. Messaging, specific support programs, and urban planning/development metrics will be analyzed to create valid statements and suggestions for a more sustainable and secure development of urban space; leading to an improved “quality of life” for young people. The investigation area is the city of Graz, Austria’s second largest city with about 250,000 inhabitants. The main focus of the proposed trans-disciplinary approach lies in the analysis of juvenile crime under specific urban influence factors. Together with city planners, government officials, police officers, and youth groups, key features of the built environment which contribute to youth crime will be extracted from the imagery to create and support innovative prevention measures. Additionally, prevention initiatives will be measured by applying “risk-management” and/or “predictive policing” methods.

## PREFACE & ACKNOWLEDGMENT

I am so grateful that I was given the opportunity by the Marshall Plan Foundation and the University of Graz to study in the United States, concretely doing research on my doctoral thesis in the field of “Juvenile Crime and Urban Planning – How to Measure Crime Factors and Promote Prevention by Using Geospatial Technologies?”. The Louisiana State University (LSU) at Baton Rouge/Louisiana was a perfect location and institution which provided an office space and full staff rights during my stay from January 15th 2014 until May 2<sup>nd</sup> 2014. The reason for choosing Baton Rouge as my destination was that one of my supervisors, Prof. Michael Leitner (in addition to Prof. Friedrich M. Zimmermann from the University of Graz) is working at LSU as an expert in the research field of crime geography. At LSU I could use all the facilities, by using the library it disclosed a significant access to further valuable literature that I have used for my theoretical part of the thesis. That also helped me in dealing with a trans-disciplinary approach and encouraged me in thinking across borders, which I personally see as a central aspect of scientific research. This led to the fact that my dissertation is based on a trans-disciplinary fundament because – underpinned by the literature review - I recognized that crime needs to be investigated by linking research and society as well as legislation and education. Therefore the focus of my research will lie on the attempt to link social, economic, and environmental issues. Only by considering as much factors as possible, more accurate predictions and meaningful prevention measurements can be made.

In the U.S. I have networked with experts of crime research related organizations, companies and law enforcement agencies. There has been an intense exchange of know-how and in response to that the niveau of my research work got massively enhanced. Moreover, I could also achieve a satellite imagery grant of DigitalGlobe™, one of the most important and influencing remote sensing companies of the U.S. The DigitalGlobe Foundation Employee Advisory Committee (FEAC) has approved my application for an imagery grant that I can use for special analysis methods regarding crime. In return I have to make efforts to presenting my research at conferences in Europe as well as in the U.S. Moreover, the conference papers presented at these conferences will be published in conference proceedings and will therefore be evaluated by a wider scientific audience. In addition to the imagery grant of DigitalGlobe™ the application for accessing data from the SIMO (**S**icherheits**M**onitor), provided by the Federal Crime Investigation Office Austria (Bundeskriminalamt Österreich), finally got accepted too and I fully appreciate their support in handling and interpreting the data set. As the SIMO data are highly sensitive and confidential, I am not allowed to publish my dissertation within three years after having finished it. However, the combination of the sensitive data and the satellite imagery will assumingly lead to very promising results. The City of Graz also provided me with supporting data, such as parishes, population data, dwellings and accommodations as well as social data. One of the largest non-academic research institutes in Austria, Joanneum Research, is working on a KIRAS project, which is essentially dealing with security research, and I am participating at their meetings to reach synergies for my research approaches. They provide and support me with their project related information and contacts to the police and other crime related experts which are very important for my research topic.

The constant exchange of views with a retired police officer, who is now working with juveniles (prevention) in Texas, contributes to my research immensely, as it provides a unique insight into the crucial parts of the U.S. crime system and, moreover, it provides very different perspectives by combining science and practice which finally endorses the central method of my dissertation – trans-disciplinarity.

The AAG-Conference (Association of American Geographers) in Tampa/Florida, which was taking place in April, was another milestone within my research in the U.S. By listening to numerous presentations, socializing with many experts from various research fields, and by presenting my research work, I received valuable and constructive feedback. This input made me reflect my work from different point of views finally leading to a more focused and stringent concept.

On April 25 2014 I got invited to the “Austrian Marshall Plan Foundation Fellows Workshop” at the University of New Orleans (UNO), where I had the possibility to present my concept and some intermediate results of my dissertation. The consequence of this was an invitation to Minneapolis/Minnesota in September 2014 by Prof. Günter J. Bischof, where I will be a representative of the “Center Austria/UNO and LSU” at a congress, financially supported by the OeAD (Austrian agency for international mobility and cooperation in education, science and research). There I will be given the possibility of interchanging with other people and gaining more creative inputs for my work, by presenting and discussing my research approach, and moreover, a peer-reviewed publisher’s compilation of all the presentations will be the final result.

However, the same way I’ve started this chapter I want to finish it: I am so grateful for that awesome time I could spend in the U.S. – courteously funded and supported by the

Marshall Plan Foundation. I've enjoyed every second! I am so grateful for all the people I've met! I am so grateful for all the friends I've made! And I am so grateful for all the experiences I could make! And that is why I have to give my biggest thanks to my boss and supervisor, Prof. Friedrich M. Zimmermann – he encouraged me in making this big step and he has always been immensely supporting, no matter what! THANK YOU!

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## LIST OF ABBREVIATIONS

.BK	Bundeskriminalamt (Federal Criminal Police Office – Austria)
BM.I	Bundesministerium für Inneres (Federal Ministry for the Interior – Austria)
CBD	Central Business District
CDC	Center for Disease Control and Prevention
CPTED	Crime Prevention Through Environmental Design
e.g.	Example Given – For Example
ESRI	Environmental Systems Research Institute
EU	European Union
FBI	Federal Bureau of Investigation
GIS	Geographic Information System
GWR	Geographically Weighted Regression
ICPC	International Centre for the Prevention of Crime
LISA	Local Indicators of Spatial Association
p.m.	Post Meridiem
SWOT	Strengths, Weaknesses, Opportunities and Threats
US	United States
USA	United States of America
WHO	World Health Organization

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DRAFT/CONFIDENTIAL

# 1 INTRODUCTION

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## 1.1 Crime Prevention and its Challenges – A Problem Assignment

On the basis of the literature review it seems that the topic “Crime Analysis” is mainly a big issue in the USA, Great Britain, Australia and New Zealand. Despite all, in Austria crime prevention is getting more important, as the latest report of the “Federal Criminal Police Office – Austria” (.BK) shows. Due to the development of new strategies over the past few years the total crime rate in Austria has declined by 10 % and the level has maintained until today (see [Figure 1](#)) – hence, a continuous downward trend can be noted (BM.I/Polizei, 2013: 2). The period of 2004 to 2012 even shows a decrease of about 15 % - in 2004 643,648 crimes were registered, whereas in 2012 only 548,027 crimes were recorded. Nevertheless, in 2012 (compared with 2011) an increase of 1.5 % was observed which leads back to new forms of crime, like cyber-crime (BM.I/Polizei, 2013: 2).

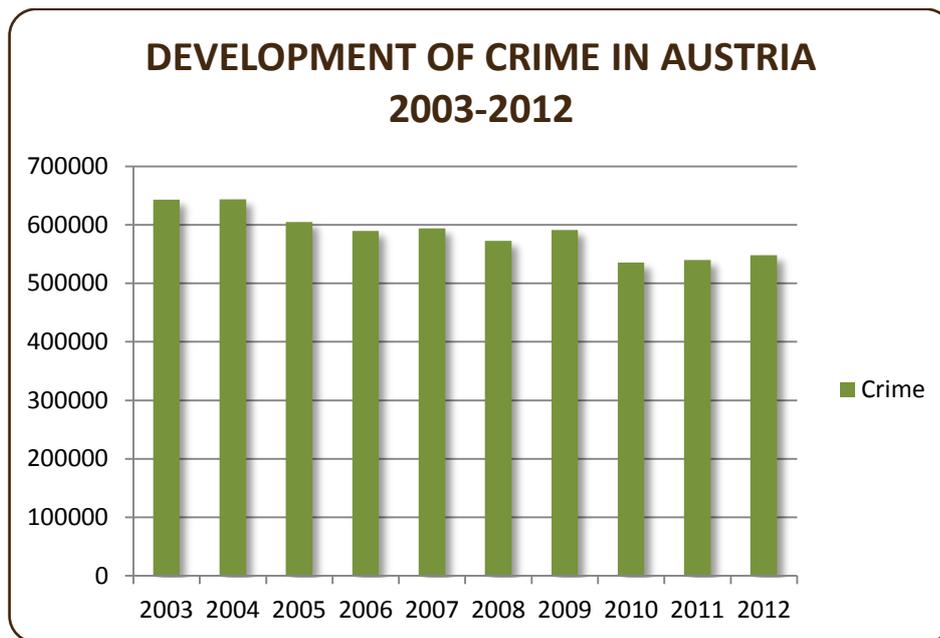


Figure 1 – Development of Crime in Austria – 2003-2012 (own illustration based on BM.I/Polizei, 2013: 2)

Nevertheless, the above mentioned figures show that even if there can clearly be observed a declining trend, a lot more precautions have to be set – 548,027 crimes (in 2012) are 548,027 crimes too much. The consequence within strategic planning is to extend the traditional forms of crime prevention and social measures of integration with the help of urban planning and environmental design.

## 1.2 The Objectives of the Challenge

This approach deals with a comparably new research field in Europe: the concept of this project is trans-disciplinary, working closely together with criminal investigation departments and urban planners to combine geospatial technologies with environmental and social aspects and applying it to (primarily juvenile) crime issues. Spatial analysis can

support an urban planner, the police, etc., and gives more visual information on crime hot spots. Referring to Bowers et al. (2004: 646), the use of GIS is a big advantage for operational policing purposes, when analyzing and mapping crime data - the results can easily be visualized with GIS maps. Moreover, factors, such as crime rate compared to crime prevention initiatives can be combined and monitored over a certain period of time (Bowers et al., 2004: 643).

Crime prevention plays a significant economic role within crime analysis, as prevention costs less than apprehending criminals after the crime has happened (Osborne and Wernicke, 2003: 1). But why does this research primarily focus on juvenile crime? According to Schumacher and Kurz (2000: 13) it is three or four times more likely that a juvenile, who commits a crime at the age of fifteen or younger, will reoffend than an older person. As a matter of fact, the criminal justice system has a meaningful influence on that circumstance as the young teenagers never get that much attention and intervening support they would need at this age. However, it basically means that prevention has to start at a very early stage – violence and crime have to be stopped before it even starts (CDC, 2014).

The cooperation with the State Office of Criminal Investigation Styria (Landeskriminalamt Steiermark), the Federal Ministry for the Interior (Bundesministerium für Inneres - BM.I), the DigitalGlobe Foundation, the State University of Louisiana, and Joanneum Research Graz, and all the other crime related organizations, guarantee a trans-disciplinary approach with analyses that won't only concentrate on one aspect, but will deal with several perceptions.

The results of this research will primarily be published as part of my dissertation. In addition, efforts will be made to present the research at conferences in Europe as well as the U.S. It is hoped the conference papers presented at these conferences will be published in the conference proceedings.

All in all, this research project has potential in finding, testing and evaluating new concepts for crime prevention in urban planning and to making valid statements and suggestions for a sustainable and a much more secure development of the urban space. Ecological, economic and social variables can play a major role in enhancing the safety in urban regions.

### 1.3 Research Questions

Usually, when analyzing crime, one would only concentrate on environmental and/or economic factors, but this research project additionally focuses on social, economic, and environmental driving factors for crime. This holistic approach anticipates a fully new and innovative gaze at the topic crime.

# 2 MAINSTREAMS OF CRIME RESEARCH

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Crime is a topic nearly everybody is confronted with in our everyday life. As this is the fact it's not surprising that many various disciplines are dealing with this topic. In the course of the literature review a synthesis of the numerous research fields resulted into a trans-disciplinary approach. For a better understanding the topic crime was classified into six main categories – Crime and Law, Crime and Sociology, Crime and Psychology, Criminology, Crime and Environmental Design, and Crime and GIS. These categories helped in getting a clear structure and in attaining a much more sustainable and integrative perspective.

The following subsections will give a brief overview of the findings of the research.

## 2.1 Crime and Law

*“... a crime is that which is proceeded against in the criminal courts, and the criminal law deals with those acts that are crimes.”*

Farmer, 2005: 175

Crime and law, respectively, criminal law deals with all variations of criminal conducts and its jurisdiction, criminal punishment, and criminal liability. This won't be subject of this thesis though, so this part will be kept very brief.

However, defining criminal law is not really easy, as it is not only about murders, thefts, and assaults as everybody would think of; it's also about crime against public morals, traffic and pollution offenses, and a lot more (Herring, 2012: 2). According to Farmer (2005: 175) criminal law deals with all the acts that are considered as a crime. And a crime is something that is proceeded against in the criminal courts (Farmer, 2005: 175). Still, it is difficult to explain what a crime is, or what a crime is not. It's more a matter of moral philosophy (Allen, 2007: 1).

## 2.2 Crime and Sociology

*"The power of sociology is that it teaches how society influences people's lives, and it helps to explain the consequences of different social arrangements."*

Andersen and Taylor, 2008: 1

When it comes to sociology and crime, books and researches primarily deal with deviance of criminals. Especially within the Anglo-American society, criminal sociology is considered as part of criminology.

