ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

THE EFFECTS OF PASSIVE AND ACTIVE STREET INTERFACES ON USERS' PERCEIVED SAFETY

M.Sc. THESIS

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THE EFFECTS OF PASSIVE AND ACTIVE STREET INTERFACES ON USERS' PERCEIVED SAFETY

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Lujain-zaibak, a M.Sc./a Ph.D. student of İTU Graduate School student ID 519191029, successfully defended the thesis/dissertation entitled "THE EFFECTS OF PASSIVE AND ACTIVE STREET INTERFACES ON USERS' PERCEIVED SAFETY", which he/she prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

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To my parents,

FOREWORD

Having the opportunity to make a positive impact on the world in a tangible and meaningful way has always been my passion as an urban designer and an architect. Since I lived in different environments and cities throughout my life, I came to acknowledge the importance of urban design and its effect on our feeling of safety and security in space.

Obtaining this knowledge and attempting to add useful outcomes to the body of research on perceived safety is certainly an achievement I'm proud of.

Completing this study was an intriguing journey for me. A journey that wouldn't be possible to complete without the guidance of my thesis advisor Assoc. Prof. Dr. Dilek YILDIZ ÖZKAN, who I would like to express my sincere gratitude for her invaluable guidance and feedback.

Having the opportunity to pursue my passion wouldn't be possible without the unconditional support of my family. Especially, my Mom and Dad for whom I will always be grateful.

Finally, this journey could not be completed without the motivational words and support from the people closest to my heart, Yasmin and Tala. Thank you for always believing in me.

May 2023

Lujain ZAIBAK
(Architect)

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SUMMARY

Perceived safety at the street interface is directly related to a set of factors that define the activeness and passiveness levels. However, there is ambiguity concerning the amount of the desired activeness and passiveness at the street interface for it to be perceived as safe by its users.

Therefore, this study aims to fill this gap, by first classifying the street interface into different types of active and passive relying on the factors that affect perceived safety, then testing the effect of these classified types on users' perceived safety. The Individual factors that affect perceived safety were kept constant throughout the study to avoid complexity. The diagnostic observation was performed to classify the street interfaces into different types and choose the appropriate case study areas from the city of Istanbul. These chosen interfaces were then used to test each type's effect on the users' perceived safety.

This study employed a quantitative research method using a questionnaire containing photographs of the selected interfaces, to test each type's effect on the users' perceived safety. The analysis of variance (ANOVA) test and Tukey's HSD test in SPSS were then applied to the data to understand whether the perceived safety created by each type is significantly different from the other.

The results show that a certain level of activeness defined by certain factors is desired to create a safe street interface. Too much activeness or passiveness at the street interface was perceived unsafe by the users. This study also revealed which of the factors that were used to classify the street interface into passive and active types had the most influence on perceived safety in each of the case study areas.

These results can be applied to streets to determine which part of the street interfaces are considered safe in relation to their activeness and passiveness levels. Consequently, this approach aims to aid urban designers in creating street interfaces that are perceived as safe by their users.

PASİF VE AKTİF SOKAK ARAYÜZLERİNİN KULLANICILARIN GÜVENLİK HİSSİ ÜZERİNDEKİ ETKİLERİ

ÖZET

Modern planlama, şehirlerimizde kentsel mekanların ayrışmasına neden oldu. Ayrışan ve sürekliliğini kaybeden kent mekanlarının ölümü yanında, iç mekan ve dış mekan arasındaki geçiş bölgeleri olan sokak ara yüzleri terkedilmiş ve insanların kullanması için güvensiz alanlar haline gelmeye başladı. Oysa sokak ara yüzü, sokak canlılığını ve güvenliğini artırmayı sağlayan ana odak noktasıdır. Zira, insanların kamusal alandaki refahı ve mekansal deneyiminin zenginliği ile sağlıklı ve güvenli bir kentsel çevrenin oluşumubüyük ölçüde şehirdeki bu geçiş bölgeleri veya sokak ara yüzleri tarafından kontrol edilmektedir.

Kentsel mekanların tasarımı ve bu tasarımın algılanan güvenlik üzerindeki etkileri önceki araştırmalarda sıklıkla tartışılmış konulardan biri olmuştur. Sokak ara yüzündeki algılanan güvenlik, bu arayüzün aktif ve pasif olma seviyesini belirleyen bir dizi faktörle doğrudan ilişkilidir. Ancak sokak ara yüzünde algılanan güvenliği sağlayan aktiflik ve pasiflik düzeyi konusunda bir belirsizlik söz konusudur. Bu nedenle, bu çalışma, sokak ara yüzünü algılanan güvenliği etkileyen faktörlere göre farklı aktif ve pasif tiplere ayırmayı ve bu sınıflandırma ile farklı tiplerin kullanıcılarda oluşturduğu algılanan güvenlik üzerindeki etkisini test etmeyi amaçlamaktadır. Algılanan güvenliği etkileyen bireysel faktörler ise çalışmada sabit tutulmuştur.

Bu çalışma beş bölümden oluşmaktadır. Giriş bölümünde, araştırmanın temel motivasyonu, amaçları ve önemi tanıtılmaktadır. İkinci bölüm olan literatür özetinde, araştırmanınteorik arka planı okuyucuya tanıtılmaktadır. Sokaktaki gözler, savunulabilir mekan, kırık pencereler, rutin aktivite ve açık mekan/gizli mekan kuramları gibi alandaki ana kuramlar ve ilgili araştırma bulguları bu teorik arka planda açıklanmaktadır. Ayrıca, sokak ara yüzünün tipolojik sınıflandırılması konusunda da ilgili araştırma bulguları sunulmaktadır. Yöntem bölümü, araştırmada kullanılan veri toplama ve analiz tekniklerini, çalışmanın kısıtlarını ve İstanbul'da seçilen vaka çalışması alanlarının tanıtımını içerir. Üçüncü bölümde, çalışmada elde edilen bulgular analiz ederek sonuçlarını tartışılmaktadır. Son bölümde ise, çalışmanın araştırma soruları yanıtlanmakta ve çalışmanın genel bir sonucu ortaya konmaktadır.

Giriş bölümünde, araştırma sorusunun arka planı, araştırma amaçları ve çalışmanın kapsamı sunulmuştur. Çalışmanın iki ana araştırma sorusu bulunmaktadır. İlk soru, aktif ve pasif sokak ara yüzlerinin kullanıcıların algılanan güvenliği üzerindeki etkisini anlamayı amaçlamaktadır. İkinci soru, sokak ara yüzünde kullanıcıların algılanan güvenliği üzerinde en çok hangi faktörlerin etkili olduğunu anlamayı amaçlamaktadır.

Literatür özetinde, algılanan güvenlik konusundaki beş ana kuram ve ilgili araştırma bulguları tartışılmıştır. Bu kuramlar, sokaktaki gözler, savunulabilir mekan, kırık pencereler, rutin aktiviteler ve açık mekan/gizli mekan kuramlarıdır. Daha sonra, algılanan güvenlik ile ilgili kavramlar ve faktörler, fiziksel faktörler, sosyo-kültürel faktörler ve bireysel faktörler olarak üç gruba ayrılmış ve özetlenmiştir. Son olarak, sokak ara yüzlerini tipolojik olarak inceleyen ve sınıflandıran önceki araştırmalar sunulmuş;ve son olarak pasif ve aktif sokak ara yüzleri tartışılmıştır.

Yöntem bölümünde, algılanan güvenliği etkileyen faktörler sokak ara yüzünü farklı aktif ve pasif tiplere ayırmak için kullanılmıştır. Çalışma kapsamında bazı sosyo-kültürel faktörler, araştırma yönteminin belirli kısıtları nedeniyle ölçülememiştir. Çalışma, sokak ara yüzlerinin gerçek görüntülerini kullanan bir anket kullanarak yapıldığından, sosyal uyumsuzluk, topluluk uyumu, medya etkisi ve suç oranları gibi faktörler ölçülememiştir.

Toplamda, 10 sosyo-kültürel ve fiziksel faktör, sokak ara yüzünü farklı aktif ve pasif tiplere ayırmak için belirlenmiştir. Kullanıcı yoğunluğu, şeffaflık, açıklıklar ve aktivite çeşitliliği olmak üzere dört ana faktör belirlenmiştir. Bunların yanı sıra, araç bağımlılığı, geri çekilmeler, bina yüksekliği, fiziksel görünüm, yeşillikler ve aydınlatma elemanları olmak üzere altı adet ikincil faktör belirlenmiştir. Bu faktörler, sokak ara yüzünü çok aktif, aktif, orta/nötr, pasif ve çok pasif olmak üzere beş farklı aktif ve pasif tiplere ayırmak için kullanılmıştır.

Vaka çalışması alanları teşhis edici ön gözlemlerle belirlenmiş ve İstanbul'dabeş sokak ara yüzü seçilmiştir. Her vaka çalışması alanından yaklaşık 30-40 metrelik bir sokak boyu seçilmiştir. Beş ana tip için seçilen sokaklar şunlardır: çok aktif tip için İstiklal Caddesi/Beyoğlu ara yüzü, aktif tip olarak Bağdat Caddesi/Kadıköy ara yüzü, orta/nötr tip olarak Çırağan Caddesi/Beşiktaş ara yüzü, pasif tip olarak Mürsel Paşa Caddesi/Fatih ara yüzü ve çok pasif tip olarak Büyükdere Caddesi/Şişli ara yüzü.

Bu çalışmada, farklı aktif ve pasif arayüz tiplerinin kullanıcıların algılanan güvenliği üzerindeki etkisini test etmek için seçilen sokakların fotoğraflarını içerenbir anket kullanılarak nicel bir araştırma yöntemi uygulanmıştır. . Anket, her bir vaka çalışması alanındaki belirtilen konumlardan gece ve gündüze ait gerçek hayattan görüntüleri içermektedir. Beş vaka çalışması alanının her biri için iki adet soru sorulmuştur. İlk soruda, kullanıcıların belirtilen sokak arayüzünde kendisini güvende hissedip hissetmediği 1 ila 5 arasındaki Likert ölçeğinde sorulmaktadır. İkinci soru, her bir vaka çalışması alanında etkili olan birincil ve ikincil faktörlerin algılanan güvenlik üzerindeki etkisiniyine 1 ila 5 arasındaki Likert ölçeğinde ölçmeyi amaçlamaktadır. Anketin ikinci kısmında, algılanan güvenliği etkileyen yaş, cinsiyet ve doğrudan veya dolaylı mağduriyet deneyimini içeren bireysel faktörler bulunmaktadır. Son olarak, çalışmada ankete katılanların büyük çoğunluğu üniversite öğrencisi olduğundan, katılımcıların sosyo-ekonomik ve eğitim düzeyleri sabit tutulmuştur.

Her bir tipte oluşan algılanan güvenliğin diğer tiplerden önemli ölçüde farklı olup olmadığını anlamak için elde edilen verilere ve SPSS'teki varyans analizi (ANOVA) testi uygulanmıştır. SPSS'teki Tukey HSD testi ise, sokak ara yüzünde literatür özetinden gelen farklı faktörlerin algılanan güvenlik üzerinde etkisini karşılaştırmak için kullanılmıştır.

Çalışmanın üçüncü bölümündeanalizler sonucunda elde edilen bulgular tartışılmaktadır. Sonuçlar, aktif ve orta/nötr sokak ara yüzlerinin algılanan güvenlik açısından en başarılı sokak ara yüzü tipleri olduğunu ortaya koymuştur. Sokak ara yüzünde çok fazla aktiflik veya pasiflik istenmemekte ve bu sokak arayüzleri kullanıcılar tarafından güvensiz olarak algılanmaktadır. Ayrıca, algılanan güvenliği etkileyen faktörlerin, sokak ara yüzünü farklı tiplere ayırmak için kullanılan faktörler olduğu ve her bir sokak ara yüzü tipinde, belirli faktörlerin diğer faktörlere göre algılanan güvenlik üzerinde daha fazla etkisi olduğu ortaya çıkmıştır. Dolayısıyla, çalışma tüm bu faktörlerin kombinasyonunu dikkate alarak tasarlanmış sokak ara yüzlerinin, algılanan güvenlik açısından en başarılı sokak ara yüzü tipi olduğunu göstermektedir.

Son olarak, bu çalışma, sokak ara yüzündeki algılanan güvenliği etkileyen faktörlerin analiz edilmesi ve sınıflandırılması için kavramsal ve tipolojik bir çerçeve sunmaktadır. Bu sınıflandırma, sokak ara yüzündeki pasiflik ve aktiflik düzeylerine göre algılanan güvenlik seviyelerinin belirlenmesinde kullanılabilir. Sokak ara yüzünün pasiflik ve aktiflik düzeyleri gözlem kullanılarak belirlendiğinden, bu kavramsal ve tipolojik çerçeve, diğer araştırmacılar tarafından kullanıcıların algılanan güvenliğini çeşitli sokaklarda analiz etmek için uygulanabilir.Ayrıca, bu çalışmanın sonuçları, kullanıcıların güvenliğini sağlamak için daha güvenli sokak ara yüzleri oluşturmak isteyen şehir plancılarına ve yine bu amaçla yasal düzenlemeler ve kentsel tasarım kılavuzları oluştururan yerel yönetimlere de faydalı olabilir.

1. INTRODUCTION

1.1 Problem Statement and the Aim of the Study

Modern planning has shaped our cities in a way urban spaces were set aside. Alongside the death of urban spaces, the street interfaces, which are the transition zones between indoor and outdoor, became deserted and perceived as unsafe spaces for people to use (Newman, 1972). The street interface is a key focus in increasing street vitality and safety (Alkhadim et al., 2018). Thus, a vital, safe, and healthy urban environment that can encourage the wellbeing of people, while giving them the best experience, is majorly controlled by these transition zones or street interfaces in the city.

In previous research, various topics were discussed concerning the physical design of urban spaces and their effect on perceived safety. For example, it is well known that the spaces that encourage the presence of people, creating natural surveillance and eyes on the street are perceived as safe (Angel, 1968; Bell, 1992; Bell Planning Associates and Gaston, 1995; Clarke and Mayhew, 1983; Crowe, 2000; Geason and Wilson, 1989; Jacobs, 1961; Jeffery, 1971; Newman, 1972). Also, the presence of a mixed land-use environment, that has a diversity of functions and encourage people to participate in various activities, increasing the space's livability, has a positive influence on perceived safety (Branas et al., 2018; Bell, 1992; Bell Planning Associates and Gaston, 1995; Cohen and Felson, 1979; Jacobs, 1961; Jiang et. al., 2018; White and Sutton, 1995). Furthermore, the physical appearance of the urban environment has a tremendous effect on perceived safety in public spaces. Physical incivilities and physical disorders in the urban environment have proven to promote fear among people. (Austin et al., 2002; Brown et al., 2004; Doeksen, 1997; Lewis and Maxfield, 1980; Wood et al., 2008; Skogan & Maxfield, 1981; James Q. Wilson &George Killing, 1982; Keizer et al, 2008; O'Brien and Sampson, 2015; Mirrlees-Black and Allen, 1998; Ross and Mirowsky, 1999; Tulloch, 2000).

The urban theories of perceived safety encourage certain factors such as the density of users, diversity of activities, building height, transparency, openings, etc. to help make

the street interface active, and consequently perceived as safer by its users. However, the passive street interfaces are also important for the city as they have a meaning and a message (Whyte, 1988). These interfaces are more flexible and express a sense of place, as well as social and cultural meaning for their users (Moreau, 2020). Some even argued that the density of users which is presumed to make the street interface active has a negative effect on perceived safety. Especially when the density level crosses a certain threshold (Tchinda and Kim, 2020).

Further research is needed to investigate how the various factors influencing the activeness and passiveness of street interfaces affect users' perceived safety. To address this knowledge gap, the present study offers a better understanding of the desired activeness and passiveness level at the street interface for it to be perceived as safe by its users.

1.2 Research Question and Methodology

The study's main research questions were:

- What is the effect of active and passive street interfaces on users' perceived safety?
- Which factors of the street interface had the most influence on the users' perceived safety?

To research the effect of passive and active street interfaces on perceived safety, the street interface was classified into different types of active and passive according to the factors that influence perceived safety. These factors were determined from a systematic review of the previous literature. A diagnostic observation was then conducted to choose the best case study areas that comply with the classified types. Then, the effect of these classified types on the user's perceived safety was tested using a questionnaire. The questionnaire used real imagery of the case study areas both day and night. For data treatment, the ANOVA test and Tukey's HSD test in SPSS were used to measure the significance level between mean values.

1.3 Significance and Contribution of the Study

The results of the study can be used to understand which type of street interfaces are perceived as safe by users according to their passiveness and activeness levels. In

addition, it revealed which of the factors that were used to classify the street interface into passive and active types significantly affect perceived safety. The study outcomes intend to aid urban designers in creating safer street interfaces for users. It can also benefit local government while establishing legislation and urban design guides.

1.4 Scope and Structure of the Study

This study includes five chapters. The first chapter, which is the introduction part, introduces the reader to the subject, the research aims, and the study's significance. The second chapter, which is the literature review, aims to familiarize the reader with the exciting theoretical background of the research topic. It includes the major theories and related research findings on the issue of perceived safety as well as the factors that affect perceived safety. It also includes the related research findings on the street interface's typological classifications. The third chapter, which is the methodology part, includes the data collection and analysis techniques that were used in the study, along with the limitations of the study. The fourth part discusses the results of the study and answers the research questions. The fifth part concludes the study by summarizing the key findings of the research, in relation to the study aims and research questions. It also reviews the study's contribution to the field of perceived safety and proposes opportunities for future research (Figure 1.1).

