Towards Delivering Restorative Street Design Principles in Shanghai, China

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A Thesis for the Degree of Doctor of Philosophy

October 2020

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United Kingdom

ACKNOWLDGEMENT

My most sincere gratitude must go to my advisor, Dr Kevin Thwaites, who has guided me walk through the past three years and influenced me a lot with his patience, intelligence, knowledge and academic attitude.

I wish to say 'thank you' to my parent, Mr. Yin and Mrs. Ren, for their unconditional support. Their love is my power of moving forward.

Special thanks to my research partners Dr Yuhan Shao and Miss Zhenyin Xue for their unreserved help and encouragement, and to my dearest friend Miss Qingxue Meng and Mr. Xin Hua for their company and love.

Finally, I would also like to thank all my lovely friends in Sheffield, my colleagues in University of Sheffield and Shanghai Tongji Urban Planning and Design Institute Co. Ltd., as well as those strangers who have offered valuable suggestions to my research.

I hope this work would make all of you proud!

ABSTRACT

This thesis explores the restorative opportunities that can be delivered to urban inhabitants through their routinely used urban street settings in the context of high-density urban development. This is important because despite the obvious benefits accompanied with high-density urban development, numerous urban stressors also come with it. Psychological issues such as depression, stress and mental fatigue facilitate people's desire to contact with nature for seeking a period of recovery. However, the diminishing nature resources in urbanisation process constrained the creation of and access to the sort of green vegetated spaces conventionally associated with restorative experience. This research sets out from exploring solutions for this dilemma and contributes to delivering an efficient way of providing people with restorative opportunities in an everyday urban setting – street, in a typical megacity, Shanghai in China. Restorative potential of urban street is a rather overlooked part in the long development of restorative environment research. Urban streets are essential components of urban outdoor spaces that are easily accessible to people. Any restorative potential urban street environments have (or can be designed to have) can have a significant impact in urban daily life. This research proposes that there is a necessity in exploring restorative benefits of urban streets under the current circumstance. Moreover, it asserts that the restorative benefits of street should be delivered differently to conventional restorative settings since they are not spaces simply created for leisure purposes. Street has multiple functions and characteristics other than bringing users with restorative experiences, thus the delivery of street restorative quilt should be achieved without compromising its other necessary qualities. Therefore, users' street restorative expectations are assumed to be an essential standard in the delivering of street restorative potential.

This research devotes itself to firstly justify the significance and necessity of exploring street restorative potential and establishes its conceptual framework through investigating the overlaps between urban street design and restorative environment research. In order to meet the fundamental aim of developing a Restorative Street Design Approach (RSDA) for providing people with restorative experiences according to their expectations, a multi-method approach including document analysis, case study, questionnaire and interview is used. The whole process is designed into three consecutive stages. The first stage investigated people's expectations of having restorative experiences in different types of urban streets using a developed restorative measurement instrument, Restorative Component Scale (RCS). This research then attempted to bridge users' restorative perceptions with street design attributes in the second stage by constructing the Street Restorative Measurement Framework (SRMF). SRMF includes restorative related street design indicators identified from the literature and validated using an on-site questionnaire-based survey. The last important stage discussed possible restorative design instructions based on information obtained in previous two stages, including: users' evaluations on the expected and current street restorativeness, as well as the relationship between restorative perceptions (measured with RCS) and restorative related street design indictors (measured with SRMF). The whole research process is conducted in the context of Shanghai, therefore four typical Shanghai street types classified in Shanghai Street Design Guidelines are focused and representative case-study streets are selected.

In such respect, this study takes a step forward in broadening the scope of restorative environment research, and to understand the difference between restorative streets and conventional restorative settings. More important, this study has managed to bridge between peoples' restorative perceptions and street design aspect, so that necessary design interventions can be developed according to their relationships. It also confirmed that people's restorative experiences in different types of street environment do vary with each other and their restorative expectations on these different streets reveal differences as well. This research is carried out through a step-by-step procedure, of which each stage was founded on the outcome of the last one and responded to issues that emerged in the previous. The most important research outcome, Restorative Street Design Approach (RSDA), can not only be used as an integrated process to provide restorative street design solutions, but can also become an independent tool in many other aspects of street design practices. The process of developing RSDA also illustrates an example of applying perceptive qualities in practical environmental design.

Keywords: Restorative benefits, urban streets, ART, expectation, street typology.

AWARD

Faculty Research Support Scheme 2019

International Associations of People-environment Studies (IAPS) Young Research Award 2018

INVITED PRESENTATIONS

Yin, Y. (2018a). "Evaluating Expected and Current Street Restorative Quality in Shanghai, China - Using a self-rating restoration scale (RS) as a measurement tool." In 25th International Associations of People-environment Studies (IAPS) Conference: *Transitions to sustainability, lifestyles changes and human wellbeing: cultural, environmental and political challenges*, Rome, 8-13 July 2018.

Yin, Y. (2018b). "Measuring Expected and Current Street Restorative Quality in Shanghai, China - Using a self-rating restoration scale (RS) as tool" In 13th International Symposium for Environment-Behavior Studies (EBRA) conference: *Differences and integration of urban and rural environment*, Wuhan, 2-4 November 2018.

Yin, Y. (2020). "The identification and evaluation on restorative streetscape elements – a case study of University Road in Shanghai, China". In 25th International Associations of People-environment Studies (IAPS) Conference: *Setting the pace for future generations,* Quebec (Virtual), 21-26 June 2020.

PUBLISHED PAPERS

Yin, Y., Shao, Y., Xue, Z., Thwaites, K., and Zhang, K. (2020). An explorative study on the identification and evaluation of restorative streetscape elements. Landscape Architecture Frontiers, 8(4), 76-89.

Yin, Y., Thwaites., K, Shao, Y., Sun Zeliang (*In publication*). The Balance of the Restorativeness and Functional Value of Street Environment --- Taking Shanghai Commercial Street and Traffic Street as an Example. New Architecture.

Yin, Y., Thwaites., K. and Simpson, J. *(In revision).* Measuring Street Restorative Expectations in Shanghai – using Restorative Component Scale as an Explorative Approach. *Urban Design and International.*

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ABBREVIATIONS

Restorative Street Design Approach (RSDA)

Restorative Component Scale (RCS)

Street Restorative Measurement Framework (SRMF)

Attention Restoration Theory (ART)

Stress Reduction Framework (SRF)

Perceived Restoration Scale (PRS)

Perceived Restorative Potential (PRP)

Restoration Outcome Scale (ROS)

CHAPTER 1 INTRODUCTION

This research of 'Towards Delivering Restorative Street Design Principles in Shanghai, China' aims at developing an approach for delivering restorative experiences in the urban street environment, which contributes to highlight restorative potential as an essential quality in promoting the social value of urban streets. This approach is referred as Restorative Street Design Approach (RSDA) and it is built on users' restorative expectations of different street types. After developing and validating the RSDA, it is then used in this research to develop a set of design principles for four case-study streets selected in Shanghai, in order to show how this approach is can be used effectively in street design practices. Restorative environment research has formative roots in environmental psychology, focusing on developing the understanding of environmental characteristics with the potential to restore depleted psychological, physiological and social resources (Ulrich, 1983; Ulrich, 1984, Hartig, Mang and Evans, 1991, Hartig et al., 2003). In urban contexts, there is evidence of increasing research attention being given to the restorative potential of natural elements within the built environment, such as urban parks (Hartig, Mang and Evans, 1991; Hartig et al., 2003; Nordh et al., 2009). To date, however, it tells us relatively little about the ordinary urban streetscapes that are often the settings that feature in peoples' everyday lives. It is, therefore, important for this aspect of urban design to receive more systematic research to develop better insight into the restorative potential of these common urban settings; this is particularly true given that the green and vegetated spaces conventionally regarded as restorative are becoming rarer in contemporary high-density urban areas. The urban street environment is gradually playing an increasingly important role in urban daily life, with the discovery of its expanded social value. This research asserts that this may successfully be focused on the capacity of urban streetscapes to act as networks of linked spaces offering a host of restorative opportunities. The significance of this research lies in broadening the scope of existing restorative environment research, as it stresses the restorative potential of manmade urban settings and the necessity of providing restorative experiences in easily accessible, daily environments to urban residents.

This research is innovative in a variety of aspects. First, it asserts that, in addition to natural environments and natural-dominated urban spaces, the common urban street environment has the potential to provide users with restorative experiences, the significance of which should be realised by both practitioners and researchers. This is even more important under the current global situation, where natural resources are becoming extremely limited in highly densified urban areas. It also identifies the need for the restorative benefits of the urban street setting to be delivered in consideration of peoples' expectations, as well as the differences that exist between expectations and street types – streets are urban spaces, not simply designed for the purposes of leisure. Finally, it proposes a way of developing restorative street design interventions through constructing and utilising a framework of street design indicators that are associated with restorative experiences. Subsequently, this research also contributes to successfully bridging the void between restorative environment research and urban design or, more specifically, between restorative perceptions and street design; this relationship connects intangible restorative perceptions with tangible attributes of urban street environments. On the basis of this established relationship, this research investigates the restorative experiences of people, both the current and the expected, as they walk through different types of urban streets. The objective of investigating these experiences is to benefit future design practices by providing instructive design implications towards promoting restoration in response to users' expectations. This will be achieved through a case study approach implemented in Shanghai, China. This thesis provides evidence for future research and practices by developing the Restorative Street Design Approach (RSDA) and demonstrating its feasibility, applying it to improve the restorative benefits of a selection of urban street settings.

The first chapter illustrates an outline of this thesis, starting with an introduction focussing on the general research context and research rationale. Through clarifying the scope of the problem, the research aim and objectives are defined. This is followed by a clarification of the significance and novelty of this research. It concludes with a brief on the thesis structure.

1.1 Research Background

1.1.1 Restorative environment as a response to social sustainability

Concern for human dimension is never outdated (Gehl, 2010), particularly when humans are in the middle of a 'great social experiment that humanity has ever undertaken: that of unprecedented migration from the countryside to cities (Thwaites, Mathers and Simkins, 2013). The future of the world's population is urban (UN, Department of Economic and Social Affairs, 2019). In the World Cities Report 2018, an estimated 55.3% of the world's population lived in urban settlements, and the global urban population is projected to grow by 2.5 billion urban dwellers in the next 30 years (United Nations, 2019). Highly densified urban development processes generate greater chances of achieving sustainability, as this ideally leads to a reduction in car use and an increase in resource efficiency, accessibility and economic viability (Jenks, Burton and Williams, 1996). However, it is difficult to realise these benefits in practical situations (Burgess, 2000) as there are many disadvantages that come with the inflating high-density megacities. One significant and common disadvantage for urban inhabitants is that of health issues, including physical issues, such as obesity – caused by a high dependency on car use – and psychological illness, such as depression, anxiety and insomnia – resulting from urban stressors, including noise from traffic, congestion, fear of crime and crowding. The Healthy Cities movement is one of the first formal approaches in direct response to urbanisation's negative health consequences; the acknowledgement of these issues by both planners and policy makers is as vital to an urban environment's ability to provide citizens with 'a complete state of physical, mental, and social well-being, and not merely the absence of disease or infirmity' (World Health Organisation WHO, 1948, p.1), as it is to facilitate economic and social development.

It is worth reiterating that environment has long been understood and evidenced as being influential to human wellbeing (Sclar and Northridge, 2001). Previous research on restorative environment revealed the healing aspect of nature and proved that humans possess an inherent need and desire to connect with nature on a psychological level (Kaplan and Kaplan, 1989; Orians and Heerwagen, 1992). This need for nature has remained adaptive, even for those who live in cities, and it appears to be stronger for those who suffer from mental fatigue and decreased attention capacity, directly resulting from the depleted psychological resources associated with the continuous stimulation and decision-making that urban living often demands (Ulrich, 1979, 1984; Kaplan and Kaplan, 1989; Hartig, Mang and Evans, 1991; Hartig, 2004). However, opportunities for the relief provided by nature seems increasingly rare in contemporary densified cities： in these modern cities environments, green spaces have to make way for housing the increasing numbers of urban inhabitants and equipping them with necessary services and facilities. With the world becoming ever more urbanised and the urbanisation ever more threatening, the availability of nature and a focus on meeting human needs in the urban context is vital, not to mention the importance that nature plays in human well-being (Matsuoka and Kaplan, 2008). One way of fulfilling people's psychological needs, without compromising the overall agenda of achieving a sustainable urban development from an urban design perspective, is to consider whether this kind of restorative processes can be achieved in everyday urban environments.

1.1.2 The significance of urban street environment to be restorative

Although it has been argued that people's desire for a spacious, green, and quiet environment is inherently paradoxical with the compact development in urbanisation (cf. Wiersinga, 1997), there is no reason to compromise the overall agenda of maintaining the sustainable benefits that accompany highly densified urban development. Limited provision of and access to conventional restorative environments in highly densified urban environments has forced researchers and practitioners to explore more sustainable alternatives that contain natural elements, such as public parks and gardens (Hartig, Mang and Evans, 1991; Hartig et al., 2003; Nordh et al., 2009). However, there is relatively little evidence on whether urban hardscapes can play a potential role in this. This research, therefore, explores the restorative possibilities of urban settings, and suggests that restorative street design may provide balance to urban areas with high-density populations, through the provision of easy and everyday access to restorative experiences. Streets account for 25–35% of all developed urban land (Jacobs, 1995), which is substantially higher than the percentage of urban areas dedicated to parks and other public spaces. It is an elementary urban space that constitutes people's lives outside (Jacobs,

1995) and it is one of the main places where residents spend their time outdoors (Getz et al., 1982). Designing urban streets with restorative benefits that are equally accessible to all is in line with the essence and objective of the Healthy Cities movement – to deliver potential health benefits and ensure that they reach all citizens in urban areas across the world (Rydin et al., 2012). Inspired by the socio-psychological benefits outlined in previous restorative environment research, the assertion here is that this may be successfully focused on urban streetscapes and their ability to act as networks of connected spaces that deliver a host of restorative opportunities; it may also prove to be a beneficial way of augmenting the placeness of streets.

Other urban hardscapes, such as plazas and shopping malls, may also play an important role in delivering restorative experiences to urban residents. Given the incomparably high accessibility of urban streets, this research contributes to exploiting the restorative potential of urban street settings. Streets are urban vessels, and cities, especially large ones, possess a high density of road networks in order to maintain rapid and efficient operations for both vehicular and pedestrian movement (Figure 1-1). The connected street networks, as a result of the rapid urbanisation process, provide a good base for streets to deliver accumulative and relatively short periods of restorative experience; as long as people venture from their homes on foot, whether recreationally or for a specific purpose, contact with the urban street occurs. Another fundamental reason for this thesis to focus on the street environment is that previous research findings suggest that, although people only spend a limited time in these mundane environments (e.g., short bouts of walking for 10–15 minutes), they can accumulatively play an important role in people's effective functioning and well-being (Hartig, 2007a) and are associated with shifts towards increased arousal and positive effects (Ekkekakis et al., 2000). The inevitability of street functions unconsciously influences people each time they go out, indicating that any restorative potential a street environment may have, or can be designed to have, could provide substantial benefits to urban life. As a large and growing number of people living in densified urban areas need to satisfy their restorative requirements on and around urban streets, it is necessary to explore the restorative potential of the urban street environment (Lindal and Hartig, 2013).

City		Road Density (km/km2)
United States	New York	13.1
	Chicago	18.6
Japan	Tokyo	18.4
	Yokohama	19.2
	Osaka	18.1
Spain	Barcelona	11.2
China	Beijing	5.59
	Shanghai	**7.10**
	Shenzhen	9.50
	Guangzhou	7.02

Figure 1-1 Street Density (left, Source: Wang, Zhang and Xue, 2008) and Network (right, Source: Jacobs, 1995) of World Major Cities.

1.1.3 A reasonable approach of delivering restorative street environment

This study highlights a relatively overlooked aspect of restorative environment research, proposing that streetscape design can optimise the restorative potential of street experiences in an appropriate way. By using the word appropriate, this research specifically highlights a specific agenda for the study of street restorative potential that does not necessarily apply to other traditional restorative environments, such as parks, gardens and squares. The appropriate level of street restorativeness is determined by the balance between its capacity to provide restorative experiences and its other functions, such as supporting movement and social life. This delicate balance is influenced by every aspect of a street's characteristics; for example, a motorway is not expected to be as restorative as a residential street lined with maple trees, outdoor cafes and food vendors. Hence, the novelty of this research not only lies at trying to broaden the general scope of restorative environment research but also contributes to exploring a coherent and flexible way for urban street environments to appropriately provide restorative experiences. It is worth emphasising that this research does not seek a formula or static result, but to illustrate a way of utilising this developed approach RSDA to generate context-based restorative street design solutions, with the consideration of users' expectations. This is achieved through a case study on four typical streets in Shanghai, selected to represent the four major street types proposed in the Shanghai Street Classification System.

When attempting to design restorative settings, it is important to know which physical aspects and key properties to work with in the design process (Ivarsson and Hagerhall, 2008) and to thoroughly evaluate their current situations. A comprehensive and efficient evaluation framework can offer an insight into the environmental and restorative perceptions of current street conditions, as well as to provide a basis for instructing future design improvements. However, bridging the void between environmental perceptions and design aspects is never easy. Environmental attributes may not tell us much about the experience of walking in a particular street environment, and this kind of information may be harder to come by when focussing on restorative experience: a complex perception composed of more than one psychological perspective that may have complex or subtle relationship with physical environmental attributes.

The need for a straightforward relationship between street restorative perceptions and urban streets attributes has revealed the critical step of this research. Through a literature review-based discussion on the overlaps between restorative environment theory and urban street design, this research developed a framework composed of both the restorative related street design indicators and their associations with street restorative benefits – Street Restorative Measurement Framework (SRMF). Drawing on people's restorative expectations, this research finalises the restorative design approach, the critical step of which is to utilise the newly developed SRMF to provide restorative street design instructions. During the research process, each step offers necessary evidence and instructions for moving forwards and finally achieving the aim and objectives of this research.

1.2 Scope of Problems: the neglected restorative value of street environments in Chinese super cities

There was a time when the extended function of streets was undermined and overwhelmed by a tendency to define and use streets solely by their movement function. However, people all over the world are reclaiming their streets as public spaces, with an awakening realisation of their social values. As a fundamental component of public spaces, urban street networks connect public and private spaces to other public and private spaces (UN Habitat, 2013). The late 20th century witnessed significant urban expansion and an imbalance of development during the urbanisation process, as many city areas developed during this period failed to deliver a diverse, transit-friendly, human-scaled and walkable urban environment, not to mention also overlooking the aesthetic, economic and ecological aspects and the locality and identity it may provide. The urban street environment in many cities eventually became a space solely for transportation functions under the car-dominated street design paradigm, ruling out irrational and unpredictable human activities for the purpose of serving fast and increasing mobile traffic movement. The traffic utility of roads was over-emphasised, while other qualities of streets were relatively neglected, causing fragmentation in urban areas and problems with severance (Carmona et al., 2003). Jacobs (1961) believed that it is the technical road design paradigm that directly leads to the suburbanisation of cities and the desertification of streets, weakening the sense of community, the identification of landmarks and places, and to the eventual decline of cities. Similar concerns for the endangerment of daily urban life stem from the fear and worry of cars conquering the streets (Gehl, 2010). The inspiring and provoking calls for more diverse, liveable and sustainable urban spaces made by Alexander (1964) and Jacobs (1961) in the 1960s and more recently by Gehl (1977, 1986, 1996), Hillier (1996), Salingaros (2005) and Marshall (2005a) – diverted attention from cars to pedestrians, encouraging a desire to create pedestrian-dominated environments, facilitated by a range of travel modes (Carmona et al. 2003).

The current emphasis on streets as utilitarian corridors is gradually moving towards a focus on their potential contribution as urban places. This general shift is evidenced in the increased consideration of the nature of urban streets in coping with various social and environmental challenges exposed during the urbanisation process over the last ten years, as well as by an emerging wave of published street design guidelines across global cities. Several cities across the world have published their own city design guidelines, such as the *NYC Street Design Manual* (New York City Department of Transportation NYC DoT, 2009; 2015), *London Streetscape Design Guidelines* (Transport for London TfL, 2019) and *Shanghai Street Design Guidelines* (Shanghai Planning and Land Resources Administration Bureau SPLRAB, 2017). However, an efficient delivery of street design practices still lags behind the multiple roles streets assume in the urban open space system, and it has been embodied and recognised in these guidelines. Despite the general well-intentioned planning visions, specific regulations and instructions are still predominantly structured by utilitarian values; subsequently, the expression of social values in practical design are still limited. For example, the design of physical street features (e.g., crossing signals and turning radius) are usually prioritised and account for the majority of the 'Safety' section in these guidelines, while a broader perspective of safety, such as the perception of being safe, is rarely mentioned. This limitation has also been reflected in street classification criteria adopted in the street design guidance in various countries; most guidelines classify streets according to their place and movement functions, for example, the *NYC Street Design Manual* and *London Streetscape Design Guidance*. However, most of these guidelines are still relatively vague in their classifications, with only the intensity of transport and place functions of streets being provided. These imperfections in street classification systems leads to difficulties in pursuing street design practices. An attempt to represent specific street characteristics can be observed in the street classification typology, raised in the *Shanghai Street Design Guidelines* (SPLRAB, 2017), but it still lacks a coherence between street categorisations and its following recommended specific design instructions.

1.3 Research Aims and Objectives

The social value of streets has gradually been recognised and revealed not only through the developing of street design concept (see Jacobs, 1961; Appleyard and Lintell, 1972; Appleyard, 1981; Bosselman et al., 1999; Sauter and Huettenmoser, 2008; Sanders, 2015) but also through classification system and design guidelines (see SPLRAB, 2017; TfL, 2019). Therefore, every dimension of urban streets, including their physical and psychological benefits, should be explored as comprehensively as studies covering other urban open spaces. While agendas of this sort can greatly increase the general understandings of street design in urban contexts, much work remains to be done so that these principles can be embedded at the practical level and their implementation can be incentivised. One response to this, which also forms the focus of this research, is to explore the restorative potential streets may provide, as a means to influence and steer planning and design decision-making in the direction of more socially responsive and sustainable street solutions.

This research devotes itself to develop a Restorative Street Design Approach that is capable of delivering restorative experiences for street users, according to their expectations on different street types (the aim). This approach can be used by professionals in streetscape design to optimise the restorative potential of the street experience. The research aim of developing the RSDA is addressed through achieving the following five objectives:

- To develop the conceptual framework of restorative streets by respectively reviewing restorative environment and urban street literature and discussing their overlaps.
- To investigate users' current and expected restorative experiences in different types of street environments, in Shanghai.

- To develop an evaluation framework - Street Restorative Measurement Framework (SRMF) composed of street design attributes identified from relevant literature that are potentially associated with users' restorative experiences.
- To bridge the gap between street design attributes (measured with the evaluation framework SRMF) and users' restorative perceptions, using a multi-method approach.
- To develop restorative street design implications according to disclosed discrepancies between users' restorative expectations and their evaluations on current restorativeness (perceptions), with the help of the established connection between restorative related street indicators and restorative perceptions.

Accordingly, two additional research outcomes besides of the RSDA are expected during the process of developing it:

- The development of a street restorativeness evaluation framework (SRMF) composed of environmental perceptions and establishing their relationship with restorative perceptions.
- The utilisation of discrepancies between users' restorative expectations and their experiences in current street settings to indicate possible street restorative design improvements, with the help of the aforementioned SRMF.

1.4 Research Significance, Novelty and Expected Outcome

1.4.1 Research significance

The urbanisation process produces both positive and negative outcomes, regardless of whether it is in a Chinese or a Western context. Inactive urban lifestyles, inefficient and uneven distribution of public green landscapes and an urban environment that increasingly relies on automobiles have combined to create the current crisis in obesity and triggered a variety of fatal diseases (Intelligence, 2013). Compressed living space, limited accesses to natural environments, traffic congestion, crowding and noise are part of living in an urban environment and contribute to inhabitants' physiological and psychological issues. With the rapid development of the Chinese urbanisation process in past decades, China is in the throes of a mental health crisis, with 54 million Chinese residents suffering from depression, accounting for 4.2% of the country's overall population, and the number is continuously climbing (Huang et al., 2019). Natural settings have been proven to be more beneficial to humans' psychological health, compared to urban settings (Herzog et al., 1997; Laumann, Gärling and Stormark, 2003; Hartig and Staats, 2006). However, there is an apparent mismatch between green space provision and population density in most Chinese megacities. A recent study (Xu et al., 2019) found that the average service coverage rate of urban green parks in prefecture-level cities in China only reaches 64.8%, and there are more than 20% of prefecture-level cities that have a service coverage rate of less than 50%. These results indicate a gap between the actual service level of urban green parks and the current national standards (100% of coverage). Even for those cities with a relatively higher coverage rate, such as Beijing, Shanghai and Guangzhou, obviously uneven distributions of urban green space can be observed, with a higher density of parks at the peripheral area where population is sparser than that of the inner-city area (Figure 1-2). Subsequently, urban parks are becoming increasingly scarce green resources in high-density cities, as they are not equitably accessible to everyone, particularly after taking into consideration of travelling time and distance.

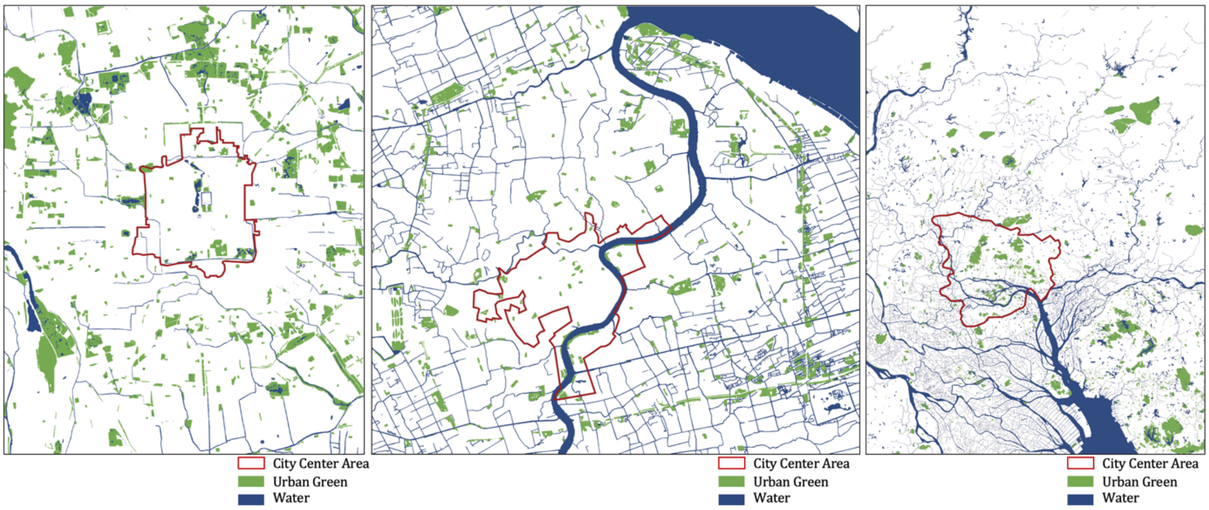


Figure 1- 2 Urban Parks and Water Patches extracted from Google Map (L-Beijing; M-Shanghai; R-Guangzhou). Source: the author.

Several attempts have been made to ascertain the possibility of providing restorativeness through small green alternatives that are more accessible to people in everyday life, such as small pocket parks (Nordh et al., 2009), roof gardens (Heerwagan, 2009) and street vegetation (Lindal and Hartig, 2015). Some have even argued that a well-designed urban environment can rival nature in terms of providing restorative experiences (Ivarsson and Hagerhall, 2008; Karmanov and Hamel, 2008). This study proposes restorative experiences that can help urbanites recover from the pressure, stress and mental fatigue of an urban environment and asserts that these benefits should also be provided in more common urban settings (i.e., streets). Here, street environment is regarded as an integral urban setting in which restorativeness is not simply generated by its single element but as a synthetic outcome of flexible and dynamic interactions between various streets attributes. Unlike urban parks that share similar functions regardless of the context, every street undertakes its own functions and, therefore, presents its own unique characteristics. The essence of the street being an elementary open space in urban environment determines its intimate relationship with people's outdoor life, therefore, determining the potential social significance if streets were designed to have restorative benefits. However, the potential of streets becoming common restorative settings in urban life has been relatively underestimated, both in theory and practice. This research attempts to bridge this gap by highlighting the socio-psychological capacity of the urban street environment in accumulatively delivering brief restorative experiences to street users in their everyday routines. It also explores potential restorative street design solutions on the basis of expectation-oriented design evaluations.

1.4.2 Research novelty

This research is in response to an increasing global concern relating to the potential role of the urban street environment in supporting and maintaining the social sustainability of the urban realm (Allocated and Core, 2013), through the provision of restorative benefits. Most existing efforts have been based on the restorative potential of natural environments (Ulrich, 1979, 1984; Hartig, Mang and Evans, 1991; Hartig et al., 2003); however, the significant novelty of this study is its assertion that urban street environments, which are not typically associated with the delivery of restorative experiences, have this capacity. Given streets are open spaces routinely used by urban dwellers, any restorative potential they may offer is significant, particularly in highly densified urban contexts experiencing a diminishing provision of and access to green vegetated spaces that are conventionally associated with restorative experiences (Ulrich, 1983; Ulrich et al., 1991; Hartig et al., 2003; Ivarsson and Hagerhall, 2008; Van den Berg et al., 2014). The attempt to explore potential opportunities within commonly available and routinely encountered street settings is necessary and important, as street restorative experiences, however fleeting, are more easily and frequently accessible than a daytrip away from a city, staying in a natural environment, or spending a few hours wandering in an urban park.

This research makes a bold assertion: the restorative potential of street environment should be considered differently to more traditional restorative environments (i.e., urban green spaces) by introducing the concept of restorative expectations and investigating their relationship with different street types. The street setting has complicated functions, rather than being a simple place for people to use recreationally. Unlike other urban spaces, such as parks and plazas, that are created specifically for people to relax and enjoy, the street setting has a role in supporting movement and commercial and social interactions. Providing restorative experiences is an essential quality street setting should possess; however, it does not mean all streets should be designed to reach the same level of restorative capacity. This explains why people's restorative expectations are of particular importance under the current research context, as it can help develop restorative design improvements in an economic and rigorous way, according to users' wishes. Users' expectations are determined, or at least influenced, by their cognitions of former experiences in similar settings (Zajonc, 1980), combining their embedded feelings, images and thoughts. Therefore, this research also highlights the need to take street categories into consideration, when exploring restorative expectations in the street context. Exploring the restorative potential of different environments, both on a comprehensive level (including more scene types) as well as on a detailed level (concentrating on one scene type) (Ivarsson and Hagerhall, 2008), is more necessary than ever when the research focus is on street contexts. Street categories are defined by multiple factors, including locality, surrounding land uses, landscape attributes, other streets connections and how people normally use it. This research proposes that certain types of street are expected to provide a higher level of restorative experience than others, as the emphasis of each street may vary depending on the category they belong to and their defining characteristics.

A research focus on restorative streets can also contribute to restorative environment research by broadening the scope of environments that are considered to offer restorative benefits. Even though previous studies have started to pay more attention to the restorative benefits of well-designed urban environments (Ivarsson and Hagerhall, 2008; Karmanov and Hamel, 2008), streets are not typically thought of as places where people would usually go for restorative purposes. Previous studies use traffic-dominated street environments in opposition to natural settings to highlight the healing advantages of natural environments (Hartig et al., 2003). Restorative environment theory traditionally favours natural environments, as they possess certain attributes that facilitate some physical and psychological variations that promote restoration. However, there is no solid rationale for why these attributes can only be provided by typical natural settings (i.e., forests and wetlands) or those environments dominated by elements of nature (i.e., gardens and parks). It is worth noticing that among the few researchers who have tried to address this, Scopellti and Guiliani (2004) stress the particular potential of historic buildings in the restorative process. Following this, several urban places with special or significant meaning were proven to be restorative, as their special identities convey an experience away from everyday routines, such as a monastery (Ouellette, Kaplan and Kaplan, 2005), or a house of worship (Herzog et al., 2010). However, historic buildings and those places with special meanings or functions are less frequently accessible in daily urban life than green spaces and can sometimes be costly. This research attempts to broaden the scope of restorative environment research by highlighting the importance of the everyday urban environment, starting by exploring the restorative potential of common street environments.

1.4.3 Expected research contributions

In summary, this research is expected to contribute to four important aspects of restorative street design. First, it intends to measure users' restorative expectations for different street settings, which will then be used to instruct the improvement of street restorative potential. It is assumed that users' expectations will be extremely beneficial to human-oriented urban design, as its focus is trained on people's environmental experiences. The second contribution is the construction of an evaluation framework comprised of restorative related street indicators that are of particular relevance in evaluating street settings – SRMF. SRMF has been developed with the potential of becoming a basic framework for future research in this or related arenas of exploration. The third contribution, which also the aim of this study, is to deliver the Restorative Street Design Approach (RSDA) step by step which will assist in the production of restorative street design instructions, based on users' expectations and street categorisations. The essence of this approach is to bridge the gap between street design attributes and users' restorative perceptions and use this connection to instruct necessary design improvements from the perspective of users. The final contribution is four sets of restorative street design instructions, produced by applying this experimental and newly developed RSDA on four case-study streets, in the chosen Shanghai city context.

1.5 Thesis Structure

This thesis is structured in three parts with a total of nine chapters. It presents the process of moving from the integration of two realms of theory, restorative environment and urban design, under the urban street research context, before synthesising these theoretical findings to create a methodological framework for further reshaping and refinement and, finally, the developing of a design approach that can be applied in practices (Figure 1-3).

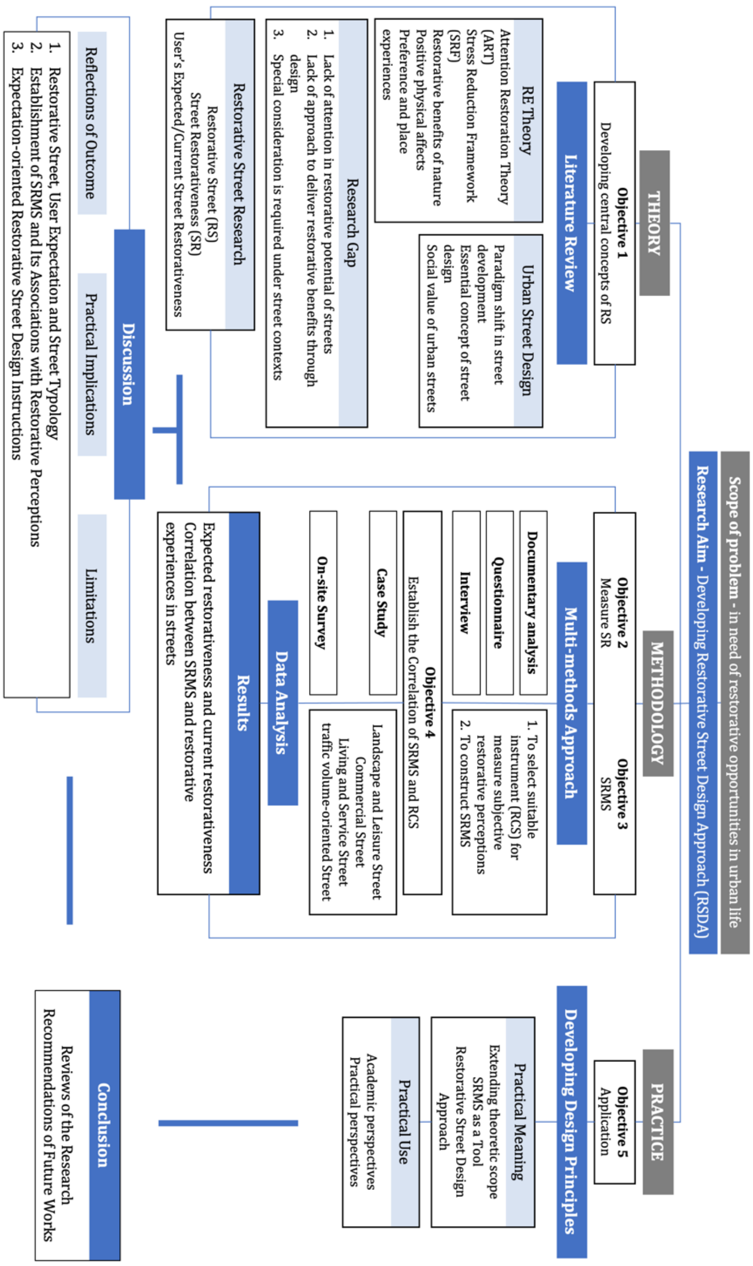


Figure 1- 3 The structure of this thesis. Source: the author.

Chapter 1 (Introduction) clarifies the central focus of this research and its theoretical background. It concisely introduces the scope of research problems and highlights aim and objectives of this study. Research significance and novelty are then further explained to make reader more understand of the research foundations. Relevant literature is then reviewed in **Chapter 2** (Literature Review) to develop essential concepts of street restorativeness in this research. The study is theoretically embedded in two research traditions: restorative environment; and street design studies. Accordingly, the literature review chapter is structured into two sections. This part is critical to the thesis since it not only developed the central research concept, but it also reveals the final product this research intends to deliver, as well as necessary steps towards achieving it by disclosing research gaps. **Chapter 3** (research methodology) starts to provide an outline of general methodological possibilities relevant to this kind of investigation in response to stated research objectives. It then focuses on the actual methods that will be deployed and explaining why these are the best ones. This methodology is then applied through a case study in Shanghai, China, the process of which is described in later three chapters. And **Chapter 4** (case-study streets) introduces four typical streets selected in Shanghai as case-study streets, respectively representing for Landscape and Leisure Street, Living and Service Street, Commercial Street and Traffic-oriented Street.

Chapter 5 illustrates an attempt of measuring people's expected level of restorative perceptions in order to set up a base line so that it can be used to compare with the current street restorativeness. Restorative Component Scale (RCS) is selected from existing psychometric questionnaires as an instrument to measure restorative perceptions in this study. The critical relationship between restorative perceptions and environmental attributes is then established in **Chapter 6**. This chapter starts from constructing a restorative relevant design framework from existing evidences, which is referred as Street Restorative Measurement Framework (SRMF), and then have it validated and refined through the case study on four Shanghai streets. **Chapter 7** gives out an example of utilising the outcome of previous chapters to develop restorative design instructions for the four case-study streets. Together with Chapter 4 and 5, they present a complete process of the development and application of a Restorative Street Design Approach (RSDA).

The **Chapter 8** of this thesis firstly demonstrates whether this research has achieved its stated aim and objectives. It then discusses the practical applications respectively from theory, methodology and findings to further highlight the importance of this study in relevant research and design practices. Limitations in each stage of this research are also generalised to inform necessary improvements in future studies. The thesis is then comprehensively reviewed in **Chapter 9** (conclusion) in terms of its major contributions and concluded with an outlook on potential future works in both research and practices aspects.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The core of this research is to explore how urban streets can be designed with the capacity of providing restorativeness as one of its common functional attributes. Unlike certain existing urban design concepts that are based on fruitful theoretical findings established by the 'giants' in relevant arenas, the use of restorative environment theory in practical urban design is still under exploration, possibly due to that the restorative street is a concept rooted in the overlaps of urban design and environmental psychology. Therefore, this research starts by developing the concept of restorative streets through a literature review involving the two perspectives mentioned above. Essential gaps have been identified in both arenas of the research on restorative environments and urban streets, again confirming the necessity and significance of this research. Potential ways to fill these gaps by utilising the overlaps of restorative environment research and urban street design are then discussed. Accordingly, this literature review is structured to respectively depart from restorative environment and urban streets research perspectives, and simultaneously attempt to reach out to each other from their own positions.

The review of restorative environment theory firstly provides a general introduction on its development and mainstream theories. This is followed by three sections illustrating the main focuses of previous studies that are particularly relevant to the current research, including discussions on dominant nature environment research in this field, measurements developed for restorative environmental appraisal and the relationship between restorative environments and two other essential concepts: place identity and preference. This part concludes by generalising three types of limitations identified in restorative environment research. The second part of the urban streets research begins with outlining the development process of urban streets and discussing the changes in roles due to urban development. This research proposes a broader viewpoint of considering the value of streets in urban life, developed from four essential planning concepts. Among these, restorative potential in particular contributes greatly to achieving Healthy Streets objectives.

In general, the literature review is expected to contribute to this research by approaching **Objective 1**, which is to develop the conceptual framework of restorative streets by respectively reviewing restorative environment and urban street literature and discussing their overlaps. The most important thing in this process is to develop a clear and comprehensive definition of restorative streets. This is also stated in this chapter, which will identify and justify which line of restorative theory is most applicable for this research. Several relevant terms that will repeatedly appear in this thesis will then be introduced and clarified accordingly. This chapter concludes with a summary, including a statement on key limitations discovered in previous literature and how this research will proceed in terms of filling the identified research gaps and progressing towards achieving the final research aim.

2.2 Restorative Environment Theory

Natural environments have long been considered to have restorative benefits regarding human health. This view can be traced as far back as the earliest large cities (Ulrich and Parsons, 1992). Earlier, well-known practical applications of this benefit can be traced back to the concept of 'healing gardens', which were previously popular in health care institutes for helping with patient recovery. The investigation regarding positive interactions between humans and nature has mainly progressed in the domain of environmental psychology, with one branch gradually evolving into restorative environment research. Two mainstream theories – Kaplan and Kaplan's (Kaplan, 1983; Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989; Kaplan, 1995) attention restoration theory (ART) and Ulrich's (Ulrich, 1983; Ulrich et al., 1991) stress reduction framework (SRF) – in restorative environment research have been introduced. The similarities and differences between these two theories will be discussed. The second section will focus on reviewing conventional restorative environment studies that provide particularly useful justifications for putting forward the current research. The section will firstly state that the restorative potential is overlooked due to the theory originating from investigations on the psychological benefits of nature. The positive changes resulted from exposing to nature will then be generalised, and commonly used measurements will be reviewed in order to determine possible ways to measure restorative perceptions according to the specific requirements of this research. The essential interactive relationship between restorative environment, preference and place identity will be discussed at the end of this section; thus, the necessity of involving the concepts of 'users' expectations' and 'environmental types' into restorative design will be revealed. The literature review will conclude with the generalising limitations identified in the current research and a discussion on how these limitations shed light on possible paths for proceeding with the current research.

2.2.1 Development of restorative environment theory

- From healing gardens to restorative environment

The idea that nature, the wilderness and enclosed gardens can have positive influences on human well-being is continuously developing throughout history. The ancient Romans documented that they valued their exposure to nature as an 'antidote' to the noise, congestion and other stressors in city life (Glacken, 1967). Beginning with the inspiring work of public health reformer, Florence Nightingale, an expression of design and health can be observed throughout the urban development process. This awareness is reflected in settings ranging from medieval monastic infirmaries, to the large municipal hospitals of the 17th and 18th centuries, to the pavilion-style hospitals, asylums and sanitoria of the 19th and early 20th centuries (Cooper-Marcus, 2007), where green nature, sunlight and fresh air were emphasised through particular arrangements of built form. The first hospitals in Europe to apply the concept of healing gardens in the Middle Ages were infirmaries in monastic communities, where cloistered gardens were designed and provided to bring relief to the ill (Cooper-Marcus and Barnes, 1999; Ulrich, 2002). This awareness can also be observed in Olmsted's influential justification for providing pastoral parks and other nature in America's cities, which came from his intuitively based ideas about the restorative effects of nature. He suggested that for individuals experiencing stresses associated with city life, viewing nature can be effective in refreshing and rejuvenating (Olmsted, 1952). The relationship between the environment and human well-being has been explored and utilised for centuries, from healing gardens (see Ulrich, 1992; Cooper-Marcus and Barnes, 1999) – such as Greek *asklepieia* that promoted patients to get recovery by arranging wards with southern orientation and Roman *valetudinarium* hospitals where central courtyards were provided for patients to enjoy fresh air and take a walk (Westphal, 2000) – to a broader concept of restorative environments (see Ulrich, 1983; Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989;) that has emerged in recent decades that emphasises the restorativeness of certain environmental features, and to a more general level of 'Healthy Cities Movements' (WHO, 1995) promoted to benefit human wellbeing by urban environmental design.

However, this widely adopted awareness was not formalised until 1984, when the first report about the measurable effects of nature's influence on health was published (Ulrich, 1984). Studies ever since have formed the basis of relevant realms of restorative environment research. A well-known study that demonstrated the therapeutic influences of nature was conducted by Ulrich (1984) on surgical patients to investigate whether ward windows displaying a natural scene could have positive influences on post-operation recovery. The results showed that the patients with a window view of trees had shorter postoperative hospital stays, fewer negative evaluative comments from nurses, took fewer moderate and strong analgesic doses and had slightly lower scores for minor postsurgical complications. Ulrich then further conceptualised these findings (1979a, 1981, 1983) into a psycho-evolutionary framework and proposed that natural environments have certain kinds of 'preferenda' that can produce visual ambiences that can quickly elicit affective/arousal reactions. Positive affective reactions can then trigger an important adaptive function for recovery from under-stimulation or excessively low arousal. Central to Ulrich's restoration theory (1983, 1984, 1991), commonly referred to as the stress reduction framework by later researchers, is that the psychological component positively changes in emotional states, e.g., reduced levels of negatively toned feelings such as fear or anger, and increases in positively toned affects (Zuckerman, 1977; Ulrich, 1979, 1991). Another significant study of relevance that also contributed greatly to restorative environment theory is the Outdoor Challenge Project, which was conducted over ten years (Kaplan and Talbot, 1983) with the purpose of finding convincing evidence proving increased exposure to the wilderness offers considerable and lasting benefits for a variety of individuals. Furthermore, it sought to more thoroughly explore both the nature of the benefits that such experiences offer and the ways in which such impacts are accounted for by an individual's experience in a wilderness environment. This programme has laid a foundation for restorative environment theory through describing a number of factors relevant to people's restorative experiences that are not in themselves unique to the wilderness setting (Kaplan and Talbot, 1983), which were later formalised into four major components in ART (Kaplan and Kaplan, 1989).

- Two mainstream theories

In the earlier stage of restorative environment research development, the majority of research concerning with environmental influences on human conditions involved extreme or unusual environmental conditions such as heat-related stress or noise pollution due to aircraft (van den Bosch and Sang, 2017; Münzel et al. 2018). Since then, environmental psychology studies have generally shifted to a different, though complementary, perspective on the influences between human and the environment. This becomes evident in the question of whether different common, non-extreme physical environments have distinct influences in terms of fostering or hampering recovery from stress (Ulrich and Simons, 1986). Rather than focusing on the negative impacts of extreme conditions, restorative environment research considers the recovery process in regard to people having depleted cognitive, psychological and physiological resources in their daily lives. Restorative effects in terms of negative impacts from everyday life have been generalised in previous studies, including reduction in cognitive fatigue, decreased stress levels, decreased negative affect activity and increased focus and positive affects (Hartig, Mang and Evans, 1991; Gullone, 2000). Restorativeness (Kaplan and Talbot, 1983; Kaplan and Kaplan, 1989) is, in this way, considered as a result of complex place experiences that emphasise the recovering aspects of places allowing people to restore their psychological, physiological and social resources that have been depleted in everyday life. Two mainstream theories, as mentioned above, have emerged in existing literature, both focusing on the recovery from a precedent condition. ART (Kaplan 1983; Kaplan and Talbot 1983; Kaplan and Kaplan 1989; Kaplan 1995) is concerned with recovery from directed attention fatigue, while the SRF (1991; see also Ulrich 1983) focuses on recovery from psychophysiological stress.

ART (Kaplan and Kaplan, 1989) mainly deals with the renewal of a depleted capacity for directing or focusing one's attention. ART proposes that after a period of prolonged use of directed attention, a person's capacity to ward off distractions becomes exhausted (Staats, Kieviet and Hartig, 2003). This builds primarily on assumptions about the evolution of human cognitive capabilities in natural environments (Hartig, 2007a) as well as a distinction between directed attention and fascination (James, 1892). Directed attention refers to 'attention that requires effort and is susceptible to fatigue' (Berto et al., 2010, p. 494), which is considered to be a necessary but exhaustible resource (Cohen and Spacapan, 1978; Driver, 2001), while fascination or 'soft attention' (Van der Linden et al., 2003; Berto, 2005; Kaplan and Berman, 2010; Basu, Duvall and Kaplan, 2018) refer to stimuli that require little effort and allow mental space for reflection. There are four factors that have been proposed for the renewal of a depleted capacity for directing attention. The first component is providing people with opportunities for ***being away*** from unwanted situations that consume directed attention. Kaplan and Talbot (1983) proposed three different patterns regarding these unwanted situations: people might want to get away from distractions such as noise and crowds, escape their typical routine work or have a break from pursuing a certain purpose that is more internal in origin. The second component is ***extent***, which is defined by two essential properties: connectedness and scope (Kaplan and Kaplan, 1989). Scope refers to how far the environment extends in both time and space, while connectedness refers to an environment that is sufficiently connected to constitute a larger whole (Kaplan, 1983). Together, they allow opportunities to explore and suggest a larger framework of rich possibilities. The third component, ***fascination***, is what one experiences when attention is effortless (Kaplan and Talbot, 1983). Therefore, a place with *fascination* allows people to function without having to use their direct attention, or what James (1892) called 'involuntary attention'. The last component in forming a restorative environment is ***compatibility***, which refers to the match between one's goals and inclinations, and environmental affordance in support of that inclinations; that is to say, 'the setting must fit what one is trying to do and what one would like to do' (Kaplan, 1995, p. 173). The importance of each component in delivering restorativeness varies. Herzog, Maguire and Nebel (2003) provided empirical data showing that the four components have different relative effectiveness as predictors of the restorative potential of environments, with *being away* and *compatibility* being far more powerful than *extent* and *fascination*.

The SRF (Ulrich et al., 1991; see also Ulrich, 1983) was derived from a psycho-evolutionary perspective mainly concerned with the emotional, attentional and physiological aspects of stress-reducing effects brought by the exposure to the natural environment. Stress is defined as the process through which an individual responds psychologically, physiologically and often behaviourally to a situation that challenges or threatens their well-being (Davidson and Baum, 1986). Accordingly, the SRF highlights stress reduction, rather than attention restoration, as the predominant benefit of exposure to nature. Furthermore, it emphasises positive changes in emotional states as the central psychological component of restoration (Ulrich et al., 1991). In addition to psychological components, the beneficial effects also include physiological aspects indicated by activity responses in numerous bodily systems (e.g., cardiovascular, skeletomuscular and neuroendocrine changes) and behavioural aspects (e.g., avoidance, alcohol or cigarette use, decreased cognitive performance in tasks such as proofreading) (ibid., p. 2). Ulrich (1983) proposed that perceiving particular qualities and contents in a scene can support psychophysiological stress recovery. Moderate depth, moderate complexity, the presence of a focal point, gross structural qualities and natural content (e.g., vegetation and water) can evoke positive emotions, sustain non-vigilant attention, restrict negative thoughts and aid the return of autonomic arousal to more moderate levels (cf. Fredrickson and Levenson, 1998; Shapiro et al., 2001). The fundamental contention of this framework is that this responsive process to nature settings with particular characteristics should be adaptive, ranging from stress and avoidance behaviour to restoration and approach behaviour (seeking out, staying in, not avoiding) (Ulrich, 1983, p. 93–95). Generally, this framework holds that restoration occurs when particular environmental properties facilitate an evident shift towards a more positive and active emotional status and a decreased level of physiological arousal.

- ART and SRF: similarities and differences

There are some debates on how to understand the relationship between attentional fatigue and stress during individuals' recovery processes. Previous research concluded that ART and the SRF mainly differ in the perspectives offered regarding what happens during a restorative experience, including the description of antecedent conditions from which the person becomes restored, restorative outcomes (Hartig, 2007a) and the time required for them to occur (Korpela and Ylén 2005). Some researchers have held attentional fatigue to be an after-effect of stress (Cohen, 1978), while others have treated it as a condition that makes a person more susceptible to stress (Kaplan, 1995; cf. Lepore and Evans, 1996). Environmental effects on attentional performance and physiological arousal were proven through separate processes (Hartig et al., 2003), which means that the antecedent conditions may occur alone or have reciprocal relationship with each other. Given the presumed antecedent conditions are different, the expected benefits brought by restorative experiences are also correspondingly different. ART suggests that an obvious improvement in cognitive performance, especially in tasks that heavily rely on attentive focus, can be observed for restoration regarding directed attention, while the SRF asserts that this kind of restoration is indicated by evident emotional and physiological arousal. In terms of the time required for restoration to occur under different conditions, previous evidence has shown that different effects of natural and urban environments can appear quickly in physiology (within four minutes in Ulrich et al., 1991; cf. Fredrickson and Levenson, 1998) and emotional states (within 10–15 minutes; e.g., Ulrich, 1979a), while environmental effects on performance have not consistently emerged after 15–20 minutes (cf. Hartig et al., 1996; Laumann, Gärling and Stormark, 2003), though they have appeared after longer periods.

In essence, there is no contrast between ART and the SRF, as both frameworks point to qualities of person–environment interactions (Korpela and Hartig, 1996). Although the two theories offer different perspectives on what happens during a discrete restorative experience, they appear to complement one another in some important respects (Hartig, Kylin and Johansson, 2007). The arousal and negative emotional characteristic of stress can occur in the absence of directed attention fatigue, while, conversely, elevated arousal and negative emotions need not always accompany attentional fatigue (Kaplan, 1995). In the wider empirical research arena, mental fatigue and decreased attention span are often treated as consequences of the stress associated with continuous stimulation and decision-making, particularly in urban environments. Nevertheless, researchers should be very cautious about selecting an appropriate framework for the basis of their research, which should be determined directly by the specific research contexts – what issue the research focuses on (e.g., depression caused by long-term stress, temporary mental fatigue due to long working hours), what participants are focused on (e.g., patients suffering from chronic issues, students following mid-term examinations) and the purpose of the research (i.e., what particular aspect of environmental benefits they intend to investigate).

2.2.2 Relevant focuses in restorative environment research

- Restorative benefits and natural environment

The restoration process people can undergo when exposed to a natural environment is the underlying reason why restorative environment research was firstly facilitated. Kaplan and Talbot (1983) discovered the progression of responses to the wilderness in their Outdoor Challenge Project. With their stays last longer, participants experience a range of psychological benefits, from an intense awareness of their relationship with the natural environment, to an increase in self-confidence and a sense of tranquillity, followed by an emphasis in contemplation. During the gradual restoration process, people are able to have 1) tranquillity, peace and silence, which human beings require at least occasionally; 2) integration and wholeness, which lead to a significant life development goal and improved self-esteem; and 3) oneness, a sense of being at one with the universe. These recovery effects brought by nature have also been confirmed in Ulrich's (1983) well-known study with post-surgery patients. Following above mentioned contributions, earlier restorative environmental studies gave great attention to uncovering the restorative benefits of nature.

Previous studies found that just a glance at a small park on the way to work might have a positive influence on mood (Whyte, 1980). Viewing nature from a window at home or in the workplace can support micro-restorative experiences (Ulrich et al., 1991; Kaplan, 1993, 2001; Tennessen and Cimprich, 1995). Ekkekakis et al. (2000) found that travelling through a natural setting for 10–15 minutes may provide a respite that, although brief, interrupts the process of resource depletion and promote a shift towards increased activation and positive moods (see also Van den Berg, Hartig and Staats, 2007; Korpela et al., 2008). This natural benefit has been proven to be effective for the elderly (Berto, 2007) and children (Bagot, 2004). Following on from this, researchers have also noted that environments with other prominent natural characteristics can help people in recovering their mental and physical resources that have been depleted in stressful or wearying situations (Kaplan, Kaplan and Ryan, 1998). This 'urban' perspective on restorative opportunities is also encouraged by a recognition that the nature focused on in much of the earlier work on restorative environments was close to urban homes or workplaces (see Ulrich et al., 1991; Kaplan, 1993, 2001; Tennessen and Cimprich, 1995; Parsons et al., 1998). Previous research found that urban parks are closely correlated with restoration likelihood and lead to perceived stress recovery, enhanced attentional restoration and positive physiological responses (Nordh et al., 2011; Tyrvaeinen et al., 2014; Wang et al., 2016). This is also the case for natural components in small-scale parks within neighbourhoods (Nordh et al., 2009; Nordh and Østby, 2013), as well as trees, flower beds and other natural elements in residential streets (Todorova et al., 2004; Lindal and Hartig, 2015).

However, very little focus has been given to other types of urban environments aside from natural or nature-dominated urban settings. Largely due to restorative environment research being rooted in natural environments, most existing studies take typical urban settings dominated by natural elements (such as urban streets, industrial areas or residential blocks) as the opposite of nature. Urban streets have been selected as comparative examples in many studies for highlighting the benefits of a setting containing paths in natural environments (Laumann, Gärling and Stormark, 2003; Van den Berg et al., 2003; Hartig and Staats, 2006). Even if urban environments have the potential of delivering a certain degree of restorative benefits, this type of strong comparison between typical nature and typical urban settings may conceal the restorativeness of the disadvantaged side in the same way that the brightness of a flashlight can be concealed by sunshine. Therefore, this research proposes that when natural resources are extremely limited in modern urban life, it is of great importance to examine the potential of common urban settings in satisfying the psychological needs of urbanites.

- Positive effects and restorative perception measurements

The concept of restorative environments has become a research focus on psychology, behaviour and environmental design, largely due to its significance in improving the psychological and physical health of human beings with no side effects, being readily available and having a low cost. The inadequacy of certain resources may cause chronic damage, leading to negative consequences in terms of physical and psychological health (Hartig, 2007a). An understanding of the underlying theory can help in promoting the design of restorative environments, which is expected to be improved through an instrument for measuring psychological factors thought to aid restorative experiences. Hence, an increasing number of empirical studies have contributed by exploring ways of measuring restorative influences on human well-being. In general, there are two approaches identified in literature: one is to capture positive effects caused by the restoration process, which involves a wide range of physiological and emotional monitoring as well as cognitive performance tests, while the other one measures restorative perceptions, mainly through the application of psychometric scales.

a) Positive effects measurements

Previous studies have shown that the restorative benefits of environments manifest themselves in the emotional, physiological, cognitive and behavioural responses of humans. *Physiological variations* (e.g., cardiovascular, neuroendocrine and musculoskeletal changes) can involve either a reduction of excessive physiological arousal or a return from under-stimulation to a normal or moderate state (Ulrich et al., 1991) in response to stress reduction. Physiological effects can normally be indicated by variations in systolic blood pressure (SBP), diastolic blood pressure (DBP), brain electrical activity (EEG) and cortisol level, which are widely utilised as stress markers in studies. Coss (1990) found that the SBP of patients was 10–15 points lower when they were exposed to a ward ceiling with pictures dominated by natural components. Ulrich (1981) found that unstressed participants who viewed slides of unspectacular natural landscapes had greater brain electrical activity (EEG) in the alpha frequency range than those who viewed slides of non-blighted urban scenes. Similar stress-releasing effects have also been noticed in people when visiting forests, revealed through lower blood pressure and pulse rate, reduced cortisol level, suppressed sympathetic nervous activity and enhanced parasympathetic nervous activity (Park et al., 2010; Lee et al., 2012; Tsunetsugu et al., 2013). A short visit to natural areas has been found to effectively decrease the salivary cortisol level, which also indicates the positive effects of nature on stress reduction (Tyrvaeinen et al., 2014).

Positive changes in *emotional states* are central to the psychological component of restoration (Zuckerman, 1977; Ulrich, 1979). These generally include positive feelings such as pleasure, happiness, satisfaction and tranquillity or, broadly speaking, a positively toned emotional state (Ulrich et al., 1991). Negative feelings such as anger, fear, aggression or arousal were deduced in previous studies when participants were exposed to natural scenes (Ulrich, 1979; Ulrich et al., 1991; Hartig, Mang and Evans, 1991; Hartig et al., 1996). Both laboratory studies and field experiments have found evidences suggesting that exposure to natural environments (Hartig, Mang and Evans, 1991; Hartig et al., 2003; Tsunetsugu et al., 2013), seeing pictures of nature (e.g., Heerwagen, 1990; Ulrich et al., 1993; Hartmann and Apaolaza-Ibáñez, 2010) or seeing nature through the windows at home or in the workplace (e.g., Ulrich, 1984; Kaplan and Peterson, 1993; Tennessen and Cimprich, 1995; Kaplan, 2001) can promote positive effects on emotional states.

The prominent role of directed attention in sustaining *cognitive functioning* has been well demonstrated in psychological research (Posner and Rothbart, 2007). The centrality of directed attention in ART and the cruciality of it in effective cognitive functioning mean that restorative environments should be able to provide cognitive benefits. According to ART, environments that possess inherently fascinating stimuli (e.g., vegetation, water, sunset) invoke indirect attention and therefore allow direct-attention mechanisms to be refreshed (Kaplan, 1995). Proofreading tasks have been used to compare the restorative effects from walking in a regional park with the effects from walking in a city centre (Hartig, Mang and Evans, 1991). The results of this clearly demonstrated better performance from the group that took a walk in the nature. Hartig and his associates (Hartig, Mang and Evans, 1991; Hartig et al.,1996a, Hartig et al.,1996b; Hartig et al., 2003) then conducted a series of studies with different attention measures, including Search and Memory Task and Neck Cube Pattern Control (Tennessen and Cimprich, 1995; Ottosson and Grahn, 2005), in order to demonstrate improved cognitive and behavioural performance in participants assigned into groups exposed to natural settings. Similarly, several later studies attempted to highlight the environmental restorative influences on cognitive and behavioural reactions with a wide range of measures for attention, including, but not limited to, Digital Span Backward (Berman et al., 2008; Taylor and Kuo, 2009; Perkins et al., 2011), Sustained Attention to Response Test (Berto, 2005) and Attention Network Task (ANT) (Berman et al., 2008).

b) Restorative perception measurements

There are two major directions of empirical attempts on measuring restorative perceptions have been identified in the related literature. One direction is developed mostly on the basis of ART, as it has a clear strength in offering a set of components with clear instructions regarding the necessary conditions of restorative environments and also has potential utility for understanding various restoration outcomes, including through the *perceived restorativeness scale* (PRS) (Hartig, 1996, 1997a, 1997b), *restorative component scale* (RCS) (Laumann, Gärling and Stormark, 2003), and *perceived restorative potential* (PRP) (Herzog et al., 2003). In essence, they have been developed through similar procedures on the basis of a deep and comprehensive anatomy of ART, and the final form of these scales normally composed of a series of psychometric questions measuring the four components proposed in ART (*being away*, *extent*, *fascination* and *compatibility*). A similar approach was also used to develop measurements for particular groups of participants (such as the perceived restorative components [PRC] for children [Bagot, 2004]), for particular places (such as the perceived restorative characteristics questionnaire [PRCQ] for zoo attractions [Pals et al., 2009]) and for particular sensations (such as the perceived restorative soundscape scale [PRSS] for measuring soundscape restorativeness in urban parks [Payne, 2013]). A detailed review-based discussion on ART-based measurements is introduced in Chapter 5 of this thesis for the purpose of selecting the most appropriate one to use in this research.

Another direction involves various measurements developed from extended theoretical groundwork in environmental restoration theory, with more emphasis on emotional and physiological variations. Rather than the theoretical grounds adopted in an ART-based dichotomy, the self-rating *restoration scale* (RS) (Han, 2001) is developed directly from four aspects of psychological theories. It incorporates eight variables measuring emotional, physiological, cognitive and behavioural responses of people in terms of restorative perceptions. The *restorative outcome scale* (ROS) (Korpela et al., 2008) consists of six items, with three items reflecting relaxation and calmness (e.g., 'I feel calmer after being here'), one reflecting attention restoration ('my concentration and alertness clearly increased here') and two reflecting clearing one's thoughts (e.g., 'I can forget everyday worries here'). Inspired by Kaplan and Kaplan's description of restorative natural experiences as a sequence of interrelated and deepening levels of restorativeness (1989, p. 196–197), Van den Berg and his associates (2014) developed the *restorative state scale* (RSS) for capturing the overall experience and tapping into more distinct levels or functions of restorative natural experiences (Van den Berg et al., 2014).

However, the restorative effects of nature appear to be less consistent in research results than is often assumed, particularly in regard to positive effects. The benefits of exposure to nature vary considerably across subjective and objective measures according to a meta-analysis conducted on a wide range of relevant studies (Bowler et al., 2010). Among these, the results regarding cognitive performance and physiological states appear to be less reliable than improvements in self-reported emotion. Inconsistency was also observed, but found to be rarer, in perceptive measurement results.

Laumann et al. (2003) intended to determine if participants would be less mentally fatigued after watching a video of nature. However, there was no significant difference in restorative perception ratings between the two groups of participants after watching videos of natural and urban scenes. More importantly, the most relevant measurements involving physiological/emotional indicators and cognitive performance can only demonstrate the result of restorative influences. Further information on what environments contribute to promoting restoration and how they do so remain unclear when employing objective measurements in restorative research. This research intends to generalise design instructions on improving environmental restorativeness from users' restorative perceptions, but it can offer very limited help as a general fluctuation in physiological/emotional indicators. Perceptive psychometric scales, however, not only present a rather consistent and valid result across research contexts and participants but can also provide a clear connection between restorative components and human responses. Another consideration is that psychometric questionnaires are easily applicable in outdoor settings in comparison to medical instruments tracking physiological variations. Hence, this research has attempted to capture users' restorative perceptions in urban street environments with the help of psychometric measurements and then explore possible ways of turning restorative perceptions into applicable design instructions.

- Restorative environment, preference and place experiences

One possible explanation for the inconsistent findings of restorative indications in previous findings is that restorative benefits may be contingent on factors related to the participants, such as the individuals' formal environmental experiences, their associations with nature and variations in the social context within which nature is experienced or evaluated (Bowler et al., 2010) that are, in general, presented in the form of individual preferences. Some studies have argued that restorative quality of environments can also be regarded as a possible frame of reference for landscape preference evaluations (Purcell et al., 2001), with preferences reflecting on how well the given environment is capable of supporting effective functioning and well-being (Kaplan and Kaplan, 1982). Empirical evidence showing the relationship between preference and restorativeness has been provided (Hernández et al., 2001; Purcell et al., 2001; Laumann, Gärling and Stormark, 2003) in some studies, in which restoration has been described as a plausible cause of preference (Staats, Kieviet and Hartig, 2003; Staats and Hartig, 2004). In some other studies, restoration is regarded as a mediator between the physical environment and preference (Staats, Kieviet and Hartig, 2003; Van den Berg, Koole and Van der Wulp, 2003; Staats and Hartig, 2004; Hartig and Staats, 2006). The unneglectable effects of individual preferences decided by internal states and conditions can intensely influence a class of environmental features and stimuli ('preferenda') (Zajonc, 1980) that are believed to be able to facilitate the affective responses of people. Natural environments are greatly preferred by respondents over constructed environments and rank higher in ART components (Hernández et al., 2001; Purcell et al., 2001; Laumann, Gärling and Stormark, 2003). Staats, Kieviet and Hartig (2003) explained the underlying relationship between restoration and preference through an experimental study, in which expectations for recovery and reflection to occur were believed to be able to provide a basis for environmental preference. A considerable amount of evidence showing preference is related to what is interpreted as the naturalness of places. This has also been found in previous research, with natural scenes being highly preferred and constructed scenes being less preferred (Kaplan et al., 1984; Hartig et al., 1996; Hartig et al., 1997). However, the relationship between restorative likelihood and preference remains unclear in existing studies (Purcell and Lamb, 1984; Peron et al., 1998; Purcell, Peron and Berto, 2001). Some research findings across different types of environments have indicated that scenes rated as restorative do not always receive higher preferences ratings (Purcell, Peron and Berto, 2001; Han, 2010), suggesting that urban life experiences significantly impact on how we perceive the space (Gehl, 2010).

Most of these studies have emphasised the physical characteristics of restorative and preferred environments. A different view would be to consider their functions (for instance, as places to live in or to visit), thus introducing the concept of 'place experiences' as another mediator explaining the intricate connection between restorative likelihood and preference (Stokols, 1995; Korpela and Hartig, 1996). People normally go to their favourite places to relax, calm down and clear their minds (Korpela, 1992). This presents another perspective for considering the meanings of places, generally composed of their 'identity' (what a place is actually like) and 'image' (a combination of this identity with the perception of the place originating from the individual's feelings and expressions) (Montgomery, 1998). More specifically, Korpela (1989; see also Korpela and Hartig, 2006) proposed that place identity is partly constituted in the processes of emotion and self-regulation triggered by restorative experiences. In this perspective, an important line of restorative environment research turned its attention to the experiences people have in their favourite places, showing strong relationship between restorative experiences, favourite places and the development of personal identity. Through a series of studies on children, adolescents and the youth, experiences in favourite places were found to be characterised by high levels of *being away*, *fascination*, coherence and *compatibility*. This affirms that there is an interaction between favourite places and restorative experiences (Korpela, 1992; Korpela and Hartig, 1996; Korpela et al., 2001; Korpela, Kytta and Hartig, 2002). In line with this perspective, previous studies have found that places holding a special meaning, such as museums (Kaplan et al., 1993) and monasteries (Ouellette et al., 2005), can also provide restorative experiences. Scopelliti and Giuliani (2004) pointed out that the particular restorative potential of historic buildings is largely due to their historic meanings. More interesting evidence regarding the influence of place meanings on restoration likelihood is a study conducted by Hartig et al. (1998) to explore people's restorative experiences at home, in which females was found to be less likely to have restoration at home compared to males, as they less frequently have time to relax there.

The ambiguous restorative benefits of nature and its complicated relationship with preference and place experiences raise a number of issues in restorative environment research and necessitate an urban perspective in relevant research, particularly under the research context of seeking restorative solutions for people living in high-density urban areas. Man-made spaces can refine the feelings and perceptions of humans (Tuan, 1977). Their familiarity and strong attachment to urban settings might heavily influence their chances of obtaining restoration in an entirely natural setting. Hence, it seems quite reasonable to assume that certain types of urban environments can rival nature in terms of delivering restorative benefits to urbanites. In fact, several studies have made similar attempts (Nordh et al., 2009; Nordh et al., 2011; Wang et al, 2016) on identifying possible urban alternatives, but most of their attentions are still restricted within the environmental type of urban green. In addition, the influence of place experiences on restorative perceptions also necessitates further research on the concept of 'expectations', which seems more than necessary when the restorative research context shifts towards urban settings. Unlike natural environments, places in urban areas are endowed with multiple and diverse meanings by the people using them. Restorative expectations stem from the values that different groups of people attribute to the experiences they have usually had there; what people do and with whom they are enjoying their time are likely key aspects of these experiences, which are obviously related to the identity and image of a place. In response to this issue, this research has attempted to investigate people's restorative expectations on urban streets so that their comprehensive understandings of various functions, physical attributes and meanings of urban streets can be presented and utilised for moving towards developing restorative-oriented design implications.

2.2.3 Limitations of current research

The general limitations of restorative environment research can be classified as three issues. First, the research is quite limited in regard to environmental subjects, with most focus placed on exploring natural settings (Kaplan, 1973; Kaplan and Kaplan, 1989; Hartig and Evans, 1993; Kaplan, 1995). Even when the research focus is generally shifted towards urban settings, the emphasis is still typically on urban green spaces (Whyte, 1980; Burgess et al., 1988; Kaplan, Kaplan and Ryan, 1998; Grahn and Stigsdotter, 2003; Thwaites et al., 2005; Velarde, Fry and Tveit, 2007) and nature-dominated urban settings (Nordh et al., 2009; White et al., 2010). Many studies have presented similar conclusions and indicated that living close to nature, spending time engaged with it or even simply knowing it exists nearby can benefit individual well-being through reduced brain reactivity to stress (Ulrich et al., 1991; Kaplan, 2001; Lederbogen et al., 2011), improvements in cognitive and emotional functioning (Berman, Jonides and Kaplan, 2008) and potentially through facilitating physical recovery from illness (Ulrich, 1984; Mitchell and Popham, 2008). However, 'if the greens are more than three minutes away, the distance overwhelms the need' (Alexander et al., 1977, p.305); this further highlights the fundamental difficulties between densified urban populations and sufficient provision of urban greenery. The restorative capacity of natural environments is typically established for ART and the SRF in similar ways, with the restoration of attentional resources demonstrated by an improvement in cognitive tasks performed after exposure to natural environments (Laumann, Gärling and Stormark, 2003; Hartig et al., 2003), while affective arousal is suggested to be triggered after exposure to natural environments (Ulrich, 1984; 1991; 1999). However, there is no solid reason to assume that the improvement of cognitive functioning is exclusively attributed to natural or nature-dominated environments. Theoretically, all environments that possess certain attributes should have the ability to promote the restoration process (Karmanov and Hamel, 2006).

Another limitation mainly concerns the comparative methods used in previous studies and their limited participants. To be specific, these studies mostly have treated ‘natural’ and ‘urban’ as global, undifferentiated environmental categories (Velarde, Fry and Tveit, 2007), which may bring two kinds of restrictions to relevant research. First, in order to have a more obvious result in comparing the restorative potential of urban and natural settings, trunk roads, industrial areas and other unattractive urban environments are selected to serve as a foil to fascinating natural settings that typically contain lakes, trees and lawns. Polarisation in these comparative studies typically misleads people into believing that most urban settings (those that are dominated by hardscape) are incapable of delivering restorativeness at all. However, there is a possibility that they do have some restorativeness potential that, being at a relatively low level compared to natural settings, is often concealed or overlooked. It is also crucial to consider that there are many other types of settings in urban areas that might be more interesting and diverse and have higher restorative likelihood than the extreme examples used in previous studies. Moreover, the overemphasis on nature has resulted in environmental variations being overlooked in previous studies. Kaplan and Kaplan (1989) and other scholars have proposed that to achieve expert judgements on the value of a setting, it is necessary to make a series of decisions regarding the categories to which it belongs and who will use it (Kaplan and Kaplan, 1989). An individual’s evaluation of a certain place is closely related to whether their ‘purposes’ are fulfilled when they stay in that place. This awareness, as stated in Chapter 1 of this thesis, has inspired a core research concept – restorative expectation. People certainly decide to go to places with ascribed meanings indicating what one can do there; for example, people dine in restaurants, have coffee in cafés and laundry in a launderette, as such behaviours are likely to be a significant component of the place’s meaning (Canter, 1977; Canter and Tagg, 1980). The focus on the ‘purpose’ of a place also leads to the question of how appropriate it is, and how good or bad it is for certain experiences or activities. The classification, evaluation and expectation of a place are difficult to separate. However, most relevant studies that have evaluated environmental restoration have emphasised how the physical characteristics of restorative environments influence environmental preferences (Hernández et al., 2001; Purcell et al., 2001; Laumann, Gärling and Stormark, 2003; Staats, Kieviet and Hartig, 2003), placing more emphasis on the ‘effect’ in the relationship between restorativeness and place experience. Relatively few studies have focused on the ‘cause’, which, in this case, should refer to the concept of ‘environmental expectation’.

The third major limitation is that no coherent approach has been established to inform how the design of specific environmental attributes can help in achieving attention restoration and other health objectives. On the basis of restorative effects in terms of physiological, emotional and cognitive aspects, previous studies have developed and employed a wide range of measurements to indicate variations before and after exposure to natural and urban settings, including those for measuring restorative perceptions (e.g., PRS, RCS and PRP), capturing physiological and emotional changes (e.g., SBP, DBP, ZIPERS) and for investigating cognitive and behavioural performances (e.g., NCP and SMT). One issue not yet addressed here, which also leads to this specific research limitation, is that these measurements can only measure people’s reactions and perceptions to certain environments. However, this information is not valuable enough in urban designs until the relevant environmental attributes and components, such as water, greenery, vistas and mystery, along with the different restorative factors described by the Kaplan and Kaplan (1989), have been fully explored. Very few studies have been conducted to address how specific characteristics of urban settings might assist in psychological restoration (Lindal and Hartig, 2012), with most that do focus on natural components such as grass, trees and flowers in urban greenery (Nordh et al., 2009; Lindal and Hartig, 2015). Another possible reason responsible for the inefficiency in constructing this relationship is disciplinary boundaries. Even though restoration is not difficult to comprehend, it is not something people would commonly talk about in everyday life, and the environments studied have only been described in coarse terms (Velarde, Fry and Tveit, 2007). In fact, the root of the concept of restorative environments in environmental psychology makes it a difficult notion to convey, not only to the average person, but also to urban design professionals committed to enhancing environmental restorativeness. Hence, there are two communication boundaries here: one between environmental psychologists and urban designers, and another between professionals and the average users. Numerous researchers and practitioners have highlighted the importance of public participation in applying design interventions, and it seems more than necessary to involve users in restorative environmental design as much as possible so that misinterpretations can be mitigated, communication constraints can be minimised and an efficient connection between restorative perceptions and design dimensions can then be established.