Sociology tries to understand a diverse society. It deals with individuals and their culture, their social interaction, their socialization status, and how groups and peers affect each individual's life. The discipline also looks closely at social inequality issues, such as gender, race and ethnicity, age, culture, sexuality, and social classes. However, the social status is dependent on both economic and environmental factors. Because, what if you were born another sex and a different race and you were raised in a different country? That affects each individual immensely, thus, the social location of each other plays a significant role, as it shows both the limits and possibilities of everybody's life (Anderson and Taylor, 2008: 1). Consequently, the sociology's power surely is to demonstrate how our lives are influenced by the society. Sociology deals with analyzing the human behavior within the society. Although, as discussed in more detail in chapter 2.3 *Crime and Psychology*, psychology also deals with the observation of human behavior, but always considering the individual on its own and not referring to the influencing society, hence, the role within a peer/group – that's the big difference (Anderson and Taylor, 2008: 2).

Social values and norms are important for the handling within a society. These things were brought to us by socialization, which, however, doesn't mean, that everybody conforms to that. In that case this is called deviance (Browne, 2011: 233).

## 2.3 Crime and Psychology

*“Psychology:*

*The study of the nature, functions, and phenomena  
of behaviour and mental experience.”*

Colman, 2009: 619

Throughout the centuries a lot of psychological studies have been undertaken to trying to understand crime. As it is with criminology, crime in combination with psychology is more an inter-disciplinary approach, as the topic affects, amongst others, law, criminology/sociology, biological measures, etc. (e.g. criminal behavior, mental disorder, criminal justice, crime prevention, and punishment).

Psychology can be seen as a study of the (predominantly human) behavior, rather than of the mind, even though the etymology of the word psychology would indicate that (Colman, 2009: 619). Specifically, psychology focuses on both the functioning of an individual, and the interaction between each other (Hollin, 2013: 1). However, there is a special field within this discipline, which is called criminological psychology, where sociological theories are somehow eschewed, also known under the term forensic psychology. It deals with offenders' risk assessment, eyewitness testimony, and in finding strategies for the treatments (Webber, 2010: ix). Thus, the emphasis of sociology lies on society which is affected by economic and environmental factors, the role of psychology in the study of crime is studying the individual person on its own (Webber, 2010: 4). But

that hasn't been like that all the time. In 1894 the American Journal of Sociology stated that sociology and psychology are devoted to each other (Small et al., 1896: 452). In the late nineteenth century psychology initiated to encompass when starting to dealing with questions about the human behavior (Webber, 2010: 6). However, the trend in psychology is more going to the statistical risk assessment or judgment rather than looking closely at the risk posed by an offender (Webber, 2010: 7).

## 2.4 Criminology

*“Criminology was born in a crime wave, raised on a crusade against torture and execution, and then hibernated for two centuries of speculation.”*

Sherman, 2005: 115

Edwin H. Sutherland, a well-known American sociologist and one of the most influential criminologists, describes criminology as a scientific study of law making, law breaking, and the response to law breaking (Vito et al., 2007: 4-5). Criminology deals with the study of crime and delinquencies and can be termed as a social phenomenon (Sutherland et al., 1992: 3). Moreover, criminology can be seen as a discipline, where the causes of crime are investigated (law breaking), whereas criminal justice can be seen as a response to criminology, where the focus lies on, e.g. courts, corrections, and policing (Vito et al., 2007: 5). In our society norms play, in addition to criminology, a major role in

everyone's life, as these are our guidelines. If somebody violates these norms, the person shows a deviant behavior. Nevertheless, it always depends on the response to the violation of how inappropriate the behavior was or not. One can divide the term norm into three categories (Vito et al., 2007: 5):

- Folkways: if, related to the western world, somebody eructs after eating one will probably evoke some teasing.
- Mores: if somebody e.g. has got an affair, it can evoke a more serious response from the society compared to folkways.
- Laws: if somebody kills another person, the law tells exactly what has to be done – it is codified.

The big question is, if every deviant behavior is always criminal or not? It clearly can be answered with 'no', as e.g. being a member of a motorcycle gang does not necessarily mean that the person is criminal (Vito et al., 2007: 5). Even though a deviant behavior can be shocking, according to the law not all deviants are criminals. In criminology, however, it is not the goal to study the behavior of a deviant or even try to understand or identify the difference of criminal and unusual behavior, as this is part of sociology (Siegel, 2009: 5).

Even though one would think that criminology has been existing for many years, decades or even centuries, criminology is relatively a new area of research, although criminal codes have already existed for thousands of years. The punishment and the description of the crime were codified (Siegel, 2009: 5).

If someone violated the norms or dealt in any form with religion during the Early Middle Ages the person immediately would have been accused of witchcraft and usually would

have been burned alive at the stake. These atrocities (superstition and harsh punishments) didn't end for a long time, even though legal manners were specified by the government in the middle of the thirteenth century. Until the seventeenth century thousands of people were burned to death or chased throughout the whole European continent (Siegel, 2009: 5).

Jeremy Bentham, a well-known philosopher, one of the most important social reformers and the founder of the utilitarianism from the eighteenth century believed that people only behave against the law when they are sure that the benefit is much bigger than the pain or punishment. In the reverse conclusion it would mean that criminal behavior could be eliminated if the pain of punishment surpassed the benefits of crime. A significant Italian reformer in criminal law, Cesare Beccaria, adopted these assumptions and wrote in his most famous essay "On Crimes and Punishment" that torture and tough punishment is incongruous as people don't want pain, but pleasure. A balanced way has to be found that the pain of punishment is somehow adequate, just that much that the pleasure obtained from crime is repressed. The writings of Beccaria and of his followers were part of the classical criminology (Siegel, 2009: 5-6).

At the end of the nineteenth century scientific methods got enforced, as scientists started to observe and analyze their experiments and were looking at the cause of crime - so they ended up with new discoveries, especially in astronomy, chemistry, and biology. However, the new way of thinking lead to assumptions that the human behavior could be studied and verified scientifically – for many researchers Charles Darwin's theories were the role models of these new trends. At this time the classical criminology clearly turned into positivism. Verifying and not only believing – that was the golden rule (Siegel, 2009: 6). Still, today's crime theories work with the same principle - a crime the-

ory is nothing else than showing which causes are leading to criminal behavior. Though, the theory always has to be testable (Vito and Maahs, 2011: 8). All in all, Sherman's statement (which is indicated at the beginning of this chapter) outlines the criminology's history perfectly (Sherman, 2005: 115): *"Criminology was born in a crime wave, raised on a crusade against torture and execution, and then hibernated for two centuries of speculation."* After the time of speculation and with the input of Darwin's theories, the researchers and scholars finally recognized to change something (Sherman, 2005: 115).

All in all it can be said, that criminology is not really a discipline on its own, it's more like an inter-disciplinary approach, as historians, geographers, economists, sociologist, and psychologists can contribute significantly to this topic (Webber, 2010: 5).

## 2.5 Crime and Environmental Design/Urban Fabric

*"... the proper design and effective use of the built environment can lead to a reduction in the fear of crime and the incidence of crime, and to an improvement in the quality of life."*

Crowe, 2000: 1

### 2.5.1 An Introduction to Environmental Design Theories

Crime and Environmental Design or simply Geography of Crime has got its origin in the early nineteenth century. At this time the focus of research was lying on statistics of crime and statistics of ethics. André Michel Guerry and Lambert Adolphe Jacques Quételet are the main representatives of this epoch. The core goal for Guerry was to analyze and investigate whether the origin of crime is provoked by poverty, lack of education and population density. On the other hand, Quételet concentrated on statistics of characteristics of life expectancy, as well as of social factors. Both representatives laid the foundation for data preparation with the help of geographic representation methods (Würtz and Lustig, 2014).

Since the 1920s the School of Chicago has played a significant role in developing the first crime of geography theories, where possible approaches have been made to trying to explain, if there is a relation between crime and space or not. Due to the rapid urbanization and its associated social problems the approach was dealing with the question of how criminal acts evolve in an urbanized area being influenced by cultures and milieus (Würtz and Lustig, 2014).

A well-known representative of the Chicago School, Clifford R. Shaw, introduced the term "Delinquency Area". Together with his colleague Henry D. McKay he has been investigating Chicago and some other cities from North America for a longer period – they closely looked at the parts where a lot of change in ethnicity has happened. The results showed that social factors generate delinquent behavior, but not the environment. The approach also confirmed the theory of the Concentric Zone Model of Burgess (Figure 2),

where much more crime could be observed, the closer it gets to the downtown area (Würtz and Lustig, 2014).



Figure 2 – Concentric Zone Model of Burgess (own illustration based on Park and Burgess, 1984: 51)

According to Park and Burgess (1984: 50) the Loop, respectively the Central Business District (CBD) shows the center of an ideal structured city. The Zone in Transition can be seen as an area with a lot of crime, prostitution, etc. All the people, who got away from the deterioration zone, and who want to be close to their working place, can be found within the Zone of Workingpeople's Home. The fourth zone represents the residential area with family dwellings, luxury apartments, etc. A commuters' zone is already a sub-urban area or a satellite city and it takes the commuters about a 30 to 60 minutes ride to get to the CBD (Park and Burgess, 1984: 50). The model did work well for Chicago, but it

didn't fulfill all the needs of many other cities. Further models got implemented, such as the Sector Model by Homer Hoyt, or the Multiple Nuclei Model by Harris and Ullman (Tischler, 2011: 380).

However, Oscar Newman, a well-known architect and urban planner developed the "Defensible Space Theory" in 1970. Its basic assumption is the relation between both the architecture of buildings and the crime rate. Functionality is the basis of every modern architecture, but functionality also magnitudes the anonymity in the residential areas and in the neighborhood. That, however, leads to a weak social community and as a consequence to many social problems. The idea of overpassing this kind of difficulty is, to designing an environment that both allows and promotes individual responsibility (Würtz and Lustig, 2014). Newman's theory got, at least concerning Germany, disproved by Rolinski in 1980 (Kasperzak, 2000: 100). Rolinski did research on behalf of the Federal Criminal Police Office in Germany. He closely looked at architectural factors that could have a big influence on crime, such as the size of a house, the composition of the flats, the position of a building regarding its neighbor buildings, etc. Having the results of Newman in mind, the consideration was that in skyscrapers with ten or more floors (denoted as a "Non-Defensible Space") more defenses are happening than in a multiple dwelling unit (denoted as a "Defensible Space") with up to 5 floors. By taking social classes into account the following hypothesis was proposed: in dwellings with residents of a poor social class more significant defenses are happening than in dwellings with residents of a better-off social class (Kasperzak, 2010: 100-101). Rolinski came to the conclusion, that there can't be found a relation between both the structure of a building and the crime rate – no matter if it is a skyscraper or a multiple dwelling unit. The crime rate is not influenced by it instantaneously or on its own (Kasperzak, 2010: 101). Newman argues that due to a lack of defensible space a higher crime rate can be observed. Rolin-

ski on the other hand says that the higher crime rate is a result of the social structures that can be found within the dwelling units (Würtz and Lustig, 2014). Even though this theory is still a controversial issue, it also set the basis for the “Crime Prevention Through Environmental Design” theory, which will be discussed in the next subsection.

One of the most popular theories in the 1980s and also inspired by the Chicago School, was originated by Jaems Q. Wilson and George L. Kelling – the Broken Window Theory. That theory indicates that broken windows emblemize disorder/messiness, dilapidated buildings in a certain district of a city and that nobody cares about negligence. This kind of environment draws attention to criminals and the anxiety of the residents is rising (Würtz and Lustig, 2014). An experiment in the Netherlands (undertaken by the University Groningen) showed that it is vital to keep up with maintenance and removing all graffiti, or any other signs of vandalism as soon as possible. That experiment clearly proved the theory, as the behavior of the people has changed and offenses have doubled, and it can be said that one criminal act (e.g. graffiti) very likely leads to another (e.g. stealing) (Fennelly and Crowe, 2013: 250).

The Broken Window Theory shows that crime can be reduced through environmental design where all the residents feel safe and moreover territorial - the environment has a significant effect on us and on our feelings that shouldn't be underestimated (Fennelly and Crowe, 2013: 251). The next chapter will give more information on crime prevention and environmental design.

### 2.5.2 Crime Prevention Through Environmental Design (CPTED)

Crime Prevention Through Environmental Design (CPTED) is a special type of security design. It deals with the assumption that a certain design of the environment could lead to more crime (Atlas, 2008: 3). In the past years and centuries criminologists have only concentrated on the offenders' background and the offenders' behavior, like the social, psychological and biological factors, but they have never thought about the environmental design. So, most of the approaches are dealing with focusing on the offenders. However, by using CPTED there is a good chance in improving the quality of life and in reducing the exposure to crime (Fennelly and Crowe, 2013: 15).

CPTED can be divided into three main categories, respectively, into three types of approaches. One approach would be, as already described briefly before, the Defensible Space Theory by Oscar Newman. The second approach, simply called CPTED, was initiated by C. Ray Jeffery in 1971 for the first time. Besides of mentioning that the criminologists have never looked into the environmental approach, he also stated that lead would cause a severe brain damage and furthermore, delinquency in children (Clarke, n.d.: 1). Jeffery believed that a proper design of the environment will lead to a better quality of life, as the fear of crime can be reduced by this type of method (Crowe, 2000: 1). However, a major supporter of this inter-disciplinary approach was the criminologist Timothy D. Crowe. He stressed in his book (1991) that understanding the link between both environmental design and social behavior is very important and so valuable (Fennelly and Crowe, 2013: xv). CPTED is somehow an enhancement of Newman's Defensible Space Theory, as CPTED additionally is dealing with commercial retail, industrial institutional and low-density residential environments. The basic characteristics of CPTED, such as natural surveillance and natural access control, and territorial concern, find its origin within the Defensible Space Theory (Fennelly and Crowe, 2013: 8). The third approach

would be situational crime prevention – this, however, doesn't involve the built environment – this method helps reducing crime in general in any space and in any setting and it got introduced by the British Government in the mid of the 70s (Clarke, n.d.: 2-3).