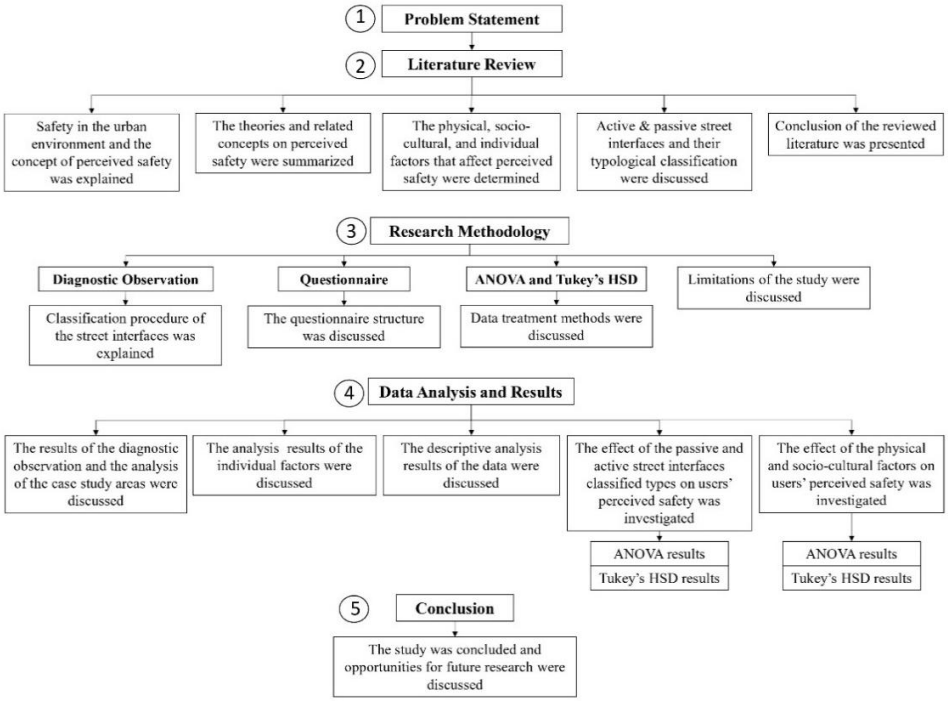


Figure 1.1 : A flow chart presenting the thesis's structure.

2. LITERATURE REVIEW

In the first part of the literature review chapter, urban safety will be explained and highlighted as a major key element in the urban environment. The difference and connection between real and perceived safety will be explained. Then, the developed theories and concepts on perceived safety, followed by the physical, sociocultural, and individual factors that affect perceived safety will be investigated, to understand the urban design's role in creating safe cities for people.

In the second part of the literature review chapter, the significance of street interfaces as a crucial element in urban and architectural design will be discussed. Then, the classification of these interfaces into various typologies will be examined, to understand their morphology that influences many urban design features, including perceived safety. Finally, the passive and active street interfaces will be defined and compared.

2.1 Safety in the Urban Environment

Safety in the urban environment has always been one of the crucial issues that urban designers, planners, and urban governance consider while designing urban spaces. The urge for survival is rooted in the so-called Maslow's Hierarchy of Needs theory. It's a motivational theory in psychology that postulates that humans are motivated by unfulfilled needs in a hierarchical order. In other words, certain lower needs must be satisfied before the person can address higher needs. At the bottom tier of the pyramid are the basic physiological needs: food, water, rest, and warmth, as well as safety, and security (Maslow, 1943) (Figure 2.1). Therefore, safety is an essential need of human beings. It is often regarded as a key component of a sustainable community. Without safety perceptions, individuals can easily lose their confidence in their communities, and this causes them to have detrimental effects on their well-being (Allik & Kearns, 2017).

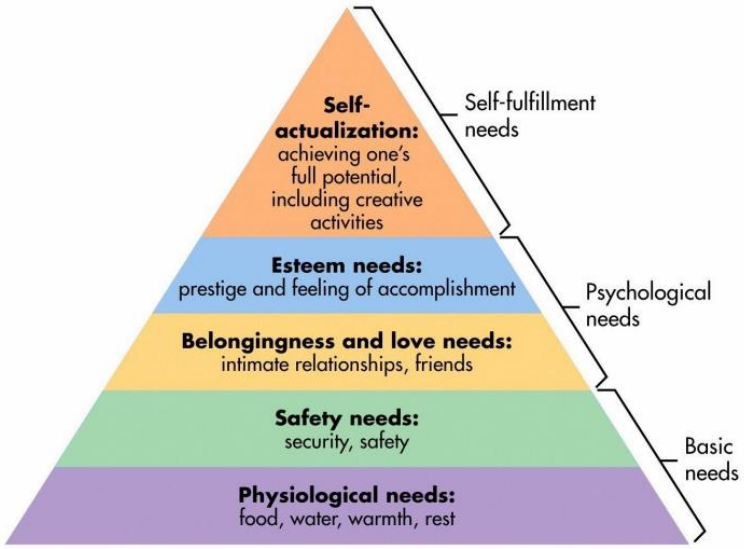


Figure 2.1 : Diagram presenting Maslow's hierarchy of needs (Maslow, 1943).

In ancient times, people were compelled to leave their homes and seek other secure places, due to the increasing number of dangerous and unpredictable situations around them. Meanwhile, in our modern communities, safety in public spaces has become a great issue for many scholars. In 1961, Jane Jacobs criticized the modern lifestyle of Western society. Many of the public areas became privatized and turned into small enclaves. The urban sprawling and the automobile invasion have shaped our cities in a way that they were not conducive to the well-being of the people who lived in them (Jacobs, 1961). The scale of cities has become very inhuman as Gehl (2010) criticized. High-rise buildings and highways created lost spaces as Trancik (1986) mentioned in his book Finding Lost Spaces. All these modern development issues have contributed to the death of public spaces.

Since the public spaces that used to make the city alive and safe have turned into lost and deserted spaces, urban safety has become a concerning issue for designers, policymakers, and scholars around the world. Urban governance aimed to solve the problem of increasing crime and the lack of safety perception among the public by creating semi-private public spaces and gated communities, which didn't solve the problem of safety, but rather manifested a bigger problem by creating physical and social segregation in the city. Adding up to the phenomenon of dying open public spaces in the city, which contributed to the increasing issue of crime and the lack of urban safety.

2.1.1 Perceived Safety

Perceived safety refers to an individual's subjective perception of the level of safety or security in the urban environment. It is defined as the perception of risk and the individual's level of comfort and security within the urban environment. Thus, perceived safety is mainly connected to the concept of fear of crime (Jiang et al., 2018). It is based on personal experiences and influenced by many physical and socio-cultural factors in the urban environment. However, it may not necessarily reflect the actual level of safety in the environment. Although real safety or crime is a defining factor in the quality of urban spaces, the issue of perceived safety is seen as more important, because it influences people's psychology and perception of the space. The declined levels of perceived safety directly influence the quality of the urban space as well. Lack of perceived safety has negative effects on an individual's social behavior as they tend to avoid public gatherings and urban spaces, which decreases the quality of these spaces. In addition, the poor levels of perceived safety cause people to have poor mental and physical health (White and Sutton, 1995). For this reason, urban designers adopted many strategies and theories to design a safe urban environment, where people can feel confident to use the space, increasing its quality and liveliness of it. Overall, the perception of safety in an urban environment is complex and can vary widely between individuals and groups. City planners, urban governance, and other stakeholders need to understand the factors that influence perceived safety, to create livable environments that make people feel safe and secure.

2.1.2 Real safety vs. perceived safety

Real and perceived safety has been the subject of urban safety studies in many fields. Two types of concepts are commonly used in the field of urban safety. These are: being unsafe and feeling unsafe. Being unsafe is an objective concept that refers to the fact that there are crimes in a certain area that makes it an unsafe space. Thus, there are no individual perceptions taken into consideration while studying real safety. Feeling unsafe on the other hand is a subjective matter that relates to the individual feeling of unsafety. For instance, an area can be perfectly safe, but due to certain physical, or individual factors, people might perceive it as unsafe.

The concepts of crime and fear of crime are similar to the concepts of real and perceived safety. Studies on perceived safety aim to collect information that seeks to

understand people's perceived fear of crime and risk of victimization (Shepherdson, 2014). Studies have shown that people's fear of crime and low perceptions of safety is a widespread common issue that is separate from the actual crime itself (Gray et al., 2008). To further explain, crime is a tangible event, whereas people's perceived risk of victimization is related to their anxiety about becoming the target of a crime in public areas. Although the actual risk of becoming a crime victim is less than people think, it can still lead to anxiety and avoidance of public spaces (Kelly, 1986). Thus, people's emotions and perceive safety has a bigger impact on their behavior than the actual crime rates or real safety (Mason et al., 2013). Even though there's a clear distinction between real crime and the perceived perception of risk, that doesn't mean they don't influence each other tremendously. Doran and Burgess (2012) noted that the relationship between them resembles a vicious circle. This is because when people feel unsafe, they tend to abandon the urban space, which contributes to lowering its quality and increasing crime rates. Other researchers also concluded that crime rates do play a role in the perception of unsafe locations, but certainly not the most important one (Vrji & Winkel, 1991). Finally, a safe urban environment can only be fully realized when the real, as well as the perceived safety of people, is taken into account (Alkhadim et al., 2018).

Understanding the subjective behavior of people and the effect of the various individual, sociocultural, and physical objective factors on this behavior can improve safety in the urban environment. The failure in understanding these subjective behaviors and objective factors leads to a lack of perceived safety feeling, which limits a person's ability to carry out their daily activities in a safe manner. This is because people tend to avoid spaces that are perceived unsafe by them, which can lead to a reduced quality of life in urban spaces (Fisher and Nasar, 1992; Warr and Ellison, 2000). This issue also affects the sustainability of a city by reducing the number of people walking in the streets and increasing automobile domination (Warr and Ellison, 2000).

In conclusion, it is necessary to note that crime, real safety, and perceived safety are deeply connected as they influence each other. For example, an urban space that is surrounded by highways and can be classified as a poorly designed public space will eventually turn into a deserted space, which leads to the user's low perception of the safety of this space. This feeling of unsafety influences urban governance to create

gated communities and encourage further creation of these low-quality blank urban spaces, which will increase real crime and negatively impact perceived safety in the city.

2.2 Theories and Concepts on Perceived Safety

Perceived safety has always been an issue of interest for many scholars. Numerous theories and strategies concerning crime and perceived safety were developed to become key theories, that are now crucial to review and study by urban designers to improve safety in urban spaces.

Scholars Such as Jane Jacobs, Oscar Newman, and Elizabeth Wood gave birth to a concept that relates the physical design of the urban environment with crime and fear of crime prevention. This concept of Crime Prevention Through Environmental Design (CPTED) was then developed by Ray Jeffery (1971). It is defined as the proper design and effective use of the built environment that can lead to a reduction in the fear of crime and incidents of crime (Crowe, 2000). This concept is mainly based on theories developed by important researchers over time.

Many researchers implemented these theories to test their effectiveness in crime prevention and increasing perceived safety in public spaces. They suggested that certain physical interventions in urban design can improve the safety of public places, whether it's perceived or real (Branas et al., 2018). The improvement of design fixtures such as lighting quality, mixing of land use, implementing landscape design, and architectural design seems to improve perceived and real safety (Crowe, 2000). However, some studies have shown the opposite. Their results have shown that the implementation of CPTED strategies seems to be effective in reducing crime occurrence only, and not perceived safety (Minnery and Lim, 2005).

In conclusion, whether CPTED is effective in increasing perceived safety has been researched in existing studies. It is comprised of important theories of perceived safety, which are proven to help improve both real and perceived safety. These important theories that relate urban design with perceived safety and crime occurrence, can be summarized into five main theories: eyes on the street theory, defensible space theory, broken windows theory, routine activity theory, and prospect and refuge theory.

2.2.1 Eyes on the street theory

By examining, and observing various American cities including her neighborhood, Jacobs (1961) brutally criticized the modern development of cities in 1961. Although she was criticized at the beginning, many of her studies became revolutionary, especially, in the area of urban safety and crime. She mainly focused on what makes the city livable and active. Her concept of *"eyes on the street"* has become one of the main theories that explain the relationship between the urban environment, urban safety, and crime.

Feeling safe and secure is one of the important qualities of a thriving well designed urban space. Although it was believed that the presence of police and surveillance is the best way to make a place safe, Jacobs suggested another type of surveillance which is natural surveillance. The concept of eyes on the street or natural surveillance suggests that the more people on the streets, the safer they become. Their eyes on the street provide natural surveillance of the urban environment. In other words, the presence of people creates a vibrant and safe urban space for other people to move safely in that space (Figure 2.2).

To further explain the importance of this concept, Jacobs (1961) gives an example of a well-lit subway station that is considered a dangerous space, because it's often deserted and lacks the presence of natural surveillance. Whereas a dark theatre is considered safer, even though it is dark, because of the presence of people and natural surveillance. Hence, lighting which is considered a very effective factor in increasing perceived safety is not effective without the presence of eyes on the street.

Jacobs (1961) proposes four key design elements to improve the safety of urban spaces. She suggests that: density, mixed-use buildings, diversity of users & buildings, and short blocks, are the four key design elements that support the concept of eyes on the street and improve the safety of urban spaces.

Starting with density, Jacobs (1961) argues that dense urban areas are safer than less dense ones. This is because having people on the street promotes the feeling of safety as these strangers are believed to be ready to aid and assist in case of danger. She describes the mix of people on the street as a dance, where everyone contributes to the safety of the street by making it a livable place. On the contrary, quiet and deserted

spaces generate a feeling of discomfort and danger where criminal activity is likely to occur in such abandoned spaces.

Mixed-use buildings attract a larger variety of users and allow for a diversity of users at different times of the day (daylight, nighttime), and different seasons (summer or winter). This activates the public areas and the street edges surrounding them. Thus, it helps to improve the eyes on the street concept which increases urban safety and livability. For example, a residential neighborhood is perceived as safer when there's a variety of uses in the neighborhood such as schools, markets, shops, cafes, etc. But when it's a single functional area it limits the variety of functions, users, and activities that happen in that area, resulting in no eyes on the street and a lack of safety feeling.

Other than mixed-use buildings, small-scaled buildings or short blocks help increase urban safety, as Jacobs (1961) suggested. She criticized the high-rise buildings as having a very uncomfortable scale that limits urban walkability because they make the user uncomfortable walking at their edges. Resulting in empty urban spaces that lack safety. In addition, she emphasized that short blocks along with the variation in façade types, textures, colors, and materials also help improve urban walkability and activate the streets. Eventually, all these features lead to the presence of more eyes on the street.

Furthermore, the variation in buildings' age and condition increase the variation of people. They attract different ages, social backgrounds, and ethnicities. All lead to activating the public space and improving the eyes on the street concept, which positively affects the urban safety of public spaces and streets.

Till now, Jacob's theories have been creating conflicts among researchers. We still don't know the exact truth behind her findings, because of limited testing. However, some studies aimed to test her theories. Weicher (1973) for example, converted her theory to an equation. His findings had little evidence to support her theories. Fowler (1987), however, found more evidence to support her work in his studies. He found a strong relationship between crime and the diversity of physical structures. Another study by researchers done in Los Angles explored the relationship between land use and urban crime. They conducted an empirical study in 205 blocks in 8 neighborhoods that have high crime rates, with similar demographic characteristics of users, but different land use characteristics. The results of the study supported Jacob's theory. It

was found that mixed-use neighborhoods (commercial and residential) are safer than commercial-only-use neighborhoods (Anderson et al., 2013).

To sum up, according to Jane Jacobs (1987), urban design significantly impacts crime and perceived safety in urban spaces. Her theory of eyes on the street supported by four key urban design techniques which are: density, mixed-use buildings, diversity of users and buildings, and short blocks, is seen as an effective tool to increase perceived safety in urban spaces.

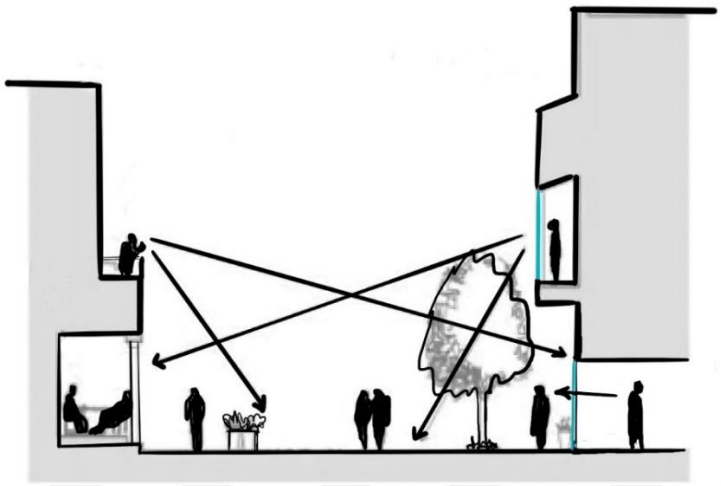


Figure 2.2 : Sketch presenting the eyes on the street theory at street interfaces (Author, 2023).

2.2.2 Defensible space theory

Although both Jane Jacob's (1961) and Oscar Newman's (1972) work focused on the urban environment design role in preventing crime and promoting the feeling of safety between people, they had opposing approaches to the issue. Jacobs with her concept of eyes on the street, encouraged permeable environments that are open to a variety of users, including locals and strangers as the natural surveillance mechanism for the street's safety. Newman with his concept of defensible space, encouraged impermeable environments. He identified strangers as a source of danger and encouraged the presence of clear boundaries. For him, the inhabitants are the only natural surveillance mechanism that should exist in the neighborhood and defend against strangers or intruders.

In urban design terms, Jacob's theory supports open and permeable street interfaces, where the entrances are open to the street from both sides. While Newman's theory

supports street interfaces that open inwards, or as he describes them defensible enclaves, with clear boundaries separating the building from the street.

Oscar Newman's theory of defensible space is a result of numerous studies and publications he conducted from 1972 until 1996. This theory relates the urban environment design with urban safety and crime. By examining and focusing on residential neighborhoods, he suggests that public areas should be clearly defined in terms of their ownership for them to become safe. In other words, the design of the spaces in the neighborhood should be organized in a hierarchal order starting from private to semi-private and then to public, with clearly defined boundaries between these territories (Figure 2.3).