Considering the existing limitations outlined above, this research generalises that there are three issues in restorative environment literature that remain unsolved. First, restorative environment research should extend the scope of its focuses from nature and nature-related settings to broader types of environments that are more regularly experienced by people living in cities. This research takes urban streets, a common setting in urban life, as a start. Second, a coherent and direct connection between restoration and environmental cues has to be built so that users' restorative perceptions can be interpreted and translated into applicable design implications. Third, participation during the process of delivering a restorative design has to be encouraged as much as possible. Furthermore, users' expectations should be investigated when exploring restorative solutions in order to 1) utilise their expectations to identify necessary improvements and 2) avoid misinterpretations, given restorativeness is not an easily conveyable term in design practices, regardless of whether it is viewed from the perspective of the average person, design professionals or environmental psychologists. Thus, the first step of this research focuses on bridging between tangible urban design attributes and intangible restorative responses. Starting with a review-based discussion on current literature, this research seeks to identify potential environmental cues that might be relevant in delivering restorative experiences. This is a critical step in the current research (see Chapter 6 for further elaboration), as it assists the further establishment of a coherent and directive relationship between restorative perceptions and design outputs.

2.3 Urban Streets

This part of the literature review approaches the central idea of this research from another theoretical focus – urban streets. Starting with a description of the street evolutionary development process of street development, it attempts to illustrate how street value has been continuously changing in the past few decades from an important component of social and political urban life in ancient cities to being conquered by automobile prevalence across the world and then to its awakening significance in sustaining public life. It follows a section introducing current roles of urban streets in contemporary cities that include spaces for sustaining transportation, spaces representing city characteristics (aesthetic and cultural), spaces to facilitate economic growth and spaces for encouraging outdoor life and social Interactions. Street design concepts emerged during the paradigm shift including *safe streets, walkable streets, liveable streets* and *healthy streets* are introduced in this chapter. Relevant research and practical applications of these concepts are reviewed to disclose core values of street environments derived from its undertaken urban roles. This part concludes with a section of generalising limitations identified in current research and a discussion concerning possible approaches on how these limitations can be overcame to put forward the current research.

2.3.1 The paradigm shifts of street development

- From car-oriented towards people-oriented

Urban street development has experienced ups and downs throughout the history of city development, which can be generalised into three phases: grid planning, hierarchical street planning and neotraditional design. In the ancient era, streets were designed to represent a vision of civilisation rather than a function of the economy with multiple purposes including commercial, economic, civic, ceremonial, political, cultural and social value. Many ancient cities, such as Egyptian, Greek and Roman empires, were characterised by the grid pattern of the street network, which has prevailed across many cities of Europe and North America for a long duration until the twentieth century (Stanislawski, 1946; Gelernter, 2001; Belozerskaya and Lapatin, 2004; Burns, 2005; Laurence, 2007). This has been beneficial for promoting social interactions and commercial exchanges that prompted a realisation of the street's full potential as a public place (UN Habitat, 2013).

The rapid population growth and massive immigration from rural to urban areas accompanied by the Industrial Revolution had a huge impact on the evolution of urban form. High dependency on automobile travel as a result of urban expansion has caused the traditional monocentric form of cities to be progressively replaced by polycentric cities (UN Habitat, 2013). 'Changes in urban growth patterns were accompanied by changes in street patterns' (ibid, p.9). The predominance of automobiles has emphasised the transport function of roads to an unprecedented level. Therefore, traffic engineers, who are more comfortable with paying attention to things inside of road property lines, have gained an absolute discourse of power in road planning in the late twentieth century since they were thought to know how to improve the operational efficiency of road systems. Street design had become narrowly focused, which viewed the unencumbered vehicular movement as the overarching concern (Jacobs, Macdonald and Rofe, 2002). Despite that this car-oriented paradigm has increased traffic efficiency, the spatial organisation it generated favours the separation of activities and discontinuity of the public realm (Hebbert and Webb, 2007) as well as dysfunctional layouts lacking in urbanity (Marshall, 2005a). This paradigm also resulted in a number of social problems such as loss of street life, loss of community, loss of public safety and social isolations (Newman and Kenworthy, 2000, p. 109).

With the upsurge of New Urbanism that is represented by Jane Jacobs, Christopher Alexander, William Whyte and Jan Gehl, the diversity and liveability of urban places, which were thought to be closely associated with the quality of the urban walking environment and people's experiences within it, have been emphasised and captured for worldwide attention. New Urbanism advocates the gridded layouts, opposite to the trend of car-oriented development involving security-controlled entry points, gates and access roads without pavements (Hebbert and Webb, 2007) and promotes that 'the best way of bringing security to streets is to make them delightful places that honourable and decent citizens will want to walk in' (Kunstler, 1996, p. 130). Some tentative approaches (traffic calming, multi-way boulevard, etc.) have been carried out in practical design projects such as *Home Zone* in the UK and *Woonerf* in the Netherlands in the late twentieth century to explore ways to re-design street environments to balance its place and movement function. The multiple and diverse value of urban streets, especially its placeness, has become a focus in research and practices and has received an increase of attention in recent years.

- The reflection of paradigm shifts on the street classification system

The hierarchical organisation of the road system based on the functional classification of city streets, which was adopted universally as the way to design cities after World War II, is a major culprit in this failure to create urban places (Rofe, 2009). The hierarchical street planning, those that assign different levels of importance and functions to different streets (e.g., residential streets, arterial streets and collector streets adopted in the US once), started to dominate to accommodate the car predominance in the latter half of the twentieth century. The functional classification system (FCS) of streets was largely adopted by transport engineers, which provided more emphasis on auto-traffic other than the appropriate uses of streets in response to solving the conflict between fast movement and access to abutting properties on the streets (Jacobs, McDonald and Rofe, 2002). The FCS was developed as a method of communicating the road's character of services (Forbs, 2000) and has become dominant in the era of traffic-oriented planning, but this only reflects the importance of street as the Link (or Movement) (Jones et al., 2007b). The basic form of FCS incorporates two dimensions with one that articulates information about the road settings (e.g., urban or rural) and the other that describes the hierarchy of movements including main movement, transition, distribution, collection, access and termination (Liu et al., 2017). The shortcoming of FCS is rather obvious from a contemporary perspective since it not only rules out other transport modes but also neglects other road functions aside from access and mobility (Forbs, 2000).

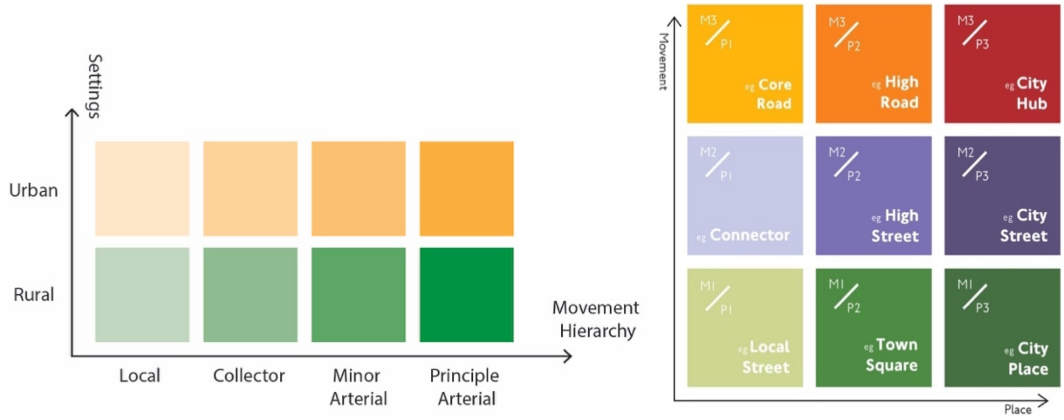


Figure 2- 1 FCS and Street Types Matrix (Source: UK DOT, 2007).

Functional classification, which promotes car priority, is soon to be challenged when New Urbanism arises, and this paradigm shift will be reflected on the street classification system. Jones et al. (2007b) proposed a two-dimensional classification system, which is adopted in the 'Manual for Streets' (UK DOT, 2007), suggesting urban street activities can be generalised as links (or movement) and place (Figure 2–1). Following the paradigm shift, more humanistic considerations have been adopted in later classification systems. In line with the idea of Complete Streets, emphasising a balance between transport, community and environment in street design, New York City classified its streets into five types: general street, boulevard, slow street, transit street and pedestrian-only street (NYC DOT, 2009). Liu et al. (2017) proposed a three-dimensional classification system that highlighted the importance of frontage activities in street design. In the recent published Shanghai Street Design Guidelines (SPLRAB et al., 2017; hereinafter as Shanghai Guidelines), streets in Shanghai's inner city are categorised into five major types: Commercial Street, Living and Service Street, Landscape and Leisure Street, Traffic-oriented Street and Comprehensive Street (Figure 2-2). These are based on an integral consideration of their frontage activities, traffic movement and aesthetic characteristics, showing a more comprehensive perspective of defining and classifying urban streets.

Figure 2- 2 Shanghai Street Matrix (Source: SPLRAB et al., 2017).

2.3.2 The role of streets in urban life

A street is the most fundamental urban product that makes up more than 80 per cent of all public spaces (NYC DOT, 2009). It takes on multiple roles in urban life and is not a sole space for transport movement but a place for promoting social interactions, facilitating economic growth and presenting the aesthetic, cultural and historic characteristics of cities as well. The main objective of urban streets is to be conduits that link places and provide equitable access to all kinds of users, whether on foot, bicycle, car or public transit. Under the most comprehensive consideration, urban street environment incorporates spaces for the tram, automobiles (cars and buses), bicycles and pedestrians that are different in scale and size, movement speed, travel time, distance, and space occupation (Figure 2–3). It undertakes the responsibility of providing flexible and efficient movements to every transport mode as well as offering opportunities for different transport modes to converge and exchange. Typical combinations of daily travel in cities can be walking or riding for 5–10 minutes to get to the nearby public transit station, then walking or riding to reach the destination after the public transit or driving to a parking lot close to the destination and then walk or ride for the rest of the journey. The concept of 'streets for all' (The Center for Active Transportation, 2011) requires that the street environment should be able to balance the various needs of various users to shape an enticing environment that guarantees access, safety, comfort and enjoyment for each traveller.

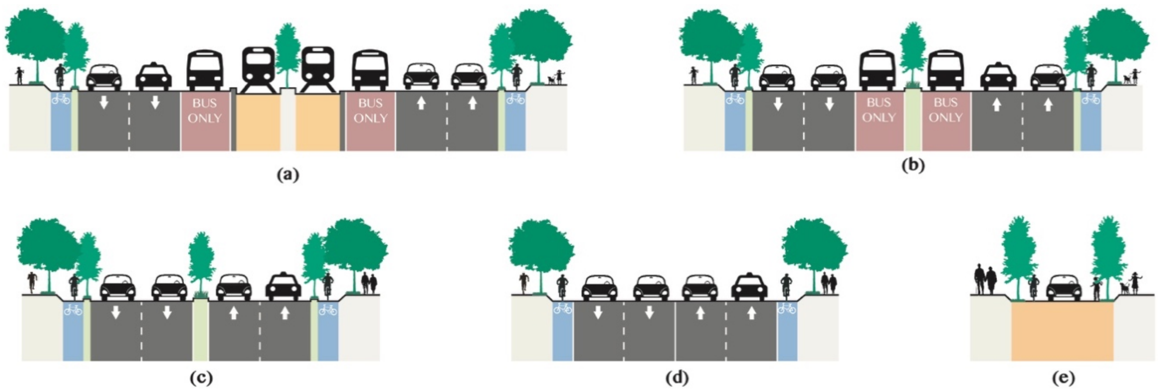


Figure 2- 3 Different Types of Street Sections. Source: the author.

It is also elementary for urban streets to be places for social encounters and interactions. Streets are places people meet and have contact with other people, which is a basic human need and an original reason to have cities (Jacobs, 1995). First of all, urban streets spatially allow people to stay outside, especially under the context of a high-density urban area when most people live and work in high-rise buildings with no front yard and only limited access to parks and plazas. It holds people for different lengths of time, from a few minutes to a few hours, and naturally generates social opportunities since it is the people that attract other people (Gehl, 2010). In addition, streets are defined by functional buildings on both sides and functionally encourage people to come and use them. For a street with cafés and restaurants on both sides, a wide range of related activities are encouraged, such as eating meals, meeting friends, reading, having a rest and walking dogs. However, sometimes people do come to certain streets that serve no functional purpose but go for specific experiences that are created out of street functions. Whether people come with or without purposes, their presence on the streets itself provides necessary conditions that foster social activities.

The role of streets in facilitating economic growth can be interpreted from two levels of perspective. From a broader perspective of the urban street network, streets as urban places also foster urban prosperity, for this can promote infrastructure development by providing adequate infrastructures such as water and sanitation, enhancing environmental sustainability through protecting the urban and natural resources while maintaining its growth, supporting high productivity by generating decent jobs, improving the quality of urban life by enhancing the use of public spaces and eliminating social inclusion through ensuring equitable distribution and redistribution of urban benefits (UN-Habitat, 2013). From a narrow perspective of the street itself, it owns commercial functions for the exchange of services or goods that come from ancient times. This function is determined either by temporary on-street commercial activities, such as vendors or street markets, or long-term street-side commercial frontages, such as shops and restaurants, or both. It was common for people to sell and buy on the streets before the age of the automobile when the speeds of walking and transport were not that different. The street market was one of the major places for people to trade before the prosperity of high-rise stores. They are business places (Jacobs, 1995) and are natural drivers for boosting the urban economy.

Urban streets constitute the first impression of a city. Lynch (1960) proposed a path, routes along which people move throughout the city, to be one of the five fundamental components forming the image of a city, which is also highlighted by Jane Jacobs (1961, p. 29) in her famous book *The Death and Life of Great American Cities,* 'Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull'. For example, Les Champs-Élysées indicates the romance and leisure of Paris, the Fifth Avenue represents the prosperous and vitality of New York, Regent Street reveals the historical features of London and Chang'an Avenue embodies the authority and political significance of Beijing. These streets convey to people the aesthetic, cultural and historic characteristics of cities through their constituent elements as well as their spatial arrangements. However, streets in newly built towns and cities gradually lose their characteristics as a result of compromising to massive construction and short-term delivery. Nowadays, similar streets can be found in different countries, and streets in different cities look like replicas produced from the same machine. The overlook on the aesthetic, historic and cultural value of urban streets may further lead to the deprivation of city characteristics and become a major cause of cookie-cutter development in many contemporary cities.

2.3.3 Essential concepts of developing urban streets

Today, people are reclaiming their streets as public spaces and require them to be liveable and complete. Urban streets have now been recognised as an integral factor in achieving sustainable urban development (UN Habitat, 2013). The developing realisation on the social value of urban streets indicates a profound change in our understanding of them and requires corresponding attempts. Various notions have successively been put forward worldwide towards improving the quality of urban streets, including 'liveable' streets (Lusher et al., 2008), 'complete' streets (Finn and McElhanny, 2012), streets for all (Svensson, 2004), 'friendly' streets and 'healthy' streets that all are contained with similar concepts (more or less) that concern people's well-being and urban vitality. Considering the general context of this research, this part enumerates essential street concepts to present advocated themes that are general, necessary and applicable for all urban streets no matter what street categories they belong to and are a benefit for all pedestrians, no matter what age, gender or occupation. The focus of pedestrian-level research also implies that instead of exploring a broader level of literature contributed to the forming of street pattern and network, only studies relevant to physical street attributes that are directly in contact with people and influence their perceptions are discussed in this section to avoid the dazzle. This section ends with a trending topic of the street environments in recent years, a concept extending from and based on our established understandings and achieved consensus on street quality – healthy streets, which reveals exactly where the current research has departed.

- Safe street

Movement is the basic function of urban streets; therefore, pedestrian safety lies at the centre of concern when considering and designing urban streets and is a fundamental design principle in worldwide street design guidelines such as Complete Streets by Design (Finn and McElhanny, 2012) and the Urban Street Design Guide (NACTO, 2013). The initial motivation for constructing highway systems is that it was regarded to be safer for pedestrians by separating them from the vehicles. Existing literature is mostly concerned with possible collision points of pedestrians and automobiles in street environments, such as at intersections (Gårder, 1989; Tiwari et al., 2007), crosswalks (Herms, 1970; Hauck, 1979; Zhang et al., 2017) and bus stops (Truong and Somenahalli, 2011; Lakhotia et al., 2019); hence, there is an attempt to ensure safety with traffic approaches including controlling driving speed, narrowing the width of lanes and increasing the turning radius.

As well as the threats caused by vehicles, the quality of the walking environment itself is important in providing people with safety. Pedestrian falls caused by uneven pavement and footpaths, or extreme weather conditions, account for up to 70 per cent of pedestrian injuries and comprise up to 29 per cent of fatal injuries among older (60+) people (ITF, 2012). This line of research normally contributes to identify street facilities that can influence pedestrian safety; for example, adequate pavements, pedestrian crossing facilities, suitable curb ramps and good quality lighting of facilities are confirmed to be effective for increasing pedestrian safety (Zegeer, 1998; Davies, 1999). In addition to the aspect of physical safety, pedestrians' perceived safety has also gained increasing research attention, of which a basis has been founded mainly by defensible-space and prospect-refuge theories. Research findings suggested that building façades can reduce perceived safety by causing feelings of entrapment and concealment, while trees normally mitigate these emotions (Blöbaum and Hunecke, 2005). Factors related to streetscape enclosure including street tree canopy, the number of buildings along a block and the cross-sectional proportion were proven to have a positive effect on pedestrians' perceived safety (Nasar et al., 1983; Nasar and Fisher, 1993; Harvey et al., 2015). Negative indicators such as graffiti, litter, poor maintenance and hidden walkways were reported to generate a sense of danger (Kuo et al., 1998).

To ensure pedestrian physical and perceived safety, several safety evaluation methods have been developed to assess street facility services. A widely adopted method is the pedestrian level of service (PLOS), which evaluates street infrastructure and facilities for providing safety (Fruin, 1971; Petritsch et al., 2006; Asadi-Shekari et al., 2014). Landis et al. (2001) developed a PLOS model particularly for describing pedestrians' perceptions of safety or comfort in the roadway environment between intersections. An evident limitation of earlier evaluation studies is that they only considered limited street facilities, some of them solely focused on intersection safety (Asadi-Shekari et al., 2014). The pedestrian safety index, which evaluates facilities along the streets for pedestrians, was developed to provide pedestrians with safety along street segments (ibid, 2014). Through a case study on Canberra Road in Singapore, it was found that street elements such as street trees, lightings and pedestrian signals have obvious influences on pedestrians' safety. With the development and extension of the urban street concepts, safety has gradually been absorbed as an important component of other concepts such as liveable streets and walkable streets.

- Walkable street

The concept of 'walkability' was firstly raised to cope with the increasingly sedentary lifestyles observed in cities, which caused high rates of obesity due to people depending on automobiles for travel. The dramatic decrease in walking has been linked to an increased risk of heart disease, stroke and other health problems (CDC, 1999; PBIC, 2019). It is also believed to affect the quality of life and sense of community by social scientists, architects and planners (Alfonzo, 2005). Walkability is defined as the extent to which the built environment supports and encourages walking (Southworth, 2005). Researchers in the fields of planning and design have focused on identifying environmental qualities that can make a city, neighbourhood and street better places to walk. The optimised vision of a walkable city, walkable neighbourhood and walkable street has not only encouraged walking as a way to commute but also as a kind of physical activity and recreation that can fulfil urban inhabitants with sensorial and experiential pleasure and relaxation. A wide range of cities in the world, including Germany, Netherlands, France, Italy and Spain, carried out various projects to pedestrianise shopping streets as the first step and then extended this to zones and districts. Some approaches have been applied to provide the inhabitants with safety, comfort and pleasant walking environments including 'full pedestrianisation'. It is a way of re-defining pedestrians' priorities by the removal of non-commercial vehicular access, together with the re-design of public areas, pedestrian-only malls and pedestrian-priority urban neighbourhoods and prevailed traffic calming, which has been implemented in various forms throughout worldwide cities (Zacharias, 2001).

At the level of urban streets, one of the most famous cases of full pedestrianisation is the regeneration of Strøget street in Copenhagen, Denmark. It was changed into a car-free pedestrian street in 1962 when cars were beginning to dominate Copenhagen's old central streets (Figure 2–4). The idea was controversial at that time, but it soon proved to be a success that allowed pedestrian plazas and cycle tracks to flourish and boasted more shoppers, cafés and a renewed street life. Because of the benefit from the success of Strøget, the pedestrian network in the Strøget District has extended and become a remarkable example of reclaiming urban spaces from traffic and designing a pedestrian-friendly walking environment, which inspired numerous research and practices. A city with a high level of walkability can not only mitigate congestion and pollution but also has social and recreational value as well as the promotion of mental and physical health of its residents. In Southworth's study (2005) to investigate essential criteria of delivering walkable cities, it was found that for the street itself, walkability is closely related with its ability to provide safety, a good quality of footpath and well-designed surrounding context. In a study investigating the relationship between walkable perceptions and environmental physical features, a more walkable environment was confirmed through environmental characteristics, providing greater traffic and social safety; pleasing aesthetics; natural features; pedestrian amenities and land use diversity with a more positive social environment, less social and physical discomfort and more attractive natural and built environment features (Brown et al., 2007). However, most earlier studies have characterised walkable environments from a broader perspective using the 5Ds: density, design, diversity, destination accessibility and distance to transit (Saelens, Sallis and Frank, 2003; Frank et al., 2006; Sallis and Glanz, 2006). Few of them have contributed to reflect on the street-level environment and the impact of its physical characteristics on pedestrian walking behaviours partly because of the limitation in obtaining research stimulus for measuring walkability. Ewing and Handy (2009) managed to measure five urban design qualities that are related to street walkability through a time-consuming and complicated process: visual enclosure, imageability, human scale, transparency and complexity. Mehta (2008) identified and associated seven categories with walkability based on both user perceptions and street characteristics: feasibility, accessibility, usefulness, safety, comfort, sense of pleasure and a sense of belonging (Maslow, 1954; Steele, 1973; Alfonzo, 2005; Southworth, 2005). With the development and application of the street view image database, more detailed research on street elements has been conducted. The visual enclosure of the street environment has been found to have influences on perceived walkability and walking behaviours in recent studies using Google Street View images (Yin and Wang, 2016).

Figure 2- 4 Strøget in Copenhagen, Denmark (Before and After). (Source: Google. Available at: https://www.google.com/search?rlz=1C5GCEA_en__884GB886andsxsrf=ALeKk03QaQ6eXjKVLUmF6PYrpm4eDvGSmg:1602341832102andsource=univandtbm=ischandq=Str%C3%B8get+before+and+afterandsa=Xandved=2ahUKEwjC9de9pKrsAhUXXSsKHedPBb0QjJkEegQIChABandbiw=1119andbih=582)

Many tools have been developed to measure the quality of the walking environment during the past few years and are generally called walking audit instruments. Robert Wood Johnson's Active Living Research website posts over 30 walking audit instruments (https://activelivingresearch.org/search/site/content_tools_and_measure?f%5B0%5D=bundle%3Acontent_tools_and_measure) with 14 of them targeted on the road and street environments. The earliest invented walking audit for urban streets is called the Walking and Bicycling Suitability Assessment, which assesses the suitability of local streets for walking and bicycling. This audits the walkability as well as bikeability of urban streets (Emery and Crump, 1998). The Systematic Pedestrian and Cycling Environmental Scan measurement is used to evaluate physical environmental factors' influence on walking and cycling and is used with additional tools based on Geographic Information System (GIS) (Pikora et al., 2000). Another computer-based instrument for trained observers to assess physical characteristics of community trails and paths, including design, amenity and aesthetics/maintenance items, is named the Path Environment Audit Tool (Troped and Cromley, 2005). The Irvine-Minnesota Inventory (IMI) was developed to measure a wide range of built environment features that are potentially linked to active living, especially walking, which includes 162 items, respectively, measuring four dimensions of accessibility, pleasure, perceived safety from traffic and perceived safety from crime (Day et al., 2006). The IMI was gauged to be the most comprehensive of the walkability audits (Nickelson et al., 2013) and has been applied in many later studies (e.g., Boarnet et al., 2011; Dzhambov et al., 2016).

- Liveable street

Liveability is a concept closely related to people's well-being and is defined as the 'standard of living or general well-being of a population in some area such as a city' (Okulicz-Kozaryn, 2013, p. 433). The concept of liveable streets was emphasised in Appleyard's (1981) book under the same name, which started from a detailed review of the quality of life enjoyed by residents in three streets in San Francisco with similar forms but different levels of traffic (Biddulph, 2008). Five liveability indicators that are found to be inverse with traffic volume were identified in the San Francisco case study based on interviews along selected streets: traffic hazard (i.e., the danger of traffic), stress, noise and air pollution, social interaction (i.e., the friendliness of the street and number of friends and acquaintances) and environmental awareness (i.e., how well residents know their street in terms of locations of trees, benches, details of buildings, etc.). A consensus on the characteristics describing liveable streets has been distilled from previous research (Jacobs, 1961; Appleyard and Lintell, 1972; Appleyard, 1981) claiming that liveable streets, at a minimum, seek to enhance the pedestrian character of the street by providing a continuous pavement network and incorporating design features that minimise the negative impacts of motor vehicle use on pedestrians. An essential value of Appleyard's work is it represents an early attempt to stress the importance of social lives within and across streets and formalised the concept of liveable streets for subsequent research and design practices.

Influenced by the research of Appleyard and Lintel (1972), other studies continuously associate liveable streets with calm traffic conditions. A comparative study involving three different streets with different contexts and driving speeds shows that streets with slow-moving traffic, limited space for parking and good environmental qualities offer a large potential for cultivating street liveability (Bosselman et al., 1999; Sauter and Huettenmoser, 2008; Sanders, 2015). Later, some researchers have looked at how to mitigate the negative effects of traffic on liveability and social cohesion, as well as traffic calming interventions. Bosselman et al. (1999) examined the liveability of boulevards and conventional streets and found that landscape malls along the boulevard can mitigate the negative effects of high traffic volume. In the research on neighbourhood commercial streets, generous pavements, ample seating and other street furniture, tree cover and other landscape elements, articulated street façades of buildings built to the pavement are observed to be essential contributors towards street liveability (Mehta, 2007). Street features such as paving, parking space, traffic management, maintenance and cleaning are also identified to be important determinants of street liveability in a study carried out in Malaysia (Mahmoudi and Ahmad, 2015). Previous research also proved that over-crowded street space has an evident negative effect on the liveability and quality of living of residents (Conteh and Oktay, 2016), though a certain level of street activities is required to sustain the necessary vitality (Bosselman et al., 1999; Sauter and Huettenmoser, 2008; Sanders, 2015).

- Healthy street

It has been over 50 years since the first time the Healthy Cities Movement was raised. The capacity of a city for improving the health and well-being of its inhabitants has received increasing attention in recent years, driven by the unneglectable physical and psychological health issues urbanites were suffering while in contemporary urban life. Though it would be ridiculous to count on the physical environment for solving people's health problems, it is plausible to assume that a better environment can positively influence a citizen's health in many ways. The central idea of the Healthy Cities concept is to have cities providing a positive setting in which action strategies value on the health of city dwellers can be developed (Tsouros, 2009). Based on WHO's foundation work (1948), many ideas and initiatives contributed to the concepts of Healthy Cities throughout the latter half of the twentieth century (Kenzer, 2000). This concept was first developed in Europe and North America and was greatly enriched by Thomas McKeown, who found that the major factors on improving health in the United Kingdom and elsewhere in the nineteenth and twentieth centuries were not advanced medical care and technology but social, environmental and economic changes (McKeown, 1979).

As the concept of Healthy Cities matured, streets, due to their significance in being urban open spaces, are endorsed with an extended social value in contemporary cities, which is to benefit human health. The Healthy Streets Approach was developed by Lucy Saunders (2017), and she found 10 street indicators that matter with human health (Figure 2–5). Key elements that are found to be contributors to a person's well-being can normally also benefit from making urban places socially and economically vibrant and environmentally sustainable (ibid, 2017). This approach was later embedded in Healthy Streets for London, produced by Transport for London (TfL) in 2017 to revitalise the city and change the widespread sedentary lifestyle and its accompanying health issues including a range of chronic diseases such as diabetes, dementia, depression and heart disease (TfL, 2017). The 10 Healthy Street Indicators were developed into a toolkit for designers and policymakers to understand people's experiences of using a street and how their experiences would influence their health conditions, which covers the whole process from initial assessment through implementation to evaluation (TfL, 2017). The Healthy Street concept is promoted in different cities across the world either in the form of independent and complete materials, such as the Hungarian Guide to Healthy Streets (Jarokelo, 2019) or as an essential theme included in the general developing vision of street design guidelines, such as the Abu Dhabi Street Design Guidelines.

Figure 2- 5 10 Healthy Street Indicators (Source: Healthy Streets Website. Available at: https://healthystreets.com/home/about/).

Even though some of the indicators, such as safety and walkability, seem to be repeated, the concept of Healthy Streets brings about a deeper understanding of what city streets can do for individual urban dwellers. Some later studies have paid attention to how the air quality of different street environments can influence human health, especially diseases caused by air pollutants, including nitrogen dioxide (NO^2) and inhalable particles (Baldauf et al., 2008; Dones et al., 2013). Another line of research tries to investigate how a properly designed street environment can encourage people to walk and, therefore, increase their physical health (Brownson et al., 2001; Balfour and Kaplan, 2002; Berman et al., 2012). A modelled compact city scenario that encourages walking and cycling has been observed with evident health gains of 420–826 disability-adjusted life-years per 100,000 population (for diabetes, cardiovascular disease and respiratory disease) using a health impact assessment framework (Stevenson et al., 2016). These efforts not only explored the street value in facilitating human health and well-being but provided a broader view evoking further exploration on the unexcavated potential of urban streets. It also highlights an awareness that streets are capable of undertaking multiple and diverse roles in urban life in response to multiple and diverse human needs just like other public places.

2.3.4 Limitations of current research

The quality of streets is a synthesis presentation of itself and the surrounding context, and it is largely determined by the role it takes in urban life and the development vision proposed in the concurrent urban development. With the urban development process and its accompanied various changes in social, economic and environmental aspects, the focus of street quality varies accordingly. During the early stage of car dominance, pedestrian safety was seriously threatened by the overwhelming speed and power of auto vehicles and, therefore, the street was more valued for the safety (including people's perceived safety) it can provide as a walking environment. It was then deduced that, in addition to safety threats, increasing dependency on car use also resulted in the recession of street life and the reduction of physical activities. When the placeness of streets caught the attention of researchers and practitioners, its value in promoting human well-being by encouraging walking activities and sustaining urban vitality by stimulating social life is highlighted accordingly and is important as a universal design principle. However, there is reason to believe that the current recognition presented by existing literature of urban streets is still not comprehensive and its value in city life should be considered broadly, since the recognition of the urban street is a dynamic process that is continuously growing and extending, even though planners' and designers' initial perspectives of urban streets is rather narrowed. This awareness highlights a necessity of excavating the potential of streets from a similar viewpoint on how other public spaces are required and explored. One typical approach illustrated in existing research is to consider whether it can be designed to have the quality of improving human well-being. However, the considerable amount of existing evidence mostly concerns the importance of walkable environments in improving the physical health of people, including the presence of pavements, busy streets, enjoyable scenery and typographic variations (Brownson et al., 2001) as well as poor lighting, excessive noise, heavy traffic and a lack of public transit (Balfour and Kaplan, 2002).

Nevertheless, well-being is multidimensional and context-specific (Rogers et al., 2012). WHO's report has defined health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (WHO, 1948). This suggests the mental health of urban residents is a factor in improving their quality of life as important as physical health. There is a body of research that has contributed to study the direct and indirect effects of the built environment on mental health, but relatively inadequate attention, to date, has been paid to investigate the connection between specific streetscape characteristics and human mental health. Wang et al. (2019c) investigated the relation between neighbourhood walkability and elders' mental health with a specific focus on street enclosures. Moreover, vulnerable groups such as elders, children and low-income families received extra attention, even from a broader literature on environmental factors rather than only on street attributes (Kuller and Lindsten, 1992; Wiles et al., 2009; Wang et al., 2019c). However, street users vary greatly in the social backgrounds including age, gender, occupation, education, cultural background and life status. Most people who walk on normal urban streets are not those diagnosed with significant psychological issues but people who suffer from common psychological issues such as mental fatigue and stress sourced from everyday life. These problems, which are mostly ignored, can seriously affect people's mental health in the long term. In terms of mental health issues of this kind, it is fair and reasonable to assume that it is the adult group who takes the burden both from work and their family; they are more vulnerable than others.

Another limitation identified in the existing literature has been a major obstacle between environmental assessment and efficient design improvements because most assessment tools of environmental quality only measure the current situation. Little was said about how relevant improvements should be made accordingly and coherently, especially when the principle of 'the more the better' can hardly be applied. Towards a more human-oriented design approach, the appropriate environmental design should be decided with the consideration of both the current and users' expected situation. People are invited to participate in various processes of the environmental appraisal so they can inform professionals in urban design and planning of what their evaluations are of current environmental qualities. The other factor, in most cases, is determined by professionals and mostly the upper limits of design improvements, which are only determined by environmental, economic and demographic carrying capacities. It is feasible and reasonable in some ways, but certain advantageous design interventions do not seem to be advantageous to streets in the same way as they may be to other environments. Due to the complex roles the urban streets take and the balance they need to maintain, they are more sensitive than other urban public spaces in terms of delivering a balanced and appropriate design, especially when it comes to perceptual qualities such as comfort, pleasantness and restorativeness. For example, greenery is welcome but too many trees and bushes in the streets might block the sight of both vehicles and pedestrians, threatening their perceived sense of safety. In addition, people's expected condition of streets can vary with different streets. Similarly, the crowding level of a street that is meant for leisure purposes would be different with a street designed mainly for movement.

To conclude, this part of the literature review generalised two major setbacks in delivering urban street design efficiently and properly in response to assessment results. Instead of clarifying the limitation, the first point proposed in this section is more inclined to have a broader elicitation of urban street studies and puts forward a retrospection on what has been missed in previous considerations about streets. Through widening the conventional perspective of considering urban streets, this research intends to introduce a way of enriching their influences on urban life by exploring whether they can be designed to become a place that offers normal working people with more opportunities to recover psychological sources depleted in everyday life. This research asserts that while the difference between urban streets and other public spaces exists, an innovative viewpoint is required so that more comprehensive potential of urban streets as public places can be uncovered. As long as this innate difference is considered and discreetly tackled during research and following practices, the balance between multiple roles an urban street takes can still be achieved and its full capacity can be optimised in sustainable and appropriate ways. One possible way of handling this difference, in respect of designing streets to provide restorative experiences, is to evaluate both the current and expected restorativeness of street users, and how discrepancies of expected restorativeness disclosed between street types can be utilised in appropriately delivering street restorative benefits without compromising any other of its functions.

2.4 Developing the Concept of a Restorative Street

According to the above review-based discussion of restorative environment research and urban street design, it has been shown that there is a lack of exploration in restorative potential of common and easily accessible urban settings, though evidence has gradually emerged to suggest that a well-designed urbanscape can rival nature in terms of being restorative (Ivarsson and Hagerhall, 2008; Karmanov and Hamel, 2008). This research also asserts that restorative potential of urban settings should be distinguished further within scene types. Most previous studies neglected the restorative potential of urban environments since they are compared with the dominant natural settings. Another limitation in restorative environment research is that there is, to date, still a lack of effective methods to use the evaluation results of environmental restorative potential to guide urban design practices. In response to these limitations, the literature of urban street design provides two justifications, suggesting that exploring possible restorative benefits the urban streets have (or can be designed to have) cannot only overcome deficiencies identified in restorative environment research but also remedies current insufficiencies in urban street design agendas. First, the urban street system provides sufficient opportunities for people to achieve restoration since streets are most frequently accessible urban spaces, especially under the current situation of increasingly limited green space resources in high-density cities. Second, the acknowledgement of urban streets being essential open spaces requires researchers and practitioners to further explore their possible social value that has not been fully disclosed. One possible way of addressing these gaps is to investigate the overlaps of the restorative environment and urban street design; that is, to assign urban street environments with those restorative related characteristics through design interventions. Therefore, the conceptual framework of restorative street should be constructed based on the restorative environment theory with the consideration of the urban streets' attributes (Figure 2–6).

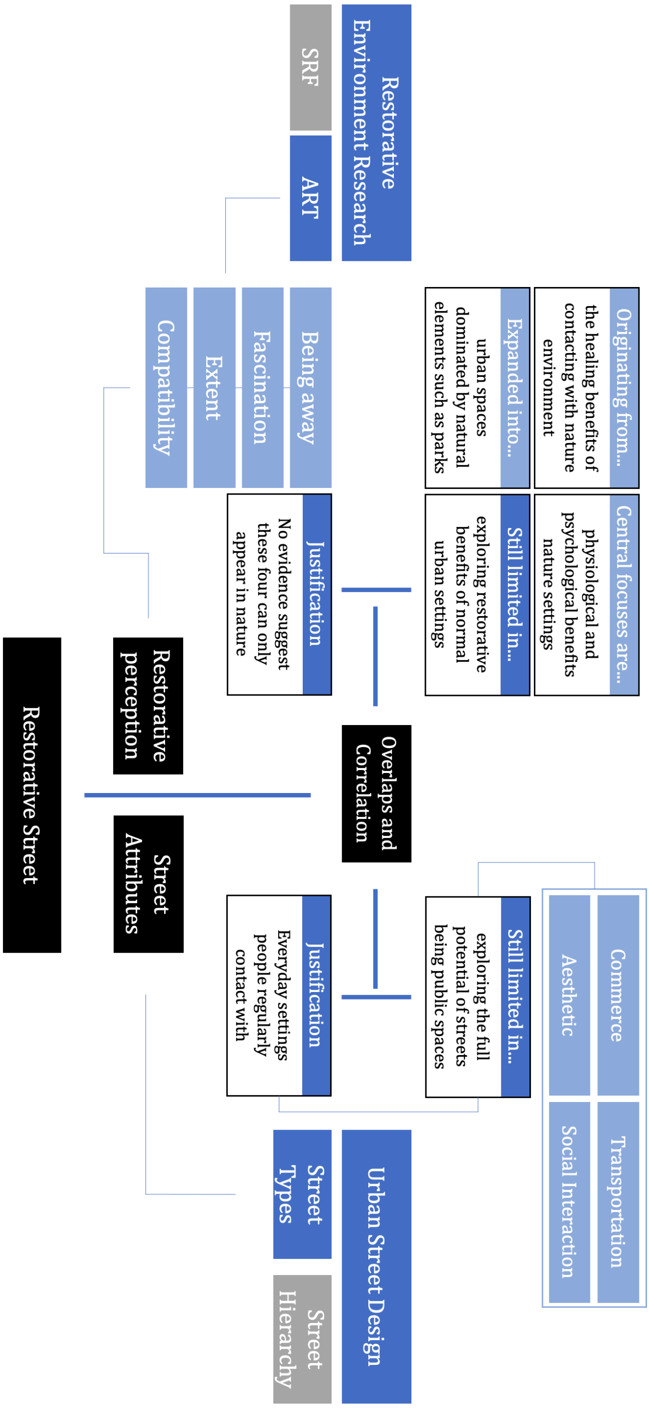


Figure 2- 6 Developing Restorative Streets from Existing Research Gaps. Source: the author.

The term ‘restorative’ refers to a person's return of strength or health through renewing abilities (Dictionary, 2004). As it has been introduced earlier in this chapter, discrepancies exist in describing the antecedent conditions people recover from in psychological restoration theory and, correspondingly, relevant restorative environmental research. Accordingly, slight differences exist in the definition of the restorative environment across previous studies. In general, the concept of ‘restorative environments’ (Kaplan and Talbot, 1983) emphasises recovering aspects provided by places, which would allow people to distract, relax, free their minds and distance themselves from ordinary aspects of life. They are defined as places that can help replenish emotional and cognitive resources (Kaplan and Kaplan, 1989; Hartig, Mang and Evans, 1991; Hartig, 1993; Kaplan, 1995; Kaplan and Berman, 2010), ′re-charge’ people′s attentional capacities (Hartig et al., 1996; Korpela and Hartig, 1996; Hartig et al., 2003; Hartig and Staats, 2006), reduce psycho-physiological stress (Ulrich et al., 1991) and enhance mood and positive affect (Ulrich, 1984; Ulrich et al., 1991; Bowler et al., 2010). The concept of restorativeness is explained as the result of complex place experience in which cognitive, affective, social and behavioural components are considered together with the physical aspects of the environment (Scopelliti and Giuliani, 2004).

Attention Restoration Theory is considered to be the most appropriate theoretic basis to proceed with the current research since it contributes in two ways. The multiple function and value of urban streets make them different from other public spaces and requires them to achieve balances between different types of values with the considerations of the functional purpose they are created to serve (see 2.3). This research asserts that restorativeness of urban streets should be varied according to their categorisations. To differentiate restorative levels between street types, this research has developed another concept, restorative expectations, which is largely constructed by the image of the place from people’s former experiences and the meaning they endowed the streets with that are particularly relevant to restorative experiences. By allowing for a greater temporal extension of the restoration process and a greater range of effects, including changes in perspectives on oneself and one’s place in the world (Kaplan and Talbot, 1983), Attention Restoration Theory (ART) allows greater latitude for relating restorative experiences to place identity (Korpela and Hartig, 1996). This specific advantage ART can provide is fundamentally in line with this research, proposing relating restorative expectations with street types, which are classified according to functions and characteristics of urban streets. Allowing to relate a restorative experience with place identity means allowing people to differentiate their restorative expectations according to different street identities, and in that allowing a greater leeway to differentiate within street types. Moreover, it offers a set of components with potential utility for understanding various restoration outcomes realised by purposive individuals acting in full-scale environments, and this particular set of components can be described as mediators of the relationship between the physical environment and restoration (Nordh et al., 2009). Its four components (*being away*, *fascination*, *extent* and *compatibility*) are considered to be more applicable in existing empirical research, especially in the development of related evaluation measurements. This contributes to another important aspect of this research, which is to translate users’ restorative perceptions into design interventions.

Restorative streets, the theme of the current research, should be defined in line with critical assertions of Attention Restoration Theory. This assumes that attentional fatigue as the precedent condition of restoration, and this kind of fatigue can be replenished when surrounding environments are capable of providing the sense of *being away* and *extent*, as well as *fascination* and being ‘compatible’ with users’ needs. As for the street environment, it refers to those in possession of the above four restorative characteristics that would facilitate the process of recovering people from depleted attentional capacities. Its derived term, street restorativeness, measures the degree of how well street environments can provide people with restorative experiences. This research considers it as one of the essential environmental qualities that urban streets should have (or improve if they do not have enough), and this quality should be varied between different street types. It asserts that a balance should be achieved between providing restorativeness and other street qualities. Streets should not be covered with trees, flowers and bushes only because natural elements are confirmed to be beneficial for restoration. Not every street should be required to provide the ultimate level of restorative experiences because their functions and characteristics vary significantly. Street restorativeness is necessary and should be delivered as a part of the general vision of well-designed urban streets. To explore an efficient design approach of delivering street restorativeness corresponding to street categorisations and users' expectations, this research proposes two concepts: current restorativeness and expected restorativeness (Figure 2–7). These two concepts respectively describe how people perceive street restorativeness under the current situations, and what their expectations are in terms of having restorative experiences in the streets. When the design of the street restorative quality causes its current restorativeness to exceed its expected level, it might result in a waste of environmental resources and even threaten the expression of other street qualities. In contrast, people may not be satisfied with their restorative experiences when the current restorativeness is lower than the expected restorativeness. The optimum situation of a street in terms of providing people with restorative experiences is when the current restorativeness of this street equals the expected restorativeness people want to experience in the street.

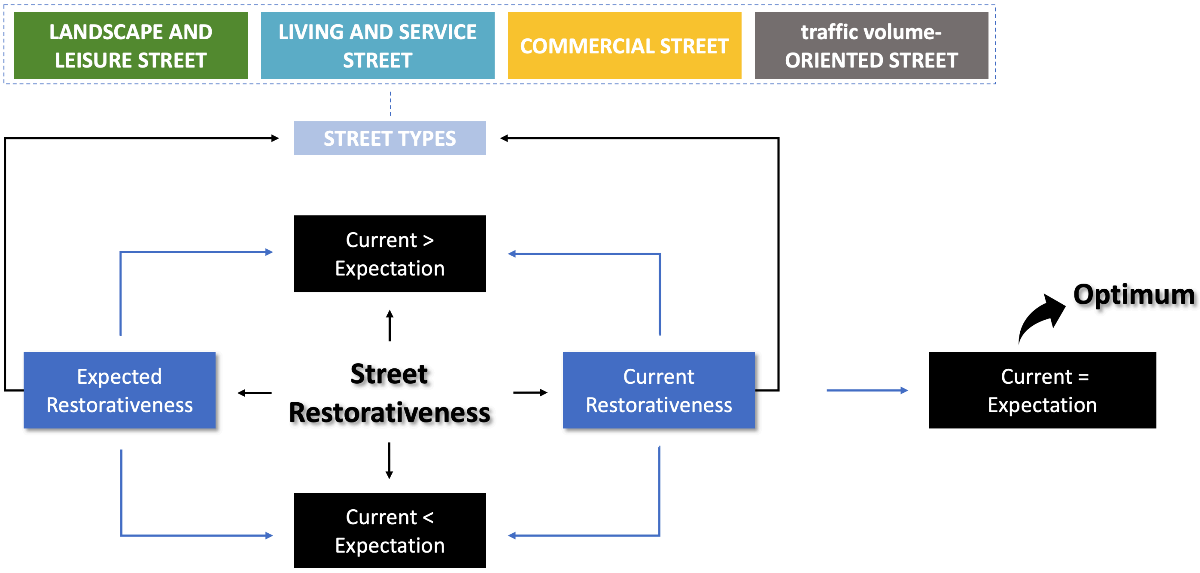


Figure 2- 7 Overview of the Current and Expected Street Restorativeness Relationship. Source: the author.

2.5 Summary

This research sets out from a common understanding that planners and designers should seek possible ways of providing people with opportunities for restoration as part of their everyday lives, without preventing them from moving into cities. Instead of focusing on green resources such as urban parks, of which access is extremely limited by the resources available, this research proposes that it is meaningful to explore the restorative potential of another typical urban setting: a street. A psychological approach to understanding the human–environment interaction is most valuable only when it contributes meaningfully to design and management by identifying measurable physical features (Wohlwill, 1976; Daniel and Ittelson, 1981; Daniel and Vining, 1983). Similarly, this research intends to discover possible ways to design restorative streets. This chapter started from a comprehensive literature review respectively from the perspectives of the restorative environment theory and urban street design to identify whether an overlap existed and, if so, how this overlap can help develop the central research concept of the restorative street.

Limitations emerged from restorative environment research, and urban street design also implies a necessity of utilising their overlaps, which is then formalised into the concept of a restorative street in this research. Current restorative environment research focuses are quite limited in environmental variations with an over-emphasis on the natural environment or natural-dominated urbanscape; hence, the restorative potential of urban settings that are not designed for recreational purposes has not been fully exploited. Also, a polarised comparative approach adopted widely in relevant research, which uses urban and natural settings for comparing restorativeness, could conceal the restorativeness urban settings might have. More importantly, no solid connection has been established to direct environmental design from the perspective of improving environmental restorativeness, since most existing restorative environment measurements only describe perceptions and variations that are intangible in design practices. On the other hand, research limitations that emerged from urban design literature also suggested that the social value of urban street environments has not been fully disclosed. There is an opportunity to further amplify the social value of urban streets with the development of human-oriented street design, within which one way is to explore its full potential to be a type of urban space by considering whether it can be designed to improve human well-being. This review also pointed out that urban streets, unlike other urban spaces, are places undertaken from multiple functions. Therefore, the delivery of restorativeness in an urban street environment should be balanced with the other functions the streets have. This balance can be achieved by considering the restorative potential of streets together with their inherent characteristics, which resonate with the place identity concept discussed in the restorative environment research.

From time to time, each party of restorative environment research and urban design has thrown bridges across from one side to the other trying to break the disciplinary boundaries between environmental psychology and urban design, but neither side had approached close enough to the other to provide many points of fusion that we should regard as indispensable to solve our present enquiry. Through this review chapter, this research highlighted existing gaps that need to be overcome and identified overlaps between these two research realms that are extremely useful for pushing forward this research in terms of developing restorative street concepts, as well as establishing a methodologic framework for achieving other research objectives as stated in Chapter 1. In response to identified research gaps, Chapter 3 discusses and provides justifications for applicable methods that are planned for bridging the gap between street design and environmental restorative benefits. Every stage has a detailed design included in Chapter 3 and introductions on the relevant method, followed in the next few chapters by illustrations of attempts to overcome current research gaps according to the methodologic processes designed in Chapter 3, so that the final aim of delivering an efficient Restorative Street Design Approach (RSDA) from users' perspectives can be achieved without compromising the streets' inherent characteristics.

CHAPTER 3 DEVELOPING THE RESEARCH METHODOLOGY

3.1 Introduction

Following the definition on the central concept of the 'Restorative Street' and related essential concepts in this research, this chapter intends to construct a methodology framework in order to solve the identified research gaps. The whole research starts from the overlaps of restorative environment research and urban street design and sets up the central goal of developing a Restorative Street Design Approach (RSDA). This chapter starts with referring to Maxwell's interactive model (1996) for preliminary research design to further discuss on how the research process should be organised and how relevant data should be collected, analysed, and interpreted.

Even though the interactive model (Figure 3-1) was originally developed for the purpose of designing qualitative research (Maxwell, 1996), it helps in organising relevant research ideas and revealing their logical connections. The most obvious difficulty in this research lies in 'translating' restorative perceptions into street design language, which requires a relationship being established between the psychological components of restorative environmental theory and the environmental attributes of urban streets. Therefore, this research should depart from the two ends of the relevant domains respectively and explore whether they overlap with each other and how this overlap can be transformed into their relationship. Five objectives are raised in this research (see 1.3) in order to identify and utilise their overlaps; these objectives also illuminate the necessary stages of conducting this study. It can be concluded, from further disassembling each research objective as the research progresses, that there is more than one type of information required to be collected during each stage of this study.

The next section describes the development of the research methodology framework, based on the implications of the general research strategies. The choice of primary data collection and analysis methods in particular is outlined in the following sections. The limitation of each method is then discussed, and necessary adjustments are proposed for making them adaptable to realise research objectives. This methodology chapter ends with a summary of the developed methodology framework and its incorporated specific stages, the research methods used in each stage, and explanations on how these stages lead towards the final destination. As mentioned above, sections in this chapter include the following:

Section 3.2 describes the process of developing an appropriate methodology framework setting out from reflecting on underlying research philosophy; respectively introduces four major research methods employed in this study; and provides justifications for their employment, reviewing their limitations and discussing necessary improvements required to be made in this study.

Section 3.3 explains the reason and criteria of determining sample size for each research stage.

The last section summarises the major stages designed for this research and points out the next necessary step.

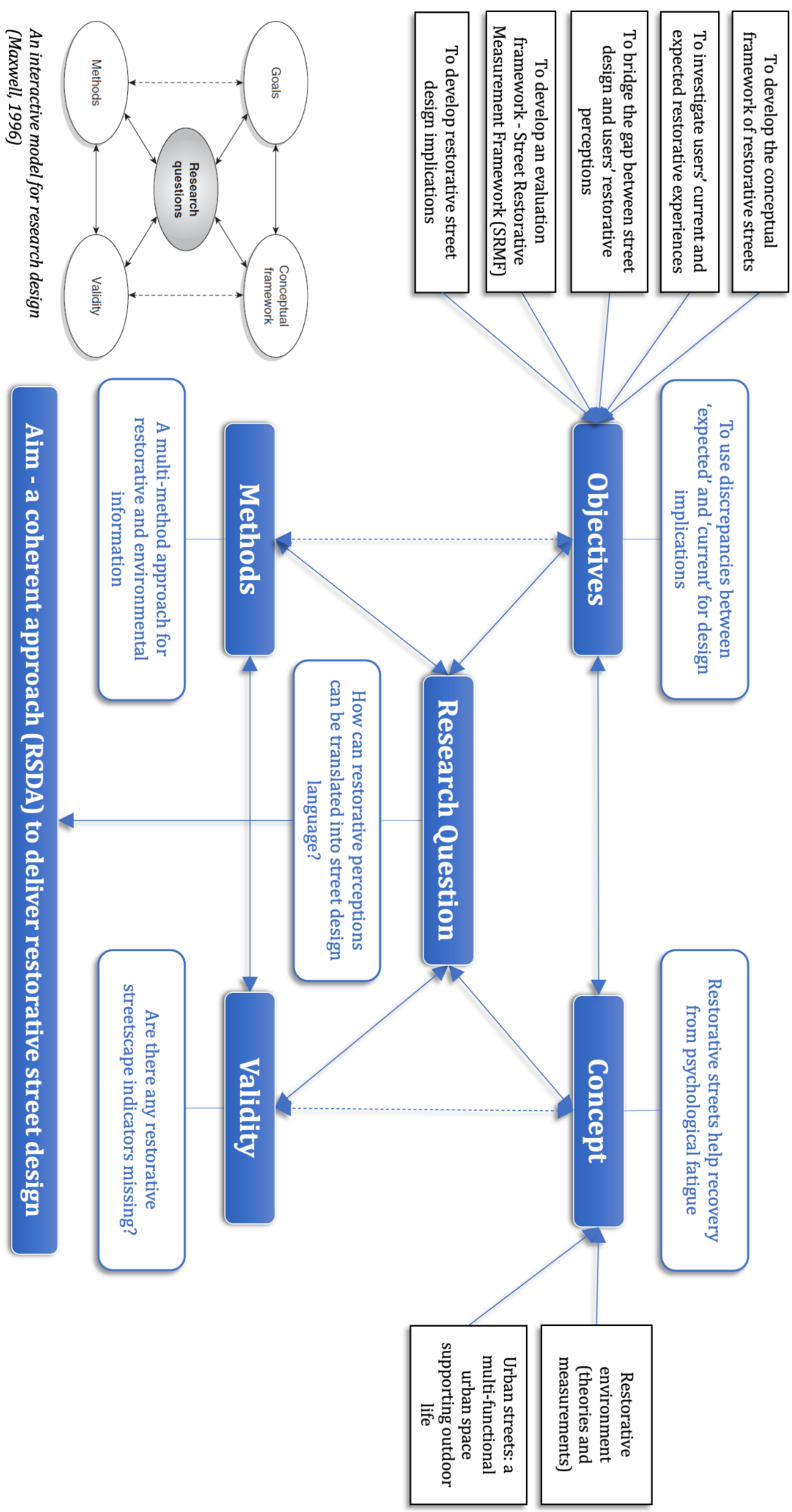


Figure 3- 1 Organising relevant ideas into a research design framework. Source: the author.

3.2 Developing the Methodology Framework

This research attempts to explore a way of delivering restorative street design. The research process involves gathering perceptive information on people's restorative experiences and exploring possible ways to correlate them with street attributes, so that specific restorative improvements can be provided. As mentioned in Chapter 2, the central gap of achieving the research aim is to 'translate' restorative perceptions into design languages. Existing instruments can measure environmental restorative benefits and street quality, but none of them is able to measure the urban street quality that can indicate the restorative benefits of streets. Given that both qualitative and quantitative information are required in order to overcome this research gap, a mixed-method approach is designed for data collection, and a quantitative method is used for data analysis. Together, they function as the basis for constructing the main methodology framework in this research (Figure 3-2).

To be more specific, this study is designed into three stages in response to its research aim and objectives. The first stage tries to resolve Objective 2, which is to measure people's expected and current restorative evaluations. This is required firstly to find an applicable instrument under the urban street context. The selected instrument needs to be validated for its efficiency before officially employing it for obtaining information on restorative perceptions. Hence, the document analysis is used to find the potential instrument, and the pilot study approach is used to test it. In the pilot study, a short interview is also considered to be useful in gathering further information on how the selected instrument should be modified in the current research context. To conclude, **document analysis** is used to select the proper measurement, a **scaling questionnaire** (given that most measurements derived from ART are psychometric scales) is used to investigate restorative perceptions, and an **interview** is used to gather advices on how to adjust the questionnaire in the first stage.

The next stage intends to identify potential street design indicators that might be associated with restorative experiences. Theoretically, there are two ways. One is to investigate the influence of each, and every single street indicator has on users' restorative perceptions. The other is to identify design indicators particularly relevant to streetscapes from existing literature describing the overlaps of restorative environments and environmental attributes, and then have them validated all at once. Both ways would involve a great amount of work reviewing previous literature. Considering the time and resources available, the latter approach is more feasible in this study. **Document analysis**, hence, is used as the major research method in the second stage to identify potential restorative-related street indicators from relevant literature.

An essential subsequent stage is to bridge between restorative perceptions and street design indicators. This stage is designed not only to validate whether the environmental attributes identified in the second stage are adaptable to street environments (which indicates that another pilot study is required), but also to disclose their interactive mechanism so that design improvements can be generalised accordingly. The **questionnaire** method is necessarily engaged in this stage to obtain two sources of information, users' restorative perceptions on streets and their evaluations of street indicators. The emerging relationship between restorative perceptions and street design indicators in the third stage, together with the discrepancies between expected and current restorativeness, can imply possible design interventions on improving street restorativeness in response to users' wishes. This stage of research is conducted based on carefully selected case-study streets, so that design principles are expected to be generalised as one of the research outcomes. To summarise, this is a study intends to develop the Restorative Street Design Approach (RSDA) through a mixed-method approach composed of document analysis, questionnaire, interview, and case study methods.

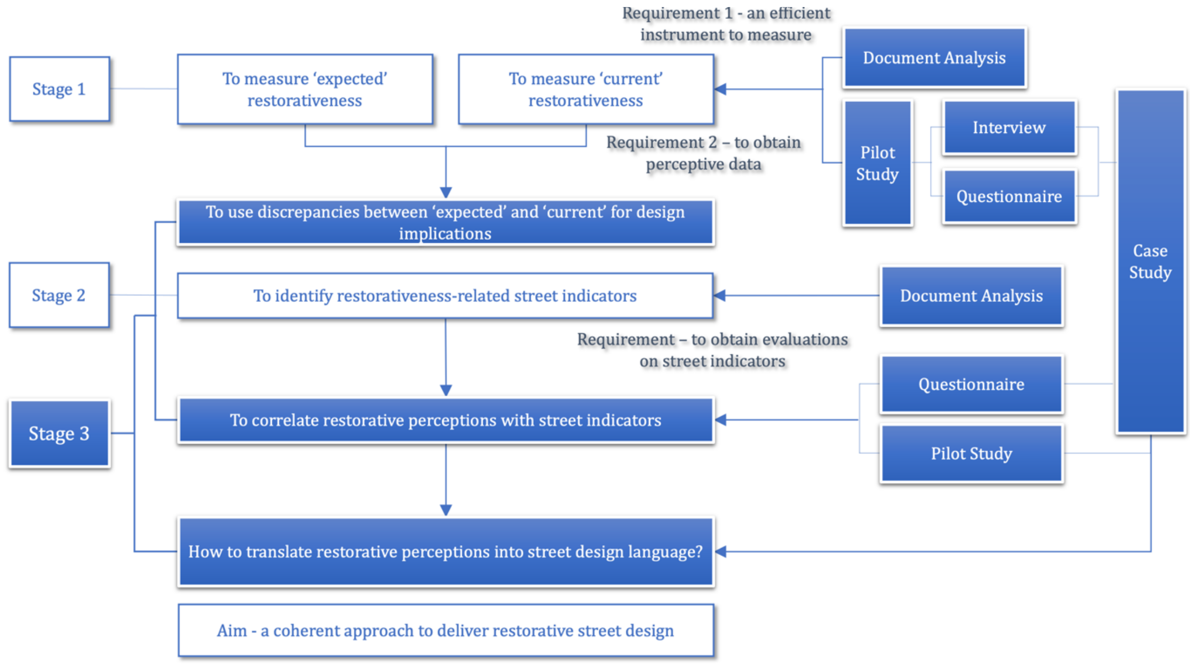


Figure 3- 2 Developing Methodology Framework from research purposes. Source: the author.

In general, the underlying philosophy of this research should be classified as pragmatism, according to the essence of the methodology framework (Figure 3-2). The pragmatist research philosophy (Figure 3-3) was raised as a necessary supplement to two previously dominated philosophical paradigms, the positivist paradigm (normally linked to quantitative research) and the interpretivist paradigm (normally linked to qualitative research) (Business Research Methodology, 2019). It asserts that, in response to research questions, the centre of the research, more than one approach or strategy can be adopted, and multiple research methods can be involved within the same study, according to the nature of its research questions (Table 3-1) (ibid, 2019). Qualitative and quantitative methods involve different strengths and weakness: a quantitative approach can measure the reactions of a great many people to a limited set of questions so that a comparison and statistical aggregation of the collected data is achievable, while qualitative methods typically produce a wealth of detailed information about a much smaller number of people and cases (ibid, 2019). Hence, the application of a mixed-method approach can not only accommodate different needs of data collection; it can also reduce and neutralise the disadvantages and negative impacts that are caused by the usage of only a single or few research methods (Sommer and Sommer, 2002; Bryman, 2016; Coolican, 2014).

Table 3- 1 Research philosophy classification and strategy.

Philosophy	Research Approach	Ontology	Axiology	Research Strategy
Positivism	Deductive	Objective	Value-free	Quantitative
Interpretivism	Inductive	Subjective	Biased	Qualitative
Pragmatism	**Deductive/Inductive**	**Objective or subjective**	**Value-free/biased**	**Qualitative and /or quantitative**

Source: Research Philosophy Website. https://research-methodology.net/research-philosophy/

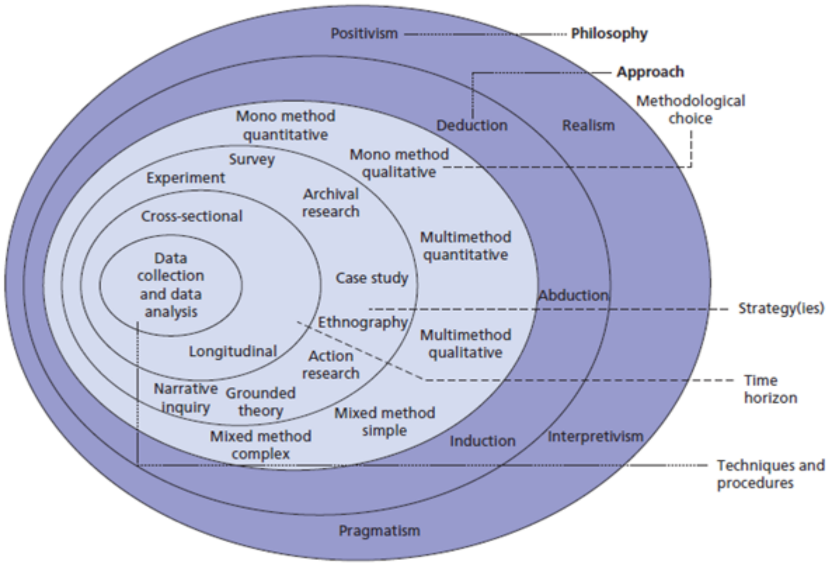


Figure 3- 3 Research philosophy in the 'research onion'. (Source: Research Philosophy Website. https://research-methodology.net/research-philosophy/)

3.2.1 Document analysis method

Document analysis is a type of qualitative research for answering specific research questions through a systematic procedure of analysing evidences from existing documents (Gross et al., 2015). It can be treated as an independent study of obtaining a specific range of information to answer questions, or as a composition of a mixed-method approach, normally in triangulation, where documents can corroborate, refute, elucidate, or expand on findings across other data sources to help avoid bias (Gross et al., 2015). There are numerous types of document data that can be used in research, including policies and regulations, papers about the operation and history of an organisation, reports, budgets, newsletters, meeting minutes and agendas, organisational charts, presentations, manuals/handbooks, book chapters, and journal articles. Even though document analysis is a cost-effective, efficient, and relatively stable qualitative method, there are also limitations that need to be considered when it is applied in research (Bowen, 2009). The most influential limitation is that the documents reviewed are originally produced for some other purpose and may be insufficient for answering the exact question raised in this research (Gross et al., 2015). In addition, some documents may be biased, as they are representatives of the author's perspective, and the sample as a whole may suffer from selectivity if it represents an incomplete collection or limited selection of the available documents on the topic (Gross et al., 2015). These limitations of using document analysis, however, can be reduced or eliminated by involving a broader range of relevant materials and by carefully making inclusionary and exclusionary criteria according to research objectives (ibid., p.6).

Document analysis is used in this research for two purposes. The first is to select a suitable instrument to measure people's restorative perceptions; therefore, it is carried out as a stand-alone method at this stage of research solely for choosing an appropriate instrument and providing sufficient justifications for the selection. Numerous efforts have been made in previous restorative environment studies to develop relevant measurements; it is expected that this study will select one of them and use it to measure users' current and expected street restorativeness. Related documents for analysis should be research literature, particularly that concerned with development and application of restorative measurements. Since, as discussed in Chapter 2, Attention Restoration Theory is taken as the theoretical basis of this research, instruments developed on the basis of the Stress Reduction Framework and any other psychological grounds are therefore excluded. Another purpose of employing document analysis is to identify, from existing literature, environmental attributes that are potentially associated with restorative experiences. However, one major research gap is that only limited efforts have been made to excavate the restorative potential of streets, as has been clarified in the first chapter of this thesis. Very little evidence can be found explaining what exact street indicators influence people's restorative experience and how.

This study decides to expand the scope of the included restorative environment literature for collecting restorative-related environmental indicators, so that the result can be as comprehensive as possible. To ensure that the identified evidence is convincing, the documents reviewed at this stage should be the relevant literature, and majorly academic sources, ranging from journal articles to dissertation works, professional presentations, and reports. Considering that very little evidence in restorative environment research has directly led towards the street environment, restorative-related indicators identified through document analysis should be verified in street contexts. It is also necessary to find out whether any indicators were either missed in the literature or missed in the process of reviewing the literature. Therefore, document analysis is used, together with other necessary methods at this stage, to retrieve missing indicators. Details of the document searching procedure and exclusionary criteria are clearly outlined in Chapter 6 of this thesis.

3.2.2 Questionnaire method

The questionnaire method can be defined as both qualitative and quantitative, depending on the nature of the questions designed and the information collected. It is in essence a set of standardised questions organised in a fixed scheme in order to collect individual data about one or more specific topics (Trobia and Lavrakas, 2008). The following types of questionnaire are commonly used in the data collection process: online questionnaire, telephone questionnaire, in-house survey, and mail questionnaire. Telephone questionnaire and in-house survey methods, in general, serve for a smaller sample size than the online and mail questionnaire methods. As for the type of questions composing each questionnaire, there are normally open-ended and close-ended questionnaires; the latter can be further divided into multiple-choice questionnaires, dichotomous questionnaires (with two options, 'yes' or 'no'), and scaling questions that present respondents' options ranked on the scales. Scaling questions are normally used when subjective evaluations on the level of certain topics are needed. The questionnaire possesses several advantages, such as economy, speed, wider range, and less pressure on respondents (Trobia and Lavrakas, 2008), and hence is a popular method across disciplines such as social science, psychology, and medical research.

Two sets of scaling questionnaires are used in this research, with one adopting an existing instrument measuring users' restorative perception of people, and the other constructed by the author based on evidence found in previous literature in order to obtain people's evaluations of restorative-related street attributes. Both online and onsite questionnaires are involved in this research. In terms of gathering information about local residents' expectations on their daily-use street environments, a relatively large scale of respondents is required to ensure the accuracy of the acquired results. Hence, an online questionnaire is regarded as helpful and efficient at this stage of data collection. However, it is no longer feasible in exploring how people evaluate the current restorative quality of case-study streets. First, some of the potential respondents might have never visited the selected streets if they are approached online or through any other indirect channels, such as emails and telephone calls. Also, a real street environment is the most authentic stimulation in terms of obtaining the precise perceptions of users, even though visual stimuli such as photos and videos have been widely employed in previous research (Nordh et al., 2009; Nordh, Hagerhall and Holmqvist 2013; Lindal and Hartig, 2013; Wang et al., 2016). In this case, an onsite survey is considered to be appropriate for evaluating the current restorativeness, since streets are existing entities for them to assess, feel, and experience. Despite the time and economic concerns, onsite evaluation with scaling questionnaires can offer a way of gathering the most accurate restorative perceptions, while an online scaling questionnaire can be used to investigate users' restorative expectations so that the results can speak for the majority.

3.2.3 Interview method

An interview is a useful qualitative research method to collect in-depth information on people's opinions, thoughts, experiences, and feelings; it can also be useful as a follow-up to certain questionnaires, seeking to further investigate participants' responses through conversations (Easwaramoorthy and Zarinpoush, 2006). Categorising from the way of communication, there are face-to-face interviews for the situation when in-person conversation conveys more, and telephone interviews that are more applicable when a large scale of respondents is needed. In terms of the structure of the interview content, three types are generalised: structured, semi-structured, and unstructured. Questions and the order of organising them are pre-determined in a structured interview, while in an unstructured interview, no questions are prepared in advance (Business Research Methodology, 2019). The semi-structured interview stands somewhere in between them. The interviewer follows a set of pre-designed questions but can also ask supplementary questions for clarifications according to the responses of respondents (Easwaramoorthy and Zarinpoush, 2006).

In this research, the interview is going to be carried out as a follow-up method to gather suggestions from participants on how the selected restorative measurements can be improved to fit to the urban street context, as well as in a Chinese-language context in the first pilot study. It is designed to test whether the selected instrument can be used to measure restorative expectations and differentiate within street types. Based on the specific purpose of investigating participants' feedbacks, a semi-structured interview is designed and conducted, with a limited number of questions that are coherently focused on participants' reflections while answering the questionnaire. Data analysis process for this kind of interview can be straightforward and time-efficient, as most questions are predetermined with clear purposes.

3.2.4 Case study method

A case study is an effective qualitative method used across a number of disciplines, particularly in social sciences, to address a wide range of research questions (Harrison et al., 2017). It offers researchers opportunities to closely analyse specific issues within the boundaries of a specific context. Exploratory, descriptive, and explanatory case studies are classified and justified (Yin, 1984) in this general category of research methods. The current study adopts the case study method for the purpose of investigating how a Restorative Street Design Approach (RSDA) can be applied in real street scenarios, what modifications should be made, and what results can be achieved. This research is in essence an exploratory process constructed step-by-step so that a specific context that allows a framework and an approach can be developed, validated, and adjusted as required. Therefore, the case study method used in this research is categorised as an exploratory case study. An exploratory case study contributes to finding answers to the questions of 'what' or 'who' that serve as a point of interest to the researcher (ibid., p. 3). This can also be validated by the fact that the case study method acts only as a part of the mixed-method approach for data collection, since, in studies using the case study method, the data collection process is normally accompanied by additional methods, such as interviews, questionnaires, and experiments (Dudovskiy, 2016).

The case study is carried out all the way through the three stages of the research. Three parts of data are expected to be collected, based on the selected study site: users' expectations of street restorativeness and their evaluations of current street restorativeness, people's evaluations of restorative-related street indicators, and interpretation results indicating how the restorativeness of selected sites can be improved through design interventions. Though Yin (1993) comments that the case study method is 'microscopic' because of the limited sampling cases, it considered to be useful in this research. Given the overall aim of this research is to deliver a reliable street design approach with sufficient flexibility being applicable to various street design contexts, its development and validation have to be grounded in certain street environments so that its generality and limitations can be concluded afterwards. Therefore, this research is carried out based on four selected streets in Shanghai, of which details and justifications are provided in later chapters (see Chapter 4).

3.3 Sample Size

The main purpose of sampling is to reduce the need for empirical operations which entail labour and cost (Babbie, 1990). Sample size should be considered according to the needs and reality of the research (Baker and Edwards, 2012), and the validity and quality should be considered more than the quantity in the sampling (Babbie, 1990). Sandelowski (1995) suggested that sample size in qualitative research should be neither so small as to make it difficult to achieve data saturation nor too large to undertake a deep, case-oriented analysis. The essence of this research is a mixed-method approach involving both qualitative and quantitative data collection methods; therefore, different sampling strategies should be taken, based on the research design of different data collection stages as well as the divided sampling groups (e.g., male and female; the elderly and children). In this study, there are four steps that involve determining sample sizes: the first pilot study using an onsite questionnaire together with a follow-up interview, and the subsequent formal survey for investigating the expected restorativeness using an online questionnaire, as well as the second pilot study and subsequent formal survey to measure the current restorativeness of four case-study streets, both using the onsite questionnaire.

The first pilot study is designed to test the efficiency of a selected instrument in measuring the expected restorativeness, with no specific study site involved. The sample size in this study was determined by referring to the effect sizes of existing studies on restorative environments (Bowler et al., 2010): The impact of a restorative environment on subjectively reported fatigue revealed an effect size of 0.76, while studies of the impact on cortisol, a biological measure of stress and non-restorativeness, revealed an effect size of 0.57 (minimal sample size = 24). Hence, an appropriate number of participants consists of 10 to 30 people. Determining the sample size for the online questionnaire in the formal survey to collect users' expected restorativeness of Shanghai streets should take the overall population of Shanghai into consideration, which is over 32 million people by 2019. A suitable sample size for the questionnaire should be around 380, according to the Raosoft sample size calculator for online surveys. Considering that this research only focuses on working people aged 25–55 (people retire at the age of 55), that accounts for around 50% in the demographic structure of Shanghai, the sample size of the online questionnaire aimed at investigating the general expected restorativeness of Shanghai streets should be around 150–190 in the formal survey.

The second pilot study is designed to test whether the SRMF composed of potential restorative-related street indicators identified from the literature can be assessed efficiently. Also, the formal onsite questionnaire survey conducted after the pilot study is to gather evaluation results on users' current restorative perceptions and their SRMS evaluations; participants are planned to be recruited onsite, so that it can be ensured that most of them are regular users of the selected case-study streets. In this stage of the research, each street should be treated as an independent sample, and hence the sample size of each study street should be 10–30. Referring to previous relevant studies, a sample size of 15–50 for each sample group was generally observed (e.g., Hartig, Mang and Evans, 1991; Nikunen and Korpela, 2009; White et al., 2010; Kjellgren and Buhrkall, 2010). All four of the case-study streets are branches less familiar to visitors, with regular and relatively limited everyday users. This research has decided to recruit around 30 participants for each study site, and hence the total number of participants in this stage should be around 120 for the four streets, with each street regarded as an experimental group.

3.4 Summary

The overall aim of this research is to develop a Restorative Street Design Approach (RSDA) and to utilise it to develop restorative street design principles based on a case study carried out in Shanghai. This approach has two evident innovations. First, it is established on the concept of the expected street restorativeness, which intends to illustrate people's anticipated conditions in terms of having restorative experiences in streets. This research attempts to use the discrepancy between the current and expected street restorativeness to indicate possible restorative design improvements. Accordingly, two statuses of street restorativeness, current and expected, are required to be investigated. Moreover, this research asserted that a balance should be achieved between the multiple functions of streets and their required restorative quality. This research intends to solve this by relating people's expected restorativeness to different street categorisations. It is assumed that street users expect to experience different levels of restorativeness in different street environments, and these differences arise from their prior knowledge and understanding of the street type to which they belong. From what has been outlined above, three stages are designed in this research towards reaching the final aim. Figure 3-1 in the first section of this chapter illustrates how the three stages are organised in response to the five objectives raised in Chapter 1 of this thesis. Developed from the research method design illustrated in

Figure 3-2 and the relevant methods discussed in Section 3.2, Figure 3-4 provides more details on the overall methodology framework of this research to make it more comprehensive and straightforward.

After the selection of case study sites, of which details will be stated later in Chapter 4, the first step is to investigate people's expected restorativeness and the differences of expectation within street types. A number of restorative measurements has been developed in the previous literature and widely applied in different settings, but there is no evidence showing any of them has been used in investigating an expected status of restorativeness. Hence, this research will start with a literature review-based discussion on existing measurements to find out the most promising instrument. The potential measurement will then be tested in a small-scale pilot study to see whether it is feasible in measuring expected restorativeness and whether it is sensitive in differentiating within street types. In addition, a short interview is conducted to find out what modifications should be made on the selected instrument so that it can, first, be in line with the research purposes of investigating expectations of street restorativeness, and second, be better conveyable in a Chinese context. If the potential instrument is validated to be useful in the pilot study, a formal survey on people's expected street restorativeness will be carried out afterwards using this instrument. However, either the current or expected restorativeness measured with the potential instrument are restorative perceptions that can only indicate how people feel and expect to feel while walking in certain street environments.

Restorative perceptions alone can hardly be useful in improving street's restorative benefits in response to what people want. Therefore, the other line of this study approaches the research aim through building up the connection between restorative perceptions and street indicators (Figure 3-4). Previous researchers have contributed to identify what environmental characteristics can influence restorative perceptions, but very limited evidence is directly linked to the street environment. This study departs from building up a preliminary framework (SRMF 1.0) composed of all associations between restorative experiences and environmental attributes identified from existing literature, whether direct or not, whether about streets or not, and then having them all validated on case-study streets in the second pilot study for three purposes: 1) to exclude indicators that are less relevant for urban streets; 2) to find out if SRMF 1.0 misses any potential street indicators; 3) to explore a way of correlating restorative perceptions with street indicators. This pilot study is then developed into a formal survey on four different streets in Shanghai, which composed of two parts with scaling questionnaires. The first one measures users' restorative perceptions using the potential instrument selected and validated in stage one, and the other uses the refined framework (SRMF 2.0 – adapted from SRMS 1.0) to understand people's evaluations of restorative-related street indicators. This research then attempts to establish the connection between these two evaluation frameworks (one for evaluating restorative perceptions and the other for street attributes), based on the explorative findings in the pilot study, in order to understand exactly how relevant street design indicators can influence users' restorative experiences.