When thinking of crime and loss control, there are three options: the organized design, the mechanical design, and the natural design. For the organizational approach one would need human resources, such as security personnel, which is quite cost-intensive. The other option would be the mechanical approach where hard- and software is used to monitor areas, e.g. security cameras, etc., and which is very cost-intensive too. The third option is the natural or environmental approach (Fennelly and Crowe, 2013: 17). Fennelly and Crowe (2013: 17) describe it as follows: *“In contrast, natural approaches merely factor behavior management into what was going to be done anyway.”* The best way in dealing with crime and loss control is to putting a lot of effort into the natural design, and then adjusting the organized and mechanical approach – that would be the most effective way to do (Figure 3) (Fennelly and Crowe, 2013: 17). With this kind of design, a lot of money can be saved as the human end electronic resources can be appointed efficiently. When implementing the environmental design approach the costs might rise at the initial phase, but in the end this type of design helps to reduce the costs, seen over a longer period (Fennelly and Crowe, 2013: 18-19).

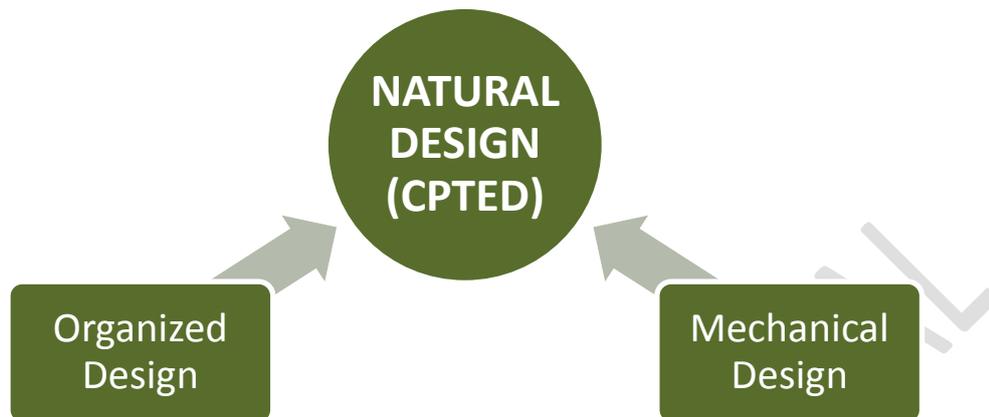


Figure 3 – Natural, Organized and Mechanical Design (own illustration based on Fennelly and Crowe, 2013: 17)

However, CPTED is not only restricted to the built environment, as it has already been successfully used in event management as well. At the Olympic Games in Sydney/Australia in 2000 increased profits and reduced incidents could be recorded just by using CPTED for the transportation, the housing, and the athletes' venues. Another example would be the World's Fair in Knoxville/Tennessee in 1982, where about \$ 750,000 could be saved due to ingenious planning on law enforcement services by using CPTED. Environmental design really can be used within any conceivable planning intention (see Figure 4), as it is applicable to urban villages, functional planning, transportation, livable cities, New Urbanism, and a lot of more space-consuming developments (Fennelly and Crowe, 2013: 19).

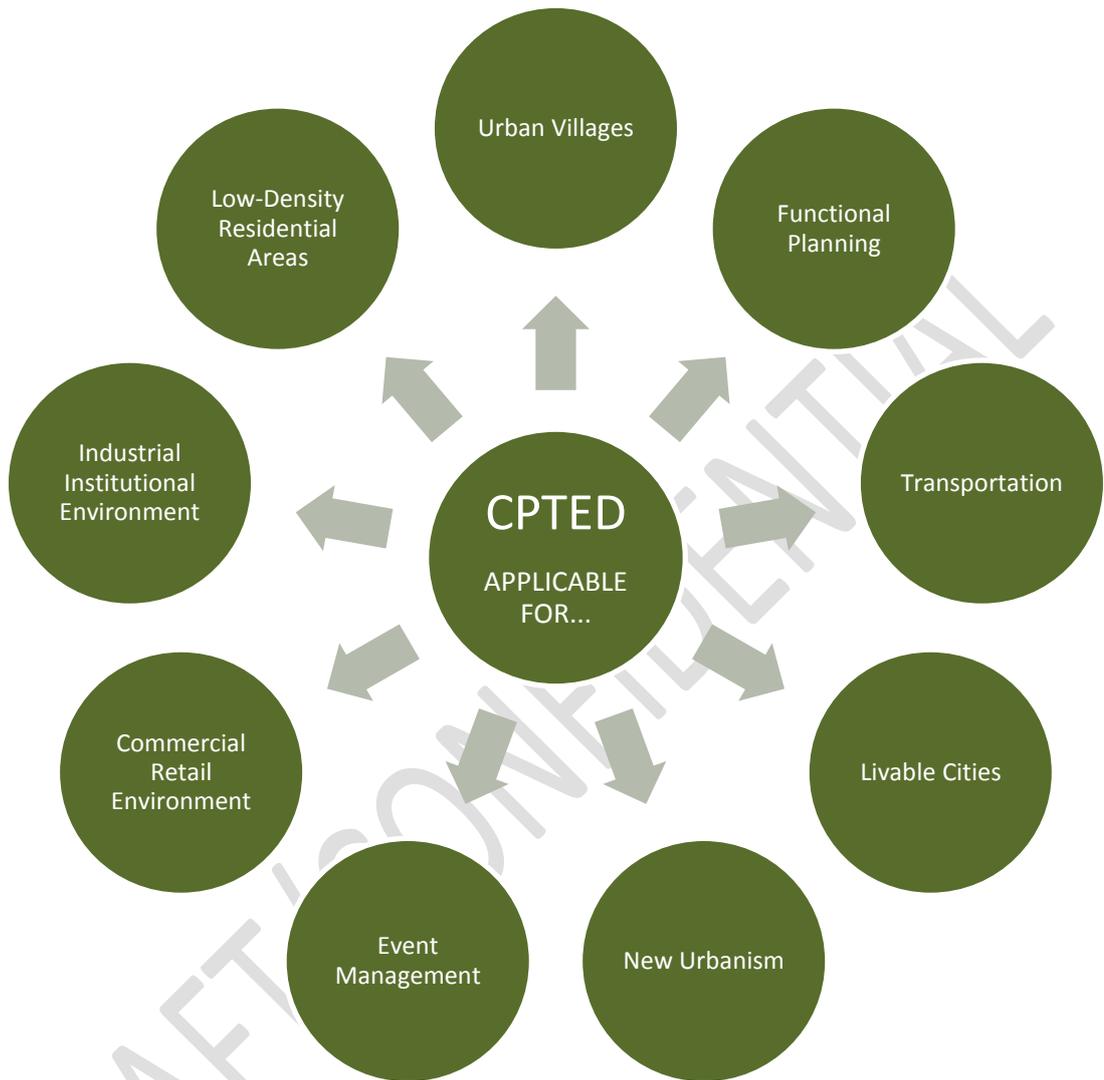


Figure 4 – CPTED is applicable for... (own illustration based on Fennelly and Crowe, 2013: 17-19 and Fennelly and Crowe, 2013: 8)

## 2.6 Crime and GIS

*“Knowledge about how the world works is more valuable than knowledge about how it looks because it can be used to predict.”*

Longley et al., 2011: 14

Crime in combination with GIS usually deals with analyzing, modeling and mapping crime, which will also be a major part of the implementation part of this dissertation. However, GIS is playing an important role when it comes to crime analysis. But GIS is much more than analyzing – according to Clarke (2003: 1292), GIS is such a powerful tool for establishing individual models representing social, environmental, or economic issues. Chainey and Ratcliffe (2005: 8) mention that before GIS was available, the law enforcement agencies were working with pin maps. And it is wrong again to say that GIS only makes the digital version of the pin maps. As already mentioned before, GIS is a powerful modeling and decision support tool, thus, a prevailing strategic analysis tool which most of the law enforcement agencies are using nowadays, as they would know about its value – especially in the last couple of years there has been a significant rise in using GIS for crime analysis (Chainey and Ratcliffe, 2005: 8). Crime analysis in combination with GIS is making a significant progress and is getting more and more important and contributing than in the past – GIS is substantial when having to make decisions - that’s for sure (Wang, 2005: vi).

When working with geospatial technologies in general, it is always vital to have a good implementation plan for solving a spatial problem, such as observing a pattern change over a certain time of period, etc. Leitner (2013: vi) recommends dividing it into the following working packages:

- Spatial problem assignment and assessment
- Crime Analysis
- Crime Modeling
- Crime Mapping
- Implementation

This kind of structure shows a logical approach to being able to implementing a spatial problem at its most effective way.

However, terminology, such as analyzing, modeling, and mapping has been used, but what exactly is crime analysis? How can crime be modeled by using geospatial technologies? Can GIS be used for mapping crime? The following subchapters will clarify these questions, but before that another very significant term has to be explained – hot spots.

### **2.6.1 Definition and Theories of Crime Hot Spots**

A hot spot is an area or region where criminal acts or offenses emerge highly concentrated. The method of analysis being used is depending on the type of the hot spot, whether it is a region, a place, a street, or something else (Eck, 2005: 2). Several theories have been developed, which will be described in the next subsections.

**Hot Spot Theory: Place**

The place theory deals with the question of why offenses are occurring at a certain place. These incidents will be visualized as points (0 dimension), such as addresses, street corners, or other small places (Eck, 2005: 3).

**Hot Spot Theory: Street**

The street theory, phenomena represented as straight or curved lines (1 dimension), examines certain street segments or sections (Eck, 2005: 3).

**Hot Spot Theory: Neighborhood**

Polygons represent the neighborhood hot spots, which usually are large areas (2 dimension), such as blocks, census regions, etc. (Eck, 2005: 3).

**Hot Spot Theory: Repeat Victimization**

While places, streets, and neighborhoods represent a certain level of detail, the repeat victimization theory doesn't regard to an explicit dimension – it can have any of these three: points, lines, or polygons. However, the theory deals with the question of why some victims will repeatedly be victimized (Eck, 2005: 3).

**2.6.2 The Meaning of Crime Analysis and Modeling**

Over the past 30 years crime analysis/modeling has been an issue many scholars have dealt with, and actually still are (Boba Santos, 2013: 2). Depending on the disciplines, crime analysis has always got a different meaning; e.g. a police department would do crime mapping and would be producing statistics; on the other hand, crime analysis

could also mean tracking serial killers or other kind of offenders or analyzing some police reports (Osborne and Wernicke, 2003: 1). In the course of the time many various definitions have been developed by the scholars (see Vellani and Nahoun, 2001: 8; Gottlieb et al., 1994: 13; Emig et al., 1980: 5). Even though most of the definitions are diverging, they would always share a common element (Boba Santos, 2013: 2). Boba (2005: 6) defines crime analysis as follows:

*“Crime analysis is the systematic study of crime and disorder problems as well as other police-related issues – including sociodemographic, spatial, and temporal factors – to assist the police in criminal apprehension, crime and disorder reduction, crime prevention, and evaluation.”*

However, crime analysis means analyzing crime and moreover, filtering out information from the infinite expanse of data that is available and finally, to pass it on to the officers and investigators in the field. Crime prevention plays a significant economic role within crime analysis, as prevention costs less than apprehending criminals after the crime has happened (Osborne and Wernicke, 2003: 1).

In general, crime analysis uses quantitative and qualitative methods and data. Qualitative methods usually will be used when having non-numerical data including field research. On the other hand, quantitative methods will be part of the statistical analysis (fundamentals, such as frequencies, percentages, means, and rates), where numerical or categorical data is used (Boba Santos, 2013: 3). Usually temporal, spatial and socio-demographic data (such as age, sex, race, etc.) will be used for the analysis. The socio-demographic data helps in finding and identifying suspects, but also in characterizing groups that relate to crime (Boba, 2005, 6-7). Vellani and Nahoun (2001: 8) advice to

always assign the problem with its timeframe, location, and type of incident – somehow, when, where, and what/or who.

### 2.6.3 Which Types of Crime Analysis Do Exist?

According to Osborne and Wernicke (2003: 5) the types of crime analysis can be categorized as it can be seen in Figure 5. Many researchers would classify crime analysis into three main types: the tactical, strategic and administrative crime analysis – Osborne and Wernicke (2003: 9), however, have defined some more types (Figure 5).

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Figure 5 – Types of Crime Analysis (own illustration based on Osborne and Wernicke, 2003: 5-11)

### **Tactical Crime Analysis**

Where, when, and how – these are the main questions that have to be resolved with the help of tactical crime analysis. The tactical crime analysis is relevant if crime is happening by now and an immediate response will be needed. Of great importance for that type of analysis would be a pattern with at least one repeatedly variable, such as time, location,

target, or the so called modus operandi (Osborne and Wernicke, 2003: 5). If one person commits several crimes, thus a crime series, the patterns will be identically and that has to be investigated by the tactical crime analyst as early as possible, as the probability of being able to predict the next offence is very high. The big challenge for an analyst is that he/she has to come up with solutions very fast, as the crime is happening in the present. Another part of the tactical crime analysis is Crime Prevention Through Environmental Design (CPTED). CPTED's aim is to examine the environment closely and finally, to establish a plan of what has to be changed, such as ineffective door locks, or too poor lightning around an area or house, etc. That means factors have to be found that could contribute to a potential crime scene, which have to be eliminated or diminished (Osborne and Wernicke, 2003: 6).

