

# Evaluation of the Effects of Environmental Stress Stimuli on Crime Prevention in Urban Design; Case Study: Rajaei Shahr Main Street, Karaj\*

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## ABSTRACT

Crime is one of the complications of modern life which reduces public satisfaction, creates fear, and lowers the quality of social life. The environment defines individual behavior and social space. The urban and social space, in which the sense of security is manifested, would reduce the citizens' perceived stress. This can be to a large extent the factor to reduce crime and promote the quality and vitality of urban space by using Crime Prevention Through Environmental Design (CPTED), identifying the environmental stress stimuli (noise pollution, air pollution, visual disturbance, density and crowd, and urban furniture), and providing solutions to deal with them in urban design, which is the aim of the present study. The present study is descriptive-analytical research based on statistical analyses. In the first chapter, the theoretical foundations and related literature are reviewed through the use of library studies and related articles. The second chapter deals with the case study with a quantitative approach through the survey. The data obtained are statistically analyzed by the SPSS (Statistical Package for Social Sciences). The statistical population includes those in the Rajaei Shahr main street in Karaj and the sample size is estimated to be 384 people. The reliability of the questionnaire (including 37 questions) was investigated by Cronbach's alpha ( $\alpha=0.764$ ). The findings show that the correlation between research variables is equal to 0.803, indicating a direct and strong correlation between the dependent variable (urban design) and independent variables (crime reduction, CPTED, and environmental stress). According to the findings, concerning environmental stress stimuli and the CPTED, most of the effective indicators are above median in the theoretical analysis conducted and considered critical factors. So, they should be especially taken into consideration in urban design, to achieve a secure urban space.

**Keywords:** Environmental Stress, Crime, Urban Design, CPTED, Karaj.

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## 1. INTRODUCTION

Human needs to obtain information from their surroundings to communicate with the environment (Barati and Soleimani Nejad 2011, 20). Sense is the first step in the communication process. In this stage, the individual receives information from the environment through the five senses and transforms it into a transferrable form to the brain. This process is named the sense of environment, and the second stage in which the perceived data is identified, interpreted, and categorized by the brain is named environment perception (Pakzad and Bozorg 2018, 85). Therefore, the process of sensing and perceiving the environment, besides determining the individual's feedback, determines his behavior. One of the factors for the emergence of the behavior is the urban space which is formed through the integration of the behaviors, social behavior, culture, and social identity. If the urban space (physical-spatial) has shortcomings to meet the psychological needs of the audience in interaction with the individual, the way for the emergence of abnormalities in him will be paved (Pourhasan et al. 2016, 45). Paying attention to the fact that human behavior is different in various spaces and places with the function latent in it, and in many cases, the space is what stimulates the man to show a specific behavior (sometimes, a behavior may be criminal) seems to be important. In this regard, one of the most effective environmental factors on the individual is stress which further increases the victim's fear in the criminal situation. Selye defines stress as the non-specific reaction of the body to any pressure imposed on it (Curtis 2000, 59).

Now, if the environment and surrounding relations cannot meet human needs, they would lead to stress and if it is repeated, it would lead to background stress. The noise and visual pollution in the urban space, lack of sufficient light, and crowds and traffic are factors considered as the causes of background stress. There is strong evidence for a wide range of short- and long-term health impacts through exposure to airborne particles and crime, and when exposed to this pollution, aggressive and criminal acts are increased (Burkhardt 2019, 4). On the other hand, the heterogeneity of urban appearance and landscape can be noted that alongside the traffic, crowd, and lack of privacy, doubles the stress and consequently, leads to the potential occurrence of abnormal behavior.

Regarding the importance of the above-mentioned matter, the present study aimed to evaluate the effects of environmental stress stimuli on crime reduction in the Rajaei Shahr district in Karaj, since Karaj city is currently ranking high regarding the rate of offenses and crimes, compared to other urban areas in the country (Zangi Abadi and Rahimi Nejad 2010, 198). This problem reduces the social security level, disturbs the city's health, and distorts the citizens' lives on the one hand, and on the other hand, forces the

judicial and law enforcement system and the general public sphere of society to spend large budgets and expenses for crime detection, prosecution and arrest of criminals, judicial proceedings, and punishment of criminals. Therefore, through the detection and analysis of the environmental stress components and their effects on crime reduction in the urban design, it can be expected that the crime rate is more effectively reduced in Karaj City in general, and Rajaei Shahr district in specific. Therefore, it is aimed to evaluate the effects of environmental stress and individual relations and interactions regarding the physical structure and effective organization of the environment to reduce crimes, which is less considered today. Meantime, it has been tried to answer the following questions:

- a) What are the influential components of environmental design on environmental stress?
- b) How can the crime rate be reduced using an approach to reducing stress in the urban space through environmental design?

## 2. RESEARCH BACKGROUND

It is required to mention the most relevant research to the research topic and then, compare its findings and results with those of the present study to express the innovation intended by the researcher. To do so, the articles would be evaluated in two domestic and international categories.

### 2.1. Domestic Research Background

1. Pourhasan et al. (2016) in a study entitled "Evaluation of the urban space design effects on reduction of people's stress and aggression while driving, Case study: Lahijan City), aimed to evaluate the effects of urban space on people's stress and aggression while driving using library studies and descriptive-analytical and inferential methods. Their results indicated that considering green space appropriate to the environmental design and employing it in urban space can be significantly effective in reducing stress and aggression, especially among drivers.

2. Heshmati & Charehjoo (2019), in a study entitled "Effects of quality of the environment on the perceived security of residents with emphasis on the first and second generations of CPTED", evaluated the perceived environmental security in the worn-out textures. It was a descriptive-analytical study carried out based on fuzzy logic using a questionnaire. The results indicated the support of natural activities and surveillance from the first generation factors, and capacity threshold and collective culture based on the factors provided in the second generation of CPTED which plays a significant role in the promotion of the citizens' sense of security.