In total, he defines three main concepts that support the defensible space theory. Those are territoriality, surveillance, and image.

Territoriality suggests that urban space should be designed according to ownership, by incorporating physical design elements such as gates, fences, and signs. Following the urban hierarchy, a well-defined area of ownership should be created. Clear boundaries give the residents a feeling of ownership, which encourage them to take care of their private space and keep stranger or intruders from interfering with it, thus creating a safe urban environment. According to this concept of territoriality, strangers or intruders should understand the existence of these boundaries that separate the space from public, semipublic, and private.

Also, the residents should care for their space, and offer natural surveillance over it. This brings us to the second concept of defensible space theory which is surveillance. It implies that residents should have a clear vision of the activities that are taking place in the semipublic, and public areas in front of their houses, so they can protect it from danger. Surveillance of the inhabitants over their land promotes the feeling of safety and makes the area safer.

Finally, the last concept which is the image, relates to the large-scale buildings that are seen as crime attractors, because they create physical segregation between the residents. Such buildings have no visual permeability towards the streets, nor semi-private spaces or defined territories that promote the feeling of ownership. Furthermore, the residents of these large-scale buildings can't provide surveillance over the space, resulting in poor urban safety. It was found that the most significant

correlation between crime rates and safety is the height of the buildings. Meaning, the higher the building the higher are crime rates.

Therefore, like Jacobs, Newman also criticized the modern development of towers and high-rise residents for generating crime and negatively affecting urban safety. He recommended tearing them all down, and build low rise buildings with private, semi-private, and public spaces that have clearly defined boundaries complying with his defensible space theory.

Newman's theory was tested and supported by many researchers. His revolutionary ideas became influential in developing the CPTED concept, which was later employed by the US Department for Housing and Urban Development. Newman's main key concepts that supported his theory were: territoriality, surveillance, and image. Although his theory differs from Jane Jacob's theory regarding the issue of permeability and the presence of boundaries as well as strangers. They both stress the significant role of surveillance and low-rise human-scaled buildings in the quality of safety in urban spaces.

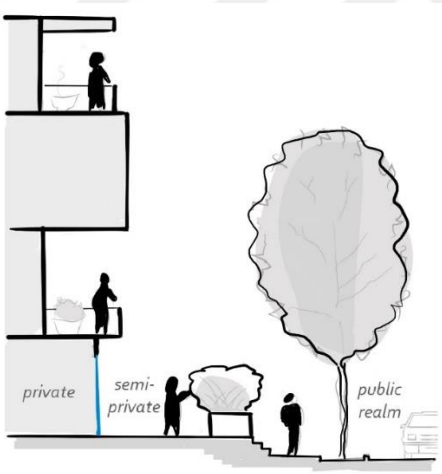


Figure 2.3 : Sketch presenting the defensible space theory at street interfaces (Author, 2023).

2.2.3 Broken windows theory

The broken window theory developed by James Q. Wilson and George Kelling (1982), is a theory that explores the effects of urbanization on social outcomes. It shows that certain physical factors such as litter and broken windows can trigger forms of disorder, resulting in crime (Figure 2.4).

The accumulation of debris and decay on the building exteriors as well as broken windows are indicators of neglect that affect the quality of life in the neighborhood. Leading the residents to withdraw from their involvement in the upkeep of the area.

According to the theory, buildings with broken windows that are left unrepaired can lead to the destruction of other windows as people think that no one cares. For example, if a piece of land was abandoned, weeds will grow, the building will be left uncared, and windows will be broken. These visual environmental cues indicate that serious crime will occur. Consequently, residents alter their behavior and withdraw from the community. As a result, the streets become empty, leading to poor levels of perceived safety among the residents (Wilson & Killing, 1982).

Therefore, the main concept of this theory is the importance of order and how environmental disorder can alter people's perceptions of the environment, leading to a negative effect on both crime and perceived safety. Order generates beliefs that the community and crime are under control. The environmental signs of disorder such as graffiti, poorly maintained landscapes, litter, vandalism, and poor lighting, etc., deliver subjective social clues that the community is not under control. Decreasing people's perceived safety and causing them to avoid public spaces, which manifests more disorder in the community. Therefore, people's perceived safety and disorder is a dangerous cycle that the broken window theory suggests breaking. This can be done by removing these environmental cues of disorder and adding signs of order to the environment that has social meaning, to improve the perception of safety and create a healthy community.

Many researchers complemented the broken window theory. Skogan for example, found that disorder is one of the main factors that negatively affect perceived safety in public spaces, even more than crime rates or victimization risk (Skogan, 2012). Another study revealed that the presence of signs of disorderly behavior such as graffiti, or food carts left unattended in parking garages, can increase the likelihood of people violating social norms and committing crimes like stealing (Keizer et al., 2008). On the other hand, some researchers argued that environmental signs of disorder are not an effective factor in perceived safety or crime. Rather than that the disorder of social conditions, or the failure of social cohesion in the community seems to harm perceived safety more than environmental cues (O'Brien and Sampson, 2015).

As a result, the broken window theory is one of the main theories that stress the importance of the physical environment design on perceived safety and crime. Its main concept relies on the idea of physical order in the urban environment, which creates safe and healthy spaces for people.

Figure 2.4 : Photos presenting an example of the environmental signs of disorder (Url-1).

2.2.4 Routine activity theory

The routine activity theory states that for urban spaces to be safe, they should be designed to accommodate regularly occurring activities such as walking, commuting, and shopping (Figure 2.5). These activities should be carried out in a manner that is convenient and accessible to the residents. Therefore, urban spaces must provide diverse and prolonged activities in the space, to add various layers of formal and informal surveillance to the urban environment, to make it safe (Cohen and Felson, 1979).

Although the theory focuses on the routine activities' effect on crime occurrences in the area, other researchers found that spaces that encourage routine activities not only have lower crime rates but are also perceived as safe by users (Branas et al., 2018). A theoretical framework was adopted to propose design interventions based on the broken windows theory and the routine activity theory. A photographic survey was conducted. This survey aimed to test people’s perceptions of safety. The outcomes revealed that the interventions that were based on the broken windows theory such as cleaning and improving the physical environment, had a minor impact on the people's safety perception of the area. On the other hand, the interventions that were based on

the routine activity theory such as strengthening the urban functions significantly improved the safety perceptions of the area (Jiang et al., 2018).

Therefore, the routine activity theory is a crucial theory to take into consideration to design safe urban spaces. The buildings that promote lingering activities, increase the eye on the street and natural surveillance. Making the area vital and safe for people.

Figure 2.5 : Sketch presenting an example of the regularly occurring activities such as, shopping, commuting, and walking (Url-2).

2.2.5 Prospect and refuge theory

In 1975, Appleton developed a theory on the physical urban environment and its effect on perceived safety. He argued that people prefer urban environments that offer them both prospects (open view) and refuge (protection) (Figure 2.6). These two concepts are considered the most important indicators of perceived safety (Appleton, 1984).

Prospect is the presence of an open view and clarity. When people can see what's ahead of them, they can be reassured. Whereas mysterious and unknown spaces, grant a feeling of distress and anxiety. Refuge is the presence of physical features that offer protection. Markets and public spaces that have buildings and people are examples of refuge spaces that provide a sense of safety and protection from criminal activities.

Other researchers further developed this theory. They argued that the ability of urban spaces to provide an escape route for people to flee a potential attack plays a big role in the people's perceived safety of this space. (Fisher and Nasar, 1992). Therefore, when possibilities for escape are low, perceived safety levels become poor. The importance of windows and the presence of low-rise, or human-scaled buildings were also emphasized as factors influencing perceived safety. Open spaces with high

visibility that limit the possible hiding spaces for offenders and offer multiple escape routes are also additional factors that influence perceived safety.

Ultimately, the prospect, refuge, and escape theory is an urban design theory developed by scholars to increase the perceived safety levels of people using urban space. It implies that spaces offering visual permeability, protection against danger, and an open environment with escape routes are perceived as safe spaces by users.

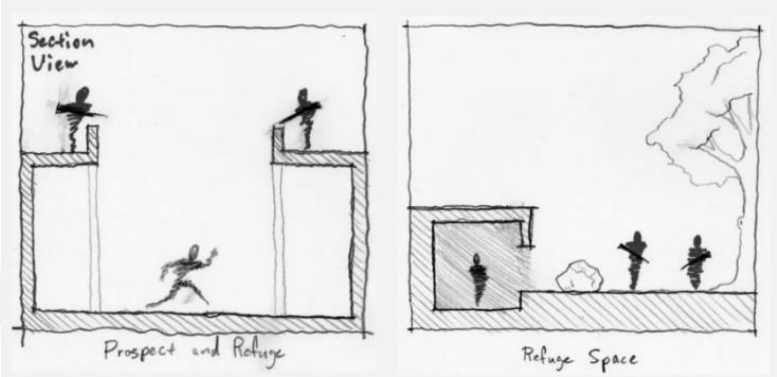


Figure 2.6 : Sketch presenting the prospect and refuge theory (Url-3).

2.2.6 Concepts related to the theories

The theories on perceived safety include many significant concepts that are crucial for analyzing perceived safety in urban spaces.

The permeability concept suggests that the perception of danger runs parallel to open view and enclosure levels (Stamps, 2010). Physical and visual permeability are stated to be the most important concepts of permeability that influence perceived safety (Stamps, 2012). Physical permeability is defined as the ability to move without obstructions or physical borders that block the way. Whereas visual permeability is defined as the ability to perceive the environment, without the presence of elements creating visual boundaries that block the view (Stamps, 2010) (Figure 2.7). Theories such as Appleton's prospect and refuge theory and Jacob's eyes on the street theory emphasized the importance of physical and visual permeability on perceived safety. Appleton (1984) emphasized the importance of open views that enables the person to perceive what's ahead, as well as the importance of spaces that offer refuge and routes of escape in case of danger. Jacobs (1961) stated that open views, as well as an open environment without the presence of boundaries, increase the eyes on the street and affect perceived safety positively. A recent study that aimed to study how the different

types of boundaries between public and private affect perceived safety revealed that the presence of blind and physical boundaries, which allowed no physical nor visual permeability resulted in a considerate decrease in people's perceived safety, supporting Jacob's ideas (Rocha, 2017). Another study revealed that the high level of enclosure and physical boundaries implies the feeling of threat and danger from a possible offender. The poor levels of physical permeability create a sense of fear among people, decreasing perceived safety (Fisher and Nasar, 1992). Another study aimed to explore the effect of visual permeability on safety. It showed that the presence of buildings blocking the view or the lack of an open view resulted in low levels of perceived safety in the space (Vrji & Winkel, 1991). Finally, both physical and visual permeability are significant concepts that have a major effect on perceived safety.

Figure 2.7 : Sketch presenting the physical and visual permeability concept at the street interface (Author, 2023).

Crowdedness is another important concept of perceived safety that the eyes on the street theory support. Jacobs (1961) noted that the presence of people encourages others to use the space. Their eyes on the street create a safe environment for people to use. People tend to feel less safe in crowded environments because they may feel vulnerable or exposed to potential threats. However, it's important to note that perceived safety is subjective and can vary from person to person. Some individuals may feel perfectly safe in crowded areas, while others may feel uncomfortable and anxious. This can depend on a range of factors, including past experiences, cultural background, and physical attributes of the urban environment.

Ownership is a significant concept related to the theory of defensible space. Newman (1972) suggested that strangers propose fear to the urban environment. Whereas, the

locals who obtained ownership or a sense of belonging to their community protect the spaces from danger and feel safe in their urban environment. A study suggested that residents who obtained ownership of their homes defended the urban environment near their homes and felt safer, opposing the resident who did not appropriate space in this way (Brunson et al., 2001). In public spaces, urban designers may work with the community to create a sense of ownership and engagement in the space, which can increase feelings of safety and security for all users.

Another concept that is related to the defensible space theory is the spatial hierarchy of spaces from private to semi-private and then to the public. The spaces between the public and private allow the residents to provide natural surveillance over the public space, which creates a safer urban environment for people to use. Understanding spatial hierarchy in urban spaces is important for urban planners, architects, and designers in creating safe and vibrant spaces that meet the needs of their communities.

Human scale is another concept that was crucial to the defensible space theory. Newman (1972) stated that the image of buildings or the environment is crucial to the perception of safety. Urban design that considers the human scale prioritizes the needs and experiences of people at the street level. It emphasizes walkability, safety, comfort, and accessibility, as well as the creation of vibrant and livable public spaces (Figure 2.8). Therefore, the human-scaled urban design puts the human being as a key element in the design. This can be done with a balanced proportion between street width and building height as well as a considerable or low building height (Carmona et al., 2003). Street furniture, landscaping, and the presence of people also contribute to the human scale concept by making the space livable, inviting, and safe for people to use.

Figure 2.8 : Sketch presenting the human scale concept at the street interface (Url-4).

Finally, environmental order and quality were the main concepts of the broken windows theory, developed by Wilson and Kelling (1982). Lansing and Marans (1969) stated that an environment of high quality conveys a sense of well-being and satisfaction to its population through characteristics that may be physical, social, or symbolic. The concept of environmental quality has been an issue of interest for many urban designers from Jacobs (1961) and Lynch (1960) to Ghel (2010). They argued that design quality creates a safe and healthy urban environment that encourages people to use it.

Environmental order, on the other hand, is related to two main concepts which are physical disorder, and social disorder. Wilson and Kelling (1982) argued that untended disorder is the starting point for crime. This disorder accumulates and sends signals to the community that the space is unsafe, making the users terrified, and causing them to withdraw from these unsafe spaces. The deterioration of the physical environment like worn-out buildings, litter, graphite, etc. creates social disorder in the community which makes people avoid the streets and decreases the environmental quality of the space as well as perceived safety (Perkins and Taylor, 1996).

2.3 Factors that Affect Perceived Safety

The previously discussed main theories and concepts of perceived safety are the base knowledge for the factors that affect perceived safety.

These factors were categorized by many researchers. For example, Austin et al. (2002) summarized the factors that affect perceived safety into three categories: demographic factors, victimization experiences, and the urban condition. In his report for the city council of Auburn, he mentioned the following factors: age, gender, ethnicity, socio-economical statue, victimization experiences, media, sense of community, location, and crime.

In another study by Suojanen et al. (2019), it was concluded that the safety of public space is the combination of three factors: perceived space, perceived social presence, and perceived information. First of all, perceived space or physical factors is the first category that affects the perception of safety in an urban environment. It includes the design of the space, its aesthetics, and the presence of nature. It also includes the existence of own space, and the separation from risk factors, which comply with

Newman's defensible space theory. The active street, or the presence of people, which comply with Jacob's eyes on the street theory, as well as other factors such as the amount of control the user has in the space, and the presence of animals, are also included among the first category which is the perceived space. The second category which is perceived social presence is mainly related to the presence of people. The presence of people includes familiar people (friends or family), unfamiliar people (people we barely know such as neighbors, or shop owners), and strangers. Their presence gives a feeling of safety that someone might be there in case of danger. The presence of children was also presumed to increase the feeling of safety. Finally, perceived information is the last category of the factors that affect perceived safety. It is described as the social perceived climate and can be divided into two aspects: trust in the government, and trust in the society. Perceived information is also different from one person to another according to their background, and the information, or the experiences that they receive from their society such as the media, education, news, or their gender, age, and ethnicity (Suojanen et al., 2019).

For this study, the factors that affect perceived safety are divided into three categories: physical factors, socio-cultural factors, and individual factors (Maruthaveeran and Konijnendijk, 2014). The physical factors are the factors that can be influenced by urban designers. They are defined as the objective or static factors that affect perceived safety. The socio-cultural factors are the factors that are concerned with society and its effect on the individual's perception or behavior. The individual factors are considered the subjective or dynamic factors that affect perceived safety in urban spaces. To create a holistic approach to studying perceived safety in urban spaces all these factors must be taken into consideration.

2.3.1 Physical factors

The theories of perceived safety aimed to study perceived safety concerning urban design, and the physical environment. Later on, these theories were tested by many scholars resulting in a huge body of research on perceived safety in the urban environment.

The physical factors are the factors that are concerned with the spatial design of the urban environment and were derived from the theories and concepts that are related to

perceived safety. They include transparency, openings, diversity of activities, car dependency, setbacks, building height, physical appearance, greenery, and lighting.

Transparency

The visual permeability concept states that the presence of open view or glazed interfaces that allow for transparency between indoor and outdoor spaces have a positive effect on perceived safety (Vrji & Winkel, 1991; Appleton, 1984; Fisher and Nasar, 1992; Rocha, 2017; Jacobs, 1961; Newman, 1972; Stamps, 2010; Stamps, 2012).

Jacobs (1961) promoted the significance of visual permeability at the street interface. Her eyes on the street concept stressed the contribution of transparent facades to street vitality and safety. Alexander et al. (1977) stated that the transparent interfaces supported by glazing or windows encourage the observers to make a physical connection with the space. It also makes the interface safe and more exciting to interact with. He noted that 80% or more transparency of the street interface surface promotes a highly active and safe street interface (Figure 2.9).

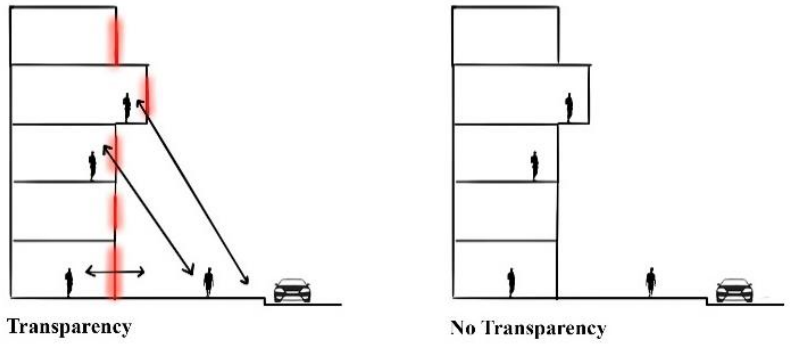


Figure 2.9 : Sketch presenting the transparency factor at the street interface (Author, 2023).