By the end of the previous two stages, the collected information in this study is expected to include the following: 1) users' evaluations of the expected restorativeness of different street types; 2) users' evaluations of the current restorativeness of case-study streets; 3) users' evaluations of the SRMF composed of potential restorative-related street indicators; 4) an established relationship suggesting how SRMF indicators influence restorative perceptions. Consequently, the last important stage is to synthetically analyse the discrepancies between the expected and current restorativeness with the help of the connection constructed between restorative perceptions and street indicators, so that possible restorative design instructions can be developed accordingly. In general, four methods are included in this research to achieve the final aim, respectively are: document analysis, case study, questionnaire, and interview. Document analysis and an online questionnaire survey will be used to investigate people's expected restorativeness in the first stage of this research. The second stage involves identifying potential street indicators through document analysis; and then correlating restorative perceptions with relevant street indicators through an onsite questionnaire. The final stage of this research develops restorative street design instructions for four case-study streets based on a synthetic analysis of results obtained from the previous stages. Three stages together illustrate the process of developing and applying the RSDA on case-study streets. The next chapter will provide details on the general research context, Shanghai, as well as of the case-study streets selected for developing and validating the Restorative Street Design Approach (RSDA).

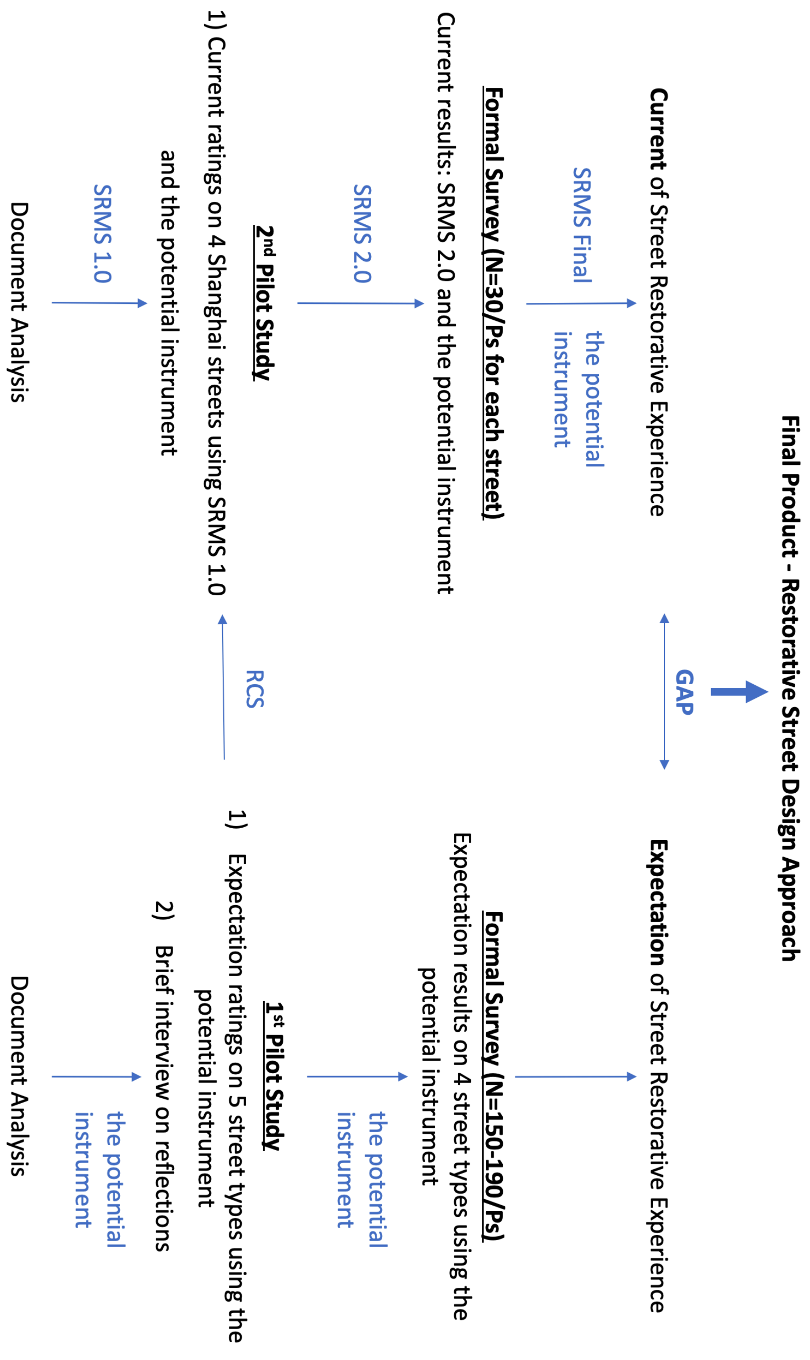


Figure 3- 4 Overall methodology framework of this research. Source: the author.

CHAPTER 4 THE SELECTION OF STUDY SITES

This research is innovative in highlighting the potential of urban street environments being necessary substitutes for urban green spaces, providing urban dwellers with daily, cumulative, restorative experiences. The necessity for this arises from the decreasing provision of the green resources that have conventionally delivered restorative experiences in high-density urban environments. The study also suggests that considering the restorative potential of urban streets is a way to enhance the 'place-ness' of urban streets and to compensate for the deprivation of street spaces caused by development that follows the 'car-dominated' paradigm. Most Chinese cities have experienced a rapid urbanisation development process in recent decades, with enormous road construction projects completed across the country catering for the prevalence of automobiles.

This study intends to develop a street-design approach that is capable of designing streets to be restorative, hence a case-study method (see 3.2.4) is used as one of the critical research methods. This research attempts to achieve this goal based on streets in one city and then provide necessary adjustments for it to be applicable to others. Therefore, a typical, highly densified city in China has been selected to develop and validate the Restorative Street Design Approach. The RSDA is claimed to be the most significant contribution and also the final product of this research. Shanghai is one of the supercities in China and suffers from urban issues created by fast development since the 1980s. The city has made evident efforts to alleviate these negative consequences in multiple aspects, including the use of urban design interventions. Its huge population (which restricts green space allocation), the proactive planning and design political environment sustaining and encouraging its urban regeneration, as well as its characteristic and developed street system together make Shanghai an appropriate case-study site for this research.

4.1 The General Context of Shanghai

4.1.1 A high-density-development supercity

Shanghai was classified as an Alpha^{+} Globalisation and World City (GaWC) in 2018 and has long been functioning as a significant engine for boosting economic development in China, especially for the Yangtze River Delta area. It is one of the municipalities in China with a population of over 2.4 billion and has an area of 6340.5 km^2. An obvious tendency towards population agglomeration in Shanghai central city can be observed from the population density distribution (Table 4-1): Shanghai central city (inside the inner ring road) has a population density of 29940 persons/km^2 while the density drops to 17070 persons/km^2 if it is calculated from inside the outer ring road. Compared with similar cities around the world, Shanghai presents greater centrality from the perspective of population-density distribution, even though the population density of the whole urban area is relatively low.

Table 4- 1 Comparison of the size and density of world cities.

	Scope	Tokyo	London	New York	Paris	Seoul	Singapore	Shanghai
Population density (Pop. Per/km2)	Kernel Circle (R < 5 km)	11840	/	26552	23619	10357	8500	29940
	Central Circle (R < 20 km)	13092	7290	10407	8084	17459	7531	17070
	Outer Circle	5798	4858	10407	916	17459	7697	3376
	Metropolitan Area	2618	1395	1086	916	2047	/	2222 (urban area and surroundings)
Ecology (%)	Forest coverage (Administrative Area)	67	>70	24	27	64	>70	15

Source: Shanghai Master Plan 2017–2035

Naturally, as it is constrained by the compact land-use in the inner city of Shanghai, the distribution of urban green resources, such as parks, reveals a reverse tendency when compared with population agglomerations (Figure 4-1). A recent evaluation on the provision of urban green parks within Shanghai's outer ring road suggests that the provision, measured by population per unit area of urban parks, is relatively low in the central area along Huangpu River, while areas close to the outer ring, especially in the northeast and east have an evidently higher level of provision (Zhao et al., 2017). Regardless of the impact of the road system on the practical accessibility of urban parks, the uneven distribution of urban parks has hindered their use by people living in the inner-city area. Considering the long-term, intensive development strategy of Shanghai, it is important to explore the restorative potential of other urban spaces as necessary substitutes for urban parks to provide Shanghai residents with more opportunities to recover in easily accessible, everyday urban environments.

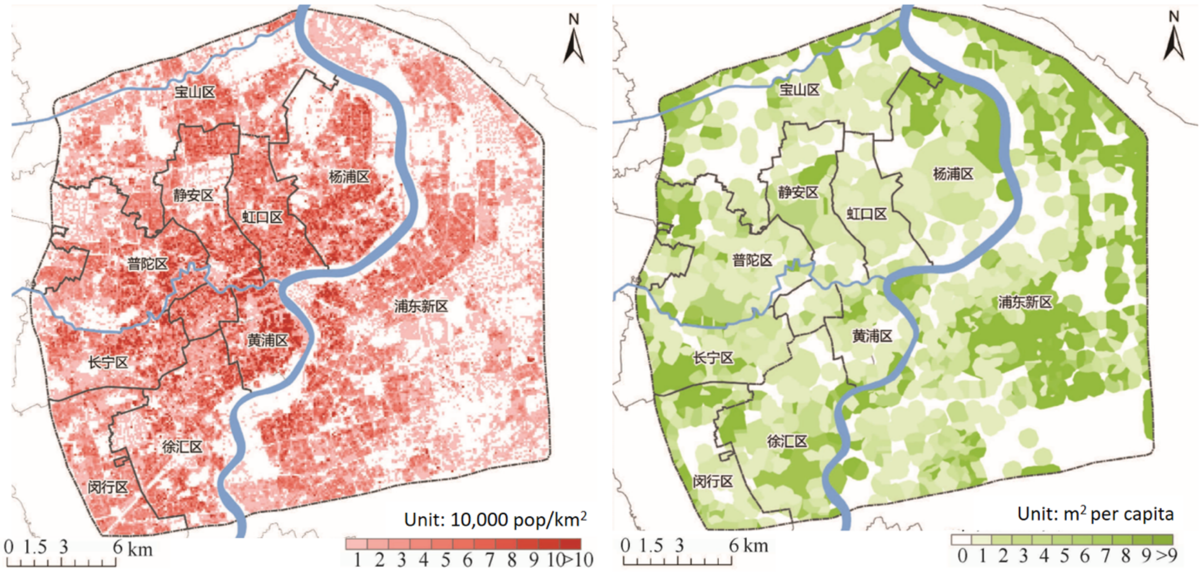


Figure 4-1 Population density (left) and provision of urban parks per capita (right) within the outer ring road of Shanghai. Source: Zhao et al., 2017

4.1.2 A city with a unique and developed street and alley system

Changes in urban growth patterns reflect changes in urban development and lifestyles, and these transformations have also been accompanied by changes in street patterns (UN Habitat, 2013). Shanghai was originally a coastal market town that developed from fishing villages. By 1843, it had more than 100 streets and alleys along the Huangpu River, in and around the city, that later formed its characteristic traditional streets and alley system as a riverside town (SPLRAB et al., 2017). After the Opening in 1843, the idea of urban planning was introduced into the city development of Shanghai. Influenced by cultural collision and the introduction of carriages, Shanghai has formed diverse road grids and corresponding street spaces in the more than 170 years since the Opening. Today's road network in the central city of Shanghai formed through several stages of planning adjustments to adapt to the evolving development requirements of the era. However, the structure of a circular, radial, arterial system, which was established in 1953 after the founding of the People's Republic of China, has largely remained.

The characteristic street and alley system reflects the influence of the development process on Shanghai's urban fabric and represents different characteristics of different times. This system constantly evolves with the pace of Shanghai's development and plays an important role in contemporary urban daily life. By the year 2018, the road network density in Shanghai administrative area reached 7.10 km/km^2, with a branch density of 13 km/km^2 (Shanghai Statistic Bureau Website, 2019). The intensive street system, especially in the central area of Shanghai city, provides people with sufficient convenience to walk and, hence, creates sufficient opportunities for people to experience street environments. Another evidence that streets are important spaces in Shanghai's urban life is the public transit split rate (excluding walking and cycling), which is over 50% in the year 2018; the proportion of individual, motorised traffic is expected to fall to under 15% by 2035. This means that there will be increasing numbers of urbanites in Shanghai choosing to travel without cars; therefore, there will be increasing numbers of urbanites in Shanghai with more opportunities to walk on streets, since any mode of travel other than driving (walking, cycling, and using public transportation) involves more or less physical contacts with street environments.

4.1.3 Shanghai's street-design guidelines and street-classification system

Street design in Chinese cities has long been rooted in a culture that dominated by automobiles, but a shift can be observed in the focus of recent street-design guidelines compiled in major Chinese cities, such as Beijing and Shanghai. In the past few decades, great improvements in road construction have been achieved in Shanghai, with the aim of adapting to rapid economic and social development. Nevertheless, this overemphasis on movement-efficiency naturally impedes street spaces from delivering social wellness. The mismatch between vehicle-oriented road design and urbanites' eagerness for more street life reveals the need to recognise the social value of Shanghai's streets. An attempt to respond to the multiple roles urban streets take can firstly be observed in 'Specification for Design of Urban Road Engineering', which was released in Shanghai in 2012 (Liu et al., 2017). A two-dimensional classification system is suggested, incorporating the aspect of surrounding context into the traditional classification system. However, this system can still be considered as being dominated by traffic priority: the descriptions of each street type in this two-dimensional system largely stress on its road-design instructions, such as the distribution of lanes and width regulations (Table 4-2).

Table 4- 2 Road classification and typical cross-sections in Shanghai.

Types	Expressway (A)	Arterial (B)	Sub-Arterial (C)	Branch (D)
Central Business District	Separate section of main roadway and side roadway	1 roadway for special uses	2 or 3 roadways for higher volumes; 1 roadway for lower volumes	1 roadway
Central Business District	Separate section of main roadway and side roadway	4 or 3 roadways 2 roadways applicable for lower None Motorised Vehicle (NMV) volumes	2 or 3 roadways for higher volumes; 1 roadway for lower volumes	1 roadway
Urban Area	Separate section of main roadway and side roadway	4 or 3 roadways 2 roadways applicable for lower NMV volumes	2 or 3 roadways for higher volumes; 1 roadway for lower volumes	1 roadway
Rural Area	Integral section (4 or 2 roadways)	2 or 3 roadways	2 roadways with shared space for pedestrian and (NMV)	1 roadway
Rural Area	Integral section (4 or 2 roadways)	2 or 3 roadways	Separate section for riverside road to isolate through-traffic	1 roadway
Independent Development Zone		2 roadways	2 roadways with shared space for pedestrians and NMV	1 roadway with shared space for pedestrians and NMV
Scenic Area	Integral section (4 or 2 roadways)	4 or 2 roadways	2 or 1 roadway with shared space for pedestrian and NMV	2 or 1 roadway
Cultural Heritage Area	Integral section (4 roadways) or separate section (tunnel)	Not limited to a certain cross section subject to control requirements	Not limited to a certain cross-section subject to control requirements	1 roadway
Commercial Area		1 or 3 roadways	1 or 2 roadways	1 roadway
Transit Corridor	Integral section(4 roadways) or separate section(elevated), where bus lines gather or rail lines are combined with road	Bus-only lane recommended; 2 or 4 roadways with reserved Bus Rapid Transit or rail right-of-way	Bus-only lane recommended; 2 or 3 roadways	1 roadway

Source: Specification for Design of Urban Road Engineering, SH URCTC, 2012

In response to the call to return street-space to public life and the innovative, cultural, and ecological planning vision for Shanghai (SUPDRI, 2017), the Shanghai Street Design Guidelines were promulgated in 2017 (SPLRAB et al., 2017; hereafter referred to as the ***Shanghai Guidelines***). It proposed delivering 'Safe, Green, Vibrant, and Smart' streets in Shanghai and highlighted a shift from the 'emphasis on motor vehicles' to the 'overall focuses on peoples' lifestyles', from the 'control over redlines' to the 'control of street spaces', from 'engineering-dominated design' to 'integral environment planning', and from 'highlighting traffic efficiency' to 'enhancing street integral design and development' (SPLRAB et al., 2017). Catering to these proposed street-design visions, Shanghai streets are classified into five major types (Table 4-3) in the Shanghai Guidelines, with a comprehensive considerations of street activities, spatial landscape characteristics, and traffic function. These types are ***Commercial Streets***, ***Living and Service Streets***, ***Landscape and Leisure***

Streets, ***Traffic-oriented Streets,*** and ***Comprehensive Streets***. Design and maintenance instructions are then provided in the following chapters of the Shanghai Guidelines.

Table 4- 3 Shanghai's street classification system.

Street types in Shanghai	Definition and description
Commercial street	This type of street is dominated by retail, food services, and other commercial businesses, with a certain level of service capability and industrial attributes.
Living and service street	This type of street is dominated by residential services, small- and mid- scale retail, food services, and other businesses as well as public facilities.
Landscape and leisure street	Characterised by waterfront, landscape, or historic characteristics and equipped with leisure and entertainment facilities.
Traffic-oriented street	Dominated by traffic-function, with mostly closed frontages.
Comprehensive street	Street types and frontage types are highly mixed, or a street contains more than two types of characteristics.

Source: Shanghai Street Design Guidelines, SPLRAB et al., 2017.

The sustainable benefits of high-density development can sometimes be difficult to achieve in the context of increasing urban densification in megacities, such as Shanghai. People's desire for psychological recovery can scarcely be met by the opportunities they are offered, due to limited access to nature and urban green spaces. This reveals a need to explore potential restorative settings in Shanghai's more common and everyday scenarios. The city's developed street and alley system provides sufficient street-network density, which is now an essential spatial carrier of urban daily life and social interactions. The newly adopted classifications in the Shanghai Guidelines reveal street-design practices that aim to explore the more comprehensive roles that streets can play in urban daily life. The Shanghai Guidelines, therefore, not only indicate that the street environment is in the spotlight again, after many years of domination by the automobile, but more importantly, provide a solid and open policy foundation encouraging more practical and academic interest in exploring the potential of Shanghai streets to deliver social benefits. To conclude, Shanghai is a typical high-density development city in China, with a large population and limited accessibility of urban green resources. It is of practical significance to explore the restorative potential of Shanghai's streets so that people's quality of urban life can be improved. Therefore, Shanghai is considered to be an appropriate context for conducting the current research to develop a Restorative Street Design Approach, with an optimistic spatial and political environment and urgent practical needs as strong drivers.

4.1.4 Convenience and feasibility

In addition to the objective justifications stated above, the researcher is personally very familiar with the city Shanghai and the characteristics of Shanghai's streets. It is convenient to gather related information and identify potential research streets during the field-work process. This familiarity also provides useful knowledge in the stage of analysing collected information and interpreting the results to develop design-improvement strategies.

4.2 Selection of Study Sites: Four Branch Streets in Shanghai

As discussed earlier, Shanghai has a very developed street and alley system with over 8000 streets (Shanghai Statistic Bureau Website, 2019) and this number is increasing. This study is unlikely to cover every street in Shanghai, nor is this necessary. Streets vary in many aspects but also share evident commonalities. In response to one of the research novelties stated in Chapter 1 suggesting that street restorativeness should be delivered in accordance with its characteristics defined by its street type, this research begins with the five street types classified in the Shanghai Guidelines. Therefore, this project chooses several case-study streets, representing the above-mentioned five different street types (see 4.1.3). Potential case-study streets should belong to urban branches, since the developed and diverse branch system of Shanghai is a significant spatial carrier of urban outdoor life (Cai, 2005; Yang and Zhou, 2009). Moreover, the increase in traffic volume and larger spatial scale of the street with higher traffic hierarchy weaken its sense of place-ness. Potential research streets should also have clear start and finish points to avoid confusion, and a moderate street length is required so that participants can finish the walking on foot without excessive exhaustion. Limiting the length of the selected streets can also ensure that the whole street can be clearly classified into a specific street category. This is because streets, especially those with an extended length, can sometimes hardly be classified into a specific type; instead, they resemble a combination of different types of sections. This tendency becomes more obvious as their length increase. In addition, potential research streets should be easily classified into certain street categories, with a relatively consistent functional type along the street sides. Therefore, University Road, Sujiatun Road, Zhangwu Road, and Guokang Road in Yangpu District, Shanghai have been selected as the four case-study streets, representing four different street types in this study (Figure 4-2). The type of Comprehensive Street was excluded after the first pilot study, which is explained in Chapter 5 (see 5.3.3).

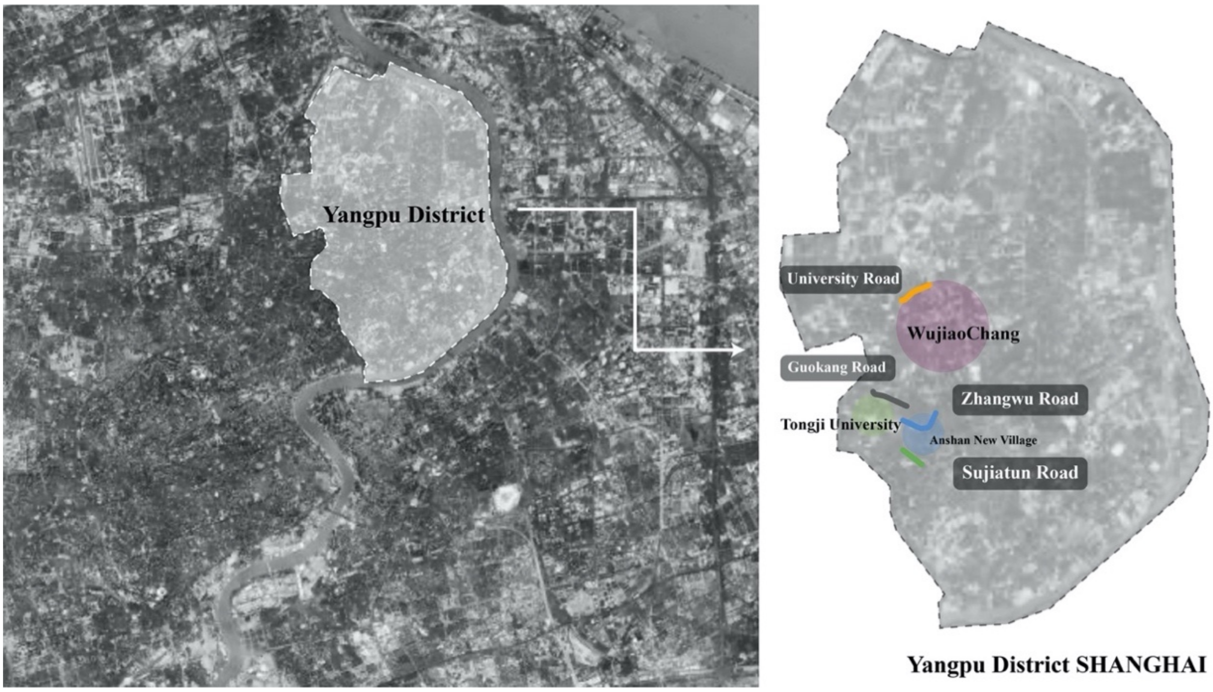


Figure 4- 2 The location of the four streets in Shanghai, China. Source: the author.

4.2.1 Commercial Street - University Road

University Road is a well-known Commercial Street located in the Wujiaochang creative industrial park in Yangpu district. It was selected to be the representative of Commercial Street (Figure 4-3, Figure 4-4). University Road is surrounded by land with mixed commercial and office uses, with a knowledge and innovation community located one block away (200–300 meters). Hence, it is a regular place for people working nearby to spend their time in lunch break. In addition, the east end of University Road connects with a metro station, making it an optional commuting path towards the west-side residential blocks of University Road. University Road is an east–west oriented street, around 600 meters in length and 30 meters in width (including pedestrian pavements and setback distance). Both sides of University Road have bicycle lanes, with no on-street parking allowed. There is no physical isolation between the vehicle and bicycle lanes. The pedestrian pavements are 2–3 meters in width, and the building setback normally provides another 3–5 meters. In its greenbelt space, bicycle parking is allowed in designated spaces. There are street trees on both sides of the street and flower planters at appropriate intervals. University Road is a street with commercial frontages along both sides, including cafes, restaurants, bakeries, and various retail shops. These street frontages are normally decorated with windows, flowers, and greenery. Outdoor seats with sunshades are provided by most ground-floor retails to attract customers, which hence creates opportunities for attracting stationary activities.

Figure 4- 3 Panoramic photo of University Road (photo by the author, in May 2019).

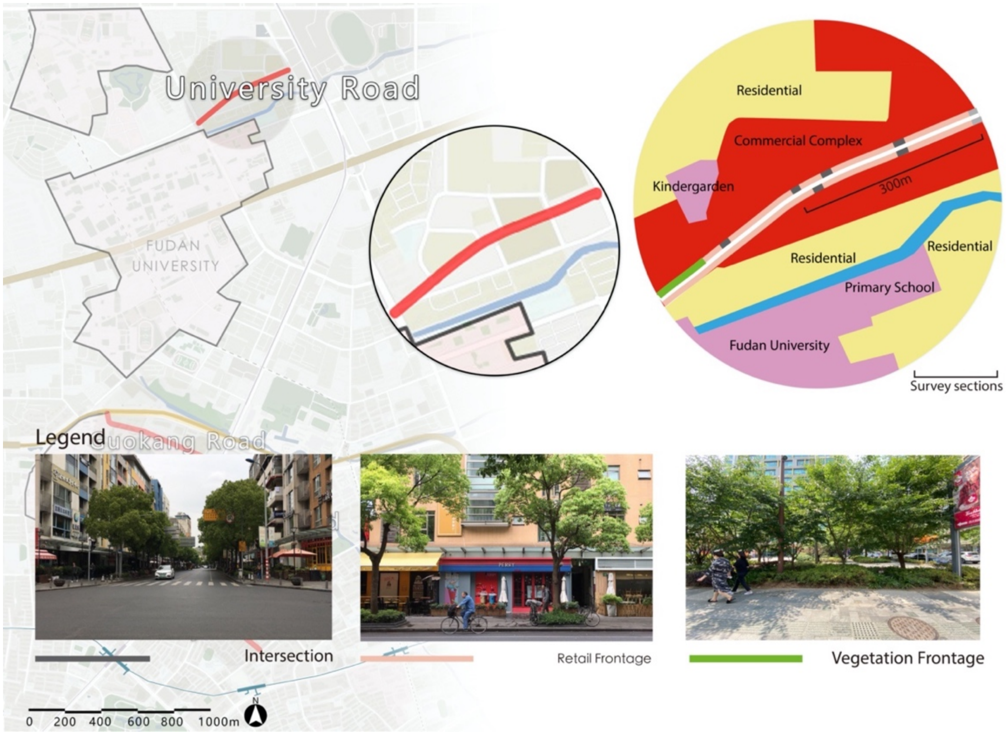


Figure 4- 4 Site analysis: University Road. Source: the author.

4.2.2 Landscape and Leisure Street - Sujiatun Road

Sujiatun Road is a street characterised by landscape features, located in the centre of a residential neighbourhood in Yangpu District. It was selected to be the representative of Landscape and Leisure Street (Figure 4-5, Figure 4-6). Sujiatun Road is surrounded by purely residential buildings with well-designed green landscaping along both sides; hence, it attracts many nearby residents to spend their leisure time and exercise there. Also, it is a commuter pathway, linking its south-side metro station to residential blocks and to its north-side office buildings. Sujiatun Road is a north–south oriented street, around 400 meters in length and approximately 12 meters in width (including pedestrian pavements and setback distance). It is a one-way, shared street with one vehicle lane. The pedestrian pavements are 1.5–2.0 meters in width on both sides and one side of the street has a greenway for walking and jogging (one metre in width). Sujiatun Road has dense street trees along both sides with various types of flowers and shrubs as decorations. The street frontages of Sujiatun Road are similar on both sides, interspersed with pocket parks and greenery. Two small-scale pocket parks are located on the west side of the street and a larger one on the east. There is also a residential greenway located on the east side of Sujiatun Street, next to the pedestrian paths. Seats and exercise facilities are set along the street sides and within the pocket parks. There is a metro station one block away (200–300 meters) and it is about 10–15 minutes on foot to nearby office building blocks.

Figure 4- 5 Panoramic photo of Sujiatun Road (photo by the author, in May 2019)

Figure 4- 6 Site analysis: Sujiatun Road. Source: the author.

4.2.3 Living and Service Street - Zhangwu Road

Zhangwu Road is a typical Living and Service Street close to Tongji University, located in Yangpu District (Figure 4-7, Figure 4-8). It is connected to Guokang Road, the representative of Traffic-oriented Street, by Siping Road and to Sujiatun Road by Fuxin Road. The north side of Zhangwu Road is mainly residential blocks with retail frontages, while on the south side there is mixed commercial and residential use. It is a 'L-shaped' street with one dead end leading to a residential neighbourhood and the west end connected with Tongji University and its adjacent metro station; hence, it is also a commuter pathway for surrounding residents. Zhangwu Road is an east–west oriented street around 800 meters in length and 20 meters in width (including pedestrian pavements and setback distance). It is a three-lane, two-way street with a greenbelt, set between bicycle and vehicle lanes on both sides. The pedestrian pavement is 3–5 meters wide, and setback distances vary from 0–10 meters along the street. No on-street parking is allowed along the whole street. Street trees are planted along both sides of Zhangwu Road, with well-designed greenbelt vegetation featuring shrubs and flowers. There are four types of street frontages in Zhangwu Road that mainly include the walls of surrounding residential blocks, retail shops with no setback provided, retail shops with setbacks, and street-side greenery composed of trees and shrubs. In addition, there is a small-scale, neighbourhood commercial area with restaurants and living services located at the west end of Zhangwu Road (close to Tongji University). This, therefore, generates a larger setback space, decorated with greenery and resting spaces.

Figure 4- 7 Panoramic photo of Zhangwu Road (photo by the author, in May 2019).

Figure 4- 8 Site analysis: Zhangwu Road. Source: the author.

4.2.4 Traffic-oriented Street - Guokang Road

Guokang Road is located at the north side of the Tongji University campus, and its north side abuts several office blocks. There two bus stops on Guokang Road and it links to the nearest metro station 800 meters away, which mainly serves the commuting needs of university staff and people who work in the surrounding office buildings. Therefore, Guokang Road is selected as the representative of Traffic-oriented Street (Figure 4-9, Figure 4-10). Guokang Road is an east–west oriented street, about 720 meters in length and 16 meters (including pedestrian pavements) in width. It is two-lane, two-way street. One side of Guokang Road has allocated on-street parking and the rest of the road space (within road red lines) is shared by automobiles and bicycles. The pedestrian pavements are around 2–

3 meters wide and, in general, there is no setback space along this street. Bicycle parking is allowed in designated spaces within the pedestrian space. There are street trees along both sides of Guokang Road. Its south-side frontage is dominated by the fences of the university campus and there are two types of frontage on its east side: the fences of the surrounding office blocks and greenery. The university fences are made of red bricks and iron bars, while the office block fences are simple iron bars. Street-side greenery consists of trees, shrubs, and herbaceous plants.

Figure 4- 9 Panoramic photo of Guokang Road (photo by the author, in May 2019).

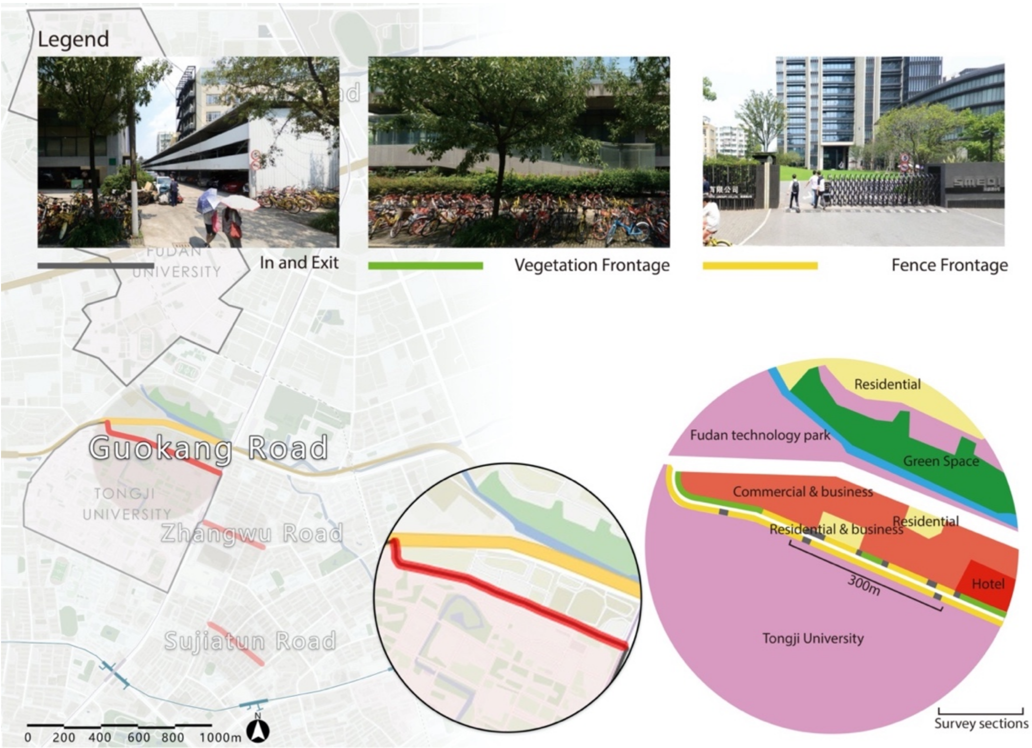


Figure 4- 10 Site analysis: Guokang Road. Source: the author.

4.3 Summary

This chapter continues the development of the research's methodologic framework by providing details on the selected research context, Shanghai, and the four case-study streets selected in Shanghai. The central reason for conducting a case-based study is determined by the eventual aim of this research, which is to develop a design approach for delivering restorative benefits in urban street settings. A newly developed approach requires validation before application, and slight adjustments are also necessary when it is subsequently applied in different practical contexts. Therefore, the author of this research decided to develop a restorative street-design approach based on Shanghai, since it is a typical, high-density urban area with a developed street and alley system. In addition, streets in Shanghai are varied and classified into five evidently different types according to their function and characteristics, which provides a good foundation for adopting the innovative concept proposed in this research: users' restorative expectations vary with street type. Four branch streets in Shanghai – Sujiatun Road, Guokang Road, Zhangwu Road, and University Road – were selected to respectively represent Landscape and Leisure Street, Traffic-oriented Street, Living and Service Street and Commercial Street, which are generalised in the Shanghai Street Classification System (SPLRAB et al., 2017). These four streets were selected according to careful considerations (see 4.2) and possess the following commonalities. First, they are all branch streets located in Yangpu District, Shanghai. Second, they have a similar length with rather consistent frontage functions along both sides. Third, they are distinctive from each other and can be easily categorised by normal users. Starting from these four streets, and the four street types they belong to, the next step of this research is to investigate users' restorative expectations on these four different types of Shanghai street, so that a baseline for improving the restorative benefits of streets can be revealed.

CHAPTER 5 INVESTIGATING THE EXPECTED STREET RESTORATIVENESS

5.1 Introduction

As it has been stated earlier in the chapter of literature review (see chapter 2.4), the expected street restorativeness depends entirely on what street users want (particularly referring to pedestrians in this study) in terms of having restorative experiences. This includes the way and the extent they want to be restored, and the particular restorative aspects they focus on in a certain street environment. Inspired by the viewpoint that restorative environments can be either real or imagined places, and restorative experiences can happen either in a physical or in an illusionary world, or a combination of both (Kaplan, Kaplan and Ryan, 1998), this research attempts to understand people's expectations through their imaginations on well-designed street environments that are perfectly in line with their requirements in terms of having restoration. It can be regarded as a kind of scenario approach, which usually asks participants to imagine certain scenes according to given instructions. Scenario approach has been employed in several previous restorative environmental studies, including imagining a precedent psychological state such as after a whole day of intensive study and being extremely exhausted (Herzog et al., 2003; Staats and Hartig, 2003; Staats, Kieviet and Hartig, 2003; Staats et al., 2016). Also, in some studies participants have been asked to imagine a place they know of or one of their favourite places (Korpela and Hartig, 1996; Laumann, Gärling and Stormark, 2003; Korpela et al., 2001; Korpela et al., 2008). However, so far, hardly any of these studies has attempted to ask participants to depict an expected environmental condition in their imaginations based on their previous knowledge and cognition or to apply this approach in differentiating restorativeness within setting types.

Investigating the expected street restorativeness of actual street users in essence is an attempt to know more about the street environment from the perspective of users. Departing from the theoretical and methodological foundations stated in previous chapters, this chapter starts with a review on relevant restorative measurement tools. An appropriate instrument is selected for investigating what restorative experiences people expect their daily-used street environments can provide to them. This research shows that an important aspect of this lies with variations in the expected restorativeness people have in relation to different types of streets. Differences in the expected restorativeness are especially important in the context of streets because this acknowledges that it is unnecessary for every type of urban street to possess the equivalent level of restorative benefits. Feasibility of this instrument is at first tested with a pilot study, accompanied by a follow-up interview designed to find out what necessary adjustments need to be made. Afterwards, it is used to formally investigate the expected restorativeness of street users' and address the following questions:

- Can the expected restorativeness between street types be differentiated by using this method? And if so, what are the implications of these differences?

This chapter concludes with a general description of the expected restorativeness people have of streets and the differences between their restorative expectations within street types. A clarification of the next step of this research is then provided in the last section of this chapter.

5.2 Research Design for Measuring the Expected Restorativeness

It has been discussed and justified earlier in the literature review chapter (see chapter 2) that this thesis is developed on the basis of Attention Restoration Theory (ART) throughout. Hence, this section outlines relevant attempts identified in previous studies in developing instruments for assessing restorative experiences grounded in ART and discusses the most appropriate one to use in measuring the expected restorativeness in this study. Since restorative ratings are subjective perceptions, one could argue that when research participants use the scale to rate the same stimulus, they respond in various ways depending on their prior experiences, their interpretation of the wording, and the stimulus attributes (Pasini et al., 2014). This provides another justification for using ART as the basic theoretical framework in this research since it assumes our 'prior experience' in relation to natural stimuli to be similar (Kaplan and Kaplan, 1989). A pilot study is then designed to find out if any necessary modifications are needed for the instrument under the specific context of this research. Information is expected to be gathered from formal surveys about people's expectations on four different categorisations of Shanghai streets with this adjusted version of the RCS.

5.2.1 A review of restorative measurement tools

Perceived Restorativeness Scale A representative measurement among ART-based measurements, called the Perceived Restorativeness Scale (PRS) (Korpela and Hartig, 1996; Hartig et al., 1997; Hartig et al., 1997). It is a widely adopted measurement composed of 44 items covering four components proposed in ART (*being away, extent, fascination*, and *compatibility*), which is derived from a project led by Hartig (1991) to test the utility of different theoretical models of restorative experiences. A series of studies were then carried out, which further shaped the PRS (Korpela and Hartig, 1996; Hartig et al., 1997; Hartig et al., 1997) into 16 items to cover the same four components. Validation results of the PRS appeared not to be in accordance with the four-factor structure since only two factors emerged, with the *being away, fascination and compatibility* factors were loaded on one empirical factor while the *extent* factor was loaded on a separate one (Laumann, Gärling and Stormark, 2003). A possible explanation is that only the *extent* factor was negatively worded while the other three were positively worded in their statement (Laumann, Gärling and Stormark, 2003; Pals et al., 2009). Even so, PRS is a widely adopted instrument in existing literature due to its early development, a rigorous analysis of psychological components in ART during developing process and its rather strict validation process afterwards (Carrus et al., 2017; Nordh et al., 2017). For example, it was used in differentiating restorative perceptions between the elderly and young adults (Berto, 2007). Its efficiency in distinguishing between scene types has also been confirmed (Tenngart and Hagerhall, 2004; Ivarsson and Hagerhall, 2008; Purcell et al., 2001). PRS has also been translated into other languages to be applicable in a wider research context (Pasini et al., 2009; Pasini et al., 2014).

Restorative Component Scale (RCS) Following the contributions by Hartig and his associations (1996), two studies (Laumann, Gärling and Stormark, 2003) were conducted with the aim of developing a set of rating scale measures of environmental restorative components to solve some of the noted shortcomings of the PRS, which was later referred as the Restorative Component Scale (RCS). The first study was to test whether the RCS can distinguish between more or less restorative environments by asking participants to rate urban and natural environments recalled from their memories. The second study further tested the ability of the RCS to differentiate between environments varying in restorativeness. Results revealed a five-factor structure in which the *being away* was split into two factors: a physical level (referred to as *novelty*) and a psychological level (referred to as *escape*). This finding seems to be reasonable given that in the ART, there are also physical and psychological components of *being away* (Pals et al., 2009). In Laumann et al.'s first study evaluating memories, they also found that the five components, *fascination*, *novelty*, *escape*, *extent* and *compatibility,* could predict preferences for both natural and urban environment (Laumann, Gärling and Stormark, 2003). RCS has also been used in later studies as an efficient method such as in evaluating the restorativeness of museums (Packer and Bond, 2010), and as a basis to develop measurements for a specific context (Bagot, 2004; Bagot et al., 2007).

Perceived Restorative Potential (PRP) Herzog et al. (2003) has developed a direct rating approach based on the definitions of each ART component to measure four ART components, referred to as Perceived Restorative Potential (PRP). It incorporated the same research strategy of PRS and RCS for developing and validating itself but with four additional predictor variables (*openness, visual access, movement ease* and *setting care*) as well as four major methodological differences. First, PRP only highlights the psychological aspects of *being away* from everyday thoughts and concerns rather than stressing the physical aspect of staying away from everyday environments (Herzog et al., 2003). Also, each participant was asked to rate only one ART component in PRP, rather than on all four components, in order to reduce the halo effects in the ratings. This is quite different with rating procedures conducted in existing relevant studies (Herzog et al., 2003) with most of them asking participants to rate all the items (Korpela and Hartig, 1996; Hartig et al., 1997; Laumann, Gärling and Stormark, 2003; Korpela et al., 2008). Another difference is that Herzog et al. (2003) used settings instead of ratings as analysis units, to measure four ART components and to directly measure the perception of restorative potential (Herzog et al., 2003, p.161). However, PRP measures perceived restorative potential rather than the actual perceived restorative benefit of a certain setting. Therefore, its application in later studies has been more or less restricted. It has mainly been used only in evaluating very general environment types such as nature and urban landscape (Abkar et al., 2011; Pazhouhanfar and Kamal, 2014) or vacation destination (Lehto, 2012). Twedt et al. (2016) have chosen to use PRP comparing formal and informal gardens. It has also been used in research investigating whether restorative differences can be observed when bird sounds are associated with different environmental conditions (Ratcliffe et al., 2020).

Restoration Outcome Scale (ROS) Departing from previous findings with regard to positive outcomes of restoration process, the Restoration Outcome Scale (Korpela et al., 2008) was constructed to investigate restorative emotional and cognitive outcomes of people's experiences in different environments. It is primarily based on ART but extended itself a bit further with three of its items reflecting relaxation and calmness, one item reflecting attention restoration and two items reflecting clearing one's thoughts. ROS was later used in several research studies often in combination with other more mature instruments, for measuring restorativeness as well as to test the validity of the scale. For example, it has been used in investigating how focusing light on different elements of a scene can influence restorative affects with PRS (Nikunen and Korpela, 2009). Another research study conducted in Japan (Takayama et al., 2014) adopted ROS within a set of questionnaires including Profile of Mood States (POMS), Positive and Negative Affect Schedule (PANAS) and Subjective Vitality Scale (SVS) to explore the positive effects of a short period of forest walking and viewing.

Other measures that fall into the ART-based category are developed following similar procedures to construct questionnaire items based on ART components, or directly refer to PRS, RCS and PRP with slight modifications. Most of them have restricted applications in measuring restorative perceptions concerned with particular population groups or environmental settings. Bagot (2004) tried to establish an instrument to measure the perceived restorative component scale particularly for children (PRCS-C) primarily based on RCS (Laumann, Gärling and Stormark, 2003), which was later adopted in another children-targeted research (Collado, 2017). Pals et al. (2009) developed the perceived restorative characteristics questionnaire (PRCQ) inspired by both the PRS and RCS to measure restorative characteristics of zoo attractions. The potential of soundscape in providing psychological restoration was also paid attention to in Payne's (2013) research in which a perceived restorative soundscape was adapted from the general perceived restorativeness scales used (Hartig, Mang and Evans, 1991; Laumann, Gärling and Stormark, 2003). All these efforts are significant in the context of this research because they highlight a well-established approach to restorative understandings that can also be applied to predominantly built environments. This research will show how the field survey in Shanghai can take this forward in a particular kind of built environment routinely occupied by people—the street.

5.2.2 Selection criteria of appropriate measurement

Considering the general context of this research and referring to the above review of relevant measurement scales, this study considers the RCS (Laumann, Gärling and Stormark, 2003) to be the most promising instrument in the first stage of this research for investigating the expected restorativeness of urban streetscapes for the following reasons. First, the factor structure of RCS appearing in later validation is more consistent with the four-factor structure of ART compared with other essential ART-based measurements—PRS. In addition, the feasibility of RCS has been validated on both real and imagining scenarios. This research intends to measure restorative expectations of streets and shares similarities with research that attempted to validate the RCS by evaluating restorative potential of places that participants recalled from memory. Besides, the wording of RCS items describing four ART components remained consistent so that it is more understandable for people, especially non-specialists. Therefore, RCS is considered to be more conveyable to participants and therefore can deliver more accurate evaluation results in terms of people's restorative perceptions. Nevertheless, whether RCS is sensitive enough to differentiate between settings within the same category remains unknown since most developed scales are validated through comparing evidently contrastive setting types, such as nature with urban (Staats and Hartig, 2004; Berto, 2007; Roe and Aspinall, 2011), or urban parks with urban hardscapes (Abkar et al., 2011; Wilkie and Clouston, 2015; Wilkie and Clementes, 2017).

The next section of this study explores the possibility of using RCS to investigate people's expected restorativeness, which is their expectation of having restorative experiences while walking in streets. Street categorisation is involved in this part of the data collection in order to find out whether people expect different levels of restorative experiences according to their previous recognitions of streets with different functions and characteristics. A pilot study using RCS was designed with three specific purposes: 1) to test whether users' restorative expectations on streets are measurable with the selected restorative measurement tools – RCS; 2) to explore the efficiency of RCS in differentiating among street types under the research context of Shanghai in China and its street classification system proposed in the Shanghai Street Design Guidelines; 3) and to investigate how the RCS should be modified to be more conveyable in Chinese under the research context of Shanghai streets. RCS is then modified based on the information gathered in the pilot study and then applied later in a formal survey for the purpose of determining the users' expected street restorativeness of different Shanghai street types as the baseline. Slight adjustments are expected to be made in the formal survey according to the interview feedback collected in the pilot study, but in general, the data collection will be carried out in a similar way for both the pilot study and the formal survey for obtaining users' restorative expectations.

5.3 Pilot Study on the Feasibility of Restorative Component Scale (RCS)

In response to the purposes mentioned above, a semantic scenario approach, an onsite questionnaire and a short follow-up interview are used in this pilot study. The first step of this pilot study involves a questionnaire method with the help of a semantic scenario to validate if the RCS can be used in measuring street restorativeness expectations on five types of street environments that participants picture in their imaginations. A short interview was also designed to be conducted in this pilot study following the RCS questionnaire to gather participants' feedback on the survey procedure. The quantitative scaling results and qualitative interview results are respectively analysed using suitable methods to investigate whether RCS should be continuously used and whether the research design should be adjusted in a later larger-scale formal survey carried out in the case study site of Shanghai.

5.3.1 Method and procedure

- Questionnaire preparation

The questionnaire (see Appendix 1) contains two parts with the first part collecting participants' background information including gender, age and professional relevance since previous studies found that individual differences can result in different perceptions (Kaplan and Kaplan, 2002; Scopelliti and Giuliani, 2004; Berto, 2007; White et al., 2010). The second part is designed based on the RCS to investigate participants' restorative expectations in terms of different types of streets with slight adjustments in order to make it more adaptable in measuring urban street settings and more conveyable in a Chinese context (Table 5-1). The whole process of the field work was conducted in Shanghai, China, but the original RCS method was developed in English. Therefore, the translation of all related materials is necessary. In order to ensure the accuracy of translation on the descriptive factors in the PRS, the researcher referred to Laumann et al.'s method (2001) to have them translated into Chinese by one individual first and then have a different individual translate them back into English. All invited translators have lived or studied overseas in English-speaking countries for at least two years. A high similarity between the English and Chinese translations were found, and small differences were easily resolved.

The original version of the RCS (Laumann, Gärling and Stormark, 2003) incorporates 22 items. The survey questionnaire applied 16 of them in the study. This screening of RCS items took into account the following considerations: 1) whether these items were relevant to street environments; 2) and whether the items indicate similar meanings that might lead to misunderstandings, especially after being translated into Chinese. Consequently, three items in the *novelty* were deleted ('I am in a different setting than usual'; 'I do something different than I usually do'; 'I am in a different environment than usual') and two items ('when I am here, I do not need to think of my responsibility' and 'I am away from my obligations') in the *being away* were combined together. The final RCS consists of 16 items with three of them describing the *being away*; four of them describing the *extent*; five of them describing the *fascination*; and four of them describing the *compatibility*. Each item is formed by the responses on 6-point Likert Scales (0 = not at all; 1 = very little; 2 = rather little; 3 = neither little nor too much; 4 = rather much; 5 = very much; 6 = completely.)

Table 5- 1 The Revised RCS based on Laumann et al's (2003) work.

ART COMPONENTS	RCS STATEMENT
BEING AWAY (B)	B1 - When I am here I feel free from work and daily routine.
	B2 - When I am here I feel free from other peoples' demands and expectations.
	B3 - When I am here I do not need to think of my responsibility and obligations.
EXTENT (E)	E1 - The elements here go together.
	E2 - The existing elements belong here.
	E3 - All the elements constitute a larger whole.
	E4 - The surroundings are coherent.
FASCINATION (F)	F1 - There is plenty to discover here.
	F2 - This setting has many things that I wonder about.
	F3 - There are many objects here that attract my attention.
	F4 - There is plenty that I want to linger on here.
	F5 - I am absorbed in these surroundings.
COMPATIBILITY (C)	C1 - The environment gives me the opportunity to do activities that I like.
	C2 - I can handle the kinds of problems that arise here.
	C3 – I can rapidly adapt to this setting.
	C4 - There is an accordance between what I like to do and this environment.

- Structured interview

A short interview with five questions was conducted after the participants completed the RCS questionnaire. Participants were asked if they would like to talk about their ideas and help improve the questionnaire. Of the 45 participants, only 22 agreed to be interviewed (mostly from the people completing the questionnaire onsite). Five interview questions were asked in following order:

1. Is there any phrases or terms in this questionnaire hard for you to understand?
2. Is it hard for you to imagine a street in its ideal condition?
3. Is it feasible for you to differentiate between street types?
4. Is there any specific street appeared in your mind when you are in the imagination process?
5. Do you have any other suggestions?

- Stimuli

Five street categories (Commercial Street, Living and Service Street, Landscape and Leisure Street, Traffic-oriented Street and Comprehensive Street) generalised in the Shanghai Guidelines (SPLRAB et al. 2016) were used as stimuli to trigger participants' memories or former experiences in order for them to do the expectation ratings. Descriptions of each street type were given according to the definition stated in the Shanghai Guidelines along with the researcher's oral explanation in order to help participants understand better. For avoiding instructive effects caused by the researcher, neither figure illustration nor specific street name was provided. The following descriptions of each street type were given:

Commercial Street - This type of streets is dominated by retail, food services and other commercial businesses with a certain level of service capability and industrial attributes.

Living and Service Street - This type of streets is dominated by residential services, small and middle scale retail, food services and other businesses as well as public facilities.

Landscape and Leisure Street - Characterised by waterfront, landscape or historic characteristics and equipped with leisure and entertainment facilities along the street.

Traffic-oriented Street - Dominated by traffic function with mostly closed frontages.

Comprehensive Street - Street types and frontage types are highly mixed, or a street contains more than two types of characteristics.

- Participants and procedure

Potential lay participants were targeted at outdoor places including streets, cafes and shopping malls as well as the front porches of some companies that are accessible to the public, while potential professional participants (those who have study or work experiences in urban planning and design, landscape or architecture) were approached at the front porch and nearby cafes of Shanghai Tongji Urban Planning and Design Institute Co. Ltd. The questionnaire survey was only conducted during weekdays. Potential participants were asked at first if they have been living in Shanghai over a year. Only those who answered 'yes' were invited to take part in the survey. A total of 48 people was invited to fill in the questionnaire. Some participants agreed to do the questionnaire on site while a few of them wanted to take it home and then send it back through email. A total of 45 questionnaires were collected before the deadline set by the researcher. In general, a 1:1 ratio of male and female participants was achieved in both the professional group and the lay group.

First, a short brief on the study was introduced by the researcher to people who were willing to participate, explaining that they were invited to take part in a survey that aims to understand their experience of streets. All participants were reminded by the researcher to read the information sheet (see Appendix 2) carefully and to sign on the consent form (see Appendix 3) before the survey. After participants read and signed the consent form, the survey started. After filling in personal background information, participants were asked to rate 16 RCS items in terms of five different street types according to the descriptions given out by the researcher. It was suggested that they either recall a favourite street from their memory or imagine an ideal one based on their own expectations according to the descriptions. Each RCS item was described with a statement, and then participants were required to read and ask themselves 'how much does this statement apply to my expected experience there?' During the rating process the researcher repeatedly stressed to participants that they were rating their expected status for the five street types. The whole process of filling the RCS questionnaire took about 10 minutes, and the follow-up interview for each participant took 20-25 minutes.

5.3.2 Results

- Manipulation checks

Data was analysed using SPSS V 25.0 and was examined for internal consistency with Cronbach's alpha (Hinton, 2014). Calculation of the internal consistency using Cronbach's α is the preferred measure of inter-rater reliability when cases are rated in terms of some interval variable or interval-like variable, such as the Likert scales used in this study. The α values of 4 ART components, *being away*, *extent*, *fascination* and *compatibility*, in the ratings of the five street types (Table 5-2) showed sufficient internal consistency (α value should be higher than 0.6) and hence, guaranteed the reliability of the obtained RCS ratings. Data was also tested for normality to ensure that all the data collected are acceptable for further analysis. Given the small scale of the samples collected, the most reliable way to know how the gathered data distributes is to create a P-P plot (probability-probability plot or percent-percent plot) using the SPSS software. Results indicate that all the data are normally distributed, and therefore reliable for further statistical analysis (see Appendix 4).

Table 5- 2 Pilot study internal consistency results of expectation ratings.

Street Type	**Commercial Street**				**Landscape and Leisure Street**				**Living and Service Street**			
ART components	B	E	F	C	B	E	F	C	B	E	F	C
Cronbach's α	.70	.86	.93	.81	.93	.89	.88	.74	.91	.89	.96	.82
No. of Participants	45				45				45			
No. of Items	3	4	5	4	3	4	5	4	3	4	5	4
Street Type	**Traffic-oriented Street**				**Comprehensive Street**							
ART components	B	E	F	C	B	E	F	C				
Cronbach's α	.94	.84	.93	.83	.94	.87	.96	.87				
No. of Participants	45				45							
No. of Items	3	4	5	4	3	4	5	4				

(B=Being away; E=Extent; F=Fascination; C=Compatibility.)*

- General description of the expected street restorativeness

General description of the expected street restorativeness are concluded in Table 5-3. Differences of restorative expectations between street types are clearly presented in the diagram below (Figure 5-1). Results indicated that the Landscape and Leisure Street received the highest expectation ratings in regard to all 16 RCS items while the Traffic-oriented Street received the lowest. It is not a surprising result since literally, Landscape and Leisure Street implies an evidently different functional inclination than Traffic-oriented Street. The great difference of restorative expectations identified between Landscape and Leisure Street and Traffic-oriented Street suggests that people's expectations do vary with their understandings of different street types. Commercial Street ranks as the second highest on its expectation ratings in general, and it is particularly higher in the *fascination* ratings, which can be explained by its anticipated frontages composed of various retailing shops. Normally, street-side shops, especially those with window frontages, provide strong attractions for people passing by. Living and Service Street was rated relatively lower in the *fascination* and being-away components but high in the *compatibility* and *extent* ratings comparing with Commercial Street. A suitable explanation would be that the Living and Service Street is imagined to be a more common setting type than the other four, and therefore is assumed to be adapted to easily.

Table 5- 3 General descriptions of the RCS expectation results in the pilot study (N=45).

	B1-CM	B2-CM	B3-CM	E1-CM	E2-CM	E3-CM	E4-CM	F1-CM	F2-CM	F3-CM	F4-CM	F5-CM	C1-CM	C2-CM	C3-CM	C4-CM
Mean	3.84	3.00	2.71	4.18	3.98	4.18	4.36	4.07	4.02	4.51	4.13	3.67	3.58	3.33	4.40	3.58
N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Std. Deviation	1.57	1.78	1.50	1.44	1.45	1.71	1.42	1.86	1.85	1.44	1.69	1.76	1.80	1.73	1.25	1.59
	B1-LS	B2-LS	B3-LS	E1-LS	E2-LS	E3-LS	E4-LS	F1-LS	F2-LS	F3-LS	F4-LS	F5-LS	C1-LS	C2-LS	C3-LS	C4-LS
Mean	2.93	2.62	2.31	3.82	3.98	4.04	4.09	3.04	2.96	3.33	3.11	2.98	3.18	3.62	4.58	3.84
N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Std. Deviation	1.75	1.78	1.54	1.50	1.49	1.76	1.59	1.73	1.82	1.69	1.77	1.79	1.76	1.74	1.14	1.58
	B1-LL	B2-LL	B3-LL	E1-LL	E2-LL	E3-LL	E4-LL	F1-LL	F2-LL	F3-LL	F4-LL	F5-LL	C1-LL	C2-LL	C3-LL	C4-LL
Mean	4.82	4.42	4.11	4.87	4.78	4.78	4.89	4.24	4.18	4.71	4.91	4.78	3.91	3.40	4.51	4.09
N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Std. Deviation	1.35	1.36	1.58	1.06	1.11	1.26	1.19	1.37	1.48	1.16	1.15	1.15	1.43	1.36	1.24	1.31
	B1-TO	B2-TO	B3-TO	E1-TO	E2-TO	E3-TO	E4-TO	F1-TO	F2-TO	F3-TO	F4-TO	F5-TO	C1-TO	C2-TO	C3-TO	C4-TO
Mean	1.29	1.36	1.20	2.84	3.02	3.49	3.78	1.38	1.27	1.38	1.24	1.36	1.60	2.44	3.40	2.29
N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Std. Deviation	1.29	1.17	1.14	1.41	1.52	1.55	1.52	1.32	1.32	1.21	1.43	1.33	1.41	1.77	1.63	1.63

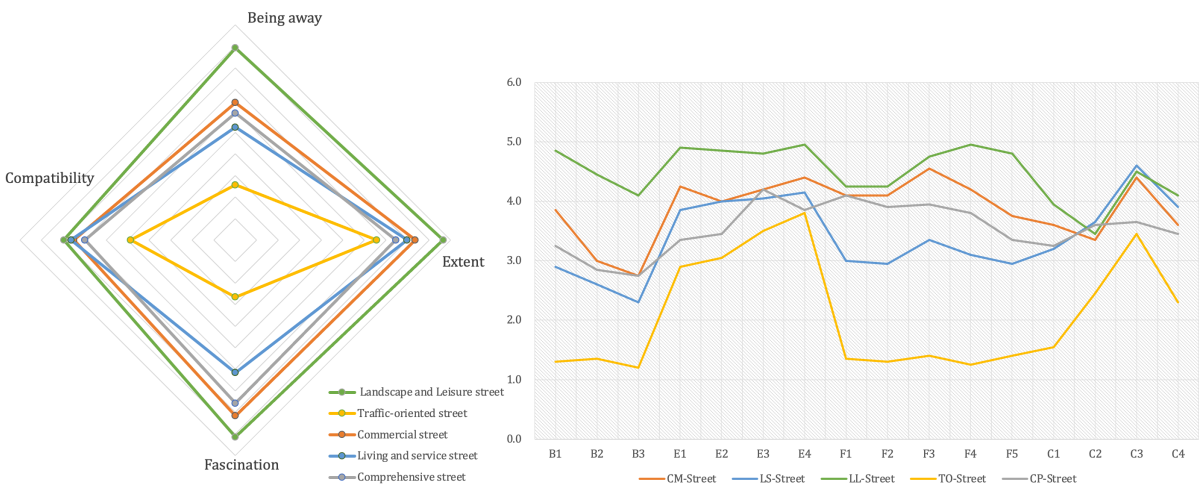


Figure 5-1 Overall mean ratings of restorative expectations for five street types in pilot study (N=45).

(B=Being away; E=Extent; F=Fascination; C=Compatibility; M= Mean values; LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented; CP=Comprehensive Street)*

- Comparison between street types

In response to a major purpose of this study, which is to find out whether and how restorative expectations vary with different street types, a one-way ANOVA with LSD post-hoc test was conducted. The overall ANOVA result shows that significant differences do exist between street types using mean ratings for all 16 RCS items, which suggests that the RCS is a sensitive approach in distinguishing restorative expectations between street types (Table 5-4, also see Appendix 5).

Table 5- 4 ANOVA results for the 16 RCS items using the mean ratings in the pilot study (Sig. < .005).

	B1	B2	B3	E1	E2	E3	E4	F1	F2	F3	F4	F5	C1	C2	C3	C4
Sig.	.000	.000	.000	.000	.000	.005	.002	.000	.000	.000	.000	.000	.000	.005	.000	.000

(The value of Sig. indicates whether differences within groups are significant. Sig. < 0.005 suggests that significant differences can be identified within five types of streets in terms of a specific factor, such as B1, and vice versa.)*

This step of the analysis is also aimed at investigating what the differences are between street types in terms of expected restorative components, by making comparisons between each street pair (e.g., Landscape and Leisure Street vs Commercial Street, Commercial Street vs Traffic-oriented Street) for significantly different RCS items. The LSD post-hoc test result has been generalised in Table 5-5 (also see Appendix 5) and indicates that each street type pair comparison includes more or less significantly different RCS items, besides of the pair of Commercial Street and Comprehensive Street. Also, only one item (F1) was found to be evidently different between Living and Service Street and Comprehensive Street. The most obvious differences appeared between Landscape and Leisure Street and Traffic-oriented Street, in which all 16 RCS items are presented with significant differences. This result is in line with the general descriptions of expectation ratings in which the Landscape and Leisure Street receives highest restorative expectations and the Traffic-oriented Street receives the lowest restorative expectations. Traffic-oriented Street also shows evident differences on restorative expectations from the other four street types: 13 RCS items different from Commercial Street, 14 RCS items different from Living and Service Street, and 11RCS items different from Comprehensive Street. Commercial Street has four different items from the Landscape and Leisure Street, three of which describe the *being away* component and five different items from the Living and Service Street, four of which describe *fascination*. These findings indicate that people expect evident differences between the Commercial Street and the Landscape and Leisure Street, in terms of providing the sense of *being away*, and between the Commercial Street and the Living and Service Street in terms of providing the sources of *fascination.* (Table 5-5)

Table 5- 5 Post-hoc results for comparing 16 RCS items between street pairs (Sig. <0.05).

	Being away				Extent				Fascination				Compatibility			
	B1	B2	B3	E1	E2	E3	E4	F1	F2	F3	F4	F5	C1	C2	C3	C4
CM and LS	0.004	0.235	0.187	0.232	1.000	0.686	0.385	0.003	0.002	0.000	0.002	0.037	0.237	0.403	0.521	0.405
CM and LL	0.002	0.000	0.000	0.021	0.007	0.070	0.083	0.599	0.655	0.505	0.018	0.001	0.324	0.847	0.688	0.111
CM and TO	0.000	0.000	0.000	0.000	0.001	0.038	0.061	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.000	0.000
CM and CP	0.065	0.000	0.883	0.009	0.099	1.000	0.112	0.948	0.701	0.047	0.250	0.311	0.324	0.479	0.009	0.728
LS and LL	0.000	0.000	0.000	0.001	0.007	0.027	0.010	0.000	0.001	0.000	0.000	0.000	0.031	0.520	0.810	0.445
LS and TO	0.000	0.000	0.000	0.001	0.001	0.093	0.311	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
LS and CP	0.285	0.529	0.143	0.156	0.099	0.686	0.469	0.003	0.008	0.055	0.050	0.280	0.843	0.898	0.001	0.238
LL and TO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000
LL and CP	0.000	0.000	0.000	0.000	0.000	0.070	0.001	0.554	0.406	0.008	0.001	0.000	0.049	0.607	0.003	0.053
TO and CP	0.000	0.000	0.000	0.062	0.116	0.038	0.772	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.335	0.000

(Boxes marked in red show no difference in this item between street pairs. B=Being away; E=Extent; F=Fascination; C=Compatibility. LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented; CP=Comprehensive Street)*

- Comparison between groups (professionals vs lay participants)

In addition, one-way ANOVA analysis was also conducted to discover whether the expectation results differ between the professional group and the lay group of participants for each street type. Overall, there is a consistency of restorative expectations observed between these two groups (Table 5-6, Table

5-7). Significant differences were only found in one item describing the Commercial Street, F4 (*Sig.=.027*) Significant differences were found in three items describing the Landscape and Leisure Street, which respectively are: E1 (*Sig.=.012*), E4 (*Sig.=.018*), and F5 (Sig.=.025). This finding suggests that in terms of restorative expectations, people with professional backgrounds and those without have similar perceptions. And slight differences of expectations only exist between the professional and lay participant groups regarding their restorative perceptions on Landscape and Leisure Street. The complete ANOVA results is included in Appendix 5.

Table 5- 6 General descriptions for comparing professional group (N=20) and lay group (N=25)

		CM-Street			LS-Street			LL-Street			CP-Street			TO-Street		
		Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err
B1	Pro	3.850	1.461	0.327	2.600	1.759	0.393	5.000	1.214	0.271	3.100	1.447	0.324	1.050	1.191	0.266
	Lay	3.840	1.675	0.335	3.200	1.732	0.346	4.680	1.464	0.293	3.400	1.323	0.265	1.480	1.358	0.272
B2	Pro	3.100	1.832	0.410	2.350	1.785	0.399	4.600	1.095	0.245	2.750	1.482	0.331	1.150	1.182	0.264
	Lay	2.920	1.778	0.356	2.840	1.772	0.354	4.280	1.542	0.308	2.880	1.236	0.247	1.520	1.159	0.232
B3	Pro	2.750	1.682	0.376	2.050	1.395	0.312	4.200	1.508	0.337	2.650	1.424	0.319	1.100	1.119	0.250
	Lay	2.680	1.376	0.275	2.520	1.636	0.327	4.040	1.670	0.334	2.840	1.344	0.269	1.280	1.173	0.235
E1	Pro	4.450	1.538	0.344	3.850	1.694	0.379	5.300	0.733	0.164	2.750	1.552	0.347	3.050	1.538	0.344
	Lay	3.960	1.338	0.268	3.800	1.354	0.271	4.520	1.159	0.232	3.920	1.412	0.282	2.680	1.314	0.263
E2	Pro	4.050	1.538	0.344	4.150	1.387	0.310	5.050	1.191	0.266	3.050	1.395	0.312	3.050	1.538	0.344
	Lay	3.920	1.412	0.282	3.840	1.573	0.315	4.560	1.003	0.201	3.840	1.344	0.269	3.000	1.528	0.306
E3	Pro	4.200	1.908	0.427	4.200	1.673	0.374	4.850	1.387	0.310	4.200	1.508	0.337	3.550	1.638	0.366
	Lay	4.160	1.573	0.315	3.920	1.847	0.369	4.720	1.173	0.235	4.160	1.519	0.304	3.440	1.502	0.300
E4	Pro	4.800	1.508	0.337	4.600	1.353	0.303	5.350	1.040	0.233	3.700	1.559	0.349	4.000	1.622	0.363
	Lay	4.000	1.258	0.252	3.680	1.676	0.335	4.520	1.194	0.239	4.000	1.500	0.300	3.600	1.443	0.289
F1	Pro	4.400	1.603	0.358	2.800	1.735	0.388	4.500	1.235	0.276	4.350	1.496	0.335	1.050	1.050	0.235
	Lay	3.800	2.041	0.408	3.240	1.739	0.348	4.040	1.457	0.291	3.800	1.756	0.351	1.640	1.469	0.294
F2	Pro	4.350	1.531	0.342	2.550	1.791	0.400	4.550	1.317	0.294	4.200	1.576	0.352	1.150	1.387	0.310
	Lay	3.760	2.067	0.413	3.280	1.815	0.363	3.880	1.563	0.313	3.640	1.777	0.355	1.360	1.287	0.257
F3	Pro	4.900	1.119	0.250	3.150	1.755	0.393	5.050	0.999	0.223	4.250	1.410	0.315	1.250	1.164	0.260
	Lay	4.200	1.607	0.321	3.480	1.661	0.332	4.440	1.227	0.245	3.640	1.604	0.321	1.480	1.262	0.252
F4	Pro	4.750	1.333	0.298	3.100	1.804	0.403	5.200	1.056	0.236	4.100	1.714	0.383	1.200	1.508	0.337
	Lay	3.640	1.800	0.360	3.120	1.787	0.357	4.680	1.180	0.236	3.480	1.558	0.312	1.280	1.400	0.280
F5	Pro	4.050	1.538	0.344	2.900	1.944	0.435	5.200	1.005	0.225	3.600	1.536	0.343	1.350	1.496	0.335
	Lay	3.360	1.890	0.378	3.040	1.695	0.339	4.440	1.158	0.232	3.120	1.740	0.348	1.360	1.221	0.244
C1	Pro	3.350	1.725	0.386	3.500	1.504	0.336	4.150	1.424	0.319	3.200	1.609	0.360	1.300	1.302	0.291
	Lay	3.760	1.877	0.375	2.920	1.935	0.387	3.720	1.429	0.286	3.280	1.542	0.308	1.840	1.463	0.293
C2	Pro	3.350	1.599	0.357	3.900	1.518	0.340	3.550	1.050	0.235	3.750	1.585	0.354	2.400	2.010	0.450
	Lay	3.320	1.865	0.373	3.400	1.893	0.379	3.280	1.568	0.314	3.440	1.557	0.311	2.480	1.584	0.317
C3	Pro	4.350	1.461	0.327	4.750	0.910	0.204	4.600	1.465	0.328	3.450	1.191	0.266	3.550	1.791	0.400
	Lay	4.440	1.083	0.217	4.440	1.294	0.259	4.440	1.044	0.209	3.840	1.281	0.256	3.280	1.514	0.303
C4	Pro	3.650	1.785	0.399	4.150	1.461	0.327	4.150	1.461	0.327	3.500	1.433	0.320	2.150	1.663	0.372
	Lay	3.520	1.447	0.289	3.600	1.658	0.332	4.040	1.207	0.241	3.440	1.474	0.295	2.400	1.633	0.327

Table 5- 7 ANOVA results for comparing professional group and lay group using mean ratings (Sig.<.05).

	Being away			***Extent***				***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***E4***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.983*	*.741*	*.879*	*.260*	*.769*	*.939*	*.059*	*.288*	*.294*	*.106*	***.027***	*.194*	*.455*	*.955*	*.814*	*.788*
LS Street	*.258*	*.363*	*.313*	*.913*	*.493*	*.601*	*.053*	*.403*	*.185*	*.522*	*.971*	*.798*	*.277*	*.343*	*.370*	*.251*
LL Street	*.437*	*.438*	*.741*	***.012***	*.141*	*.735*	***.018***	*.267*	*.133*	*.080*	*.131*	***.025***	*.321*	*.513*	*.671*	*.783*
TO Street	*.271*	*.297*	*.604*	*.389*	*.914*	*.816*	*.387*	*.138*	*.602*	*.533*	*.855*	*.980*	*.204*	*.882*	*.587*	*.615*
CP Street	*.472*	*.750*	*.649*	*.011*	*.061*	*.930*	*.516*	*.272*	*.276*	*.188*	*.211*	*.338*	*.866*	*.514*	*.301*	*.891*

(B=Being away; E=Extent; F=Fascination; C=Compatibility; LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented; CP=Comprehensive Street)*

- Feedback from the follow-up interview (see Appendix 6)

Q1 – 'Is there any phrases or terms in this questionnaire hard for you to understand?'

Participants normally felt that the descriptions of RCS items and the street type descriptions were obscure. Fifteen respondents reported problems with the way they were asked, since it was hard for them to grasp the main intentions of the questions. Several participants said, '*it is largely different from the way we normally speak',* and '*it feels like there is distance between these questions and daily life*', as well as '*it is something you use in written work, not in face-to-face communication*'. Two respondents mentioned the item 'it constitutes a larger whole' in particular, saying it was extremely hard to understand. For those who reported issues concerning street type descriptions, two said that Comprehensive Street was not understandable from its description and another said, '*I cannot connect your questions with these streets*'. Only two exact terms in this questionnaire have been identified as unconveyable. One of the participants mentioned the term 'restoration' and another mentioned 'accordance'.

Q2 – 'Is it hard for you to imagine a street in its ideal condition?'

This question aimed to find out whether it was feasible to ask participants to imagine an ideal scenario of streets with only verbal descriptions provided. Among 22 participants, 15 of them replied with an answer such as '*no, it's not hard for me*' and '*it's ok/works for me',* while the other seven people replied saying, '*certain street types such as Comprehensive Street are a little hard to imagine*'. One respondent described his feelings to the researcher as '*Comprehensive Street feels like some kind of combination...but I don't have a clear image of it'*. A female participant who replied with difficulties imagining said, '*I can only clearly imagine some of them like Commercial Street and Landscape and Leisure Street. For Traffic-oriented Street and Living and Service Street, they become a little bit vague but still okay. And I'm totally confused with Comprehensive Street.*'

Q3 – 'Is it feasible for you to differentiate between street types?'

This question aimed to discover whether these five street types could be understood and distinguished by participants. Again, Comprehensive Street proved to be hard for people to understand and to imagine an ideal state of it in this section. Nine respondents directly pointed out that Comprehensive Street was hard to understand while another three participants suggested that they could not tell the difference between Comprehensive Street and Living and Service Street. Another two participants reported difficulties understanding what Traffic-oriented street was.

Q4: 'Did any specific street appear in your mind when you were in the imagination process?'

This question was designed to find out if the selection of case-study streets could be inspired from respondents' imaginations. Only three participants replied saying, *'not a particular street, but some flashes of streets I saw before.*' The other 19 participants confidently replied yes, but most of them could hardly give out any specific street names, probably due to the fact that pedestrians pay less attention to street names compared to drivers, since what they need to remember is the route rather than street names. Several streets were nominated, including Dapu Road, Xujiahui Road, Tongming Road, Xiayang Road, South Shanxi Road and Daxue Road, but none of them appeared twice in the obtained interview results.

Q5 – 'Do you have any other suggestions?'

This question was designed to gather suggestions from participants on how to improve the survey and the questionnaire design. Fourteen of them provided valuable advice while the other six people could not think of any. Their advice could be categorised into four aspects. One primary issue of concern was whether any illustrations, such as pictures or street names of the five street types, could be presented as references. Fifty per cent of the participants who gave out advice mentioned *'examples'*. The second highest-mentioned problem regarded the expression of the questionnaire items.

Participants thought the items in the RCS questionnaire were '*not the way we speak or communicate with others*,' *and 'feels like a written language…a little bit weird,*' and '*some terms are not what we normally use in everyday life.*' It seems the format and intention of the questionnaire were obstacles for them as well. In the pilot study, the RCS was designed to be rated five times on five different street types (one sheet for each street), hence some participants complained about the tedious and complex process. Three participants were confused about the questionnaire intentions though instructions were provided at the beginning. There was one response that could not be categorised into any of the four aspects mentioned above. One participant said, '*I feel like your question set does not fit to one street. I thought over one street when I answered a part of your questions and suddenly my imagination jumped to another one when I moved on to another part of your questions',* which might have been due in part to their difficulty in understanding the intention of this questionnaire, and the other part in the imagination.

5.3.3 Discussions and implications for the next step

Through a questionnaire investigating people's restorative expectations of five Shanghai street types, restorative expectations not only proved to be measurable using the RCS under the context of street environment in this study, but also proved to be significantly varied within street types. Besides Comprehensive Street, a clear ranking of restorative expectations on four other street types were observed, with the highest to the lowest being: Landscape and Leisure Street, Commercial Street, Living and Service Street and Traffic-oriented street. The findings in this pilot study showed that it was feasible to use the RCS in the next step of this research. It was also confirmed in the pilot study that people's expected restorativeness did vary with street types. Findings from people's expectations indicated that it was reasonable to make certain types of streets more restorative than others. However, whether these expectations of revealing different levels of restorativeness can be realised through design interventions requires further exploration in this research.