3. In their descriptive-analytical study entitled "analyzing the relationship between the physical

quality of urban space and citizens' perceived stress (Case study: Isfahan metropolis)", Azadeh et al. (2020) investigated this relationship using a researcher-made questionnaire and multivariate linear regression. They found that the physical quality of the environment predicted 67% and 46% of the variations in the citizens' perceived stress in the Moftabad and Mardavij neighborhoods, respectively. The results showed that people living in low-quality urban spaces are more exposed to stress.

## 2.2. International Research Background

1. Perry & Fennelly (2020) in a study entitled "Encompassing effective CPTED solutions in 2020 and beyond: concepts and strategies" proved that the individual (and not the buildings) is highly effective in crime reduction. The matter of crime prevention using the CPTED is not just a rule and warning. They believe that various cases should be considered for investigation of the crime, prevention, neighborhood surveillance, crime prevention and economic situations, and creating a stable culture of security. Therefore, we should be aware of our surroundings and implement plans (based on CPTED strategies, territorialism, natural surveillance, hardening the target, and controlling the entry and exit) that lead to crime reduction in societies. The main point here is the provision of solutions to the reader for the detection of the problems.
2. Jimenez et al. (2020) in a study entitled "Effect of Urban Trips on Stress and Cognitive Performance, A Study in Bogotá, Colombia" investigated whether urban trips affect the adults' mental health in the urban body or not with the use of a descriptive-analytical method and the statistical-software results of seven participants in separate days with public transportation and bicycle to approve the effects of the components. The results indicated that bicycle trips and appropriate urban design infrastructure more positively affect people's mental health, followed by public transportation.
3. Da Silva & Da Silva (2020) in a study entitled "Sustainable modes and violence: Perceived safety and exposure to crimes on trips to and from a Brazilian university campus" investigated the detection of effects of violence-related aspects on the mode of going to the university in the environmental design, using the descriptive-analytical method and an online survey. The results indicated that walking students grab the attention of criminals, so the type of route design and the vegetation cover are effective in this regard. On the other hand, the increase in the surveillance of the regions with high participation in the pedestrian-oriented modes and considering a driver route beside the pedestrian route to increase person-on-person surveillance can lead to stable results in the creation of the security and prevention of a stressful environment, theft, and violence.

## 3. THEORETICAL FOUNDATIONS

Based on the background and to achieve the conceptual model of the study, supporting concepts and theories are required in this regard. Therefore, The following includes the subsections of the nature of environmental stress, environmental stress stimuli, physical quality of the environment and mental health, and finally, the CPTED.

### 3.1. Definition and Nature of Environmental Stress

The term 'stress' is derived from the French term 'Estrece' which is itself derived from the Latin term 'Estritus' meaning compressed and under pressure (Cooper 1994, 42). In the present century, stress has become a part of human beings' daily life which seems to be unavoidable and affects human life. Selye (1974) defines stress as the non-specific reaction of the body to any type of pressure imposed on it. This response can be made to any internal, cognitive, external, and environmental stimuli and stress stimuli (Curtis 2000, 59). In a general view, two different types of definitions are provided for stress:

a) Systemic stress: This definition focuses more on medical data. Selye sought to detect the role of stress in repairing injuries and the body's ability to resist diseases. In his idea, the response to stress consists of three stages namely alarm, resistance, and exhaustion. He believed that adaptive diseases (headaches, high blood pressure, insomnia, and the like) occur in the resistance stage. The studies on the role of stress in diseases indicate a bilateral effect. While the disease affects stress, its progression is controlled by the stress response and rate (Salimi et al. 2015, 39).

b) Psychological stress: One of the most comprehensive theories about the role of cognitive factors in stress is provided by Lazarus. Based on this theory, how an individual evaluates an event plays a fundamental role in the determination of the stress response and the adaptive strategy the individual might employ when faced with stress, happening in two stages:

The first stage) Primary evaluation: at this stage, it is determined whether a stressful event causes damage, loss, threat, or challenge. Loss refers to the damage inflicted, such as losing a family member. Threat refers to something that can cause damage or loss (Fariyabi et al. 2016, 3). Challenge means a potential power for growth, dominance, or forms of success or vice versa. Here, the equivalent of the threat or challenge can be observed such as the dark spaces on the corner, the space under the overpasses, under the bridges located on the rivers, abandoned and unused spaces, and the like where passers-by, especially women are associated with losing a sense of security and their stress is intensified (Capasso Da Silva and Da Silva 2020, 6).

The second stage) Secondary evaluation: After the primary evaluation, the individual evaluates his adaptive sources and choices. How an individual responds in this stage depends on the positive or negative feelings created in him by these reactions. Anyways, when people consider an event to be threatening, they become desperate and stressed, and when they think this challenge is stimulating and dynamic, they feel satisfied. People who interpret the events to be challenging, get involved in adaptive responses for stress reduction (Shams Isfandabadi 2017, 79-80). This adaptive response in the urban space is reminiscent of Altman's theory of behavioral settings, i.e., people, when dealing with their surroundings, show the same behavior the collection of people shows.

### 3.2. Environmental Stress Stimuli in Urban Space

In environmental psychology, many environmental elements such as noise are considered to be stress stimuli. The stress stimuli such as work pressure, war, natural disasters, and even any epidemic abnormal

behavior (drug dealing) in the urban space are among the stimuli that jeopardize people's minds and health. Stress, which consists of physiological, emotional, and behavioral components, is a reaction to such stimuli (Burkhardt 2019, 6). The studies indicate that stress and mental pressures are increased in some environments and situations such as harsh working conditions, unfavorable weather, being away from family for a long time, as well as facing physical and mental dangers, being threatened or attacked, and inappropriate perceptual conditions in the environment (intense light, darkness and the like). Meantime, one of the most important stress and mental pressure modulators is social support for the individual. Social support means providing material and spiritual support from relatives for a person who is exposed to stressful or harsh conditions (Mousavian Khorasani et al. 2019, 3), raised in the field of architecture and urban planning in the category of crime prevention design under the title of public surveillance, which is a kind of social support. Cohen divides environmental stress stimuli into the following three basic categories.