Openings

The physical permeability concept states that an opening in the street interface that allows for a physical connection between indoor and outdoor spaces significantly affects the perceived safety at the street interface (Appleton, 1984; Fisher and Nasar, 1992; Rocha, 2017; Jacobs, 1961; Newman, 1972; Stamps, 2010; Stamps, 2012).

It was noted that an opening at the wall or an entrance is far more valuable than a glass transparent connection (Alexander et al., 1977). Gehl et al. (2006) defined various

typologies of street interfaces in relation to their physical features. He noted that 15 – 20 doors per 100m is the most active type of street interface which is considered permeable and safe, whereas, 0 – 2 doors per 100m is the most passive type of street interface which is considered impermeable, and unsafe (Figure 2.10).

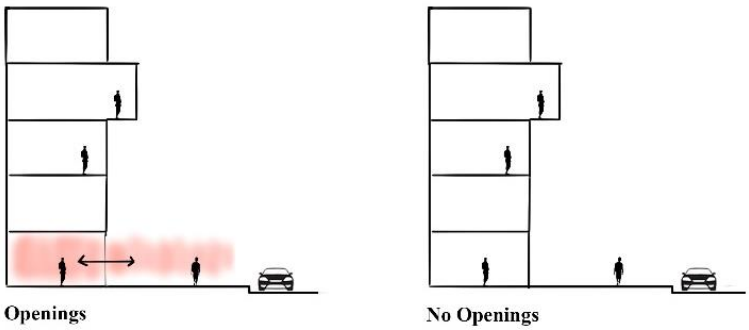


Figure 2.10 : Sketch presenting the openings factor at the street interface (Author, 2023).

Diversity of activities

The routine activity theory encourages the variation of activities as well as regularly occurring activities to create a safe urban environment (Cohen and Felson, 1979). Jacobs (1961) was one of the major theorists that encouraged the diversity of activities in urban design and planning. She stressed that the variation of activities in an area increases people's activity and encourages more eyes on the street, which positively affect people's perceived safety. This concept was further tested by many researchers, as mixed results were confirmed by scholars. While many studies supported Jacobs's theory, verifying that the diversity of activities does increase perceived safety (Anderson et al., 2013; Fowler, 1987; Gehl et al., 2006; Yunmi & Garcia, 2019) many others reached different results contradicting this theory (Kinney et al., 2008; Schweitzer et al., 1999). Anderson et al. (2013) conducted an empirical study on the effect of zoning on safety in neighborhoods with high crime rates. He concluded that mixed-use neighborhoods are safer than commercial-only neighborhoods. This is because the diversity of activities in the street attracts more people and a larger density of users. Land uses such as, the presence of small shops and businesses attract locals who in return provide natural surveillance and increase safety perceptions among people (Ekblom, 2011). It was noted that interfaces that have a diversity of activities attract many people, making the street active and safe, whereas interfaces that have no visible diversity of activities create a passive and unsafe street interface (Gehl et al., 2006). However, neighborhoods that have shared driveways and nearby convenience

stores propose high levels of fear among people. It was found that these nearby stores cause crime and fear of crime, probably because they attract people who are more likely to commit crimes such as gangsters and teenagers. Therefore, shared driveways and porches had a negative effect on safety, contrary to Jacobs's theory about their importance in increasing the eyes on the streets and safety (Schweitzer et al., 1999). Some mixed-use environments might attract strangers and outsiders who are more likely to be criminals, causing fear among people (Kinney et al., 2008). In conclusion, the diversity of activities does indeed positively influence perceived safety, but not all variations of activities work in favor of increasing perceived safety.

Car dependency

The edges of car roads form passive walls and lost spaces in the city (Figure 2.11). The extensive usage of automobiles decreases walkability, kills the public spaces in the city, and creates an unsafe environment for people to exist (Alexander et al., 1977). Gehl (2010) noted that the 5 km/hr architecture is a convenient speed for cities to reduce blank interfaces that are boring and unsafe to walk by and increase pedestrian setbacks that give fuel to the vitality of urban spaces. Pedestrianized streets that allow for walkability are seen as an important factor that improves perceived safety in public spaces. Because it makes the space alive and active, which in turn has a huge influence on the eyes on the street concept that increases perceived safety (Jacobs, 1971). A study that explored the relationship between perceived safety and urban design in a suburban neighborhood has shown that a more walkable neighborhood, where the usage of an automobile is well controlled is a place where residents feel safer (Foster et al., 2010). Therefore, the car dependency factor plays an important role as a physical determinant of the level of perceived safety in an urban space.

Figure 2.11 : Photo presenting the car dependency and the passive edges of the highways (Url-4).

Setbacks

Setbacks are the spaces between the private building and the public street. They are the basic entry zone to private spaces. The presence of setbacks supports the spatial hierarchy concept that was stressed by Newman (1971) in his defensible space theory. As these spaces provide natural surveillance for the public areas, making the street safe for users. Setbacks can be divided into three types: no setback/direct, pedestrian setback, and car setback (Dovey and Wood, 2015). The pedestrian setback is where these in-between spaces are used and dominated by pedestrians, such as a porch, a front garden, or a café's sitting area. This type of setback enhances social activities in the area and provides more eyes on the street, making the area perceived as safe by users. The car setback is dominated by vehicles such as parking, or a garage, where pedestrian flows are separated from the entrance by parking space. No setback is where the private space is open directly to the public area without the presence of a semi-private space in between. Thus, pedestrians enter directly into private space from the street, without an interstitial zone of semi-private space (Figure 2.12).

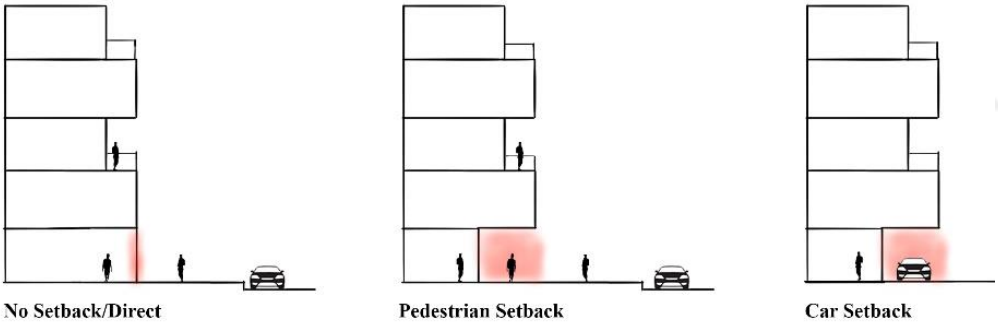


Figure 2.12 : Sketch presenting the setbacks factor at the street interface (Author, 2023).

Building height

Jacobs (1961) was one of the important theorists that criticized high-rise buildings for their influence on people's feelings of discomfort. She stressed that they attract criminal activities because they create lost and empty spaces. Many theorists such as, Gehl (2010) also stressed the need for low-rise buildings which should be in proportion with the human scale. He argued that the large scaled buildings decrease safety in urban spaces. This is because they decrease its quality and create a feeling of discomfort, making the people abandon the space, which turns it into an unsafe area.

Massive buildings are observed as threatening and slightly intimidating for people (McAllister, 2019). Some studies concluded that the correct use of building height, which is an element of urban design could improve the urban space tolerance for crime and create a safer environment (Newman, 1972). Since the height of the building is decided by how many floors it has, Gehl (2010) concluded that the fifth floor is the maximum height for people to feel engaged and intimate with their surroundings. As for the street width, it shouldn't be more than 10 meters. According to Alexander et al. (1977), the street width should not be more than the building's height for it to be perceived as safe for users. The ratio between building height and street width is also important to the perception of safety. The ratio of building heights to street width is defined as the enclosure ratio of the street (Carmona et al., 2003). The street width to building ratio should be 1:1 or 1:2 for it to be perceived as safe and comfortable for users (Figure 2.13).

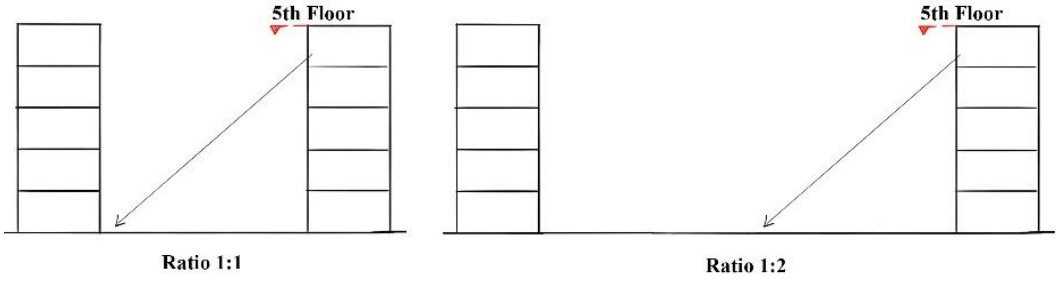


Figure 2.13 : Sketch presenting the building height factor at the street interface (Author, 2023).

Physical appearance

The broken windows theory suggests that the physical disorder in the physical environment negatively affects crime and perceived safety (Wilson & Killing, 1982). Many scholars supported this theory in their research. Various physical characteristics such as graffiti, car wrecks, litter, vandalism, and broken windows are defined as suburban incivilities or physical disorders in the urban environment that can trigger a feeling of unsafety among people. These visual cues are seen as threatening by people, where the urban space is perceived to attract crime and criminals because of its physical disorder (Lewis and Maxfield, 1980; Austin et al., 2002; Wood et al., 2008; Brown et al., 2004; Skogan & Maxfield, 1981; Smith & Sturgis, 2011; Mirrlees and Allen, 1998; Tulloch, 2000). Abandoned buildings were seen as a sign of a physical disorder that can cause a feeling of unsafety (Doeksen, 1997; Ross and Mirowsky,

1999). Cleanliness of the area and the maintenance of properties are also seen as crucial concepts that should be taken into consideration when studying perceived safety in public spaces. People are often reluctant to venture into spaces that seem neglected or have any type of physical disorder for the inherited fear of encountering any criminal situation (Hale, 1996; Painter, 1996).

Finally, the visual appearance of the built environment as a whole plays a huge role in the outcome of perceived safety surveys when taken in situ (Miller, 2008).

Greenery

It is generally agreed upon that the presence of nature and green spaces increase the feeling of safety (Nasar and Jones, 1997). A study has shown that one of the methods to create a safer environment and reduce fear of crime is to add more greenery to the neighborhoods on the micro level (Jing et al., 2021). Although the presence of greenery increases the feeling of safety, there are particular cases where it creates a feeling of unsafety and encourages crime occurrence. The degree of enclosure and maintenance is one of the most important factors that should be taken into consideration when associating greenery with the issues of perceived safety. In a study that used 360° immersive virtual environments, it was concluded that people perceive highly enclosed environments that are surrounded by vegetation as significantly less safe than medium and low-enclosure environments (Baran et al., 2018). This is because people prefer spaces that are open and visible, which allow for easy escape opportunities in case of danger. Therefore, when the presence of greenery limits visibility and create obstacles, it can diminish the feeling of safety among people (Herzog and Kutzli, 2002). The scale, type, density of vegetation, and form of landscape elements can moderate the sense of enclosure and visibility. A row of trees, for example, can limit visibility and create enclosed spaces, whereas trees with high limbs can create a visible and safer environment (Stamps, 2012). Another factor that can also influence perceived safety is how well the greenery is maintained and cared for. Poorly maintained greenery suggests that people don't care for the area. This encourages criminal activities and decreases the perception of safety (Kuo et al., 1998; Troy et al., 2016).

Therefore, the presence of well-maintained greenery that doesn't create visual or physical obstacles can positively affect the perception of people's safety in urban spaces (Figure 2.14).

Figure 2.14 : Photo on the left presents an example of well maintained greenery. Photo on the right presents an example of poorly maintained greenery that creates visual and physical obstacles (Yin et al., 2022).

Lighting

One of the most important factors that influence perceived safety in public spaces is lighting. In almost all the studies that discussed perceived safety in public spaces, lighting was a major contributing factor to the issue of safety.

For instance, when pedestrian safety perception was studied in the urban street setting, it was found that lighting is the main factor that enhanced the perception of safety among people, followed by the diversity of land use and density (Yunmi & Gracia, 2019).

Another study was performed on a bridge that is presumed as an unsafe threatening location. The study was conducted in the evenings. On the first evening, the original lighting was used. On the second evening, the street lighting was adjusted to have a better quality of light. Results show that the adjusted better-quality lighting results in a safer perception of the environment (Vrji & Winkel, 1991). This is because poor visibility and darkness create anxiety that criminal activities might happen in the darkness or blind spots. Whereas well-lit spaces give an overview of the space, delivering a feeling of safety and insurance to people (Brands et al., 2015; Painter 1996) (Figure 2.15).

Thus, it can be concluded that the implementation of comprehensive and well-designed urban development plans that prioritize the enhancement of street lighting infrastructure can significantly contribute to the overall enhancement of the perceived safety levels in urban spaces (Hale, 1996).

Figure 2.15 : Photo on the left presents an example of good quality of lighting. Photo on the right presents an example of poor quality of lighting that creates blind spots (Url-6).

2.3.2 Socio-cultural factors

Socio-cultural factors are the second category of the factors that affect perceived safety in urban spaces. They are caused by society which influences the individual's perception of safety. These factors cause anxiety and insecurity leading people to avoid public spaces. They include the density of users, social incivilities, community cohesion, media influence, and crime rates.

Density of users

It is stated that the presence and density of users have major effects on the perception of safety in the area. In 1961, Jane Jacobs suggested that dense neighborhoods are safer than less dense ones. She stressed that the presence of people provides natural surveillance for the streets, creating a safe environment (Jacobs, 1961). Many researchers supported her theory and confirmed that density does have a positive effect on perceived safety (Vrji & Winkel, 1991; Goffman, 1971; Yunmi & Gracia, 2019). The social presence or the sense of being together increases the feeling of safety, only if the presence of others doesn't seem threatening or they don't seem to have a criminal intention (Warr, 1990). Other scholars, however, found a negative effect of density on perceived safety. For example, a study was conducted to discover the relationship between pedestrian density and perceived safety in the public spaces of Yaoundé, Cameroon. Results concluded that Jacob's theory of eyes on the street is not valid when the density of people exceeds a certain threshold. Therefore, high levels of density don't have a positive effect on perceived safety (Tchinda and Kim, 2020). Another study also confirmed that high population density in certain periods of the day

influences crime occurrence and decreases perceived safety in public spaces (Lee, 2019).

Consequently, the density factor plays either a supportive, or negative role in the safety perception of users, according to its level and the related social incivilities in the area.

Social incivilities

The presence of people in public spaces is mainly considered a positive factor that affects perceived safety. When people see others engage in activities or use a specific space they provide a positive social clue for others to use it and promote a feeling of safety related to this space (Warr, 1990; Whyte, 1980). However, some argue that not all people provide positive social clues which promote the feeling of safety among others. Dangerous-looking people, for example, can be considered as social incivility that evokes a feeling of unsafety in public spaces (Lagrange et al., 1992). People constantly look for social incivilities in the area, when they are feeling unsafe, or threatened (Goffman, 1971).

Therefore, the presence of social incivilities is an important factor to consider when studying perceived safety in public spaces.

Community cohesion

Factors including attachment to the place, quality of life, and community cohesion don't only influence people's psychological well-being but are also linked to the perception of safety in the community. Studies on community cohesion in residential neighborhoods revealed that neighborhoods with a higher sense of community have higher perceived safety levels than neighborhoods that lacked community cohesion (Schweitzer et al., 1999). This is because community cohesion is an important factor that provides people with the feeling of territorial control. This feeling of control over the environment leads to a feeling of safety (Greenburg et al., 1982). Community cohesion also promotes the feeling of trust in the community, which increases the feeling of safety among people in their neighborhoods.

Therefore, many studies have emphasized the importance of community cohesion which is seen as a determinant factor in promoting perceived safety among people (Di Masso et al., 2011; Franc et al., 2012; Innes, 2004; Taylor and Hale, 1986).

Media influence

The media dominated by the internet, television, social media, and newspaper is an influencer of perceived safety in public spaces (Pain & Shirlow, 2003). News about crime and the danger of crime in certain spaces create a distant feeling of unsafety for those who come across such news. It leads them to develop a fear of using certain spaces that are perceived as threatening by the media, without even visiting them. However, the effect of media on perceived safety tends to be inconclusive. For example, some studies found that the media may stimulate fear in the eye of the viewer, leading them to avoid some spaces (Coleman, 1993). Other studies that aimed to expose crime on television, showed that certain people revealed no correlation between the influence of media and perceived safety (Banks, 2005).

Even though there are conflicting studies concerning the media and its effect on perceived safety, it shouldn't be ignored as an influencing factor in people's perceived safety.

Crime rates

Crime has a direct effect on perceived safety. In many studies, crime rates in an area were seen as the most influencing factor that affects the safety perception of the citizens in that area. It is therefore well accepted that there's a direct correlation between the existence of crime and perceived safety (Brunton and Sturgis, 2011). A study has found that the level of perceived safety is positively associated with the concentrations of recorded crime in the area, along with other physical factors such as disorder in the physical environment (Brunton and Sturgis, 2011). Although recorded crime rates in the area have a major effect on perceived safety, studies that define locations as unsafe primarily based on these crime rates are classified as incomplete.

Therefore, crime does play a major role in perceived safety but certainly, it's not the most important one (Vrji & Winkel, 1991).

2.3.3 Individual factors

Personal experiences and characteristics are considered among the subjective factors that influence perceived safety. In Cozen's studies, he acknowledged these individual factors as the strongest determinants that influence perceived safety in public spaces (Cozens et al., 2005). Other researchers also emphasized the importance of individual

factors in studying perceived safety (Blobaum et al., 2005; Byrne & Wolch, 2009; Garafalo, 1981).