Moreover, it was also observed in this research that very limited divergences existed between the professional group and layman group participants, possibly due to the fact that the restorative perceptions that this research intended to explore were a relatively psychological concept rather than an urban design concept. Participants with urban design professional knowledge could hardly become determinants as this would not cause evident differences in their restorative perceptions. This result was basically in line with previous findings in landscape preference research suggesting that professional training, in the form of planning, had no apparent influence on people's judgement (see Dearden, 1984). Hence, group difference was regarded to be noninfluential to the result of the expected restorativeness of street users.

In terms of the five street types, Comprehensive Street seemed to be rather hard for people to understand, and even harder when they were asked to imagine it in an ideal condition. One possible explanation was that it was actually a combinative type of the other four. The length of streets is quite varied in Shanghai and sometimes it is impossible for a street of more than 2km in length to maintain consistency regarding street functions and characteristics from the beginning to the end, as streetside frontages normally change with their surrounding contexts. Comprehensive Street is the kind of street that incorporates various sections, where each section might fall into an independent category, but together can be difficult for users to picture using their imaginations without the help of professional knowledge and understanding. Therefore, it is worth considering excluding the Comprehensive Street type in the formal survey as long as the street length is controlled when selecting study sites.

In the follow-up interview, participants were asked, '*Did any specific streets appear during the imagination process*?' Over 85 percent of participants replied with affirmative answers, but only three of them were able to provide specific street names. In most cases, flashes of some real street sections they had seen before were taken as prototypes for them to imagine better versions when completing the questionnaire. This question was designed to see if their responses could shed light on a way to select target streets when evaluating the current restorative potential of streets later in this study. However, not a single street appeared twice in their answers and these nominated streets were rather scattered in terms of their location, suggesting that participants were more likely to nominate some streets from their familiarised living environments. This part of the questionnaire should be considered for removal since little practical value could be provided if the streets nominated by participants were dispersed in the inner city of Shanghai. Another consideration was the intention in this stage to explore whether selected case-study streets were equally restorative with people's desires. Choosing case-study streets from people's imagination prototypes might not be a good idea at all if their imagined streets already fit their expectations. The decision to select case study sites was therefore decided by the researcher in the end.

5.4 Investigating the Expected Restorativeness of Streets

5.4.1 Method and procedure

Slight improvements and modifications were made in the research design according to participants' feedbacks in the pilot study interview clarified in section 5.3.4. The following sections of method and procedure only describe adaptations made in the formal survey according to issues revealed in the pilot study.

- Questionnaire

Three major adjustments have been made to the questionnaire contents. Firstly, one of the *extent* items ('all the elements constitute a larger whole') was excluded as it was hardly conveyable to respondents, especially under the Chinese context. Therefore, the further revised RCS included 15 items. In addition, age classification had been modified from four groups: 22–30, 30–40, 40–50 and above 50, to another four groups: under 25, 26–35, 36–45 and 45–55. The modification was made as it had been found in the pilot study that some working group people finished their studies around 20 years of age, perhaps only just graduated from high school. Hence, 25 had been set as the lower age limit because it was the common graduation age from a master's degree, and the level of 'under 25' was set in case potential participants joined the working group without a master's degree. It was noted that 55 was the retirement age in China, so respondents aged over 55 should not be considered in this study. Moreover, two additional pieces of background information were investigated including income and educational background. Sensitive information such as age was asked in the form of multiple-choice questions in order to avoid people's antipathy and resistance. In addition, the Chinese translation of the RCS questionnaire was twisted in places based on participants' advice on grammar mistakes during the pilot study. The format for organising this online questionnaire was changed into one RCS item followed by four rows of street types ratings, also based on valuable advice from interviewees in the pilot study (see https://www.wjx.cn/jq/41328414.aspx).

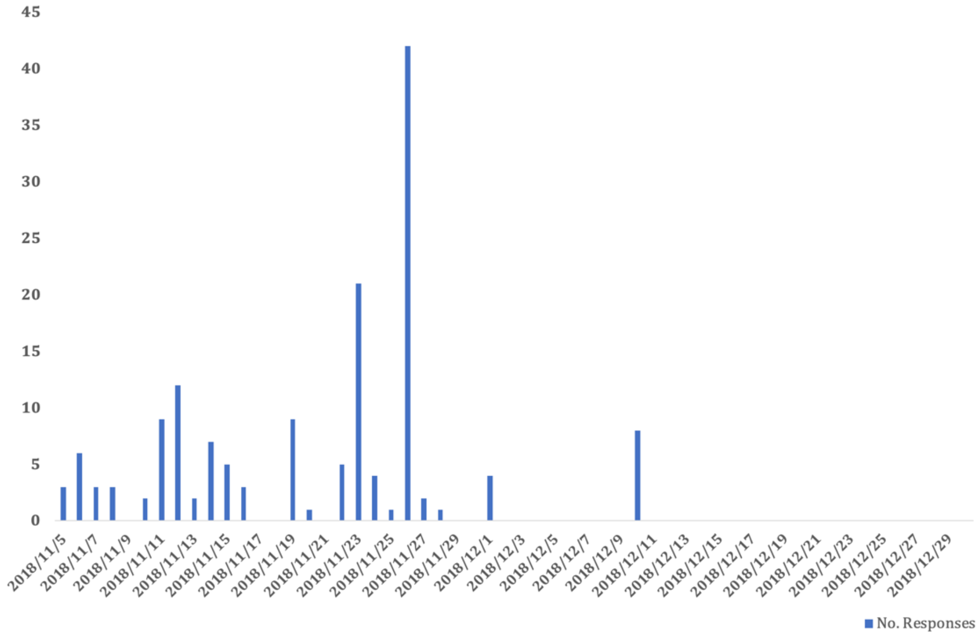
- Stimuli

The Comprehensive Street type was excluded in the formal survey based on two considerations. First of all, participants of the pilot study had expressed their confusion about this type. Also, it was in essence a combination of the other four street types which was explained in section 5.3.3. So only the other four types of Shanghai streets, Landscape and Leisure Street, Commercial Street, Living and Service Street and Traffic-oriented Street, were rated for their expected restorativeness in this step of the research. Only literal descriptions were provided to trigger people's imagination and descriptions of each street type remained unchanged.

- Participants and procedure

Differing from the onsite questionnaire used in the pilot study, the formal survey utilised the Internet to spread this questionnaire so that a larger group of people with diverse backgrounds could be reached. The RCS questionnaire was edited into an online version using the Wenjuanxing website (see https://www.wjx.cn/), an online open platform similar to Survey Monkey, that is used for designing, editing and promoting questionnaires and surveys. It generates website links and QR codes that can be forwarded through different social apps including WeChat, QQ, LinkedIn and email. Through publishing the link on personal websites and forwarding the link across social media groups, the questionnaire was dispersed within diverse social networks so that it could be accessed effectively by a large population group with minimum time and economic costs. WeChat was selected as the major platform for spreading this questionnaire due to its dominating number of active users across all social apps in China, which has a total of over 1 billion active users per calendar month. This step of the online questionnaire was stopped after the number of respondents ceased to increase over ten consecutive days (Table 5-8). By the day it was suspended for access in the online system, it had been promoted using the WeChat app for 30 days and with a total number of 154 responses received.

Table 5- 8 Response rate during online survey.



5.4.2 Results

- Manipulation checks

Replicating the data analysis process conducted in the pilot study, all of the RCS ratings were first examined for reliability with Cronbach's alpha (Hinton, 2014) using SPSS (V 25.0). The α value for ART components of the four street types showed sufficient internal consistency (the α value should at least be over 0.6) and hence, guaranteed the reliability of the obtained RCS ratings (Table 5-9). Data were also tested to see whether they were normally distributed so that its feasibility to go through further analysis could be ensured. The results using the P-P plot (probability-probability plot or percent-percent plot) indicated that all ratings for the 15 items were normally distributed and therefore qualified for the next-step analysis (see Appendix 7).

Table 5- 9 Formal survey internal consistency results of expectation ratings

Street Type	**Commercial Street**				**Landscape and Leisure Street**				**Living and Service Street**				**Traffic-oriented Street**			
ART components	B	E	F	C	B	E	F	C	B	E	F	C	B	E	F	C
Cronbach's α	.85	.91	.90	.84	.85	.90	.92	.88	.84	.89	.91	.86	.92	.88	.96	.87
No. of Participants	154				154				154				154			
No. of Items	3	3	5	4	3	3	5	4	3	3	5	4	3	3	5	4

(B=Being away; E=Extent; F=Fascination; C=Compatibility; LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented Street)*

- General descriptions of the expected street restorativeness

General description of the expected street restorativeness are concluded in Table 5-10. A very similar pattern of the four street types could be observed between the pilot study and the formal survey in terms of people's expected restorativeness ratings, though slight differences existed in certain items (Figure 5-2). Landscape and Leisure Street was still expected to have the highest level of restorativeness and Traffic-oriented Street the lowest. Also, the RCS ratings on Living and Service Street and on Commercial Street were still tangling with each other. Differing from previous results in the pilot study, expectation ratings on Landscape and Leisure Street were stable across 15 items, while in the pilot study there were ups and downs, with especially lower ratings on items B2, B3, C1, C2, C4, F1 and F2 (Figure 5-1). For Traffic-oriented Street, lower ratings could be found in the *being away* and *fascination* items, while higher ratings were mostly located in the *compatibility* and *extent* items, which both presented a similar trend as in the pilot study results. The difference between Comprehensive Street and Living and Service Street seemed to be less obvious than in what has been revealed in the pilot study findings.

Table 5- 10 General descriptions of the RCS expectation results in the formal survey (N=154).

	B1-LL	B2-LL	B3-LL	E1-LL	E2-LL	E3-LL	F1-LL	F2-LL	F3-LL	F4-LL	F5-LL	C1-LL	C2-LL	C3-LL	C4-LL
Mean	5.71	5.67	5.29	5.39	5.56	5.48	5.50	5.44	5.67	5.88	5.79	5.53	5.48	5.54	5.48
N	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
Std. Deviation	1.28	1.29	1.50	1.33	1.26	1.32	1.40	1.45	1.27	1.31	1.18	1.37	1.40	1.31	1.38
	B1-TO	B2-TO	B3-TO	E1-TO	E2-TO	E3-TO	F1-TO	F2-TO	F3-TO	F4-TO	F5-TO	C1-TO	C2-TO	C3-TO	C4-TO
Mean	3.31	3.39	3.36	4.45	4.44	4.48	3.50	3.54	3.70	3.24	3.48	3.60	3.80	4.25	4.36
N	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
Std. Deviation	1.78	1.82	1.75	1.65	1.66	1.63	1.75	1.72	1.82	1.86	1.83	1.72	1.78	1.71	1.78
	B1-CM	B2-CM	B3-CM	E1-CM	E2-CM	E3-CM	F1-CM	F2-CM	F3-CM	F4-CM	F5-CM	C1-CM	C2-CM	C3-CM	C4-CM
Mean	4.60	4.40	4.18	5.03	4.92	4.98	5.07	5.08	5.10	4.84	4.57	4.60	4.54	4.76	5.10
N	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
Std. Deviation	1.54	1.51	1.68	1.34	1.40	1.37	1.42	1.48	1.39	1.44	1.56	1.56	1.51	1.44	1.30
	B1-LS	B2-LS	B3-LS	E1-LS	E2-LS	E3-LS	F1-LS	F2-LS	F3-LS	F4-LS	F5-LS	C1-LS	C2-LS	C3-LS	C4-LS
Mean	4.66	4.58	4.16	5.05	5.13	5.01	4.86	4.81	4.92	4.80	4.56	4.66	4.94	5.10	5.23
N	154	154	154	154	154	154	154	154	154	154	154	154	154	154	154
Std. Deviation	1.49	1.46	1.56	1.33	1.37	1.36	1.54	1.47	1.45	1.55	1.60	1.55	1.44	1.36	1.42

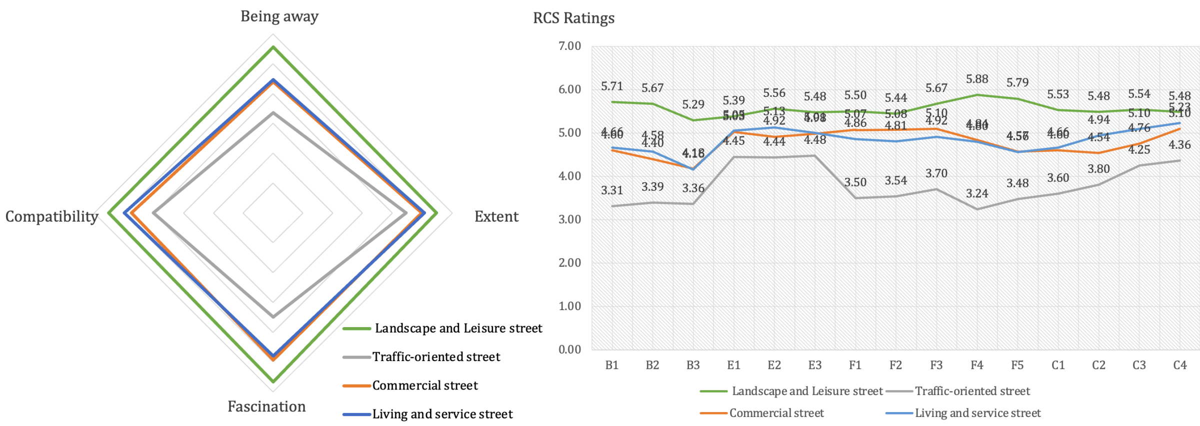


Figure 5- 2 Overall mean rating results of restorative expectations for street types (N=153).

(B=being away; E=extent; F=Fascination; C=Compatibility)*

- Comparison between street types

Similar findings were also discovered when testing whether users' restorative expectations varied with street types using one-way ANOVA with the LSD post-hoc test (see Appendix 8). The overall ANOVA result, which aimed to identify differences within the groups, showed significant differences existed within the street types using mean ratings of 15 RCS items. This again proved that the modified version of RCS with 15 items was still sensitive in distinguishing restorative expectations between street types (Table 5-11).

Table 5- 11 ANOVA results for 15 RCS items using mean ratings (Sig. < .005).

	B1	B2	B3	E1	E2	E3	F1	F2	F3	F4	F5	C1	C2	C3	C4
Sig.	.000	.000	.000	.000	.000	.005	.000	.000	.000	.000	.000	.000	.000	.000	.000

(B=being away; E=extent; F=Fascination; C=Compatibility)*

Major differences between the pilot study and the formal survey results were also revealed in this section (Table 5-5, Table 5-12). It was observed that significant differences existed between Landscape and Leisure Street with Traffic-oriented Street, Living and Service Street with Traffic-oriented Street, Commercial Street with Traffic-oriented Street and Commercial Street with Landscape and Leisure Street. Results indicated that people's expectations of these street type pairs were quite different in each and every RCS item. However, it seemed that Commercial Street could hardly be differentiated between Living and Service Street given that 13 RCS items showed no differences. Similarity was also observed in C4 between Landscape and Leisure Street with Living and Service Street. Findings of the LSD post-hoc test in general suggested that people's expected restorativeness were evidently different and these differences could be clearly distinguished within most street types. The only exception which emerged was that restorative expectations of Commercial Street and Living and Service Street were relatively close to each other, with only slight differences having emerged in the *compatibility* component. This finding is in accordance with the general description of RCS ratings, in which the ratings of these two street types are very similar with each other.

Table 5- 12 Post-hoc results for comparing 15 RCS items within street types (Sig. <0.05).

	Being away			Extent			Fascination					Compatibility			
	B1	B2	B3	E1	E2	E3	F1	F2	F3	F4	F5	C1	C2	C3	C4
LL and CM	0.000	0.000	0.000	0.028	0.000	0.002	0.015	0.038	0.001	0.000	0.000	0.000	0.000	0.000	0.024
LL and LS	0.000	0.000	0.000	0.041	0.010	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.009	**0.134**
LL and TO	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CM and LS	**0.738**	**0.316**	**0.916**	**0.873**	**0.188**	**0.873**	**0.235**	**0.129**	**0.287**	**0.798**	**0.942**	**0.741**	0.024	0.043	**0.442**
CM and TO	0.000	0.000	0.000	0.000	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000
LS and TO	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

(Boxes marked in red show no difference in this item between street pairs. B=being away; E=extent; F=Fascination; C=Compatibility; CM=Commercial Street, LL=Landscape and Leisure Street; LS=Living and Service Street; TO=Traffic-oriented Street)*

- Comparison between groups (professional, gender, income and age)

Differences in the expected restorativeness between groups included professional background groups (professional and lay participants, 2 groups, Table 5-13, Table 5-14), gender groups (male and female, 2 groups, Table 5-15, Table 5-16), age groups (4 groups, Table 5-17), income-level groups (3 groups, Table 5-18) and education-level groups (5 groups, Table 5-19). The complete ANOVA results is included in Appendix 8. Overall, there was consistency in restorative expectations when comparing those with professional backgrounds to those without, which was in accordance with the pilot study results. Significant differences between these two groups were only found in one item, that B2 (*Sig. =.036*) in describing Living and Service Street, and four items describing Landscape and Leisure Street which respectively are E3 (*Sig. =.015*) and *F*1(*Sig.=.025*), F2 (*Sig.=.025*), F3 (*Sig.=.013*). However, a major difference in the pilot study results were the 11 items in Traffic-oriented Street, which were found to be significantly different between professional and lay participant groups' expectations in the formal survey results.

Table 5- 13 General descriptions for comparing professional group (N=24) and lay group (N=129)

	Occupation	N	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err
B1	Pro	24	5.208	1.250	0.255	2.250	1.422	0.290	4.458	1.532	0.313	4.208	1.318	0.269
	Lay	129	5.806	1.269	0.112	3.504	1.782	0.157	4.628	1.557	0.137	4.744	1.517	0.134
B2	Pro	24	5.292	1.042	0.213	2.292	1.398	0.285	4.000	1.560	0.319	4.000	1.319	0.269
	Lay	129	5.744	1.330	0.117	3.597	1.831	0.161	4.473	1.495	0.132	4.682	1.468	0.129
B3	Pro	24	4.750	1.648	0.336	2.292	1.517	0.310	3.875	1.872	0.382	3.833	1.523	0.311
	Lay	129	5.395	1.465	0.129	3.558	1.727	0.152	4.233	1.656	0.146	4.217	1.571	0.138
E1	Pro	24	5.042	1.429	0.292	3.708	1.706	0.348	4.917	1.381	0.282	4.792	0.977	0.199
	Lay	129	5.450	1.317	0.116	4.589	1.618	0.142	5.047	1.340	0.118	5.101	1.385	0.122
E2	Pro	24	5.250	1.225	0.250	3.625	1.740	0.355	4.875	1.541	0.315	4.958	1.268	0.259
	Lay	129	5.612	1.271	0.112	4.589	1.609	0.142	4.922	1.378	0.121	5.163	1.391	0.122
E3	Pro	24	4.875	1.484	0.303	3.667	1.606	0.328	4.958	1.546	0.316	4.875	1.361	0.278
	Lay	129	5.589	1.266	0.111	4.628	1.601	0.141	4.984	1.346	0.119	5.031	1.363	0.120
F1	Pro	24	4.917	1.816	0.371	2.500	1.383	0.282	5.042	1.367	0.279	4.792	1.414	0.289
	Lay	129	5.612	1.295	0.114	3.682	1.759	0.155	5.078	1.439	0.127	4.876	1.576	0.139
F2	Pro	24	4.833	1.606	0.328	2.667	1.404	0.287	5.333	1.435	0.293	5.000	1.383	0.282
	Lay	129	5.558	1.403	0.123	3.705	1.734	0.153	5.031	1.500	0.132	4.775	1.496	0.132
F3	Pro	24	5.083	1.558	0.318	2.625	1.439	0.294	4.917	1.613	0.329	4.833	1.465	0.299
	Lay	129	5.783	1.192	0.105	3.899	1.828	0.161	5.132	1.348	0.119	4.930	1.453	0.128
F4	Pro	24	5.583	1.381	0.282	2.208	1.285	0.262	5.125	1.676	0.342	4.958	1.601	0.327
	Lay	129	5.930	1.300	0.114	3.426	1.903	0.168	4.791	1.396	0.123	4.767	1.554	0.137
F5	Pro	24	5.417	1.139	0.232	3.083	1.932	0.394	4.792	1.560	0.318	4.625	1.313	0.268
	Lay	129	5.860	1.184	0.104	3.550	1.816	0.160	4.527	1.567	0.138	4.543	1.658	0.146
C1	Pro	24	5.083	1.248	0.255	3.125	1.296	0.265	4.708	1.517	0.310	4.875	1.154	0.236
	Lay	129	5.612	1.382	0.122	3.690	1.780	0.157	4.581	1.575	0.139	4.620	1.621	0.143
C2	Pro	24	5.083	1.283	0.262	3.583	1.586	0.324	4.708	1.083	0.221	5.208	1.021	0.208
	Lay	129	5.558	1.419	0.125	3.845	1.822	0.160	4.512	1.582	0.139	4.891	1.506	0.133
C3	Pro	24	5.250	1.113	0.227	3.833	1.685	0.344	4.625	1.245	0.254	5.125	1.191	0.243
	Lay	129	5.589	1.350	0.119	4.326	1.715	0.151	4.783	1.479	0.130	5.093	1.400	0.123
C4	Pro	24	4.708	1.517	0.310	3.542	1.865	0.381	5.250	1.189	0.243	5.250	1.073	0.219
	Lay	129	5.628	1.311	0.115	4.512	1.737	0.153	5.070	1.324	0.117	5.225	1.486	0.131

Table 5- 14 T-test results for comparing Pro-group and Lay-group using mean ratings (Sig. <.05).

	Being away			***Extent***			***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.624*	*.160*	*.343*	*.665*	*.879*	*.932*	*.910*	*.363*	*.488*	*.299*	*.448*	*.716*	*.560*	*.624*	*.535*
LS Street	*.107*	*.036*	*.271*	*.298*	*.504*	*.607*	*.807*	*.495*	*.765*	*.583*	*.818*	*.463*	*.325*	*.917*	*.937*
LL Street	*.035*	*.117*	*.054*	*.171*	*.199*	*.015*	*.025*	*.025*	*.013*	*.236*	*.092*	*.083*	*.129*	*.248*	*.002*
TO Street	*.001*	*.001*	*.001*	*.016*	*.009*	*.008*	*.002*	*.006*	*.002*	*.003*	*.254*	*.141*	*.511*	*.197*	*.014*

(B=Being away; E=Extent; F=Fascination; C=Compatibility; CM=Commercial Street, LL=Landscape and Leisure Street; LS=Living and Service Street; TO=Traffic-oriented Street)*

In respect to gender difference, only Commercial Street and Living and Service Street respectively did there appear four different items, while no significant difference was found in the Landscape and Leisure Street and Traffic-oriented Street expectation ratings. The expected *compatibility* component on Commercial Street revealed discrepancies between male and female groups. For Living and Service Street, different RCS items between gender groups were rather scattered with one in the *extent* component, one in *fascination* and two in the *compatibility* component. Very slight differences were found within the four age groups on the RCS items, with significant differences only observed in two items (B2 and F5) in Commercial Street and two items (B2 and F4) in Living and Service Street. Besides, no difference was observed within different education groups and different income groups.

Table 5- 15 General descriptions for comparing male group (N=71) and female group (N=82).

			LL-Street			TO-Street			CM-Street			LS-Street		
	Gender	N	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err	Mean	Std. Dev	Std. Err
B1	M	71	5.789	1.393	0.165	3.408	1.961	0.233	4.493	1.602	0.190	4.732	1.585	0.188
	F	82	5.646	1.180	0.130	3.220	1.626	0.180	4.695	1.505	0.166	4.598	1.422	0.157
B2	M	71	5.634	1.514	0.180	3.577	1.932	0.229	4.465	1.548	0.184	4.535	1.501	0.178
	F	82	5.707	1.083	0.120	3.232	1.731	0.191	4.341	1.484	0.164	4.610	1.438	0.159
B3	M	71	5.479	1.501	0.178	3.549	1.819	0.216	4.423	1.670	0.198	4.338	1.585	0.188
	F	82	5.134	1.505	0.166	3.195	1.688	0.186	3.963	1.688	0.186	4.000	1.540	0.170
E1	M	71	5.380	1.458	0.173	4.197	1.670	0.198	5.000	1.342	0.159	4.789	1.443	0.171
	F	82	5.390	1.235	0.136	4.671	1.626	0.180	5.049	1.351	0.149	5.280	1.189	0.131
E2	M	71	5.592	1.358	0.161	4.268	1.723	0.205	4.803	1.327	0.157	4.986	1.389	0.165
	F	82	5.524	1.189	0.131	4.585	1.602	0.177	5.012	1.461	0.161	5.256	1.350	0.149
E3	M	71	5.507	1.403	0.166	4.366	1.588	0.188	4.944	1.351	0.160	4.845	1.390	0.165
	F	82	5.451	1.259	0.139	4.573	1.678	0.185	5.012	1.401	0.155	5.146	1.325	0.146
F1	M	71	5.606	1.488	0.177	3.493	1.835	0.218	4.859	1.313	0.156	4.676	1.593	0.189
	F	82	5.415	1.333	0.147	3.500	1.694	0.187	5.256	1.497	0.165	5.024	1.499	0.166
F2	M	71	5.507	1.548	0.184	3.620	1.839	0.218	4.915	1.528	0.181	4.521	1.520	0.180
	F	82	5.390	1.377	0.152	3.476	1.627	0.180	5.220	1.449	0.160	5.061	1.400	0.155
F3	M	71	5.662	1.393	0.165	3.690	1.909	0.227	4.873	1.473	0.175	4.704	1.562	0.185
	F	82	5.683	1.175	0.130	3.707	1.767	0.195	5.293	1.291	0.143	5.098	1.330	0.147
F4	M	71	5.761	1.449	0.172	3.239	1.901	0.226	4.592	1.555	0.184	4.620	1.562	0.185
	F	82	5.976	1.186	0.131	3.232	1.855	0.205	5.061	1.309	0.145	4.951	1.547	0.171
F5	M	71	5.803	1.249	0.148	3.465	1.904	0.226	4.521	1.491	0.177	4.451	1.575	0.187
	F	82	5.780	1.133	0.125	3.488	1.786	0.197	4.610	1.631	0.180	4.646	1.636	0.181
C1	M	71	5.563	1.500	0.178	3.577	1.713	0.203	4.254	1.583	0.188	4.394	1.626	0.193
	F	82	5.500	1.260	0.139	3.622	1.740	0.192	4.902	1.487	0.164	4.890	1.466	0.162
C2	M	71	5.521	1.539	0.183	3.577	1.762	0.209	4.282	1.596	0.189	4.789	1.473	0.175
	F	82	5.451	1.288	0.142	4.000	1.792	0.198	4.768	1.408	0.155	5.073	1.412	0.156
C3	M	71	5.648	1.353	0.161	4.113	1.745	0.207	4.648	1.494	0.177	4.930	1.477	0.175
	F	82	5.439	1.287	0.142	4.366	1.689	0.187	4.854	1.398	0.154	5.244	1.253	0.138
C4	M	71	5.606	1.357	0.161	4.155	1.833	0.218	4.803	1.380	0.164	4.986	1.526	0.181
	F	82	5.378	1.402	0.155	4.537	1.737	0.192	5.354	1.180	0.130	5.439	1.306	0.144

(B=Being away; E=Extent; F=Fascination; C=Compatibility; CM=Commercial Street, LL=Landscape and Leisure Street; LS=Living and Service Street; TO=Traffic-oriented Street)*

Table 5- 16 ANOVA results for comparing gender groups using mean ratings (Sig. <.05).

	Being away			***Extent***			***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.423*	*.616*	*.094*	*.823*	*.358*	*.759*	*.086*	*.209*	*.062*	*.044*	*.728*	*.010*	*.047*	*.380*	*.009*
LS Street	*.580*	*.754*	*.184*	*.022*	*.225*	*.172*	*.166*	*.024*	*.095*	*.190*	*.454*	*.049*	*.225*	*.156*	*.050*
LL Street	*.495*	*.728*	*.159*	*.964*	*.745*	*.796*	*.404*	*.622*	*.920*	*.314*	*.908*	*.777*	*.760*	*.330*	*.311*
TO Street	*.516*	*.245*	*.214*	*.078*	*.239*	*.437*	*.980*	*.608*	*.954*	*.980*	*.939*	*.874*	*.145*	*.364*	*.189*

Table 5- 17 ANOVA results for comparing age groups using mean ratings (Sig. <.05).

	Being away			***Extent***			***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.528*	*.046*	*.156*	*.909*	*.690*	*.667*	*.937*	*.945*	*.513*	*.174*	*.042*	*.587*	*.220*	*.457*	*.497*
LS Street	*.053*	*.038*	*.023*	*.404*	*.946*	*.427*	*.423*	*.860*	*.327*	*.032*	*.092*	*.202*	*.936*	*.762*	*.379*
LL Street	*.135*	*.191*	*.160*	*.305*	*.509*	*.351*	*.432*	*.764*	*.444*	*.308*	*.322*	*.293*	*.224*	*.106*	*.591*
TO Street	*.012*	*.111*	*.140*	*.134*	*.438*	*.275*	*.001*	*.026*	*.007*	*.002*	*.002*	*.025*	*.034*	*.227*	*.388*

Table 5- 18 ANOVA results for comparing education background groups using mean ratings (Sig. <.05).

	Being away			***Extent***			***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.096*	*.058*	*.292*	*.700*	*.799*	*.751*	*.871*	*957*	*.623*	*.887*	*.555*	*949*	*.634*	*.970*	*.492*
LS Street	*.105*	*.130*	*.175*	*.513*	*.705*	*.238*	*.272*	*.073*	*.269*	*.064*	*.055*	*.071*	*.883*	*.234*	*458*
LL Street	*.347*	*.361*	*.652*	*.600*	*.818*	*.607*	*.317*	*.361*	*.726*	*.572*	*.744*	*.531*	*.881*	*.416*	*.599*
TO Street	*.001*	*.001*	*.001*	*.010*	*.013*	*.065*	*.003*	*.047*	*.003*	*.001*	*.004*	*.002*	*.004*	*.017*	*.239*

Table 5- 19 ANOVA results for comparing income-level groups using mean ratings (Sig. <.05).

	Being away			***Extent***			***Fascination***					***Compatibility***			
	B1	***B2***	***B3***	***E1***	***E2***	***E3***	***F1***	***F2***	***F3***	***F4***	***F5***	***C1***	***C2***	***C3***	***C4***
CM Street	*.234*	*.271*	*.677*	*.592*	*.139*	*.421*	*.961*	*.736*	*.578*	*.765*	*.590*	*.903*	*.558*	*.854*	*.055*
LS Street	*.194*	*.336*	*.581*	*.786*	*.696*	*.550*	*.689*	*.380*	*.619*	*.740*	*.708*	*.667*	*.792*	*.530*	*.619*
LL Street	*.888*	*.265*	*.977*	*.679*	*.753*	*.973*	*.542*	*.737*	*.813*	*.721*	*.845*	*.942*	*.844*	*.588*	*.777*
TO Street	*.703*	*.691*	*.455*	*.336*	*.963*	*.675*	*.971*	*.833*	*.833*	*.556*	*.734*	*.515*	*.445*	*.877*	*.822*

(B=Being away; E=Extent; F=Fascination; C=Compatibility; CM=Commercial Street, LL=Landscape and Leisure Street; LS=Living and Service Street; TO=Traffic-oriented Street)*

5.4.3 Discussions

In respect to a general tendency, the results of the pilot study and the formal survey regarding people's expected restorativeness on four Shanghai street types appeared to be consistent. This consistency confirmed that the Restorative Component Scale (RCS) was an efficient measurement for investigating restorative experiences under the context of urban street environments and differentiating within street types. More importantly, it also proved in this step that synthetically using the RCS with a scenario approach to measure the restorative expectations of street users is feasible. However, a noticeable discrepancy could be observed in the section of the post-hoc test for identifying significantly different RCS items within street pairs. There was an obvious increase in significantly different RCS items between street pairs in the formal survey results compared to the pilot study, which could be explained by the increased sample size included in the formal survey. Commercial Street was found to be very similar with Living and Service Street in both of the two rounds of the RCS questionnaire survey, which was coherently in line with the result of the general description on their mean ratings.

In addition, the background information of participants was also collected in this stage of the survey for testing individual perceptive differences. In general, there were very limited perceptive differences in terms of having restoration within groups of background information, among which income level and education background seemed to have no influence on people's expected street restorativeness. Since their irrelevance having been proven, these parts of the information should be excluded in the next steps of this study to make the survey as concise as possible to avoid participants' impatience and antipathy. Age, gender and whether participants have a professional background should be kept for later stages of analysis in this research because varying degrees of perceptive differences in terms of these factors have appeared in the results. In addition, these three background items could be easily answered by ticking boxes with only limited options were provided for each of them.

5.5 Conclusion

Investigating users' expectations at this stage revealed a way to design restorative streets according to people's expectations so that restorativeness, as one necessary street quality, was not overemphasised, jeopardising other necessary qualities, or unable to meet users' expectations. Appleyard (1981) also highlighted that users' prior expectations and understanding could be essential in influencing their interactions with surrounding environments, saying 'when people expect traffic to be heavy, they tend to adapt to it and tolerate it. When they expect it to be safe, a hot-rodder can be especially dangerous.' Knowing peoples' restorative expectations were extremely important in the urban street context, since it is not a conventional type of restorative environment and it undertakes multiple roles in urban outdoor life. Environmental design appraisal has always been focused on design, first starting from a building performance assessment (Küller, 1972) and later developed into a wider context. Although the four components of ART were initially proposed two decades ago (Kaplan 1983), the development of measures for these components has only recently been addressed. Measures of restorative qualities have long been regarded as useful for practical purposes since some have recognised the value of translating restorative environment theory into design options (Kaplan, Kaplan and Ryan, 1998; Cooper, Marcus and Barnes, 1999). It could also be used to assess the restorative potential of existing and proposed settings, and so, inform various kinds of design efforts (Hartig et al., 1996). Investigating users' expectations was similar to common design evaluations, but with a scenario approach asking participants to imagine an perfect setting as experimental stimuli.

This stage of research started with a review-based discussion on the developed instruments for measuring environmental restorative potential to select an appropriate one for this research, among which the Restorative Components Scales by Laumann et al. (2001) appeared to be the most appropriate one in the application of measuring street restorative quality according to the following selection criteria: 1) whether its accuracy had been validated; 2) what environment it had been tested on and whether it would be applicable for urban street settings; and 3) whether four ART components were worded consistently and were worded in a way that people with no professional knowledge could understand. The first pilot study, therefore, was designed using the RCS to see: 1) if it was efficient for measuring streetscape restorative quality, and 2) if it was sensitive when measuring people's expectations on street restorative quality of varying street types. Results suggested that: 1) street restorative quality could be measured using the RCS though some inefficiencies existed, and 2) the RCS was sensitive in differentiating restorative expectations within street types, which also indicated that people had different restorative expectations on different types of street. Findings in the pilot study suggested that people's expectations of restorative quality were measurable and therefore confirmed that this study started out in the right direction.

Following the RCS proved to be useful under this research context in the pilot study. A formal survey using the same method and similar procedure was conducted to collect information on what expectations street users had in terms of having restorative experiences in different types of street settings. Results of the formal survey were basically in line with pilot study findings with only one aspect of obvious difference emerging. Results suggested that users expected the highest restorative quality in Landscape and Leisure Street, while the lowest expectations were expressed for Traffic-oriented Street. People's expectations on Commercial Street and Living and Service Street were very close and tangled with each other on several ART components. Results in this stage indicated that street design efforts should be concentrated on making up the difference between current street restorativeness and users' expectations. As for perceptive differences that were mentioned in several studies (Scopelliti and Giuliani, 2004; Berto, 2007; White et al., 2010) as potential influential factors within groups of different backgrounds, this research found that in general no significant difference existed between age groups, gender groups, professional relevance groups, income level groups or education level groups, with only several slightly different RCS items appeared in the former three.

This stage of research attempts to investigate people's restorative expectations on four different street types as proposed in the Shanghai Street Classification System, which could be used for informing necessary design implications to improve street restorative quality. This comes from an assertion that streets are places where diverse traffic and social activities encounter each other and hence, each street should have its own specific emphasis. A balance should be achieved between restorative quality and other traditional qualities of streets. Critical research findings in this stage include: 1) RCS, among other developed restorative measurements, has been shown to be appropriate in investigating restorative expectations under urban street contexts, and 2) users' expectations of having restorative experiences in street environments evidently vary with street types, with Landscape and Leisure Street expected to be the highest and Traffic-oriented Street to be the lowest. Restorative expectation results based on street types provide us a baseline, so that the necessary improvements on case-study streets can be developed according to the street types each of them belongs to. However, a significant limitation existed in this stage is that the RCS was originally developed to find out whether and how much a certain street setting was perceived as restorative but is unable to identify street characteristics that could contribute to environmental restorativeness. Therefore, there still isn't a coherent way to apply these expectations into design practices. This revealed a necessity to bridge restorative perceptions and street attributes, which is another existing gap this research intends to overcome. Therefore, the next step of this research contains two purposes, the first one is to build up an evaluation framework composed of street design elements that are potentially associated with users' restorative experiences, and the second one is to establish the relationship between the evaluation framework composed of restorative related street indicators with users' restorative perceptions. By achieving the above two purposes, the final aim of delivering a Restorative Street Design Approach (RSDA) to make streets as restorative as people's wishes becomes possible.

CHAPTER 6 DEVELOPING RESTORATIVE STREET DESIGN FRAMEWORK

6.1 Introduction

It was proved in the previous chapter that users' expectations of restorative street settings can be measured by the Restorative Component Scale (RCS), and these restorative expectations vary with street type in terms of four ART components: *being away, fascination, extent, and compatibility.* Differences in restorative expectations can be supported by Kaplan's explanation of ART, asserting that environments vary in their levels of each of the four components, thus altering the overall restorative quality of each environment; it is the presence or absence of high levels of the four components that together determine whether an environment is restorative (Kaplan, 1995). The efficiency of RCS in measuring street restorative potential is an important first step in this research, since the valid measurement of environmental restorative effects could help efforts to link theoretical factors to specified outcomes experienced in different settings (Hartig et al., 1997b). However, the results obtained with RCS, reported in Chapter 5, are restorative perceptions that can hardly be employed in instructing street design practices. Information about restorative effects that is based solely on perception is not useful unless its relationship with street design attributes is established. Therefore, this chapter aims to overcome this central gap from a different perspective of street design attributes.

The fundamental work in designing restorative street settings is to know what physical aspects and key attributes of streets to deal with (Ivarsson and Hagerhall, 2008). In order to fulfil this requirement, a relationship between restorative experiences and urban streetscape must be established. As discussed earlier (see Chapter 3.2), this stage of research starts with identifying evidence from existing studies to gather potential environmental indicators that may have relevance to street restorative benefits. These potentially relevant indicators are then validated with the help of RCS, and those proved to be efficient in the street setting are formed into a framework – Street Restorative Measurement Framework (SRMF). SRMF, therefore, is a framework composed of restorative related street design indicators and their established relationship with restorative perceptions. It is an essential mid-product towards achieving the final aim of delivering the Restorative Street Design Approach, since it is expected to be a bridge between restorative perceptions and environmental attributes, and hence tells us which street indicators are relevant to promoting restorative benefits and how they can be moderated for enhancing the benefits of restorative street design.

This chapter begins with a brief on the overall procedure of developing the SRMF and then attempts to establish its connection with restorative perceptions. Following this, it depicts the process of constructing the preliminary framework (SRMF 1.0) through discussion based on a literature review; this is later validated and refined with another pilot study based on a case study of four selected streets in Shanghai (see Chapter 4). Independent of the study introduced in Chapter 5 that piloted RCS to test its effectiveness in a street context, this pilot study explores another angle of this research with the purpose of validating and refining the preliminary framework (SRMF 1.0) to produce a framework composed of restorative-related street indicators (SRMF 2.0). Following this is a major step in achieving the final SRMF: establishing relationship between SRMF 2.0 indicators and restorative perceptions measured with RCS, through an on-site survey conducted in Shanghai. This led us to the final framework which contains both the street indicators particularly relevant to people's restorative experiences as well as the exact restorative influences of each SRMF indicator. To conclude, the first two versions of this framework, SRMF 1.0 and SRMF 2.0, only include restorative related street design indicators, while the final SRMF is composed of street indicators and their relationship with restorative perceptions. This chapter ends with a summary of the final SRMF, discusses how this framework can contribute to forming the Restorative Street Design Approach, and eventually helps proposing restorative street design principles for selected Shanghai case-study streets.

6.2 Overall Structure of Developing SRMF

In general, the construction of the SRMF is a process of exploring and establishing the links between specific street design indicators and street restorative qualities. It is a fundamental component of the final research product and also a significant evaluation framework that can function independently. The construction of the SRMF includes three steps (Figure 6-1). The first step is a literature-review-based discussion exposing direct and indirect evidence on what might influence the restorative benefits of street environments. Given that very limited attention has been paid to street settings in restorative environment research, this study extends the scope of the literature review which is clarified in the next section. The expected outcome of this step is a preliminary framework (SRMF 1.0) composed of potential restorative related environmental indicators identified from existing literature. These indicators must be validated under the specific research context of urban streets, informing the exact next step towards finalising the SRMF.

According to this research, a pilot study using an on-site questionnaire is designed to validate whether these indicators in SRMF 1.0 are applicable in presenting restorative effects for street settings. SRMF 1.0 indicators are developed into questionnaire items targeting street environments on the basis of their originally studied context. They are then evaluated by real street users recruited on-site of case study streets. The on-site pilot study is also expected to discover whether there are any additional indicators that people believe might contribute to promoting restoration, but have been missed in existing research literature or in the process of reviewing relevant literature. The expected outcome of this step is a refined framework (SRMF 2.0) composed of validated indicators that are associated with people's restorative experiences while walking in street environments.

The last step in this stage is to reveal the specific associations between street restorative benefits and SRMF 2.0 indicators and to point out the mechanism of influence of these indicators in facilitating or inhibiting the restoration process in the context of four case-study streets. Given that a street's restorative quality was proved to be measurable in a previous pilot study (see 5.3) using a developed measurement scale, RCS, RCS is therefore used together with SRMF 2.0 in the formal survey to establish the relationship between indicators in SRMF 2.0 and restorative perceptions. Their associations are explored using the correlational analysis. The result of this step is expected to show which SRMF 2.0 indicators influence restorative perceptions and how they do so. By the end of this stage, the final SRMF, which includes street restorative indicators and their effects on delivering restorative experiences, is constructed. The pilot study and the formal survey in this stage are both conducted within the context of four case-study streets in Shanghai.

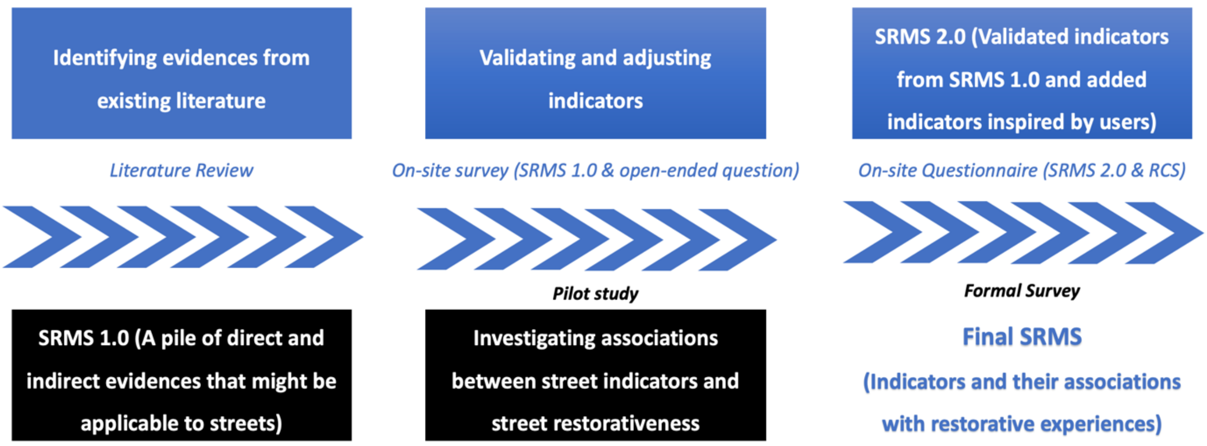


Figure 6- 1 Overall structure and the process of developing SRMF. Source: the author.

6.3 SRMF 1.0 – Identifying Potential Restorative Related Indicators from Literature

The restorative streetscapes this study seeks to deliver may be achieved via multiple transmission pathways by which the components of streetscapes influence the delivery of restorativeness. To identify these pathways, we must first rely on the available literature. Given that very limited studies (Lindal and Hartig, 2013, 2015; Xu et al., 2019) have directly considered the street attributes that can promote or hinder restoration, this part of the literature review expands its focus to consider both natural environments and other types of urban settings. Research on restorative environments has proceeded along several lines. The three that are most relevant are reviewed in this section as they provide evidence in response to the interactions between restorative experiences, preference and place identity discussed in Chapter 2 (Figure 6-2).

The first line of research directly focuses on how environmental attributes promote or inhibit restorative experiences. The second expands into landscape preference literature since it has been demonstrated that people's environmental preferences are influenced by their restoration needs and their beliefs on where restoration can best take place. The third line of research departs from the perspective of 'place identity', which stresses that restorative experiences feature in the emotion- and self-regulation processes through which individuals develop place identity (Korpela, 1991). To conclude, direct evidence in the first line of restorative environmental literature and indirect evidence from the other two lines of related literature, including relationship between environmental attributes with preference and with place identity, are both reviewed and generalised in this chapter as a basis of the Street Restorative Measurement Framework (SRMF).

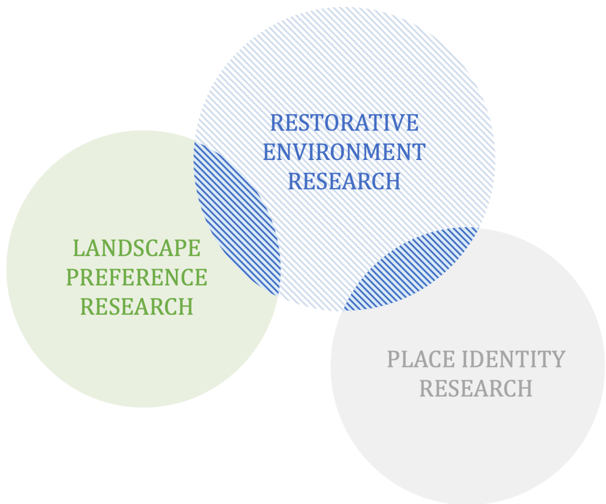


Figure 6- 2 The overlaps between restorative environment, landscape preference and place identity. Source: the author.

The people–environment relationship is a rather complicated theme integrating multi-disciplinary knowledge (Ewing and Clemente, 2013). Strictly speaking, ART components (*being away, extent, fascination and compatibility*) are properties of a person–environment interaction rather than of an environment per se (Kaplan, 2001). Overall, restorativeness is a general outcome that is influenced not only by individual reactions but also by their cumulative and interactive effects. There is certain research has contributed to distinguishing different levels of environmental attributes. The consecutive efforts of Ewing and his colleagues on moving from highly subjective definitions to operational definitions that capture the essence of each urban design quality, clearly explain the relationship between physical environmental attributes, urban design qualities and individual reactions. Every physical feature of the built environment contributes to the formation of certain urban design qualities, but they are more than the individual physical features they comprise as they have a cumulative effect that is greater than the sum of the parts (Ewing et al., 2013). In addition, the distal and proximal cues proposed by Fischl and Gärling (2008) present similar differentiations with the former consisting of environmental components, the quality of which are perceived directly but manifested in the measurable characteristics of the setting, while proximal cues are the subjectively appraised impressions of the distal.

The major challenge in constructing the SRMF for measuring environmental restorativeness is to comprehensively contain all the perspectives of the influences within the considerations of their overall effects, and then to logically organise each identified indicator to form the SRMF. In December 2018, the researcher started the first round of the systematic search for relevant literature, using the University of Sheffield database, the Scopus database and the Google Scholar search engine, to identify books, peer-reviewed journal articles and open-access reports. The second round of the literature search was based on their reference lists. Over 200 papers and studies containing direct and indirect themes regarding environmental design dimensions and their relationship with restoration, preference and place identity were reviewed. It can be concluded that the emerging evidence from this review process contains the existing efforts on different levels of environmental characteristics. This research decided to categorise them into urban design qualities and environmental contents, referring to Ewing and Clemente's classification principle, since it is more straightforward and accessible than other forms of classification. It is necessary to highlight here that the organisation of the following sections that relate to Ewing et al's categorisation levels (2013) is only for the convenience and clarity of presenting the relevant evidence and hence has no practical influence on either the SRMF structure or its contents.

6.3.1 Direct evidence: the relationship between restoration and environment

This subsection reviews evidence from the restorative environment literature to reveal established connections between environmental attributes and restorative quality. It was found that many attempts have been made to identify environmental attributes and elements that can facilitate restoration. However, there have been limited efforts in relation to the street context. The procedure for constructing the SRMF model is to firstly identify all the potential restorative indicators that have been proven to correlate with environmental restorative quality in earlier literature, regardless of their original environmental contexts. Validation will be carried out afterwards to exclude those that are not sensitive and applicable to urban streets. Potential restorative indicators found in this literature can be generalised into two categories, those that belong to urban design qualities and those that belong to environmental contents. The following is a list of short paragraphs describing each environmental indicator directly related to restoration and the relevant evidence found in the previous research. All direct evidence discussed in this section are then summarised in Table 6-1.

- Potential indicators describing urban design qualities

Seven indicators of urban design quality relevant to environmental restorative experiences have been identified in existing restorative environment research, including ***openness***, ***complexity, visual depth, mystery, enclosure***, ***upkeep*** and ***familiarity***.

Openness. Openness refers to how open a setting appears to be (Harzog et al., 2003). The panoramic value of places, in turn, includes the dimension of openness (see Nasar, 1997) and supports the exposition of natural scenes that can lead to an increase in the level of restorativeness (Hartig et al., 1996). Its wider meaning, spaciousness, contains the dimensions of openness as well as visual pleasure and ease of movement. Openness and ease of movement are proved to be effective indicators of Perceived Restorative Potential (PRP, a measurement scale of environmental restorative quality), with openness being a negative indicator and ease of movement a positive one (Herzog et al., 2003). However, a positive association was confirmed (Galindo and Hidalgo, 2005) between openness (which can imply a lower level of enclosure) and the components of *being away* and *fascination*. But direct evidence also suggested that perceived restorativeness was higher inside forests with a view that was closed to the urban matrix compared to semi-closed and open views (Hauru et al., 2012).

Complexity The basic definition of complexity is the number of elements presented in the immediate environment (Herzog et al., 1982) and more particularly as the 'noticeable difference' between elements (Rapoport and Hawkes, 1970, p. 109). In later literature, it is more oftenly described as the richness or diversity of the immediate setting (Herzog, 1989). A moderate level of complexity is believed to be the most restorative (Fredrickson and Levenson, 1998; Shapiro et al., 2001). However, complexity is not a cue that is evident in the restorative environment literature, though many previous studies have involved nature scenes with different levels of complexity as stimuli. Rather than focusing on the overall complexity of certain scenes, existing literature concentrates more on the complexity of certain parts within a setting, normally presented as the value of entropy. For example, Lindal and Hartig (2013) found that increasing the details of the façade and overall variations at the streetscape level created circumstances that promoted a sense of *being away* (Lindl and Hartig, 2013).

Visual Depth Moderate depth can evoke positive emotions, sustain non-vigilant attention, restrict negative thoughts and so aid the return of autonomic arousal to more moderate levels (Fredrickson and Levenson, 1998; Shapiro et al., 2001).

Mystery This refers to those features of an environment that promise that there is more to be seen and encourage one to walk deeper into the environment (Kaplan, 1987). An intricate spatial layout may induce a sense of mystery and suggest an opportunity for exploration (Kaplan and Kaplan, 1989).

Enclosure A sense of enclosure in the urban environment can be generated with unbroken blocks of buildings that represent the walls of an outdoor room in which the streets and sidewalks represent the 'floor' and the sky the 'ceiling' (Ewing and Handy, 2009). It has been described as the degree to which 'streets and other public spaces are visually defined by buildings, walls, trees, and other vertical elements' (Ewing, 2013, p.3). Though Kaplan (1995) believes that enclosure, both visual and physical, can create a feeling of entering a whole other world, which could trigger restorative experiences, later research found opposite conclusions. Research by Lindl and Hartig (2013) indicates that greater building height affects restoration likelihood negatively since higher buildings reduce the sense of *being away*, which in turn reduces the expectation that restoration will take place.

Upkeep Poor management of parks was found to be a cause of lower restoration likelihood (Nordh and Østby, 2013).

Familiarity Location familiarity has been proven to be an impact on PRP (Hartig and Staats, 2006) and restoration (Korpela et al., 2008).

- Potential indicators describing environmental contents

Seven indicators of environmental content relevant to restorativeness are provided below with evidence from previous research, including ***naturalness, waterscape, visual landmarks, the presence of other people, history, quietness*** and ***traffic.***

Naturalness The benefit of nature facilitates restorative environment research. A huge body of evidence has been provided in earlier studies confirming the potential of nature in promoting psychological recovery. For example, views of nature from a window at home or in the workplace (Ulrich et al., 1991; Kaplan, 1993, 2001; Tennessen and Cimprich, 1995), or just a glimpse of a small park on the way to work (Whyte, 1980), might have a positive influence on human mood and in that way lead to an increase in psychological health. Even small urban green spaces may have substantial restorative value (Kaplan, Kaplan and Ryan, 1998). Previous research (Nordh et al., 2009; Nordh and Østby, 2013) tries to identify components in small urban parks that correlate with restoration likelihood. Variables that are most predictive of the restoration likelihood are the presence of grass, bushes and trees. ART component, *being away*, was found to be strongly influenced by the presence of these elements (Nordh et al., 2009), while a park containing these features also is likely to offer some enclosure (Dee, 2003). Their findings are in line with the claim that the greener or more 'natural' the outdoor environment, the better it is likely to be for restoration (Kaplan, 1995). In another study using an eye tracking device, Nordh, Hagerhall and Holmqvist (2013) found that grass was significantly positive for restoration likelihood, which is in accordance with their previous findings (Nordh et al., 2009; Nordh and Østby, 2013). The findings of Wang et al.'s (2016) study on Chinese parks also support previous research and theory suggesting that contact with natural dominated spaces can lead to perceived stress recovery, enhanced attention restoration and positive physiological responses. Ratings for restoration likelihood increase with the increase in the number of street trees and the presence of flowers beds (Lindl and Hartig, 2015). The presence of natural elements along streets was found to be able to promote restorative perceptions in urban environments (Todorova et al., 2004; Lindl and Hartig, 2015), which is also in accordance with the assertion by Thwaites, Helleur and Simkins (2005) that streets with a dense network of small, well-designed public spaces, serve the restorative needs of people in high-density urban environments.

Waterscape It has been noted in numerous studies that water is a preferred attribute both in nature and the urban environment since it is perceived as calming, soothing and comforting (Ulrich, 1984; Kaplan and Kaplan, 1989; Heerwagen and Orians, 1993). Water is believed to be capable of replenishing cognitive energy and is a component that usually gives high scores on both preference and restorative quality (Schroeder, 1982; Ulrich et al., 1991; Korpela et al., 2001; Purcell et al., 2001; Laumann, Gärling and Stormark, 2003; Berto, 2005; Regan and Horn, 2005). Though the role water plays in our psychological health is far less obvious than in our physiological health (White et al., 2010), it seems reasonable to presume from an evolutionary perspective that we have evolved preferences for aquatic environments since they provide the fresh water we need to survive. In explorations on the relationship between restorative potential and environmental preference, Wilkie and Stavridou (2013) also found evidence suggesting that locations with pleasant waterscapes were considered potentially more restorative than ones containing negative imagery or those without water. Some indirect evidence also proved that water has long fascinated human beings (Herzog, 1985; Kaplan and Kaplan, 1989). Participants in Purcell et al.'s (2001) study ranked 'lake' scenes as the most preferable and restorative, if not the most familiar, landscape. Of Berto's (2005) 25 restorative images, 76% contained water while water was present in only 8% of non-restorative scenes. And of the six landscape posters used by Kweon et al. (2008) to reduce anger and stress at work, five were of aquatic scenes. The highest-ranked forest scenes in Han's (2003) Restorative Scales validation research contained water as well. Felsten (2009) noted that 'natural murals, especially those with water, were more restorative' (p. 160). Nordh et al. (2009) found that small urban 'pocket parks' containing water were rated as more restorative, in terms of the ART components of *being away* and *fascination*, than those without water. Finally, although not predicted, Karmanov and Hamel (2008) found an urban scene with a large amount of water was generally rated positively as a rural green space.

Facilities Not too many studies have been directly focused on the role that environmental facilities play in promoting the restoration process. However, the presence of benches in small parks has been proven to be positively correlated with restorative experiences (Nordh, Hagerhall and Holmqvist (2013), while seats and sculptures were found (Abdulkarim and Nasar, 2013) to be promising in making places more restorative.

Visual Landmarks It has been suggested in the literature that visual landmarks facilitate orientation and therefore provide a sense of ease and rest (Kaplan, Kaplan and Ryan, 1998) that can promote restoration. They are also important determinants of perceived attractiveness and interestingness (Karmanov and Hamel, 2006) that may lead to restoration.

The Presence of Other People Appleton (1975) suggested that being able to see others without being seen or disturbed may affect people's ability to relax. Findings in later studies (Staats and Hartig, 2004; White et al., 2010) prove that the presence of other people can aid restoration as long as they are not threatening. However, the presence of other people is found to be related to disturbances in a study of pocket parks (Nordh and Østby, 2013), which would lead to lower restoration likelihood ratings.

Historic-ness Historical settings emerged as high-quality and highly restorative environments that can both promote restorative experience and evoke the feeling of pleasantness and relaxation. (Scopelliti and Giuliani, 2004; Galindo and Hidalgo, 2005; Fornara and Troffa, 2009).

Quietness This is a visual aspect of environment related to hearing disturbance. A study of pocket parks (Nordh and Østby, 2013) confirmed that lower levels of quietness lead to lower restoration likelihood ratings.

Traffic Significant surrounding traffic has been proven to be negatively correlated with restoration likelihood (Nordh and Østby, 2013; Lam et al., 2005) under the research context of pocket parks.

- Other potential restorative related factors

Restoration is a complex pattern that involves affective, cognitive, social and behavioural aspects interacting with the physical features of places (Scopelliti and Giuliani, 2004; Staats and Hartig, 2004). Not too much research has been done on the role of social context in promoting restoration, but literature is beginning to appear on this subject (Staats et al., 2004; Cole, 2010; White et al., 2010; Korpela and Staats, 2014). Six social background indicators, including ***weather, setting size, visit duration and frequency, life stage***, ***being alone or with company*** and ***experimental stimuli,*** have emerged in the literature that correlate with restoration. These are not environmental attributes (hence will not be included in the SRMF) in urban street settings but are still important factors influencing people's perceptions. Therefore, these social factors should be treated as control variables in later validation on SRMF 1.0.

Weather It has been found in previous studies that perceived weather is tightly associated with perceived restorativeness and the level of perceived restorativeness, as well as related factors, such as decreased air quality, both perceived and objective (Hipp and Ogunseitan, 2011). It was found that the warmer the temperature, the less the environment was rated as psychologically restorative, which might be due to an associated loss of physical comfort (Zacharias et al., 2004; Thorsson et al., 2007).

Setting size The relationship between the size of a setting and its restoration likelihood has only been found in a study on small urban parks (Nordh et al., 2009) in which it was suggested that the bigger the park, the better it was for psychological restoration. However, a later study provided inconsistent results suggesting that the likelihood of restoration is not only a matter of park size but also of park design (Nordh et al., 2009).

Visit duration and frequency With a prerequisite for acknowledging that nature is restorative, previous studies reported a positive linear relationship between the frequency of visiting nature and promoting restoration (Hansmann et al., 2007). In terms of visit duration, White et al.'s study echoed some earlier results (Hansmann et al., 2007; Barton and Pretty, 2010) indicating that feelings of restoration were positively associated with the length of stay, but with a more complicated quadratic effect with higher restoration for both relatively short and long visits (Barton and Pretty, 2010).

Life stage Scopelliti and Giuliani (2004) found that the general restorativeness score of the natural environment was lower in the elderly than in young adults and adolescents. However, Berto (2007) found similar restorative ratings between the elderly and young adults. Feelings of restoration were lowest among those aged 16–24 (White et al., 2010), which is consistent with research suggesting that the restorative properties of nature may be lowest during the years of late adolescence (Kaplan and Kaplan, 2002). These variations are explained by the difference in expectations and needs between individuals as well as within a person over time (e.g., Kaplan, 1995). People's perceived environmental restorative qualities are therefore not constant (Hauru et al., 2012).

Being alone or with company Staats and Hartig (2004) found that company can also enable psychological restoration and their study participants preferred to have company while during a forest walk. However, when perceived safety is assured, this preference may decrease (Staats et al., 2004; Korpela and Staats, 2014).

Experimental stimuli Real outdoor settings have been proven to be more effective in triggering restorative perceptions than using visual simulations, such as videos (Kjellgren and Buhrkall, 2010; Gatersleben and Andrews, 2013) and 3D modelling (Xu et al., 2019), of real settings in laboratory environments.

Table 6- 1 Direct evidence of restorative indicators

Street Qualities	Existing Evidences	Literature	Street Contents	Existing Evidences	Literature	Social Factors	Evidences
Openness	A positive relation was found with restoration	Hartig et al, 1996; Herzog et al., 2003; Galindo and Hidalgo, 2005; Hauru et al., 2012	**Naturalness**	A positive relation was found with restoration	Ulrich et al., 1991; Kaplan, 1993, 2001; Tennessen and Cimprich, 1995; Hartig, 2007; Nordh et al., 2009; Nordh and Østby, 2013; Todorova et al., 2004; Lindl and Hartig, 2015	**Weather**	Hipp and Ogunseitan, 2011; Thorsson et al., 2007; Zacharias et al., 2004
Complexity	The more moderate the better for restoration	Fredrickson and Levenson, 1998; Shapiro et al., 2001; Lindal and Hartig, 2013	**Waterscape**	A positive relation was found with restoration	Schroeder, 1982; Herzog, 1985; Kaplan and Kaplan, 1989; Ulrich et al., 1991; Korpela et al., 2001; Purcell et al., 2001; Laumann et al., 2003; Berto, 2005; Regan and Horn, 2005	**Setting size**	Nordh et al., 2009
Visual depth	An inverted-U relation was found with restoration	Fredrickson and Levenson, 1998; Shapiro et al., 2001	**Landmarks**	A positive relation was found with restoration	Karmanov and Hamel, 2006	**Visit duration and frequency**	Barton and Pretty, 2010; Hansmann et al., 2007
Mystery	A positive relation was found with restoration	Kaplan and Kaplan, 1989	**People**	An inverted-U relation was found with restoration	Staats and Hartig, 2004; White et al., 2010; Nordh and Østby, 2013	**Life stage**	Kaplan and Kaplan, 2002; Scopelliti and Giuliani, 2004; Berto, 2007; White et al. 2013
Enclosure	A negative relation was found with restoration	Kaplan, 1995; Lindal and Hartig, 2013	**historicness**	A positive relation was found with restoration	Scopelliti and Giuliani, 2004; Galindo and Hidalgo, 2005; Fornara, 2009; Fornara and Troffa, 2009	**Being alone or with company**	Coble et al, 2003; Herzog and Rector, 2009; Staats et al., 2014; Korpela and Staats, 2014
Upkeep	A positive relation was found with restoration	Nordh and Østby, 2013	**Quietness**	A positive relation was found with restoration	Nordh and Østby, 2013		
Familiarity	A positive relation was found with restoration	Hartig and Staats, 2006; Korpela et al., 2008	**traffic volume**	A negative relation was found with restoration	Nordh and Østby, 2013; Lam et al., 2005	**Experimental Stimuli**	Kjellgren and Buhrkall; Gatersleben and Andrews, 2013
			Facilities	A positive relation was found with restoration	Nordh et al., 2013; Abdulkarim and Nasar, 2013		

6.3.2 Indirect evidence: the relationship between preference and environment

Environmental preference is often defined as 'liking' (Peschardt and Stigsdotter, 2013) or finding locations aesthetically pleasing (Hartig and Staats, 2006). It is considered to be the result of PRP, according to which certain locations restore depleted cognitive resources (van den Berg et al., 2003). Environmental restorative benefits have also been regarded as a convincing reference for preference judgements on different scene types (Purcell et al., 2001). Although there is little information that specifically points to the attributes of physical environments affecting restoration and judgements of restoration likelihood (Lindl and Hartig, 2013), previous research has uncovered strong and clear associations between preference and judgements of restoration likelihood (Purcell et al., 2001; Laumann, Gärling and Stormark, 2003; Staats, Kieviet and Hartig, 2003; Berto, 2008; Ivarsson and Hagerhall, 2008). Therefore, it is also necessary to look at the environmental preferences literature to further uncover evidence of physical attributes that could affect the restorative experience in urban settings through the mediator 'preference'. The significance of turning to the preference literature in the following sections is that it helps develop the SRMF in identifying possible restorative indicators in addition to the relatively limited 'direct evidence' existing in the first line of research. Evidence identified in the preference literature is generalised under three sections similar to the structure of 6.3.1 and all the indirect 'preference' evidence discussed in this section is presented in Table 6-2.

- Potential indicators describing urban design quality

Eleven indicators of urban design quality relevant to environmental preference judgement are identified in the existing preference research, including ***complexity, openness, enclosure, coherence, visual depth, mystery, familiarity, upkeep, unity, legibility and typicality.***

Complexity Sufficient evidence has been found in existing literature suggesting that people's perceived complexity is strongly associated with preference for both natural and urban scenes. In Kaplan and Kaplan's (1982) framework of environmental preferences, perceived complexity is considered an important determinant of preference since it encourages people's inclination for exploration and enhances a sense of involvement. Ulrich (1983) proposed complexity as a key determinant that influences the liking of unspectacular natural scenes. In an attempt to predict preference judgements from geometrical properties of residential façades, the most important factor influencing visual preference also turned out to be the surface complexity (Stamps, 1999). Normally, complexity is believed to work closely with coherence to prevent a disturbing visual sequence. The high complexity of urban areas was proved to be an important determinant of perceived attractiveness and interestingness (Karmanov and Hamel, 2006), while a necessary prerequisite of being highly coherent was also proposed (Herzog, Kaplan and Kaplan, 1982). Mixed results for the relationship between preference and complexity have been reported in previous studies. A positive linear relationship has emerged in most of the relevant research within the content categories (Kaplan, Kaplan and Wendt, 1972). Herzog et al. (1976) identified in their research that in terms of familiar urban scenes, there is a positive relationship between complexity and preference. A linear relationship between diversity and preference also appeared in Nasar's research (1984), suggesting that participants in Japan and America preferred complex urban scenes. Later, in another of Herzog's (1992) attempts to identify preference in urban spaces, well-structured, relatively complex urban spaces were found to be preferred to less visually stimulating areas. Particularly with street scenes, a clear preference for a street environment that is interesting rather than bland, a factor which might seem to have a bearing on perceptions of complexity, was uncovered in Nasar's (1988) study of visual preference. In contrast, Stamps (2004) found a negative relationship between preference and complexity. There is also considerable research pointing to an inverted-U relationship (Day, 1967; Vitz, 1966; Imamoglu, 2000). For example, in a study targeted at residential streetscapes (Lindl and Hartig, 2013), an inverted-U relationship was discovered between perceived complexity and preference. In contrast, Stamps (2004) found a negative relationship between preference and complexity.

Openness The concept of openness has been defined as the ease of physical and visual access (Gallagher, 1977; Kaplan, 1987; Stamps, 2005a) or as the feeling of space to wander (Herzog, 1992). It was reported by Gallagher (1977) as a negative contributor to preference. Anderson (1978) defined openness somewhat differently as 'perceived or experienced depth', but also as a negative aspect of preference. Herzog's (1989) study, however, reported a positive relation. Kaplan (1987) proposed in his preference framework that people should like openness because visual connections might encourage movement and evoke pleasure through the exploration of space and it does not conceal any unexpected threats ahead (Nasar and Fisher, 1993; Nasar and Jones, 1997). This is in line with Appleton's (1996) prospect–refuge theory that assumes that environmental preferences are strongly influenced by the innate instinct for survival developed during earlier stages of human evolution.

Enclosure Herzog (1992) found that his participants tended not to like large, unstructured, open spaces, just as they tended not to like enclosed settings and blocked views. They mostly preferred a category with smaller spaces that were well-structured in depth. These results suggest that moderate levels of enclosure are preferred over both very low and very high levels. This finding echoes earlier studies proposing that environments that offer a balance of both outlook and enclosure would be most preferred (Appleton, 1975). Similarly, Alkhresheh (2007) took safety and sense of comfort as preference indicators and showed that they had an inverted U-shaped relationship with the degree of enclosure in streetscapes, as manipulated by the ratio between building heights and street width (ranging from 1:6 to 6:1). Similar results were also reported in Lindl and Hartig's (2013) study on residential streetscapes. These results were, however, obtained with images of streets without a building at the end to block the view. But Stamps (2005a) has reported that the depth of view strongly affects perceived enclosure in a negative way – the greater the depth, the lower the sense of enclosure.

Coherence Coherence has been established as having a close relationship with strong effectiveness and preference (Kaplan and Kaplan, 1989). It refers to the degree of order or structure present in the immediate environment (Herzog, 1984) or the degree to which a scene hangs together or makes sense (Kaplan and Kaplan, 1989). In many cases, coherence and related components, such as order, organisation, legibility, coherence and fittingness, are related to environmental preference (Lowenthal and Riel, 1972; Ertel, 1973; Kaplan, 1975; Wohlwill, 1978). However, the effectiveness of coherence on influencing preference is not consistent within previous studies. Kaplan (1975) found it was not relevant to preference in nature scenes, while in some other studies (Gallagher, 1977; Anderson, 1978), it has been successfully proved to be positively related to preference, particularly for rivers and riverside environments (Kaplan, 1977). People should like order because it helps them make sense of what is going on (Kaplan,1987) and, indeed, most studies confirm a preference for variables linked to organisation (such as order, coherence, fittingness, congruity, legibility and clarity). In a study using photos of architectural exteriors from around the world, Oostendorp and Berlyne (1978a) also confirmed a positive relationship between preference and order. In another study of preference within four settings (older buildings, concealed foreground, tended nature and contemporary buildings) conducted by Herzog (1989), coherence was found to be able to predict preference even independently of category differences.

Visual Depth This is defined as the extent to which the environment depicted gives the impression that 'it is a long way to the bottom' and emerged as a significant indicator of preference in its own right in Herzog's study investigating the relationship between mystery, danger and preference (Herzog and Smith, 1988). Early in Ulrich's (1983) study, he noted that a nature scene should be preferred if there is a moderate to high level of depth that can be perceived unambiguously. It has also been suggested in a comparative study exploring landscape preference of real versus photographed scenarios that 'depth of field of vision' was a dominant characteristic influencing many preference decisions (Bemáldez et al., 1988). However, the consistency of the result was not proved in Stamps' (2007) study. His findings suggest that short views of the built environment (looking at small shops) were preferred over distant views (of large malls), while for natural environments the depth of view (or degree of prospect) did not influence preference ratings.

Mystery This refers to the extent to which the environment seems to promise further information if the observer could walk deeper into it (Herzog, 1984), which is regarded as one of the most significant indicators of preference (Woodcock, 1984; Kaplan and Kaplan, 1989; Herzog, 1989). Early in Cullen's 'Townscapes' (1961), he suggested that mystery could be a powerful factor in the urban scene. Studies found strong support for the role of mystery in the prediction of preference in both the built (Herzog and Miller, 1998) and the natural environment (Kaplan, 1975; Gallagher, 1977; Ulrich, 1977; Kaplan and Kaplan, 1978, 1982; Herzog, 1984; Kaplan, 1987). Positive relationship between mystery and preference are also reported by Herzog and Smith (1988), and later again confirmed by Hagerhall (2000) who proves that preference is related to whether or not the landscape is interesting to explore (mystery). However, two studies conducted by Stamps (2007, 2008) presented contrary results suggesting the negative effect of mystery. Later mystery-preference studies, with a more detailed focus, found certain environmental attributes, such as curving pathways, partial concealment and shadows, to be the kinds of features that would enhance mystery (Gimblett et al., 1985; Hammitt, 1980; Ruddell et al., 1989).

Familiarity Even though the sense of familiarity evoked by a setting has been selected as an indicator of preference (Herzog, Kaplan and Kaplan, 1976, 1982; Oostendorp and Berlyne, 1978a; Garling, 1976; Herzog, 1984), the exact impact of familiarity in influencing environmental preference remains unclear. It seems from existing literature that the role familiarity plays in preference is influenced by many other factors, such as lifespan (age) and scene types (Jacobsen and Beudt, 2017). Sonnenfield (1966) found that young people preferred exotic natural scenes, while others preferred familiar scenes. Canter and Thorne (1972) found that residents of Scotland and Australia preferred foreign to native urban scenes. This factor was also significantly and positively related to preference for two of the three types of scene in a study of field and forest environments (Nasar, 1989). Herzog, Kaplan and Kaplan (1976) found that familiarity was an effective indicator for preference ratings, though slight inconsistencies appeared within scenes containing different contents. For example, the sense of familiarity emerged as an effective indicator in his study (Herzog, 1985) of preference for waterscapes. Dearden (1984) found that familiarity with landscape types appeared to have a positive relationship with landscape preference. In the study of Whitfield (1983), preference was found to be positively correlated with typicality and negatively correlated with novelty/unfamiliarity. It would be interesting to study what it is that makes certain designs gain in preference as they become more familiar while, for others, preference declines when the initial novelty begins to wear off (Herzog, Kaplan and Kaplan, 1976). However, familiarity was found neither in relation to the perceived restorative value of a place nor preference in Purcell et al.'s (2011) research.

Upkeep People should prefer well-kept to run-down environments because of the higher status associated with well-kept environments and because they offer a sense of safety (Duncan, 1973;

Marans, 1976). Run-down environments convey cues to a breakdown in the social order (Perkins and Taylor, 1996). Both theory (Nassauer, 1995) and previous research (Herzog and Miller, 1998; Herzog and Chernick, 2000) have implicated this kind of variable in accounting for preference and security reactions. Earlier studies found that well-maintained walking surfaces (e.g., pavement quality, absence of litter and graffiti) are positively related to perceived attractiveness for walking (Booth et al., 2000; Borst et al., 2008). A well-kept and uniform residential streetside environment has appeared in other research as a salient factor related to residential preference (Marans, 1976; Nasar, 1981). Studies on urban parks and built areas (Grahn, 1991; Nassauer, 1995) have also found a connection between the upkeep of the environment and the feeling of safety. Previous studies found that the reduction in the visibility of automobiles (reduced on-street parking and screened parking areas), the reduction of poles, wires and signs and the introduction of vegetation were associated with an improved level of maintenance, which leads to an increased environmental attractiveness (Nasar, 1981).

Unity This is defined as the sense of harmony or the clash between a man-made feature and its natural background (Wholwill, 1979). Low congruity correlates highly with high-colour contrast, high-texture contrast, size of the feature and low congruity of shape. It is proposed that congruity is usually greater when the feature is understood as permanent rather than temporary. Examples of permanent features are buildings, fences and greenery, whereas elements such as billboards, cars and people are temporary. However, when the uniformity increased to a level associated with a reduced promise of new information, it may also risk decreasing preference (Nasar, 1981).

Legibility This has become a well-developed concept in the work of Lynch (1960) and is described as 'the ease with which its parts can be recognised and organised into a coherent pattern' (pp. 2–3). Herzog (1992) more specifically defined it as the apparent ease of wayfinding in the larger environment that includes the immediate setting. Legibility has proved to be a strong indicator of preference (Woodcock, 1984) since a relatively legible environment is normally associated with one that is easy to comprehend and attractive to the human mind.

Typicality Purcell (1987) defined typicality as a rating of 'how good an example of a category (p.1)' a given setting was, especially useful in accounting for preferences of churches. More generally, it refers to how good the fit is between a specific member of a category and the ideal or prototypical member (Herzog and Staats, 2006). In environmental psychology, typicality has been investigated primarily as an indicator of preference reactions. Two theoretical models of how typicality related to environmental preference have been proposed with one model holding that a simple linear relationship exists between typicality and preference, and the other one implying that a curvilinear relationship exists instead (see Peron et al., 1998, for a review). It was an ineffective indicator in Herzog's (1989b) urban nature study but was found to be negatively related to preference in his later urban space (1992) study. Hagerhall (2000) also found a significant positive linear relationship between typicality and preference, while Herzog and Staats (2006) demonstrated that preference and typicality can be positively related within one setting category and negatively related within another.