**Table 1. Different Types of Environmental Stress Stimuli**

Types of Environmental Stress Stimuli	Description
Major Stress Stimuli	They usually occur suddenly and have a strong impact that causes a more or less universal response. It usually takes a lot of effort to cope with them. Events such as tornadoes, volcanoes, and unnatural events such as war, and infectious diseases are among these types of stimuli.
Personal Stress Stimuli	Events such as illness, death of loved ones, or losing one's job. These stress stimuli affect fewer people compared to major events. The beginning of these events has the strongest impact on a person. In personal events, the number of people who can support a person is much less than in major events.
Background Stress Stimuli	These stress stimuli are repetitive and have much less power compared to the previous stress stimuli, But they are usually chronic. They cause persistent problems of low severity, such as arguments between spouses or constant air pollution, repeated theft, and violence that constantly affects a person's life, such as cell phone theft, car theft, coercion, and even constant problems with neighbors (due to living in apartments and the presence of different cultures and ethnicities with different customs), which due to being repeated and observed in big cities, the person always fear them.

(Shams Isfandabad 2017, 82)

What is aimed by the present study is the background stress stimuli. To cope with these stress stimuli, social support is usually not enough, and designing

a suitable urban space can greatly help in this regard. The cases that can create background stress stimuli in the urban space are as follows.

**Table 2. Most Important Environmental Stress Stimuli in the Urban Space**

Title	Definition and Outcome
Crowd	e crowd is a social situation that is the consequence of the inefficiency of the solitude mechanisms, so it does not reach the required level and the social relationship exceeds the required level (Pakzad and Bozorg 2018, 255-257). In the meantime, the issue that most often happens to a person in a crowd is the lack or dimming of the environment's cartography. In fact, cognitive maps are related to recognizing where a person is, predicting what will happen, evaluating good and bad events, and knowing what actions to take. The diagnosis makes people understand the environment, prediction is the need for a cognitive basis for subsequent decisions, evaluation is the need to reduce worry from discouragement towards something, and action is the need to perceive the logical results of subsequent actions (Lang 2018, 154). Clearly, the crowd has a direct relationship with delinquency. When a person gets confused in the cognitive map, stress prevails and this issue will provide the platform for the crime to occur for the criminal and being victimized.

Title	Definition and Outcome
Visual Pollution	The concept of visual pollution refers to the existence of any kind of disturbance and undesirable visual quality in the shape of the city, including facades and forms and physical volumes of buildings. Among the types of visual pollution, we can mention the presence of buildings with broken windows and a dirty and distorted appearance, the degree of inconsistency in the rhythm of facades and spatial elements, abnormal graffiti, and the quality of colors used in the space and environmental pollution. The broken windows of a building show the lack of individual and collective control there, and the lack of social controls is like a green light for criminals who are waiting to seize the opportunity and commit crimes in these places, and this causes tension and stress for many people (Salehi 2007, 84). The findings of studies and field observations in the Rajaei Shahr main street in Karaj city prove that there is a significant correlation between the mentioned environmental pollution and behavioral distortion. The mushroom-like diversity and accumulation of signs without any order and proportion in front of shops and along the sidewalks also provide the basis for the aggravation of nervous disorders and background stress in the city.
Noise Pollution	Noise is an environmental stress stimulus and in combination with other stress stimuli, it can exacerbate mental disorders even under certain conditions, it can affect the efficiency of people, and on the other hand, any kind of abnormality is easily caused by people. It should be in a place with noise pollution so that the voice of people asking for help (for example, in a robbery) is not heard by anybody and the criminals' actions remain hidden. According to this article, it can be said that the more areas with noise pollution, the higher the crime percentage of the area (Mahshid and Faruzandeh 2013, 7).
Lack of Adequate Light at Night	Most of the misbehaviors and crimes occur at night, in dark and dimly lit places, and it provides a good opportunity for criminals to commit their criminal acts under the cover of darkness. Moreover, the rate of robberies at night is much higher than during the day (Salehi 2007, 87). In fact, the purpose of city lighting is to provide public security, safety, and well-being in crossings, streets, squares, and public stations. As explained before, the presence of dark and dimly lit corners in the streets of the city and the old and unorganized texture and the like are the cause of environmental stress and provide conditions for misbehaviors.

### 3.3. Physical Quality of the Environment and Mental Health

The quality of urban physical spaces increasingly affects human health (Pourhasan et al. 2016, 3). Health has various mental and physical aspects. Mental health is the basis for physical health (Satcher, Okafor, and Dill 2012, 2). Mental health helps with the person's welfare, familial relationships, and functional abilities. One of the main indicators in the field of mental health is perceived stress. Today, this issue is known that the physical qualities of the built spaces increasingly affect the citizens' mental health and welfare (Chan and Liu 2018, 213), i.e. the characteristics of the neighborhoods and residential areas are deeply correlated with mental health indicators (Desantis et al. 2016, 277) among which the most important one is the green space (Kuo 2011, 10). In fact, being in the natural environment reduces stress to a large extent. Also, the other factor is the different types of transportation in the urban space.

Access to pedestrian routes and the ability to use a bicycle is directly correlated with the citizens' mental health. Another important indicator is the quality of public spaces (Knoll, Neuheuser, and Rudolph-Cleff 2015, 247-250). Public spaces allow for social interactions. The increase in interactions as well as the fellowship between the citizens increases their self-confidence and consequently, makes them show more appropriate physiological reactions to changes. Appropriate physiological reactions reduce stress, especially background stress. Environmental security can be noted as another indicator. In fact, studies have shown that violence and theft threaten mental health in urban communities and residential neighborhoods, and deeply affect psychological behavior and function (Azadeh et al. 2020, 101). Among the other cases also, the urban furniture arrangement, density, and crowd, which were previously mentioned, can be named. In the following, the most important studies in the field of physical quality of the environment and mental health will be noted in Table 3.