These factors include age, gender, ethnicity, and direct and indirect victimization.

Age, gender, and ethnicity

The demographical factors which are age, gender, and ethnicity rely on the concept of vulnerability. This concept suggests that certain people feel more vulnerable to crime, according to their demographic characteristics. In particular, those that are concerned with age (Zako, 2009), gender (Felson and Clarke, 1998), and ethnicity (Pain, 2001; Skogan and Maxfield, 1981).

The concept of vulnerability applies to the elderly who feel isolated and vulnerable to danger, due to their poor physical health. They are considered the most group in terms of age that has low levels of perceived safety (Braungart et al., 1980). Young and middle-aged people, on the other hand, have high levels of perceived safety. Especially, the ones who own their homes and have lived a long period in the neighborhood (Skogan & Maxfield, 1981). Many studies concluded that the elderly, who is surprisingly the least group that is at risk of being victimized, feel more vulnerable and less safe in public spaces (Painter, 1996; Taylor and Hale, 1986). Whereas, young people and adults who are more often to be the victims of crime in public spaces, have higher levels of perceived safety (Warr, 1990).

The concept of vulnerability applies to women as well as the elderly. Many studies show that women feel vulnerable to crime and sexual harassment. This is due to their low physical power and their poor control over dangerous, stressful, and threatening situations (Hale, 1996). Many studies showed that women feel less safe than men in urban spaces, especially while walking at night (Fisher & Nasar, 1992). Furthermore, spaces that have physical incivilities, where the feeling in control of the situation in case of danger is limited, are perceived as extremely unsafe by women (Lohman et al., 1986). Statistically, men and young people are often the victims of crimes, whereas women and the elderly who are at the least risk of being victimized, have the highest fear of these crimes (Brå, 2014; Maruthaveeran & Konijnendijk, 2014; Katz & Webb, 2003; Painter, 1996; Taylor & Hale, 1986).

As for ethnicity, it was stated that people from different ethnic groups feel vulnerable and unsafe. This is because people are most comfortable around others who are similar

to them in terms of age, gender, and ethnicity. Therefore, ethnic minorities feel unsafe in public spaces, mainly because they feel vulnerable to danger, especially against racism and violence (Maruthaveeran & Konijnendijk, 2014). A study in Melbourne revealed that ethnic minorities such as Arabs, Asians, and Jews have poor levels of perceived safety in public spaces against racist violence (Human Rights and Equal Opportunity Commission, 1991). Another study revealed that race also affects perceived safety. Non-whites feel less safe than whites in public spaces (Lagrange et al., 1992). The main reasons why these minorities feel unsafe are the feeling of vulnerability and the fact that the physical environment they inhabit is unsupervised and in very poor condition (Davis, 2006). However, the effect of race and ethnicity on perceived safety is seen as somehow insignificant. Some studies revealed no significant difference in the safety perception of people from different ethnicities or races (Hogan & Gertz, 1997).

Direct & indirect victimization

Being a crime victim (direct victimization), or witnessing someone being a crime victim (indirect victimization) in a certain space is seen as one of the most influencing factors of perceived safety in public spaces (Sandstig, 2010). The previous experiences of direct and indirect victimization tremendously affect people's perceived safety in public spaces (Hale & Pack, 1987; Skogan, 1987). Furthermore, these previous experiences of victimization create a place-specific feeling of unsafety. For example, if a person were to experience crime in a certain place, this person will automatically link this space to fear and perceive it as an unsafe space (Curiel & Bishop, 2017).

2.4 Street Interfaces

The urban street is a key element of public spaces. It's the glue that connects the various layers of cities. It can be defined as a shared public space that allows for human interaction and movement through the city. Its edges are comprised of architectural elements which are the street interfaces. Consequently, the street interface is a component of the urban street, which is considered a vital part of public spaces in cities. Urban designers and planners have always been concerned with the transition zones between public and private spaces in the city (Figure 2.16).

This issue is considered to be one of the most critical issues when it comes to the development of urban areas. These transition zones from one type of space to another,

from private to public or from outdoor to indoor, are called street interfaces. They were defined by many scholars based on their urban context, use, and configuration as the spaces that are in between urban and architectural dimensions on the ground floor level. These transition zones were also given different terminologies other than an interface such as a boundary, an edge, a threshold, and a liminal space (Alexander et al., 1977; Gehl, 2010; Jacobs, 1961).

The street interface was a place of interest to many renowned scholars such as Jan Gehl, Jane Jacobs, Oscar Newman, and Christopher Alexander. Gehl (2010) stressed the importance of their morphology to an active and lively street environment. Since they are the transition zones between urban and architectural spaces, they play a significant role in influencing the user's experience of both the public space and the architectural space. On an architectural scale, although they comprise 10 percent of the building's space, their morphology determines 90 percent of the building's influence on the user's experience. Jacob's (1961) theories such as eyes on the street and active edges regarded the street interface as a crucial part of social and commercial exchange. She stressed their importance in increasing vitality and safety in the city. The street interface was also a key focus for Newman (1972) in increasing street vitality and safety. He criticized modern planning that eradicates the important transition zone between buildings and public spaces. His theory of defensible space encouraged one typology of the street interface, which is the semi-private street interface with setbacks and defined boundaries. Alexander's book Pattern Language was also a major study that stressed the crucial role of street interfaces in creating successful cities. He also criticized modern development and introduced design solutions that work in favor of human well-being. Among which these solutions, are solutions that are concerned with the design of the street interface (Alexander et al, 1977). In the field of environmental psychology street interfaces plays an important social role. Goffman (1971) noted that these interfaces are the places where identities are performed in everyday life. Whereas Altman (1975) focused on the importance of privacy which can be acknowledged depending on the socio-physical interface control.

Finally, a vital, safe, and healthy urban environment that can encourage the well-being of people while giving them the best experience, is majorly controlled by these transition zones or the street interfaces in the city.

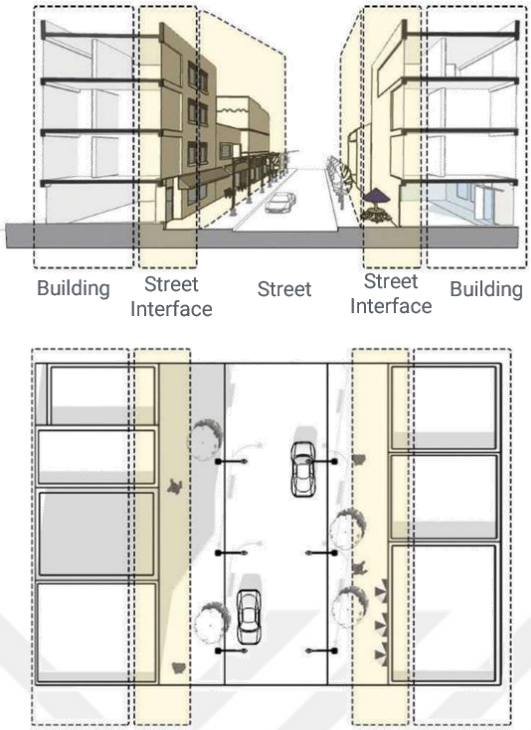


Figure 2.16 : Sketch presenting the street interface (Aytuğ and Yıldız, 2017).

2.4.1 Classification of street interfaces

After discussing the importance and significance of the street interface as a place of social and commercial exchange in the city that influence people's well-being and experience, the different methods researchers used to categorize the street interfaces into various typologies will be examined.

The mapping and analysis of street interfaces are essential to understand the influence of their morphology on different factors, among which is perceived safety. Many researchers aimed to classify street interfaces into different categories based on various perceptions.

Gehl et al. (2006) classified street interfaces into two types: the soft type (active) and the hard type (passive). He defined five scaled typologies based on variables such as speed which is car dependency versus pedestrian usage, transparency, activity, diversity, and design quality. These five typologies of the street interface range from A Quality (active, open, soft, 15 – 20 doors per 100m, large variety of functions) through to E Quality (inactive, passive, closed, hard, 0 – 2 doors per 100m, no visible variation in function) (Figure 2.17). His concept of this evaluation is that the A and B types maintain a vital and safe urban environment, whereas the E type kills vitality and

creates unsafe or dead urban spaces. Accordingly, the main focus of Jan Gehl was to eliminate blank walls or passive street interfaces and promote active interfaces that are transparent, permeable, and can encourage social activity (Gehl et al., 2006).

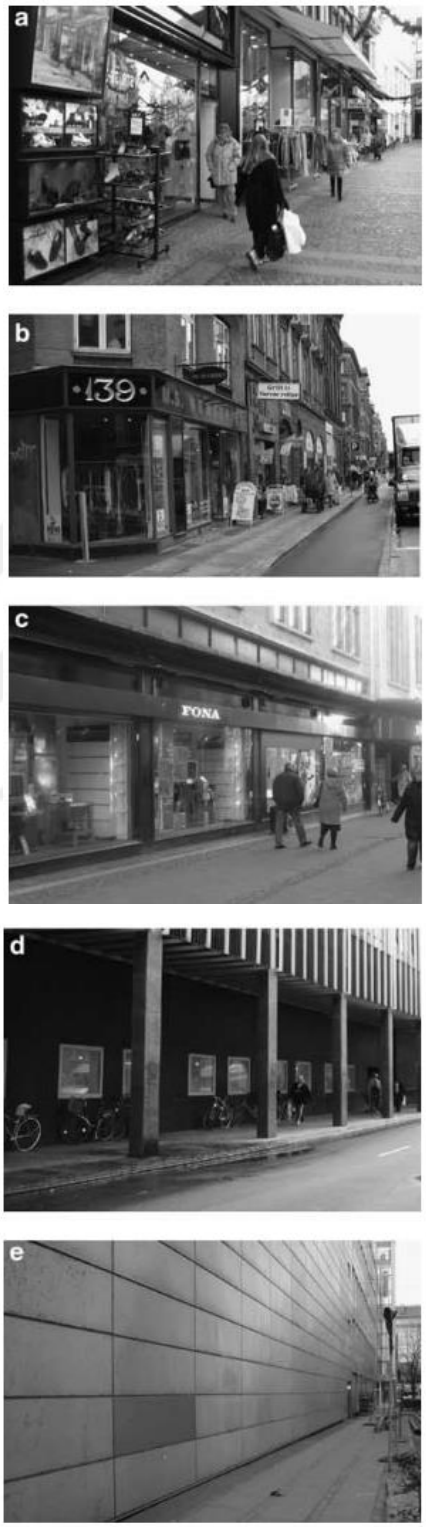


Figure 2.17 : Classification of the street interface from A quality to E quality types (Gehl et al., 2006).

Dovey and Woods (2015) developed a simple typology of five primary interface types: 1-impermeable/blank, 2-direct interfaces, 3-direct/transparent, 4-pedestrian setback, and 5-car setback (Figure 2.18). These types were classified according to four variables: access, setback, transparency, and mode of access. The first variable describes the degree to which the interface is permeable or accessible. The second variable setback is defined as the primary entry zone into private space, which is very important because it extends the public gaze and creates an interstitial space between public and private. The third variable which is transparency is the perception ability of users through public and private spaces or outdoor and indoor spaces. The last variable describes the mode of access in the space, whether it's by car or on foot. Other variables could be included such as sound penetration and entry protocols, but they would all lead to complex non-understandable typologies. Finally, the complex combination of these variables creates countless typologies of street interfaces. However, five primary interface types were determined. The first one which is impermeable/blank is an inactive street interface that includes blank walls or physical boundaries, without the presence of physical or visual permeability. The second type which is direct interfaces is mostly common in residential areas and has no transitional zone of semi-private space. The third type which is direct/transparent has a direct visual link to private spaces. The fourth type which is pedestrian setback is defined as a zone of semi-private pedestrian space before crossing into the fully private space. The fifth type which is car setback is where the setback is dominated by cars such as a parking space that obstruct the pedestrian flow at street interfaces. In conclusion, this classification followed a complex adaptive system in which these five main types which were classified according to access, setback, transparency, and mode of access, can adapt to become secondary types.

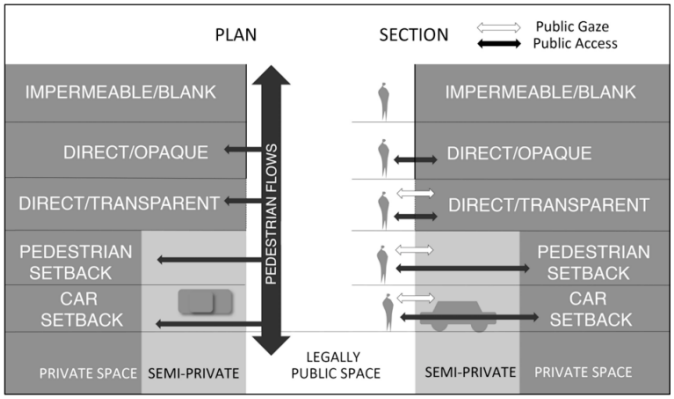


Figure 2.18 : Classification of the street interface into five types (Dovey & Wood, 2015).

Drawing upon an extensive and comprehensive array of research from the realms of morphological analysis, social dynamics, and psychological investigations, Biobic (2004) developed a classification of typologies for street interfaces, which is considered one of the most detailed studies on this subject. The street interface was classified into seven main types and forty subtypes, based on variables such as setback, transparency, behavior, and design quality. He didn't only include visual and physical variables, but he also considered psychological variables as well. However, the classification didn't make a clear distinction between pedestrian and car interface types.

Another detailed study of the urban street interface was made considering social, visual, physical, and psychological variables. The street interface was classified into six dimensions which are: morphological, perceptual, social, visual, functional, and temporal (Ziad et al., 2019)

Gehl, Kaefer, and Reigstad (2016) have further developed the classification of street interfaces by incorporating variables such as scale and rhythm. They proposed an interface typology based on the presence or absence of setbacks, accessibility, transparency, scale, and rhythm.

Other studies also attempted to make a classification of the street interface, each according to their research topic. For example, Habraken's (1988) focus was on pedestrian flow between different territories. He developed a typology of entrances, taking into consideration the flow of pedestrians, the physical connections between indoors and outdoors, and the type of boundary at the street interface. Resulting in a useful typology that could be used to understand the flow of people between different territories of indoor and outdoor, or public and private spaces.

Kamalipour (2016) on the other hand, focused on two main variables only, proximity and connectivity, to create six different typologies which are adjacent impermeable, adjacent accessible, adjacent porous, distant impermeable, distant accessible, and distant porous (Figure 2.19). It is through this typological classification system that Kamalipour's study effectively presents a comprehensive understanding of the nature of street interfaces, grounded in the fundamental concepts of connectivity and proximity. Therefore, the study provides an understanding of street interfaces based on connectivity and proximity.

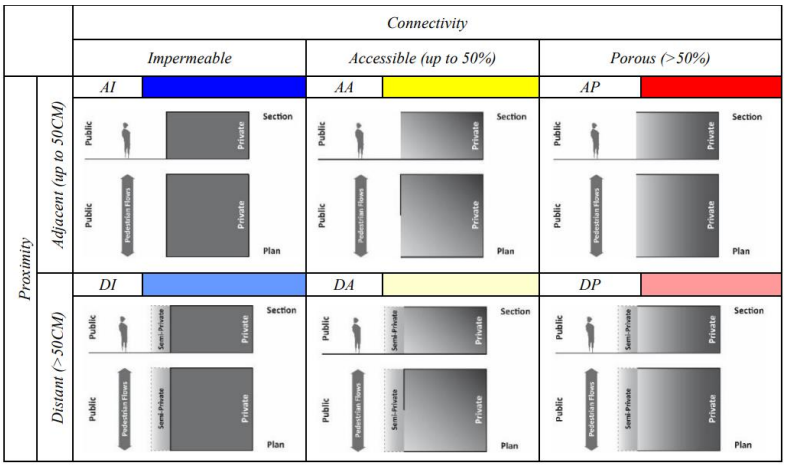


Figure 2.19 : Classification of the street interface into six types according to proximity and connectivity (Kamalipour, 2016).

Other studies classified the street interface types according to the urban environment. For example, a classification of interfaces in urban alleys was made according to building type, ownership status, directness, access, and position (Figure 2.20). The result was a classification of seven types of street interfaces in residential alleys which are: Impermeable, Back door, back garage, front door, front dual entrance, setback front dual entrance, and transition (Moreau, 2020).

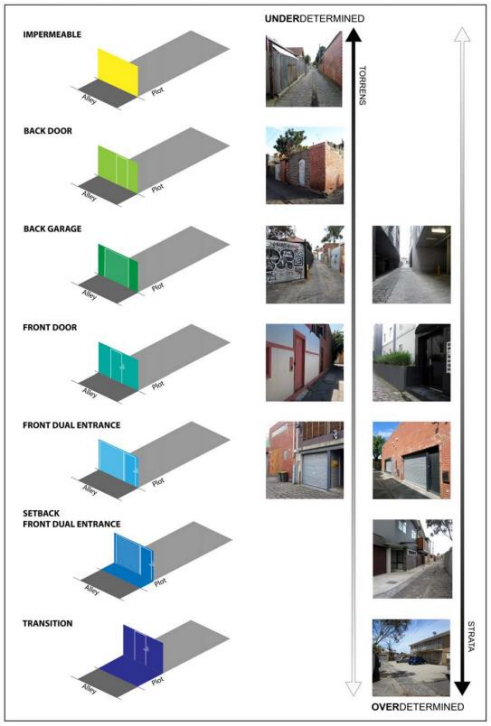


Figure 2.20 : Classification of the street interface in residential alleys according to building type, ownership status, directness, access, and position (Moreau, 2020).