### **Strategic Crime Analysis**

The contrary to tactical crime analysis would be strategic crime analysis as it is dealing with long time surveillance – hence, observing crime trends, so to speak. The results of the long-term observation will be passed on to several institutions, like crime prevention officers or community-oriented policing officers, and so they can establish an action plan for fighting the increasing crime trend in a certain area (Osborne and Wernicke, 2003: 7).

### **Administrative Crime Analysis**

Compared to the strategic crime analysis, the administrative crime analysis deals with summarized data and statistics by observing trends in general. That information helps the public and the administration to have a better understanding of the community crime and disorder problems. Descriptive statistics is the basis of this analysis type and it

is more like an automated process – so the analyst can concentrate on their tactical and strategic crime analysis (Osborne and Wernicke, 2003: 8-9).

### **Investigative Crime Analysis**

This type of analysis especially deals with profiling suspects and victims, also known as “criminal investigative analysis”. However, this kind of analysis must not be mixed up with the profiling of serial killers or rapists, done by the Federal Bureau of Investigation (FBI), as this has to be seen more in general, like, what type of person is committing a particular crime series? Criminal investigation also comprises field work, where the analyst is collecting aspects of profiling serial criminals and the on-site inspection helps in finding new leads (Osborne and Wernicke, 2003: 9).

### **Intelligence Analysis**

When having terrorist threats or dealing with organized crimes, intelligence analysis will be the tool for it. However, it will only be used on a federal and state basis. The major difference to other types of analysis is that an already identified problem is known, e.g. a particular terrorist group. On this basis, specific data and information will be investigated, analyzed, and disseminated (Osborne and Wernicke, 2003: 10).

### **Operations Analysis**

*“How is a law enforcement agency using its resources?”* that would be the question an operation analyst is dealing with. The analysts are part of projects, e.g. when annexing additional land (Osborne and Wernicke, 2003: 10).

#### 2.6.4 Spatial Crime Analysis Methods – What to Do and How to Use Them...

When browsing through the books, various analysis methods are introduced, such as block aggregation, kernel smoothing, Voronoi diagrams, and animation (Hirschfeld and Bowers, 2003: xxv).

##### **Mapping Clusters**

There are several ways of being able to map clusters, or hot spots. Cameron and Leitner (2005: 35) recommend four special types of methods:

- ArcGIS Choropleth Mapping,
- ArcGIS Spatial Analyst,
- CrimeStat, and
- GeoDa.

The major difference between ArcGIS Choropleth Mapping and ArcGIS Spatial Analyst is the usage of the data type – for the latter raster data (grid of cells) is used, while for the choropleth mapping vector data (discrete features, such as points, lines, and areas) is applied. The big advantage of vector data is that it embodies irregular object boundaries with high precision, whereas the raster data has its strength in modelling geographic patterns across continuous space with greater efficiency (Cameron and Leitner, 2005: 35-36).

However, choropleth maps help to get a good overview of the study area, and they are representing data (visualized by different color shades) summarized by statistical or administrative areas (which is also a big disadvantage, as the crime incidents are not evenly distributed). The relative size of an area on the map lets the big areas seem to be dominating (Cameron and Leitner, 2005: 36, 39). The classification methods, which can be applied to, are natural breaks, quantile, equal interval, and standard deviation (Cameron and Leitner, 2005: 36). On the other hand, the spatial analyst method projects the density of a specific crime incident as a continuous field by interpolating the data. With that method one can see the highest concentration of crimes taking place (Cameron and Leitner, 2005: 40).

CrimeStat and GeoDa are not part of the Environmental Systems Research Institute (ESRI) family, as it is with ArcGIS Choropleth Mapping and ArcGIS Spatial Analyst. However, the major difference of these two software tools is that GeoDa (see also [Figure 7](#)) deals with analyzing area patterns and offers a regression module for modeling correlations and crime's determinants, whereas, on the other hand CrimeStat (see also [Figure 6](#)) has no regression module, as it offers tools for calculating spatial distribution or centrophobic statistics, distance statistics, hot spot analysis routines, and interpolation statistics. All the features that can be used with this software are point patterns (Cameron and Leitner, 2005: 43-44). Centrophobic statistics is the most common method when wanting to analyze spatial distribution of the crime incidents by using standard deviation, mean center, (Cameron and Leitner, 2005: 44) or median center, center of minimum distance, standard distance deviation, or standard deviational ellipse (CrimeStat, 2005: 2). The nearest neighbor index method is part of the distance statistics, where the distance between each point and its nearest neighbor is compared. According to the results, this method also provides indication of clustering, if the nearest neighbor index

value is less than 1.0. (Cameron and Leitner, 2005: 46). Another possibility for finding hot spots are the hot spot analysis routine methods, where hierarchical spatial clustering, K-means clustering, or local Moran statistics can be used – all of these methods have a slightly different way of grouping the clusters (Cameron and Leitner, 2005: 46). A kernel density estimation routine is a method where the density values will be disseminated more smoothly, as this application contributes more weight to points near the center of the search area than to those near the perimeter (Cameron and Leitner, 2005: 42).

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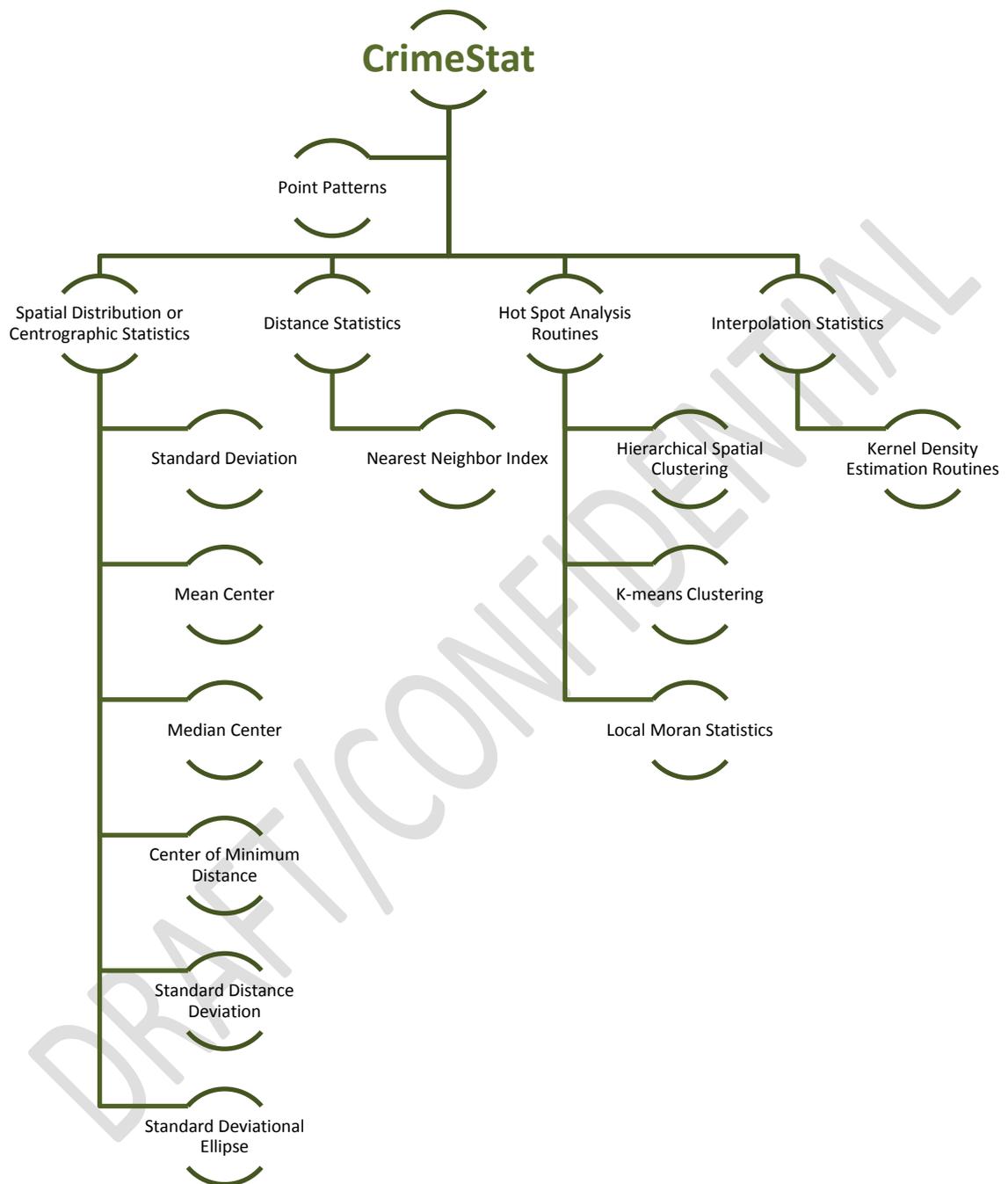


Figure 6 – CrimeStat – Types of Analyzing Methods (own illustration based on Cameron and Leitner, 2005: 43-46 and CrimStat, 2005: 2)

As already mentioned before, GeoDa deals with analyzing area patterns and offers a regression module for modeling correlations and crime's determinants (Cameron and Leitner, 2005: 43). However, this software requires ESRI shape files and the objects being used can be either point coordinates or polygon boundary coordinates. The functions of GeoDa can be categorized into six groups: spatial data manipulation and utilities, data transformation, mapping, exploratory data analysis, spatial autocorrelation, and spatial regression (Cameron and Leitner, 2005: 50-51). The spatial data manipulation and utilities section give the possibility to importing, exporting, and converting the data. Transforming already existing variables or creating new variables can both be done with the data transformation tool (Cameron and Leitner, 2005: 50). With GeoDa it is possible to create choropleth maps, cartograms, and map animations. The exploratory data analysis tool establishes statistical graphics, such as box plot maps, percentile maps, global and local indicators of spatial association, Local Indicators of Spatial Association (LISA) local Moran maps, and Moran significance maps (Cameron and Leitner, 2005: 51). Spatial autocorrelation can somehow be explained by one of the most famous laws in geography – Tobler's first law: *"... everything is related to everything else, but near things are more related than distant things ..."* (Longley et al., 2011: 101). Spatial autocorrelation is all about determining similarities in both location and attributes (Longley et al., 2011: 102). According to Brunson et al. (1998: 431) spatial regression is a very common used method for seeing the linkage amongst geographic variables, although, the relationships between the variables regarding the location is not considered at all. To compass the "no relationship to the location" problem, Brunson et al. (1998: 431) introduce Geographically Weighted Regression (GWR), so that a stable use of regression parameters is guaranteed.

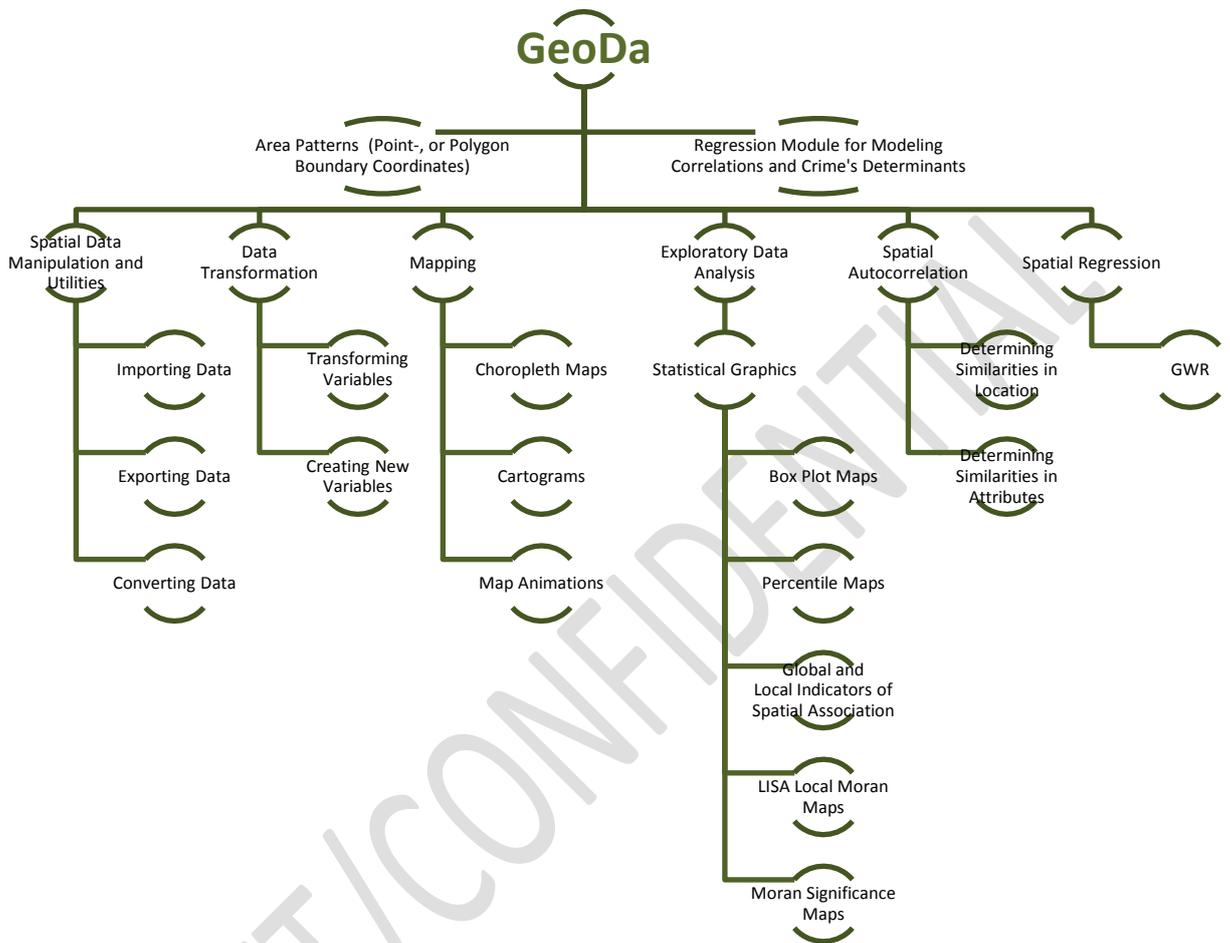


Figure 7 – GeoDa – Functions (own illustration based on Cameron and Leitner, 2005: 43-46)

### 2.6.5 Using GIS for Crime Mapping

Maps play a major role in crime analysis – maps have already got a long tradition, but since the 1990s innovations in technology, internet, databases and software have been helping to establish the maps as an inherent part of every police department, by not only using hand drawn wall maps with pins on it. Nowadays, the most common way of

mapping is using GIS (Boba Santos, 2013: 5). GIS doesn't only consist of many digital maps, it is more like a problem-solving tool, hence, a spatial decision support system, with the possibility of doing analyses and making things visible one wouldn't see on an ordinary map (Longley et al., 2011: 16). Boba Santos (2013: 5) defines GIS as a tool for analyzing, querying, visualizing, and modifying spatial data. However, within the discipline "Crime Analysis" three main functions of crime mapping do exist, as Figure 8 shows (Boba Santos, 2013: 6).