- Potential indicators describing environmental content

Preference judgement that has been posed in previous research may well depend on both the characteristics of the environments and their contents (Nasar and Terzano, 2010). This section introduces eight indicators of environmental content that may affect environmental preference while walking along a street. These are ***naturalness, waterscape, people, history, pavement surface, typological variation, daylight and quietness.***

Naturalness Naturalness has been linked to environmental preference (Appleyard and Lintel, 1972; Kaplan, Kaplan and Wendt, 1972). Indeed, many empirical studies have confirmed the positive relationship between the preference for natural environments (Herzog, 1984, 1985, 1987; Kaplan, 1973; Ulrich, 1977; Woodcock, 1984) and for urban nature (urban areas high in foliage and other forms of vegetation) (Herzog et al., 1982). Kaplan (1983) provides a review of early studies that support nature settings in general as the most preferred, while among urban settings those containing natural elements are more preferred. It is also proposed in Kaplan's research (1983) that unmanaged nature is relatively less preferred than landscaped areas, and trees are highly valued components of urban nature. Similarly, Thayer and Atwood (1978) found that the addition of natural material to urban areas increased preference. More specifically, flowers were the most preferred element in street vegetation and were seen as having a positive influence on psychological well-being (Todorova et al., 2004), especially those with low and ordered compositions of brightly coloured flowers. Studies have also found that streetscapes with trees are ordinarily more preferred than streetscapes without trees (Sommer et al., 1990; Stamps, 1997; Gorman, 2004; Giles-Corti et al., 2005; Borst et al., 2008), and the positive effects of having trees along streets may be just as important for residents as having them in parks (Getz et al., 1982).

Waterscape Evidence indicating people's value of aquatic environments comes from two perspectives. The first is from research into behavioural choices. House prices for properties with and without a view of water were reported to be significantly different. Study results (Luttik, 2000; Lange and Schaeffer, 2001) show that people are willing to pay higher prices for properties with a view of a waterscape. The other perspective comes from psychological research, which also provides information on which specific subcategories within the superordinate category of water are more preferred. Some evidence exists in literature utilising variables from an informational approach (Kaplan and Kaplan, 1978, 1982) in accounting for preferences for environments containing water. Rivers and marshes proved to be a useful distinction in Ellsworth's study (1982), with rivers easily more preferred. Scenes containing rushing water were reported by Clavin et al. (1972) as having high preference ratings. Herzog (1985) later examined preferences for different waterscapes and found that photographs of mountain waterscapes were the most preferred, while of swampy areas the least preferred. In early studies, water is more oftenly represented by natural water, such as lakes, the sea and rivers, and relatively little is known about urban water features such as ponds and fountains (White et al., 2010). Van den Berg et al. (2003) also directly compared the presence of aquatic elements in natural and urban settings. More specifically, regarding urban water components, Nordh et al. (2011) did not find any significant difference in terms of preference for a mirror pond or small fountain. However, their findings suggest that the park alternatives with water were more preferred than the ones without.

People The presence of other people had a U-shaped relationship to preference, where the middle alternative, a few people, was preferred over no people or many people (Nordh et al., 2011). This may be due to the type and size of setting under study in which the presence of a few other people can increase feelings of safety (Staats and Hartig, 2004), but more than a few people in a small space may cause feelings of crowding and noisiness.

History Frewald (1989) found that well-maintained older buildings were generally preferable to modern buildings, especially when maintenance levels were kept up (Herzog and Gale, 1996; Herzog and Shier, 2000). However, in two studies conducted by Herzog (1989, 1992), history appeared to be inconsistently related to preference with the 1989 study showing its ineffectiveness as a preference indicator in rating urban nature, while the 1992 study found it was negatively correlated with a preference for common urban spaces.

Pavements surface The role of a smooth ground texture in enhancing preference has been reported in many studies, with 'parkland' scenes (Kaplan, 1985) and 'wood lawn' land-cover type (Kaplan et al., 1989) serving as good examples. Besides smoothness, short and grassy ground textures that provide ease of movement have also been found to be positively related to preference (Daniel and Boster, 1976; Ulrich, 1977; Kaplan et al., 1989).

Typographic variation It has been found in many studies that the presence of typographic variation, such as slopes, is strongly associated with preference (Campos et al., 2003).

Daylight Ulrich (1993) found that people have a preference for spaces that feature access to daylight.

Quietness A quiet place has been proven to be a preference motivator (Jansen, 2014), especially in ratings for urban green attributes (Grahn and Berggren-Bärring, 2005; Grahn and Stigsdotter, 2010).

- Other preference-related factors

Similar to the first line of research, four background indicators are emerging as influential in the preference literature. These are ***age, professional relevance, viewing time and being alone/with company***. These four background indicators should be considered in designing validation surveys as controlled variables.

Age Berto (2007) found the evaluation of preference and familiarity differed between age groups. Lindberg et al (1992) also noticed that life span changes in residential-location preferences depended on how much the preferences were influenced by the value of comfort relative to freedom, well-being and togetherness in their study of preference differences on residential locations.

Professional relevance Though laypersons differ substantially from experts in their appraisals of the environment (Bonaiuto, Fornara and Bonnes, 2003; Bonnes et al., 2007; Hur, Nasar and Chun, 2010), professional training, in the form of planning, has no apparent influence on preferences (Dearden, 1984).

Visit duration Kaplan (1975) suggested that preference reactions might be heightened with shorter viewing times. However, later study results are inconsistent with Herzog's (cited in Steinhilber and Johnson, 2007) findings, suggesting very little difference in preference ratings between shorter and longer viewing times.

Being alone or with company Being in the company of a friend could boost the preference for some settings and lower it for others (Staats and Hartig, 2004; Staats et al., 2016). It depends mostly on the safety of the settings studied.

Table 6- 2 Indirect evidence of restorative indicators from preference literature

Street Qualities	Existing Evidences	Literature	Street Contents	Existing Evidences	Literature	Social Factors	Evidences
Openness	A positive relation was found with preference	Kaplan, 1987; Nasar, 1993; Nasar and Jones, 1997	**Naturalness**	A positive relation was found with preference	Herzog, 1984, 1985, 1987; Kaplan, 1973; Ulrich, 1977; Woodcock, 1982	**Age**	Lindberg et al, 1992; Berto, 2007
Complexity	An inverted-U and a positive relation were found with preference	Kaplan, Kaplan, and Wendt, 1972; Herzog and Kaplan, 1982; Karmanov and Hamel, 2006	**Waterscape**	A positive relation was found with preference	Kaplan and Kaplan, 1978, 1982; White et al., 2010		
Enclosure	An inverted-U relation was found with preference	Appleton 1984; Herzog, 1992; Alkhresheh 2007; Lindl and Hartig, 2013	**People**	A inverted-U relation were found with preference	Staats and Hartig, 2004; Nordh et al., 2011	**Professional relevance**	Deraden, 1984; Bonnes and Bonaiuto, 1995; Bonnes et al., 2007
Coherence	A positive relation was found with preference	Lowenthal and Riel, 1972; Ertel, 1973; Kaplan, 1975; Wholwill, 1978	**historic-ness**	A negative relation was found with urban place preference	Herzog and Gale, 1996; Herzog and Shier, 2000; Herzog, 1989; 1992.		
Visual Depth	A positive relation was found with preference	Ulrich, 1983; Herzog and Smith, 1988; Stamps, 2008b					
Mystery	A positive relation was found with preference	Kaplan and Kaplan, 1989; Gallagher, 1977; Ulrich, 1977; Herzog, 1984; S. Kaplan, 1987; Kaplan and Kaplan, 1978, 1982; Herzog, 1984	**Pavement**	A positive relation was found with preference	Daniel and Boster, 1976; Ulrich, 1977; Kaplan et al., 1989		
Familiarity	A negative relation was found with preference	Herzog, 1984; Herzog et al., 1976; 1982; Oostendorp and Berlyne, 1978a; Garling, 1976				**Visit duration**	Kaplan, 1975
Upkeep	A positive relation was found with preference	Booth et al., 2000; Michael et al., 2006; Pilora et al., 2006; Borst et al., 2008	**Daylight**	A positive relation was found with preference	Ulrich, 1993		
Unity	An inverted-U relation was found with preference	Sorte, 1971; Nasar, 1981	**Quietness**	A positive relation was found with preference	Grahn and Stigsdotter, 2010; Berggren-Bärring and Grahn, 1995		
Legibility	A positive relation was found with preference	Woodcock, 1982; Herzog, 1992				**Being alone or with company**	Staats and Hartig, 2004; Staats et al., 2016
Typicality	A positive relation was found with preference	Herzog, 1989b; Hagerhall, 2001; Herzog and Starks, 2004	**Typographic variation**	the presence of it can increase preferece	Campos et al., 2003		

6.3.3 Indirect evidence: the relationship between favourite places and environment

The interactive mechanism between restorative experiences, environmental preference and an individuals' experience of places has been outlined in the literature review chapter of this thesis (see 2.2, 2.3). Differences in preference patterns between scene types (Purcell et al., 1994) have been explained by the mediation effects of place identity and restorative needs in several previous studies.

For example, some research suggests that environmental preference is viewed as a characteristic of the individual's place identity (Lalli, 1992; Droseltis and Vignoles, 2010) or 'the dimensions of self that define the individual's personal identity in relation to the physical environment' (Proshansky, 1978, p. 155). Given that the research of place experiences contains a broader scope of topics, this part of the literature review will concentrate on the studies relevant to both 'place identity' and 'restorative environment'. It has been noted that in existing literature this is mostly studied from two perspectives: 'place identity' and 'self-identity'.

Some studies assert that place identity may influence people's location choice when they are seeking direct attention restoration (Wilkie and Stavridou, 2003; Adevi and Grahn, 2011) because of its underlying relationship with environmental perceptions. The majority of these studies introduce the concept of 'favourite places' to investigate the difference in reported restorative likelihood between favourite and least favourite places. Korpela and Hartig (1996) found that the restorative ratings of favourite places were significantly higher than certain common places nominated by researchers and least favourite places of people, using the Perceived Restorativeness Scale (PRS). Similar findings have also been found in later research (Korpela et al., 2001; Korpela et al., 2010), and the favourite and least favourite ratings differed substantially in all four ART restorative components but especially in *being away* and *compatibility* (Korpela et al., 2001). Some other studies focused on proving the restorative potential of spaces with significant meaning, such as museums (Kaplan et al., 1993), monasteries (Ouellette et al., 2005), historical sites (Fornara and Troffa, 2009) and houses of worship (Herzog et al., 2010). Other contributions are concerned more about potential background determinants, including situational factors in life (Korpela et al., 2008), and urban or nature orientation (Wilkie and Stavridou, 2003; Korpela et al., 2008; Morton et al., 2017). Very limited evidence, however, pointing directly at specific environmental attributes. Only that ***naturalness*** and ***waterscape*** were confirmed as being able to enhance restorative experiences in the favourite places people nominated (Wilkie and Stavridou, 2003; Korpela et al., 2010).

6.3.4 Discussion and summary

Key indicators of the urban environment were identified based on a review of the literature on the restorative environment. Without much empirical evidence, these qualities are presumed to influence people's opportunities in receiving psychological benefits on their walk to a destination, a stroll in their leisure time, or just hanging out and socialising on the street. A total of 22 indicators emerged from the review, with 11 of them describing environmental content and the other 11 describing environmental qualities. The significance of the review process is that it helps develop the SRMF by putting together a body of useful evidence (direct and indirect) from relevant literature, including that on the restorative environment, environmental preference, and place experiences. Below, Figure 6-3, in its embryonic form, attempts to group all the emergent indicators together into the form of a simple framework, so that the relationship between them and the ways in which they contribute directly and indirectly to restoration can be presented. This led us to a comprehensive result of the above literature review – SRMF 1.0 (Figure 6-5). However, limitations still exist, since most of them have not been validated in the context of an urban street. Moreover, to date, no attempt has been made to treat different types of urban setting as a whole and to provide a holistic restorative solution accordingly. This basic framework, therefore, presents possible contributors to the restorative environment and indicates a necessary next step – having this framework validated by applying it to the evaluation of four different types of urban street in Shanghai (see Chapter 4) and having it refined according to the results.

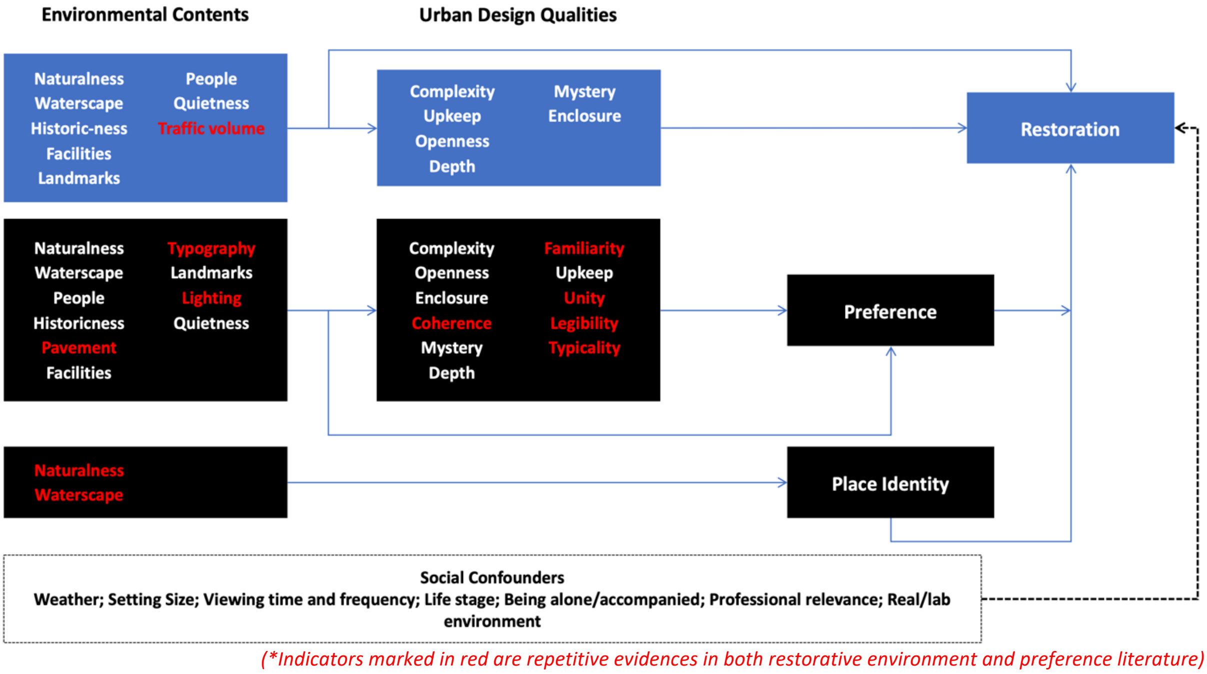


Figure 6- 3 Categorising evidence found in three lines of research literature. Source: the author.

Besides the environmental indicators that reveal potential relationship with restorative experiences, social confounders have also been found to be effective in influencing people's environmental perceptions in terms of them being restored. These social factors should be considered when designing the validation experiment of SRMF 1.0 indicators in urban street settings, since though they do not influence the design of restorative street environments directly, they influence people's perceptions. A total of 8 background indicators that require our further attention were discovered from the literature: ***weather conditions, setting size, viewing time and frequency, life stage, professional relevance, being alone/accompanied, and real/simulated research settings***. Of these, weather conditions, viewing time and frequency, being alone/accompanied, and real/simulated settings can easily be controlled in the experimental design. However, personal background factors can hardly be controlled for, such as life stage and professional relevance. These should therefore be treated as variables to investigate as part of the survey so that subsequent analysis can be conducted to rule out individual perceptive differences. Given that the outdoor street environment is the focus of this research, one way to control the setting size is to choose street with similar length and width, which has already been considered and realised in the streets selected for the case study (see Chapter 4).

6.4 SRMF 2.0 – Validation and Adjustment of Potential Indicators with a Pilot Study

Following SRMF 1.0 – a preliminary framework composed of direct and indirect evidence – being established from literature, a pilot study with two specific purposes is designed. First of all, SRMF 1.0 must be validated for its efficiency and feasibility in the context of the urban street, since most identified potential indicators constituting SRMF 1.0 come from a wider scope of environmental contexts. In essence, it is a set of environmental indicators that may potentially be associated with street restorative experiences; hence the most reliable way is to test it in the evaluation of four case-study streets in Shanghai and then using the factor analysis to explore the most appropriate structure of SRMF 1.0. In addition, it is necessary to find out if any indicators are missing from existing literature or were missed in the process of reviewing the literature. This is expected to be achieved by adding an extra open-ended question at the end of the questionnaire, based on the framework of SRMF 1.0. In general, the on-site questionnaire survey is the method used to collect the data, and factor analysis is the method used to analyse it.

6.4.1 Questionnaire method and factor analysis

This pilot study intends to validate SRMF 1.0 by using it to obtain user evaluations on four case-study streets, with participants being asked to evaluate the current street conditions. Even though videos or pictures are commonly used as visual stimuli for environmental ratings (Zube et al., 1975; Hetherington et al. 1983; Brown and Daniel, 1991; for a review, see Kjellgren and Buhrkall, 2010), several studies found that the restoration of attention appeared to be stronger when respondents took a walk in a real setting compared to show them a video or picture in a laboratory environment (Gatersleben and Andrews, 2013). An urban street is a relatively complicated environment because of its multiple functions and various features. It is not only the visual elements that can influence people's restorative perceptions while walking but also other sensory dimensions such as sound and other people. Therefore, it was decided to take an on-site survey in the pilot study, in order to obtain users' evaluation results as precise as possible. This pilot study was carried out on four case-study streets in Shanghai (see 3.4.2), with University Road selected to represent the Commercial Street, Sujiatun Road to represent the Landscape and Leisure Street, Guokang Road to represent the Traffic-oriented Street, and Zhangwu Road to represent the Living and Service Street (see Chapter 4). Figure 6-4

Figure 6- 4 Case-study streets selected in Shanghai context.

The questionnaire (see Appendix 9) consists of two sections: the first section collects participants' background information, including gender, age, and relevant professional experience (whether they have study or work experience related to urban planning, urban design, or landscape and architecture). Age is asked in the form of a multiple-choice question only, indicating general categories in order to avoid people's antipathy. Previous research suggests that lifespan stages influence people's restorative perceptions (Scopelliti and Giuliani, 2004), hence age is divided into four groups accordingly: 1) 22 (university graduation age)–29; 2) 30–39; 3) 40–49; 4) 50–60). These groups are decided based on the Chinese social culture. The second section is a set of scaled questions, developed from SRMF 1.0 and describing its 22 street design indicators identified in the literature potentially related to street restorative perceptions (Figure 6-5). Clarifications of SRMF 1.0 indicators are defined in a positive way referring to their original study context and adjusted according to the current research context (see Appendix 9). The SRMF 1.0 questionnaire responses are measured using a seven-point (0–6) Likert scale to indicate the agreement level of participants. An additional question – '*Please list other elements that you think can help you recover from mental fatigu*e' – was included at the end of the questionnaire. The SRMF 1.0 questionnaire was translated in the same way as the RCS (see 5.3.1), to ensuring the accuracy of its expression.

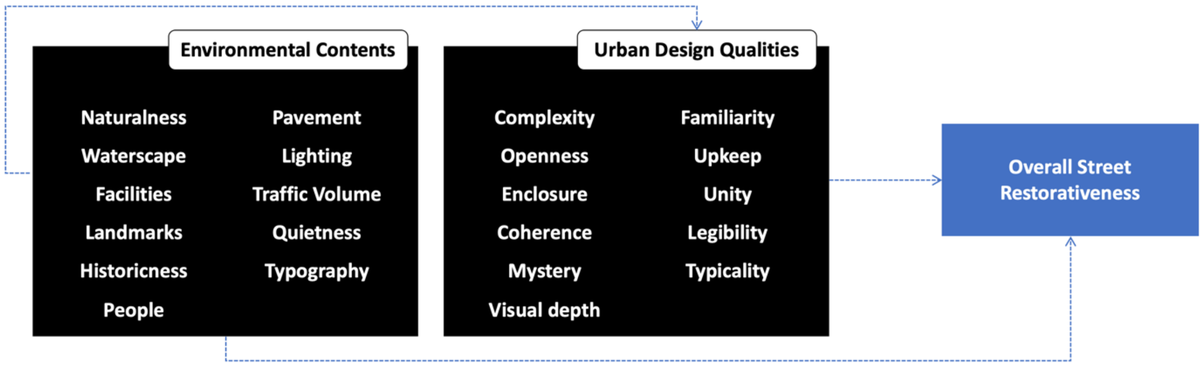


Figure 6- 5 SRMF 1.0 framework (22 indicators). Source: the author.

6.4.2 Participants and procedure

Participants were recruited on-site on each chosen street. Given that walking with or without company has been proven to be an important indicator influencing people's restorative perceptions (Staats and Hartig, 2004), pedestrians who walk alone and seem not to be in a hurry on their way were asked if they were willing to take part in a short survey of a research project. If they were willing to help, they were promptly briefed on what the survey was about and the approximate time it would take. Participants were informed that they were invited to take part in a survey investigating their experiences of streets in Shanghai, and the information sheets and consent form (see Appendix 3, 4) were provided. The pilot study was conducted during weekday (Monday to Friday) lunch breaks (12.00 p.m. to 1.30p.m.), from 04/03/2019 to 29/03/2019. Each street site was allocated a duration of around a week for data collection. Since previous studies have found that weather is closely associated with perceived restorativeness (Hipp and Ogunseitan, 2011), on-site surveys were only conducted on days fulfilling the following weather conditions: 1) mild temperature with no rain; 2) no visible smog, with AQI less than 120.

All participants were reminded by the researcher to read the information sheet (see Appendix 3) and consent form (see Appendix 4) carefully before taking the survey. After participants had read and signed the consent form, the survey began. Participants were asked to walk in their normal state (in terms of walking speed and glances) along the target street while answering to the researchers' questions. The researchers deliberately walked behind the participants to prevent any visual influence, and the participants were told not to turn their heads back toward the researchers when they heard their questions. They were firstly asked about their restorative perceptions (measured by RCS) walking in this street and then followed by questions of street attributes (measured by SRMS). All participants walked within the same section in targeted streets, but their starting location slightly varies (depends on where we approached the participants and whether they wanted to walk to our predetermined starting points).

Learning from the experience of the 1st pilot study, items in RCS and SRMF 1.0 were described and explained by the researcher and understandable examples were provided during the survey. Questions were described and explained in a consistent way across all participants. The survey took each participant 10–15 minutes. Small gifts were awarded to those who completed the whole survey. During the one-week period allocated for each street, 18 participants took part in the survey on Sujiatun Road (Landscape and Leisure Street), 17 participants on University Road (Commercial Street), 22 participants on Guokang Road (Traffic-oriented Street), and 15 participants on Zhangwu Road (Living and Service Street). For each street, the ratio of male to female participants was controlled at about 1:1, and the number of participants with relevant professional backgrounds did not exceed 20% of the total number.

6.4.3 Results

In response to the objectives of the pilot study, the process of data analysis needed to include the following steps: 1) manipulation checks to ensure the reliability of obtained ratings and the applicability for further analysis; 2) factor analysis on the 22 SRMF 1.0 indicators to decide which of them should be excluded; 3) use of the descriptive method for analysing the answers to the open-ended questions to decide if any indicators should be added.

- Manipulation checks

SRMF 1.0 ratings were firstly examined for reliability with Cronbach's alpha (Hinton, 2014) using SPSS 26.0. The α value of the four streets' SRMF 1.0 evaluation results (Table 6-3) show sufficient internal consistency (α value should at least be over 0.6) and hence guarantee the reliability of the obtained SRMF 1.0 ratings. Data was also tested to see whether there was a normal distribution, so that the feasibility of undergoing further analysis could be ensured. Results using a P-P plot (probability-probability plot or percent-percent plot) indicated that all ratings for the 22 indicators were normally distributed and therefore qualified for the next step of analysis (see Appendix 10).

Table 6- 3 Inter-rater reliability results of SRMF 1.0 in the pilot study

	LL-Street	**CM-Street**	**T0-Street**	**LS -Street**
Cronbach's Alpha	.81	.79	.75	.70
N of Responses	18	17	22	15
N of Items	22			

(LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented Street)*

- General descriptions of the SRMS 1.0 results

General descriptions of the SRMS 1.0 are concluded in Table 6-4.

Table 6- 4 General descriptions of SRMS 1.0 results in the pilot study for current restorativeness.

Landscape and Leisure Street N=18		Complexity	Openness	Enclosure	Coherence	Mystery	Visual Depth	Familarity	Upkeep	Unity	Legibility	Historic
	Mean	4.22	3.89	4.33	4.50	3.17	4.33	4.72	4.72	4.39	4.72	0.28
	N	18	18	18	18	18	18	18	18	18	18	18
	Std. Dev	0.88	0.68	0.91	0.79	1.20	0.97	1.13	1.13	0.85	0.75	1.18
		Typicality	Naturalnes s	Waterscap e	Facilities	Landmarks	People	Pavement	Lighting	MV	Noise	Typograph y
	Mean	4.56	4.28	0.28	4.06	4.06	3.50	4.33	4.94	2.83	2.44	2.00
	N	18	18	18	18	18	18	18	18	18	18	18
	Std. Dev	1.25	1.02	1.18	1.21	1.06	1.10	0.84	0.64	0.99	1.25	1.24
Commercial Street N=17		Complexity	Openness	Enclosure	Coherence	Mystery	Visual Depth	Familarity	Upkeep	Unity	Legibility	Historic
	Mean	4.88	3.53	4.00	3.88	2.53	3.35	4.41	3.82	4.47	5.29	0.12
	N	17	17	17	17	17	17	17	17	17	17	17
	Std. Dev	0.70	0.80	1.12	1.36	1.42	0.79	1.50	1.67	0.94	0.77	0.49
		Typicality	Naturalnes s	Waterscap e	Facilities	Landmarks	People	Pavement	Lighting	MV	Noise	Typograph y
	Mean	4.82	3.35	0.00	3.24	2.18	4.18	4.24	4.82	3.47	2.53	0.24
	N	17	17	17	17	17	17	17	17	17	17	17
	Std. Dev	1.13	1.06	0.00	1.39	1.55	1.29	0.90	0.88	0.87	1.07	0.44
Traffic-oriented Street N=22		Complexity	Openness	Enclosure	Coherence	Mystery	Visual Depth	Familarity	Upkeep	Unity	Legibility	Historic
	Mean	3.00	2.64	3.50	3.27	2.23	3.55	3.41	3.50	3.55	4.00	2.27
	N	22	22	22	22	22	22	22	22	22	22	22
	Std. Dev	1.23	1.29	1.14	1.39	1.69	1.34	1.62	1.26	0.96	1.07	1.72
		Typicality	Naturalnes s	Waterscap e	Facilities	Landmarks	People	Pavement	Lighting	MV	Noise	Typograph y
	Mean	2.86	3.23	0.00	2.23	2.73	3.50	2.86	4.73	4.45	2.95	0.50
	N	22	22	22	22	22	22	22	22	22	22	22
	Std. Dev	1.73	1.02	0.00	1.19	1.45	1.01	1.46	1.28	0.96	1.29	0.91
Living and Service Street N=15	LS-Street	Complexity	Openness	Enclosure	Coherence	Mystery	Visual Depth	Familarity	Upkeep	Unity	Legibility	Historic
	Mean	3.87	3.20	3.40	3.33	1.53	2.87	3.93	3.67	4.07	4.40	2.47
	N	15	15	15	15	15	15	15	15	15	15	15
	Std. Dev	0.99	0.78	0.74	1.11	1.25	0.92	0.88	1.23	1.03	1.12	1.64
		Typicality	Naturalnes s	Waterscap e	Facilities	Landmarks	People	Pavement	Lighting	MV	Noise	Typograph y
	Mean	3.53	3.07	0.00	3.80	2.13	5.13	3.73	4.73	4.87	4.00	0.53
	N	15	15	15	15	15	15	15	15	15	15	15
	Std. Dev	1.41	0.96	0.00	1.52	2.13	0.74	0.88	0.70	0.83	1.20	0.74

- Validation of SRMF 1.0 using factor analysis

Factor analysis, developed by Spearman in 1904, is a reliable method of validating the structure of a newly developed evaluation model. It is normally used in either confirming or negating the hypothesised structure of a confirmative study or to try to discover a structure in an exploratory study

(Olkin and Sampson, 2001). This method of analysis has been used in the validation of many restorative evaluation frameworks, such as PRS (Hartig 1996; 1997a; 1997b), RCS (Laumann, Gärling and Stormark, 2003), and PRP (Herzog et al., 2003). Referring to previous research, this study uses explorative factor analysis to validate the structure of SRMF 1.0. It is helpful in reducing the variables to a smaller set of factors based purely on their values, as a first step, but further explorative adjustments are still required according to the specific research context, since it is street indicators rather than psychological descriptions that this research investigates.

SRMF 1.0 evaluation results were firstly put through factor analysis in SPSS V26.0, under the extraction criteria of ‘based on eigenvalue’; this means that the 22 indicators in SRMF 1.0 were cumulated and loaded based on the differences in their normalised values. Results in KMO (*.647*) and Bartlett’s Test (*Sig.=.000*) indicated that SRMF 1.0 evaluation ratings qualified for factor analysis. A seven-factor structure was emerged in the preliminary analysis, but this is not a reasonable result since each factor cannot be categorised only by its loaded indicators (Table 6-5). Hence, the cumulative results and scree plot (Figure 6-6) were checked, and it can be observed that both the m line and the slope of the line become gentle after the 15th factor. SRMF 1.0 results were analysed again with a prerequisite of changing the extraction criteria from ‘based on eigenvalue’ to ‘fixed number of factors’.

Table 6- 5 SRMF 1.0 preliminary factor analysis results – seven-factors structure.

Rotated Component Matrix^a

	1	2	3	4	5	6	7
Complexity	0.102	**0.686**	0.239	-0.176	-0.061	0.234	0.269
Openness	0.254	0.270	**0.665**	0.105	0.070	0.243	-0.052
Enclosure	0.305	0.075	**0.788**	-0.086	0.038	0.092	0.051
Coherence	**0.660**	0.026	0.418	-0.134	0.065	0.123	0.239
Mystery	0.145	0.103	0.292	-0.095	0.089	**0.749**	-0.046
Visual Depth	0.104	-0.038	0.145	-0.204	**0.690**	-0.024	0.142
Familarity	0.270	0.583	-0.082	0.011	0.216	0.303	-0.099
Upkeep	**0.837**	-0.011	0.035	-0.020	0.305	0.130	0.077
Unity	**0.667**	0.251	0.201	0.014	-0.056	-0.113	-0.105
Legibility	0.055	**0.799**	0.028	-0.009	0.056	-0.218	0.154
Historic	-0.036	-0.272	-0.053	0.614	-0.186	0.267	0.486
Typicality	0.359	0.552	0.369	-0.092	-0.074	0.358	-0.049
Naturalness	0.067	0.022	0.542	-0.018	0.540	-0.063	0.044
Waterscape	0.004	0.096	0.167	0.547	0.308	0.340	-0.122
Facilities	0.348	0.290	0.350	0.281	0.248	-0.362	0.098
Landmarks	0.011	0.160	-0.150	-0.056	**0.630**	0.372	0.349
People	0.183	0.424	-0.524	0.325	-0.205	-0.120	-0.132
Pavement	**0.674**	0.478	0.096	-0.063	0.075	0.148	-0.019
Lighting	0.117	0.277	0.134	0.053	0.142	-0.126	**0.754**
MV	-0.164	-0.037	-0.230	**0.709**	-0.075	-0.186	0.335
Noise	-0.002	-0.062	-0.014	**0.770**	-0.078	-0.185	-0.141
Typography	0.178	0.056	0.090	0.214	**0.690**	0.022	-0.353

**Numbers marked in red show an inclination of loading together.*

Factor 1	Coherence	Upkeep	Unity	Pavement
Factor 2	Complexity	Legibility		
Factor 3	Openness	Enclosure		
Factor 4	Traffic	Quietness		
Factor 5	Visual Depth	Landmarks	Typography	
Factor 6	Mystery			
Factor 7	Lighting			

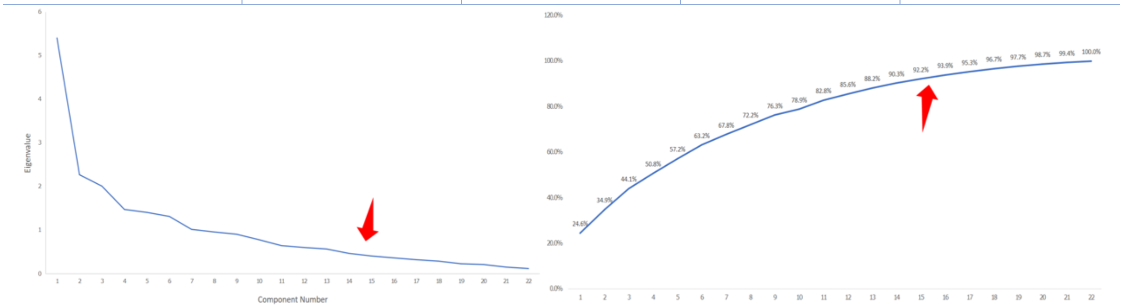


Figure 6- 6 Scree plot (L) and cumulative percentage (R) of SRMF 1.0 factor analysis (7-factor)

This study then tried the ‘fixed number of factors’ backwards from 22 to 7 and found that the validation results became stable and reliable after the number 15. The 15-factor structure (Table 6-6) appeared with ‘complexity’ and ‘typicality’ loaded onto the first factor, ‘openness’ and ‘enclosure’ loaded onto the second factor, ‘upkeep’ and ‘pavement’ loaded onto the third factor, and ‘historic-ness’ and ‘traffic’ loaded onto the fourth factor. 11 other indicators loaded on their own as independent factors, while ‘coherence’, ‘unity’, ‘legibility’, and ‘quietness’ were not loaded. Compared to the original seven-factor structure, the 15-factor structure is more reasonable in terms of component loading results (closer to 1.0) and communal extraction rates (closer to 1.0) but still requires slight adjustments considering of the design and research context.

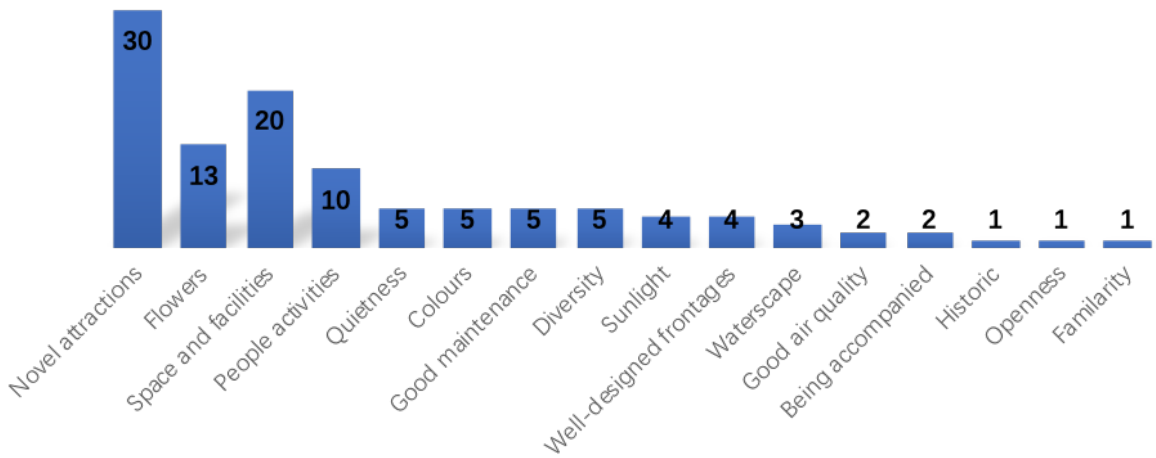
Table 6- 6 The 15-factor structure of SRMF 1.0.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Factor 11	Factor 12	Factor 13	Factor 14	Factor 15
Complexity	0.815	0.056	0.110	-0.145	0.168	0.113	0.038	-0.074	-0.002	0.043	-0.237	0.134	0.125	0.196	0.162
Openness	0.123	0.866	0.134	-0.031	0.000	0.182	0.029	0.079	0.053	0.163	-0.049	0.067	0.088	0.181	0.102
Enclosure	0.114	0.812	0.145	-0.099	0.172	0.111	-0.194	0.048	0.218	-0.183	0.116	-0.044	0.024	-0.029	0.151
Coherence	0.166	0.196	0.438	-0.096	0.260	0.422	-0.024	-0.069	0.380	-0.398	0.100	0.022	-0.008	0.150	0.263
Mystery	0.134	0.252	0.115	-0.088	-0.033	0.861	-0.128	0.061	-0.040	0.168	0.003	0.087	0.136	-0.052	-0.023
Visual Depth	-0.093	0.108	0.081	-0.065	0.083	0.028	-0.146	0.869	0.115	0.068	0.097	0.187	0.097	0.101	0.129
Familiarity	0.280	0.043	0.233	-0.086	0.091	0.257	0.139	0.053	0.169	0.758	0.050	0.127	-0.025	-0.030	0.121
Upkeep	-0.016	0.084	0.875	-0.012	0.088	0.170	-0.050	0.080	0.175	0.073	0.158	0.082	-0.032	0.120	0.113
Unity	0.133	0.209	0.239	-0.084	0.010	-0.040	0.109	0.130	0.849	0.125	-0.050	-0.076	0.071	0.151	-0.012
Legibility	0.613	0.058	-0.019	-0.015	0.457	-0.055	0.282	0.160	0.043	0.163	0.354	-0.199	-0.073	0.044	-0.093
Historicness	-0.001	-0.076	0.016	0.852	-0.041	0.057	-0.107	-0.114	-0.014	-0.177	-0.233	0.146	0.220	0.071	-0.063
Typicality	0.710	0.354	0.196	-0.016	-0.124	0.195	-0.116	-0.093	0.334	0.132	0.145	0.122	-0.047	0.047	-0.039
Naturalness	0.065	0.200	0.109	-0.062	0.023	-0.004	-0.192	0.139	-0.001	0.069	0.103	0.091	0.085	0.155	0.891
Waterscape	0.043	0.086	0.015	0.152	0.007	0.111	0.074	0.059	0.055	-0.001	0.172	0.038	0.931	0.020	0.074
Facilities	0.174	0.133	0.141	0.058	0.107	-0.032	0.068	0.065	0.147	-0.021	0.141	0.002	0.019	0.894	0.155
Landmarks	0.100	0.027	0.068	0.027	0.143	0.080	0.022	0.196	-0.055	0.068	0.145	0.910	0.041	-0.002	0.081
People	0.053	-0.107	0.043	0.084	-0.034	-0.107	0.921	-0.137	0.082	0.088	-0.035	0.025	0.078	0.062	-0.169
Pavement	0.432	0.296	0.731	-0.135	0.051	-0.059	0.169	0.042	0.100	0.158	0.026	0.006	0.104	0.035	-0.015
Lighting	0.102	0.097	0.119	0.112	0.913	-0.004	-0.055	0.043	0.011	0.036	-0.105	0.162	0.015	0.094	0.035
Traffic	-0.154	-0.056	-0.129	0.843	0.178	-0.173	0.234	-0.006	-0.095	0.125	0.112	-0.107	-0.028	-0.016	-0.015
Quietness	-0.368	0.028	-0.049	0.375	0.096	-0.138	0.005	-0.486	0.033	0.406	0.180	-0.141	0.190	0.289	-0.036
Typography	-0.041	0.044	0.211	-0.099	-0.109	0.024	-0.054	0.063	-0.037	0.037	0.814	0.205	0.249	0.172	0.131

- Open-ended question result analysis

An extra question ‘*Please list street elements that you think can help you recover from mental fatigue’* was added at the end of the pilot study questionnaire in order to find out if there were any missing restorative street indicators, with the help of participants’ responses. After preliminary categorisation of the responses (Figure 6-7), the results indicate that the street element mostly often mentioned by participants was 'greenery' (39/150). This is highly consistent with the fact that most existing evidence pointed out the obvious restorative benefits of greenery, vegetation, or nature (Ulrich et al., 1991; Kaplan, 1993, 2001; Tennessen and Cimprich, 1995). Following 'greenery' is 'novel attractions' (1/5), such as interesting shops, sculptures, street artists, and graffiti. The suggestion of having 'more space and facilities' accounted for over 13% of the total responses, and 'flowers' was mentioned 13 times in the gathered responses. 'Human activity', such as the presence of children and the elderly was also raised by ten out of 150 respondents as essential components in promoting restorative experiences.

Among the 18 restorative street indicators raised by respondents, only three have not been directly included in SRMF 1.0: 'colours (5/150)', 'sunlight (4/150)', and 'being accompanied' (2/150). However, 'being accompanied' is a variable controlled for in the design of the pilot study and hence should not be considered. 'Colour' is mentioned as an important component in five responses but not particularly linked to any specific entities, such as colourful flowers, colourful frontages, or colourful billboards, therefore the researcher thinks it may have been raised for the same purpose as the indicator labelled as 'complexity', that focuses on achieving a certain level of variation in street environments. 'Sunlight' can be classified with the indicator of 'lighting', given that no artificial lighting was existed during the survey time (in the midday of lunch break).



(Each participant was allowed to propose more than one elements.)*

Figure 6- 7 Restorative street indicators mentioned by respondents in the pilot study.

- Comparison between groups (age, gender, and professional relevance)

SRMF 1.0 was also tested for whether there are individual perceptive differences between people of different age, gender, and professional background (Table 6-7). The results of the comparison found that seven indicators were significantly different between age groups, but they were located in different street settings and there appears to be no consistency across the four streets. A total of eight indicators were observed to be noticeably different between gender groups, with 'upkeep' appearing as a factor in both Zhangwu Road (Living and Service Street) and Guokang Road (Traffic-oriented Street). In terms of professional relevance, four indicators revealed differences between groups, with 'typography' appearing twice – both in University Road (Commercial Street) and Zhangwu Road (Living and Service Street).

Table 6- 7 Differences between age, gender and pro/lay groups

Age	CM-Street	LS-Street	TO-Street	LL-Street	Gender	CM-Street	LS-Street	TO-Street	LL-Street	Pro/Lay	CM-Street	LS-Street	TO-Street	LL-Street
Complexity	0.529	0.558	0.767	0.873	Complexity	0.606	0.234	0.536	0.163	Complexity	0.995	0.649	0.675	0.494
Openness	0.298	0.157	0.490	0.025	Openness	0.168	0.841	0.777	0.171	Openness	0.709	0.567	0.169	0.480
Enclosure	0.024	0.226	0.196	0.315	Enclosure	0.350	0.326	0.978	0.239	Enclosure	0.618	0.411	0.098	0.385
Coherence	0.310	0.269	0.349	0.427	Coherence	0.216	0.978	0.475	0.055	Coherence	0.460	0.932	0.227	0.309
Mystery	0.207	0.668	0.707	0.857	Mystery	0.788	0.808	0.658	0.764	Mystery	0.386	0.429	0.222	0.627
Visual Depth	0.485	0.146	0.188	0.742	Visual Depth	0.872	0.538	0.019	0.889	Visual Depth	0.607	0.268	0.129	0.365
Familarity	0.689	0.068	0.738	0.771	Familarity	0.467	0.158	0.315	0.069	Familarity	0.086	0.893	0.091	0.151
Upkeep	0.870	0.196	0.122	0.962	Upkeep	0.088	0.003	0.013	0.175	Upkeep	0.067	0.635	0.032	0.894
Unity	0.707	0.622	0.923	0.215	Unity	0.081	0.791	0.963	0.755	Unity	0.529	1.000	0.864	0.309
Legibility	0.697	0.497	0.194	0.830	Legibility	0.137	0.558	0.450	0.798	Legibility	0.109	0.004	0.301	0.539
Historic	0.304	0.218	0.435	0.008	Historic	0.025	0.162	0.483	0.063	Historic	0.456	0.269	0.251	0.361
Typicality	0.561	0.153	0.800	0.097	Typicality	0.007	0.919	0.628	0.524	Typicality	0.154	0.319	0.161	0.813
Naturalness	0.938	0.376	0.548	0.282	Naturalness	0.204	0.002	0.286	0.364	Naturalness	0.442	0.388	0.223	0.916
Waterscape	--	--	--	--	Waterscape	--	--	--	--	Waterscape	--	--	--	--
Facilities	0.969	0.832	0.925	0.230	Facilities	0.797	0.986	0.476	0.787	Facilities	0.285	0.752	0.411	0.210
Landmarks	0.673	0.607	0.557	0.282	Landmarks	0.827	1.000	0.617	0.564	Landmarks	0.724	0.595	0.199	0.872
People	0.036	0.688	0.727	0.793	People	0.109	0.970	0.968	0.261	People	0.675	0.445	0.458	0.778
Pavement	0.952	0.576	0.007	0.727	Pavement	0.970	0.338	0.090	0.119	Pavement	0.459	0.495	0.463	0.260
Lighting	0.057	0.660	0.030	0.927	Lighting	0.172	0.032	0.199	0.063	Lighting	0.138	0.751	0.207	0.098
Traffic	0.510	0.486	0.777	0.156	Traffic	0.208	0.514	0.207	0.335	Traffic	0.037	0.294	0.074	0.683
Quietness	0.591	0.572	0.691	0.170	Quietness	0.729	0.391	0.890	0.265	Quietness	0.138	0.134	0.634	0.752
Typography	0.343	0.047	0.480	0.060	Typography	0.050	0.880	0.142	1.000	Typography	0.024	0.007	0.284	0.372

Groups	**Landscape and Leisure Street**	**Commercial Street**	**Living and Service Street**	**Traffic-oriented Street**
Age	Openness, Historic-ness	Enclosure, People	Typography	Pavement, Lighting
Gender		Historic-ness, Typicality, Typography	Upkeep, Naturalness, Lighting	Visual depth, Upkeep
Pro/Lay		Traffic, Typography	Legibility, Typography	Upkeep

(Pro=Professional group; Lay=Non-professional group.)*

6.4.4 Discussion

It was decided that several adjustments should be made to the framework of SRMF 1.0 in response to the results of the factor analysis and open-ended question analysis. The open-ended question results do not suggest that there are any indicators that should be supplemented into the SRMF. Even though 'colours' and 'sunlight', as mentioned by participants, appear to be not directly included, they are actually respectively represented by 'complexity' and 'lighting' in SRMF 1.0. Given that 'lighting' and 'complexity' respectively cover a wider range of meanings more than 'sunlight' and 'colours', it is decided that no change will be made with regard to these two indicators. In terms of people's desire relating to 'being accompanied', this was a controlled variable when designing the survey procedure. Considering that personal confounders are not the central focus of this research, potential participants in future steps will still be limited to those walking alone, in order to eliminate unnecessary experimental errors.

As for the 15-factor structure loading results, there are four pairs of indicators loading on four factors respectively. Among these, only one pair of indicators can be combined together while the other three pairs should be remained seperate. Firstly, the 'historic-ness'/ 'traffic volume' pair should not be combined into one factor, since there is no reasonable explanation for doing so – no connection can be found between the two. Hence, they are kept as two independent indicators in SRMF 2.0. The other pair that cannot be classified into one factor is 'complexity'/ 'typicality', since the loading value (0.679) is relatively low compared to other loaded pairs (mostly above 0.7), and neither of them is capable of representing the other. However, there may be some overlap between these two indicators. For example, when an environment is highly complex, it may become typical in either a good or a bad way. 'Openness' and 'enclosure' are loaded onto one factor but will not be combined, since even though they describe opposite perspectives of environmental qualities, they can hardly be seen as 'two sides of one coin'. Only the 'upkeep'/ 'pavement' pair, loaded onto one factor, was combined in SRMF 2.0; 'upkeep' was used to represent 'pavement'. Most evidence in previous literature (ITE, 2010; Singh, 2016) relevant to pavement is concerned with its smoothness and provision of comfort for supporting walking behaviour – both are largely decided by its maintenance level. In addition, 'waterscape' is absent from SRMF 2.0 because no such characteristic was found on the four case-study streets.

It was also noted in the pilot study that two indicators, 'coherence' and 'unity', are very similar to certain RCS items. 'Coherence' is described in the pilot study as '*the degree to which the elements of this street environment are connected with themselves and with the integral environment*', but it basically asks the same question as one RCS item in the *extent* component – *'the elements here go together'*. Besides, 'unity' also replicates the meaning described in two RCS items in the *extent* component – *'existing street elements belong to this street'* and *'this street is coherent with surrounding environments'*. Therefore, it was decided that both of 'coherence' and 'unity' should be excluded. In conclusion, the refined SRMF 2.0 is condensed into 19 indicators (Figure 6-8) on the basis of SRMF 1.0 (22 indicators).

As for the way each SRMF 1.0 indicator is stated, the wording of the question around noise levels is decided to be altered, since it was noticed during the pilot study that inquiry into the noise level of certain street environments is in essence a negative way of providing a description. Hence, its description should be changed to, '*Please describe the extent of quietness in this street environment*' rather than '*Please describe the noise level of this street environment*'. No consistent results were found in the comparison of the individuals' perceptive differences between groups (age, gender, and professional relevance); across the four streets, rather few significant differences were observed. Only seven indicators revealed differences between age groups, five between gender groups, and only two between pro/lay groups. These findings are generally in line with previous research (Lindberg et al; 1992; Kaplan, 1995; Scopelliti and Giuliani; 2004; Berto; 2007) suggesting that the relevancy of background indicators have only been found in terms of age-group (life stage) differences. Therefore, differences between age groups will be validated again in the next step of the formal survey, while gender and professional relevance can be paid with less attention.

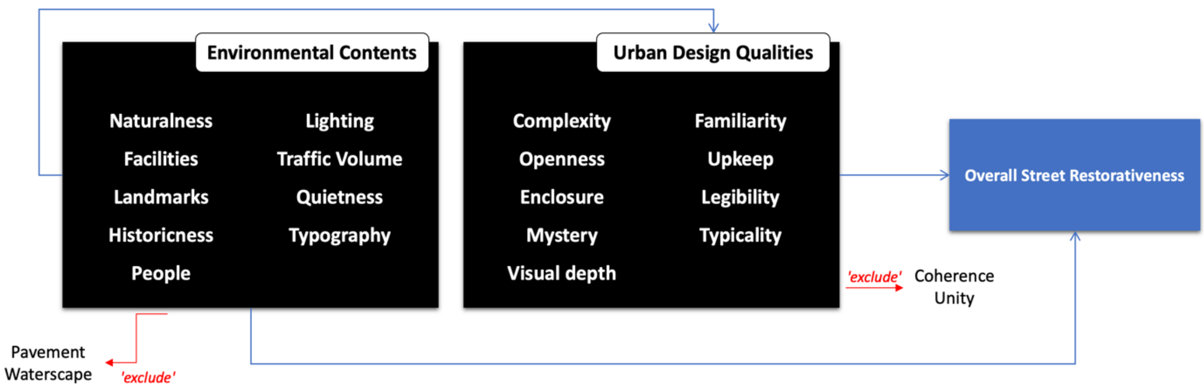


Figure 6- 8 SRMF 2.0 framework (18 indicators). Source: the author.

6.5 The Final SRMF and Its Application on Four Case-study streets

In this research, environmental restorative benefits are intended to be realised in urban street settings in response to users' expectations. This step tries to disclose the connection between restorative perceptions and street attributes, so that design improvements can be developed accordingly. Now that the structure and components of SRMF 1.0 have been validated in the pilot study and refined into SRMF 2.0, the next critical step in this research is to explore the connection between the SRMF 2.0 indicators and street restorative experiences. In Chapter 5, it was proved that street restorativeness can be efficiently measured with a mature restorative measurement method, RCS. Consequently, the major purpose of this step is to establish the connection between street attributes measured by SRMF 2.0 and restorative experiences measured by RCS. The final SRMF, therefore, should be composed of validated restorative street indicators and their influences on delivering street restorative benefits.

Traditionally, there are three paradigms in constructing this kind of environmental quality evaluation framework: *Expert Paradigm, Cognitive Paradigm, Experiential Paradigm and Psychological*

Paradigm. The Expert Paradigm normally depends on professional experts to do the evaluation based on professional aesthetic or ecological assessment criteria, which emphasise the analysis of physical landscape attributes (Chen, 2006). On the contrary, the Cognitive Paradigm and Experiential paradigm are entirely based on public preference ratings, and therefore more focused on users' subjective perceptions of landscape (Chen, 2006). However, neither of them can meet the requirement of this research to establish a connection between users' perceptions and environmental attributes. The fundamentality of the Psychological Paradigm is to explore how subjective aspects link with objective aspects (Chen, 2006), and it is therefore regarded to be the most applicable paradigm in the context of the current research.

Adopting the Psychological Paradigm in the conventional way, the formal survey is designed to respectively investigate users' restorative evaluations by RCS and their assessment on street attributes by SRMF 2.0 under the four case-study Shanghai streets contexts. The relationship between these two frameworks is then explored statistically using correlational analysis. Correlational analysis is a method of statistical evaluation used to establish if there are possible connections between variables (Prematunga, 2012). Results should be able to indicate whether, and how, each SRMF 2.0 indicator is connected with the four ART components (*being away, fascination, extent, and compatibility*). Integrating with people's expectations on street restorativeness, it is expected to discover what design improvements should be made in terms of each SRMF 2.0 indicator, so that the current restorative level of streets can meet with users' expectations on them through a case study conducted on four streets in Shanghai. The outcome of this step is the final SRMF, composed of both restorative related street indicators and their exact influences on street restorativeness.

6.5.1 Questionnaire method

Following the strategy of establishing a restorative streetscape evaluation framework discussed above, the survey questionnaire (see Appendix 11) is changed into three sections instead of two (background information and SRMF 1.0) in the pilot study. In addition to the background information section (age, gender, and professional relevance) and the section of SRMF 2.0, RCS is added as the third section so that SRMF 2.0 ratings results can be correlated with RCS items mathematically. It should be highlighted here that five of the SRMF 2.0 indicators (*Naturalness, Landmarks, Human Activities, Traffic Volume* and *Typographic Variations)* are better measured by their amount according to their definitions. This necessitates a variation in the rating scale for these indicators, as explained by the surveyor: *0 = Not at all; 1 = Very little; 2 = Rather little; 3 = Moderate; 4 = Rather much; 5 = Very much; 6 = Too much,* while the scale for other 14 indictors in SRMF 2.0, and all 15 items in RCS, is rated with the former criteria of *0 = Not at all; 1 = Very little; 2 = Rather little; 3 = Neither little nor much; 4 = Rather much; 5 = Very much; 6 = Completely.*

6.5.2 Survey time

This survey was carried out during weekday lunch breaks, 12.00–13.30 p.m., from 29/04/2019 to 29/05/2019. Again, each street was given a duration of one week to conduct the survey. In alignment with conditions that were carefully determined in the pilot study, the on-site formal survey was conducted in workdays fulfilling the following conditions 1) mild temperature with no rain; 2) no visible smog, with AQI less than 120. Even though both the pilot study and the formal survey were both conducted within spring (March to May), a time of year when the weather in Shanghai is generally mild and comfortable, it was apparent that the streetscape had noticeably different in early spring (March, when the pilot study was conducted) compared to early summer (May, when the formal survey was conducted). Hence, streetscapes can be perceived differently in terms of providing restorative experiences between the pilot study and the formal survey. However, there will be no influence on their perceptive evaluations across the four streets, and the discrepancies between the pilot study and the formal one is further discussed.

6.5.3 Participants and procedure

According to the sample size calculation explained in chapter 3.3, around 30 participants are required for evaluating each case-study street. Therefore, the total sample number should reach 120. During the survey period, 30 participants were recruited for Sujiatun Road (Landscape and Leisure Street), University Road (Commercial Street), and Zhangwu Road (Living and Service Street), and 31 participants were recruited for Guokang Road (Traffic-oriented Street). For each street, the ratio of male to female participants was controlled at about 1:1, and the number of participants with relevant professional backgrounds did not exceed 20% of the total number.

The procedure for conducting the formal survey basically replicated the procedure of the pilot study, with adjustments made only on the sample size, as mentioned above (refers to 6.4.2).

6.5.4 Results

- Manipulation checks

All SRMF 2.0 and RCS evaluation ratings were firstly examined for reliability with Cronbach's alpha (Hinton, 2014) using SPSS 26.0. The α value for the 18 SRMF 2.0 indicators and the RCS evaluation results on current restorativeness of the four case-study streets (Table 6-8) showed sufficient internal consistency (α value should at least be over 0.6), though the *extent* of Commercial Street, Living and Service Street and Landscape and Leisure Street were observed with a relatively lower α value. Data was also tested to see whether there was a normal distribution, to ensure the feasibility of it undergoing further analysis. Results using a P-P plot indicate that all ratings for the 18 SRMF 2.0 indicators and 15 RCS items are normally distributed, and therefore qualify for the next-step analysis (see Appendix 12,13).

Table 6- 8 Internal consistency results of RCS and SRMF 2.0 (α≥0.7)

Street Type	CM Street				LS Street				LL Street				TO Street			
Cronbach's α (RCS)	.86				.86				.90				.89			
	B	E	F	C	B	E	F	C	B	E	F	C	B	E	F	C
	.71	*.60*	*.82*	*.76*	*.94*	*.63*	*.76*	*.76*	*.86*	*.60*	*.85*	*.66*	*.70*	*.70*	*.88*	*.75*
Cronbach's α (SRMF)	.77				.87				.85				.75			
No. of participants	N=30				N=30				N=30				N=31			

(B=Being away; E=Extent; F=Fascination; C=Compatibility; LL=Landscape and Leisure Street; LS=Living and Service Street; CM=Commercial Street; TO=Traffic-oriented Street)*

- General descriptions on restorativeness of four streets (RCS questionnaire analysis)

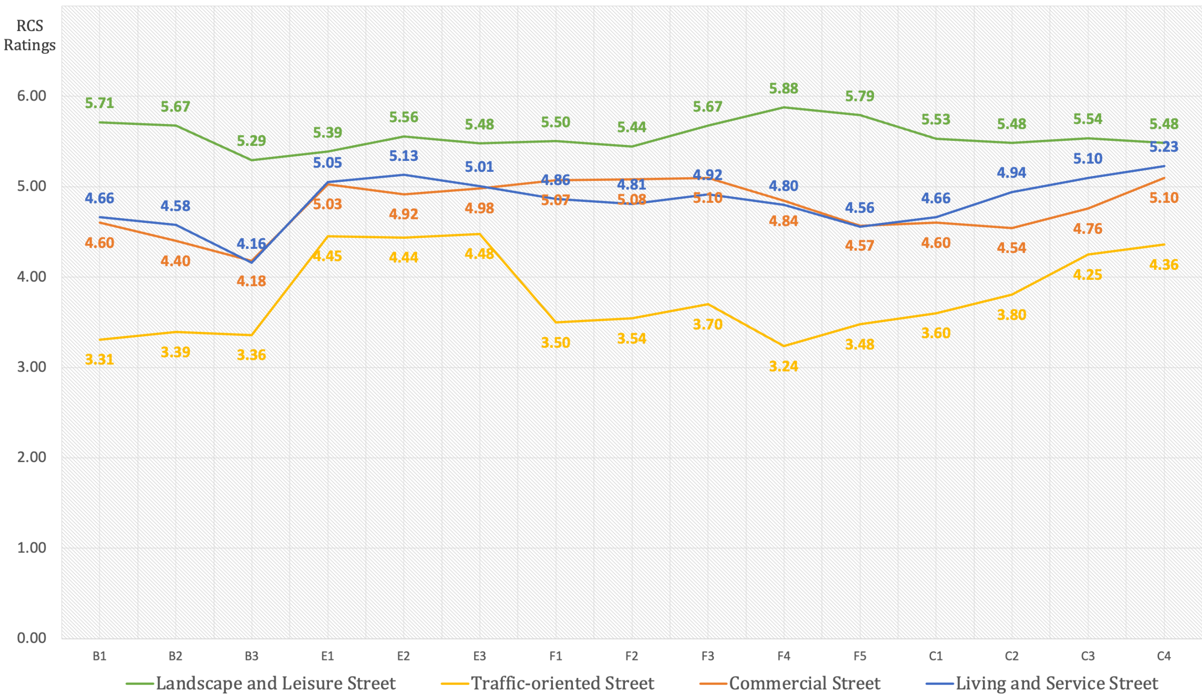
General descriptions of the SRMS 2.0 and RCS are concluded in Table 6-9, Table 6-10. The results from the RCS ratings show the users' evaluations of the current restorativeness of four selected streets (Figure 6-9). In the four streets, obvious differences in the current street restorativeness can be observed; only the RCS ratings of Zhangwu Road (Living and Service Street) and Guokang Road (Traffic-oriented Street) are similar. Overall, the street restorative ratings of University Road (Commercial Street) and Sujiatun Road (Landscape and Leisure Street) were higher than that of Zhangwu Road (Living and Service Street) and Guokang Road (Traffic-oriented Street). In terms of the four ART components, Sujiatun Road was rated highest on the *being away, extent, and compatibility* components, while University Road exceeded the other three on *fascination*. The results seem reasonable, as the Commercial Street is lined with a variety of retail stores, restaurants, and cafes, providing sufficient attraction for pedestrians. Sujiatun Road's *compatibility* score was significantly higher than that of the other three streets, which may be due to the fact that Sujiatun Road provides sufficient exercise facilities and rest places along the street, which largely meets the outdoor activity needs of surrounding residents.

Table 6- 9 General descriptions of SRMS 2.0 results in the formal survey for current restorativeness.

University Road (Commercial Street) N=30		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality
	Mean	3.67	3.33	3.23	2.43	3.10	3.73	3.77	3.57	4.37
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	0.84	0.99	1.04	1.41	1.09	1.64	1.07	1.17	0.72
		Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
	Mean	2.83	3.20	3.83	-1.23	-0.50	-2.37	-0.13	-0.27	-1.43
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	1.12	1.06	1.02	1.07	1.25	0.96	0.97	1.14	1.04
Zhangwu Road (Living and Service Street) N=30		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality
	Mean	3.93	3.53	3.73	2.70	3.80	4.77	4.23	3.80	3.57
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	1.08	1.22	1.08	1.18	1.06	1.30	1.14	1.45	1.36
		Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
	Mean	2.93	3.57	4.27	-1.10	-0.43	-1.97	-0.23	-0.17	-1.07
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	1.28	1.63	1.36	1.21	0.90	1.27	0.90	1.29	0.94
Guokang Road (Traffic-oriented Street) N=31		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality
	Mean	2.16	2.06	2.65	1.90	2.71	3.65	3.03	3.10	2.87
	N	31	31	31	31	31	31	31	31	31
	Std. Dev	1.16	0.93	1.02	1.40	1.51	1.92	1.11	1.33	1.43
		Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
	Mean	3.26	2.13	3.45	-1.13	-0.16	-1.77	-0.84	0.65	-1.26
	N	31	31	31	31	31	31	31	31	31
	Std. Dev	1.44	1.52	0.99	1.26	1.00	1.54	1.27	1.28	1.09
Sujiatun Road (Landscape and Leisure Street) N=30		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality
	Mean	3.37	2.80	3.30	1.83	3.37	4.03	3.20	3.07	3.63
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	1.10	1.42	1.06	1.51	1.16	1.35	1.35	1.57	1.30
		Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
	Mean	3.00	2.90	3.40	-1.30	-0.50	-2.47	-0.57	-0.77	-1.20
	N	30	30	30	30	30	30	30	30	30
	Std. Dev	1.39	1.16	0.97	1.09	0.68	1.07	1.04	1.07	0.81

Table 6- 10 General descriptions of the RCS results in the formal survey for current restorativeness.

N=30	CM-B1	CM-B2	CM-B3	CM-E1	CM-E2	CM-E3	CM-F1	CM-F2	CM-F3	CM-F4	CM-F5	CM-C1	CM-C2	CM-C3	CM-C4
Mean	4.23	3.77	2.83	4.33	4.43	3.87	4.30	3.93	4.57	4.43	4.20	4.30	4.07	4.67	4.63
N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Std. Dev	1.17	1.17	1.53	1.09	0.97	1.22	1.47	1.62	1.07	1.43	1.10	1.32	1.20	0.76	0.96
N=30	LS-B1	LS-B2	LS-B3	LS-E1	LS-E2	LS-E3	LS-F1	LS-F2	LS-F3	LS-F4	LS-F5	LS-C1	LS-C2	LS-C3	LS-C4
Mean	3.63	3.60	3.47	3.97	4.17	3.37	2.57	2.57	3.17	3.23	3.33	3.57	4.23	4.67	4.43
N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Std. Dev	1.40	1.40	1.36	1.25	1.21	1.19	1.45	1.25	1.15	1.19	1.15	1.36	1.14	0.96	1.10
N=31	TO-B1	TO-B2	TO-B3	TO-E1	TO-E2	TO-E3	TO-F1	TO-F2	TO-F3	TO-F4	TO-F5	TO-C1	TO-C2	TO-C3	TO-C4
Mean	3.23	3.16	2.77	4.42	4.06	3.42	2.65	2.58	3.06	2.74	3.26	3.52	4.10	4.84	3.90
N	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
Std. Dev	1.41	1.39	1.38	1.15	1.09	1.46	1.92	1.63	1.39	1.81	1.59	1.55	1.33	0.97	1.35
N=30	LL-B1	LL-B2	LL-B3	LL-E1	LL-E2	LL-E3	LL-F1	LL-F2	LL-F3	LL-F4	LL-F5	LL-C1	LL-C2	LL-C3	LL-C4
Mean	4.40	3.83	3.27	4.47	4.63	3.77	3.30	3.10	4.17	4.50	3.97	4.77	4.37	5.17	4.53
N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Std. Dev	1.13	1.37	1.31	0.82	1.03	1.79	1.51	1.58	1.21	1.48	1.56	0.94	1.03	0.75	1.28



*(*B=Being away; E=Extent; F=Fascination; C=Compatibility.)*

Figure 6- 9 General restorativeness descriptions of four case-study streets

- Establishing the connection between RCS and SRMF 2.0 indicators

Since the structure of the SRMF 2.0 factors has been validated, correlational analysis in SPSS 26.0 was used to establish the connection between the 18 SRMF2.0 indicators and four ART components (measured by RCS) under the research context of four different types of street in Shanghai. It was discovered that SRMF 2.0 indicators are differently correlated with four ART components and have varying influential mechanisms across the four street environments (Table 6-15). 11 SRMF indicators appeared to be related to restorative experiences in University Road (Commercial Street); among them only ‘naturalness’ was found to be negatively related to the component of *being away*, and ‘landmarks’, ‘legibility’, and ‘typicality’ were negatively correlated with *fascination* (Table 6-12). For Sujiatun Road (Landscape and Leisure Street), ‘naturalness’ also displayed a negative relationship to *extent* and ‘traffic’, while the other 11 indicators showed positive relationship (Table 6-13). In terms of Zhangwu Road (Living and Service Street), all 13 indicators were proved to be beneficial in promoting restoration (Table 6-14). Only seven SRMF indicators were found to be correlated with restorativeness on Guokang Road (Traffic-oriented Street), among which, ‘openness’, ‘familiarity’ and ‘traffic’ were negatively related with *extent*, and it was found that ‘naturalness’ can inhibit *compatibility* (Table 6-11).

Table 6- 11 Correlational analysis result of SRMF and RCS in Guokang Road

		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
B1	Pearson Correlation	-0.105	-0.343	0.104	0.181	0.001	-0.105	-0.090	0.095	0.164	0.003	-0.170	-0.171	0.055	-0.091	-0.132	-0.152	-0.213	0.082
B2	Pearson Correlation	0.025	-0.318	0.018	.368*	-0.009	-0.264	0.018	-0.117	0.078	-0.038	-0.262	-0.343	0.031	0.139	-0.250	-0.166	0.089	0.203
B3	Pearson Correlation	-0.247	-0.118	0.060	-0.012	-0.064	-0.194	0.027	-0.097	-0.066	-0.137	-0.002	-0.214	0.078	0.309	0.056	-0.055	-0.216	0.312
E1	Pearson Correlation	0.073	-.370*	0.046	-0.015	-0.062	-0.338	0.120	-0.071	0.135	0.134	-0.013	0.121	0.039	0.119	0.058	0.273	-0.009	0.328
E2	Pearson Correlation	0.176	-0.070	-0.158	-0.018	0.012	-.480**	0.108	0.019	-0.037	0.201	0.175	0.064	-0.091	0.162	-0.068	0.329	-0.150	0.209
E3	Pearson Correlation	0.216	0.201	0.059	0.037	0.027	-.385*	.425*	0.168	0.139	0.217	0.185	.371*	0.285	-0.066	0.090	0.215	-.383*	0.279
F1	Pearson Correlation	0.266	0.312	0.138	0.334	0.021	-0.314	.442*	0.027	0.055	0.336	0.255	0.121	0.146	0.159	-0.039	-0.030	-0.310	0.050
F2	Pearson Correlation	0.302	0.063	-0.073	0.245	-0.309	-0.145	.469**	-0.120	0.090	0.105	0.103	0.141	0.119	0.141	0.264	0.147	-0.042	0.199
F3	Pearson Correlation	0.221	-0.107	-0.101	0.175	-0.070	0.109	0.150	0.141	0.105	0.025	0.122	0.051	0.043	-0.040	0.102	0.259	0.107	0.055
F4	Pearson Correlation	0.339	-0.049	0.202	.491**	0.057	-0.276	0.270	0.178	0.283	0.232	0.158	0.067	0.058	0.344	-0.038	-0.054	-0.171	-0.035
F5	Pearson Correlation	0.302	-0.034	-0.024	.461**	0.088	-0.285	0.222	0.177	0.147	0.101	0.206	0.156	0.001	0.069	0.003	0.177	-0.035	0.154
C1	Pearson Correlation	0.120	-0.210	-0.303	0.270	-0.105	-0.104	0.281	-0.106	-0.044	0.058	0.098	-0.027	0.172	0.098	0.145	0.279	0.146	0.318
C2	Pearson Correlation	0.250	-0.005	-0.048	0.221	-0.152	-0.261	0.224	-0.119	0.182	0.319	0.308	0.320	0.188	-0.163	0.299	0.228	-0.195	0.156
C3	Pearson Correlation	0.024	-0.173	-0.229	0.136	-0.124	-0.103	-0.119	0.090	0.105	0.151	0.105	0.009	0.174	-0.268	0.047	0.239	-0.128	0.117
C4	Pearson Correlation	-0.139	-0.075	-0.244	0.136	-0.063	-0.078	-0.109	0.043	0.114	0.254	0.104	0.009	0.326	-.381*	-0.069	0.204	-0.194	0.073

Table 6- 12 Correlational analysis result of SRMF and RCS in University Road

		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
B1	Pearson Correlation	-0.023	0.139	0.295	.378*	0.008	0.052	0.045	0.001	-0.147	0.190	0.184	0.063	-0.148	-.366*	0.263	0.180	0.178	0.058
B2	Pearson Correlation	0.199	0.308	0.360	0.253	-0.035	0.219	0.258	-0.001	0.147	0.340	.373*	0.053	-0.321	-.437*	0.167	0.215	.418*	-0.086
B3	Pearson Correlation	-0.151	-0.008	0.112	0.195	0.134	0.188	0.164	-0.080	-0.037	-0.037	0.190	0.246	0.059	-0.296	0.330	-0.062	0.052	0.105
E1	Pearson Correlation	-0.100	.370*	0.142	0.194	0.202	.513**	0.157	0.226	0.234	0.188	.386*	0.330	-0.167	-0.327	0.153	0.076	-0.037	0.040
E2	Pearson Correlation	0.224	.524**	0.170	-0.041	0.250	.638**	0.233	.385*	0.357	0.228	0.013	0.354	0.001	0.043	0.175	-0.083	0.108	0.192
E3	Pearson Correlation	0.022	.378*	0.350	0.255	-0.093	0.050	0.317	0.151	0.175	0.135	0.180	.396*	-0.340	0.022	0.045	0.361	.639**	-0.101
F1	Pearson Correlation	-0.139	-0.260	-0.115	0.135	-0.342	-0.267	-0.195	-.547**	-.370*	-0.011	0.159	-0.265	0.243	-0.066	0.154	-0.068	0.091	0.088
F2	Pearson Correlation	-0.093	-0.179	-0.093	0.241	-0.152	0.006	-0.148	-0.345	-0.156	0.108	0.168	-0.237	0.249	-0.102	0.094	-0.050	-0.122	0.187
F3	Pearson Correlation	-0.241	-0.086	0.001	0.312	-0.079	0.030	0.149	-0.045	-0.010	0.053	0.230	-0.005	-0.031	0.013	0.008	0.108	0.212	0.351
F4	Pearson Correlation	0.067	0.210	-0.024	0.315	0.037	0.301	0.180	0.199	0.041	0.090	0.213	0.051	-0.269	-0.279	0.019	0.340	0.305	0.154
F5	Pearson Correlation	0.075	0.285	-0.103	0.345	-0.247	0.088	0.100	-0.173	-0.096	0.085	0.290	0.093	-.370*	-0.352	0.007	0.252	.457*	-0.163
C1	Pearson Correlation	-0.217	0.211	0.149	0.151	-0.141	0.166	0.124	-0.002	-0.047	0.012	0.251	0.039	-0.071	-0.157	0.144	0.328	0.215	-0.078
C2	Pearson Correlation	-0.181	0.212	0.153	0.350	-0.136	0.097	0.307	0.218	0.170	-0.017	0.259	0.150	-0.309	-0.137	0.081	.391*	.390*	-0.004
C3	Pearson Correlation	-0.233	0.015	0.233	0.302	0.083	-0.157	0.198	-0.091	0.042	-0.068	0.171	-0.030	-0.057	-0.073	-0.126	-0.016	0.252	-0.015
C4	Pearson Correlation	0.014	.384*	0.157	0.274	-0.062	0.242	0.114	0.007	0.051	0.005	.444*	0.216	-0.086	-0.357	0.073	0.130	0.033	0.008

Table 6- 13 Correlational analysis result of SRMF and RCS in Sujiatun Road

		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
B1	Pearson Correlation	.433*	.500**	.646**	0.242	.620**	0.329	0.262	.410*	.478**	0.153	0.216	0.195	0.297	-0.223	0.017	0.082	-0.051	-0.061
B2	Pearson Correlation	0.341	.496**	.538**	.420*	.584**	0.152	0.224	0.246	0.294	-0.127	0.055	0.078	.429*	-0.277	0.227	0.271	0.192	-0.063
B3	Pearson Correlation	0.145	0.288	.488**	0.337	.433*	0.150	0.242	0.192	0.181	0.000	-0.027	-0.087	.421*	-0.039	.508**	0.115	0.175	-0.111
E1	Pearson Correlation	0.302	.378*	0.311	0.344	.431*	-0.015	0.069	0.109	0.361	0.030	0.197	0.191	0.085	-.555**	0.138	0.038	0.029	0.042
E2	Pearson Correlation	.457*	.534**	.515**	.401*	.577**	0.231	0.228	0.312	.410*	0.072	0.286	0.324	0.267	-.465**	0.089	-0.072	-0.045	0.033
E3	Pearson Correlation	-0.008	0.278	0.311	0.214	.440*	0.003	0.006	0.274	.376*	0.180	0.005	-0.004	-0.055	-0.155	0.228	-0.221	-.383*	0.014
F1	Pearson Correlation	0.201	0.253	0.115	0.310	0.289	0.248	0.172	.368*	0.286	-0.131	-0.061	0.221	0.203	-0.150	0.110	-0.042	0.040	0.023
F2	Pearson Correlation	0.177	.407*	0.167	.411*	0.224	0.240	0.216	.412*	0.270	-0.204	0.043	0.288	0.178	-0.271	0.191	-0.027	0.047	0.070
F3	Pearson Correlation	.603**	.462*	.555**	.470**	.596**	.377*	0.276	.521**	.591**	0.021	.384*	0.266	0.302	-0.272	0.062	-0.060	-0.138	0.036
F4	Pearson Correlation	.414*	0.327	0.099	.424*	0.271	0.129	0.225	.444*	0.278	-0.084	0.212	0.289	.461*	0.017	-0.065	0.056	0.163	-0.116
F5	Pearson Correlation	0.329	.523**	.487**	.538**	.406*	0.131	0.297	.603**	.469**	0.016	.456*	0.237	0.338	-0.048	-0.051	-0.012	-0.036	0.022
C1	Pearson Correlation	.590**	0.223	0.248	.509**	.368*	0.088	0.284	.479**	.438*	0.133	.393*	0.107	0.200	-0.297	0.231	-0.141	-0.116	0.119
C2	Pearson Correlation	0.272	0.262	0.117	.416*	.402*	-0.157	0.094	0.239	0.283	-0.192	0.147	0.124	0.224	-0.024	0.253	0.104	0.293	0.050
C3	Pearson Correlation	.470**	.519**	.591**	.392*	.684**	0.097	0.171	0.284	.527**	0.033	0.300	0.286	0.191	-0.169	0.057	-0.185	0.036	0.057
C4	Pearson Correlation	.691**	0.344	.465**	0.190	.538**	0.249	0.276	.495**	.371*	0.155	0.271	0.072	.466**	-0.198	0.087	0.054	-0.144	-0.027

Table 6- 14 Correlational analysis result of SRMF and RCS in Zhangwu Road

		Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
B1	Pearson Correlation	-0.131	0.118	0.161	0.161	0.157	-0.030	0.142	0.065	0.258	.407*	-0.027	0.089	0.039	.390*	0.258	-0.235	-0.016	0.033
B2	Pearson Correlation	-0.314	0.269	0.177	0.300	0.060	-0.053	0.190	-0.125	0.069	0.329	0.087	0.076	-0.105	0.295	0.220	-0.049	-0.057	-0.047
B3	Pearson Correlation	-0.049	.405*	.417*	.435*	0.210	0.161	0.285	0.049	0.151	.453*	0.172	0.117	-0.054	0.257	0.270	-0.106	-0.171	-0.002
E1	Pearson Correlation	.434*	.442*	.531**	0.204	.594**	0.313	.372*	0.149	0.359	0.322	0.196	0.310	0.340	0.233	0.305	0.116	0.018	.409*
E2	Pearson Correlation	0.115	0.125	0.115	0.158	.430*	0.026	.424*	0.000	.383*	0.341	.458*	0.182	0.342	.451*	.378*	-0.058	0.107	0.252
E3	Pearson Correlation	0.020	0.122	0.240	0.180	0.115	-0.099	-0.091	-0.176	0.081	-0.006	0.173	-0.148	.385*	0.283	.448*	0.309	-0.116	0.360
F1	Pearson Correlation	0.222	0.212	0.121	.485**	0.232	0.072	0.001	0.236	.408*	0.169	0.252	0.304	0.346	0.353	.381*	.448*	.365*	0.079
F2	Pearson Correlation	0.054	0.224	-0.012	.423*	0.296	-0.001	-0.096	0.008	0.353	0.175	0.327	0.252	0.334	.441*	.529**	.490**	.381*	0.208
F3	Pearson Correlation	0.176	0.352	0.232	0.191	.509**	0.165	0.260	0.228	.602**	.382*	.390*	0.323	0.235	.407*	.398*	0.173	0.136	0.265
F4	Pearson Correlation	0.039	-0.017	0.130	.370*	0.174	0.169	0.137	0.088	0.299	0.100	0.195	-0.018	0.207	.484**	.380*	-0.076	0.183	0.075
F5	Pearson Correlation	0.129	0.211	0.295	.557**	0.056	-0.038	0.281	-0.062	0.316	0.271	0.225	-0.037	0.221	0.311	0.321	0.144	0.131	0.148
C1	Pearson Correlation	-0.020	0.040	0.177	0.261	0.153	-0.079	0.046	0.095	.400*	0.339	0.177	-0.122	0.057	0.209	0.268	-0.171	-0.023	-0.131
C2	Pearson Correlation	0.097	.404*	0.305	0.312	.411*	0.085	.465**	0.092	0.180	.508**	0.149	0.137	0.093	0.170	0.233	-0.080	-0.208	0.144
C3	Pearson Correlation	0.011	0.333	0.244	0.275	0.135	-0.037	0.201	-0.174	0.230	0.233	0.301	0.097	-0.030	0.067	0.320	0.147	-0.019	-0.025
C4	Pearson Correlation	0.083	-0.024	0.042	-0.003	0.341	0.192	0.192	0.164	.590**	0.094	0.222	-0.034	0.265	0.196	0.333	0.071	0.077	0.062

Table 6- 15 Overal correlational analysis result of SRMF2.0 and RCS

	COMMERCIAL STREET	LANDSCAPE AND LEISURE STREET	LIVING AND SERVICE STREET	TRAFFIC-ORIENTED STREET
Being Away (+)	Mystery, Facilities, traffic volume	Complexity, Openness, Enclosure, Mystery, Visual Depth, Legibility, Typicality, Landmark, historic-ness	Openness, Enclosure, Mystery, Quietness, Naturalness	Mystery
Being Away (-)	Naturalness	--	--	--
Extent (+)	Openness, Familiarity, Legibility, Facilities, Lighting	Complexity, Openness, Enclosure, Mystery, Visual Depth, Typicality	Complexity, Openness, Enclosure, Visual Depth, Upkeep, Typicality, Facilities, Landmarks, Naturalness, historic-ness, Typography	Upkeep, Lighting
Extent (-)	--	Naturalness, traffic volume	--	Openness, Familiarity, traffic volume
Fascination (+)	traffic volume	Complexity, Openness, Enclosure, Mystery, Visual Depth, Legibility, Familiarity, Typicality, Facilities, Landmarks	Complexity, Mystery, Upkeep	Mystery, Upkeep
Fascination (-)	Landmarks, Legibility, Typicality	--	--	--
Compatibility (+)	Facilities, People, traffic volume, Openness	Complexity, Openness, Enclosure, Mystery, Visual Depth, Legibility, Typicality, Facilities, Landmark	Visual Depth, Typicality, Quietness	--
Compatibility (-)	--	--	--	Naturalness

- Open-ended question result

The results of the additional open-ended question, ‘*Please list street elements that you think can help you recover from mental fatigue*’, which is the same question as in the pilot study and is designed to investigate missing potential restorative related indicators, suggest that most street elements mentioned by respondents have already been included in the SRMF 2.0. The top three frequently mentioned elements – ‘greenery’, ‘plants’, and ‘flowers’ – can all be classified within the indicator labelled ‘naturalness’. In addition, ‘human activities’, ‘upkeep’, ‘facilities’, ‘lighting’, ‘traffic volume’, and ‘safe’ were repeatedly stressed by participants as restorative related street elements. However, four indicators mentioned by participants – ‘temporary activities (e.g., show, market, exhibition)’, ‘waterscape’, ‘comfort’, and ‘music’ – were not included in SRMF 2.0, among which ‘waterscape’ was not a newly emerged indicator since it was an indicator excluded from SRMF 1.0 considering the real situation of case study streets. Figure 6-10

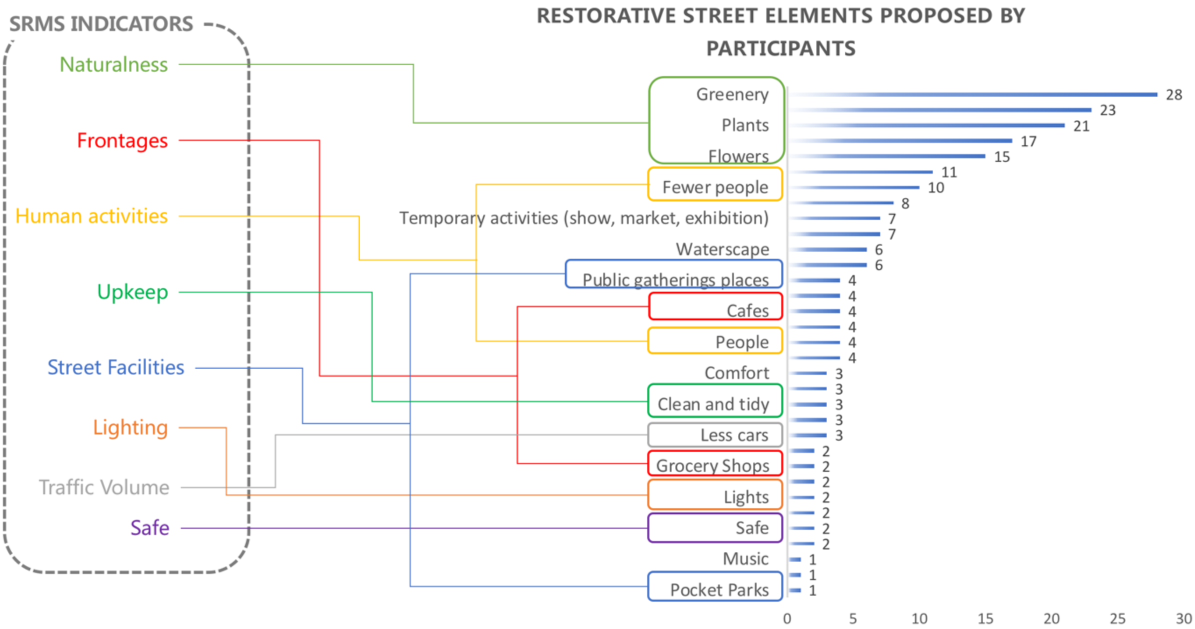


Figure 6- 10 Restorative street elements proposed by participants. Source: the author.