**Table 3. Indicators of Quality of the Environment and Mental Health**

Title	Indicators Intended by Theorists	Theorist/Year
Ideal Features of a Quality Neighborhood	High-quality stores, high-quality restaurants, human dominance over cars, variety of services, social interactions, residents' responsibility, cultural and ethnic diversity, the emergence of local activities, and respect for children.	Brower and Taylor, 1997

Title	Indicators Intended by Theorists	Theorist/Year
Perceived Environmental quality Indicators in Urban Neighborhoods Case Study: Rome	The quality of green space, facilities, access to urban services, public transportation services, safety and security of the environment, and the beauty of the environment	Bonaiuto et al. 2003
Quality of Life and Stable Urban Development	Quality of residential units, car independence, sense of security, quality of public space, the beauty of buildings, and green spaces	Kowaltowski et al. 2006
The Impact of the External Features of the Built Residential Environment on the Mental Health of Adults	Types of walls, doors, and windows, green spaces, building density, waste disposal system, and street lighting	Ochodo et al. 2014
Quality of the Neighborhood and Extensions: Validation of Residential Environment Quality Assessment Tools	public spaces, quality of roads, natural elements, the beauty of the environment, vegetation and trees, variety of housing, parking, safety and security of the environment	Poortinga et al. 2017
Physical Quality of Housing and Neighborhood: Mental Health of Children	Construction materials, order, cleanliness, environmental health, privacy, hierarchy, road network, spatial continuity, diversity, activity, building density, population density, walkability, connection with nature, and facilities	Rollings et al. 2017
Evaluation of the Relationship Between Types of Housing and Satisfaction with the Living Environment in Tabriz City	Access to the work environment, access to shopping centers, access to educational centers, access to public transportation, access to health services, and the quality of the road network.	Azimi and Esmaeilzadeh, 2017
Housing, Stress, and Mental Health among Immigrants in Chinese Cities	Housing type, housing costs, number of rooms in a residential unit, internal facilities of a residential unit, housing per capita, noise pollution, neighborhood security, services per capita, access to commercial stores, access to health services, access to schools, facilities, quality of road network, street lighting, and garbage collection system	Li and liu, 2018

(Adapted from Azadeh et al. 2013, 101)

### 3.4. Crime Prevention Through Environmental Design (CPTED)

Numerous studies have considered urban developments, crime, and lack of security to be interrelated, and have shown that physical qualities of urban design have the required potential to affect the crime hotspots (Heshmati and Charehjoo 2019, 86). Therefore, the CPTED is of great importance. The term 'prevent' means "to advance, overtake and rush in front of something", and also "to inform, give news of something, and warn". However, in preventive criminology, prevention is the use of different techniques to prevent crimes, face the crime, and outrun the criminal (Dorostan et al. 2020, 13). Crime prevention seeks to answer the question "what can be done so that the non-criminals would never commit a crime, or commit the least crimes?". It also considers the places and situations that have not faced problems due to criminal acts. For example, in

the early 80s, a new mining town named 'Tumbler Ridge' was built in northeastern British Columbia. The designers of this town predicted an appropriate route for the passengers all over the town and an easy view of all potential hot spots as well as some other actions, which resulted in a town with the least crime rate (Mohamamd Nasl 2014, 27-33). CPTED was officially raised in the early 60s with the abbreviation 'CPTED' which aimed to prevent crime through environmental and architectural design. This concept requires understanding the correlation between physical design and criminal acts and is a design created with the aim of crime production (Heshmati and Charehjoo 2019, 91). The main concepts raised in CPTED can be discussed in six categories: a) territory, b) surveillance, c) hardening or target physical security, d) access control, e) support of activities, and d) maintenance (Perry and Fennelly 2020, 10). The theories provided in this field can be examined in two generations which are presented in Table 4.

**Table 4. Theories of the Researchers in the Field of CPTED**

Theories of the CPTED Researchers, First Generation		Theories of the CPTED Researchers, Second Generation	
Title of Theory, Theorist	Solution	Title of Theory, Theorist	Solution
The Use of Welfare Facilities, Elizabeth Wood <sup>1</sup>	Hiring a janitor in residential complexes, creating anti-destruction facilities, presence of urban managers among citizens to better identify cases	Architecture, the Determinant of Behavior, Coleman	Weaker design, more social problems, the negative impact of high-rise buildings on behavior, spatial privatization in settlements
Using the Old Pattern of Street Design, Jane Jacobs	The overlook to the street, lots of comings and goings by facilities (parks, shops), the neighborhood is a combination of old and young people and houses.	Landscape Improvement, Greenland	The social difference is effective in crime prevention design. The crime prevention design is closely related to the fear of crime. The development of design is based on traditional forms. Special attention is paid to the appearance of the building
Defensible Space, Oscar Newman	Four components of defensible space are the territory, surveillance, building facade, proximity to residential facilities and other facilities	Composition of Space, Hillier	Attention to the non-objective effects of design in architecture and its effects on the audience. A quiet environment has more crime potential. The front of the houses on the sidewalks and the resulting empty space is the silent space that creates crime by design.
Crime Distribution, Patricia & Brantingham	Examining the behavior of criminals and their secret life, examining the body of the neighborhood in the occurrence of crime, and explaining emotional-hasty crime and opportunistic crime.	Shrinking the Neighborhoods, Cleveland	Providing standards that have somehow followed the first generation, neighborhood residents accountability, creating facilities for young people, making neighborhoods smaller, and as a result, close local, economic, and social connections between people.
Management of People and Environment, Clark	The use of hard materials in the environment, the removal of damaged elements in the urban landscape, official care and surveillance, and the engraving of an official code on the property to prevent the sale of stolen property.		