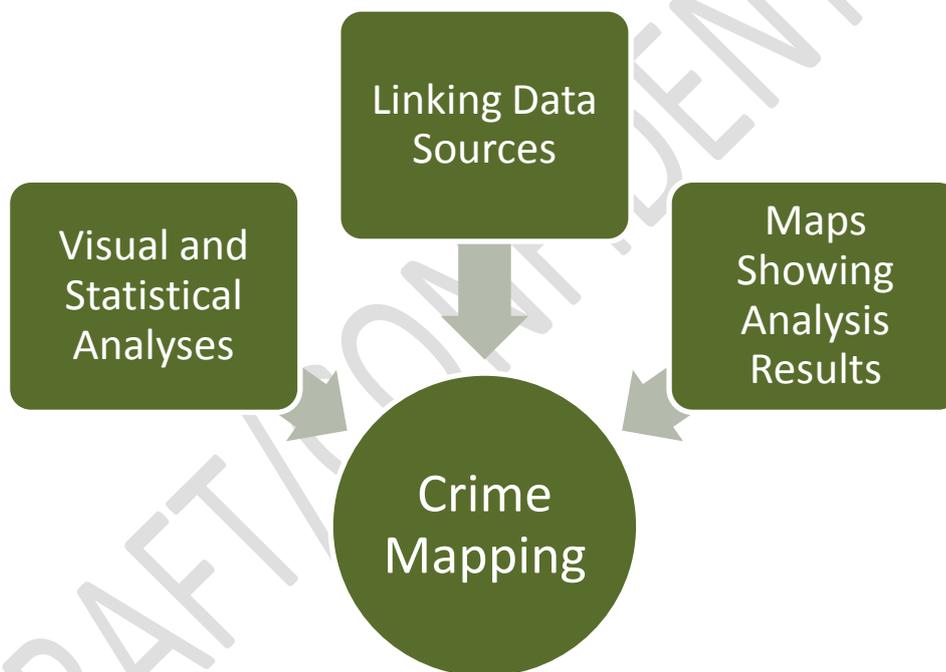


Figure 8 – Three Main Functions of Crime Mapping within Crime Analysis (own illustration based on Boba Santos, 2013: 6)

### 2.6.6 Crime Analysis Excursus: Crime Prediction – Myth or Reality?

Perry et al. (2013: 8) divide the predictive policing methods into four main categories.

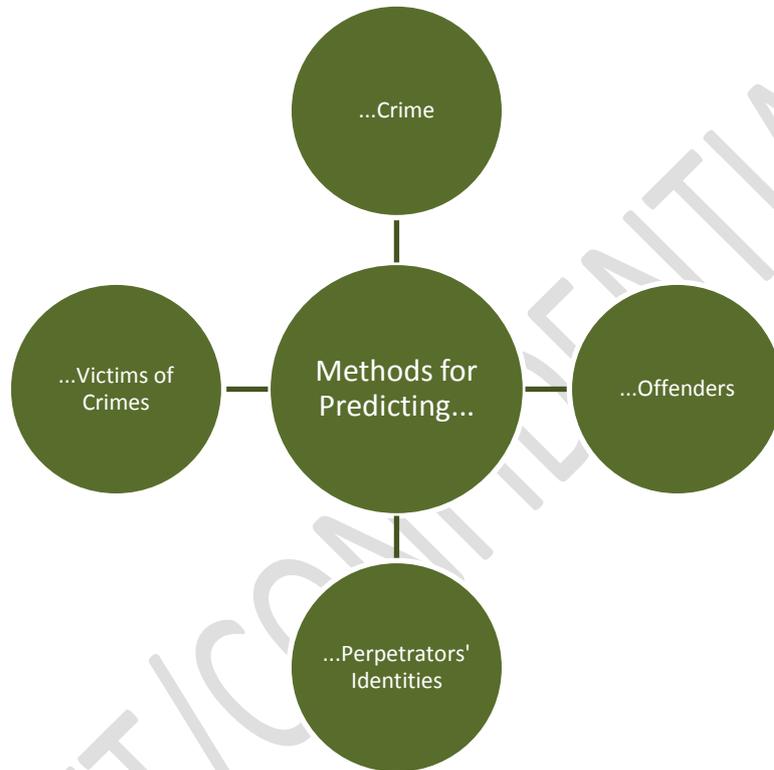


Figure 9 –Types of Predictive Policing Methods (own illustration based on Perry et al., 2013: 8)

The methods for predicting crimes focus on predicting places and times with a high probability of criminal offenses. The predictions of offenders identify offensive individuals. Offender profiles will be established by the use of the predicting perpetrators' identities method. By in a way combining all three methods mentioned before, the method for predicting victims of crimes identifies groups or partially even individuals who likely become victims of crime (Perry et al., 2013: 8-9).

# 3 JUVENILE CRIME & PREVENTION

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In the course of the literature review, juvenile violence and crime appears to be a bigger issue than one would probably think. Many researches have been undertaken, but it seems, that it is a never ending story. Though, what does juvenile crime or violence actually mean? When is a juvenile regarded as violent? Where are the boundaries? The official definition for juvenile violence of the Center for Disease Control and Prevention (CDC – a Department of the U.S. government) is, that the ferocious behavior can already start at a very early age and it is believed that this habit continues into young adulthood, no matter the juvenile is a victim, an offender, or a witness (CDC, 2014). However, once again it is shown, that prevention has to start at a very early stage – violence and crime have to be stopped before it even starts. One stage of the youth violence is committing more mental than physical harm, such as bullying, slapping, or hitting. The other side of the youth's violence would be much more harmful, hence, serious injury or even death (CDC, 2014). Referring to the World Health Organization (WHO, 2006: 1) at least an average of 565 juveniles is dying through interpersonal violence every day across the world – but the bitter thing is, that the young people are only within the age group of ten to twenty-nine. One could say that juvenile violence or crime is a public health problem; and that is what the WHO has declared numerous times in several publications (e.g. Krug et al., 2002: 6).

### 3.1 The Meanings of Violence – Blurred Lines or Facts?

Several studies show, that violence is very difficult to define. All the various forms of violence, such as individual acts or organized actions of groups or states, etc., happen to be a big challenge for all the researchers within their individual field work, like psychology, sociology, etc. (Heitmeyer and Hagan, 2003 : 3). However, the WHO presented a comprehensible and well-structured definition of violence in the *World Report on Violence and Health*. There are supposed to be three forms of violence, as it can be seen in Figure 10 (Krug et al., 2002: 6):

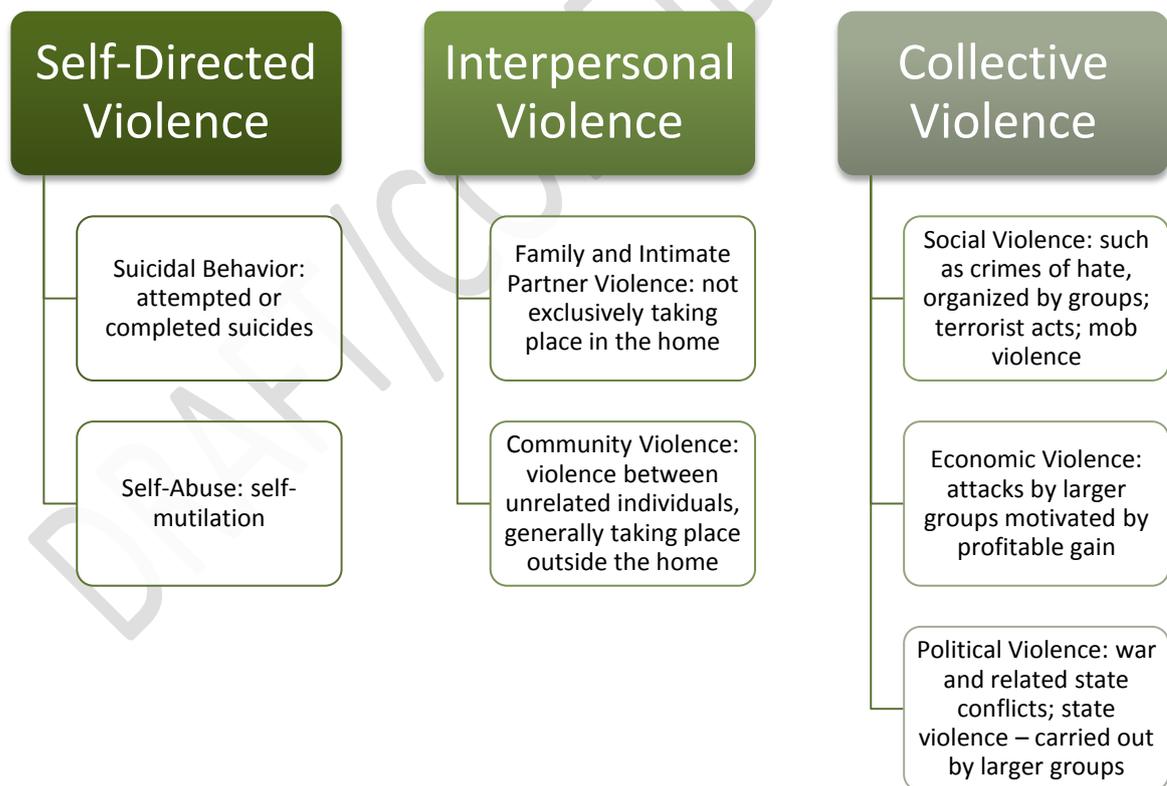


Figure 10 – Forms of Violence (own illustration based on Krug et al., 2002: 6)

As seen in the previous figure (Figure 10), Krug et al. (2002: 6) came up with three forms of violence, such as self-directed violence (suicidal behavior and self-abuse), interpersonal violence (family and intimate partner violence and community violence), and collective violence, which can be divided into three subcategories (social violence, economic violence, and political violence). As a further step, Krug et al. (2002: 6) also defined the typology of violence, which the next figure (Figure 11) shows. The horizontal entries demonstrate who of each violence's category is affected, respectively, vertically seen, how they are affected (Krug et al., 2002: 6). The three "nature of violence types" (physical, psychological, and deprivation or neglect) arise in each category, only the violence type "sexual" isn't part of the self-directed violence category. A child can be neglected and/or abused physically, psychologically, and sexually. In a community one would rather suffer physical assaults between juveniles, whereas in the workplace sexual violence would be the most possible case. Within long-term care facilities, older people could be neglected. However, all in all it has to be mentioned that the lines between the different types of violence are often blurred, both in practice and research (Krug et al., 2002: 7).