Levi and del Rio (2016) classified the street interface according to the presence and typology of walls as follows: no wall, symbolic wall, security wall, privacy wall, fortress wall, and blind wall. The no wall type has no boundaries and the transition is defined with symbols or signs. The symbolic wall has physical boundaries such as a fence but it has visual permeability between the spaces. Security wall is a barrier that keeps intruders or strangers from entering the space. Privacy wall is similar to the security wall but with the addition of blocking the visual connection between spaces. Fortress wall is a combination of security and privacy walls, but usually taller and equipped with security measures. Finally, blind walls are street interfaces that don't offer any kind of connection between indoor and outdoor spaces (Levi and Rio, 2016).

In conclusion, the street interface was classified by many scholars according to different variables. These classifications are important to create a useful conceptual module that is used in studying different topics related to the street interface.

For this study, the street interface is classified into two types which are active and passive. This classification was made according to street livability which is a complex concept affected by many physical, social, and cultural factors (Mehta, 2013). A livable street is an active, healthy, and vibrant street. Its morphological characteristics and design should provide the user with the desired social activities and functions to participate in the urban environment.

Many designers and theorists stressed the importance of active street interfaces. The urban designer Jan Gehl in particular, supported active interfaces that encouraged permeability and activities. Whereas, passive facades such as blank walls were undesirable for creating a livable urban environment. He defines the active street interface as a key factor in a successful urban space (Gehl, 2011). Whyte (1988) on the other hand, argues that passive blank walls have a message. Although he criticized the modern development, which resulted in the creation of blank walls in cities that turned their backs on the people. He asked the questions of: Do we need active everywhere? and conversely: How much blankness is too much?

2.4.1.1 Active street interfaces

Active interface, or the edge of a space that provides visual, and physical permeability, as well as various functions to promote the social life of people encourages the vitality

of urban spaces, as opposed to passive blank walls that are considered boring and unloved by the people (Carr, et al., 1992) (Figure 2.21).

According to Jan Gehl, many physical factors that are related to urban design can affect the livability, vitality, and safety of street interfaces by making them active edges. He incorporates factors such as transparency, openings, car dependency, building scale, diversity of activities, the density of users, design quality, and physical appearance. The outcome of his studies resulted in a series of design recommendations and strategies to create active street interfaces and healthy cities. These included removing large areas of blank and uninviting walls and promoting ground-level building facades that provide interest through windows and visible indoor activity, to encourage people to walk through and stay longer in the space (Gehl, 1994).

Both transparency and the presence of openings encourage people to use the street interface actively. A study aimed to define the most important factors of street interface configuration that influence people's visual perception has shown that pedestrians spend a great amount of time interacting with permeable and accessible interfaces more than any other interface type (Al Mushayt et al., 2021). Another study aimed to measure street interface permeability both in qualitative and quantitative terms has shown that transparency and the presence of openings or entries are crucial factors to promote intense interaction between outdoor and indoor spaces. Lack of transparency and openings negatively affect the density of users, social interactions, and urban vitality (Andrade et al., 2018).

Car dependency is another significant factor that influences active interfaces. It was referred to by Gehl (2010) as the 5 km/hr architecture, which is the convenient speed for cities to become vital and active. A blank passive wall is mainly formed because of the presence of car roads. For this reason, modern cities are pedestrianizing many streets, creating underground parking spaces and drive-through spaces to activate the ground-level street interface. This method is gradually transforming our cities into exciting, active, and safe spaces to live in.

The human scale was also another concept stressed by the urban designer Jan Gehl. He noted that cities should be designed and observed at eye level (Gehl, 2010). In other words, the pedestrian point of view is crucial for urban designers to take into consideration when designing the street interface. From his perspective, interfaces that

are designed considering the human scale are more comfortable and enjoyable to walk by. They consider the relationship between senses, communication, and scale, making the street interface active and vital (Gehl, 2010).

The active street interface is also influenced by the diversity of land use, or the presence of more than one activity at the street interface (Jacobs, 1961). This issue was stressed by Jane Jacobs, who advocates for mixed-use buildings because they promote lively and active street interfaces (Jacobs, 1961).

The density of users is also a factor that increases the street interface activity because people get encouraged to use the space when they see others using it (Jacobs, 1961).

In general, design quality is a key factor in creating an active street interface. Christopher Alexander's pattern language was an example of a study based on solutions and strategies such as activity pockets, arcades, canvas roofs, sitting walls, street cafes, and positive outdoor spaces which can create a vibrant and active street interface (Alexander et al., 1977).

Further design elements were also suggested such as the horizontal grain of streets, public realm, movement, green spaces, water spaces, landmarks, attention to detail, and architectural style that can help create an active street interface and encourage social interaction (Montgomery, 1998).

The active street interface is not only affected by physical factors, but the feeling that people get from the space is also important. Sensory or physical experience was seen as an important factor by many scholars (Böhme, 2017; Pallasma, 2005; Gehl et al., 2006). This experience is mainly related to materials, details, and textures. In other words, the physical appearance and fine details that provide people with a great physical experience from the close encounter with the space, help make the street interface more active and enjoyable for its users.

In conclusion, the active street interface is achieved through different factors those are transparency, openings, car dependency, building scale, diversity of activities, density of users, design quality, and physical appearance. Taking these factors into consideration while designing the street interface help create an active, vital, and livable street interface. Thus, embracing these dimensions and infusing them into the urban design guide us towards the realization of a thriving urban environment.

Figure 2.21 : An example of an active street interface (Aytuğ and Yıldız, 2017).

2.4.1.2 Passive street interfaces

Although many studies advocated for active street interfaces and the elimination of blank passive walls. Scholars such as, Whyte argued that these passive interfaces have a message (Figure 2.22). From his perspective, active interfaces do indeed increase urban vitality, but we don't need active everywhere. There should be a balance between passiveness and activeness at the street interfaces of the city (Whyte, 1988).

Furthermore, in a study using audio and video recordings made by the walk-along participants, the street interfaces that were thought of as active and had many transparent facades were seen as dull by the participants of the study. As a result, active street interfaces didn't support lingering activities that contribute to street life vitality (McAllister, 2019).

From another perspective, blank or undetermined residential street interfaces were seen as more valuable than determined developments that had specific functions to offer. In a recent study, it was found that blank interfaces or interfaces that were perceived as passive by scholars such as Jan Gehl hold a meaningful social value to them. At these undetermined blank interfaces, people seemed to engage in various activities such as fruit picking, public art, and sports. Consequently, undetermined interfaces allow for more than one activity to occur. They are more flexible and express a sense of place, as well as social and cultural meaning for their users (Moreau, 2020).

In conclusion, a variation of blank, active, and flexible street interfaces is a suggested approach to the framing and application of urban codes to make the street interfaces vital and livable.

Figure 2.22 : An example of a passive street interface (Aytuğ and Yıldız, 2017).

2.5 Conclusion

The factors that affect perceived safety were derived from the basic theories and related major concepts on perceived safety. These factors are divided into three categories: physical factors, socio-cultural factors, and individual factors.

According to the literature, the physical factors include transparency, openings, diversity of activities, car dependency, setbacks, building height, physical appearance, greenery, and lighting.

The socio-cultural factors include the density of users, social incivilities, community cohesion, media influence, and crime rates. The individual factors include age, gender, ethnicity, and direct and indirect victimization.

The physical factors along with the socio-cultural factors that affect perceived safety were also the same factors that affect the passiveness and activeness of the street interface. Thus, they were used to classify the street interface into different types of active and passive, to test the effect of these types on perceived safety.

However, some socio-cultural factors which are social incivilities, community cohesion, media influence, and crime rates were not included in the scope of this study. This is due to certain limitations in the study that will be further discussed in the methodology chapter. As for the individual factors, they were taken into consideration as important factors that affect perceived safety (Figure 2.23).

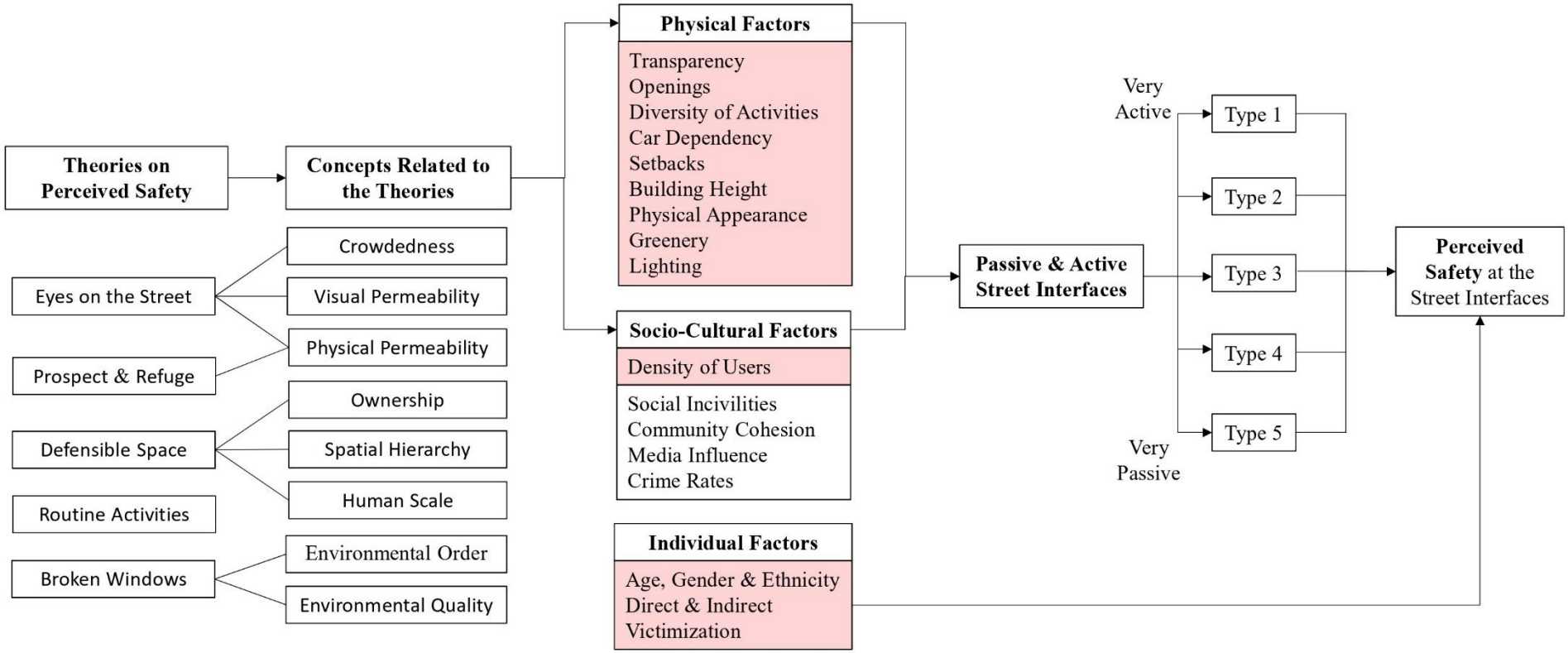


Figure 2.23 : Diagram presenting the conclusion of theories, concepts, and factors that affect perceived safety (Author, 2023).

3. RESEARCH METHODOLOGY

3.1 Methodology

This study employed a quantitative research method using a questionnaire. After the street interface was classified into different types of passive and active depending on the factors taken from the literature, a diagnostic observation was used to choose the appropriate case study areas for the classified types. An area of 30-40 meters of the streets' interfaces was chosen from each case study area. Then, the questionnaire was conducted to measure the user's perceived safety at these interfaces. For the data treatment, ANOVA test and Tukey's HSD were conducted using SPSS to calculate whether the differences between groups of means are statistically significant.

3.1.1 Classification procedure of the street interfaces

In order to classify the street interface into different types of passive and active, the factors that affect the activeness of the street interface were determined from the literature. In total 10 physical and socio-cultural factors were used for the study: density of users, transparency, openings, diversity of activities, car dependency, setbacks, building height, physical appearance, greenery, and lighting.

Four primary factors were determined to use for the classification of street interfaces into passive and active types. These factors include the density of users, transparency, openings, and diversity of activities. The other secondary factors were not used for the classification, to avoid a complex typology of street interfaces. However, they were considered for the evaluation of passive and active street interfaces in terms of perceived safety. As a result, the street interface was classified into five types: very active, active, average, passive, and very passive.

The diagnostic observation of the five streets has shown that the combination of the factors that were observed in the streets allowed each one of them to have a unique typology. These unique typologies were hypothesized to have different effects on users' perceived safety.

In total five street interfaces were chosen from different streets in the city of Istanbul. The very active street interface was chosen from Istiklal Street in Beyoglu, the active street interface was chosen from Bagdat Avenue in Kadikoy, the average street interface was chosen from Ciragan Street in Besiktas, the passive street interface was chosen from Murselpasa Street in Fatih, and the very passive street interface was chosen from Buyukdere Highway in Sisli.

The study primarily focused on the selection of cases that aligned with the classified typologies. It was not feasible to procure streets from the same neighborhood that possessed identical contextual and cultural characteristics. This constraint arose due to the absence of the five distinctive types within a singular geographic area of the city. Consequently, streets located in different regions of Istanbul were selected as substitutes. It is worth noting that these chosen streets exhibit dissimilarities in terms of their contextual and cultural attributes owing to their different locations within the city. For example, Istiklal Street is narrow, pedestrianized, and has a notable sense of enclosure. Functioning as a commercial street with important social, touristic, and political significance in the city. Whereas, Bagdat is a mixed-use avenue that is characterized to have residential buildings and some cafes and shops. This avenue is wider and has a pedestrian street along with car roads. Notably different from Istiklal Street in terms of its cultural context, and has a higher concentration of local residents relative to visiting tourists.

3.1.2 Questionnaire structure

The questionnaire was conducted to understand the effect of passive and active street interfaces on user's perceived safety, by measuring the user's perceived safety in the chosen case study areas. A non-random selection method was used for the questionnaire, targeting university students living in Istanbul. The questionnaire was available to the respondents for 30 days through the Google Forms platform and it received a total of 128 replies.

The first part of the questionnaire included real-life imagery of the case study areas both day and night. Two questions in each of the five case study areas were asked. The first question investigated whether the user felt safe at the location specified in the images (measured on a Likert scale from 1 to 5). The second question aimed to

measure the influence rate of the primary and secondary factors on perceived safety in each of the five case study areas (measured on a Likert scale from 1 to 5).

The second part of the questionnaire included the individual factors that affect perceived safety which are: age, gender, and direct & indirect victimization experience. Individual factors such as ethnicity were not taken into consideration, because of their non-significant effect on perceived safety.

3.1.3 Data Treatment

In total, 122 replies were analyzed. Non-parametric analysis was applied to the data. Then ANOVA test was conducted using SPSS to calculate whether the differences between groups of means were statistically significant. Tukey's HSD analysis using SPSS was then conducted, to compare the effect of the five types of street interface on users' perceived safety. It was also used to compare the effect of the street interfaces' factors on users' perceived safety.

3.1.4 Limitation of the study

The research methodology proposed a few limitations for the study. The real imagery method that was used to present the street interface types for the users in the questionnaire, proposed a limitation to evaluate some of the factors that affect perceived safety. Even though presenting real scenarios and imagery helps the respondents to put themselves in that situation, it allows for many potential distractions to intervene in their analysis of the space. Furthermore, some socio-cultural factors that were under the scope of the study could not be measured using this method. These factors are social incivilities, community cohesion, media influence, and crime rates.

In addition to that, another major limitation of the research methodology is related to the data collection method. The questionnaire was limited to a certain type of users, which were university students in Istanbul. This was done to keep the individual factors that affect perceived safety constant throughout the study.

Another limitation of the study is related to the contextual differences between the chosen case study areas. The chosen street interfaces were from different parts of Istanbul that have a variety of cultural, social, demographical, and contextual differences.

4. DATA ANALYSIS AND RESULTS

In this chapter, the two main research questions of the study will be answered. The results of the diagnostic observation and questionnaire will be presented both graphically and in a descriptive manner.

First, the results of the diagnostic observation that was conducted in the chosen cases of street interfaces will be presented, followed by the typological classification of street interfaces.

Second, the evaluation of the individual factors that affect perceived safety will be presented.

Third, the descriptive analysis of the data will be presented.

Fourth, ANOVA and Tukey's HSD results for the effect of the classified street interface types on perceived safety will be presented.

Fifth, ANOVA and Tukey's HSD results for the effect of the primary and secondary factors on perceived safety will be presented.

4.1 Chosen Cases of Street Interfaces

The case study areas were selected according to the classified types from important streets in the city of Istanbul. An area between 30-40 meters of the street interface was chosen from each street according to a diagnostic observation conducted by the researchers to choose the best area of the street interface that complies with the classified types.

In total, five street interfaces were chosen: Istiklal Street's/Beyoglu interface as the very active type, Bagdat Avenue's/Kadikoy interface as the active type, Ciragan Street's/Besiktas interface as the average type, Murselpasa Street's/Fatih interface as the passive type, and Buyukdere Highway's/Sisli interface as the very passive type.

4.1.1 The very active street interface: Istiklal Street/Beyoglu

Istiklal Street is located in the historical Beyoglu district, which is considered to be in the heart of Istanbul city. The street is a tourist attraction in the city and is known to be its main pedestrian boulevard.

The diagnostic observation that was conducted at Istiklal Street/Beyoglu has shown that this particular street has a huge density of users. However, this density might change according to the time of day or under special circumstances. But overall, the street's interface is characterized to have a large density of users when compared to the other four streets. Other than density, the transparent and open facades' presence at the street interface, as well as the diversity of functions and activities, have made the street very active. For example, people were seen shopping, walking, sitting, socializing, eating, taking videos and photos, etc.

As for automobile usage, the absence of cars and the subsequent prioritization of pedestrians allowed the street to attract more people and increase walkability. The presence of a tramway in the middle didn't seem to affect the walkability issue. But rather created a unique character for the street and increased activities at the street interface. People were observed to be taking selfies next to the tramway while it was passing. Although there was no presence of setbacks, the transparent and open facades made the street interface very active, allowing many eyes on the street.