The three principles that can be perceived from the above table based on the two mentioned generations can be natural surveillance, access control, and territory. Natural surveillance is one of the main concepts in the field of CPTED which has been less

considered (Kunz and lav 2015, 15). From another point of view, and in line with this approach, the measures that criminals have in priority to fulfill their intentions are also given in Table 5.

**Table 5. The Cases the Criminals Take into Consideration while Committing a Crime**

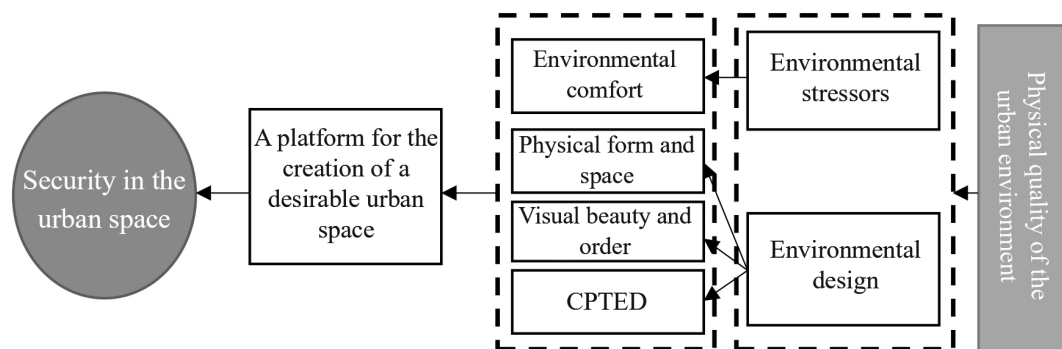
Key Factors	Theorists
The number of commercial spaces in the vicinity of people and vice versa - the type of access and transportation	Ramens, Hardins, and Powles, 2017
The way the streets are connected and the view of the neighborhood	Peters and Vander Beken, 2017
The comprehensibility of the urban body-sight-shelter, and access	Chang, 2011
The average value of the neighborhood and housing	Malczewski and Putch, 2005

Based on what was evaluated and expressed in the theoretical foundations' chapter that eventually led to the evaluation of environmental stress stimuli with the CPTED approach, the criteria and components

extracted to achieve research objectives are provided in Table 6. And finally, the theoretical model of the study is presented in Figure 1.

**Table 6. Effective Stress Stimuli in Crime Prevention**

Criterion	Component	Indicator	References used to Identify Indicators
Stress	Environmental	Noise Pollution	(Pourhasan et al. 2016; Azadeh et al. 2013; Jimenez et al. 2020; Capasso da Silva and da Silva 2020; Salimi et al. 2015; Faryabi et al. 2016; Shams Isfandabad 2017; Burkhart 2019; Mousavian Khorasani et al. 2019; Bukharaei 2007; Pakzad and Bozorg 2018; Lang 2017; Salehi 2007; Mahshid and Foruzandeh 2013; Sacher 2012; Chan and Liu 2018; DeSantis 2016; Ku 2011; Kenwell 2015; Azadeh et al. 2020)
		Air Pollution	
		Visual Disturbance	
		Density and Crowd	
		Urban Furniture	
CPTED	Physical	Territorialism	(Heshmati and Charehjoo 2019; Perry and Fennelly 2020; Capasso da Silva and da Silva 2020; Dorestan et al. 2020; Mohammad Nasl 2014; Li and Liu 2018; Rowling et al. 2017)
		Natural Care and Surveillance	
		Entrance Access Control	
		Image and Space Maintenance	
		Harden the Target of the Crime	
		Supportive Activities	

**Fig. 1. Conceptual Research Model**

#### 4. METHODOLOGY

The present study uses a statistical analysis-based descriptive-analytical method. The first chapter of this study is about the theoretical foundations and related literature, formulated by the use of library references and related articles. The second chapter is related to the case study and uses a quantitative strategy with a survey platform. "The social survey description" is among the landscape description strategies which is a type of objectivist and inductive strategy. And its main instruments are open and closed questionnaires and semi-structured interviews (Asadpour 2013, 23). Therefore, in the present study, a set of closed questions were formulated and distributed to evaluate the perceptual responses of citizens based on the theoretical foundations. The data obtained from this chapter were statistically analyzed by the SPSS. Finally, the results were presented with an

inferential and explorative approach. The divergent and convergent validity were used to approve the questionnaire's validity. The output variances should be above 0.5 for the convergent validity to be approved. For the divergent validity also, it is necessary for each of the reflective constructs that the root mean of the variances is greater than the correlation of that construct with other constructs. The statistical population included those in the Rajaei Shahr main street in Karaj (n=87000 people) and the samples were randomly selected from them. The Cronbach's alpha for evaluation of the reliability of the questions was obtained as 0.764. The questionnaire included 37 questions and the sample size was estimated 384 persons using Cochran's formula. The correlation between questions is also analyzed by the use of the Pearson Correlation Coefficient which is widely used in non-parametric statistical tests (Siegel 2004, 253). Regarding the significance level of the correlation

coefficient, if it is equal to 1, there is a completely positive correlation between the two variables, and if it is equal to -1, this correlation is completely negative.