- Comparison between groups

Even though the differences in evaluation between groups of different backgrounds (gender, age, and professional relevance) were proved to be only slight in the pilot study, it is still necessary to validate the within-group differences again in the formal survey, since the survey questionnaire was added another evaluation measurement scales - RCS. The results (Table 6-16) suggest that only three indicators appear to be different between gender groups (both in the Commercial Street context), four when comparing age groups (one for each street site), and two when comparing pro/lay groups. The overall difference between groups is less obvious than the pilot study results, possibly due to the increased sample size for each street site. Considering that perceptive differences of RCS evaluation has been eliminated through the first pilot study and formal survey in the expectation rating, individual perceptive differences will not be calculated again here.

Table 6- 16 Differences between age, gender, and professional relevance groups (SRMF 2.0 ratings)

Age	CM-Street	LS-Street	TO-Street	LL-Street	Gender	CM-Street	LS-Street	TO-Street	LL-Street	Pro/Lay	CM-Street	LS-Street	TO-Street	LL-Street
Complexity	0.385	0.987	0.964	0.740	Complexity	0.637	0.731	0.205	0.381	Complexity	0.309	0.581	0.124	**0.039**
Openness	0.135	0.150	0.846	0.313	Openness	0.937	0.382	0.269	0.122	Openness	0.774	0.874	0.642	0.848
Enclosure	0.772	**0.028**	0.627	0.763	Enclosure	0.780	0.648	0.282	0.385	Enclosure	0.362	0.756	0.264	0.631
Mystery	0.944	0.662	0.956	0.569	Mystery	0.129	0.360	0.696	0.359	Mystery	0.857	0.343	0.463	0.751
Visual Depth	0.578	0.144	0.650	0.297	Visual Depth	0.877	0.289	0.288	0.844	Visual Depth	0.112	0.294	0.533	0.409
Familarity	0.225	0.074	0.145	0.567	Familarity	0.873	0.139	**0.001**	0.076	Familarity	0.788	0.375	0.070	0.657
Upkeep	0.299	0.947	0.866	0.512	Upkeep	0.757	0.393	0.600	0.138	Upkeep	0.552	0.722	0.179	0.368
Legibility	0.650	0.615	0.528	0.994	Legibility	0.595	0.761	0.416	0.215	Legibility	0.286	0.789	0.237	0.412
Typicality	0.435	0.487	0.550	0.623	Typicality	0.976	0.400	0.239	0.072	Typicality	0.132	0.022	0.856	0.504
Quietness	**0.011**	0.981	0.437	0.711	Quietness	0.891	0.511	0.525	0.339	Quietness	0.352	0.626	0.688	0.579
Facilities	0.784	0.332	0.785	0.385	Facilities	0.896	**0.022**	0.329	0.423	Facilities	0.477	0.115	0.896	0.472
Lighting	0.359	0.887	0.756	0.102	Lighting	0.133	0.495	0.742	0.546	Lighting	0.888	0.718	0.059	0.481
Landmarks	0.760	0.922	0.923	0.699	Landmarks	0.831	0.365	0.813	0.301	Landmarks	0.342	0.297	0.604	0.096
Naturalness	0.209	0.603	0.068	0.118	Naturalness	0.144	0.922	0.941	0.959	Naturalness	0.756	0.658	0.500	0.559
Historicness	0.201	0.246	0.069	0.350	Historicness	0.770	0.497	0.409	0.970	Historicness	1.000	0.058	0.856	0.267
People	0.829	0.589	0.343	**0.038**	People	0.218	0.692	0.115	0.781	People	0.122	0.554	0.289	0.787
Cars	0.646	0.420	0.454	0.259	Cars	0.379	0.400	0.771	0.182	Cars	0.390	0.186	0.818	0.751
Typographic	0.987	0.398	**0.031**	0.626	Typographic	0.419	0.259	0.449	**0.008**	Typographic	0.125	0.217	0.331	**0.001**

Groups	Landscape and Leisure Street	Commercial Street	Living and Service Street	Traffic-oriented Street
Age	People	Quietness	Enclosure	Typography
Gender	Typography		Facilities	Familiarity
Pro/Lay	Complexity, Typography			

6.5.5 Discussion

This stage of research adopted a similar procedure to the earlier pilot study (see 6.4) but had different purposes. It was intended to establish the relationship between SRMF 2.0 indicators and RCS items to further shape the proposed SRMF for delivering restorative street design instructions. The final SRMF is composed of restorative related street indicators and their mechanism of influence on restorative experiences; this was developed according to the results of a correlational analysis in the formal survey (Table 6-17). The results show that there are 13 SRMF indicators influencing the street restorativeness of Sujiatun Road, 11 SRMF indicators influencing University Road, 13 influencing Zhangwu Road and seven influencing Guokang Road. The way of utilising the SRMF in improving street restorativeness should also take into consideration users' restorative expectations on the four street types discussed in Chapter 5 and their evaluations on current restorativeness of the four streets illustrated in this chapter (see 6.5.4).

Table 6- 17 The final SRMF.

		SRMS Associations			
SRMS Indicators (19)		Commercial Street	Landscape and Leisure Street	Living and Service Street	traffic volume-oriented Street
Formal (18)	Complexity		B(+) E(+) F(+) C(+)	E(+) F(+)	
	Openness	E(+) C(+)	B(+) E(+) F(+) C(+)	B(+) E(+)	E(-)
	Enclosure		B(+) E(+) F(+) C(+)	B(+) E(+)	
	Mystery	B(+)	B(+) E(+) F(+) C(+)	B(+) F(+)	B(+) F(+)
	Visual Depth		B(+) E(+) F(+) C(+)	E(+) C(+)	
	Familiarity	E(+)	F(+)		E(-)
	Upkeep			E(+) F(+)	E(+) F(+)
	Legibility	E(+) F(-)	B(+) F(+) C(+)		
	historicness		B(+)	E(+)	
	Typicality	F(-)	B(+) E(+) F(+) C(+)	E(+) C(+)	
	Naturalness	B(-)	E(-)	B(+) E(+)	C(-)
	Facilities	B(+) E(+) C(+)	F(+) C(+)	E(+)	
	Landmarks	F(-)	B(+) F(+) C(+)	E(+)	
	People	C(+)			
	Lighting	E(+)			E(+)
	traffic volume	B(+) F(+) C(+)	E(-)		E(-)
	Quietness			B(+) C(+)	
	Typography			E(+)	
Optional (1)	Waterscape				

*(*B=Being away; E=Extent; F=Fascination; C=Compatibility; '+'= positive relation; '-'= negative relation.)*

It can be observed from that the restorativeness of different types of urban street is influenced by different SRMF indicators. Furthermore, the mechanism of influence of each SRMF indicator varies with street types. Only one indicator, ‘mystery’, showed consistent effects across the four case-study streets, which was found to positively facilitate the component of *being away* for all of the four streets. ‘Openness’ was found to be relevant to the component of *extent* in the four street contexts, but with different influences; it was proved to be positive in University Road (Commercial Street), Sujiatun Road (Landscape and Leisure Street), and Zhangwu Road (Living and Service Street), but negative in Guokang Road (Traffic-oriented), in terms of promoting restoration. ‘Landmarks’, ‘legibility’, and ‘typicality’ were each confirmed to have a positive influence on the *fascination* component in Sujiatun Road, but also an inhibitive influence on the same ART component in University Road. Similarly, ‘naturalness’ facilitated the component of *being away* in Zhangwu Road but inhibit the same component in University Road. ‘Naturalness’ was also found to have different effects on the *extent* component, with a positive influence on the restorativeness of Zhangwu Road but a negative influence on Sujiatun Road. The same SRMF indicator sometimes even affects different ART components under different street contexts. For example, ‘traffic’ was proved to be positively related to *being away*, *fascination*, and *compatibility* in University Road, but a negative relation was also disclosed between ‘traffic’ and the component of *extent* in Sujiatun Road and Guokang Road.

Our findings suggest both consistency and inconsistency with previous research. According to the evidence that emerged from previous studies during the process of constructing the SRMF (see 6.3), most environmental indicators (besides ‘traffic’) that are directly relevant to restorative experiences have been shown to have positive relationship, or ‘U-shaped’ relationship. Although the current research results are mostly in line with previous findings, inconsistencies have also emerged. The most significant difference concerns with indicator ‘naturalness’, which was observed to have inhibitive effects on the *being away* component in University Road, the *extent* component in Sujiatun Road, and the *compatibility* component in Guokang Road. Also, another SRMF indicator, ‘legibility’, that has long been regarded as beneficial to restoration based on earlier studies, (see 6.3.1) was found to have a negative effect on the *fascination* component in University Road. In addition, ‘traffic volume’, that has widely been accepted as a negative restorative indicator (see 6.3.1), actually presented promotive effects on street restorativeness under the research context of University Road.

Responses to the open-ended question, which was designed to disclose missing indicators, show that most indicators people believe might benefit their mental recovery have already been included in SRMF 2.0. ‘Temporary activities’ and ‘music’ will not be included in the final SRMF, since they do not belong to the physical attributes of a street environment. ‘Comfort’ is a general description of walking experiences which, again, cannot being classified as a physical attribute. As for ‘waterscape’, it is an indicator deleted in SRMF 2.0 but raised again by participants in the formal survey. Considering that no waterscape is designed for any of the four case-study streets and it is very rare to observ as a component of an urban streetscape, this indicator is decided as a recommended indicator in the final SRMF (Table 6-17) which will only be evaluated when conditions allow.

The results suggest that there are no obvious individual perceptive differences influencing research findings, given that the between-group differences show no consistency between the pilot study and the formal survey, and indicators with significant differences across the groups appeared to be unstable across street types. Therefore, group differences will not be paid continuous attention in following analysis, but discussion will be provided wherever necessary.

6.6 Conclusion

‘Planners, landscape architects, land managers, public health workers, politicians aim to modify, maintain, and regulate environments so that they not only prese demand – less noise, less crowding, less air pollution, fewer scheduling constrain but also have physical, social, and temporal characteristics that promote restoration.’ (Hartig, 2003, p.103). However, this intention has always been impeded by the lack of an established, specific relationship between environmental attributes and restorative perceptions that can be modified, maintained and regulated. There is very limited evidence in existing research on restorative environments pointing towards the prominent restorative potential of certain elements, especially in urban environmental settings such as streets. This chapter described the process of identifying potential restorative related environmental indicators from existing literature. Given that very limited direct evidence of a link between restoration and environmental attributes has been found, this research extended its exploration into the literature of environmental preference and place identity, looking for indirect evidence since strong connections have been discovered between restoration and preference and between restoration and place identity. This research assumed that there may be restorative related indicators have not emerged in restorative environment literature but have actually been revealed in the other two research arenas. Therefore, the preliminary framework, composed of direct evidence from restorative environment studies and indirect evidence from preference and place identity studies, was called Street Restorative Measurement Framework (SRMF) 1.0.

SRMF 1.0, including 22 indicators potentially influential to street restorativeness, was validated through a pilot study on four selected urban streets. The results suggested that in general there was no indicator missing from SRMF 1.0, although some slight adjustments were required; the refined framework is referred as SRMF 2.0. This framework was then used together with RCS to investigate users' restorative perceptions of walking on four streets and their evaluations of current street attributes. Connection between SRMF 2.0 and RCS were explored statistically in order to find out which SRMF indicators influence street restorative perceptions, and how they do so. After two rounds (a pilot study and a formal survey) of adjustments to the SRMF, the final version (Table 6-17) was composed of 19 indicators: Ten of these (***complexity, openness, enclosure, mystery, visual depth, familiarity, upkeep, legibility, historic-ness, and typicality***) describe street quality, and the other nine (***naturalness, facilities, landmarks, people, lighting, traffic volume, quietness, typography, and waterscape***) describe street contents. This stage of research has also disclosed the specific influential mechanism of each SRMF indicator on the restorative perception of street users. It is necessary to highlight that each SRMF indicator functions on different types of street environment in different ways, and each type of street has its own relevant SRMF indicators in terms of restoration.

To the end of this stage, four pieces of fieldwork have been carried out for approaching research objectives 2, 3 and 4 respectively, with two of them set out from a restorative perception dimension and another one from a street design dimension. Chapter 5 describes two pieces of fieldwork for measuring the users' expected restorative experiences in streets. It contains a pilot study to see if RCS works in the current research context and to make any necessary adjustments based on fieldwork responses. A formal survey was designed afterwards wusing the refined RCS to gather users' restorative expectations of four types of Shanghai street, so that future restorative design improvements may be developed accordingly. This chapter describes another pair of pilot study and formal survey with the purpose of constructing and validating the SRMF, containing restorative related street indicators and their connections with restorative perceptions. The pilot study (see 6.4) is designed to validate SRMF 1.0, the preliminary framework built from existing evidence, to see whether it is feasible in the current context and make necessary adjustments. The product of the pilot, SRMF 2.0, only has street design indicators. SRMF 2.0 is then used in a formal survey together with RCS to establish the relationship between SRMF 2.0 indicators and users' restorative experiences. The product of the formal survey, which is also the product of this research stage described in this chapter, is the final SRMF, including not only restorative related street design indicators but also their specific influences on street restorativeness. So far, this study has used RCS to collect users' restorative expectations of four types of Shanghai street and their evaluations on current street restorativeness, and it has used SRMF to collect users' evaluations on restorative related street indicators; the connection between restorative perceptions and street indicators were also established using RCS and SRMF. Therefore, the next step in this research is to explore a way of utilising SRMF and users' restorative evaluations on both the current and expected street conditions to inform the necessary restorative street design instructions, so that the restorative potential of University Road, Guokang Road, Sujiatun Road, and Zhangwu Road can respectively be realised to meet people's expectations of Commercial, Traffic-oriented, Landscape and Leisure, and Living and Service Streets. Restorative Street Design Approach, the final aim of this research, hence is expected to reveal itself during the process illustrated in Chapter 5, Chapter 6, and the following Chapter 7.

CHAPTER 7 DEVELOPING RESTORATIVE STREET DESIGN INSTRUCTIONS

7.1 Introduction

This study has so far identified restorative related street design indicators from literature and established their influences with restorative experiences through an onsite questionnaire-based survey carried out on four urban branch streets in Shanghai (University Road, Sujiatun Road, Guokang Road and Zhangwu Road). These case-study streets were selected as being representative of the four typical street types set out in the Shanghai Street Classification System, which are Commercial Street, Landscape and Leisure Street, Traffic-oriented Street and Living and Service Street. Associations between street indicators and street restorativeness have been established and presented in the form of a framework, which is referred as the Street Restorative Measurement Framework (SRMF, see Chapter 6). The SRMF is an essential mid-product of this research and is capable of bridging the gap between street design aspect and restorative perceptions so that professionals can pinpoint the focus of street design with the help of the differences emerged between users' current and expected street restorativeness. Since the users' restorative expectations and their restorative experiences in the current street environment have both been evaluated with RCS in the previous stage (see Chapter 5), the next step towards finalising this research is therefore to utilise the differences between the RCS expectation and the results on current street environments to indicate street restorative improvements, and to utilise the SRMF so that specific design instructions can be properly developed.

This chapter attempts to clarify how to achieve the last stage of this research and complete the wholte process of developing RSDA. This research asserts that the discrepancies between the expected and current restorativeness can indicate necessary restorative improvements. Considering that both the current and expected restorativeness are measured using the RCS, their discrepancies can evidently be revealed mathematically. With the help of established connections between SRMF and RCS, this research assumes that necessary design instructions for adjusting restorative related street indicators can be developed accordingly. This chapter starts with a general introduction on the strategy for developing restorative street design principles based on the data and information obtained, starting with a discussion on possible design implications indicated by the differences between the expected and current street restorativeness evaluations. This is followed by four sections illustrating the evidence for proposed specific design instructions to improve street restorativeness in response to users' expectations, focusing on the four case-study streets. In the next sections, these four streets are taken as examples to illustrate the specific design instructions for improving their restorative quality according to users' expectations, coherently following the strategy described in 7.2. This chapter ends with a summary listing proposed restorative design implications based on street types. Important findings from this chapter are also highlighted in the ending section of this chapter.

7.2 Strategy of Developing Restorative Street Design Instructions

The reason for introducing the 'restorative expectation' concept has been fully explained in the earlier chapters of this thesis, which is to explore a way of delivering restorativeness efficiently and rigorously in response to users' expectations. This objective comes from the acknowledgement that the urban street is a place where multiple functions interact with each other, therefore a balance is required between its restorative potential and its ability to fulfil other place and movement functions. This study, therefore, has investigated both the current and expected street restorativeness using the RCS. It is assumed that the discrepancies between them can indicate how street restorativeness should be improved to meet users' wishes in terms of the four ART components, *being away, fascination, extent and compatibility*, that are described through the 15 RCS items.

The central focus of this research is to deliver street restorativeness coherently in response to users' expectations on different street types. The strategy of developing restorative street design instructions should be able to accurately alter the current street restorativeness to meet users' expectations. This process can be stated referring to a famous physics principle, the effect of a force is determined by its magnitude, direction and point of action (Newton, 1999). These three essential components for delivering the effect of a force correspond exactly to the information collected in this research for delivering restorative street design implications (Figure 7-1). Similarly, it is necessary to solve three problems for delivering restorative design instructions: 1) which street indicators need to be changed (‘points of action’), 2) how they should be changed (‘direction’) and 3) how much they should be changed (‘magnitude’). Accordingly, the ‘points of action’ are SRMF indicators relating to restorative benefits of different streets. For example, if the SRMF indicators ‘complexity, coherence and greenery’ are proved to be related to the Landscape and Leisure Street, these three indicators are what practitioners need to focus on when improving the restorative benefits of a street belonging to this category. ‘Magnitude’ and ‘direction’ both refer to the difference between people’s restorative evaluation on the current situation of a street and their restorative expectation of the street type it belong to, with the ‘direction’ indicated by whether the expectation exceeds the current RCS rating, while the ‘magnitude’ is represented by the discrepancy between the expectation and the current RCS rating. The following sections are organised into ‘magnitude’, ‘direction’ and ‘points of action’ to illustrate, in general, how the four selected case-study streets should be improved in terms of their restorative benefits to meet users’ requirements.

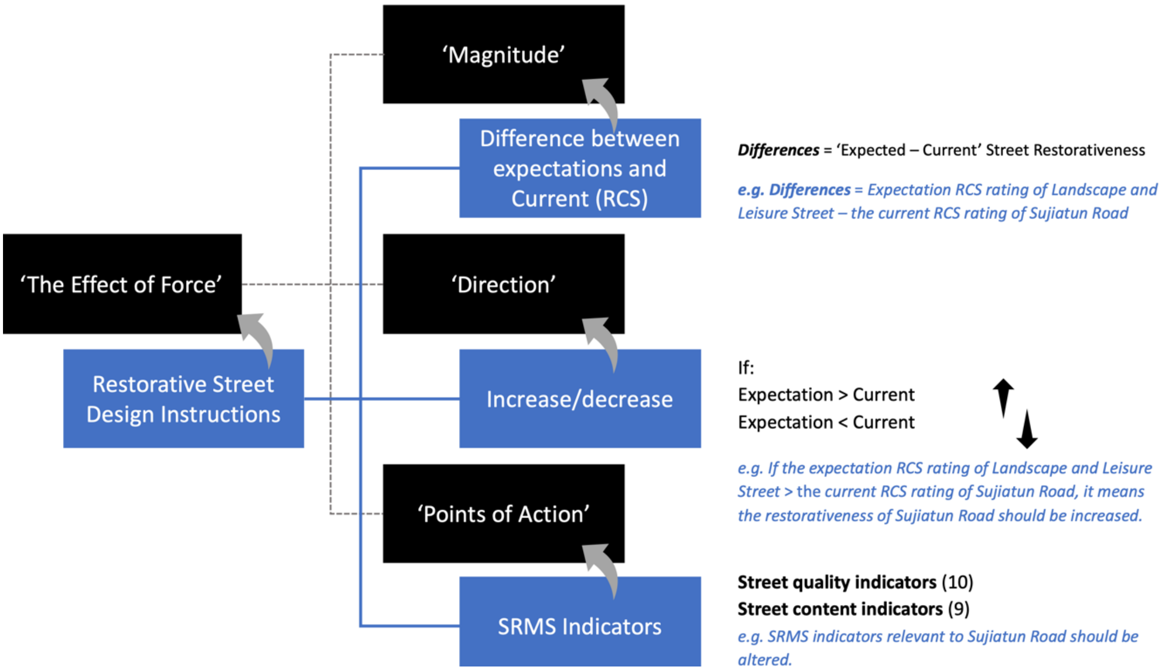


Figure 7- 1 The effect of force’ strategy for developing restorative street design instructions. Source: the author.

The **‘direction’** of alteration is determined by the negativity and positivity of the difference value between the expected and current street restorativeness, both measured by the RCS. A positive difference value suggests the current street restorative experiences do not meet users’ expectations; therefore, an improvement is required. A negative difference value means certain components of street restorativeness already fit with people’s wishes, hence no further effort is required, or a certain level of decrease can be discussed for sustainability considerations. It can be observed from the RCS rating results (Table 7-1) that the current restorativeness of the four case-study streets mostly does not meet users’ expectations in terms of almost all the ART components, except for the *compatibility* component of Guokang Road (Traffic-oriented Street). This finding implies that current restorativeness needs to be improved in relation to the four ART components (*being away, fascination, extent and compatibility*) in Sujiatun Road (Landscape and Leisure Street), University Road (Commercial Street) and Zhangwu Road (Living and Service Street), as well as three of the components (apart from *compatibility*) in Guokang Road (Traffic-oriented Street), so that they can deliver their restorative potential as per users’ expectations.

Table 7- 1 RCS ratings of expected and current restorativeness for the four case-study streets

Street Type	Restorativeness	Being away	Extent	Fascination	Compatibility
Landscape and Leisure Street (Sujiatun Road)	Current restorativeness (N=30)	3.83	4.12	3.81	4.71
	Std. Dev	1.13	0.96	1.17	0.72
	Expected restorativeness (N=153)	5.56	5.47	5.66	5.51
	Std. Dev	1.20	1.19	1.16	1.18
	Difference	1.73	1.35	1.85	0.80
	Sig.	0.479	0.095	0.648	0.002
Traffic-oriented Street (Guokang Road)	Current restorativeness (N=31)	3.05	3.97	2.86	4.09
	Std. Dev	1.10	0.98	1.38	0.99
	Expected restorativeness (N=153)	3.35	4.46	3.49	4.00
	Std. Dev	1.66	1.48	1.66	1.48
	Difference	0.30	0.49	0.63	-0.09
	Sig.	0.000	0.013	0.194	0.077
Commercial Street (University Road)	Current restorativeness (N=30)	3.61	4.21	4.29	4.42
	Std. Dev	1.04	0.80	1.03	0.83
	Expected restorativeness (N=153)	4.39	4.97	4.93	4.75
	Std. Dev	1.39	1.26	1.23	1.20
	Difference	0.78	0.76	0.64	0.33
	Sig.	0.060	0.013	0.170	0.021
Living and Service Street (Zhangwu Road)	Current restorativeness (N=30)	3.57	3.83	2.97	4.23
	Std. Dev	1.31	0.92	0.89	0.87
	Expected restorativeness (N=153)	4.46	5.06	4.79	4.98
	Std. Dev	1.31	1.23	1.31	1.21
	Difference	0.89	1.23	1.82	0.75
	Sig.	0.638	0.123	0.006	0.102

(B=Being away; E=Extent; F=Fascination; C=Compatibility)*

The **'magnitude'** of alteration is indicated by the significance level of differences existed between users' expected and current restorativeness (Table 7-1). The most significant differences (significant at 0.05 level) appeared in the *compatibility* (*Sig. .002*) of Sujiatun Road (Landscape and Leisure Street), the *being away* (*Sig. .000*) and the *extent* (*Sig. .013*) of Guokang Road (Traffic-oriented Street), the *extent* (*Sig. .013*) and the *fascination* (*Sig. .021*) of University Road (Commercial Street), as well as the *fascination* of Zhangwu Road (Living and Service Street). The moderate differences (significant at 0.1 level) were observed in the *extent* (*Sig. .095*) of Sujiatun Road (Landscape and Leisure Street), the *compatibility* = (*Sig. .077*) of Guokang Road (Traffic-oriented Street), and the *being away* (*Sig. .0.060*) of University Road (Commercial Street). No difference has been found in other ART dimensions of these four streets. These three-significance levels of differences are then used for indicating strong, moderate and weak level of design 'magnitude'.

The **'point of action'** refers to the SRMF indicators that need to be improved. In order to further investigate which aspects the design should concentrate on, we can use the SRMF since it is composed not only of restorative related street indicators but also their associations with the four restorative components, *being away*, *fascination*, *extent* and *compatibility*. Based on the previous analysis, two important associations that can contribute to developing restorative street design interventions have been established. Firstly, this research successfully revealed the gap between the current restorativeness and the expected restorativeness, so that it is now possible to know which restorative components of ART (*being away*, *extent*, *fascination* and *compatibility*) should be modified in terms of the four different streets and how this should be achieved. Also, this research managed to construct a bridge between the restorative components and the street design indicators, the relationship of which are set out in the SRMF (Table 7-2), so that necessary improvements on restorative components can be reflected in the street indicators relevant to restorativeness. It makes possible for us to pinpoint which street indicator requires our efforts for each of these four streets. Together with the 'direction' and 'magnitude', the 'point of action' helps in pinpointing restorative street design focuses.

Table 7- 2 SRMF including street design indicators and their influence on street restorativeness

SRMS Indicators (19)		Existing Evidence	SRMS	Existing Evidences	SRMS	Existing Evidences
Formal (18)	Complexity (-3 to 3)	• The more moderate the better for restoration • An **inverted-U** and a **positive** relation were found with preference	Upkeep (0 to 6)	• A **positive** relation was found with restoration and preference	Historic-ness (-3 to 3)	• A **negative** relation was found with urban place preference
	Openness (0 to 6)	• A **positive** relation was found with restoration and preference	Legibility (0 to 6)	• A **positive** relation was found with preference	Landmarks (-3 to 3)	• Not confirmed
	Enclosure (-3 to 3)	• A **negative** relation was found with restoration • An **inverted-U** relation was found with preference	Typicality (0 to 6)	• A **positive** relation was found with preference	People (-3 to 3)	• A **negative** and a **positive** relation were both found • A **inverted-U** relation were found with preference
	Mystery (0 to 6)	• A **positive** relation was found with restoration and preference	Lighting (0 to 6)	• A **positive** relation was found with preference	Traffic Volume (-3 to 3)	• A **negative** relation was found with restoration
	Visual Depth (-3 to 3)	• An **inverted-U** relation was found with restoration • A **positive** relation was found with preference	Facilities (0 to 6)	• Not confirmed	Naturalness (-3 to 3)	• A **positive** relation was found with restoration and preference
	Familiarity (0 to 6)	• A **negative** relation was found with preference	Quietness (0 to 6)	• A **positive** relation was found with restoration and preference	Typography (-3 to 3)	• Not confirmed
Optional (1)	Waterscape	A **positive** association was found with restoration and preference				

Besides the SRMF, which includes indicators and their relationship to street restorativeness (see Chapter 6), it is also necessary to refer to previous studies to establish how these SRMF indicators influence design practices within specific research contexts. Table 7-2 listed 19 SRMF indicators and their associations with restorative experiences that have been established in previous research in different environmental settings. This can help decision-makers form a basic understanding of the restorative influence of each SRMF indicator to make a synthetic judgement on how design should be introduced to improve street restorativeness. When interpreting specific design instructions, this research suggests that decision-makers should also consider how these indicators are described in the onsite-survey questionnaire. Therefore, each SRMF indicator should be interpreted referring to its emerging association with the restorative measurement results together with their descriptions in the questionnaire survey, and also their original research context (see Appendix 9). These implications are then further shaped for each of the four case-study streets to provide an example of how the obtained information should be used for developing street restorative design instructions with consideration given to the difference between the expected and the current restorative perceptions stated later in 7.3.

7.3 Developing Restorative Street Design Principles for the Four Case-study Streets

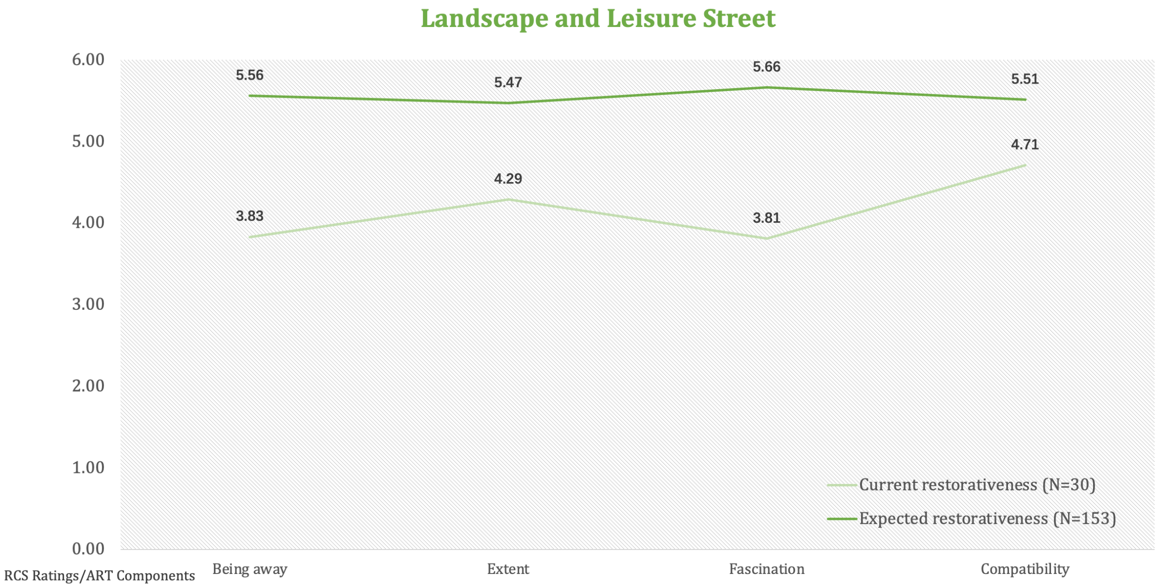
The research aim of delivering a Restorative Street Design Approach (RSDA) has been presented in this thesis from Chapter 4 to Chapter 6. So far, it has begun to reveal its shape starting with an investigation into the differences between users' expected and current restorative evaluations, then establishing connections between street indicators and restorative experiences and finally analysing these information for generalising appropriate design improvements. This part provides an example of how to develop restorative street design instructions that respond to users' expectations while also an example of how to use the RSDA to improve street restorativeness in practical street design. These design instructions on improving street restorativeness take the four case-study streets as examples. The four sets of design implications are also one of the expected research outcomes. The next four sections focus on how to utilise this Restorative Street Design Approach in relation to the four case-study streets in Shanghai and analyse the design implications for improving (promoting or inhibiting) their restorative qualities so that their current restorativeness can be enhanced (or weakened) to match people's restorative expectations. Each section discusses the three key aspects of developing restorative street design instructions, 'magnitude, direction and points of action' (Figure 7-1). The difference between the restorative expectations and the current rating is analysed to determine magnitude and direction, while SRMF indicators responsible for restorative benefits of each street are discussed one by one with the help of evidence in previous literature (Table 7-2) and the outcomes of this research uncovered in the last stage (see Chapter 6).

In the formal survey, 18 SRMF indicators ('waterscape' is excluded) are evaluated in two different ways given that one group of indicators describes street qualities, and the other group describes street contents. For those that previous research has identified as having an inverted-U relationship with restoration or preference, such as 'complexity, enclosure and visual depth', as well as those that have been rated according to whether they are of sufficient quantity, including 'naturalness, landmarks, people, traffic volume, historic-ness and typography', an evaluation rating was given from -3 to 3 with -3 meaning too little, 3 meaning too much and 0 meaning moderate. This rating criteria was provided to the participants during the survey. For the other nine indicators, 'openness, mystery, familiarity, upkeep, legibility, typicality, lighting, facilities and quietness', a rating was given based on general perception from 0 to 6 and then converted to the -3 to 3 ratings during the data analysis for the convenience of interpretation. Therefore, it is necessary to pay attention to the differences between the evaluation criteria when interpreting design implications, since 'more is better' cannot be applied to all SRMF indicators.

7.3.1 Landscape and Leisure Street – Sujiatun Road, Shanghai

In accordance with the strategies described earlier, the first step in developing the restorative design instructions for ensuring that the restorativeness of Sujiatun Road meets people's expectations is to determine how ('direction') and how much ('magnitude') restorative improvement needs to take place and then to identify the appropriate SRMF indicators to work on ('points of action').

'Direction' – The current restorative quality of Sujiatun Road, as measured by the RCS, is evidently lower than the expectation level rated by users in all the four ART components (Figure 7-2), which indicates that the restorativeness of Sujiatun Road should be promoted in terms of all four ART components, *being away*, *extent*, *fascination* and *compatibility*.



Street Type	Restorativeness	Being away	Extent	Fascination	Compatibility
Landscape and Leisure Street (Sujiatun Road)	Current restorativeness (N=30)	3.83	4.29	3.81	4.71
	Expected restorativeness (N=153)	5.56	5.47	5.66	5.51
	'Direction'	+	+	+	+
	'Magnitude'	Weak	Moderate	Weak	Strong

Figure 7- 2 The 'direction' and 'magnitude' for Sujiatun Road (Landscape and Leisure Street)

'Magnitude' – According to the above determined three level of design intervention, the *compatibility* requires a **strong** level of improvement in Sujiatun Road while the *extent* needs a **moderate** level of improvement. As for the other two components, *being away* and *fascination*, only **weak** level of improvement is necessary.

Table 7- 3 The 'points of action' for Sujiatun Road (Landscape and Leisure Street).

Landscape and Leisure Street																		
	Complexity	Openness	Enclosure	Mystery	Visual Depth	Familiarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
Being Away	+	+	+	+	+			+	+				+		+			
Extent	+	+	+	+	+				+					-			-	
Fascination	+	+	+	+	+	+		+	+		+		+					
Compatibility	+	+	+	+	+			+	+		+		+					

(B=Being away; E=Extent; F=Fascination; C=Compatibility)*

'Points of action' – In order to associate restorative difference with design instructions, it is necessary to refer to the SRMF to search for indicators related to the street restorativeness of Sujiatun Road (Table 7-3). It can be seen that six street indicators, 'complexity, openness, enclosure, mystery, visual depth and typicality', are positively correlated with the restorativeness of Sujiatun Road in the four ART components. Given that all four ART components require improvements, these six SRMF indicators, therefore, all need to be improved. In addition, 'legibility' and 'landmarks' are positively related with all the ART components apart from *extent*, and 'facilities' promotes both *fascination* and *compatibility*; hence these three indicators should be improved. On the contrary, 'naturalness' and 'traffic volume' were found to be capable of inhibiting the sense of *extent*, which may hinder the delivery of restorative experiences.

Figure 7- 3 Street picture of Sujiatun Road (Photo by the author).

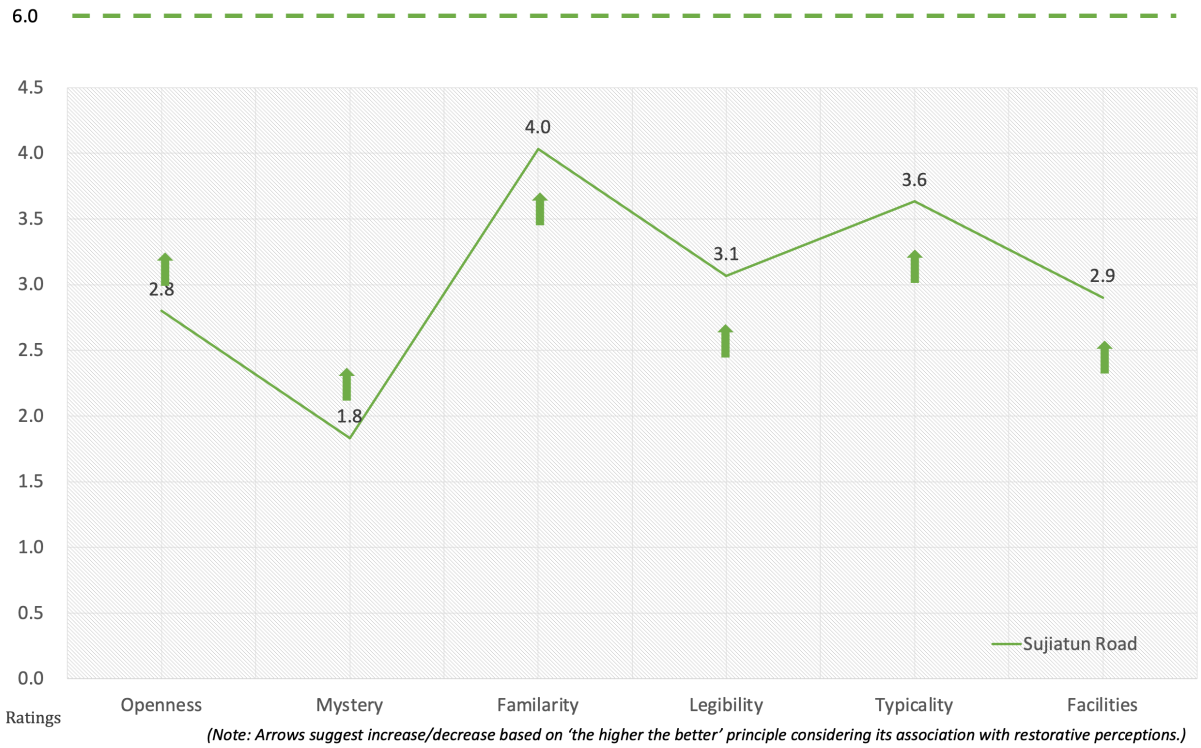


Figure 7- 4 The SRMF indicators (0 to 6) and their ratings in Sujiatun Road

Based on an integral analysis of 'direction, magnitude and point of action', participants' ratings on SRMF indicators (Figure 7-4, Figure 7-7), as well as the design implications of the SRMF indicators from previous studies (see Appendix 9), restorative design instructions for improving the current restorativeness of Sujiatun Road to meet users' expectations in terms of each relevant SRMF indicator are discussed below.

Openness (+) A positive relationship has been found between openness and the four ART components. The SRMF rating on openness (2.8) suggests that it currently lies at the general level. However, the openness of Sujiatun Road needs to be improved considering that it is positively related with street restorativeness, which is in line with certain previous research findings (Galindo and Hidalgo, 2005). Considering that the street frontages of Sujiatun Road are dominated by greenery and small-scale open spaces, its openness is primarily defined by street vegetation. This survey was conducted in early summer when all the vegetation was in leaf, so the street 'ceiling' of Sujiatun Road was covered by tree canopies. This may have resulted in the pedestrian's upward gaze being blocked, making it impossible to see the sky and leading to a low rating on openness. Shrubs and vegetation in flower beds were also flourishing during the survey season, so that may have interfered with the horizontal sight of pedestrians. In order to enhance its openness, well-designed, well-trimmed and well-maintained street-side vegetation would be helpful.

Mystery (+) As for mystery, this has been confirmed to have positive effects on the four ART components and was rated rather lower (1.8) in the survey, resulting in rather significant differences between the current and expected *fascination* level. This indicator is closely connected with 'familiarity' since the more people are familiar with Sujiatun Road, the less mystery they feel for this environment. Participants in this research were mostly regular street users who lived or worked nearby, hence Sujiatun Road is relatively lacking in mystery for them. Introducing wall art, street art and temporary weekend activities along the street edge could encourage people to explore and could therefore be useful in promoting the sense of mystery. Considering that it is a landscape-dominated street and located in the centre of a residential area, permanent changes to its streetside functions for the purpose of enhancing the sense of mystery, for example opening retail shops along the streetside, might jeopardise its original function for sustaining outdoor leisure activities.

Familiarity (+) Familiarity was only found to be related to the component of *fascination* in Sujiatun Road. Considering the large difference between the current and expected *fascination* in this street, the rather high rating of familiarity (4.0) might be a key influential factor inhibiting people from being attracted by the street environment. However, familiarity is a mediator in this research rather than a designable indicator since all target participants should be regular street users.

Typicality (+) Typicality can promote all the ART components and therefore is an important factor for achieving restorativeness. Sujiatun Road falls into the street category of Landscape and Leisure, which suggests it should be characterised by 'waterfront, landscape or historic characteristics and equipped with leisure and entertainment facilities along the street.' According to the SRMF ratings (3.6), Sujiatun Road is a typical representation of Landscape and Leisure Street, but it could still present its characteristics more prominently. Leisure facilities and natural landscape are sufficiently provided along both sides of the street. Considering its surrounds, the water element can only be delivered through small-scale waterscapes, such as fountains, if necessary. 'Historic-ness' will be discussed later in this section.

Legibility (+) The legibility of Sujiatun Road is positively related to both the *being away* and *compatibility* components and was rated at a general level (3.1) in the results. Even though Sujiatun Road is a well-known Landscape and Leisure Street in its neighbourhood, it has few outstanding features compared to other streets in the same neighbourhood, apart from having more vegetation and recreational facilities. The lack of active frontages, such as shops and cafes, weakened its general impression in pedestrians' minds and perceptions. Those pedestrians who were not using the streetside open spaces but only passing by, were less likely to notice or remember the pocket parks and street facilities set along the street, because these were mostly surrounded by dense vegetation. Considering that Sujiatun Road is a street space, the best way of improving its legibility is to create attractive frontages and its own landmarks. Here 'attractive' is not to say to introduce frontage types that are not in line with the context of Sujiatun Road, but to make streetside frontage interactive with pedestrians. Through carefully re-designing its streetside open spaces to increase interaction (both physically and visually) between pedestrians and open space users, its street 'edges' could be activated. This would enhance the legibility of Sujiatun Road. Another essential factor of legibility, landmarks, will be discussed later as an independent SRMF indicator. Figure 7-5

Figure 7- 5 Dense vegetation not only prevents pedestrians' from noticing streetside open spaces, but also weakens the legibility of Sujiatun Road (Photo by the author).

Facilities (+) The facilities indicator is responsible for two ART components, *fascination* and *compatibility*. There is a strong difference revealed between the current *fascination* and expected *fascination* level. This can partly be explained by the SRMF rating on 'facilities' (2.9), which suggests people are generally satisfied but an improvement is still required for the provision of street facilities. Currently, there are seats, neighbourhood greenways and open spaces with exercise and leisure facilities provided along the sides of Sujiatun Road. Figure 7-6

Figure 7- 6 Various and ample streetside seats and exercise facilities along Sujiatun Road generally satisfied with people's requirements (Photo by the author).

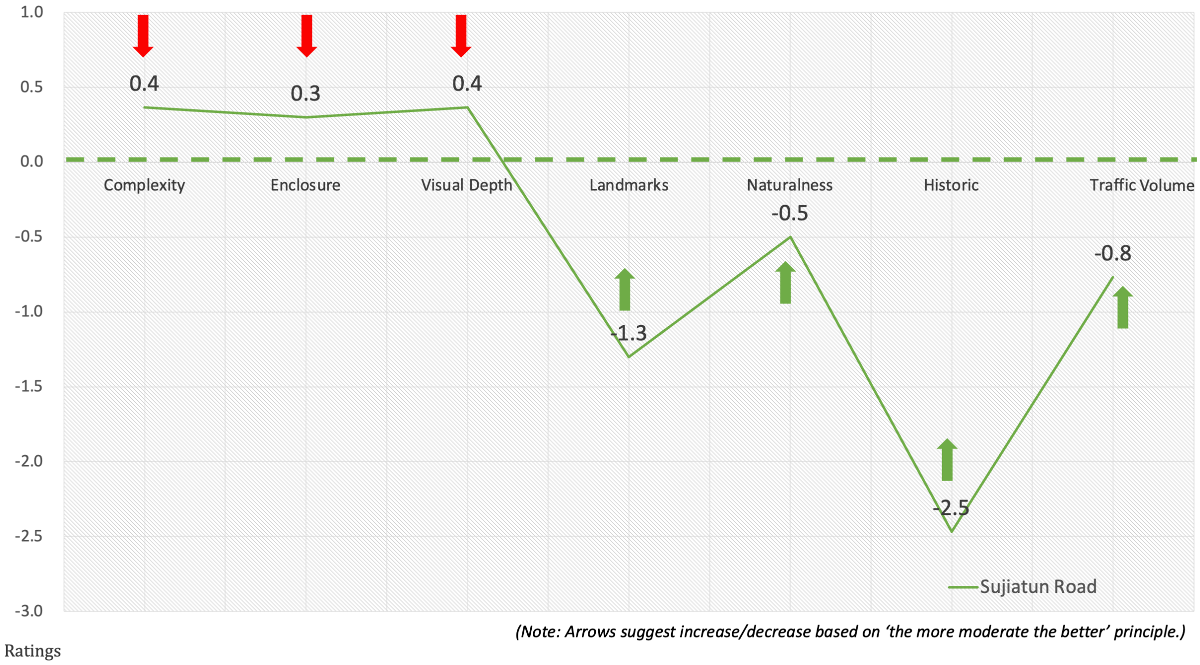


Figure 7- 7 'Direction' and 'point of action' of the SRMF indicators (-3 to 3) for Sujiatun Road.

Complexity (+) Complexity is proved to be influential to all the ART components in a positive way. The SRMF rating result indicates that the complexity (0.4) of Sujiatun Road is now at a moderate level, hence it can be lessened a little to promote restoration or stay unchanged. The predominant street element in Sujiatun Road when the survey was conducted was the green vegetation. There is also a residential greenway set aside as a pedestrian space of around 100m in length. In addition, several small-scale open spaces are located on both sides of the street to provide seats and leisure facilities (Figure 7-8). Since most street facilities in Sujiatun Road are intended for activities that make people stay, the activity level is rather high, especially during lunch breaks and after dinner. However, Sujiatun Road is a branch street that is only around 380m in length and 15m in width. Possible ways to reduce its complexity and to avoid a sense of over-design is to 1) use similar colours on its leisure facilities, which are now painted with over five colours, 2) keep street vegetation well-maintained and 3) move some of the less necessary street facilities to its connecting or nearby streets.

Figure 7- 8 Diverse and flourishing vegetation along Sujiatun Road ensure its complexity and richness in terms of street components (Photo by the author).

Enclosure (+) Enclosure is also positively correlated with the four ART components. It has an SRMF rating (0.3) slightly over the moderate level. Similar to 'openness', the strong sense of enclosure is largely determined by the street trees and greenery since the setback (mostly covered with vegetation) on each side is over 5m in width, which is now covered with vegetation that in total accounts for over 60% of its width. Densely planted vegetation and dense street trees can make Sujiatun Road seem narrower than it actually is. Again, well-designed streetside planting can enlarge its perceived width, thereby adjusting its enclosure to a comfortable level.

Visual Depth (+) Visual depth is a positive indicator on restoration in all the ART aspects. The SRMF rating (0.4) reveals that it is only slightly higher than the moderate level, hence can remain unchanged. Visual depth can be shortened perceptively by reducing sight blockage and decreasing curves. Sujiatun Road is in general a straight street, but the vegetation and street facilities might increase the view depth perceived by pedestrians while walking. Hence, possible improvements should be in line with those mentioned in the 'enclosure' and 'openness' sections, which is to have streetside vegetation that is well-designed, trimmed and maintained.

Historic-ness (+) Historic-ness was found to only be correlated with the ART component of *being away*. Hence, it is necessary to increase historic-ness to facilitate the sense of *being away*. The current SRMF rating for historic-ness (-2.5) suggests there is barely any historical atmosphere in Sujiatun Road, possibly due to the fact that it mainly serves as a residential street. Hence, the best way of presenting historical characteristics is to integrate them into design details such as through the selection of material for the seats and pavements, the design of pavilions in the pocket parks and the decoration details of street frontages. It also needs to be highlighted here that though historic-ness can promote *being away* and therefore promote restorativeness, whether and how to apply this indicator should be coherently based on local context to prevent unnecessary over-design or intrusion into that context.

Landmarks (+) Landmarks are positively related to '*being away*, *fascination* and *compatibility*', which indicates that an increase in landmarks can promote restoration. The SRMF rating for landmarks (-1.3) suggests that currently people think there is a lack of landmarks in Sujiatun Road. Considering that this street, located in the central area of the Siping neighbourhood, is residential and dominated by vegetation and exercise facilities, outstanding sculptures or symbolistic high-rise buildings would be inappropriate to its local context. There are several small-scale outdoor spaces located on the streetside of Sujiatun Road but without distinguishing characteristics (Figure 7-9). Hence, future design work may concentrate on making streetside open spaces become its landmark with relevant signage. For example, these open spaces could be re-designed with thematic concepts connecting them and giving them names that residents can easily remember.

Figure 7- 9 Streetside open spaces are sufficiently provided along street sides of Sujiatun Road, but none of them can be a landmark due to a lack of uniqueness (Photo by the author).

Naturalness and Traffic Volume (-) In order to enhance the sense of *extent*, naturalness and traffic volume should be decreased in Sujiatun Road. However, the SRMF ratings suggest that though naturalness (-0.5) and traffic volume (-0.8) are rated below 0 they are still very close to the moderate level. Hence, promoting the sense of *extent* should rely more on improving the SRMF indicators that are positively related to the component of *extent* than on decreasing naturalness and traffic volume. Of these, the traffic volume is a dynamic indicator in Sujiatun Road that changes during the day since there is no on-street parking allowed. Therefore, this indicator is difficult to control through design intervention. Design suggestions on naturalness are in line with the previous conclusions, according to the rating results.

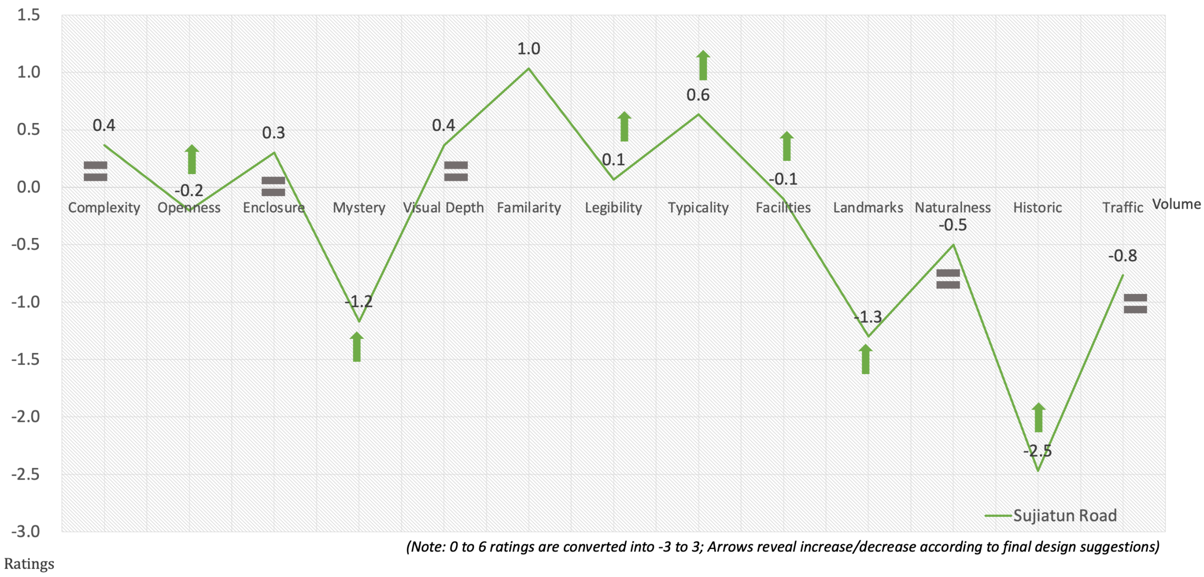


Figure 7- 10 'Direction' and 'point of action' of the restorative design approach for Sujiatun Road

To conclude (Figure 7-10), it is suggested that the four SRMF indicators relevant to the restorativeness of Sujiatun Road, 'complexity, enclosure, visual depth and naturalness', should remain unchanged or slightly decreased, if necessary. And the other seven indicators, 'openness, mystery, legibility, typicality, facilities, landmarks and historic-ness' require further enhancement in response to the level of users' expected restorativeness. 'Familiarity' and 'traffic volume' are difficult to design for and therefore will not be discussed in relation to design interventions. General street design instructions to improve the restorativeness of Sujiatun Road based on the analysis of each relevant indicator are given below:

a) To improve the SRMF indicator 'openness' through carefully designed streetside planting and maintenance, it is necessary to reduce the amount of streetside vegetation or increase the frequency of pruning, especially during summertime.

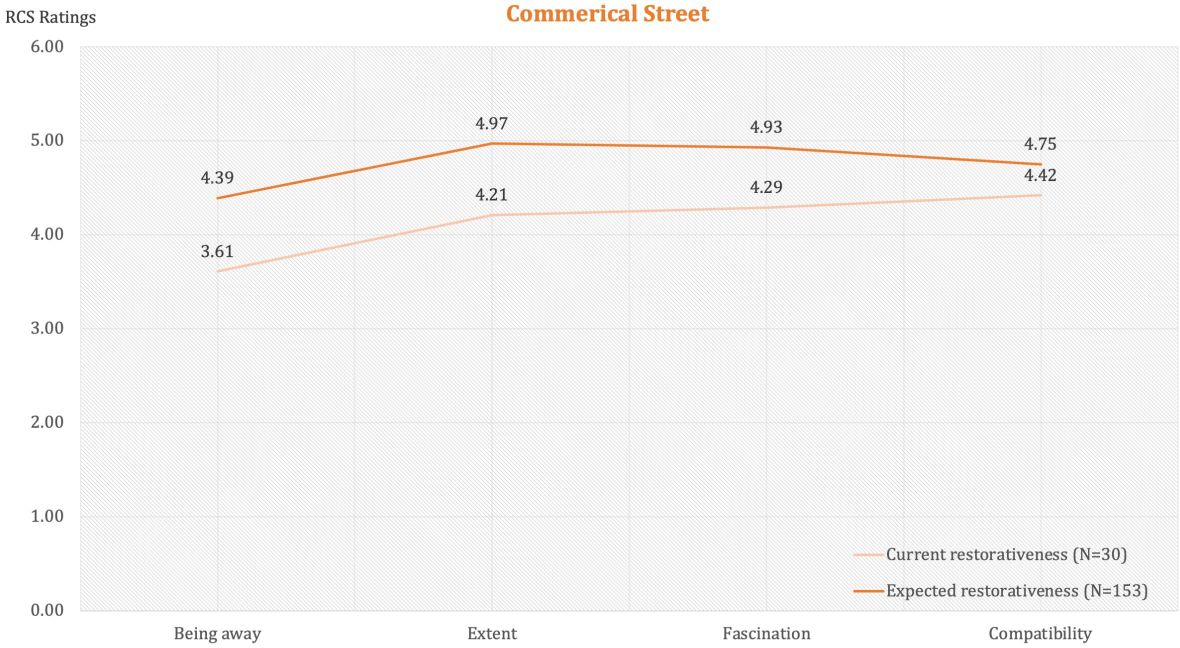
b) To improve the SRMF indicators of 'mystery, legibility and landmarks' through the careful redesign of current open spaces located along both sides of Sujiatun Road, it is proposed that the scattered small-scale open spaces be connected to each other. This can be realised by applying thematic design concepts. With meticulous design, these open spaces cannot only sustain their current capabilities for daily leisure activities but can also become an outstanding landmark for Sujiatun Road that welcomes more spontaneous and temporary activities.

c) To improve the 'historic-ness and typicality' SRMF indicators certain historic elements should be added to street frontages and facilities through design details.

d) To improve the provision of 'facilities' some leisure facilities (such as exercise equipment and children's recreational facilities) should be moved to its connecting streets, and the use of colour on street facilities should be regulated in order to increase the sense of unity.

7.3.2 Commercial Street – University Road, Shanghai

'Direction' – The current restorative quality of University Road, as measured by the RCS, is lower than its expectation level in all ART components (Figure 7-11), which indicates the direction of change in terms of its restorativeness relating to the components of *being away, extent, fascination and compatibility should all be towards promotion.*



Street Type	Restorativeness	Being away	Extent	Fascination	Compatibility
Commercial Street (University Road)	Current restorativeness (N=30)	3.61	4.21	4.29	4.42
	Expected restorativeness (N=153)	4.39	4.97	4.93	4.75
	'Direction'	+	+	+	+
	'Magnitude'	Moderate	Strong	Weak	Strong

Figure 7- 11 The 'direction' and 'magnitude' for University Road (Commercial Street)

'Magnitude' – The comparison between the expected and current RCS results (Figure 7-11) reveal that a **strong** level of improvements should be made on the ART components *extent* and *compatibility* in University Road (Commercial Street). The *being away* needs a **moderate** level of improvement while the *fascination* only requires a **weak** level of alteration.

Table 7- 4 The 'points of action' for University Road Commercial Street)

	Commercial Street																	
	Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
Being Away				+							+			-			+	
Extent		+				+		+			+	+						
Fascination								-	-				-				+	
Compatibility		+									+					+	+	

(B=Being away; E=Extent; F=Fascination; C=Compatibility)*

'Points of action' – For University Road (Table 7-4,), its ART component of *being away* is positively related to the three SRMF indicators of 'mystery, facilities and traffic volume' but negatively correlated with 'naturalness'. Positive influences of SRMF indicators on *extent* and *compatibility* components are observed only in the results with 'openness, familiarity, legibility, facilities and lighting' for *extent* and 'facilities, people, traffic volume and openness' for *compatibility*. 'Traffic volume' was found to have positive influences on enhancing *fascination* in University Road, but *fascination* can also be impeded by the inappropriate use of 'landmarks, legibility and typicality'.

Figure 7- 12 Street photo of University Road (Photo by the author).

It is necessary to highlight that the SRMF indicators relevant to the restorativeness of University Road (Commercial Street) are different to those contributing to Sujiatun Road (Landscape and Leisure Street). In addition, the influential mechanism can be different even in terms of the same SRMF indicator. Based on an integral analysis of 'direction, magnitude and point of action', participants' ratings on SRMF indicators (Figure 7-13, Figure 7-17), as well as the design implications of the SRMF indicators from previous studies (see Appendix 9), restorative design instructions for improving street restorativeness in University Road are discussed below.

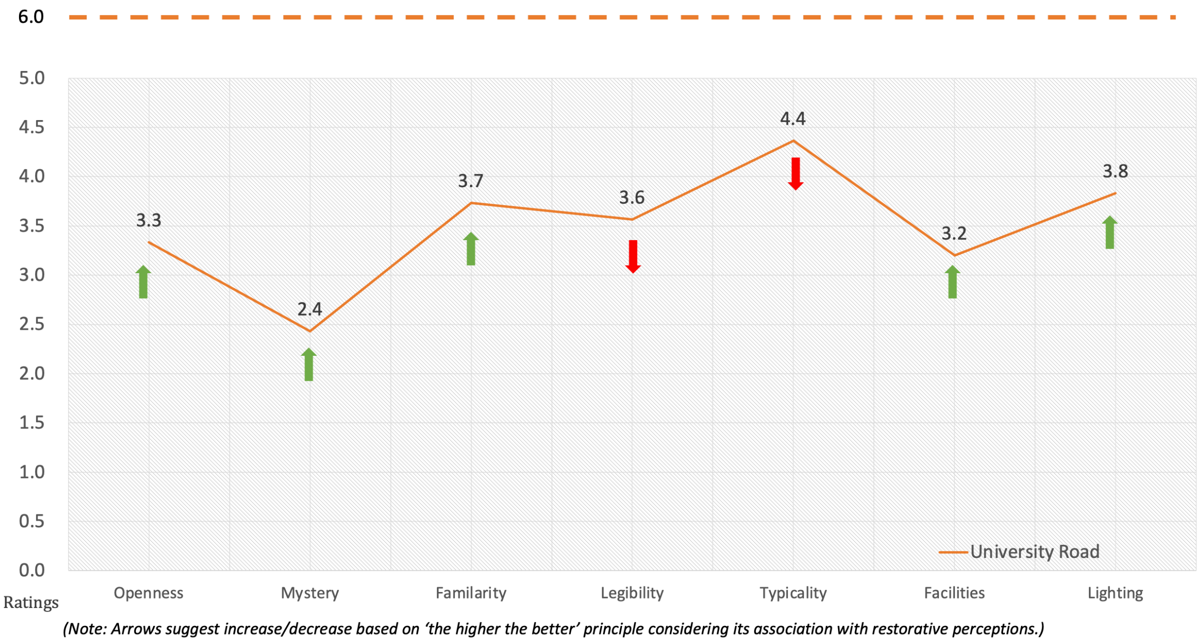


Figure 7- 13 'Direction' and 'point of action' of the SRMF indicators (0 to 6) for University Road

Openness (+) Both the *extent* and *compatibility* components of the ART can be influenced by openness in a positive way. Openness was rated 3.3 in the survey, which indicates that, at a general level, street users are satisfied. The street frontages of University Road at its northwest end are currently defined by small-scale green spaces, while residential buildings define the vertical perceptions at its southeast end. Also, street setback at its northwest end is larger than that at the southeast end since the frontages at the southeast end are mostly retail shops. The users' rating of openness might be mediated by setback distance variations along University Road since the northwest end of University Road is narrower than its southeast end. The northwest end of University Road mostly has retail shops on either side; therefore, the perceived openness of this road can be visually increased by encouraging streetside shops to use transparent frontages such as windows. Figure 7-14

Figure 7- 14 Setback differences between the northwest and southeast ends of University Road make the openness of it vary from the north side to the south side (Photo by the author).

Mystery (+) Mystery was found to be positively related to *being away* in the context of University Road. It was assessed relatively low in the survey (2.6), which reveals a necessity for improving the sense of mystery in the road to promote restoration. Given that streetside frontages along University Road are currently dominated by shops, similar ways of attracting customers have been used by most of the shops, such as French windows, outdoor seats and flower beds. Therefore, people, even those visiting for the first time, can easily figure out how the road is organised within the first 50m of walking along it. There is a lack of diversity in retail categories since it is currently dominated by the food service. A mixed-use of street frontages or retail categorisations could not only provide users with a level of uncertainty in terms of streetside functions but also naturally generate a variation in setback distances among ground-floor shops.

Familiarity (+) Familiarity was only found to be positively related to *extent* rating higher than the general level (3.7). This finding means that most participants are regular users of University Road, which is in line with the final goal of this research, to deliver restorative experiences to the working-group participants' everyday environments.

Legibility (-) There is a positive connection between legibility and *extent* and a negative connection between legibility and *fascination*. Considering the SRMF rating on legibility (3.6) is slightly above the general level, and both *extent* and *fascination* require improvements, legibility of the University Road can remain unchanged or be slightly decreased. University Road is currently well-known for being a neighbourhood Commercial Street composed of diverse food services, but its legibility is largely weakened by its overly rich street contents, especially the shop frontages. When there are too many things to focus on, people lose their focus. Therefore, improving restorativeness through legibility can be achieved by designing an outstanding landmark and decreasing the number and diversity of its current streetside shops. Figure 7-15

Figure 7- 15 Lack of variation in frontage type since most of them are small-scale retails, such as cafes and restaurants (Photo by the author).

Typicality (-) The SRMF indicator 'typicality' is especially correlated with *fascination* in a negative way, which was rated relatively high (4.4) in the SRMF results. This result suggests that University Road is a typical Commercial Street, but its typicality deters the way people perceive *fascination*, which inhibits restoration. One possible explanation is that its well-known definition as Commercial Street makes people overly expectant of what they might find there. In addition, the definition for Commercial Street is one in which 'street types and frontage types are highly mixed' or containing 'more than two types of characteristics' (SPLRAB et al., 2017). In addition, the street frontages are mostly food services and cafes, hence there is a lack of variation in frontage use. Accordingly, possible ways of increasing *fascination* are to reduce the number of shops along the side of the street and introduce more diversity in frontage use to create a softer landscape. As long as University Road is primarily composed of commercial shops, its categorisation as Commercial Street will not be weakened, and it can provide pedestrians with more attractions and variety.

Facilities (+) ‘Being away, *extent* and *compatibility*’ were all found to be positively related to facilities. Its rating (3.2) indicates that current University Road facilities can fulfil users’ needs. However, outdoor seats are mostly provided by surrounding shops, cafes and restaurants rather than the street itself, so the underlying understanding of ‘paying to use’ deters people who want to rest but have no intention of consuming anything. Some of these outdoor seats are surrounded by well-designed vegetation and fences that further indicate their ‘semi-private’ nature, while most pedestrians need them to be open and public. Therefore, it is necessary to design more public resting places along the street given that University Road provides attractions that encourage people to stay. It has also been noticed from the additional question responses that many street users think the provision of lavatories a necessity.

Lighting (+) Lighting is positively correlated with the *extent* component, which needs to be moderately improved to meet pedestrians’ restorative expectations. The SRMF rating on lighting (3.8) indicates generally satisfactory lighting conditions in University Road. In early summer, this road is shaded by two rows of trees, sunshades put up by restaurants and cafes, as well as the shade from surrounding buildings. Given that the survey was conducted in early summer when all the trees were in leaf, the sunlight might have been blocked out too much. Encouraging the use of transparent street frontages, such as glass windows, can allow indoor lights to come through and lighten up the whole street without pedestrians being burned by the strong summer sunlight. Figure 7-16

Figure 7- 16 The blooming tree canopy and sunshades of frontage shops might block the sunlight in Summertime (Photo by the author).

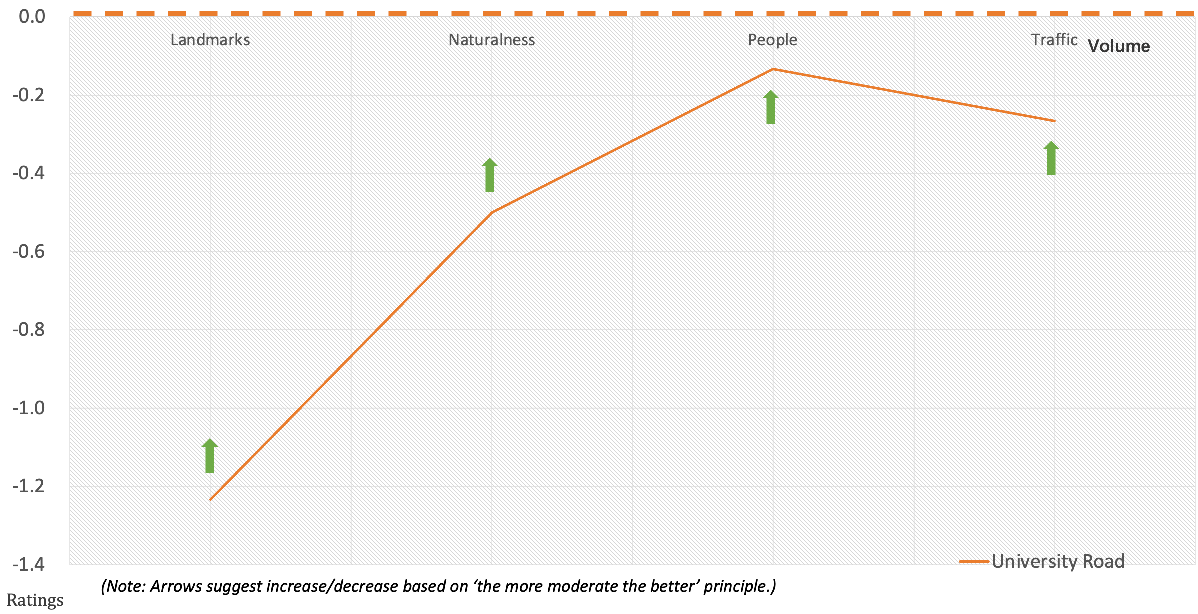


Figure 7- 17 'Direction' and 'point of action' of the SRMF indicators (-3 to 3) for University Road

Naturalness (-) Naturalness is negatively related to *being away* and therefore should be decreased in University Road if restorativeness is to be increased. The SRMF rating for naturalness (-0.5) shows that the current amount of greenery is at the general level. Besides the trees, the dominant vegetation type is the flower bed, mostly set up by surrounding shop owners in order to attract customers (Figure 7-18). The reason that greenery is identified from research findings as in need of decreasing is possibly due to the fact that the flower beds are not consistently regulated. Plants in front of shops sometimes obstruct pedestrians, both in terms of movement with ease and sight. Hence, design guidelines should be provided to shop owners to regulate this.

Figure 7- 18 Vegetation in front of shops sometimes obstruct pedestrians, both in terms of movement with ease and sight (Photo by the author).

Landmarks (+) A positive relation has been noticed between landmarks and the *fascination* component, which means that the number of landmarks needs to be increased to enhance *fascination* in University Road. The SRMF rating for landmarks (-1.2) indicates that there are relatively few landmarks, and this does not, therefore, sufficiently fulfil people's requirements for achieving *fascination*. Even though the University Road frontages are mostly active, and the street environment has sufficient flowers, trees and small-scale open spaces, it lacks any outstanding features. One possible explanation is that its higher level of activity interferes with peoples' judgement on what the landmark of University Road is. This means that too many street elements in this street make it weak in presenting its most outstanding features. This finding is in line with the analysis result in the 'legibility' section. Therefore, possible ways of delivering landmarks in University Road from the street design perspective are the same as those generalised in the 'legibility' section.

People (+) People are only associated with the *compatibility* component, which is in line with previous findings suggested in terms of social interaction as a basic human need (Staats and Hartig, 2004; White et al., 2010). The rating (-0.1) suggests that street users in University Road are moderately satisfied with the social opportunities, which is indicated by its current volume of pedestrians. Besides the shops and outdoor spaces, another way to attract people would be temporary activities, such as a market, outdoor movies and street art. University Road already has various street retailers, but temporary activities during festivals and at weekends can further strengthen its vibrancy by attracting more visitors and encouraging social interactions. An appropriate location for holding temporary outdoor activities is a small-scale open space located at the southeast end of University Road.