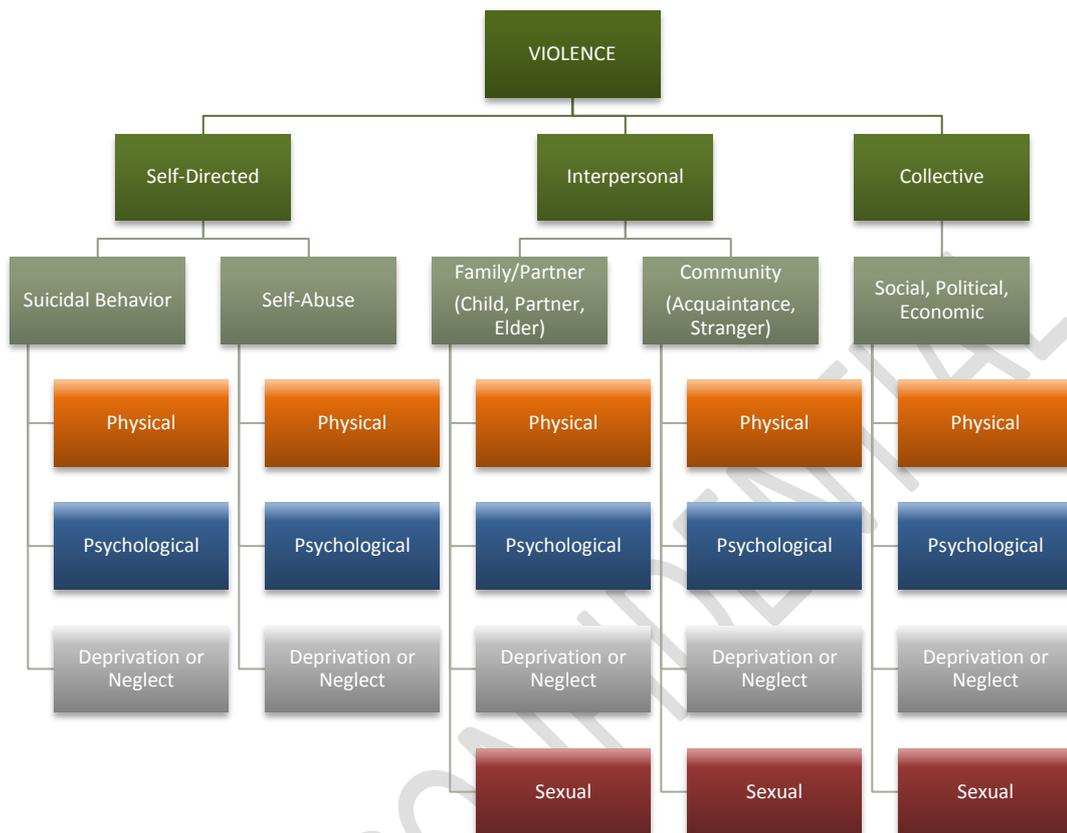


Figure 11 – Typology of Violence (own illustration based on Krug et al., 2002: 7)

### 3.2 Brief Outline of Juvenile Crime in the US, in Europe, and in Austria

Especially in the U.S. juvenile crime is a serious matter and dates back thousands of years or even longer (Shoemaker and Wolfe, 2005: 3). America's history unfortunately has to offer some incisive events; e.g. in the Mid-Atlantic States two serial killers were arbitrarily shooting children and adults. One of the killers was only at the age of seventeen and he even initiated some of the shootings. In 1999 one of the deadliest mass shootings has happened at Columbine High School in Colorado. And sadly, this list can be

continued until the present (Shoemaker and Wolfe, 2005: 1-3). Though, the situation in Europe is not really different. In 1997 Christian Pfeiffer, a German criminologist, was assigned by the European Union (EU) to make a survey of juvenile crime showing its impacts and trends in Europe. He started collecting data from most of the European Countries and Switzerland, and he also integrated the United States in his studies, as the U.S. usually has got a significant influence on crime and events that happen in Europe. Pfeiffer (1998) recognized, that some patterns are similar in most of the countries; e.g. since the mid 80's juvenile crime (group of under the age of eighteen), in particular robbery, violence, and severe forms of physical harm, has amplified extremely, as in most of the countries an increase of more than 100 % could be noted (especially in Italy, Sweden, Denmark, Germany, and the Netherlands). In contrary to that, only a slight increase, if at all, could be recorded within the age group of eighteen to twenty. Another conclusion of the survey demonstrated that juvenile offenders choose their victims being at their age or younger – hence, for young people the likeliness of being a victim is much higher than it is for adults (Pfeiffer, 1998: 255-256). All in all Pfeiffer (1998: 263-293) tried to compare several countries in Europe (such as England and Wales, Sweden, Germany, Netherlands, Italy, Austria, France, Denmark, Belgium, Spain, Greece, Switzerland, Poland), and the U.S. However, due to partial inconsistency in the data and that each country has its own regulations in defining policies, thefts, assault offenses or even the term “juvenile”, the trend of juvenile crime can only be concluded indirectly from all these studies (Pfeiffer, 1998: 261). For Austria Pfeiffer investigated the period from 1980 to 1995 as this was the only data he could get. Compared to the other countries only a modest increase of crime could be noticed (Pfeiffer, 1998: 283). The afterimage (Figure 12) shows, in addition to the study of Pfeiffer (1998), the trend of juvenile offenses in Austria between 1990 and 2012. In 1990 19,164 offenses were recorded and since then a continuous upward trend has been documented until it reached its highest value in

1999 with 31,357 incidents. Until 2002 there has been a rapid decrease of 9,796 offenses. However, since then it has been rising significantly again and in 2008 it reached its uppermost peak with 35,912 crimes. Between 2008 and 2012 there has been a steady downward trend. Please note, that Figure 12 shows all juvenile offenses, but from 1990 until 2001 juveniles at the age of fourteen to eighteen were considered as teenagers. Since July 2001 the age group for teenagers has been fourteen to seventeen, as a new age group (eighteen to twenty), called “young adults” got implemented.

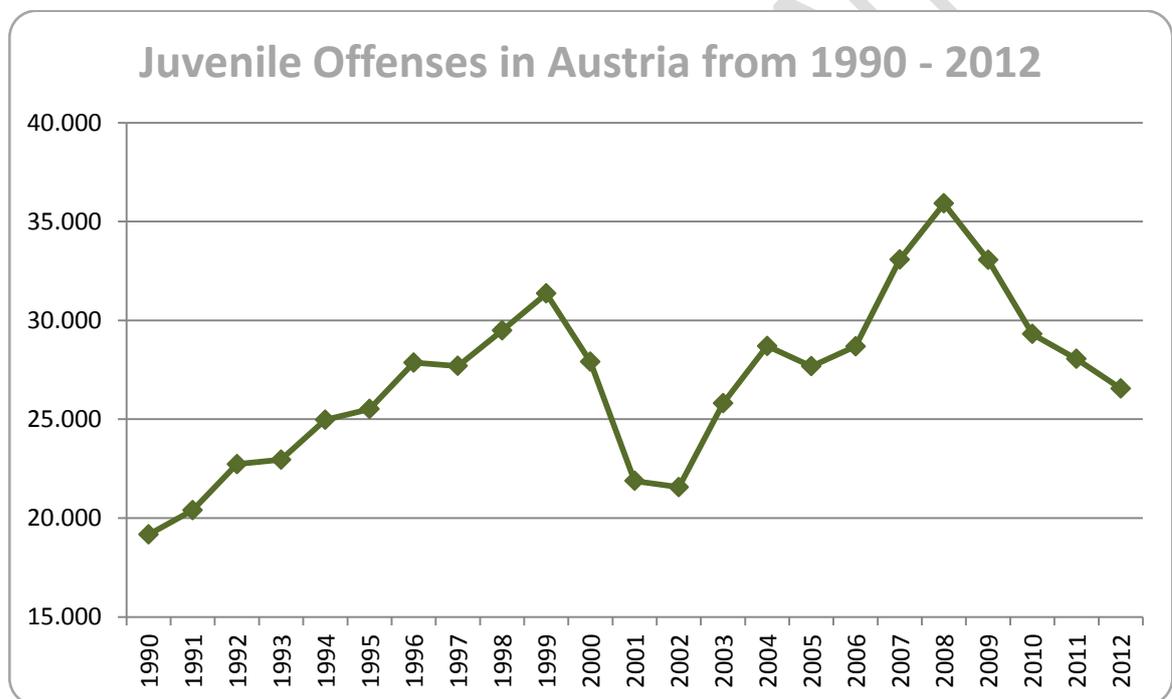
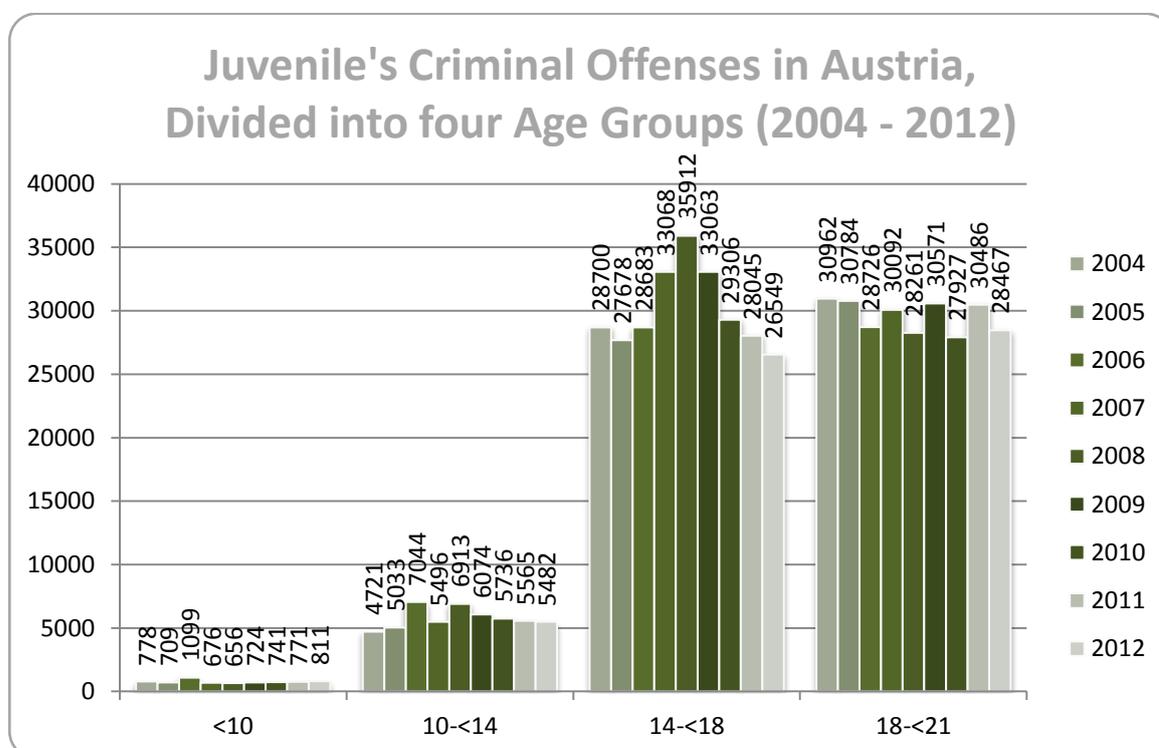


Figure 12 – Juvenile Offenses in Austria from 1990 – 2012 (own illustration based on Statistik Austria, 2013)

Figure 13 represents the juvenile’s criminal offenses from 2004 until 2012 in Austria. Within the age group “less than 10 years” a slight increase can be seen – a rate which is

truly alarming. That leads to the assumption, that prevention has to be conducted already at a very early age.



**Figure 13 – Juvenile’s Criminal Offenses – 2004-2012** (own illustration based on BM.I/Polizei, 2004: 34, BM.I/Polizei, 2005: 38, BM.I/Polizei, 2006: 39, BM.I/Polizei, 2007: 39, BM.I/Polizei, 2008: 39, BM.I/Polizei, 2009: 39, BM.I/Polizei, 2010: 35, BM.I/Polizei, 2011: 35 and BM.I/Polizei, 2012: 35)

### 3.3 Prevention Already at an Early Age

In our everyday life a lot can be read or is heard about prevention, and a lot of researchers have already dealt with it. To wrap it up and referring to ICPC (2002: 3) one could say that prevention is more like endorsing the well-being of people by supporting social, economic, educational and health-related needs - the emphasis lies on children, juve-

niles, and women, as well as on risk- and protective factors, which are related to crime and victimization. Prevention is also the initiative of building strong (neighborhood-) communities. Moreover, through environmental design and other measurements, like increasing the risk of getting caught, opportunities for criminal offenses have to be reduced. When talking from prevention, one must never forget, that there always should be granted a relief for a resocialization-process for the perpetrators. Besides, actors, like the police, the civil society, and the courts of justice should permanently be involved in the development of crime prevention policies (ICPC, 2012: 3). By considering all these essential guidelines, a good basis for prevention is given. But what does it mean, in the matter of juveniles? According to Schumacher and Kurz (2000: 13) it is three or four times more likely that a juvenile, who commits a crime at the age of fifteen or younger, will both reoffend and embarks on crime than an older person. As a matter of fact, the criminal justice system has a meaningful influence on that circumstance as the young teenagers never get that much attention and intervening support they would need at this age. However, the first perpetration of a crime at this age group would be shoplifting or stealing – gun shooting would more be an exception (Schumacher and Kurz, 2000: 14).

### **3.4 Risk Factors and Routine Activities of Juveniles**

When a juvenile offends a crime, it can't be tracked down to only one single reason that provoked the undertaking. It always involves some causes, such as social or psychological matters (WHO, 2002: 1). The WHO (2002: 1) points out in their "Youth Violence"-factsheet that there are several risk factors for juvenile crime which they have divided into three main categories:

- Individual
- Family and Peers
- Social, Political, and Cultural

The following figure (Figure 14) demonstrates the potential risk factors for juvenile crime.

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**Figure 14 – Risk Factors: Individual, Family and Peers, and Social, Political, and Cultural Factors (own illustration based on WHO, 2002: 1)**

### 3.5 Types of Prevention

Many studies have been conducted and this chapter represents the most effective types of prevention measurements. Especially at schools a lot of prevention measurements can be executed. Knowles (2001: 87) worked on a study where she identified several types of risk behavior – Figure 15 lists the relevant data for juvenile crime prevention.