The building height to street width ratio was between 1:1 and 1:2 which is considered a good enclosure ratio. The story heights ranging from 4 to 6 allowed people to feel engaged with their surroundings. Cultivating a sense of connectivity and interaction that is essential for creating an environment in which individuals feel not only physically embraced but also deeply engaged with the vibrant surroundings.

Overall, there were no physical incivilities at the street interface, with a low presence of greenery that was well-maintained and didn't create visual or physical obstacles.

Finally, the street was visited in the evening to analyze the lighting quality. The lighting quality exhibited within this street interface proved to be good, enveloping the surroundings with a warm and inviting glow. Besides the lights that were distributed between the buildings, the lights coming from the multiple stores and shops helped to make the space well-lit (Figure 4.1).

Figure 4.1 : Photos taken from the very active street interface type at Istiklal Street/ Beyoglu (Author, 2023).

4.1.2 The active street interface: Bagdat Avenue/Kadikoy

Kadikoy is one of the major historical districts, located in the Anatolian side of Istanbul. Its most important and luxurious avenue is Bagdat. It's 14km long, parallel to the Marmara coastline, and spanning between the two districts of Kadikoy and Maltepe.

The active street interface at Bagdat Avenue/Kadikoy is characterized to have a pedestrian setback between the private spaces and the public area. This setback attracted many users and activities to the interface. For example, the semi-private spaces of cafes and restaurants were visibly open to the public street, creating natural surveillance and increasing the range of activities at the interface. People were seen sitting, eating, and socializing at these pedestrian setbacks. Other than that, people were seen walking their pets and sitting on benches that were distributed along the street interface. Although the overall street width was larger than the building's height, which is a not desired enclosure ratio, the presence of large trees at the edges between the vehicular road and the pedestrian path created a human-scaled environment with a good enclosure ratio. The quality of lighting fixtures was observed to be good with

minimum blind spots created along the interface. Finally, the presence of transparent facades and balconies, as well as openings and doors allowed the interface to attract different people, and activities, making the street interface active. (Figure 4.2).

Figure 4.2 : Photos taken from the active street interface type at Bagdat Avenue/ Kadikoy (Author, 2023).

4.1.3 The average street interface: Ciragan Street/Besiktas

Ciragan Street is one of the most valuable streets in Besiktas district, located on the European side of Istanbul. It is parallel to the Bosphorus and surrounded by historical palaces and landmarks.

The average street interface type at Ciragan Street/Besiktas was observed to have less density of users than the active street interface type but still had a considerable presence of people. People were mainly seen walking, running, or driving scooters at this interface. The facades of buildings were considerably transparent with an approximate transparency rate of 50%. As for the openings or doors, there were some residential entrances and shops, or cafe entries. There was also a presence of pedestrian

setbacks, usually elevated from the street interface level, creating a physical boundary between the public and private areas. The well-maintained greenery was certainly a significant factor at this street interface. The tall limbs of trees didn't create visual or physical boundaries between the users and the interface at the viewer's eye level. It provided shade and a good enclosure ratio for users walking in the street (Figure 4.3).

Figure 4.3 : Photos taken from the average street interface type at Ciragan Street/ Besiktas (Author, 2023).

4.1.4 The passive street interface: Murselpasa Street/Fatih

Murselpasa Street is located in the Fatih district. The district is bordered by the golden horn and the city's old historical walls. It's known to be the main historical center of the city.

The passive street interface type at Murselpasa Street/Fatih was observed to have non-maintained greenery growing on passive historical walls. Other than that, some residential buildings were also worn-out, resulting in a poor physical appearance of the street interface. There was limited access or openings to the buildings at this interface, with passive walls dominating the interface. Only some occasional entrances to residential buildings or small workshops were observed at this interface. Lighting quality was observed to be poor in the evenings. Blind spots were observed, especially

along the passive edges of the historical wall. Automobile usage was certainly a dominating factor. The presence of a car setback, which was used as a parking space, limited pedestrian movement. However, the presence of some transparent facades, as well as nearby important historical buildings in the area, attracted some users to this interface. People were seen using the street interface as a passage to reach the historical attractions and leisure areas (Figure 4.4).

Figure 4.4 : Photos taken from the passive street interface type at Murselpasa Street/Fatih (Author, 2023).

4.1.5 The very passive street interface: Buyukdere Highway/Sisli

Buyukdere Highway runs through the districts of Sisli, Besiktas, and Sariyer in the European side of Istanbul city. The area that was chosen from this major highway is in the district of Sisli, which is known to be an important business center in the city of Istanbul.

The very passive street interface type at Buyukdere Highway/Sisli was observed to have a significant domination of automobile usage. The street interface edges were surrounded by passive impermeable, and non-transparent walls on one side and a

highway on the other side. There was no presence of people or activities at this interface. The enclosure ratio was observed to be poor, with a value larger than the recommended ratio which is 1:1 or 1:2. Finally, the presence of a highway resulted in a very passive typology of the street interface which is characterized to have limited or no presence of people, no activities, no transparency, and no openings. Furthermore, the quality of lighting that was distributed along the highway was observed to be very poor from the pedestrian's perspective. Darkness and poor visibility dominated the interface in the evenings and nights (Figure 4.5).

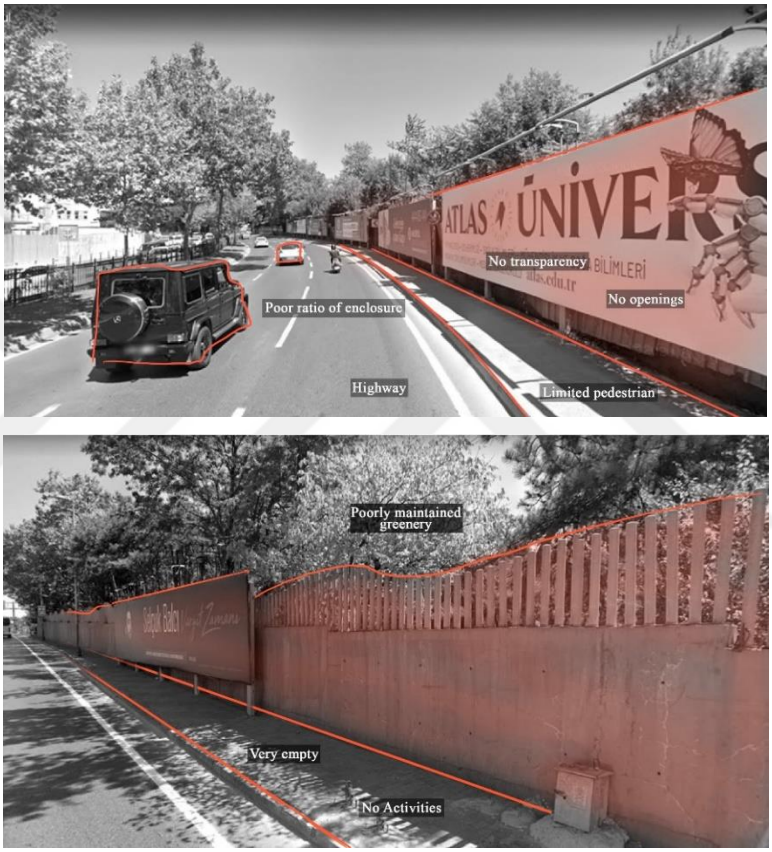


Figure 4.5 : Photos taken from the very passive street interface type at Buyukdere Highway/Sisli (Author, 2023).

4.1.6 Classification of the street interfaces

In summary, the street interface was classified into five types of active and passive interfaces according to the factors that affect perceived safety. In total four primary factors which are the density of users, transparency, openings, and diversity of activities, along with six secondary factors which are car dependency, setbacks, building height, physical appearance, greenery, and lighting were used for the classification and the evaluation of the case study areas (Figure 4.6).

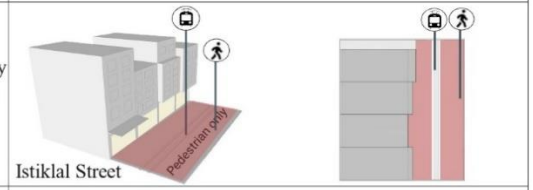
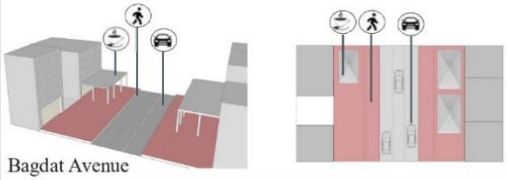
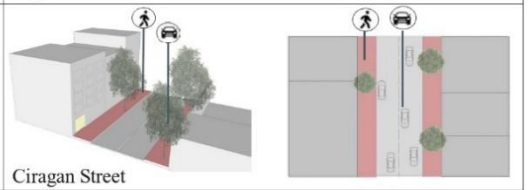
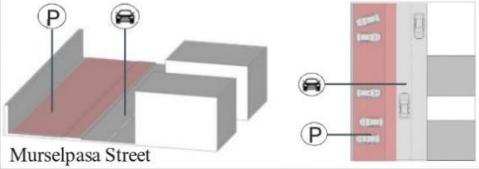
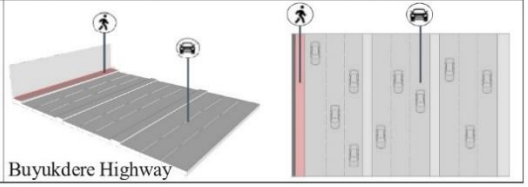
Street Interfaces	Density of Users	Transparency	Openings	Diversity of Activities	Car Dependency	Setbacks	Buildings Height	Physical Appearance	Greenery	Lighting	3D Presentation of the Cases
Type 1 Very Active	Very dense	80% and more Transparency	15 – 20 Doors per 100m	(4 to 5) Very high diversity of activities	Pedestrian / Tramway	Direct No setback	Good ratio of enclosure	No signs of physical disorder	Well-maintained greenery	Good quality of lighting	 Istiklal Street
Type 2 Active	Dense	50% to 80% Transparency	10 – 15 Doors per 100m	(3 to 4) High diversity of activities	Pedestrian / vehicular	Pedestrian setback	Good ratio of enclosure	No signs of physical disorder	Well-maintained greenery	Good quality of lighting	 Bagdat Avenue
Type 3 Average	Average	30% to 50% Transparency	4– 10 Doors per 100m	(2 to 3) Average diversity of activities	Pedestrian / vehicular	Pedestrian setback	Good ratio of enclosure	No signs of physical disorder	Well-maintained greenery	Good quality of lighting	 Ciragan Street
Type 4 Passive	Empty	10% to 30% Transparency	2 – 4 Doors per 100m	(1 to 2) Low diversity of activities	Pedestrian / vehicular	Car setback	Good ratio of enclosure	Signs of physical Disorder / Worn-out buildings	Non-maintained greenery	Poor quality of lighting	 Murselpasa Street
Type 5 Very Passive	Very empty	0% Transparency	0 – 2 Doors per 100m	(0 to 1) No activities	Limited Pedestrian / Highway	Direct No setback	Poor ratio of enclosure	No signs of physical disorder	Poorly maintained greenery	Poor quality of lighting	 Buyukdere Highway

Figure 4.6 : Diagram presenting the classification of the street interfaces into different types of active and passive, according to the factors that affect perceived safety, and the related case study areas for each type (Author, 2023).

4.2 Analysis of Individual Factors

The questionnaire received a total of 127 replies. To keep the individual factors that affect perceived safety constant, 5 people who encountered a previous victimization experience were excluded from the evaluation of the results. The total of 122 respondents had similar personal characteristics. The majority of respondents were university students with the same educational, and sociocultural level.

In terms of gender, the respondents were approximately equal with 52% of them male and 48% of them female (Table 4.1).

As for the age factor, 44% of the respondents were between the ages of 18 and 24. 53% of them were between the ages of 25 and 39, and 3% of them only were between the ages of 40 and 60 (Table 4.2).

Table 4.1 : Gender characteristics of the respondents.

Sex	n	%
Male	64	52%
Female	58	48%

Table 4.2 : Age characteristics of the respondents.

Age	n	%
18 to 24	54	44%
25 to 39	65	53%
40 to 60	3	3%
60 plus	0	0%

4.3 Descriptive Analysis of the Data

A descriptive analysis was conducted to obtain the mean values, maximum values, minimum values, and standard deviation of perceived safety at the 5 types of street interfaces (Table 4.3). The three types of streets which are, the very active street interface type at Istiklal Street, the passive type at Murselpasa Street, and the very passive type at Buyukdere Highway received a minimum of 1 and a maximum of 5, on a Likert scale from 1 to 5 (1 being the least safe, and 5 being the safest). Whereas the active street interface in Bagdat Avenue and the average street interface type in Ciragan Street received a minimum of 2 and a maximum of 5, on a Likert scale from 1 to 5 (1 being the least safe, and 5 being the safest).

Table 4.3 : Descriptive analysis results for perceived safety at the 5 types of street interfaces.

Street Interface	n	Mean	Std. Deviation	Maximum	Minimum
The active type (Bagdat Avenue)	122	4.28	0.74	2	5
The average type (Ciragan Street)	122	3.77	0.91	2	5
The passive type (Murselpasa Street)	122	2.70	0.98	1	5
The very active type (Istiklal Street)	122	2.49	1.08	1	5
The very passive type (Buyukdere Highway)	122	2.43	1.11	1	5

4.4 The Effect of the Classified Types on Users' Perceived Safety: ANOVA and Tukey's HSD Results

The results show that there is a statistically significant difference among the different street interface groups. In other words, very active, active, average, passive, and very passive street interfaces are significantly different from each other based on perceived safety ($F(4,605)=89.973$, $p < .001$).

Table 4.4 : Analysis of variance (ANOVA) results for perceived safety at the 5 types of street interfaces.

Perceived Safety	Sum of Squares	df	Mean Square	F	Sig.
Between groups	344.056	4	86.014	89.973	<.001
Within groups	578.77	605	.956		
Total	922.433	609			

In order to compare the effect of the five types of streets on perceived safety and understand which groups are significantly different from each other, Tukey's HSD analysis was applied to the pairs of street interfaces (Table 4.5). It revealed that the active street interface in Bagdat Avenue is the most successful type in terms of perceived safety with a significant difference in mean value from the other four types of streets ($N = 122$, $M = 4.28$, $SD = .74$). The average street interface type in Ciragan Street was seen as less successful with a significantly lower mean value than Bagdat's Avenue interface, and a significantly higher mean value than the other three types of streets ($N = 122$, $M = 3.77$, $SD = .91$). Whereas, the other street types which are, the very active street interface type at Istiklal Street ($N = 122$, $M = 2.49$, $SD = 1.08$), the

passive type at Murselpasa Street (N = 122, M =2.70, SD = .98), and the very passive type at Buyukdere Highway (N = 122, M =2.43, SD = 1.11), were not successful in terms of perceived safety, with a statically significant difference in mean value than the other two groups of street interface types. There was no statistical difference in mean value between these last three types of street interfaces.

Table 4.5 : Tukey's HSD analysis results for the pairs of street interfaces.

Street Interface	Street Interface	Sig.	Presence of Significance
The very active type (Istiklal Street)	The active type (Bagdat Avenue)	<.001	Yes
	The average type (Ciragan Street)	<.001	Yes
	The passive type (Murselpasa Street)	.433	No
	The very passive type (Buyukdere Highway)	.991	No
The active type (Bagdat Avenue)	The very active type (Istiklal Street)	<.001	Yes
	The average type (Ciragan Street)	<.001	Yes
	The passive type (Murselpasa Street)	<.001	Yes
	The very passive type (Buyukdere Highway)	<.001	Yes
The average type (Ciragan Street)	The very active type (Istiklal Street)	<.001	Yes
	The active type (Bagdat Avenue)	<.001	Yes
	The passive type (Murselpasa Street)	<.001	Yes
	The very passive type (Buyukdere Highway)	<.001	Yes
The passive type (Murselpasa Street)	The very active type (Istiklal Street)	.433	No
	The active type (Bagdat Avenue)	<.001	Yes
	The average type (Ciragan Street)	<.001	Yes
	The very passive type (Buyukdere Highway)	.196	No

Table 4.5 (continued) : Tukey's HSD analysis results for the pairs of street interfaces.

Street Interface	Street Interface	Sig.	Presence of Significance
The very passive type (Buyukdere Highway)	The very active type (Istiklal Street)	.991	No
	The active type (Bagdat Avenue)	<.001	Yes
	The average type (Ciragan Street)	<.001	Yes
	The passive type (Murselpasa Street)	.196	No

In summary, the passive and active street interfaces can be classified into three categories according to their perceived safety levels (Figure 4.7). The first category includes the passive, very passive, and very active street interfaces, which have poor levels of perceived safety. The second category includes the average street interface, which has fair levels of perceived safety levels. The third category includes the active street interface, which has high levels of perceived safety (Table 4.6).

Figure 4.7 : Diagram presenting the perceived safety and the significance levels between mean values at the 5 types of street interfaces.

Table 4.6 : The grouping of the 5 street interface types according to their perceived safety levels.

Group	Street interface type	Perceived safety level
Group 1	The very passive street interface The passive street interface The very active street interface	Poor level of perceived safety
Group 2	The average street interface	Fair level of perceived safety
Group 3	The active street interface	High level of perceived safety

4.5 The Effect of Factors on Users' Perceived Safety: ANOVA and Tukey's HSD Results

In order to understand why some street interfaces were successful in terms of perceived safety and others were not, ANOVA test was conducted to test the impact of the factors which are: (density of users, transparency, openings, diversity of activities, car dependency, setbacks, building height, physical appearance, greenery, and lighting) on users' perceived safety levels. Then, Tukey's HSD analysis was applied to the pairs of the street interfaces' factors, to compare their effect on perceived safety levels at each of the 5 street interface types.

ANOVA test revealed that the factors that were used to classify the street interfaces have a significant impact on the users' perceived safety in each of the 5 street interface types.