#### 4.1. Introduction of the Case Study

Karaj is the capital of Alborz province and the fifth largest metropolis of Iran, with a Longitude of 50°59'29" E, a Latitude of 35° 49' 57.58" N, and an altitude of 1297 meters above sea level, located 48 kilometers northwest of Tehran. This city, with an area of 4.175 square kilometers and a boundary of 9.178 square kilometers is located on the slopes of the central Alborz mountain range (Tabarrok 2015, 145). Its population is about 1,378,416 according to the census (Management and Planning Organization of Alborz Province 2015). As the most populous city in Alborz province, this city has had the fastest

growth rate in the province and has even caused the creation of numerous population centers in its area, such as Kamalshahr, Mahdasht, Mohammadshahr, Meshkindasht and other settlements (Razzaghi and Ziari 2011, 81). Gohardasht or Rajaei Shahr is a neighborhood in the north of Karaj. One of the social and important attractions of the Rajaei Shahr district of Karaj is its main street (the case study), which due to being pedestrian-oriented (with a length of 1800 meters) and commercial use throughout, hosts different classes of people for recreation, shopping, and social interactions. This has caused the misbehaving and criminals to have the opportunity to commit crimes because the policy of urban development and urban planning has not been properly implemented in this street and most of the time, anomalies (theft, violence, and the like) occur in this street.



Fig. 2. Location of Alborz Province in Iran, Location of Rajaei Shahr in Karaj province  
(www.Karaj.ir)

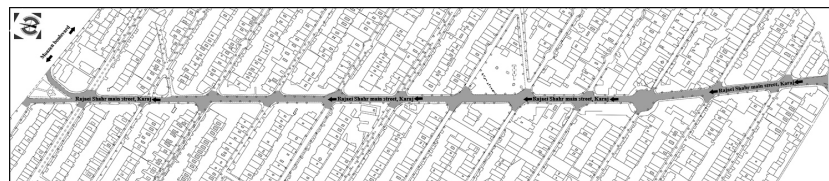


Fig. 3. Location of the Rajaei Shahr Main Street, Karaj  
(Detailed plan obtained from Karaj Municipality 2020)



Fig. 4. The Limits of the Main Street and Sidewalks in the Rajaei Shahr Main Street, Karaj

## 4.2. Findings

With the determination of the methodology, the findings are presented in the following two sections of descriptive and inferential findings.

### 4.2.1. Descriptive Findings

High diversity in environmental design and façade of the buildings can be seen based on the observations and photographing of the walls and commercial and residential buildings alongside the sidewalks. The street has a south-to-north slope and there is a cinema (at the start), a clinic, different types of commercial complexes, a park, a mosque, and finally, at the end of the street, there is the Islamic Azad University, Karaj Branch. This city is known as Little

Iran due to the migration of different ethnic groups. However, there are no traces of Iranian architecture and an environmental design specific to each territory and region that creates a sense of environmental belonging, which might be one of the effective factors in the occurrence of the crimes. The descriptive findings indicate that 48% of the respondents are female and 52% are male. Concerning the frequency of being present in the area, 62% of the respondents used the route every day, 10% used it twice a week, 23% used it every week, and 5% used it once a month. To assess the age status of the participants, they were categorized into three categories, among which 78% of the participants were 20-39 years old, 48% were 40-60 years old, and 4% were above 60 years old.

**Table 7. Descriptive Findings of the Study**

Variable		Frequency	Percentage
Gender	Female	182	48
	Male	201	52
	Total	384	100
Age	20-39	300	78
	40-60	69	18
	>60	15	4
	Total	384	100
The Frequency of Presence in the Case Study	Every day	238	62
	Twice a week	38	10
	Every week	88	23
	Once a month	20	5
	Total	384	100

### 4.2.2. Inferential Findings

With the description of the findings in the previous section and Table 7, in the following, the inferential findings of the study are discussed as follows. To do so, first, the correlation between the dependent variable of crime reduction and the independent variables (components) was explored, and after that, the questionnaire's reliability was measured by Cronbach's alpha, and finally, the semantic differential was used to evaluate the effects of environmental-psychological stress stimuli on crime reduction.

#### 4.2.2.1. Analysis of the Correlation between the Dependent Variable of Crime Reduction and Dependent Variables (Components)

Based on Table 8, which shows the correlation between the variables, the highest correlation

regarding environmental stress belongs to the density and crowd indicator among women (0.798). According to this table, the urban furniture indicator has not been significant among men (sig.= 0.067) and the null hypothesis is approved, however, it has been effective in crime reduction among women and the null hypothesis is rejected. Also, concerning the CPTED variable, the highest correlation belongs to territorialism among men (0.799). Based on the table, the supportive activities among men have not been significant (sig.= 0.092) and the null hypothesis is approved, however, it has been effective in crime reduction and the null hypothesis is rejected.

**Table 8. Correlation between the Variables**

Correlation between Variables in the Category of Environmental Stress			
Variable	Gender	Correlation Coefficient	Sig.
Noise Pollution	Female	0.412	0.000
	Male	0.769	0.040
Air Pollution	Female	0.308	0.012
	Male	0.589	0.000
Visual Disturbance	Female	0.768	0.000
	Male	0.384	0.000
Density and Crowd	Female	0.798	0.000
	Male	0.753	0.000
Urban Furniture	Female	0.509	0.000
	Male	0.672	0.067
Correlation between Variables in the Category of CPTED			
Variable	Gender	Correlation Coefficient	Sig.
Territorialism	Female	0.589	0.000
	Male	0.799	0.000
Natural Care and Surveillance	Female	0.598	0.000
	Male	0.523	0.032
Entrance access Control	Female	0.386	0.000
	Male	0.201	0.000
Image and Space Maintenance	Female	0.781	0.000
	Male	0.732	0.000
Hardening the Target of Crime	Female	0.108	0.000
	Male	0.157	0.000
Supportive Activities	Female	0.119	0.000
	Male	0.101	0.092

#### 4.2.2.2. Reliability of the Questionnaire

In the present study, Cronbach's alpha has been used for the measurement of the questionnaire's internal

consistency. The spectrums' reliability rates are presented in Table 9. Based on the mentioned table, since Cronbach's alpha is 0.764, the test enjoys acceptable reliability.

**Table 9. Reliability of the Questionnaire**

Reliability Statistics		Case Processing Summary		
Number of Questions	Cronbach's Alpha	%	N	
		100	384	Valid
		0	0	Excluded <sup>a</sup>
			384	Total
384	0.764	a. Listwise deletion based on all variables in the procedure.		