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**Figure 15 – Data Collection: What data can be looked at? And where can the data be derived from? - Relevant Data for Juvenile Crime Prevention (own illustration based on Knowles, 2001: 87)**

Knowles (2001: 89) calls this approach “Student Assistance Program” and the aim of this is to lower the substance abuse which, however, can easily be adopted for similar pre-

vention measurements. Another study, Knowles (2001: 88) investigated was the “Elementary Prevention Curriculum”. Its aim is to have an obligatory prevention curriculum where knowledge about that matter will be imparted, thus, as a consequence, a reduction of risk behavior will be observed. The “After School Activities” approaches’ (Knowles, 2001: 89) aim is to reducing the crime rate and the vandalism by implementing a fixed activity schedule from 3 p.m. until 6 p.m. for a period of more than eight weeks. However, student support groups, which can be seen as a remedial course, can also help reducing crime, thus, lowering the risk behavior, as the affected students will experience support by improving their lack of skills (Knowles, 2001: 91). Another effective way of undertaking prevention measurements is the “Student Leadership Program”. By enhancing the leader ship skills one takes the responsibility for managing a project or leading a group, accordingly, by strengthening the skills the risk factors will get reduced (Knowles, 2001: 92).

### 3.6 How to Measure Crime, Prevention, and its Impacts?

One goal of this research is that prevention should be made measurable. Doing that, crime or violent crime has to be measured at first. In **chapter XXX** the challenging problem of “How to Measure Prevention?” will be discussed.

However, a possible reason, why the trend of juvenile crime is rising, is the perception of the public and their pragmatic attitude towards crime (Maguire and Pastore, 1997: 99). But how can crime be measured? Krug et al. (2002: 7) have defined some guidelines of how to do so. It usually depends on which kind of data for which kind of purpose will be

needed. The overall rule would be: describe, understand, and know, which actually means the following (Krug et al., 2002: 7):

- Describe the degree and impact of violence!
- Understand all the factors which are affecting the increasing risk of violence and crime!
- Know how effective violence prevention programs are!

Keeping these rules in mind, a significant step for measuring crime or violence is set. Some of the substantial data for measuring violence and crime is shown in Table 1 (Krug et al., 2002: 8). A more detailed outline especially focusing on the investigation area Graz will be presented in chapter 4 - INVESTIGATION AREA GRAZ.

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Table 1 – Data for Measuring Violence and Crime (own illustration based on Krug et al., 2002: 8)

TYPE OF DATA	DATA SOURCES	EXAMPLE OF INFORMATION COLLECTED
<b>Mortality</b>	Death Certificates, Vital Statistics Registries, Medical Examiners', Coroners' or Mortuary Reports	Characteristics of the decedent, cause of death, location, time, manner of death
<b>Morbidity and other Health Data</b>	Hospital, Clinic or Other Medical Reports	Diseases, injuries, information on physical, mental or reproductive health
<b>Self-reported</b>	Surveys, Special Studies, Focus Groups, Media	Attitudes, beliefs, behaviors, cultural practices, victimization, and perpetration, exposures to violence/crime in the Home or community
<b>Community</b>	Population Records, Local Government Records, Other Institutional Records	Population counts and density, levels of income and education, unemployment rates, divorce rates
<b>Crime</b>	Police Records, Judiciary Records, Crime Laboratories	Type of offense, characteristics of offender, relationship between victim and offender, circumstances of event
<b>Economic</b>	Program, Institutional or Agency Records, Special Studies	Expenditures on health, housing or social services, costs of treating violence-related injuries, use of services
<b>Policy or Legislative</b>	Government or Legislative Records	Laws, institutional policies and practices

# 4 INVESTIGATION AREA GRAZ

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## 4.1 Concept of the Empirical Part

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Figure 16 – Concept of the empirical part of the thesis (own illustration)

## 4.2 Spatial Problem Assignment

### 4.2.1 The Driving Factors for Crime in Graz – A Systems Approach...

As discussed in detail in chapter 2 - MAINSTREAMS OF CRIME RESEARCH, the topic crime involves so many different disciplines and has got numerous approaches that find its way through the topic. The six categories (Crime and Law, Crime and Sociology, Crime and Psychology, Criminology, Crime and Environmental Design, and Crime and GIS) were the basis for an analysis on the driving factors for crime. The aspects that are influencing crime could again be categorized into four main groups (Figure 17).

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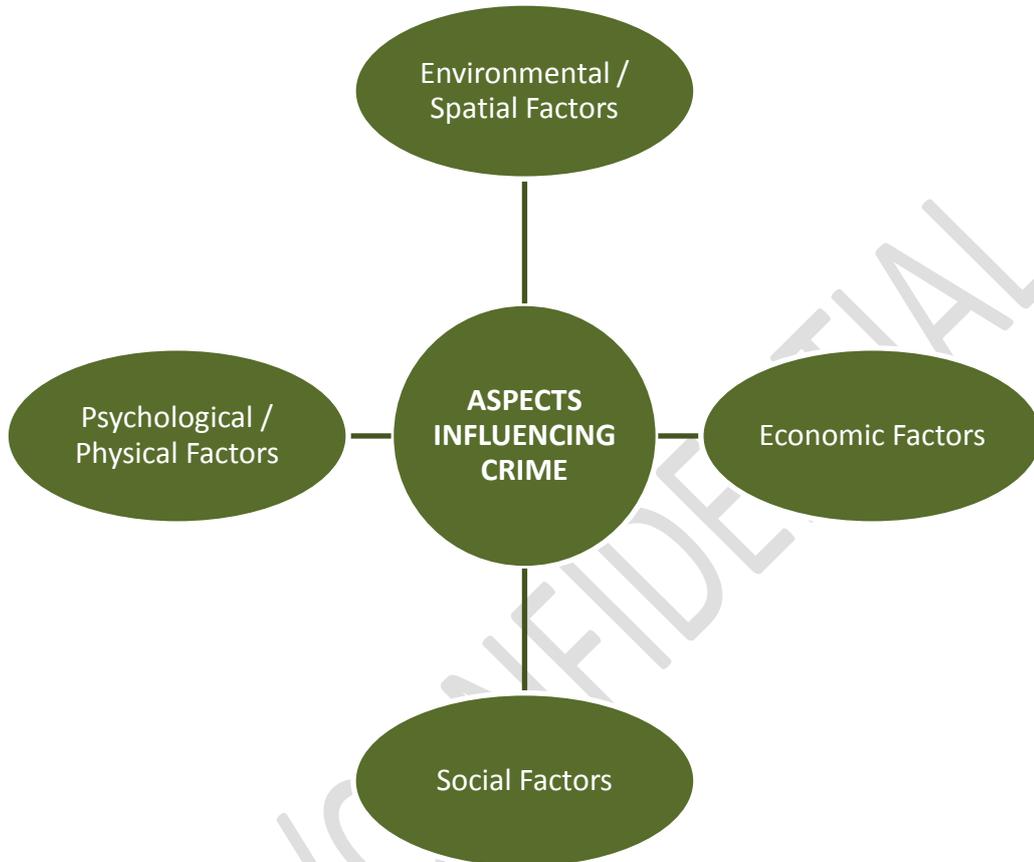


Figure 17 – Four Main Categories of Aspects that are Influencing Crime (own illustration)

These four categories can't be seen separately, thus, as each of the groups would depend on each other. E.g. an environmental factor, such as "central places, hot spots" or "densely populated areas" both would influence and are influenced by demographic change issues which fall into the economic category. Seen from a social point of view, the demographic change and the central places again affect school and peer issues. A similar example can be shown by the unemployment, which clearly is declared as an economic matter. Unemployment (economic) can lead to poverty (social) which will also

affect schools and peers (social) and the central places or hot spots (environmental/spatial), as well as the densely populated areas. However, this can be done endlessly and it should demonstrate the complexity of the interaction of these four disciplines.

For that reason, a systems approach is used, which is based on Vester (1999). Vester's systems approach is a relatively simple approach for seeing the complex system with its interdependency and influencing variables (Exner et al., 2013: 230). The overall aim of this method is to obtain decision support in the assessment of the effects of measures. A common understanding of complex relations between both active and passive interference can be achieved (Drews and Hillebrand, 2007: 153). At the beginning indicators which are acting on a system have to be determined (Drews and Hillebrand, 2007: 154). The indicator-based method should at least involve twenty to up to forty variables for describing the system (Exner et al., 2013: 230).

In this research thirty-one variables have been chosen for the system, which also was discussed with experts who are working within this field, such as a police officer who is specialized in juvenile crime and prevention. As already mentioned before, all the variables got categorized into four groups (Figure 17) – environmental/spatial, economic, social, and psychological/physical aspects.

After generating a matrix with all the thirty-one variables (see Figure 19), the direct effect of a variable on another will be assessed by using a grading scale from zero to two, as it can be seen in Figure 18 (zero means "no influence/effect at all", one means "average influence/effect", and two means "strong influence/effect") (Exner et al., 2013: 230).

EFFECT MATRIX - ASPECTS INFLUENCING CRIME

	Traffic infrastructure/road networks (Freeway Exit & Entry, Railway, Subway, Underground etc.)					
	1	2	3	4	5	6
Traffic infrastructure/road networks (Freeway Exit & Entry, Railway, Subway, Underground etc.)	1	0	2	2	2	2
Lighting	2	0	0	0	1	2
Land utilization plan, Cadastral map (business district, urban residential district, industrial estate, green space )	3	2	0	2	2	2
Forest, Vegetation	4	2	1	1	2	2
Building shapes, height of construction, agglomeration, backyards	5	1	1	2	1	2
Central Places, Points of Interest, Hotspots	6	0	1	0	1	2
Densely Populated Areas	7	2	1	2	2	2
Ethnic Groups, Culture, Class – Social Status	8	0	0	1	0	0
Gender	9	0	0	0	0	0
Age	10	0	0	1	0	0
Poverty	11	1	0	2	0	0
Ethics/Morality/Tolerance of Crime	12	0	0	0	0	0
Education	13	0	0	0	0	0
School, Community and Peers	14	1	0	0	0	2
Neighborhood, Living Conditions, Domestic Circumstances	15	0	0	0	0	1
Alcohol and other Drugs	16	1	0	0	0	2
Educational System	17	0	0	0	0	0
Unemployment	18	0	0	0	0	1
Political Change	19	1	0	1	0	1
Demographic Change	20	2	0	2	1	2
Open Borders	21	2	0	1	0	0
Real Estate Market	22	2	0	2	1	2
Media Influence	23	0	0	0	0	1
Health System	24	0	0	1	0	0
Genes (Twin Studies)	25	0	0	0	0	0
Mental Disorder	26	0	0	0	0	0
Conduct Disorder	27	0	0	0	0	0
Family Environment/Parental Behaviours	28	0	0	0	0	0
Traumatic Childhood Experience	29	0	0	0	0	0
Alcohol and other Drugs	30	1	0	0	0	2
Emotions and Cognition	31	0	0	0	0	0

Figure 18 – Detail: Effect Matrix with its both Aspects that are Influencing Crime and Assessment of the Relations (own illustration)

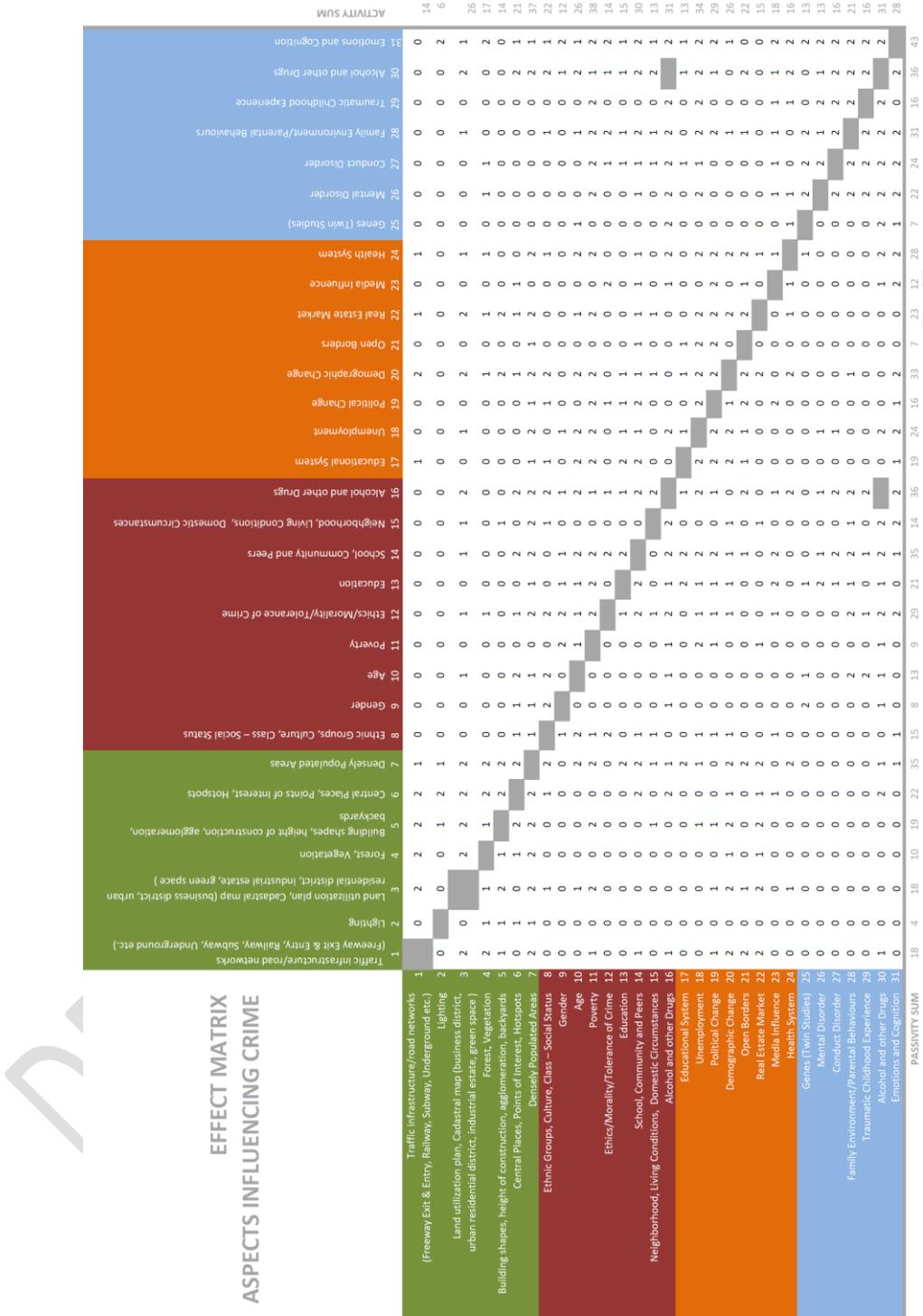


Figure 19 – Effect Matrix of Aspects that are Influencing Crime (own illustration)

When having distributed all the influencing values in the matrix, the activity sum and the passivity sum for each indicator can be calculated, as Figure 20 shows (Drews and Hillebrand, 2007: 157).