Traffic Volume (+) It has been noticed that traffic volume has a positive relationship to the restorativeness of University Road in the '*being away*, *fascination* and *compatibility*' components. Perhaps this is because people expect to experience a certain *extent* of hustle and bustle when they decide to go to a busy Commercial Street. The SRMF rating on traffic volume (-0.3) suggests that pedestrians are generally satisfied with the current traffic volume in University Road. Even though there is no requirement suggested by research findings to control the traffic volume, its current traffic regulations, such as being a one-way street and no on-street parking, should not be loosened.

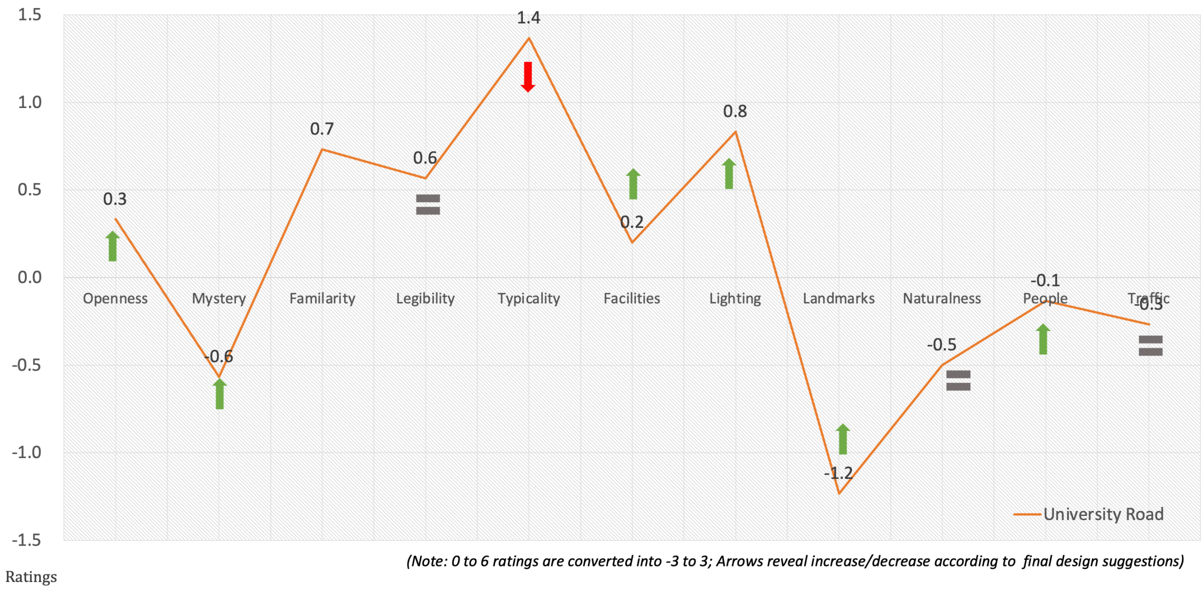


Figure 7- 19 'Direction' and 'point of action' of the restorative design approach for University Road

To conclude (Figure 7-19), among the SRMF indicators relevant to University Road, only 'typicality' needs to be decreased and six indicators, 'openness, mystery, facilities, lighting, landmarks and people', require further enhancement in response to users' expected restorativeness. 'Legibility and traffic volume' should stay unchanged since 'legibility' revealed some countereffects for *extent* and *fascination*, and street users are generally satisfied with the current 'traffic volume'. Similarly, the SRMF indicator 'familiarity' will not be discussed for specific design interventions. General street design instructions to improve the restorativeness of University Road based on the analysis of each relevant indicator are:

a) To improve the SRMF indicators of 'mystery' and 'landmarks' by reducing the number of shops along University Road and finding and highlighting its most outstanding feature as its own landmark, for example the metro station plaza located at the west end of University Road.

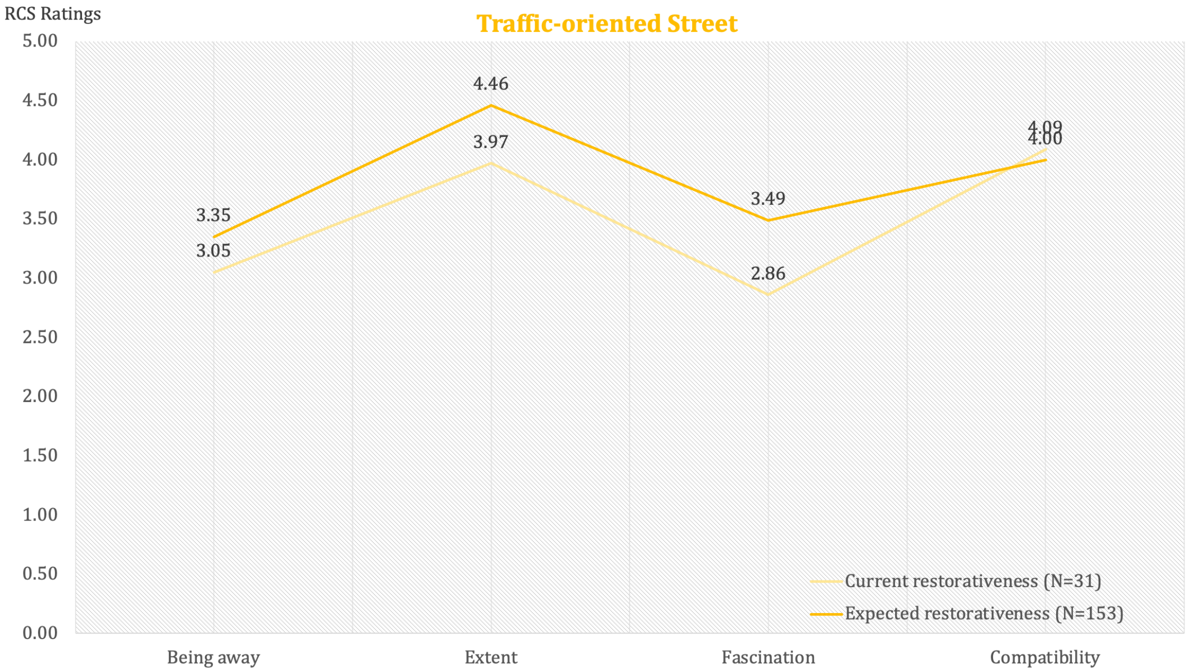
b) To improve the SRMF indicators of 'openness' and 'lighting' through the regulation of flower beds by streetside shop owners and encouraging greater use of transparent frontages to allow light transmission from surrounding buildings.

c) To improve the provision of 'facilities' by providing more resting spaces and streetside seats for the public.

d) To increase the volume of 'people' by encouraging greater variety in frontage use and introducing temporary activities, such as markets, at weekends and during festivals.

7.3.3 Traffic-oriented Street – Guokang Road, Shanghai

'Direction' – The current restorative quality of Guokang Road, as measured by the RCS, is lower than its rated expectation level in *being away*, *extent* and *fascination*, but the *compatibility* were rated higher than users' expectations (Figure 7-20). This finding suggests that, in general, the restorativeness of Guokang Road should be promoted and the relevant design should primarily focus on the components of '*being away*, *extent* and *fascination*'.



Street Type	Restorativeness	Being away	Extent	Fascination	Compatibility
Traffic-oriented Street (Guokang Road)	Current restorativeness (N=31)	3.05	3.97	2.86	4.09
	Expected restorativeness (N=153)	3.35	4.46	3.49	4.00
	'Direction'	+	+	+	-
	'Magnitude'	Strong	Strong	Weak	Moderate

Figure 7- 20 The 'direction' and 'magnitude' for Guokang Road (Traffic-oriented Street)

'Magnitude' – Two directions of alteration have emerged in the context of Guokang Road (Figure 7-20). For the *being away* and *extent*, a **strong** level of improvement is necessary while a **weak** level of improvement is expected on *fascination*. A **moderate** level of decrease should be made on the *compatibility* according to users' current and expected restorative ratings.

Table 7- 5 The 'points of action' for Guokang Road (Traffic-oriented Street)

	Traffic-oriented Street																	
	Complexity	Openness	Enclosure	Mystery	Visual Depth	Familiarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
Being Away				+														
Extent		-				-	+					+					-	
Fascination				+			+											
Compatibility														-				

(B=Being away; E=Extent; F=Fascination; C=Compatibility)*

'Points of action' – Compared with the other three streets, relatively less SRMF indicators were found to be related to the street restorativeness of Guokang Road (Table 7-5). Improvements on *being away* can be realised with an increase in 'mystery', and *fascination* can be promoted by both 'mystery' and 'upkeep'. 'Upkeep' and 'lighting' are positively related to providing a sense of *extent*, while 'openness', 'familiarity' and 'traffic' have the opposite effect on the same ART component. In addition, 'naturalness' inhibits the realisation of *compatibility* on Guokang Road.

Figure 7- 21 Street photo of Guokang Road (Photo by the author).

Based on an integral analysis of 'direction, magnitude and point of action', participants' ratings on SRMF indicators (Figure 7-23), as well as the design implications of the SRMF indicators from previous studies (see Appendix 9), restorative design instructions on each SRMF indicator for promoting the restorativeness of Guokang Road to meet peoples' expectations are discussed below.

Openness (-) Openness can inhibit the sense of *extent*, but the *extent* component of Guokang Road needs to be promoted. Hence, the current openness of Guokang Road should be further decreased. The SRMF rating on its current situation suggests that the openness of Guokang Road is now already at a rather low level (2.1). Since there are mainly university fences and greenery along Guokang Road, its openness can be visually decreased by altering street frontages and greenery. The setback of surrounding buildings is currently fixed, but perceptions can be altered by a softer landscape design. Hence, decreasing users' perceived sense of openness could be realised by increasing human eye-level vegetation design. Even though there are fences, walls and vegetation along both sides of Guokang Road, the length of its fence-type frontage is over 400m on the one side and over 150m on the other side. Fences can allow the flexibility of visual interaction between street users and people in surrounding blocks and this evidently increases people's perceived sense of openness. Therefore, growing hedgerows along fences could be useful in limiting the openness of Guokang Road.

Familiarity (-) The SRMF result showed a general familiarity of people with Guokang Road (3.6). Familiarity was found to be relevant with *extent* in a negative way, which suggested the more people were familiar with Guokang Road, the less likely they would be to get restoration here. However, users' familiarity level can be adjusted by increasing unexpected changes, which will be discussed in the following 'mystery' section. Familiarity itself can only be seen as a mediator for clarifying if participants are regular street users.

Mystery (+) Mystery is positively connected with two ART components, *being away* and *fascination*, and both need to be enhanced. The SRMF rating (3.6) also indicates necessary improvements are required to enhance the sense of mystery in Guokang Road. Considering that street frontages are mostly dominated by fences, vegetation and walls, possible ways of providing unexpected surprises for street users here would be introducing temporary activities and encouraging retailers, such as cafes, at its west end. This increase in interactive activities along street edges can provide more possibilities, which improves the sense of mystery for pedestrians.

Upkeep (+) Upkeep is positively correlated with the *extent* and *fascination* components and was rated (3.0) at a general level in the survey. Hence, the maintenance condition of Guokang Road should be improved. In a street environment, its maintenance level is largely concerned with the pavement, vegetation, street facilities (litter bins, streetlights, seats, etc.) and frontage conditions. Guokang Road is Traffic-oriented Street with no seating provided. Its street frontages are dominated by fences and vegetation. Therefore, maintenance improvements should focus on the smoothness of the pavement surface, as well as pruning and training plants.

Lighting (+) The component of *extent* can be facilitated by the increase in street lighting. Guokang Road was rated slightly over the general level (3.5) on lighting, which indicates that people are generally satisfied with current daylight conditions, though further improvement is encouraged. The daylight situation is largely influenced by tree canopies, surrounding buildings and vegetation. People's satisfaction might have been weakened because the survey was conducted in early summer when the canopy heavily shades the street. Hence, control over lighting conditions should be carefully considered together with the other SRMF indicators that are associated with *extent*.

Naturalness (-) Naturalness is negatively related to the *compatibility* of Guokang Road. The component of *compatibility* has a higher current rating than its expectation level. This indicates that there is no necessity for improvements or that only slight inhibitions are needed. This finding means that the amount of vegetation in Guokang Road should remain unchanged or be slightly decreased. The SRMF rating for naturalness (-0.2) is also in line with the above finding. Guokang Road was largely dominated by greenery such as trees, shrubs and flower beds when the survey was conducted. At that time, it was early summer when all the vegetation was green and dense. Therefore, this slight change in relation to naturalness can be ignored for now.

Traffic Volume (-) Traffic volume is confirmed to have a negative relation with *extent* and was rated slightly over the moderate level (0.6) in the SRMF survey. The current level of *extent* has not reached the users' expected level; therefore, it requires further enhancement by reducing the volume of automobile traffic. Traffic control is a planning issue rather than a street design problem; however, on-street parking can be decreased and strictly regulated. To assess this, the traffic volume indicator measured the total number of automobiles in Guokang Road, including both moving and static vehicles. Figure 7-22

Figure 7- 22 On-street parking in Guokang Road makes people less relaxed by preventing the occur of a sense of extent (Photo by the author)

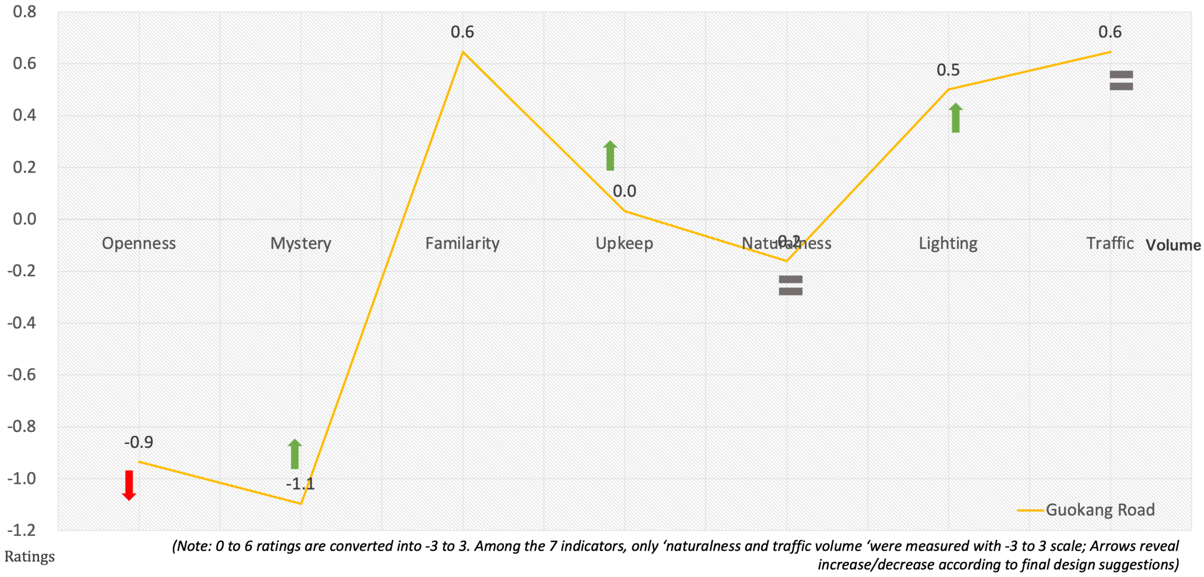


Figure 7- 23 'Direction' and 'point of action' of the restorative design approach for Guokang Road

To conclude (Figure 7-23), there are three SRMF indicators, 'lighting, naturalness and traffic', that are relevant to the restorativeness of Guokang Road and can remain unchanged, while the other three indicators, 'mystery, upkeep and lighting', require moderate enhancement in response to users' expected restorativeness. 'Familiarity' will not be discussed for design alterations and 'openness' should be moderately decreased. General street design instructions to improve the restorativeness of Guokang Road based on the analysis of each relevant indicator are:

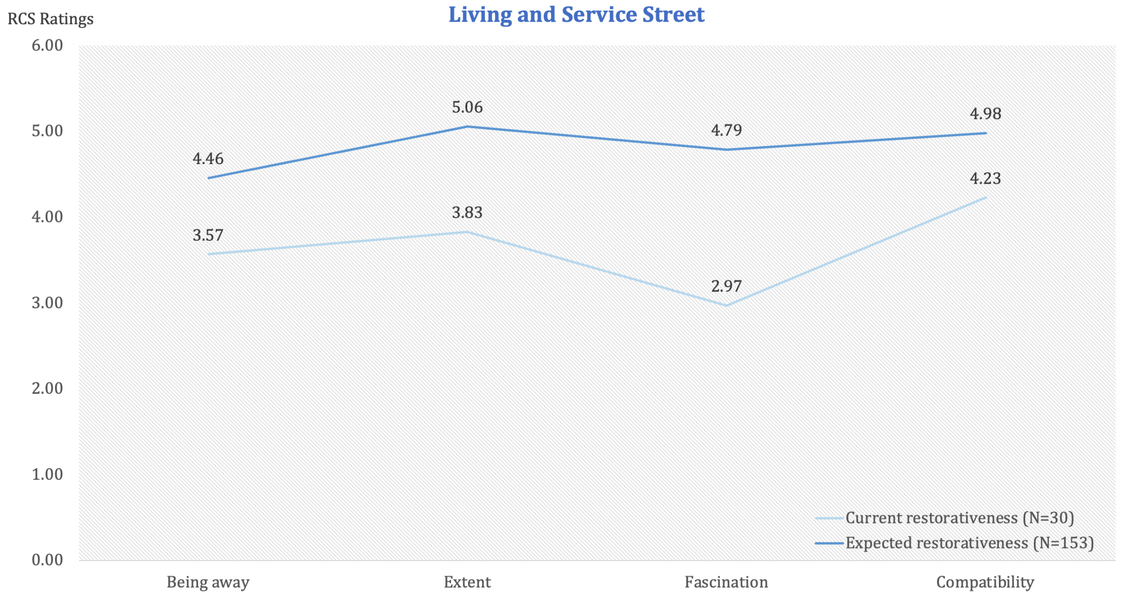
a) To improve 'mystery' by encouraging more diverse use of street frontages, such as cafés, to generate spontaneous social interactions and by encouraging more variation in streetside vegetation, such as the use of seasonal flowers and a variety of designs in flower beds.

b) To improve the 'upkeep' level of Guokang Road by paying more attention to the maintenance status of pavements and vegetation and by regulating on-street parking (cars and bicycles).

c) To adjust users' perceived street 'openness' by planting more hedgerows behind the south side of the university fences. Planting street trees in a continuous row on the west side of the street can also be helpful.

7.3.4 Living and Service Street – Zhangwu Road, Shanghai

'Direction' – The current restorative quality of Zhangwu Road, as measured by the RCS, is slightly lower than the expectation level of its users in all ART components (Figure 7-24), which means the direction for making alterations for its restorativeness in relation to the components of *being away, extent, fascination* and *compatibility* should all be towards promotion.



Street Type	Restorativeness	Being away	Extent	Fascination	Compatibility
Living and Service Street (Zhangwu Road)	Current restorativeness (N=30)	3.57	3.83	2.97	4.23
	Expected restorativeness (N=153)	4.46	5.06	4.79	4.98
	'Direction'	+	+	+	+
	'Magnitude'	Weak	Weak	Strong	Weak

Figure 7-24 The 'direction' and 'magnitude' for Zhangwu Road (Living and Service Street)

'Magnitude' – Only one direction of design alteration is required for Zhangwu Road, which is to promote (Figure 7-24). The strong level of design intervention should be taken on the *fascination* while the other three, *being away*, *extent* and *compatibility*, all only requires a weak level of promotion.

Table 7- 6 The 'points of action' for Zhangwu Road (Living and Service Street)

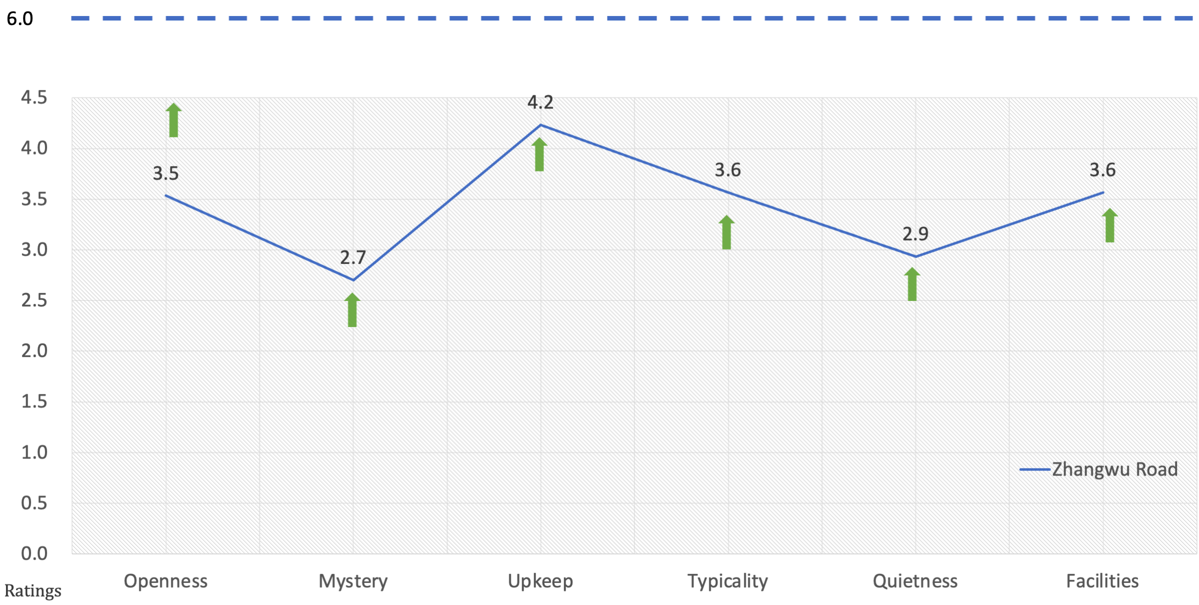
Living and Service Street																		
	Complexity	Openness	Enclosure	Mystery	Visual Depth	Familarity	Upkeep	Legibility	Typicality	Quietness	Facilities	Lighting	Landmarks	Naturalness	Historicness	People	Traffic	Typographic
Being Away		+	+	+						+				+				
Extent	+	+	+		+		+		+		+		+	+	+			+
Fascination				+	+				+	+	+			+	+	+	+	
Compatibility		+			+		+		+	+								

(B=Being away; E=Extent; F=Fascination; C=Compatibility)*

'Points of action' – A total number of 13 SRMF indicators have been found to be relevant with the restorativeness of Zhangwu Road (Table 7-6). 'Openness' and 'enclosure' were found to be useful in promoting the sense of *being away* and *extent*. 'Naturalness' is responsible for two ART components, *being away* and '*fascination*. 'Quietness' is positively related to both *being away* and *compatibility*. The SRMF indicator 'mystery' has been found positively useful in realising *fascination*, while 'facilities', 'landmark', 'historic-ness' and 'typography' are observed to have positive influences on the component of *extent*.

Figure 7-25 Street photo of Zhangwu Road (Photo by the author)

Based on an integral analysis of 'direction, magnitude and point of action', participants' ratings on SRMF indicators (Figure 7-26, Figure 7-27), as well as the design implications of the SRMF indicators from previous studies (see Appendix 9), restorative design instructions on the SRMF indicators for improving the restorativeness of Zhangwu Road in order to achieve peoples' expectations are discussed below.



(Note: Arrows suggest increase/decrease based on 'the higher the better' principle with the consideration on its association with restorative perceptions.)

Figure 7- 26 'Direction' and 'point of action' of the SRMF indicators (0 to 6) for Zhangwu Road

Openness (+) *being away* and *extent* are positively related to openness, therefore the openness of Zhangwu Road should be increased. The SRMF rating (3.5) indicates a general level of current openness. Setback distances in Zhangwu Road vary along the street with a minimum of two meters in width and a maximum of 10 meters, therefore its perceived 'openness' gradually decreases from its west end to its northeast end. Hence, design interventions should focus on visually increasing the openness at the northeast end of Zhangwu Road. Given that the current setbacks are mostly defined by buildings, possible design approaches for increasing openness at the northeast end of Zhangwu Road should concentrate on vegetation design, especially by reducing the density of greenery in the flower beds.

Mystery (+) Mystery has been confirmed to have a positive relation with two ART components, *being away* and *fascination*. It was rated at 2.7 and therefore should be increased so that *being away* and *fascination* can be enhanced accordingly. One possible explanation for the low mystery rating is that most participants are quite familiar with Zhangwu Road since they are nearby residents. Even though frontage use and setback distances vary along this street, there are limited attractions for everyday street users. Temporary activities, street art and wall art could be helpful in terms of increasing the sense of mystery since they would be unpredictable even for those who use Zhangwu Road every day. There are two suitable locations for holding small-scale temporary activities, both at the west end of Zhangwu Road. In terms of wall art, there is 150m of outside wall currently surrounding a neighbourhood on the north side of Zhangwu Road, now coloured cream. Irregularly replaced creative wall painting could enhance the sense of mystery and become a local landmark.

Upkeep (+) Upkeep can facilitate the sense of *extent* and *fascination*, and therefore obvious improvements are expected through design interventions relating to this indicator. Though the maintenance of Zhangwu Road was generally satisfactory with a relatively higher SRMF rating (4.2), it could be improved by paying more attention to the smoothness of its pavement, cleanliness and the normal provision of street facilities.

Typicality (+) Typicality is also found to be positively correlated with the two ART components of *extent* and *compatibility* in the research context of Zhangwu Road. As Living and Service Street in Shanghai, Zhangwu Road should be dominated by residential services as well as small- to middle-scale retailers. Typicality was rated 3.6 in the survey, highlighting that the users' impression of Zhangwu Road was basically in line with its definition. There are 300m of retail frontage use, primarily food services, on the south side of Zhangwu Road and 250m of mixed-use frontage on its north side composed of residential facilities and small shops. Together they provide daily services for the surrounding neighbourhood. Its well-delivered living service function is also validated with the very slight differences that exist between users' expected and current *compatibility*.

Facilities (+) The ART component of *extent* is confirmed with a positive relation to the SRMF indicator 'facilities'. Considering that the discrepancy between people's expectations and its current expectation, facilities need further refinement. The SRMF rating on facilities (3.6) suggests that users are generally satisfied with the provision of street facilities in Zhangwu Road. However, they do claim that more resting spaces are needed. In response to the above design requirements interpreted from the 'complexity' result, providing more streetside seats and resting spaces in Zhangwu Road is a necessary design intervention towards enhancing restorativeness.

Quietness (+) Quietness can contribute to promoting *being away* and *compatibility*. Further improvement is necessary considering that the current level of 'quietness' in Zhangwu Road is only rated 2.9. Improving quietness in Zhangwu Road should start with analysing its sound sources, which are primarily composed of traffic noise, people's conversations and advertising audio from the surrounding food market. Among these, people's conversations cannot be controlled since the presence of human activities in Zhangwu Road is dynamic. Traffic noise can be decreased by adopting silent tyres or road-surface material that can absorb noise. From the perspective of street design, encouraging greenery could be a solution, because trees absorb noise (Rubenstein, 1992) to a certain *extent*.

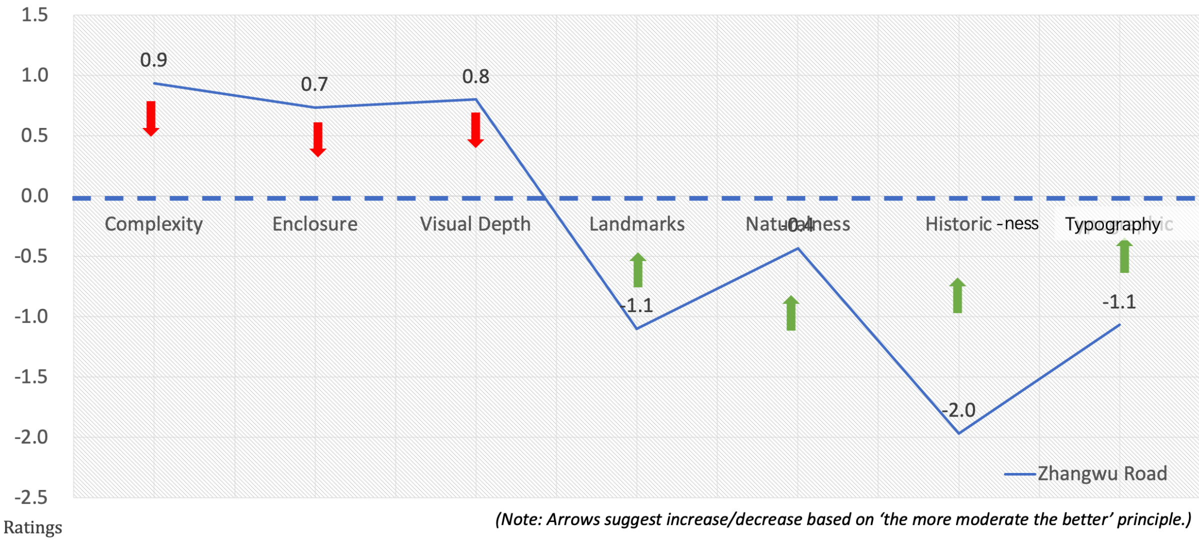


Figure 7- 27 'Direction' and 'point of action' of the SRMF indicators (-3 to 3) for Zhangwu Road

Complexity (+) Complexity has positive influences on two of the ART components, *extent* and *fascination*, in the context of Zhangwu Road. According to the RCS ratings, there is a moderate difference between the current and expected level of *extent*, while between the current and expected level of *fascination* a significant difference is observed. Results indicate that the complexity of Zhangwu Road should be increased so that its components of *extent* and *fascination* can be improved. However, the current complexity of Zhangwu Road was rated (0.9) slightly over the moderate level (0). Together with the above findings, this suggests that the complexity of Zhangwu Road can remain unchanged or marginally increased. Street elements in Zhangwu Road include streetside shops, bus stops, street trees and flower beds. Considering that the complexity of Zhangwu Road should only be marginally increased, the most appropriate way to achieve this is to increase the diversity of existing street elements rather than increasing the type of street elements.

Enclosure (+) Enclosure is positively connected to *being away* and *extent*, which both require improvements. Given that the SRMF rating on enclosure (0.7) suggests it is currently slightly higher than the moderate level, it can remain unchanged or only slightly increased. Possible ways of enhancing the sense of enclosure in Zhangwu Road include using higher hedgerows or shrubs in streetside flower beds to vertically define its boundary.

Visual Depth (+) An increase of visual depth can increase the sense of *extent* and *compatibility* and in that way promote restoration. Currently, visual depth is rated (0.8) slightly higher than the moderate level (0), hence it can stay unchanged or be slightly increased. There is a bend of nearly 90 degrees in the middle section of Zhangwu Road that might prevent pedestrians from seeing the length of the road. This bend cannot be changed through street design. Furthermore, *extent* is also influenced by many other SRMF indicators and *compatibility* only needs a weak level of improvement. Based on this, visual depth should remain unchanged for now.

Historic-ness (+) Historic-ness was found to be positively related to the component of *extent* and it was rated rather lower (-2.0) than the moderate level as an SRMF indicator. In order to promote users' restorative perceptions, restorative design should concentrate on highlighting the historic atmosphere of Zhangwu Road. As it is a residential street located in the centre of the Siping neighbourhood with its major purpose to be providing local residents with living conveniences, an appropriate way of enabling street users to perceive a sense of historic-ness is through design details rather than introducing strongly contrastive historic buildings. Historic design details can be embodied in building façades and street facilities, and the local context should be carefully considered in the delivery of historic details.

Naturalness (+) Naturalness is shown to be positively related to two ART components, *being away* and *extent*, and it was rated (-0.4) below the moderate level in the SRMF survey. This finding suggests that the number of natural elements should be increased in Zhangwu Road. Street trees are planted along both sides of the road while flower beds are primarily located close to its west end. In general, the richness of greenery decreases from its west side to its east. Based on the current situation of Zhangwu Road, diverse planting other than street trees should be introduced on the east side street sections of Zhangwu Road.

Landmarks (+) Landmarks are only responsible for the component of *extent*, also in a positive way. It was rated -1.1 and therefore an increase in the number of landmarks in Zhangwu Road is required. This requirement is in line with the need to facilitate the sense of *extent* to fulfil people's expectations. There are potentially three ways to design landmarks for Zhangwu Road. The first is to design wall art or introduce vertical vegetation on the neighbourhood wall on its north side, which is now a blank, cream-coloured wall. It is also possible to design statues for the street plaza located at the west end of Zhangwu Road. There is a gathering of food shops on the ground floor of Tongji United Plaza, close to the west end of Zhangwu Road. It now provides a space for food vendors rather than being a landmark representing the lively and leisurely atmosphere of Zhangwu Road. Hence, a well-designed and characteristic food market representing Zhangwu Road could be another approach.

Typography (+) A positive relation has been exposed between *extent* and 'typography'. The SRMF rating suggests that in Zhangwu Road there are few typographic variations (-1.1). An essential quality of a street environment is movement with ease for all street users, hence typographic variations should be delivered in the surrounding setback spaces rather than in the pedestrian areas. Flower beds and seats could also be delivered with height differences.

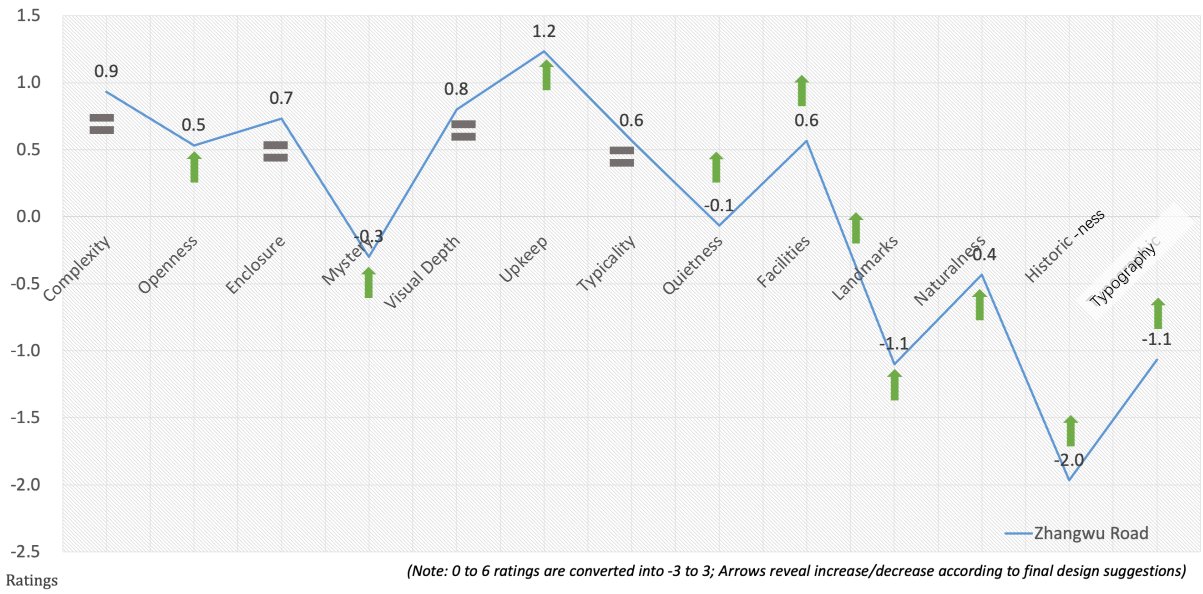


Figure 7- 28 'Direction' and 'point of action' of the restorative design approach for Zhangwu Road

To conclude (Figure 7-28), 10 SRMF indicators are required to be improved while four indicators, 'complexity, typicality, enclosure and visual depth', can remain unchanged. Taken into consideration the difference between the current restorativeness and users' expectation, 'mystery and upkeep' are expected to be evidently increased, while a moderate level of enhancement should be made to 'openness, visual depth, typicality, facilities, landmarks, naturalness, historic-ness, and quietness'. General street design instructions to improve the restorativeness of Zhangwu Road based on the analysis of each relevant indicator are:

a) To improve the SRMF indicators of 'mystery and landmarks' for Zhangwu Road by designing regularly changing wall art for its frontage wall, and by encouraging more temporary activities and designing outstanding landscape features for two open spaces (one street plaza and one food mall) located at the west end of Zhangwu Road.

b) To improve users' perceived 'openness' by carefully pruning streetside vegetation, especially in summer.

c) To improve the SRMF indicators of 'naturalness and quietness' by designing more streetside vegetation such as hedgerows and shrubs. With the consideration of 'complexity', an increase should be made to the amount of existing street vegetation rather than in terms of diversity.

d) To improve the SRMF indicator of 'upkeep' by paying more attention to the smoothness of the pavement, environmental cleanliness and the pruning of the plants.

e) More 'typographic variation' is required mainly in planting design and the design of the streetside open spaces located at the west end of Zhangwu Road. 'Historic' details are also encouraged to be embodied mainly in frontage and facility design. In addition, resting places along Zhangwu Road are currently insufficient. Therefore, street seats and resting spaces in open areas should be provided for improving the 'facilities' indicator.

7.4 Discussion

It is rather obvious from the above interpretation results that for each case-study street, their design focuses are quite different for the purpose of improving street restorativeness. For Sujiatun Road (Landscape and Leisure Street), its current restorativeness is significantly insufficient for sustaining the components of *compatibility*. Given it was found to be related to the SRMF indicators of 'complexity, openness, enclosure, mystery, visual depth, legibility, typicality, facilities and landmarks', its restorative design should focus more on the improvement of the current streetside planting, the redesign of existing open spaces, as well as the reduction in the number of recreational facilities. As for Guokang Road (Traffic-oriented Street), the most obvious restorative difference between its current condition and users' expectation lies in the *being away* and *extent* components. Among the SRMF indicators that are relevant to these two components, 'openness and traffic' were found to be negatively related while 'mystery, upkeep and lighting' were positively related. The key to improving the street restorativeness of Guokang Road is, therefore, to control on-street parking, encourage more social interactions along street edges through greater variety of streetside usage and to improve its environmental maintenance status. In terms of Zhangwu Road (Living and Service Street), its restorative design focuses on promoting the active use of its existing streetside open spaces for attracting temporary activities, encouraging more streetside planting, and designing creative wall art for neighbourhood walls. For University Road (Commercial Street), 'openness, legibility, facilities and lighting' all relate to its restorative potential by influencing *extent* which was the component that required the most improvement according to the RCS evaluations. Design instructions to achieve users' restorative expectations include: to regulate surrounding flower beds, offer more resting spaces along the street edge, introduce more variations in street frontage use and encourage temporary activities in open spaces.

When interpreting design instructions, it should be noted that there is some negative relation between SRMF rating results and the restorative association of SRMF indicators. For example, the 'naturalness' of University Road was found to be negatively correlated with its restorativeness, therefore the improvement on the *being away* component requires a decrease in naturalness. However, the SRMF rating results on 'naturalness' suggested that people think the current number of natural elements in University Road is slightly lower than the moderate level. From a synthetic perspective, the 'naturalness' of University Road should remain unchanged but pruning and meticulous plant design might be necessary. This is regarded to be reasonable because for each ART component (*being away, fascination, extent* and *compatibility*), there is normally more than one related SRMF indicator. Therefore, even if one influential indicator is left unchanged because it has a countereffect, other indicators that are also relevant to the same ART component can contribute to making it achieve the users' expectations. This attempt to improve street restorativeness through the consideration of its current environmental situation can achieve a balance between the restorative quality of the street and their other characteristics that need to be maintained.

It is also necessary to make additional clarifications on two SRMF indicators, 'familiarity' and 'historic-ness'. Though 'familiarity' was found to be positively related to the *extent* component of University Road, the *fascination* component of Sujiatun Road (Landscape and Leisure Street) and to negatively influence the *extent* component of Guokang Road (Traffic-oriented Street), it cannot be altered through design interventions. Given that this research intends to deliver street restorativeness to its everyday users, most participants are local residents using the target streets on a regular basis. This high level of familiarity has been confirmed by the SRMF results for the 'familiarity' indicator in all four streets. Therefore, 'familiarity' should be regarded as an indicator that validates whether respondents fulfil the participation requirements in this study, but still should be regarded as an influential indicator in other different research contexts. In terms of 'historic-ness', it was mentioned as important in Sujiatun Road and Zhangwu Road as a positive restorative indicator. However, the design of 'historic-ness' has to be in line with the local context without disrupting the original atmosphere of the street. Hence, the delivery of 'historic-ness' is better embedded in a hard landscape, such as street facilities and sculpture, or in the design details of surrounding building façades and silhouettes, so that historic details do not supersede what really counts in the general environments.

7.5 Conclusion

This chapter describes the process of applying the developed Restorative Street Design Approach to deliver restorative street design instructions for four case-study streets selected in Shanghai. These are University Road (Commercial Street), Zhangwu Road (Living and Service Street), Guokang Road (Traffic-oriented Street) and Sujiatun Road (Landscape and Leisure Street). It attempted to synthetically utilise gathered information from earlier stages to pinpoint which restorative components need to be improved to promote restoration for each case-study street, to identify which SRMF indicators can contribute and how, as well as to provide guidance on how much the current level of these indicators should be altered to achieve the users' expectation level. By employing this RSDA on each of the four case-study streets, restorative design instructions are presented in this chapter, and their differences and commonalities on design focuses in terms of improving street restorativeness are discussed. The following two chapters of this thesis will provide a comprehensive review on all these findings from this research with a discussion on limitations and reflections on the developed Restorative Street Design Approach. Moreover, future implications are also provided based on the experiences and findings learned during this process.

CHAPTER 8 FINDINGS AND GENERAL DISCUSSION

8.1 Introduction

In general, the **Research Aim** of developing a coherent and efficient Restorative Street Design Approach (RSDA) for improving restorative street benefits according to users' expectations, has been achieved. The process of achieving it has been illustrated in last three chapters and mainly includes following three steps: 1) evaluating the current and expected level of street restorativeness from users' perspectives; 2) establishing a connection between street design indicators and users' restorative perceptions to reflect restorative experiences on relevant environmental attributes; and 3) using the discrepancy between current and expected restorativeness, and the established connections so that restorative design instructions can be generalised and adjusted according to street context. The RSDA is developed through a mixed-method approach involving literature review and questionnaire-based and on-site surveys and it is then applied on four case-study streets selected in Shanghai to develop necessary design instructions. This set of restorative street design instructions not only confirms the feasibility of this developed approach but is itself an important output of this research.

The research aim was anatomised into five objectives listed in Chapter 1, which were then structured into progressive steps for furthering this study. The first objective (**Objective 1**) is to formalise the central research concept, restorative street, which is achieved by disclosing the overlaps between restorative environment research and the social value of urban streets via a literature-review based discussion included in Chapter 2. The second objective (**Objective 2**) is to build a preliminary framework composed of restorative related street design indicators, which was accomplished in this research by excavating restorative related evidence from previous literature. The efficiency of this framework was then validated through street case studies, and connection with restorative perceptions has been mathematically established (**Objective 3**). The whole process of constructing the validation framework (SRMF) is described in Chapter 6. Restorative perceptions were measured using the Restorative Component Scale (RCS), a mature instrument selected from developed measurements in relevant restorative environment research. Chapter 5 presents the use of the RCS for measuring restorative perceptions of street users both for their current evaluations and their expected restorative experiences (**Objective 4**). Research findings from previous stage for fulfilling these four objectives are then used for developing coherent restorative street design instructions, according to users' expectations (**Objective 5**), which is discussed in Chapter 7. In general, this research is divided into three major stages (see Chapter 3) to approach the five research objectives. The first stage, which concerns **Objectives 1,4 and 5,** is to find a way of measuring expected and current street restorativeness from users' perspectives so that discrepancies can be used to inform necessary improvements in terms of providing street users with restorative experiences (see Chapter 5). The second stage is to construct the Street Restorative Measurement Framework (SRMF) composed of restorative related environmental indicators from existing literature, and to have measurements validated in urban street contexts to achieve **Objectives 2 and 3** (see Chapter 6). The final stage is to correlate restorative perceptions with street design indicators included in the SRMF so that the discrepancies (perceptive information) revealed in the first stage can be reflected on relevant design attributes **(Objective 5**, see Chapter 7) with the help of the established connections.

Throughout this research, efforts have been made to enhance and extend current understandings of restorative environment research by demonstrating that it can be applied in hard, urban settings, especially on streets. One of the main research innovations is its proposal that restorative benefits are perceptive variables related to expectations users have for different street types. This research asserts that the delivery of street restorativeness through design practices should largely be determined by street users' expectations and should consider street typologies because streets are spaces wherein multiple functions work together. This assertion has been confirmed during the process of measuring and differentiating users' restorative expectations regarding street types. The findings of this research not only confirm that restorative benefits of urban streets exist, but also indicate that specific restorative design instructions should be developed based on street types and users' expectations.

The fundamental path for achieving the research aim and objectives has been clarified, and major outcomes have been highlighted. The following sections are organised according to the three aforementioned research findings, and each section includes discussion of reflections and practical implications. Research limitations and possible improvements are then discussed, followed by a conclusion that summarises important findings and their value on promoting potential future research.

8.2 Restorative Street, User Expectation and Street Typology

8.2.1 Reflections

This research attempts to unite environmental restoration theory and urban street design studies, and to explore if their overlaps can be utilised for delivering restorative experiences to urban street users. To date, relevant studies focus either on nature-dominated urban spaces like parks and gardens, or on natural constituents in urban spaces, which can only highlight the importance of nature by offering urbanites opportunities to relax and recover. The constraints of providing urban residents with sufficient natural contacts has been fully clarified in Chapters 1 and 2, which presented the need to disclose the restorative potential of urbanscape-dominated places, or even places entirely characterised by urban features. The general findings of this research not only indicate that street environments are restorative, but that they should be designed to be more restorative according to people's wishes and this can vary across street types. Strong and inter-connected evidence emerging from this research confirm that well-designed urban environments are capable of providing restorative experiences (Lindal and Hartig, 2005; Ivarsson and Hagerhall, 2008; Karmanov and Hamel, 2008), and this further facilitates restorative environment research in urban contexts. Departing from one of the typical urban space (the street), this research broadens the conceptual framework of restorative environment research by stressing the restorative benefits of everyday urban settings. On the other hand, this study extends the social value of urban streets by exploring restorative potential and stressing the importance of street environments as essential parts of urban places from the perspective of sustaining and optimising human health and well-being.

This research also contributes to introducing two concepts: 'restorative expectation' (the expected) and 'street typology' in investigating the appropriate way of designing streets to be restorative. It admits that urban functional spaces should not sacrifice their other values in pursuit of being as restorative as possible because, in essence, they differ from natural places that are primarily designed for leisure and recreation. Therefore, the actual street users are involved in this research to help reveal how streets should be improved so that they can have restorative experiences in the way and to the extent as they want. This research then discloses the connection between street types and users' expectations and justifies the necessity of considering street typologies. Through an on-site survey of four differing case-study streets, this study finds that users' expected street restorativeness evidently varies with street types, and their evaluations of the current restorativeness of streets reveals significant differences. This indicates that, for each type of urban street, it is more efficient and sustainable to improve restorative potential according to people's wishes instead of maximising its restorative benefits in a manner that disregards its other required functions and values. The concept of street classification introduces an essential rethinking of the current street classification system. As planning and design in contemporary cities gradually realises the human-oriented paradigm, it is worth considering the significance of having a more dedicated classification system defined by a criterion that emphasises the social value of urban streets, especially for those with fewer requirements for traffic functions.

8.2.2 Practical implications

Highlighting the necessity of urban places that are restorative has extended the scope of restorative environment research from nature or nature-dominated environments to hardscape-dominated urban settings. These findings resonate with assumptions in previous studies that indicate urban places with particular characteristics can offer the same restorativeness as natural environments, and even surpass nature in offering restorative benefits. In response to the limited exploration of streets as spaces with restorative qualities, this study not only indicates that streets should be restorative because of their role in urban daily life, but that users actually expect to have different levels of restorative experiences while walking on streets with different characteristics. The research process for investigating users' restorative expectations suggests that design implications might include: 1) designing the Landscapes and Leisure Street to be as restorative as possible and meet users' high-level of expectations (to be specific, a strong sense of *being away* from ordinary life should be provided, as well as a number of attractions along streetside to enhance *fascination*); 2) equipping the Living and Service Street with various streetside functions; and 3) making the Commercial Street more coherent in form by using delineated frontage design and seeking to be compatible with people's needs through the provision of various streetside functions.

Besides design implications, it is worth empathising that this research has ensured a certain level of public participation in exploring restorativeness-oriented street design. Because of the relative subjectivity involved in applying restorative environment theory to streets, people can be (and probably must be) involved in design processes in this context. This idea also has the potential to fit into other arenas of discourse about forms of bottom-up urbanism, as well as achieving a better balance of top-down, professionalised decision making and bottom-up participation. This potential is extremely useful for designing inclusive and accessible spaces, especially for users with learning or communication difficulties (Thwaites, Mathers and Simkins, 2013). By introducing the concept of restorative expectation, this study further guarantees an involvement of users in the planning and design process for increasing the restorative potential of urban places. Apart from an obscure concept like 'restorative environment' in urban place making, people with no professional training still encounter difficulties in the public participation of other design practices. These difficulties normally exist in two stages of the public participation; the first one lies in user's expression and the second one concerns the precise interpretation of users' wishes into design practices. It would be much easier for people to express what they want to feel and to experience in a certain environment rather than describing precisely what they expect the environment to be. Because the restorative experience is a perception that users can easily express, investigating users' restorative expectations is effective and useful in understanding what kind of restorative experiences city streets are expected to provide. However, users' restorative expectations and their evaluations on current street restorativeness are still interpreted by professionals with the help of the SRMF in the developed Restorative Street Design Approach, given the complexity of the information obtained. Less public participation in the final interpretation stage may also risk of straying from what users' desire. Future attempts should be made to increase the level of public participation in the final interpretating design interventions stage.

8.2.3 Limitations

In this stage of research, two limitations are observed. First, two mainstream theories of restorative environmental research, Stress Reduction Framework (SRF) and Attention Restoration Theory (ART) are introduced in Chapter 2, and justifications for adopting ART as a theoretical basis are provided. This research departs from ART due to practical reasons concerning the research context, including reaction time, the feasibility of on-site measurements and the extent of observable responses. Accordingly, this research only explores street restorative potential as it helps street users recover attentional resources depleted in everyday life and work. Other restorative benefits have not been considered in this research, but the definition of street restorativeness and its corresponding capability in other aspects like stress relief (Ulrich et al. 1991; see also Ulrich, 1983) should be further extended and explored in future studies. However, when identifying possible restorative related design indicators using documentary analysis (see Chapter 5), both ART- and SRF-based restorative studies have been explored and all emerging indicators have been included in SRMF 1.0 for validation. Because the RCS is developed from ART, its influential mechanism with stress-related indicators might hardly be revealed during this process. Therefore, it is necessary to enrich restorative functions of urban streets in future research by involving other psychological perspectives concerned with restoration.

Limitations also existed in the selected measurement scale - RCS. The RCS is selected from existing instruments to investigate street restorativeness, and it is developed for measuring restorative perceptions and constructed entirely based on four environmental components raised in ART. According to the interview results collected in the first stage of the pilot study for exploring whether the RCS is sensitive to differentiating street restorativeness, participants suggested that some RCS statements, particularly those describing *extent*, are rather abstract and obscure for those without professional training. To accurately express users' authentic feelings, the RCS describes 15 statements that are measured from 0 to 6, indicating the degree of agreement. People might intend to choose an unbiased response when they are uncertain or do not fully grasp the meaning of questions. Hence, RCS results can be partially influenced by the higher frequency of medium ratings. Even though the Chinese version of the RCS has been carefully modified after the pilot study, and the reliability (internal consistency) of answers has been tested before formal analysis, this study cannot guarantee that misinterpreted responses are absent, nor can it guarantee that rating errors are completely eliminated.

8.3 Establishment of the SRMF and Its Associations with Restorative Perceptions

8.3.1 Reflections

Both qualitative and quantitative research methods are used to develop the SRMF and to explore how its indicators influence users' restorative perceptions. The SRMF, composed of restorative related environmental attributes, is developed from the literature. While previous studies on street restorative potential normally focus on specific street elements like trees (Lindal and Hartig, 2015), architectural variations and building heights (Lindal and Hartig, 2013), there is generally a lack of systematic investigation on street restorative potential and its influential indicators due to the complexity and diversity of street environments. The process of constructing the SRMF starts with identifying potential restorative evidence from existing literature and then validating them within urban street contexts. The SRMF itself is developed for urban streets, but it can be adapted to other urban contexts with appropriate adjustments. This flexibility stems from its preliminary form, which gathers indicators investigated under various environmental settings. In addition to the SRMF, an attempt made from the perspective of urban street design, the RCS, is used in this study for measuring users' restorative experiences while walking in urban street environments. The RCS has been adopted in two different stages of this research. It was firstly used to measure people's restorative expectations for four different street types, and these results suggested that the RCS is not only able to measure restorative expectations using stimulus of semantic descriptions, but also sensitive in differentiating restorative expectations between street types. The RCS was then used in an on-site survey to measure the current restorativeness of streets on-site. Its successful application in both real and imagined scenarios revealed a way for using people's desired perceptions to indicate design improvements.

This research then developed and validated two essential and flexible research methods that together contribute to reaching the final aim of developing the RSDA for delivering restorative experiences according to users' expectations. One bridges restorative perceptions (measured by the RCS) and design attributes (measured by the SRMF) and successfully indicates that people's restorative perceptions are applicable in instructing practical design if relationship can be found. By quantifying human feelings and perceptions with ranking scales, this research discovered a way of constructing and utilising these relationships. Another method involves investigating users' expectations, which discloses discrepancies between users' expected levels of restorative experiences and their perceived restorative experiences in current settings so that necessary restorative design interventions can be generalised. However, the emergent perceptive differences between the restorative reality and expectation can only be interpreted with the help of the SRMF composed of both restorative relevant street indicators and their influences on the RCS. Otherwise, restorative expectations and evaluation results can only illustrate users' level of satisfaction in terms of having restoration in streets with the gap between restorative perceptions and street design still unbridged. Therefore, the SRMF is the BRIDGE that connects conventional restorative environment research with hard urban street settings.

8.3.2 Practical implications

The Street Restorative Measurement Framework (SRMF) was produced by this study as research progressed. The SRMF was developed because it was necessary for enabling this research process to work as an essential part of a wider methodological framework designed for achieving the final aim. However, it turns out that the SRMF itself has potential beyond the scope of this study to be a methodological device that could be applied to different contexts. The final version of the SRMF is composed of 19 indicators with both street quality and street content indicators relevant to restorative benefits. When evaluating streets using the SRMF, it is necessary to adjust this framework based on target street settings. For example, two SRMF indicators, 'waterscape' and 'typographic variation', might not exist on every urban street. It is also necessary for future research to focus on each SRMF indicator to investigate their importance in influencing street restorativeness, especially their influential differences within street types. For instance, 'greenery' might be more important for Landscape and Leisure Street than Commercial Street. A thorough exploration of each SRMF indicator can help practitioners quickly pinpoint the design focus for improving street restorativeness. As restorative environment research broadens in streets and other environmental contexts, the SRMF may be further supplemented. The flexibility of the SRMF is not only presented in its constituents, but also in its application to the design process. It can be used before street environment design to reveal possible improvements and can also be used after the improvement to assess whether users' expectations are achieved as a tool for evaluating restorative improvement results.

This research aims to develop a Restorative Street Design Approach (RSDA), which is also the most critical product. Three major sections, the RCS, the SRMF and their interactive connections, constitute this approach to deliver restorative street design, which is based on a rather stable framework with a certain level of flexibility allowing for application to other urban street hierarchies and city contexts. When developing restorative street design instruction for urban street hierarchies like arterial roads, the RCS and SRMF should again be validated before their relationship are established. Investigation of higher hierarchical streets, especially those with lengths exceeding 3km, should be carefully considered for whether they should be treated as several different sections with different characteristics when comparing their expected and current restorativeness in discussing design instructions. Because street restorative expectations are measured by the context of Shanghai, these criteria should also be adjusted if the city context has changed. The RCS can be replaced with other instrument or methods of measuring restorative experiences if future research intends to explore more aspects of street restorativeness.

8.3.3 Limitations

Despite of the achievement, limitations were noticed when constructing the associations between the SRMF and RCS through on-site surveys. In total, there were two sets of pilot studies and formal surveys conducted in Shanghai for investigating users' current and expected street restorativeness, and the number of responses collected for each stage of the survey are listed below (Table 8-1). Each participant rated four street types according to their restorative expectations; therefore, they are treated as a single, large sample group that should be considered according to populations and demographic percentages. The appropriate sample size calculated in Chapter 3 for the 'expectation' stage should be between 150 to 190. As for the measurement of current restorativeness, each case-study street was treated as a sample group. Determination of sample size is clarified in Chapter 3 and all requirements are met in each stage. The sample size is still relatively small considering the large population of Shanghai, though the sample size for each stage reached the lower limit. Research findings, however, are still regarded as valid for three reasons. First, although the sample size is small, criteria for choosing potential participants those who happened to be on the street were pre-determined and followed on site. Individual differences were considered referred to previous studies and analysed in each stage. Additionally, all obtained data follows a normal distribution. The determination of sample size also refers to and is in line with sample sizes from previous studies that adopted a similar approach to the current research (see explanations in Chapter 3). Limitations to the sample size are not only caused by temporal and economic factors but are also constrained by survey administration. The number of responses to the online expectation survey stopped increasing after around one month of online promotion, and strangers became lessly appeared in the on-site survey on four case-study streets, possibly due to these streets being occupied primarily by regular users.

Table 8- 1 Sample size for each survey stage in the research.

	Expected Street Restorativeness		Current Street Restorativeness	
	Pilot Study	Formal Survey	Pilot Study	Formal Survey
No. of Responses	45	154	72	121
			LL(18) CM(17) TO(22) LS(15)	LL(30) CM(30) TO(31) LS(30)

Limitations also existed in an essential step for establishing the relationship between restorative perceptions and street design indicators. Subjective perceptions can be affected by various factors and, although this research gathered much background information to exclude individuals' perceptive differences and no significant perceptive differences have been found in the results, uncontrollable and unexpected conditions might also influence the accuracy of the evaluation results. All surveys were administered during lunch breaks, before which all participants had experienced an entire morning of work. Restorative perceptions can be directly affected by the degree of fatigue, which is largely determined by morning workload. For example, some participants might begin working at 8 a.m., while others start at 9.30 a.m. Some might have a whole morning of intensive meetings while others address regular tasks. Another possible factor is pedestrians' walking speeds. People may walk at different paces in real situations comparing to when they were surveyed. This can also lead to differences in restorative perceptions. When people walk fast, they are more likely to overlook environmental details, including certain positive recovery elements. Also, people listening to music or talking on the phone as they walk may be less likely to perceive restorative information because their attention is largely occupied. Though the surveyor walked behind the participants during the experiments for not hindering people's sightlines, their existence may also influence the perception results of the participants.

Another limitation of the research design concerns participants' walking distances prior to answer RCS questions. Three requirements must be met when selecting case-study streets (see Chapter 3). Streets should be easy to categorise, and street frontage functions should remain consistent. All selected streets are less than 800 meters in length and require approximately five to eight minutes to traverse at a normal walking speed. However, participants tended to walk slower when they were answering questions, meaning that none of them ever walked the target street during the survey from beginning to end across all four sites, but only covered an approximately 500-meter-long street section in each street site. Street frontage components are generally consistent along street sides for the four selected streets. Guokang Road (Traffic-oriented Street) has three types of frontage, including fences and greenery that surround buildings. A simplicity can also be observed on University Road (Commercial Street) that is primarily composed of greenery and retail frontages. Zhangwu Road (Living and Service Street) and Sujiatun Road (Landscape and Leisure Street), however, appear to be more diverse in terms of streetside frontages. Zhangwu Road has walls, retail spaces, typographic variations and greenery along street sides, while greenery, open spaces, fences and walls are observed as frontage components on Sujiatun Road. RCS results are general perceptions of the whole street environment and are less influenced by frontage variations if the eyesight of participants has not been blocked. Participants can easily have an overview of the whole street because case-study streets are straight and open-viewed, aside from Zhangwu Road. Even though the SRMF evaluations might be affected by the limited walking sections, especially on streets with more diverse frontage elements, key information collected in this research is considered useful and conforming to reality.

8.4 Expectation-oriented Restorative Street Design Instructions on Case-study streets

8.4.1 Reflections

This research confirms that both expected and current restorativeness vary between street types; hence, the restorative design focuses of each street type are expected to vary accordingly. Results (see Chapters 5 and 6) found that obvious differences in design focus exist between street types for enhancing their restorative potential, which can be more evident when only focusing on restorative related SRMF indicators with a high significance level (Table 8-2). It can be seen that far more SRMF indicators can influence the restorative benefits of the Landscape and Leisure Street and Living and Service Street, while only three SRMF indicators affect the Commercial Street (openness, familiarity and legibility) and Traffic-oriented Street (familiarity, mystery and upkeep). Two SRMF indicators (openness and legibility) for the Commercial Street can affect the Landscape and Leisure Street, and two Traffic-oriented Street indicators (mystery and upkeep) also have influences on the Living and Service Street. This finding first discloses that, in essence, the Commercial Street is more like the Landscape and Leisure Street, while the restorativeness of the Traffic-oriented Street resembles the Living and Service Street. This may be because the former two types are less normal than the latter two, or because the Commercial Street and Landscape and Leisure Street are more expected to have leisure purposes, like shopping or exercising spaces. However, the Traffic-oriented Street and Living and Service Street are designed to fulfil people's everyday needs, such as commuting and daily services. In addition, research found that users care more about whether there is a good view in the street environment and whether the street is unique when evaluating restorativeness of streets with leisure purposes. The level of novelty and maintenance, however, are their major concerns when they want to relax on streets designed for normal uses. These differences within street types and their relevant restorative indicators, again, proved that streets with different characteristics require responsive restorative design interventions.

Table 8- 2 Restorative focuses of SRMF indicators.

	COMMERCIAL STREET	LANDSCAPE AND LEISURE STREET	LIVING AND SERVICE STREET	traffic volume-ORIENTED STREET
Being Away		Typicality, historic-ness		
Extent	Openness, Familiarity	**Openness, Enclosure, Visual Depth,** Naturalness	Enclosure, **Visual Depth**	Familiarity
Fascination	Legibility	Complexity, **Openness, Enclosure,** Mystery, **Visual Depth,** Legibility, Typicality	Mystery, Visual Depth, **Typicality,** Naturalness, historic-ness, People	Mystery, Upkeep
Compatibility		Complexity, **Openness, Enclosure,** Mystery, **Visual Depth,** Legibility, Typicality, Landmarks	Upkeep, **Typicality,** Quietness	
Overall Restorativeness	**Openness, Familiarity, Legibility**	**Complexity, Openness, Enclosure, Mystery, Visual Depth, Legibility, Typicality,** Landmarks, **historic-ness**	**Mystery, Enclosure, Visual Depth, Upkeep, Typicality,** Naturalness, **historic-ness,** People, Quietness	**Familiarity, Mystery, Upkeep**

(Note: This table only includes indicators show strong level of correlations with street restorativeness. Indicators marked in White is those repeated across street types.

Additionally, it has been observed in the results that, for each street type, there are clear differences in the four ART components. The Commercial Street, Traffic-oriented Street and Living and Service Street have only a few overlapping SRMF indicators in their four components, while four indicators repeatedly appeared in three components of Landscape and Leisure Street. Differences in SRMF indicators relevant to each component can help improve street restorativeness by making it more accurate through adjusting each component to the expected level. It means that when openness, enclosure and visual depth can influence *fascination*, *compatibility* and the *extent* component of the Landscape and Leisure Street, the design of different indicators between three components can control whether it is *fascination*, *extent* or *compatibility* that a certain street must highlight. For example, if the *extent* component of Landscape and Leisure Street is far less than users' expectations, this indicates that the 'naturalness' required extra attention in street design. Additionally, a certain level of consistency can be observed across street types in each ART component, implying that there is commonality among the determinates of each ART component. For example, SRMF indicators relevant to spatial perceptions including 'openness', 'enclosure' and 'visual depth' appeared repetitively in the *extent* component. This finding suggests that the appropriate spatial representation of a street environment can facilitate restorative experiences by intriguing the sense of *extent*. Also, 'mystery' is found to be related to *fascination* in all street types, besides the Commercial Street, which might indicate that a certain level of uncertainty and curiosity can promote restoration because it can enhance the sense of *fascination*.

8.4.2 Practical implications

In the final stage of this research, which aims to produce restorative design solutions (see Chapter 7), the outcome suggests that design implications might include: 1) improvement to current streetside planting, the redesign of existing streetside open spaces and the reduction of leisure facilities are required for Sujiatun Road (Landscape and Leisure Street); 2) implementation of the key to improving street restorativeness of Guokang Road, which involves controlling on-street parking to encourage more social interactions along street edges and to improve its maintenance status; 3) for Zhangwu Road (Living and Service Street), focusing its restorative design on promoting the active use of its existing streetside open spaces for attracting temporary activities, encouraging more streetside planting and creatively designing graffiti for neighbourhood walls; and 4) for University Road, the regulation of surrounding volunteer planting, offering more resting spaces along street sides, introducing more variations in street frontage uses and encouraging temporary activities in its open spaces. These design instructions, with a specific focus on improving street restorativeness, are important supplementary materials for the application of the current Shanghai Street Design Guidelines so that the social value of urban streets can more obviously be presented in the Shanghai Guidelines (see Chapter 4 for more details).

In addition to the purpose of applying the developed Restorative Street Design Approach (RSDA) in real settings, the four developed sets of restorative street design instructions for four selected branch streets in Shanghai can be regarded as additional by-product of this research. Even though these instructions are generalised based on survey information collected on case-study streets, they may also be regarded as design references in other street contexts that possess similar characteristics to these four selections. This generality is ensured by similar characteristics shared by streets with similar functions and locations, and only streets meeting the above requirements can refer to instructions provided in this research. For example, Guotai Road and Guoquan Road are like the Traffic-oriented Street, Guokang Road, and share similar functions and characteristics (Figure 8-1). Fuxin Road and Anshan Road, that resemble Zhangwu Road, are also very alike in function (Figure 8-2). However, University Road (the Commercial Street) and Sujiatun Road (Landscape and Leisure Street) are quite a-typical representatives of their own categories that do not frequently appear in the same neighbourhood to maintain their distinctiveness.

Figure 8- 1 Branch streets similar to Guokang Road (Traffic-oriented Street). Source: Google Street View.

Figure 8- 2 Branch streets similar to Zhangwu Road (Living and Service Street). Source: Google Street View.

8.4.3 Limitations

This research selected only four branch streets as representatives of four typical street types in Shanghai to explore street restorativeness in the most humanised scale. However, the branch street is a rather simple environment compared to other hierarchical roads like arterial and secondary roads. Street elements in branch streets are relatively stable, especially in terms of everyday traffic volume and human traffic. However, higher hierarchical streets and special street types also require attention, especially because the ultimate intention is to make urban streets systems that provide users with brief but continuous restorative experiences. Current research on branches in urban street systems can only provide insight for how to deliver street restorativeness gradually in most, if not all, urban street environments, starting from lower, hierarchical streets. Besides, only one sample street has been selected for each type in this research due to time and economic constraints. Even though general street characteristics are consistent within their categories, they are still needed to enlarge the number of sample streets if general restorative design principles based on street types are expected to direct practical design processes. Because Shanghai is a city with diverse cultural characteristics, and obvious differences exist between its old districts like Huangpu District and its newly developed districts like Pudong New District, the four case-study streets were all selected in the same district to eliminate influences on restorative perceptions brought by the surrounding environment. However, cultural and landscape characteristic variations within districts should also be considered when delivering restorative experiences in Shanghai urban street system.

8.5 Summary

This study highlights the restorative potential of urban streets, and the whole process of this research explores a way of delivering street restorativeness. Therefore, the final product of this research is to develop a Restorative Street Design Approach (RSDA). While approaching the research aim, there were two additional achievements that can be independently used in practices. The first one is the Street Restorative Measurement Framework (SRMF) and the other is four sets of Restorative Street Design Instructions for four case-study streets in Shanghai as an experimental outcome of employing this design approach. This study first investigated people’s expectations on different street types and their evaluations on the current street restorativeness of different types, using the Restorative Component Scale (RCS). Results of this stage give clear instructions on how users’ restorative experiences are expected to be improved. This research then tries to bridge an identified research gap between restorative environmental theory and urban hardscape design by developing one of the additional achievements – the Street Restorative Measurement Framework (SRMF), which was then used in this research to establish the relationship between street design indicators and restorative perceptions measured with the RCS. This established ‘bridge’ was then used to develop Restorative Street Design Instructions with an integral consideration of the difference between restorative reality and users’ expectations, and what and how SRMF indicators are related with each ART component (*being away, fascination, extent* and *compatibility*) measured by the RCS.

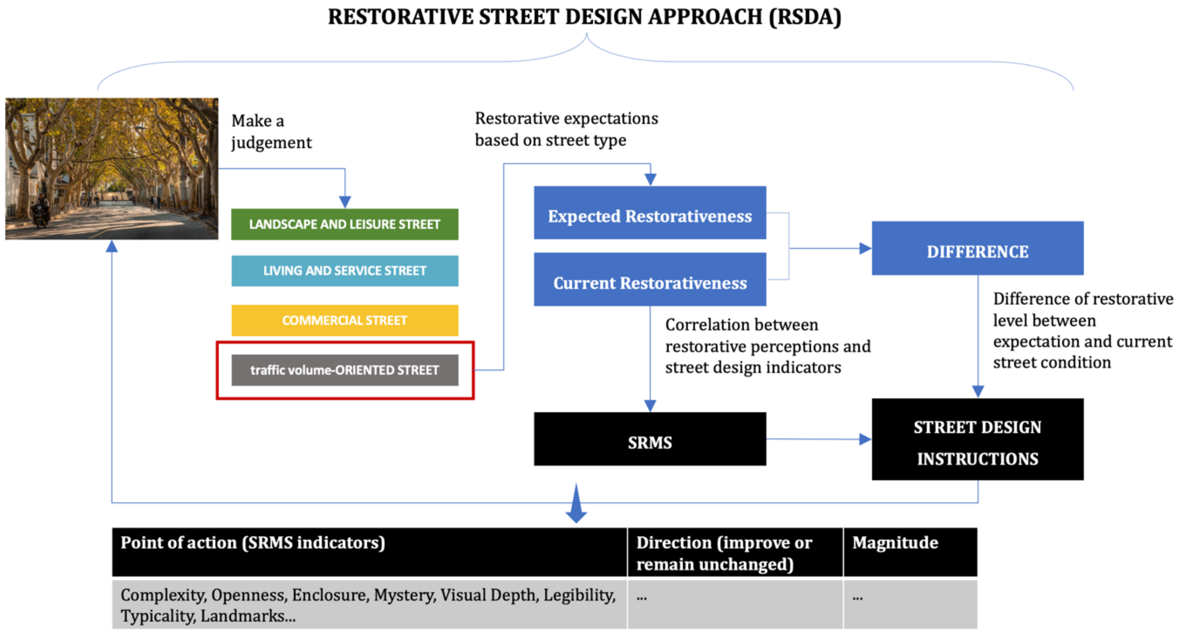


Figure 8- 3 Restorative street design approach and its application in practices. Source: the author.

The Restorative Component Scale (RCS), selected from existing mature instruments, is proved to be efficient in measuring the restorative experiences people have in urban street environments. In addition, the RCS is found to be sensitive to differentiate users' restorative experiences in different types of street environments. This not only indicates that street restorative potential varies with street types, but also that the RCS is an efficient instrument capable of presenting these differences. Moreover, this instrument can be used to illustrate users' expectations in terms of having restorative experiences while walking in particular street environments, and these expectations can also be differentiated within scene types. In the second stage, it is discovered that SRMF indicators associated with each case-study street (each representing for a street type in the Shanghai Street Classification System) for delivering restorative experiences varied within different street environments. Additionally, there is a difference on how each SRMF indicator influences restorativeness in different street contexts. A street indicator that proved to be able to promote restorative perceptions on certain streets can also be responsible for deterring the restorativeness of another. Consequently, design interventions should be discussed flexibly and synthetically in response to street contexts. This process of developing design instructions revealed the fundamental path for moving further in exploring restorative determinants of urban street contexts in this research. This path is the developed RSDA (Figure 8-3), and the result of applying it on four streets selected in Shanghai is an example of showing how restorative design instructions are generalised using this approach.

CHAPTER 9 GENERAL CONCLUSION

9.1 Introduction

The restorative street is a rather neglected topic in the long development of restorative environment research. This research is based on the assertion that any restorative potential that urban streets have, or can be designed to have, is significant in urban daily life as they are essential components of urban outdoor spaces that are easily accessible to the public. This research starts with justifying the significance in exploring the restorative potential of urban streets by investigating the overlaps between urban street design and restorative environment research. In this review-based discussion on existing and potential overlaps, the restorative street is defined as a type of street environment that possesses certain characteristics that facilitate the process of allowing people to recover from depleted psychological resources and replenish attentional capacities. In order to meet the aim of developing a Restorative Street Design Approach (RSDA), this study establishes the relationship between a street's restorative potential and street design indicators. This is then refined into the RSDA to improve streets' restorative benefits in response to users' expectations.

To further clarify, the main result of this research is the Restorative Street Design Approach (RSDA). The SRMF is an essential component of the RSDA and four sets of restorative street design instructions are results of applying the RSDA. The thesis illustrates the complete process of developing the RSDA beginning with elaborations on its theory, then discussion of potential methods and finally have an outlook on its future practices. The final chapter in the thesis starts with a general overview of this research by highlighting its significant research products, as well as their practical applications. Unlike the comprehensive reflections and discussions stated in Chapter 8, the overview in the final chapter mostly describes essential steps in the research process and their central contributions. Next, this chapter discusses future potential research directions on the basis of what has been achieved in this research from both the perspective of academic studies and practical attempts. This chapter ends with a final conclusion on the whole thesis of *Towards Delivering Restorative Street Design Principles in Shanghai, China*. Figure 9-1

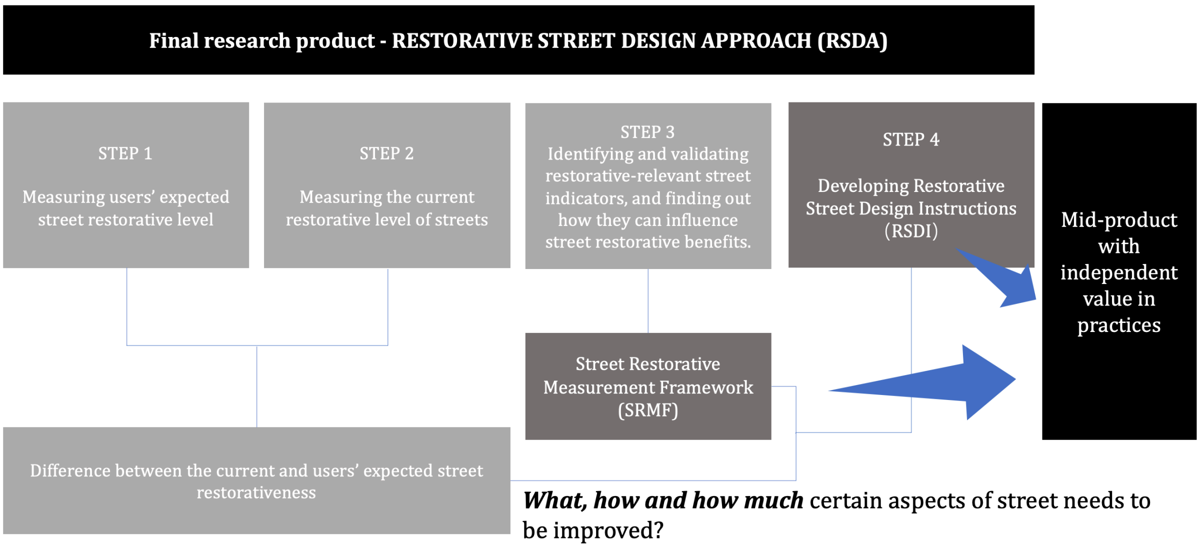


Figure 9- 1 Research products. Source: the author.

9.2 An Overview of this Research

This section stresses the significance of this study in broadening the conceptual framework of a restorative environment, its innovations in landscape assessment studies, as well as its practical importance in street design practices.

9.2.1 Research significance

- The significance of designing restorative urban streets

The restorative potential of urban streets has long been overlooked. However, due to the limitation of access to nature and green resources that are conventionally associated with restoration in highly densified supercities, the significance of urban streets in delivering restorative experiences requires more research attention. In this study, our findings suggest that even limited amounts of time spent in streets can accumulatively play an important role in effective functioning and well-being (Hartig, 2007a), thereby contributing to the restoration process of street users. This study extends the scope of restorative environment research by highlighting the restorative potential of urban streets and contributes to exploring possibilities of achieving restoration in hardscape-dominated settings. Research findings imply that an urban environment dominated by hardscape can also be restorative as long as it has the four components (or a subset) proposed in ART. This further encourages us to keep finding substitutes in urban environments in order to provide people who are impeded by time and distance to interact with nature with restorative opportunities. The urban street has been confirmed in this research as a substitute with great potential because of its inevitability in people's everyday lives.