Tukey's HSD analysis results revealed that the lighting factor was the most influencing physical factor on users' perceived safety in almost all of the street interface types. However, in each of the street interface types, certain factors affected perceived safety levels more than others.

Starting with the very active streets interface in Istiklal Street, the high levels of user density were perceived as threatening and disturbing by users. There was a significant difference between the density of users and the rest of the physical factors at this street interface (N = 122, M =4.00, SD = 1.213) (Table 4.7). Thus, the presence of people is not always perceived as safe by users, especially when the density level exceeds a certain threshold. It is important to acknowledge that the street encompasses various cultural, political, and social factors that conceivably hold an influence on the perception of safety among its users. For instance, the observed diversity of users utilizing the street potentially affects perceived safety, a factor that was unexplored

within the scope of this study. Moreover, the occurrence of crime rates and the influence of social media may likewise yield an impact on the perceived level of safety experienced by individuals traversing this particular street.

The very passive street interface in Buyukdere Highway which is deserted and has no functions, was also seen as dangerous and unsafe by users. At this street interface, the car dependency physical factor was perceived as the most influencing factor, with a statistical difference in mean value from the other factors (N = 122, M =3.95, SD = 1.332) (Table 4.8). The blank edges of the interface which are dominated by highways, create an almost deserted space for users to walk or pass by, making the street interface to be perceived as unsafe and threatening by users.

The passive street interface type in Murselpasa Street is the third street interface type that wasn't perceived as safe by users. The interface is dominated by a car park and passive edges of historical buildings. At this interface, there was no specific factor that significantly affected the perceived safety levels more than the other factors. In other words, there was no significant difference between the mean values of the pairs of factors.

The average type interface in Ciragan Street, which has permeable facades and a fair variety of activities was perceived as safe by users. Tukey's HSD analysis revealed that in this particular street interface, the greenery factor had a statistically significant impact on the user's perceived safety when compared to other physical factors such as transparency, openings, diversity of activities, setbacks, car dependency, and physical appearance (N = 122, M =3.55, SD = 1.500) (Table 4.9). Thus, the presence of well-maintained greenery has a significant positive impact on users' perceived safety at the street interface.

Finally, the active street interface in Bagdat Avenue which has a considerable amount of user density and a variation of permeable and non-permeable facades, as well as a considerable variation of functions and activities is perceived as the safest interface type by users. There was no specific factor that affected perceived safety levels significantly more than others at this street interface type. A combination of well-designed factors allowed this street to be the most successful street type in terms of perceived safety.

Table 4.7 : Tukey's HSD analysis results for the pairs of Istiklal Street interface factors.

Factors	Factors	Sig.	Presence of Significance
Density of users	Transparency	<.001	Yes
	Openings	<.001	Yes
	Diversity of activities	<.001	Yes
	Car dependency	<.001	Yes
	Setbacks	<.001	Yes
	Building height	.002	Yes
	Physical appearance	<.001	Yes
	Greenery	<.001	Yes
	Lighting	1.000	No

Table 4.8 : Tukey's HSD analysis results for the pairs of Buyukdere Highway interface factors.

Factors	Factors	Sig.	Presence of Significance
Car dependency	Density of users	.253	No
	Transparency	<.001	Yes
	Openings	<.001	Yes
	Diversity of activities	<.001	Yes
	Setbacks	<.001	Yes
	Building height	.152	No
	Physical appearance	<.001	Yes
	Greenery	<.001	Yes
	Lighting	1.000	No

Table 4.9 : Tukey's HSD analysis results for the pairs of Ciragan Street interface factors.

Factor	Factor	Sig.	Presence of Significance
Greenery	Density of users	.758	No
	Transparency	.001	Yes
	Openings	.001	Yes
	Diversity of activities	.002	Yes
	Setbacks	.020	Yes
	Car dependency	.004	Yes
	Building height	.794	No
	Physical appearance	.003	Yes
	Lighting	.932	No

5. CONCLUSION

Perceived safety at the street interface has become a recurring issue for urban designers and planners. The study aimed to research the effect of passive and active street interfaces on perceived safety.

In total 10 socio-cultural and physical factors were determined from the literature. Four primary factors were determined which are the density of users, transparency, openings, and diversity of activities, along with six secondary factors which are car dependency, setbacks, building height, physical appearance, greenery, and lighting. These factors were used to classify the street interface into different types of active and passive: very active, active, average, passive, and very passive. A questionnaire was then conducted to test the effect of these classified street interface types on perceived safety. The questionnaire also tested the influence of the primary and secondary factors on perceived safety. The individual factors that affect perceived safety were kept constant throughout the study. ANOVA and Tukey's HSD test were applied to the data using SPSS, to measure and compare the significance level between mean values.

The study answered the main research questions as follows:

- The results of the study revealed that the active street interfaces was the most successful street interface type in terms of perceived safety. Followed by the average street interface type. Too much activeness or passiveness at the street interface was not desired and was perceived unsafe by the users.
- The factors that affect perceived safety and that were used to classify the street interface into various types had a significant influence on users' perceived safety. In each type of street interface, certain factors had an influence on perceived safety more than the other factors. In general, lighting was an influencing factor in almost all the street interfaces, followed by the density of users, transparency, openings, and diversity of activities. Physical incivilities, car dependency, and greenery also had a significant influence on perceived safety. The difference between these factors' influence rate on perceived safety

was varying in each case study area. A combination of well-designed street interfaces that take into consideration all these factors was the most successful street interface type in terms of perceived safety.

The results support the previous studies. It shows that the primary factors that were used to classify the street interface into passive and active types which are, transparency and openings (Appleton, 1984; Stamps, 2010, 2012; Fisher and Nasar, 1992; Rocha, 2017; Vrji & Winkel, 1991), the density of users (Vrji & Winkel, 1991; Goffman, 1971; Yunmi & Gracia, 2019), and diversity of activities (Fowler, 1987; Anderson et al., 2013; Yunmi & Gracia, 2019) have a significant effect on perceived safety.

Finally, this study presented a framework in which the factors at the street interface can be analyzed and classified. This classification can be used to determine the perceived safety levels at the street interface according to the passiveness and activeness levels. Since the passiveness and activeness levels of the street can be determined using observation, this conceptual framework can be applied to various streets to analyze the users' perceived safety, relying on observations and analysis that can be done by the researcher. Therefore, the study results aims to benefit urban designers and planners in creating safe street interfaces for people. It can also help establishing urban design guides that will be beneficial to the local government.

Future research is needed to further develop and test the efficiency of this framework. More comprehensive classification of passive and active street interfaces can be created, using both the primary and secondary factors. For example, other than the created five main types, sub-types can be added to create a more comprehensive classification of passive and active street interfaces. Furthermore, the research methodology used for this study proposed a few limitations. Certain socio-cultural factors that were under the scope of the study couldn't be measured using the imagery presentation method. Nasar (2001) proposes a possible way to deal with this limitation in future studies. The images can be manipulated and the factors can be controlled to adapt to the required scenario and reach more conclusive results. This solution requires a detailed pre-treatment of the imagery, but it can lead to more conclusive results. Another limitation of the study was related to the recruitment of the participants. The study targeted university students. Having a wider range of participants would give more accurate results which can be included in future studies as well. Although the

results presented significant outcomes, it is important to mention that these results belong to a narrow sample of users. Attempting to collect data that covers a large diversity of users, can be a way of presenting less biased results in future studies. Finally, given the subjective nature of the perceived safety issue, future research can adopt a mixed methodology approach encompassing both quantitative and qualitative methodologies. For example, by supplementing the questionnaire-based assessment with walking interviews conducted on the streets, a more precise depiction of the results can be achieved. This combination of methods offers the potential to enhance the accuracy and depth of the findings on the issue of perceived safety.

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APPENDICES

APPENDIX A: Questionnaire Format

APPENDIX A: Questionnaire Format

Location 1: Istiklal Street (day/night)
Konum1: İstiklal Caddesi (gündüz/gece)

How safe would you feel in the location shown in the previous images? *
Yukarıdaki fotoğraflarda gördüğünüz sokakta kendinizi ne kadar güvende hissedersiniz?

	1	2	3	4	5	
Very unsafe/Çok güvensiz	○	○	○	○	○	Very safe/Çok güvende

Please indicate how the following characteristics of the street you see in the pictures affect your feeling of safety. *
Lütfen resimlerde gördüğünüz sokağa ait aşağıdaki niteliklerin güvende hissetmenizi nasıl etkilediğini belirtiniz.

	Not effecting/ Etkilemiyor	Slightly effecting/ Az etkiliyor	Moderately effecting/ Orta derecede etkiliyor	Importantly effecting/ Önemli derecede etkiliyor	Very importantly effecting/ Çok önemli derecede etkiliyor
Windows at the building facades/ Bina cephesindeki pencereler	○	○	○	○	○
Doors at the building facades/ Bina cephesindeki kapılar	○	○	○	○	○
Multiple activities/ Birçok aktiviteler	○	○	○	○	○

Density of people/ İnsanların yoğunluğu (kalabalıklık)	○	○	○	○	○
Car roads/ Araba yolları	○	○	○	○	○
Shaded cantilevered areas/ Gölgelik alanlar	○	○	○	○	○
Greenery/ Yeşil öğeler	○	○	○	○	○
Physical appearance/ Binaların fiziksel görünüş	○	○	○	○	○
Building heights and street width/ Bina yükseklikleri ve sokak genişliği	○	○	○	○	○
Lighting quality/ Aydınlatma elemanları	○	○	○	○	○

Location 2: Bagdat Street (day/night)
Konum 2: Bağdat Caddesi (gündüz/gece)


How safe would you feel in the location shown in the previous images? *
Yukarıdaki fotoğraflarda gördüğünüz sokakta kendinizi ne kadar güvende hissedersiniz?

	1	2	3	4	5	
Very unsafe/Çok güvensiz	○	○	○	○	○	Very safe/Çok güvende

Please indicate how the following characteristics of the street you see in the pictures affect your feeling of safety. *
Lütfen resimlerde gördüğünüz sokağa ait aşağıdaki niteliklerin güvende hissetmenizi nasıl etkilediğini belirtiniz.

	Not effecting/ Etkilemiyor	Slightly effecting/ Az etkiliyor	Moderately effecting/ Orta derecede etkiliyor	Importantly effecting/ Önemli derecede etkiliyor	Very importantly effecting/ Çok önemli derecede etkiliyor
Windows at the building facades/ Bina cephesindeki pencereler	◯	◯	◯	◯	◯
Doors at the building facades/ Bina cephesindeki kapılar	◯	◯	◯	◯	◯
Multiple activities/ Birçok aktiviteler	◯	◯	◯	◯	◯
Density of people/ İnsanların yoğunluğu (kalabalıklık)	◯	◯	◯	◯	◯
Car roads/ Araba yolları	◯	◯	◯	◯	◯
Shaded cantilevered areas/ Gölgelik alanlar	◯	◯	◯	◯	◯
Greenery/ Yeşil öğeler	◯	◯	◯	◯	◯
Physical appearance/ Binaların fiziksel görünüş	◯	◯	◯	◯	◯
Building heights and street width/ Bina yükseklikleri ve sokak genişliği	◯	◯	◯	◯	◯
Lighting quality/ Aydınlatma elemanları	◯	◯	◯	◯	◯

Location 3: Ciragan Street
Konum 3: Çirağan Cadessi

How safe would you feel in the location shown in the previous images? *
Yukarıdaki fotoğraflarda gördüğünüz sokakta kendinizi ne kadar güvende hissedersiniz?

	1	2	3	4	5	
Very unsafe/Çok güvensiz	○	○	○	○	○	Very safe/Çok güvende

Please indicate how the following characteristics of the street you see in the pictures affect your feeling of safety. *
Lütfen resimlerde gördüğünüz sokağa ait aşağıdaki niteliklerin güvende hissetmenizi nasıl etkilediğini belirtiniz.

	Not effecting/ Etkilemiyor	Slightly effecting/ Az etkiliyor	Moderately effecting/ Orta derecede etkiliyor	Importantly effecting/ Önemli derecede etkiliyor	Very importantly effecting/ Çok önemli derecede etkiliyor
Windows at the building facades/ Bina cephesindeki pencereler	○	○	○	○	○
Doors at the building facades/ Bina cephesindeki kapılar	○	○	○	○	○
Multiple activities/ Birçok aktiviteler	○	○	○	○	○

Density of people/ İnsanların yoğunluğu (kalabalıklık)	○	○	○	○	○
Car roads/ Araba yolları	○	○	○	○	○
Shaded cantilevered areas/ Gölgelik alanlar	○	○	○	○	○
Greenery/ Yeşil öğeler	○	○	○	○	○
Physical appearance/ Binaların fiziksel görünüş	○	○	○	○	○
Building heights and street width/ Bina yükseklikleri ve sokak genişliği	○	○	○	○	○
Lighting quality/ Aydınlatma elemanları	○	○	○	○	○

Location 4: Murselpasa Street
Konum 4: Murselpaşa Caddesi

How safe would you feel in the location shown in the previous images? *
Yukarıdaki fotoğraflarda gördüğünüz sokakta kendinizi ne kadar güvende hissedersiniz?

	1	2	3	4	5	
Very unsafe/Çok güvensiz	○	○	○	○	○	Very safe/Çok güvende

Please indicate how the following characteristics of the street you see in the pictures affect your feeling of safety.
Lütfen resimlerde gördüğünüz sokağa ait aşağıdaki niteliklerin güvende hissetmenizi nasıl etkilediğini belirtiniz. *

	Not effecting/ Etkilemiyor	Slightly effecting/ Az etkiliyor	Moderately effecting/ Orta derecede etkiliyor	Importantly effecting/ Önemli derecede etkiliyor	Very importantly effecting/ Çok önemli derecede etkiliyor
Windows at the building facades/ Bina cephesindeki pencereler	○	○	○	○	○
Doors at the building facades/ Bina cephesindeki kapılar	○	○	○	○	○
Multiple activities/ Birçok aktiviteler	○	○	○	○	○
Density of people/ İnsanların yoğunluğu (kalabalıklık)	○	○	○	○	○
Car roads/ Araba yolları	○	○	○	○	○
Shaded cantilevered areas/ Gölgelik alanlar	○	○	○	○	○
Greenery/ Yeşil öğeler	○	○	○	○	○
Physical appearance/ Binaların fiziksel görünüş	○	○	○	○	○
Building heights and street width/ Bina yükseklikleri ve sokak genişliği	○	○	○	○	○
Lighting quality/ Aydınlatma elemanları	○	○	○	○	○

Location 5: Buyukdere Highway (day/night)
Konum 5: Büyükdere Caddesi (gündüz/gece)

How safe would you feel in the location shown in the previous images? *
Yukarıdaki fotoğraflarda gördüğünüz sokakta kendinizi ne kadar güvende hissedersiniz?

	1	2	3	4	5	
Very unsafe/Çok güvensiz	○	○	○	○	○	Very safe/Çok güvende

Please indicate how the following characteristics of the street you see in the pictures affect your feeling of safety. *
Lütfen resimlerde gördüğünüz sokağa ait aşağıdaki niteliklerin güvende hissetmenizi nasıl etkilediğini belirtiniz.

	Not effecting/ Etkilemiyor	Slightly effecting/ Az etkiliyor	Moderately effecting/ Orta derecede etkiliyor	Importantly effecting/ Önemli derecede etkiliyor	Very importantly effecting/ Çok önemli derecede etkiliyor
Windows at the building facades/ Bina cephesindeki pencereler	○	○	○	○	○
Doors at the building facades/ Bina cephesindeki kapılar	○	○	○	○	○
Multiple activities/ Birçok aktiviteler	○	○	○	○	○
Density of people/ İnsanların yoğunluğu (kalabalıklık)	○	○	○	○	○
Car roads/ Araba yolları	○	○	○	○	○
Shaded cantilevered areas/ Gölgelik alanlar	○	○	○	○	○
Greenery/ Yeşil öğeler	○	○	○	○	○

Physical appearance/ Binaların fiziksel görünüş	○	○	○	○	○
Building heights and street width/ Bina yükseklikleri ve sokak genişliği	○	○	○	○	○
Lighting quality/ Aydınlatma elemanları	○	○	○	○	○

Were you directly or indirectly victimized in one of the locations mentioned before?
Fotoğraflarda bahsedilen yerlerden birinde suça kurban gitiniz mi?

- ○ Yes, in location 1/Evet, konum 1'de
- ○ Yes, in location 2/Evet, konum 2'de
- ○ Yes, in location 3/Evet, konum 3'te
- ○ Yes, in location 4/Evet, konum 4'te
- ○ Yes, in location 5/Evet, konum 5'te
- ○ No/Hayır

Please choose your age range. *
Lütfen yaş grubunu seçiniz.

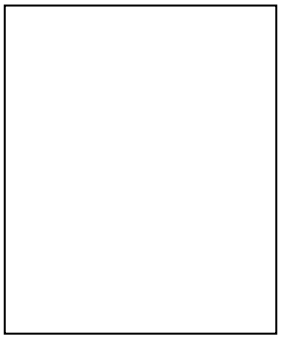
- ○ 18-24
- ○ 25-39
- ○ 40-60
- ○ 60+

Please choose your gender. *
Lütfen cinsiyetinizi seçin.

- ○ Male/Erkek
- ○ Female/Kadın

Figure A.1 : full format of the questionnaire that was used for the study.

CURRICULUM VITAE



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PROFESSIONAL EXPERIENCE AND REWARDS:

- Graduated as the first ranked student with a high honour degree from the Faculty of Architecture, Class of 2019, Eastern Mediterranean University.

PUBLICATIONS, PRESENTATIONS AND PATENTS ON THE THESIS:

- **Zaibak L., Özkan D.** 2023: A Typological Analysis of Active and Passive Street Interfaces based on Perceived Safety. IX. International Online Conference on City Planning and Urban Design - CPUP'23. May 19, 2023 Istanbul, Turkey.