#### 4.2.2.3. Multivariate Data Analysis

Multivariate regression is a statistical procedure used for the analysis of the collective and individual

effects of two or several independent variables on the changes in the dependent variable. In the present study, the urban space design variable was the dependent variable, and environmental stress

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and design variables of CPTED and crime were independent variables.

In table 10, the means, standard deviation, and the number of data for each variable are shown.

**Table 10. Descriptive Statistics**

	Mean	Standard Deviation	Frequency
Crime Reduction	26.10175	6.82145	384
Stress	60.99575	12.041325	384
CPTED	50.86875	7.94195	384

Table 11 shows the priority of the variables used. The stepwise method is also used in this regression, and in the second step, the results have been followed. In the stepwise method, the most effective variable

is inputted into the model. The stress variable was inputted in the first step, and the CPTED was inputted in the second step in the predictor equation.

**Table 11. Model's Input Variables**

Model	Input Variable	Deleted Variables	Method
1	Stress	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	CPTED	-	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: crime reduction

In table 12, the value of the correlation coefficient between the dependent and independent variables has been shown. The value of the coefficient of multiple correlations is equal to 0.803. Therefore, the stress and the CPTED, and the crime and urban space design are strongly correlated. The value of the adjusted R squared has been reported to be 0.544, i.e.,

the independent variable (predictor) of stress alone determines 0.544 of the total variance of the dependent variable (criterion). Also, ultimately, 56.6% of the data is explained by the regression model, which of course is a high percentage. To evaluate the fitness of the regression model, a test named 'ANOVA' has been used whose results are presented in Table 13.

**Table 12. Correlation Coefficient between Dependent Variables**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.793 <sup>a</sup>	0.544	0.541	2.98263
2	0.803 <sup>b</sup>	0.566	0.560	2.95127

a. Predictors: (Constant), stress

b. Predictors: (Constant), CPTED

Table 13 shows the results of the regression model's fitness results. Regarding the significance level of this test in both models (sig=.000), the regression model's

fitness can be considered at the 5% level which means the null hypothesis is rejected.

**Table 13. ANOVA Regression Model**

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	569.845	1	569.845	235.834	0.000 <sup>b</sup>
1 Residual	501.239	118	4.459		
Total	1071.084	119			

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	588.804	2	344.402	83.523	0.000 <sup>c</sup>
2 Residual	482.280	117	4.324		
Total	1071.084	119			

a. Dependent Variable: stress  
b. Predictors: (Constant), stress, CPTED  
c. Predictors: (Constant), crime reduction

Table 14 shows the regression model estimate (Column B), the standardized value, the t-test value, and the significance level. Using the second model, it can be concluded that the final model includes the environmental stress and the CPTED, and regarding the significance level of these variables (sig.<0.05),

the null hypothesis is rejected at the 5% level, and both variables are inputted into the model. Therefore, the final model is as follows:

$$\text{Crime reduction} = -1.775 + \text{stress} (0.398) + \text{CPTED} (0.236)$$

**Table 14. Regression Model Estimation**

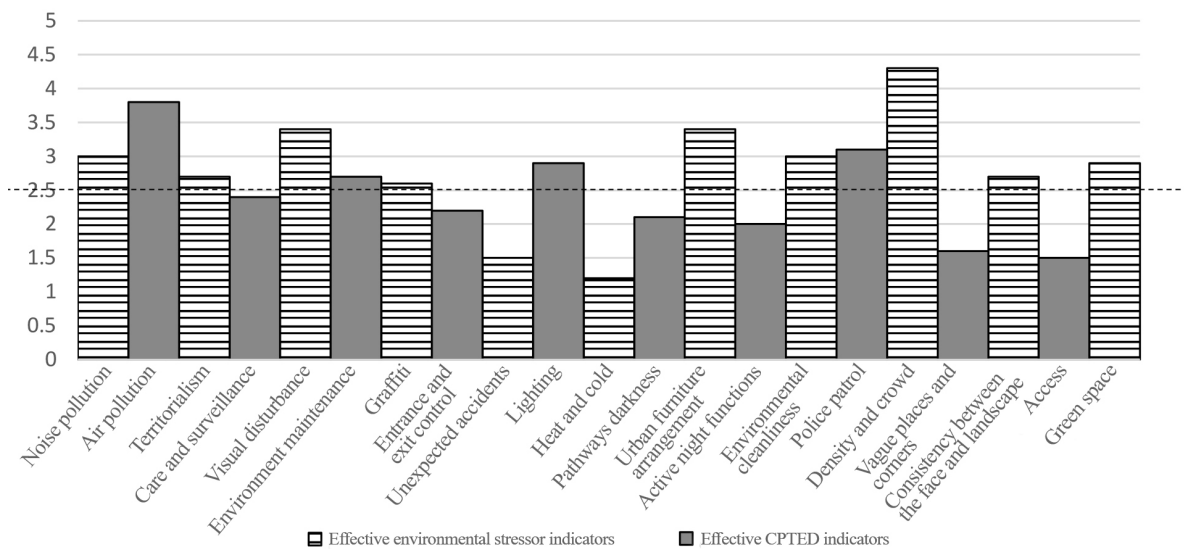
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error			
1	(Constant)	0.390	0.988		0.426	0.845
	Stress	0.516	0.46	0.834	12.655	0.000
	(Constant)	-1.775	1.297		-1.499	0.265
2	Stress	0.398	0.48	0.688	10.368	0.000
	CPTED	0.236	0.65	0.26	2.459	0.3

a. Dependent Variable: crime reduction

#### 4.2.3. Separation of Semantic Differential and the T-test

The semantic differential technique was used to evaluate the effects of environmental-psychological stress stimuli in crime reduction, and finally, it was measured by the T-test. The qualitative items of the

questionnaire were measured on a 5-item Likert scale. Therefore, the mean values of numbers lower or higher than the median of 2.5 were analyzed based on the positivity or negativity of each item. Measurement of the effects of each CPTED factor and environmental-psychological stress stimuli on crime prevention based on the t-test is presented in Figure 5.