2	1	2	0	0	0	1	0	2	0	22
	0	1	0	0	0	0	0	0	0	15
0		1	0	1	1	1	1	1	2	18
1	1		1	1	0	0	1	2	2	16
0	0	1		2	2	2	0	0	2	13
0	0	0	0		2	1	2	1	2	13
0	0	0	0	2		2	2	2	2	16
0	0	0	0	2	2		2	2	2	21
0	0	0	0	2	2	2		2	2	16
0	1	2	2	2	2	2	2		2	31
0	2	2	1	2	2	2	0	2		28
23	12	28	7	22	24	31	16	36	43	

**PASSIVITY SUM**

**ACTIVITY SUM**

Figure 20 – Detail: Assessment of the Correlation of the Variables (own illustration)

The assessment values finally get transferred into a scatter plot where the mean of both x- and y-axis form four parts (Ehetreiber, 2010:44):

- Active – high activity, low passivity: the factors are having a strong influence on the other factors within the system, but are hardly influenced by the other factors.
- **Ambivalent – high activity, high passivity: the factors are both strongly influencing and influenced within the system.**

- Buffer – low activity, low passivity: the factors are both hardly influencing and influenced within the system.
- Passive – high passivity, low activity: the factors are strongly influenced by other factors within the system, but are hardly influencing the other factors.

The ambivalent quarter of the scatter plot represents all the factors that are of great importance for the research area as the ambivalent factors have got a significant effect on it (Ehretreiber, 2010: 44).

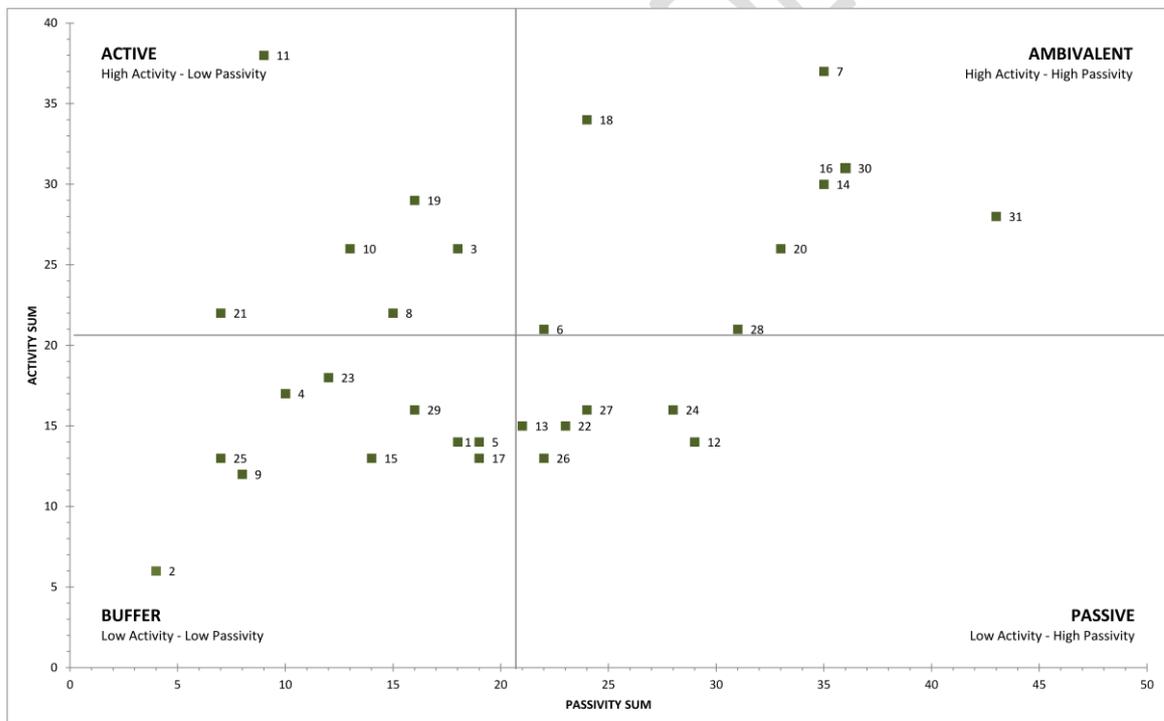


Figure 21 – Scatter Plot, divided into Quarters – Ambivalent, Active, Passive, and Buffer (own illustration)

The systems model finally will be represented as an effect diagram where the relations within the system will be demonstrated (Figure 22). Due to the visualization of the system's interdependencies, some key elements become apparent. The key elements play a major role as they are both influenced significantly by other factors and still affect other indicators. It basically means that these key elements have a leverage effect within the system and if something has to be changed, it has to be started with the key elements (Ehretreiber, 2010: 46). The following effect diagram (Figure 22) represents all the ambivalent indicators. The key elements within this model are "School, Community, and Peers", "Central Places, POIs, Hot Spots", "Family Environment, Parental Behaviors", "Demographic Change", and "Alcohol and other Drugs", as they are both influenced most and are influencing at the same time (represented by the red lines).

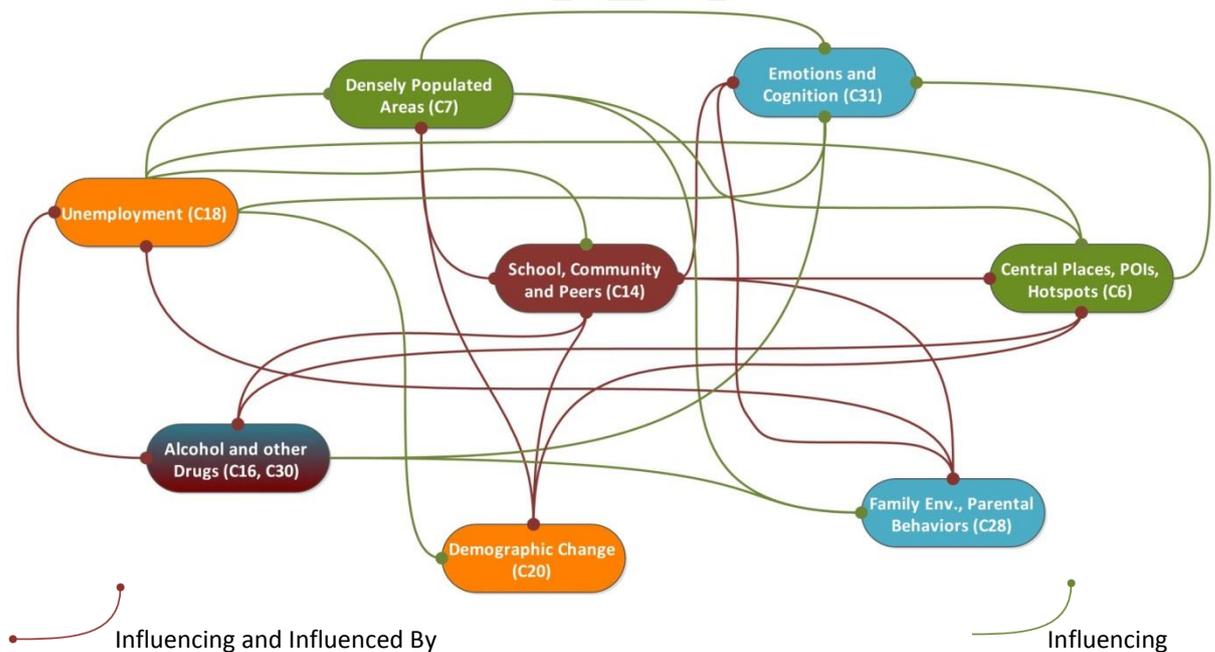


Figure 22 –Effect Diagram: the key elements are "School, Community, and Peers", "Central Places, POIs, Hot Spots", "Family Environment, Parental Behaviors", "Demographic Change", and "Alcohol and other Drugs" (own illustration)

The indicators mentioned above have a significant influence on other factors within the system, and that is why this research focuses on juvenile crime in combination with social, economic, and environmental issues. As already mentioned in the previous sections, if crime starts at an early age, the probability that the juvenile remains a criminal is very high. However, in combination with the results of the systems approach, it is crucial to look into the social issue “School, Community, and Peers”, as this is the key to the major problem - a rising trend of juvenile offenses. And that’s why prevention should be started very early, starting at schools.

### 4.3 Crime Analysis – A Trans-Disciplinary Analysis Approach

*“Crime analysis is the systematic study of crime and disorder problems as well as other police-related issues – including sociodemographic, spatial, and temporal factors – to assist the police in criminal apprehension, crime and disorder reduction, crime prevention, and evaluation.”*

Boba, 2005: 6

#### 4.3.1 Quantitative Research Methods: Diverse Analysis Tools for Deriving Juvenile Crime – Tradition meets DigitalGlobe Satellite Imagery Crime Analysis Method

- Quantitative research methods – generalization and comparability of the theories/results:
  - Descriptive statistics/descriptive analysis of data
  - Inferential statistics
  - SWOT-Analysis
  - (*Observation and shadowing*)

##### **Descriptive Statistics Method**

The descriptive statistics method, according to Zimmermann-Janschitz (2014: 30) and Neubauer (2008: 20), provides ways and means for describing data. Amongst the conventional description, the characteristics of the descriptive statistics methods are tables, classifications and groupings (Zimmermann-Janschitz, 2014: 30). Along the clear preparation of the data can lead to an amount of findings. The data then has to be characterized with parameters and finally will be visualized with both diagrams and maps. If a random sample is chosen, the result will only be relevant for the selected assortment - statistical inference is not acceptable (Zimmermann-Janschitz, 2014: 31). Amongst others, the statistical methods support this research project in a massive way. The following techniques can be used (Zimmermann-Janschitz, 2014: 35):

- Tables and diagrams (data overview).
- Thematic maps (visualizing statistical parameters or spatial distribution of crime, danger zones, etc.).
- Parameters and indices (monitoring).
- Time series analysis (comparison of the development of the crime rate).
- Correlation and dependencies on indicators and developments can bring out hidden information (perception of crime).

### **Inferential Statistics**

Compared to the descriptive statistics, the inferential or mathematical statistics allows statistical inference. The probability theory, which is part of the mathematical statistics, plays an essential role when having large data sets – in that case, statistical inference is specifically requested, as “uncertainty” has to be weighted (Zimmermann-Janschitz, 2014: 32).

### **SWOT-Analysis**

The SWOT-Analysis (acronym for Strengths, Weaknesses, Opportunities and Threats) can be the basis for urban strategies. With that analysis method it is possible to point to and moreover clearly visualize weaknesses and threats, according to e.g. current crime prevention methods. Naturally, the same can be done with the strengths and opportunities – in that case a structured overview of the “status quo” can be provided and measurement plans can be developed for keeping that level, respectively, for how to strengthen the positive aspects (Drews and Hillebrand, 2007: 141-147).

### 4.3.2 Qualitative Research Methods: Figuring Out Where, When, Why

- Qualitative research methods - data acquisition within the investigation area; development of new theories:
  - Expert interviews and/or Delphi method (.BK, Bundesministerium für Inneres [BM.I], urban planners, etc. → Effect Matrix)
  - Questionnaires
  - Mental maps

#### **Expert Interviews and/or Delphi Method → Effect Matrix**

Collaboration with experts, the expert interviews and/or the Delphi method should be the basis for the implementation of an effect matrix and moreover of an influence diagram. Finally, these results should be compared to the one that was created at the beginning of the research project (the next paragraphs give more information on that process). Moreover, the aim of the collaboration with these experts should also be the contribution of parameters for crime prevention in urban planning.

#### **Mental Maps**

Mental maps represent the subjective perception of a space; hence, mental maps are the result of cognitive mapping and not a representation of the real world (Weichhart, 2008: 170). In combination with the mental maps, the residents of the investigation area will get a questionnaire which deals with both perceived safety and crime in an urban

environment. It is believed that the gathered information on the various mental maps and the questionnaires can be used for further analyses.

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