**Fig. 5. Effects of Environmental Stressors and CPTED**

#### 4.2.3.1. Evaluation of the Effects of Indicators related to the Independent Variables to Achieve Crime Prevention

Based on Figure 5, the findings show that the average crime reduction in physical factors in the CPTED and also, the average crime reduction in the influential factors of environmental stress above the median 2.5, indicate an unfavorable situation of those factors that should be especially considered in urban planning and design.

#### 4.3. Discussion and Conclusion

In the present study, the correlation between the urban space design and the CPTED approach with an emphasis on the role of perceived stress in the citizens and its effects on the increase in crime was evaluated. The results of statistical analyses indicated that there are significant correlations between the independent and dependent variables. According to the findings, it was proven that stress and the CPTED are significantly correlated with the independent variable (urban space design). Also, based on the regression analysis, noise pollution, air pollution, visual disturbance, graffiti, urban furniture arrangement, environmental cleanliness, crowd and density, geometry, image and landscape, and green space are the most effective variables in the potential commitment of crime in the category of environmental stress, and the territorialism, environmental maintenance, lighting, and patrolling are the most effective variables in the potential commitment of crime in the CPTED. The present study explored the issue of crime in the urban design field in the Rajaei Shahr district of Karaj, and it was revealed that urban planning does not merely include the physical dimension since it should be evaluated based on all dimensions involved. One of the most important dimensions in this regard is environmental stress. In fact, the matter of crime occurrence should be studied in a multi-disciplinary field and its results should be reflected in urban design and planning. In other words, the built environment, besides many personal, social, economic, cultural, religious, and environmental issues, is the main source of environmental source. Therefore, the correlation between urban planners and psychologists should be reinforced so that solutions and policies are adopted to be able to improve the citizens' mental health's threatening factors such as stress through urban planning and design, and by doing so, design a

peaceful environment based on the dominant cultural and territorial situations in the region. Put simply, the environment designed based on the mentioned propositions would increase the belongingness, environmental belongingness, and expansion of the stimulating behavioral setting of citizens in the support and development of healthy social relations, and in such an environment, environmental stress would be minimized, as in the old and traditional textures, despite all existing problems, the severity and effects of this problem are less seen, and background stress is lower among them than people living in Karaj City. Comparing the findings of the present study with conducted studies in the field of CPTED, these findings are in line with the findings of Heshmati and Charehjoo (2019) among the domestic studies, and Perry and Fennelly (2020) and Da Silva & Da Silva (2020) among the international studies. They found that an appropriate design based on the CPTED allows for the reduction of crime, increase in security, and ultimately, improvement of quality of life. Also, regarding environmental stress, the findings of the present study are in line with the findings of Pourhasan et al. (2016) and Azadeh et al. (2020) in domestic studies, and Jimenez et al. (2020) and Da Silva & Da Silva (2020) in international studies. They found that the stimulated cognitive factors through the environment create stimuli in the audience and paying attention to these stimuli in the urban design has been fruitful and will reduce crime. Since the results of this study in the field of crime prevention have been based on first and second generation thoughts, in the first generation, the individual and environmental psychology has been less addressed or has not been addressed at all, and in the second generation, the scholars of this field have concisely discussed it due to being new. Therefore, regarding the emphasis on the role of stress in the occurrence of abnormal behavior and crime in the present study, the matter of crime prevention has been covered in a relatively broader range. Thus, the findings of environmental stress in the present study have clearly ended in further and different exploration compared to the findings of the aforementioned studies, since the environmental and individual psychology has been less reflected in the environmental design and urban space due to being multi-disciplinary, which is somehow the innovation of the present study. Therefore, to promote a secure environment regarding crime reduction, some suggestions are provided in Table 15.

**Table 15. Suggestions to Reduce the Crimes based on the Research Dimensions**

Environmental Stress Dimension	CPTED Dimension
Special attention and emphasis on the reduction of stressful factors in the dimension of urban design and elements. For example, not using vague and disturbing lines in the urban landscape, and plan and area design.	Creating places to sit and rest for people and promoting their continuous use creates a positive feeling of a safe area perceived by people and reduces the escape route for criminals.
Reducing the prevailing climatic factors by using appropriate landscape design in hot and cold seasons. For example, in the north of Iran, despite the general definition, rainfall is considered a stressful factor due to disruption in work and the environment. The use of covered corridors, suitable forefronts, and prevention of the passageways from being flooded.	Congestion control in closed and open public places through the type of physical design.
Using appropriate landscape design to moderate air and noise pollution, and preserving the skyline based on the city's identity and the architecture of the region in the plan and view.	Preserving the territory and creating personal and environmental solitude according to the space required by the work through physical design.
Training, promoting, and persuading the youth to the sociological and cultural traditions and values of each region to prevent them from turning to drugs and alcohol.	Mechanically controlling the access routes and creating a mental loading in that the environment is controlled by physical design factors (visibility) in the urban space.
Identifying and reflecting the influential environmental factors in every climate and environment in the country and transferring it in the form of symbols and lines in the urban design within the scope of the case study due to the multiplicity of ethnicities, which causes the creation of environmental belongingness in the individual.	Providing enough light in the corners, pathways, underpasses, and space outside the overpasses according to the urban physical design.
The use of light and color, and adaptation of the urban landscape and materials suitable for the environment in order to prevent visual disturbance and create a lively city at all hours of the day and night.	Implementing surveillance and maintenance of urban elements and furniture to maintain a beautiful appearance, and emphasizing that the used space is always under surveillance and maintenance.

## ENDNOTE

1. American sociologist

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