- The significance of bridging between restorative environmental research and urban design

An obvious limitation existing in previous restorative environment research, as stated in the literature review chapter (see Chapter 2), is that, to date, no efficient way has been found to deliver a restorative environment through a design approach by combining restorative environment research and urban. An important stage in this study is to overcome this limitation with two consecutive steps. The first step is to identify potential environmental indicators and the second step is to validate their connections with restorative benefits by mathematically linking them to four ART themes: *fascination*, *compatibility* and *extent*. The outcome of this stage is referred to as Street Restorative Measurement Frameworks (SRMF) which is composed of 1) restorative related street design indicators and 2) how they relate with ART components. The significance of this lies in the fact that it seems to suggest that the SRMF indicators (which are developed as part of this research project) provide the means by which particular properties of streets can be directly associated with an aspect of previously developed restorative environment research (ART). Therefore, SRMF is the *bridge* across which this study travels to connect conventional restorative environment research with hard urban street settings, and it is the bridge across the general limitation of most of the restorative environment research stated above.

- The significance of ensuring public participation with the 'expectation-current' evaluation

The restorative street, the theme of this research, is a design objective advocates on improving public mental health by helping them to recover from depleted cognitive resources. This research proposes a concept of 'restorative expectation' to bring the design of a restorative street more in line with everyday users' needs. Because of the relative subjectivity involved in applying restorative environments to streets, the public participation should be involved in design decision making processes in this case. This 'expectation-current' evaluation framework is a new and novel idea in the decision-making process, and it has the potential of fitting into other areas of discourse on forms of bottom-up urbanism.

The main emphasis in public participation is on gathering the public's wishes and on getting them involved in the decision-making process (Shao et al., 2020). Most research on public participation in Chinese context focuses on the gathering of users' wishes due to the limitation of the large population size and their diverse backgrounds on research involvement (Shao et al., 2020). Traditional ways of communicating with users in design practices mainly include interviews, questionnaires and focus group forums. However, it is difficult to ensure that the participants from the general public have an accurate understanding of the questions when the content of questionnaires or interviews is geared toward the professional. This is partly due to the speciality of certain aspects in planning and design, and partly because of communication barriers between the public and professionals. In order to achieve a more inclusive public participation method the researchers (Mendes, 2008; Thwaites, Mathers and Simkins, 2013; Liu et al., 2017) tried to analyse and utilise the interaction (physical and experiential) between people and places so that design practitioners can truly understand the needs of users.

The 'expectation-current' evaluation framework developed in this research highlights that for some design interventions with a special focus on users' experiences, such as safety and happiness, one way of ensuring the public participation efficiency might be using users' expectations to guide necessary design practices. Another critical step in this study to make sure the public participation is not just a 'process' is to establish efficient relation between users' restorative perceptions and street design attributes so that the public's wishes can be translated into the necessary design improvements. By doing this, two barriers in encouraging public participation are expected to be overcome by ensuring that 1) there is no communication barrier between professionals and users (users can directly express their perceptions and experiences with the aid of specific instruments (SRMF and RCS in this research)) and 2) there is no misinterpretations in translating people's wishes into design languages since the connection between environmental and restorative dimensions is established mathematically.

9.2.2 Research Innovations

- The innovation of investigating users' expectations

In addition, this study innovates in proposing that the delivery of street restorativeness differs from the realisation of restoration in other urban open spaces. This assertion comes from the multiple roles that streets take in urban outdoor life which include mobility, communication, commerce and social interactions – the street is not simply a space created for leisure purposes. Therefore, restorative potential, as one of the urban street's essential qualities, is required to be balanced with its other functions. In order to improve restorative street potential in an efficient and economical way this research measured users' restorative expectations in street settings and uses these expectations as a design standard. Restorative expectation is not only proven to be measurable by RCS in this research, but also presents obvious discrepancies within street types. These differences provide us with guidelines to improve street restorative benefits to achieve the 'standard', so that the optimum situation (when street current restorativeness equals its expected potential of delivering restorative experiences) can be realised. The restorative design focus of each street, therefore, is found to vary with street characteristics and priorities. Street typology, defined by street characteristics and functions, is the prerequisite for investigating and differentiating the restorative expectations of street users since their expectations are determined, or at least influenced, by their cognitions from former experiences in similar settings (Zajonc, 1980). These expectation differences were finally applied in developing restorative street design implications in four case-study streets where each of them was selected to represent one street type in the Shanghai street classification system.

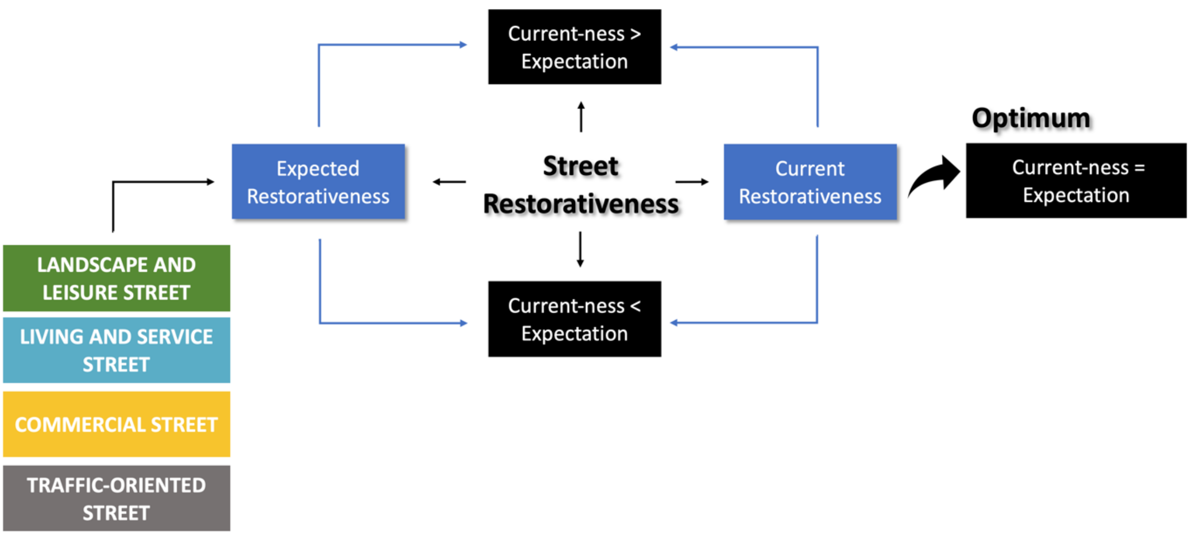


Figure 9- 2 The optimum condition of improving street restorative benefits. Source: the author.

Even though the novelty of introducing 'restorative expectation' is naturally generated under the specific context of studying urban streets, utilising the difference between users' expectations and their evaluation on current conditions can be an efficient approach in other landscape assessment research. Existing landscape assessments mostly set off by determining the central issue and criteria, which are normally evaluated either by the public or by professionals (Shao et al., 2020). Most assessments focus on the current condition of target landscapes and this 'current' is then compared to pre-determined criteria set by professionals. Very little research has tried to use participants' expectations as the criteria for landscape evaluations not only due to the 'paternalism and familism' (Turner, 1976) in planning that has rooted for decades (Thwaites, Mathers and Simkins, 2013) but also because certain landscape value, such as from an ecological aspect, can hardly be accurately understood by common people. Given that restorative benefits of urban streets are a perception determined specifically by users, people's expectations are critical. The successful use of users' expectations as evaluation criteria in this study provides professionals with sufficient confidence to move further along this pathway. It is expected that the 'expectation-current' mechanism can also be applied in other environmental assessment studies and practices which should be guided by users' perceptive qualities. Figure 9-2

- The innovation of adaptably combing the psychological and psycho-physical evaluation paradigm

In terms of research methodologies used in this research, this study manages to make subjective restorative perceptions instructive on street design indicators through mathematically identifying their relationship. The idea of correlating RCS and SRMF is rooted in the psychological paradigm of landscape assessment methods that endeavour to explain the connections between human perceptions and landscape features. In the psychological paradigm landscape assessment, either professionals or public participants are invited to rate their environmental perceptions. One of the distinct advantages of it directly employing users' perceptions as evaluation standard, but hardly be useful in instructing practical design.

Based on the psychological evaluation paradigm, this study invents SRMF and uses it to psychologically evaluate street features instead of measuring street characteristics, for example width and enclosure. Restorative experience is a user-dominated perception therefore street attributes should be measured according to how common people perceive the surrounding environment, rather than be measured, in detailed, according to what the precise entity is. The SRMF can be flexibly applied in other street settings and therefore there is no need to develop another model in future relevant studies. This slight change made on the basis of the psychological paradigm not only increases the adaptation of the assessment model, but also further encourages the level of public participation. It is worth considering using a similar methodology in other environmental studies that focus on human experiences so that socially responsive urban design solutions can be further explored.

- The innovation of developing a sequential methodological process

This research begins with one step because restorative environment theory is the only thing available to grasp. However, another step can then be developed to take what has been learnt from the overlaps of restorative environment research and urban street design. What has been learnt from that second step then influences the development of a third step and so on. Together these steps form the sequential methodological process applied in this research (Figure 9-3). Based on what has been learnt from the review of the overlaps of the restorative environment and urban design research on the environmental restorative benefits and the characteristics of urban streets, two key questions emerged for achieving the purpose of designing restorative streets. The first question is how to determine to what extent urban street should be designed to be restorative; and the other question is how to overcome the limitation of relating restorative perceptions to design attributes. The first question led this study more into an investigation on users' restorative expectations according to different street types. This is achieved by selecting appropriate restorative measurement scales from existing research and using it to measure both the users' current and expected street restorativeness. The second question forces this research to explore a way to relate restorative experiences and street design attributes. This is solved by using a revised psychological evaluation model. The information obtained while answering these two questions includes the difference between the users' expected and current street restorative level (magnitude); restorative relevant street indicators (point of action); and their influences on users' restorative experiences (direction). This information can now jointly be used to develop restorative street design instructions.

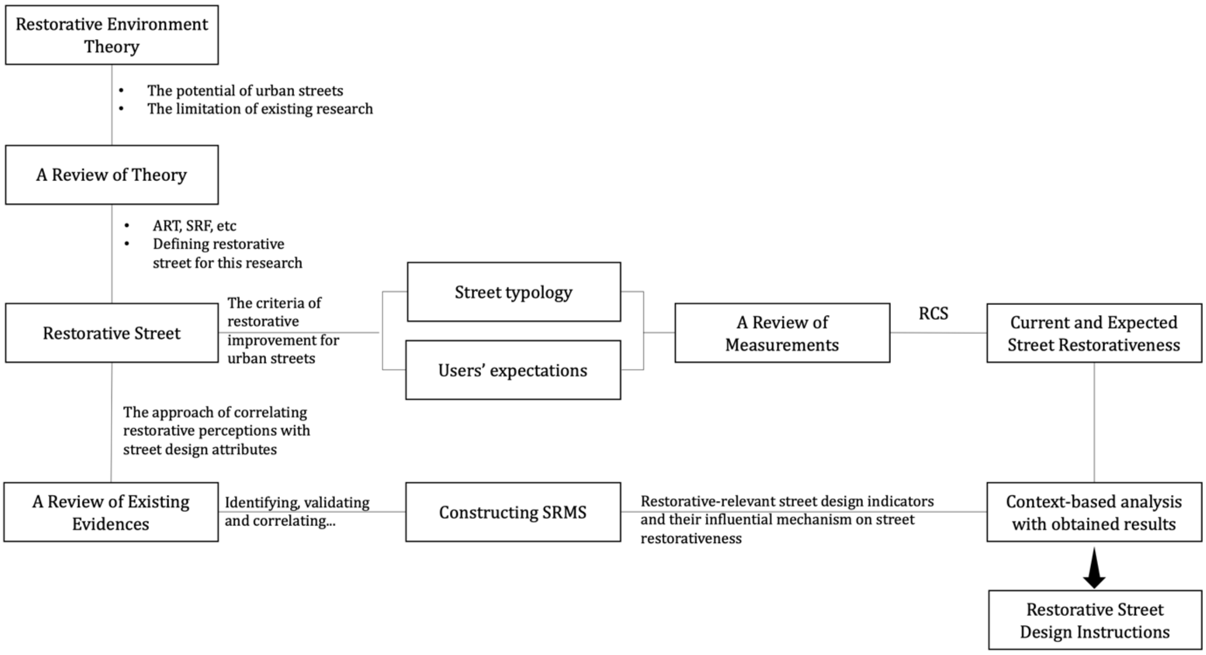


Figure 9- 3 A sequential methodological process developed during this research. Source: the author.

9.2.3 Practical importance in street design practices

In the final stage of this research, a set of restorative street design instructions were developed in response to users' expectations for each of the four case-study streets' (see Chapter 7) typological characteristics in terms of their restoration related design indicators. Obvious differences emerging from their design focuses confirms the assumption that the realisation of the restorative process in street settings should closely consider streets' categorical characteristics. Context-based urban design solutions have long been emphasised (Cantacuzino, 1996) with many efforts paid to on site surveys. However, this also led to an obstacle: design commonalities can hardly be generalised, and time-consuming processes have to be repeated over and over again. Urban streets, as one of the major types of outdoor spaces, are both ordinary and special. Even though they are easily distinguishable within street types, but within their own category, in most cases there are commonalities. Therefore, it is important to take street typology into consideration in design practices regardless of the eventual design vision. Typology-based street design solutions have great potential in their application of a more diverse design context with a pursuit of restoration. This application could not only ensure a certain level of consistency in design practices but could also allow the existence of environmental diversity.

9.3 An Outlook on Potential Future Works

9.3.1 Recommendations for future academic studies

In response to the key research limitations stated in Chapter 8, a review of the theory, methods and practices has been discussed as follows. It is recommended that future attempts should mainly focus on overcoming the limitations of theoretical foundations and research contexts.

- To consider further research under other street contexts

One of the essential stages in this research is to carry out on-site surveys to validate the SRMF and to establish its association with restorative perceptions in four case-study streets. All of the four streets are branch streets located in Yangpu District in Shanghai. Considering that the central aim of this research is to develop an efficient design approach (RSDA), it is necessary to conduct the on-site validation process under the branch-street context since 1) branch streets are important spatial carriers of urban outdoor life and 2) the higher traffic volume and larger spatial scale of higher hierarchical streets might weaken pedestrians' restorative perceptions (see Chapter 4.2). Even though this design approach to deliver restorative streets has been validated in Shanghai branch streets, it is still necessary to have it applied to other hierarchical streets in future studies, such as arterial and collector streets so that commonalities and differences of restorative design focus within different street contexts can be revealed. As the street hierarchies increase from branch streets to arterial streets, the spatial perceptions of pedestrians may change significantly. In the SRMF, there are three spatial indicators that definitely vary with street hierarchies: openness, enclosure and visual depth. The visual and psychological connections between pedestrians on two sides of the street decrease as well. This is not only because the increase of the street width but also due to interference such as an increase in traffic noise (loudness and traffic volume). Another justification for investigating other hierarchical streets is rooted in the concept of 'restorative expectation' which is also raised in this study. In most street classification systems hierarchy is the dimension that indicates traffic intensity while other dimensions indicate frontage use and landscape characteristics. This can be observed in Shanghai Street Classification System (Figure 2-2) which has two dimensions: one classifying street hierarchies and the other classifying street functions. Therefore, it is also plausible to assume that users' restorative expectations vary with street hierarchies, and this points to a necessity for future studies on other hierarchies of urban streets.

In addition to further exploring the restorative potential of other street hierarchies, streets with special functions are independently listed in the *Shanghai Guidelines* including expressways, NMV roads, pedestrianised streets, bus-only lanes, community roads and greenways (Figure 9-4). Even though among some of these, such as expressways and bus-only lanes, priority is given to vehicles over pedestrians, these special street categories also require further research because restorative experiences provided by urban streets are supposed to be continuous and cumulative, no matter of the restorative 'magnitude'.

Figure 9- 4 Special street categorisations in Shanghai. Source: Shanghai Street Design Guidelines, SPLRAB et al., 2017.

- To consider further research based on Stress Reduction Framework

This entire research is based on Attention Restoration Theory and specific justifications are provided in Chapter 2 (see 2.4). Accordingly, a questionnaire-based survey was used to measure the expected and current street restorativeness since most research (Korpela and Hartig, 1996; Hartig, Kaiser and Bowler, 1997; Hartig, Korpela, Evans and Gärling, 1997; Laumann, Gärling and Stormark, 2003) in the sphere of Attention Restoration Theory uses measurement scales developed from four ART components: *being away*, *fascination*, *extent* and *compatibility*. Whether there is any contradiction between ART and SRF remains unclear, though certain studies assert that they only differ in precedent psychological conditions: ART focuses on attentional fatigue while SRF stresses emotional and physiological variations (Ulrich, 1983; Ulrich et al. 1991). Most studies (Park et al., 2010; Lee et al., 2012; Tsunetsugu et al., 2013) following the stress reduction framework employ relevant instruments to record participants' emotional and physiological responses such as skin conductance (SC), skin temperature (ST), blood volume pulse (BVP) and electroencephalogram (EEG) so that their perceived restorative effects can be revealed. Therefore, it is also necessary for future research to investigate whether an association between SRMF indicators and RCS established in this research can be built within physiological indicators and SRMF indicators. SRF is expected to disclose how restorative related street design indicators influence people's emotional and physiological variations while walking in urban street environments. This can provide useful supplementary information to restorative design research. As the underlying relationship between SRF and ART becomes clearer from their psychological perspectives, more specific information will be provided to researchers in terms of how to utilise them under different research contexts.

9.3.2 Recommendations for future practical attempts

The final result of this research, the Restorative Street Design Approach (RSDA), is in essence composed of two stages: evaluation and design. Therefore, future practical explorations should focus on improving the application efficiency and scope of this approach in terms of these two stages.

- The possibility of using eye-tracking devices to improve evaluation efficiency

In the second chapter of this thesis a major limitation, identified from current restorative environment research, is that there is no coherent approach has been established to inform how the design of specific environmental attributes can help in achieving attention restoration and other health objectives. This study manages to overcome this limitation through multi-method research mainly based on questionnaires and literature reviews, but the process of constructing the Street Restorative Measurement Framework is time-consuming and requires a large amount of documentary analysis. With the rapid development of physiological sensory devices and AI techniques, there is a possibility to solve the aforementioned limitation with the help of these emerging research methods, and many of them aim to reflect human perceptions on environmental attributes, for example physiological multidetector and eye-tracking devices.

Previous studies have found that an eye tracker can effectively establish the relationship between human visual perception and environmental stimulus by capturing people's eye fixations and movements (Meißner and Oll, 2019). This has aroused the interest for relevant research into the application of eye-tracking devices in Attention Restoration Theory. Previous studies (Berto et al., 2008; Noland et al., 2016) have tried to use eye-tracking devices to capture users' eye movements and to indicate their visual preferences through the frequency of fixations so that restorative related environmental elements can be revealed because there is ample evidence suggesting that environmental preferences are closely related to its restorative potential (Laumann, Gärling and Stormark, 2003; Berto et al., 2008; Ivarsson and Hagerhall, 2008). However, most studies use photographs or slides as stimuli for participants to look at and then use an eye-tracker to record where their fixations are located in the static photos. However, people's restorative perceptions when looking at pictures might differ from their experiences in real settings because their eye movement can vary between the virtual and the real environment.

The author of this research collaborated with Yuhan Shao and Zhenying Xue in Tongji University to utilise mobile eye-tracking devices in real street settings to indicate restorative related environmental indicators instead of the use of SRMF. Results suggest that greenery, roads, other people and cars are street elements that have critical influences on users' restorative experiences (Yin et al., 2020). However, the accuracy of the research findings is still limited due to technological constraints given that the semantic segmentation method used for analysing videos recorded by eye-tracking devices has not yet matured (Yin et al., 2020). It is promising that the relationship between human perceptions and environmental attributes can be efficiently established with the aid of continuing development on relevant instruments and techniques. Moreover, another issue relating to the application of eye-tracking devices in relevant research is that its captured fixations can only indicate street contents but cannot indicate if other environmental attributes such as enclosure, visual depth and complexity might also be relevant to users' perceptions (Yin et al., 2020). This, in turn, justifies the method used and necessity to construct SRMF in this research.

- The feasibility of conducting large-scale restorative street assessments

This study discusses its own deficiencies in Chapter 8. One such deficiency describes an obstacle to applying this approach on a large scale since it is quite context-specific and time-consuming at this stage. However, this study posits that this long and arduous stage is necessary for the restorative result of every street (of every type, in every city) to provide us with an analysis sample that will reveal their common restorative focuses. Streets do vary, but they also share commonalities across categorisations. These commonalities can be generalised and used in restorative street mapping at city level to present larger-scale restorative characteristics and indicate necessary design interventions that as a whole can be seen as a process, from small-scale to large-scale practices. Another possible path towards large-scale restorative street design application is to set out by categorising Google's massive streetscape data based on street element percentages instead of selecting streets from the existing street classification system. Typical streetscape pictures are selected from each category, classified by element percentage and then rated for restorative perceptions. It is assumed that restorative characteristics can be generalised through synthetic analysis on classified streetscape characteristics and users' restorative ratings. This idea is referred to as an attempt to investigate the fairness of streetscape visual compensation in Shanghai by Shao et al. (2020). It can be regarded as an attempt moving from large-scale to small-scale and then back to large-scale again. This reverse process is also carried out with the help of Google's streetscape data.

9.4 Final Conclusion

Despite the obvious benefits accompanying high-density urban development, such as efficient use of resources, increased accessibilities and economic viabilities, visible and invisible urban stressors also accompany such development. Psychological issues such as depression, stress and mental fatigue strengthen people's desire to have contact with nature in order to have a period of recovery. However, the diminishing of natural resources due to the urbanisation process constrain the creation of and access to the sort of green vegetated spaces conventionally associated with restorative experience. This dilemma, therefore, uncovers a socio-psychological challenge to the pursuit of fulfilling people's psychological needs with the limited resources that one city can offer without compromising the overall agenda of maintaining the sustainable benefits brought about by highly densified urban development. This research begins by exploring solutions to this problem from the perspective of delivering a valid way of providing restorative opportunities for people in more accessible urban street settings in a highly densified urban context, for example Shanghai in China.

In this respect, this study has laid the foundation for defining restorative streets and for understanding the difference between restorative streets and other restorative settings. It has taken a step forward in extending the scope of the restorative environment research by proposing a formal definition of and framework for restorative streets. This study develops and validates a coherent approach to evaluate restorative perception from pinpointing relevant street attributes to analysing possible design implications based on a sequential procedure. Each stage designed in this study is founded on the outcome of the previous one and responds to issues that emerged in the previous stage. This sequential procedure of progressive learning and gradually building new knowledge and insights is extremely important because it points to methodological development that is evolutionary rather than pre-determined. Not only can the Restorative Street Design Approach (RSDA) be used as an integrated process to provide restorative street design solutions, but it can also be used as an independent tool in any aspect of design practice such as pre-design evaluation, public participation, and post occupancy evaluation (POE). In addition, the continuing research into the restorative street could benefit significantly by improving grounded knowledge, practical applications and public participation to deliver better and more socially responsive living environments for urban residents.

With its great potential for future development in both research and practices, this study is deemed to become an essential contributor to the solution of providing restorative choices to urban residents in megacities and to help deliver a healthy living environment under the advocated socially restorative urbanism agenda (Thwaites et al., 2003; Thwaites, Mathers and Simkins, 2013)

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APPENDICES

Appendix 1 Questionnaire for street restorative expectation in the pilot study

您好，感谢您参与该项调查问卷，我们承诺您提供的所有信息和回答将严格保密。

Please start with filling in some of your personal information. We promise that all your information and your answers will be kept in anonymous and in confidential.

1. 性别/Gender: _______男/Male _______女/ Female
2. 年龄/Age: _______22-30 _______30-40 _______40-50 _______50 以上
3. 职业/Occupation:

我们对您关于上海街道的体验很感兴趣。我们准备了以下问题帮助我们了解您的体验。 请仔细阅读每个下列每一个陈述句的内容，然后回答以下问题：**这句话的陈述内容与我的体验相符程度是多少？**

We are interested in your experience of this place. To help us understand your experience, we have provided the following statements for you to respond to. Please read each statement carefully, then ask yourself, ‘How much does this statement apply to my experience here?

请在问题后的数字刻度后面的横线上打✔来表明您的答案。下面给出了关于刻度数字含义的语言描述，这段描述会出现在问卷每一页的最下方以方便您的作答。

To indicate your answer, tick on the blanket after the numbers on the scale beside it. A sample of the scale with verbal descriptions for the values is given below and at the top of each subsequent page. Verbal descriptions for the scale values are as follows:

0 = 一点都不/Not at all; 1 = 很少/ Very little; 2 = 比较少/ Rather little; 3 = 适中/ Neither little nor much; 4 = 比较多/Rather much; 5 = 很多/Very much; 6 = 完全/ Completely.

1. 请您想象一条您理想中的**商业街道** （该类街道沿线以零售、餐饮等商业为主，具有一定服务能级和特色业态的街道），并回答下列的问题。

Please imagine your ideal **Commercial Street** *(This type of streets is dominated by retail, food services and other commercial businesses with a certain level of service capability and industrial attributes)* and answer questions in the table below.

这个环境让我能够暂时忘记工作和日常的生活； 0__1__2__3__4__5__6__ When I am here I feel free from work and daily routine. 这个环境让我能够暂时忘记他人的要求和期望； 0__1__2__3__4__5__6__ When I am here I feel free from other peoples' demand and expectations. 这个环境让我能够暂时不考虑我所承担的责任与义务。 0__1__2__3__4__5__6__ When I am here I do not need to think of my responsibility and obligations.
这个环境里的元素都是互相融合的； 0__1__2__3__4__5__6__ The elements here go together. 这个环境里的元素都是属于这里的； 0__1__2__3__4__5__6__ The existing elements belong here. 这个环境里的元素组成了一个更大的系统； 0__1__2__3__4__5__6__ All the elements constitute a larger whole. 这个环境是连贯的。 0__1__2__3__4__5__6__ The surroundings are coherent.
这个环境里有很多我想要探索的东西； 0__1__2__3__4__5__6__ There is plenty to discover here. 这个环境里有很多我感到好奇的东西； 0__1__2__3__4__5__6__ This setting has many things that I wonder about. 这个环境里有很多吸引我的地方； 0__1__2__3__4__5__6__ There are many objects here that attract my attention. 我想要花更长的时间体验这个环境； 0__1__2__3__4__5__6__ There is plenty that I want to linger on here. 我感到深深的沉浸在周围的环境中。 0__1__2__3__4__5__6__ I am absorbed in these surroundings.
这个环境让我能够做自己想做的事情； 0__1__2__3__4__5__6__ The environment gives me the opportunity to do activities that I like. 在这个环境里，我能够解决遇见的一些事情； 0__1__2__3__4__5__6__ I can handle the kinds of problems that arise here. 我能够很快的适应这个环境； 0__1__2__3__4__5__6__ I rapidly adapt to this setting. 这个环境与我想做的事之间能够达到一种匹配。 0__1__2__3__4__5__6__ There is an accordance between what I like to do and this environment.

2. 请您想象一条您理想中的**生活服务街道**（街道沿线以服务本地居民的生活服务型商业、中小规模零售、餐饮等商业以及公共服务设施为主的街道），并回答下列的问题。

Please imagine your ideal **Living and service Street** *(This type of streets is dominated by residential services, small and middle scale retail, food services and other businesses as well as public facilities)* and answer questions in the table below.

这个环境让我能够暂时忘记工作和日常的生活；

0__1__2__3__4__5__6__

When I am here I feel free from work and daily routine.

这个环境让我能够暂时忘记他人的要求和期望；

0__1__2__3__4__5__6__

When I am here I feel free from other peoples' demand and expectations.

这个环境让我能够暂时不考虑我所承担的责任与义务。

0__1__2__3__4__5__6__

When I am here I do not need to think of my responsibility and obligations.

这个环境里的元素都是互相融合的；

0__1__2__3__4__5__6__

The elements here go together.

这个环境里的元素都是属于这里的；

0__1__2__3__4__5__6__

The existing elements belong here.

这个环境里的元素组成了一个更大的系统；

0__1__2__3__4__5__6__

All the elements constitute a larger whole.

这个环境是连贯的。

0__1__2__3__4__5__6__

The surroundings are coherent.

这个环境里有很多我想要探索的东西；

0__1__2__3__4__5__6__

There is plenty to discover here.

这个环境里有很多我感到好奇的东西；

0__1__2__3__4__5__6__

This setting has many things that I wonder about.

这个环境里有很多吸引我的地方；

0__1__2__3__4__5__6__

There are many objects here that attract my attention.

我想要花更长的时间体验这个环境；

0__1__2__3__4__5__6__

There is plenty that I want to linger on here.

我感到深深的沉浸在周围的环境中。

0__1__2__3__4__5__6__

I am absorbed in these surroundings.

这个环境让我能够做自己想做的事情；

0__1__2__3__4__5__6__

The environment gives me the opportunity to do activities that I like.

在这个环境里，我能够解决遇见的一些事情；

0__1__2__3__4__5__6__

I can handle the kinds of problems that arise here.

我能够很快的适应这个环境；

0__1__2__3__4__5__6__

I rapidly adapt to this setting.

这个环境与我想做的事之间能够达到一种匹配。

0__1__2__3__4__5__6__

There is an accordance between what I like to do and this environment.

3. 请您想象一条您理想中的**景观休闲街道** （滨水、景观及历史风貌特色突出，沿线设置集中、成规模的休闲活动设施的街道），并回答下列的问题。

Please imagine your ideal Landscape and leisure Street (Characterised by waterfront, landscape or historic characteristics and equipped with leisure and entertainment facilities along the street) and answer questions in the table below.

这个环境让我能够暂时忘记工作和日常的生活； 0__1__2__3__4__5__6__ When I am here I feel free from work and daily routine. 这个环境让我能够暂时忘记他人的要求和期望； 0__1__2__3__4__5__6__ When I am here I feel free from other peoples' demand and expectations. 这个环境让我能够暂时不考虑我所承担的责任与义务。 0__1__2__3__4__5__6__ When I am here I do not need to think of my responsibility and obligations.
这个环境里的元素都是互相融合的； 0__1__2__3__4__5__6__ The elements here go together. 这个环境里的元素都是属于这里的； 0__1__2__3__4__5__6__ The existing elements belong here. 这个环境里的元素组成了一个更大的系统； 0__1__2__3__4__5__6__ All the elements constitute a larger whole. 这个环境是连贯的。 0__1__2__3__4__5__6__ The surroundings are coherent.
这个环境里有很多我想要探索的东西； 0__1__2__3__4__5__6__ There is plenty to discover here. 这个环境里有很多我感到好奇的东西； 0__1__2__3__4__5__6__ This setting has many things that I wonder about. 这个环境里有很多吸引我的地方； 0__1__2__3__4__5__6__ There are many objects here that attract my attention. 我想要花更长的时间体验这个环境； 0__1__2__3__4__5__6__ There is plenty that I want to linger on here. 我感到深深的沉浸在周围的环境中。 0__1__2__3__4__5__6__ I am absorbed in these surroundings.
这个环境让我能够做自己想做的事情； 0__1__2__3__4__5__6__ The environment gives me the opportunity to do activities that I like. 在这个环境里，我能够解决遇见的一些事情； 0__1__2__3__4__5__6__ I can handle the kinds of problems that arise here. 我能够很快的适应这个环境； 0__1__2__3__4__5__6__ I rapidly adapt to this setting. 这个环境与我想做的事之间能够达到一种匹配。

0__1__2__3__4__5__6__

There is an accordance between what I like to do and this environment.

4. 请您想象一条您理想中的**交通性街道** （以非开放式界面为主，交通性功能较强的街道），并回答下列的问题。

Please imagine your ideal Traffic-oriented Street (Dominated by traffic function with mostly non-opened frontages) and answer questions in the table below.

这个环境让我能够暂时忘记工作和日常的生活；

0__1__2__3__4__5__6__

When I am here I feel free from work and daily routine.

这个环境让我能够暂时忘记他人的要求和期望；

0__1__2__3__4__5__6__

When I am here I feel free from other peoples' demand and expectations.

这个环境让我能够暂时不考虑我所承担的责任与义务。

0__1__2__3__4__5__6__

When I am here I do not need to think of my responsibility and obligations.

这个环境里的元素都是互相融合的；

0__1__2__3__4__5__6__

The elements here go together.

这个环境里的元素都是属于这里的；

0__1__2__3__4__5__6__

The existing elements belong here.

这个环境里的元素组成了一个更大的系统；

0__1__2__3__4__5__6__

All the elements constitute a larger whole.

这个环境是连贯的。

0__1__2__3__4__5__6__

The surroundings are coherent.

这个环境里有很多我想要探索的东西；

0__1__2__3__4__5__6__

There is plenty to discover here.

这个环境里有很多我感到好奇的东西；

0__1__2__3__4__5__6__

This setting has many things that I wonder about.

这个环境里有很多吸引我的地方；

0__1__2__3__4__5__6__

There are many objects here that attract my attention.

我想要花更长的时间体验这个环境；

0__1__2__3__4__5__6__

There is plenty that I want to linger on here.

我感到深深的沉浸在周围的环境中。

0__1__2__3__4__5__6__

I am absorbed in these surroundings.

这个环境让我能够做自己想做的事情；

0__1__2__3__4__5__6__

The environment gives me the opportunity to do activities that I like.

在这个环境里，我能够解决遇见的一些事情；

0__1__2__3__4__5__6__

I can handle the kinds of problems that arise here.

我能够很快的适应这个环境；

0__1__2__3__4__5__6__

I rapidly adapt to this setting.

这个环境与我想做的事之间能够达到一种匹配。

0__1__2__3__4__5__6__

There is an accordance between what I like to do and this environment.

---

5. 请您想象一条您理想中的**综合性街道** （该类街道沿线功能高度混合，通常含有两种及两种以上的业态特征），并回答下列的问题。

Please imagine your ideal Comprehensive Street (Street types and frontage types are highly mixed or a street contains more than two types of characteristics) and answer questions in the table below.

这个环境让我能够暂时忘记工作和日常的生活；

0__1__2__3__4__5__6__

When I am here I feel free from work and daily routine.

这个环境让我能够暂时忘记他人的要求和期望；

0__1__2__3__4__5__6__

When I am here I feel free from other peoples' demand and expectations.

这个环境让我能够暂时不考虑我所承担的责任与义务。

0__1__2__3__4__5__6__

When I am here I do not need to think of my responsibility and obligations.

这个环境里的元素都是互相融合的；

0__1__2__3__4__5__6__

The elements here go together.

这个环境里的元素都是属于这里的；

0__1__2__3__4__5__6__

The existing elements belong here.

这个环境里的元素组成了一个更大的系统；

0__1__2__3__4__5__6__

All the elements constitute a larger whole.

这个环境是连贯的。

0__1__2__3__4__5__6__

The surroundings are coherent.

这个环境里有很多我想要探索的东西；

0__1__2__3__4__5__6__

There is plenty to discover here.

这个环境里有很多我感到好奇的东西；

0__1__2__3__4__5__6__

This setting has many things that I wonder about.

这个环境里有很多吸引我的地方；

0__1__2__3__4__5__6__

There are many objects here that attract my attention.

我想要花更长的时间体验这个环境；

0__1__2__3__4__5__6__

There is plenty that I want to linger on here.

我感到深深的沉浸在周围的环境中。

0__1__2__3__4__5__6__

I am absorbed in these surroundings.

这个环境让我能够做自己想做的事情；

0__1__2__3__4__5__6__

The environment gives me the opportunity to do activities that I like.

在这个环境里，我能够解决遇见的一些事情；

0__1__2__3__4__5__6__

I can handle the kinds of problems that arise here.

我能够很快的适应这个环境；

0__1__2__3__4__5__6__

I rapidly adapt to this setting.

这个环境与我想做的事之间能够达到一种匹配。

0__1__2__3__4__5__6__

There is an accordance between what I like to do and this environment.

再次感谢您的参与和配合！ Thanks again for your participation!

Appendix 2 Consent form

项目：探索疗愈性概念在上海街道应用的设计原则

同意书

请在适当的方框中打✓	**是**	**否**
■ **在您参与该项目前及参与中**		
我已经阅读并理解了项目详情页，或该项目已经有项目负责人详细的对我阐明。（如果您在此栏选择了“否”，请不要进行接下来的内容，直到您完全明白和了解了您所参与的科研项目；		
在任何时候，我都有关于项目的提问权；		
我同意参加该项目。我明白参与该项目包括完成相应问卷和眼动仪实验；我明白并接受我的回答将会以文字方式储存。		
我同意参与该项目完全处于自愿，并且我可以在 2019 年 9 月 1 日前的任何时间停止参与该项目；我了解我不需要对于我停止参与给出任何理由，我不需要对我的决定承担任何负面后果；		
■ **在项目进行中及完成后，有关您所提供的所有信息**		
我明白我的个人信息（姓名，联系方式等）绝对不会以任何一种形式被项目以外的人所知晓；		
我了解并同意我的一些回答可能会被引用于公开发表的报告、文献等研究成果中。我明白我的回答在未经我个人允许的情况下将不会被具体署名；		
我理解并同意其他研究人员在该项目保密协议的情况下可以引用我在该项目中提供的数据信息（问卷及访谈回答）；		
我同意我所参与的所有实验结果将由同济大学及英国谢菲尔德大学保存至 2025 年 10 月 31 日；		
■ **综上，您所提供的信息将由研究合法保存并使用**		
我同意由我产生的该研究相关资料版权由同济大学及谢菲尔德大学该项目所有。		

参与人姓名:　　　　签字:　　　　日期:

研究者姓名：殷雨婷　　　　签字: 殷雨婷　　　　日期:

有关该项目的更多信息，详情咨询:

研究人员：殷雨婷，博士研究生；yyin9@sheffield.ac.uk；谢菲尔德大学景观系。

Project: *Towards Developing Restorative Street Design Principles in Shanghai, China*

Consent Form

Please tick the appropriate boxes	Yes	No
Taking Part in the Project		
I have read and understood the project information sheet dated ______________ or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)		
I have been given the opportunity to ask questions about the project.		
I agree to take part in the project. I understand that taking part in the project will include wearing a eye tracker and completing a questionnaire, and my answers will be recorded in written form during the process.		
I understand that my taking part is voluntary and that I can withdraw from the study before 01/09/2019; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.		
How my information will be used during and after the project		
I understand my personal details such as name, phone number, address and email address etc. will not be revealed to people outside the project.		
I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.		
I understand and agree that other authorised researchers may use my data ((my responses in questionnaire and interview) in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.		
I give permission for all the survey results that I provide to be deposited in The University of Sheffield **until 31/10/2025**.		
So that the information you provide can be used legally by the researchers		
I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield.		

Name of participant: Signature: Date

Name of Researcher: Yuting Yin Signature: Date

Project contact details for further information:
Researcher: Yuting Yin; PhD Researcher; yyin9@sheffield.ac.uk; Department of Landscape, The University of Sheffield, Western Bank, Sheffield, S10 2TN, UK.

Appendix 3 Information sheet

Project: Towards Developing Restorative Street Design Principles in Shanghai, China

Name of Researcher: Yuting Yin

You are being invited to take part in a research project. Before you decide whether or not to participate, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

- **Introduction of Project**

This is part of a proposed PhD research project at Department of Landscape, The University of Sheffield, in UK. The aim of the research project is to discover of way of making Shanghai street restorative which means to make street to be a kind of public space that can offer people opportunities to recover from excessive psychological demands, such as stress and mental fatigue. I will first construct a framework to investigate people's expectations on street restorative quality and then to assess current street restorativeness. You are invited to take part in this survey. The result of this projects is expected to contribute in improving current Shanghai Street Guidelines in terms of delivering social benefits of streets.

- **Participants Information**

As one of the Shanghai residents, you are invited to take part in this project. It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time by **01/09/2019** without any negative consequences. You do not have to give a reason. If you wish to withdraw from the research, please contact the researcher, Yuting Yin.

- **Survey Information**

You will be asked to fill in a questionnaire and to take a short interview afterwards. The whole process is about 20-30 minutes. Your personal information (name, age, occupation etc.) might be asked during the survey but all information you provided (your personal information and your answers) will be kept confidentially by the researcher and the university of Sheffield.

- **Confidentiality**

All the information that we collect about you during the course of the research will be kept **strictly confidential** and will only be accessible to members of the research team. You will not be able to be identified in any reports or publications unless you have given your explicit consent for this. If you agree to us sharing the information you provide with other researchers (e.g. by making it available in a data archive) then your personal details will not be included unless you explicitly request this.

Due to the nature of this research it is very likely that other researchers may find the data collected to be useful in answering future research questions. We will ask for your explicit consent for your data to be shared in this way.

- **Data Protection Legislation**

All the data you provided will be kept by the research and the University of Sheffield until 31/10/2025 and then destroyed after that.
According to data protection legislation, we are required to inform you that the legal basis we are applying in order to process your personal data is that 'processing is necessary for the performance of a task carried out in the public interest' (Article 6(1)(e)). Further information can be found in the University's Privacy Notice: https://www.sheffield.ac.uk/govern/data-protection/privacy/general.

■ **Complaints and Questions**

- If you feel being treated unwell during the process, please contact the researcher and the supervisor directly.
- If you feel your complaint has not been handled to your satisfaction, please contact Head of Department of Landscape, The University of Sheffield.
- If your complaint relates to how the participants' personal data has been handled, information about how to raise a complaint can be found in the University's Privacy Notice: https://www.sheffield.ac.uk/govern/data-protection/privacy/general

■ **Please note:**

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any reports or publication.

- This project has been **ethically approved** via the University of Sheffield's Ethics Review Procedure, as administered by Department of Landscape.
- **The University of Sheffield** will act as the **Data Controller** for this study. This means that the University is responsible for looking after your information and using it properly.
- This research has no public funding.
- There are **no possible disadvantages and risks** of taking part into the interview.

Contact for further information:
Researcher: Yuting Yin, yyin9@sheffield.ac.uk
Supervisor: Dr Kevin Thwaites, k.thwaites@sheffield.ac.uk

All participant will be given **a copy of this information sheet** and **a copy of consent form** to keep.

Thank you very much for taking part in this project. Thank you!

项目：探索修复性概念在上海街道应用的设计原则

研究者：殷雨婷

您被邀请参加一个研究项目。 在您决定是否参加之前，了解研究的原因及其涉及的内容非常重要。 如果您愿意，请花时间仔细阅读以下信息并与他人讨论。有任何疑惑或问题，欢迎您随时提出。请认真考虑您是否愿意参与此项研究，感谢您的仔细阅读，谢谢!

■ **项目介绍**

您所参与的调研是谢菲尔德大学景观系博士项目的一部分。研究的主要目的是为了探索使上海的各类街道具有健康修复功能的设计原则，简单来说，就是通过城市设计手法让街道成为一种能够缓解居民压力和疲劳的公共空间。我将首先调查上海市民对于各类街道修复能力的期望值并对街道的现状进行评估。您受邀参与此次评估过程，您的帮助将会对提升上海街道作为公共空间的质量，延展街道的社会功能起到很大的作用。

■ **参与者信息**

作为上海居民，您被选中参与该试验。是否参加完全取决于您的个人意愿。 如果您决定参加，您将获得此信息表以保留（并被要求签署同意书），您仍然可以在 01/09/2019 之前随时退出，而不会产生任何负面后果。您不必给出关于退出该研究的任何理由。 如果您想退出研究，请联系研究员殷雨婷。

■ **调研信息**

您将被邀请填写一份调查问卷以及参与后续简短的访谈，整个过程约为 20-30 分钟。访谈中的问题将基于您给出的评价内容。

■ **保密条例**

我们在研究过程中收集的有关您的所有信息将严格保密，只有研究团队成员才能访问。 除非您明确同意，否则您将无法在任何报告或出版物中被识别出来。 如果您同意我们与其他研究人员共享您提供的信息（例如，通过数据存档提供），那么除非您明确要求，否则您的个人信息将不会被包括在内。

由于这项研究的性质，其他研究人员很可能会发现所收集的数据对回答未来的研究问题很有用。 我们在以这种方式共享您的数据之前会征求您的同意。

■ **数据法律保护**

您所提供的所有资料数据，将由研究者和其所在学校谢菲尔德大学严格保管至 2025 年 10 月 31 日。在改日期之后，所有数据将被统一销毁。

根据数据保护立法，我们需要通知您，我们为处理您的个人数据而应用的法律依据是“为履行符合公共利益的任务而必须进行处理”（第 6 条第 1 款））（E））。更多信息可以在大学的隐私声明中找到：https：//www.sheffield.ac.uk/govern/data-protection/privacy/general.

■ **申诉和意见**

- 如果您在此过程中感到不适，请直接联系研究人员和主管。
- 如果您认为您的投诉未得到满意处理，请联系谢菲尔德大学景观系主任。
- 如果您的投诉与参与者的个人数据的处理方式有关，可以在大学的隐私声明中找到有关如何提出投诉的信息： https://www.sheffield.ac.uk/govern/data-protection/privacy/general

■ **请注意：**

- 我们将保留在研究过程中收集的有关您的所有信息严格保密。 您将无法在任何报告或出版物中被识别出来。

- 该项目通过谢菲尔德大学的道德审查程序获得道德批准，该程序由景观系管理。
- 谢菲尔德大学将担任本研究的数据控制者，这意味着大学负责管理您的信息并正确使用它。
- 该研究没有公共资金。
- 参加该项目没有可能的缺点和风险。

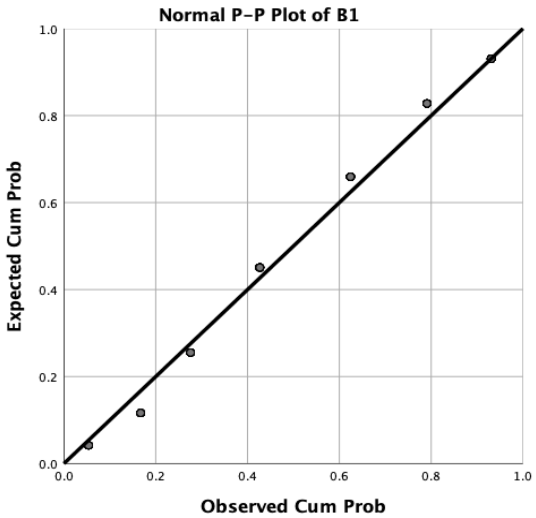
联系以下人员获取更多信息：

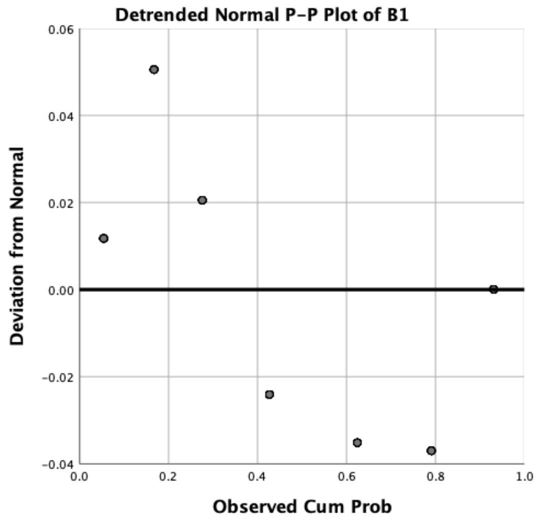
研究者：殷雨婷 yyin9@sheffield.ac.uk
导师：Dr Kevin Thwaites, k.thwaites@sheffield.ac.uk

所有参与者都将获得此信息表的副本和一份同意书副本。
再次感谢您参与这个项目，谢谢！

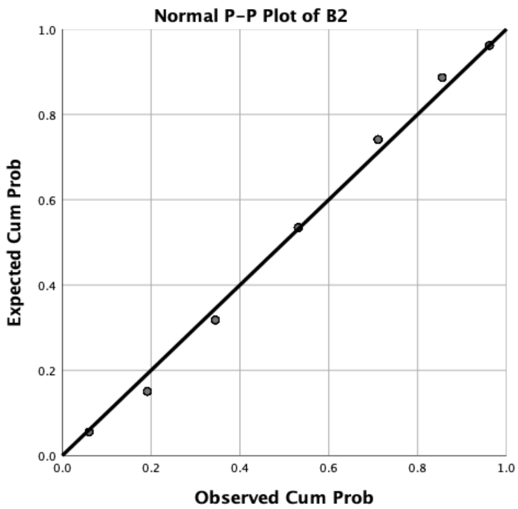
Appendix 4 P-P Plot of RCS expectation results

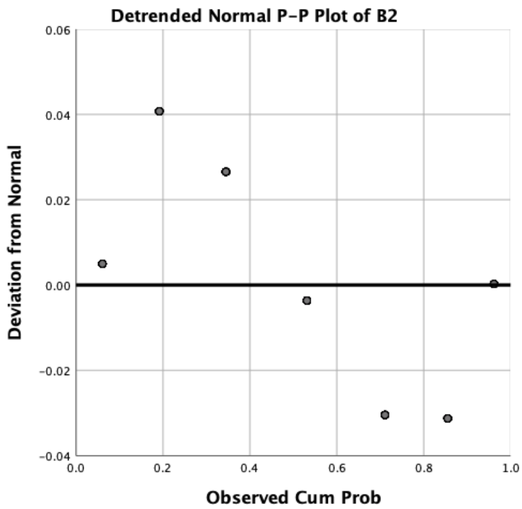
RCS-B1



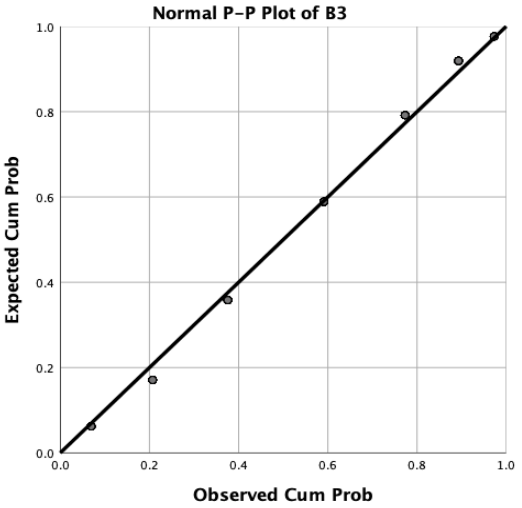


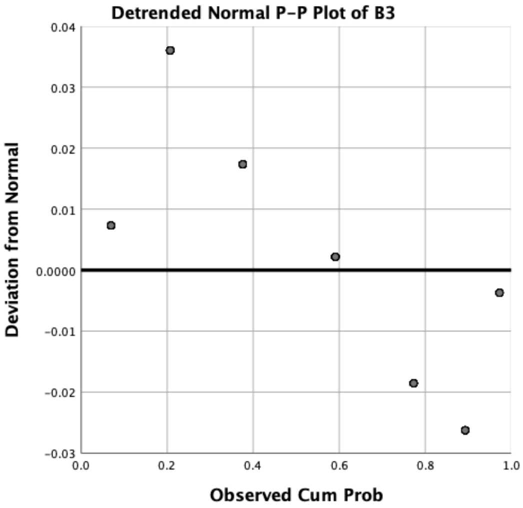
RCS-B2



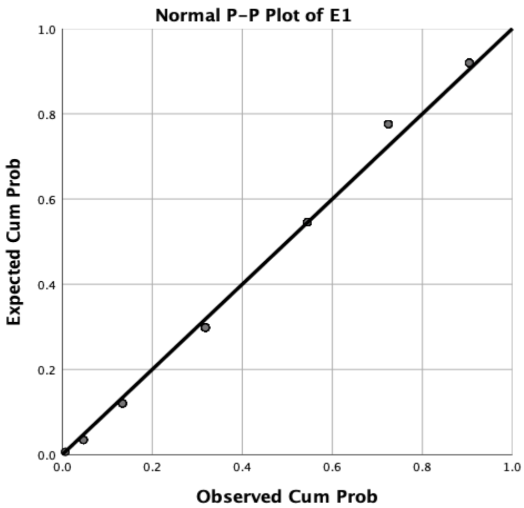


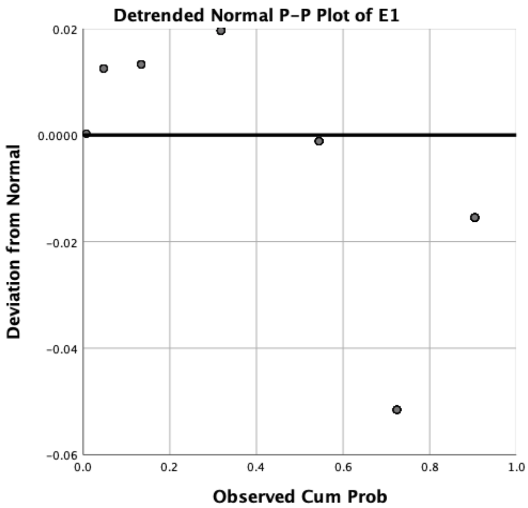
RCS-B3


Normal P-P Plot of B3
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0

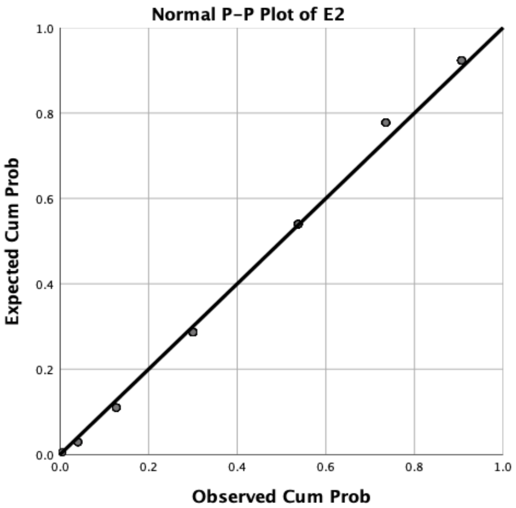

Detrended Normal P-P Plot of B3
Deviation from Normal
Observed Cum Prob
0.04
0.03
0.02
0.01
0.0000
-0.01
-0.02
-0.03

RCS-E1

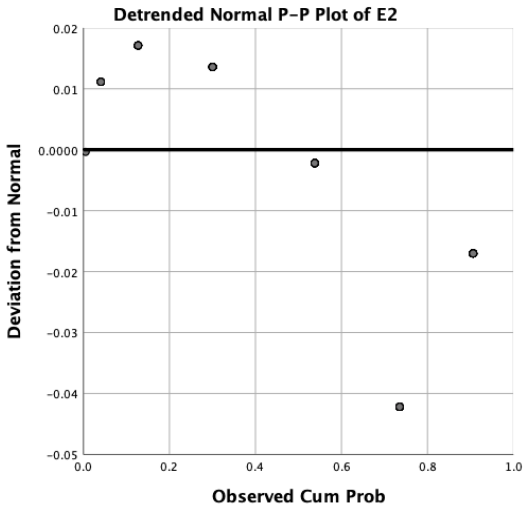

Normal P-P Plot of E1
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0


Detrended Normal P-P Plot of E1
Deviation from Normal
Observed Cum Prob
0.02
0.0000
-0.02
-0.04
-0.06

RCS-E2

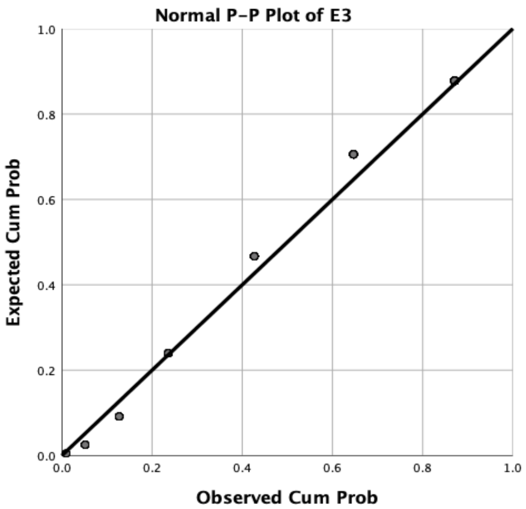


Normal P-P Plot of E2
Expected Cum Prob
Observed Cum Prob

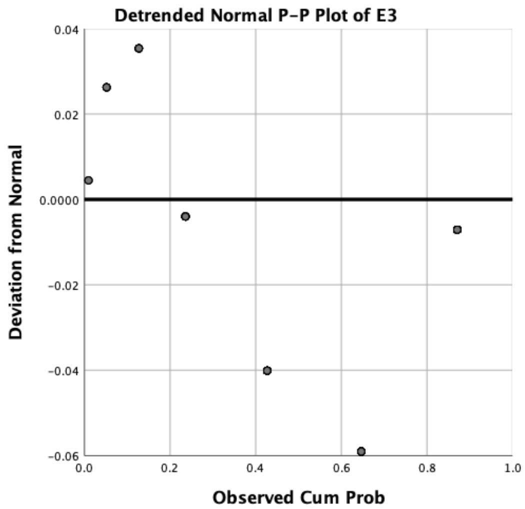


Detrended Normal P-P Plot of E2
Deviation from Normal
Observed Cum Prob

RCS-E3

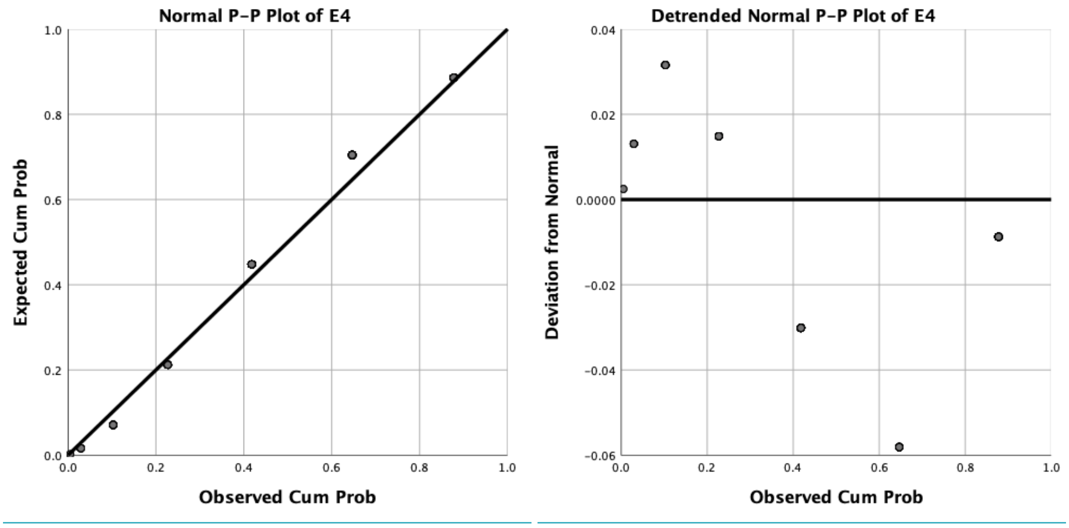


Normal P-P Plot of E3
Expected Cum Prob
Observed Cum Prob



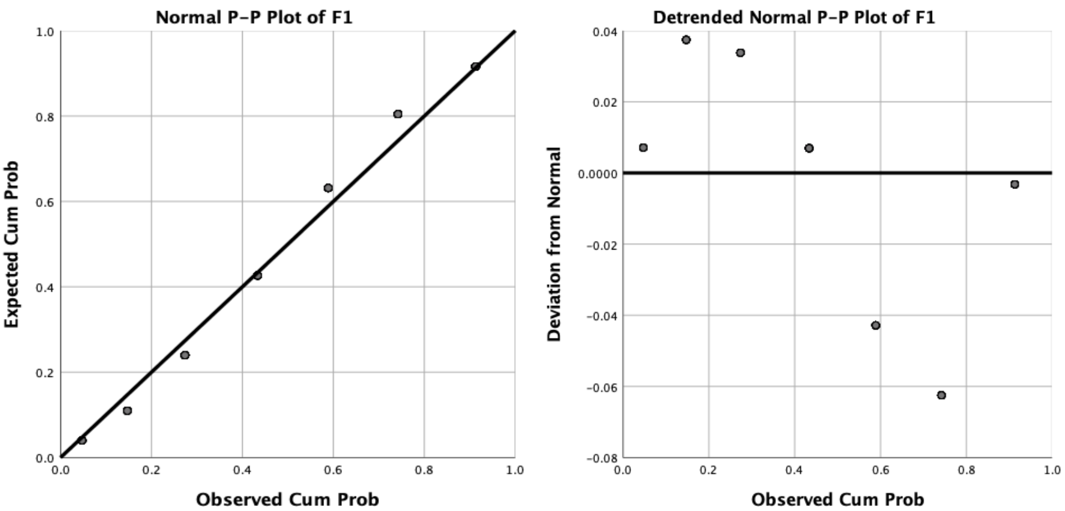
Detrended Normal P-P Plot of E3
Deviation from Normal
Observed Cum Prob

RCS-E4



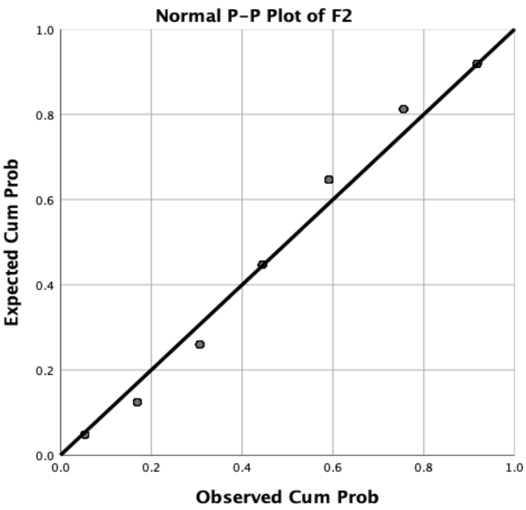
Normal P-P Plot of E4
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of E4
Deviation from Normal
Observed Cum Prob

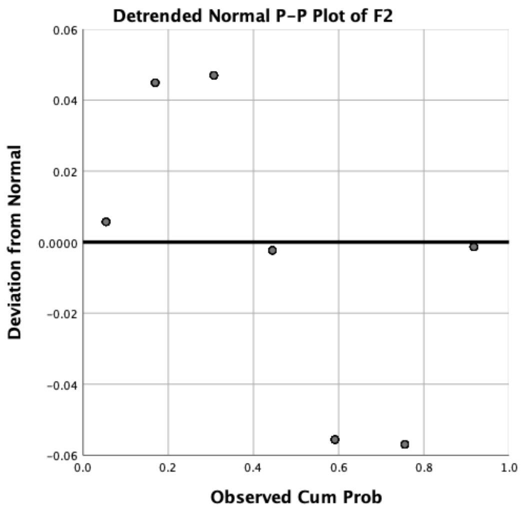
RCS-F1



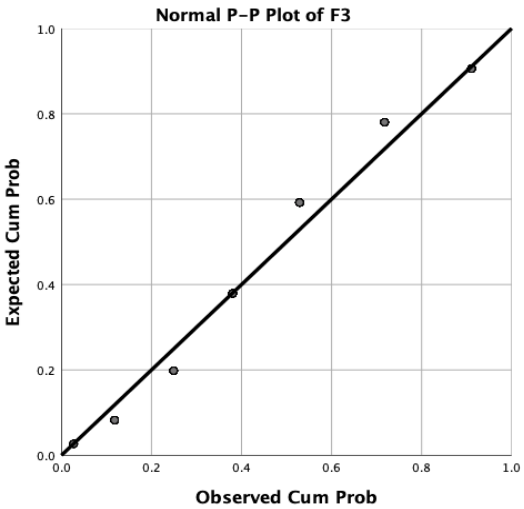
Normal P-P Plot of F1
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of F1
Deviation from Normal
Observed Cum Prob

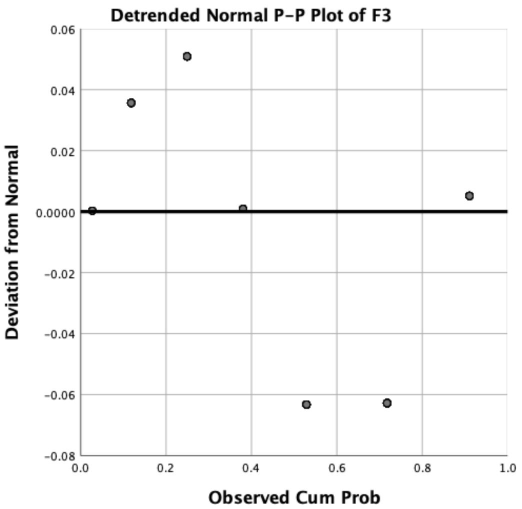
RCS-F2


Normal P-P Plot of F2
Expected Cum Prob
Observed Cum Prob

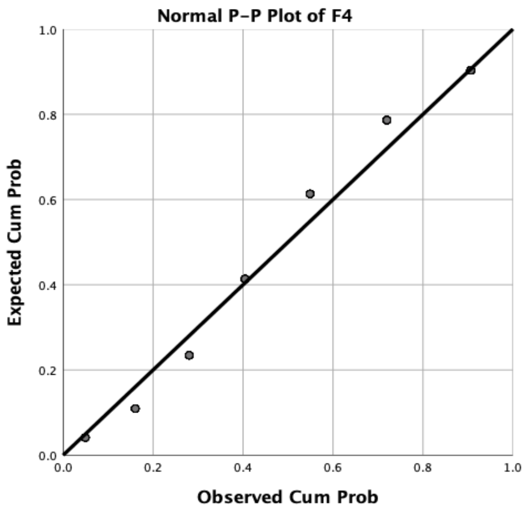

Detrended Normal P-P Plot of F2
Deviation from Normal
Observed Cum Prob

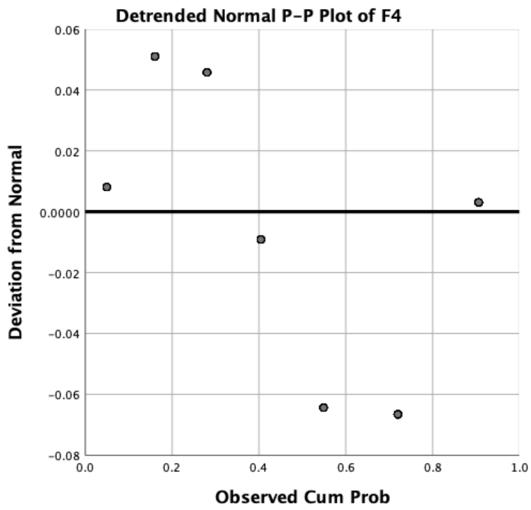
RCS-F3


Normal P-P Plot of F3
Expected Cum Prob
Observed Cum Prob

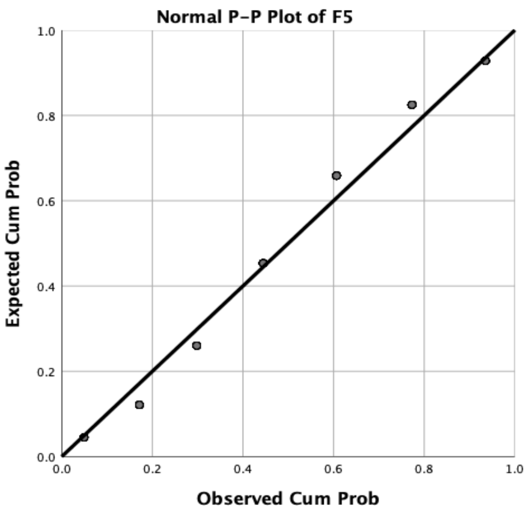

Detrended Normal P-P Plot of F3
Deviation from Normal
Observed Cum Prob

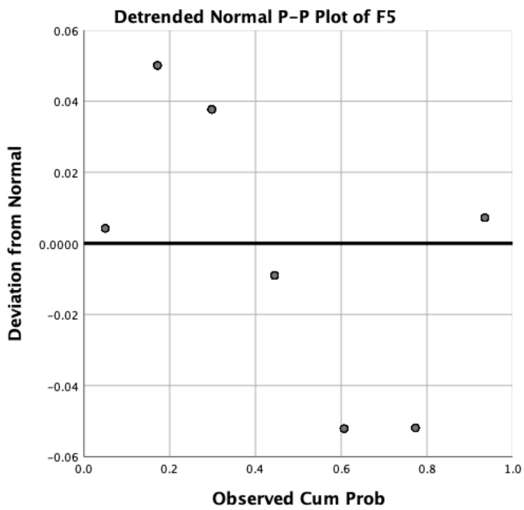
RCS-F4


Normal P–P Plot of F4
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

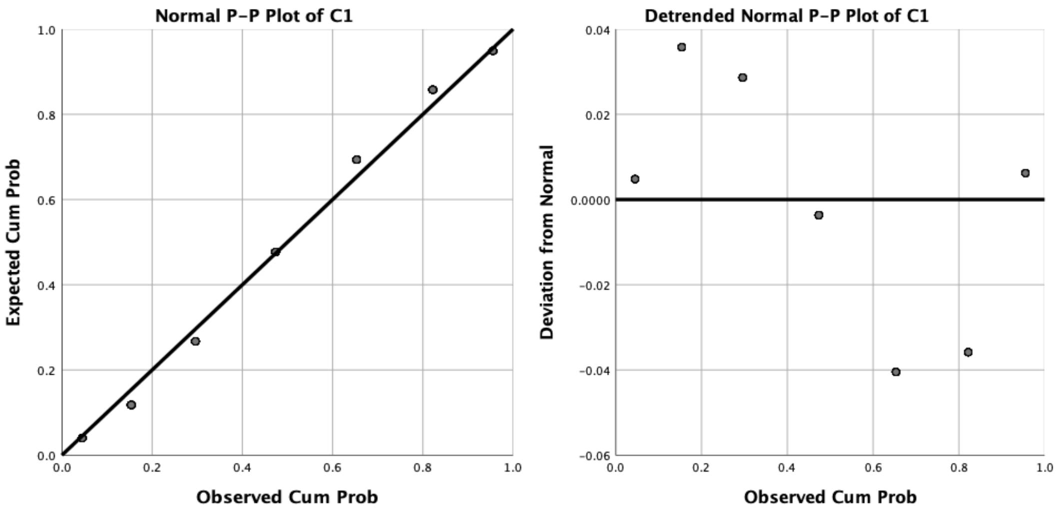

Detrended Normal P–P Plot of F4
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.0000
−0.02
−0.04
−0.06
−0.08
0.0
0.2
0.4
0.6
0.8
1.0

RCS-F5


Normal P–P Plot of F5
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

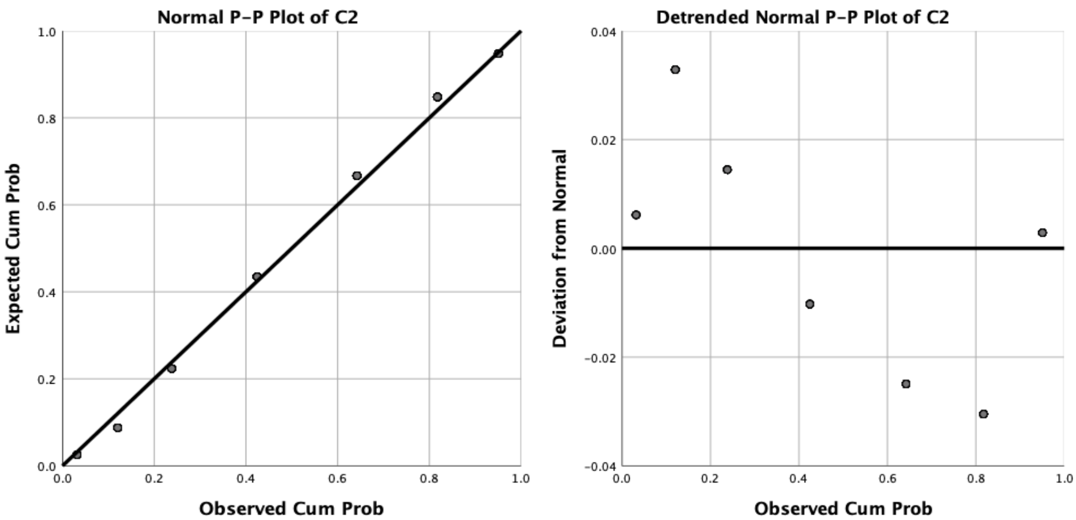

Detrended Normal P–P Plot of F5
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.0000
−0.02
−0.04
−0.06
0.0
0.2
0.4
0.6
0.8
1.0

RCS-C1



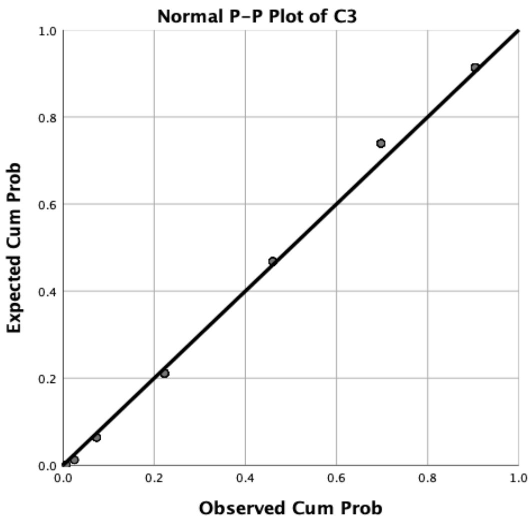
Normal P-P Plot of C1
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of C1
Deviation from Normal
Observed Cum Prob

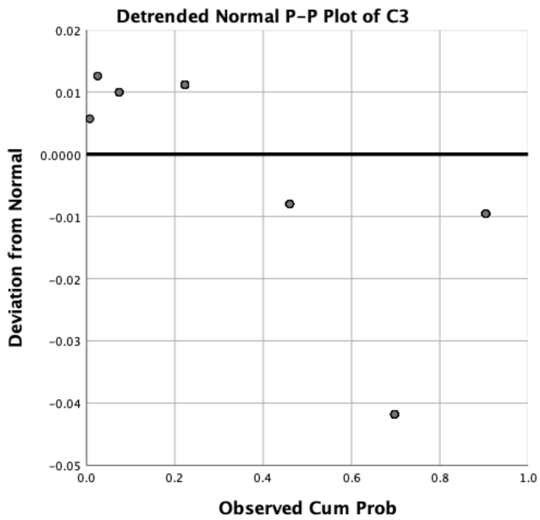
RCS-C2



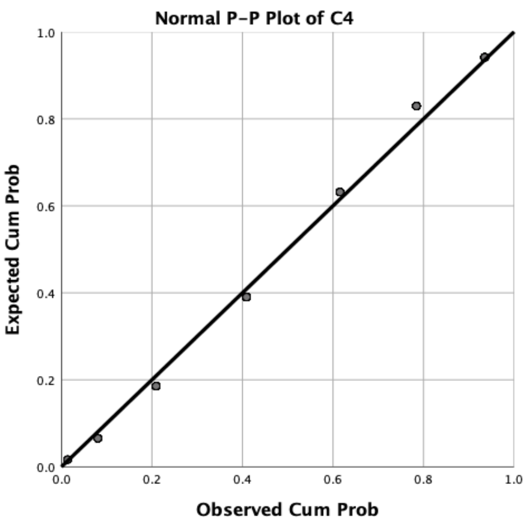
Normal P-P Plot of C2
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of C2
Deviation from Normal
Observed Cum Prob

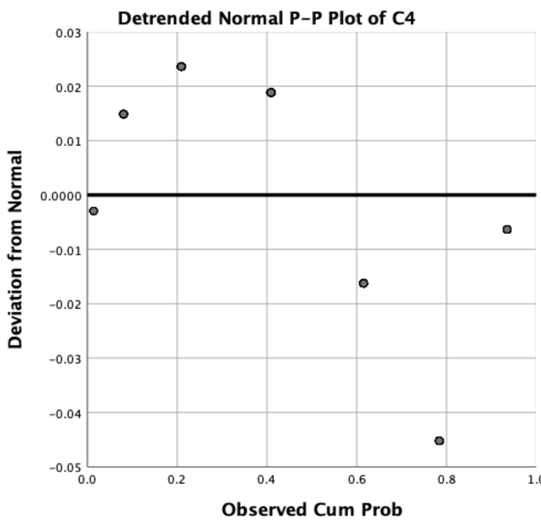
RCS-C3


Normal P-P Plot of C3
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of C3
Deviation from Normal
Observed Cum Prob
0.02
0.01
0.0000
-0.01
-0.02
-0.03
-0.04
-0.05
0.0
0.2
0.4
0.6
0.8
1.0

RCS-C4


Normal P-P Plot of C4
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of C4
Deviation from Normal
Observed Cum Prob
0.03
0.02
0.01
0.0000
-0.01
-0.02
-0.03
-0.04
-0.05
0.0
0.2
0.4
0.6
0.8

Appendix 5 One way ANOVA results of expectation rating in the pilot study

1) Comparison within street types

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
B1	Between Groups	304.649	4	76.162	34.956	0.000
	Within Groups	479.333	220	2.179		
	Total	783.982	224			
B2	Between Groups	215.111	4	53.778	23.736	0.000
	Within Groups	498.444	220	2.266		
	Total	713.556	224			
B3	Between Groups	196.284	4	49.071	23.840	0.000
	Within Groups	452.844	220	2.058		
	Total	649.129	224			
E1	Between Groups	105.822	4	26.456	13.378	0.000
	Within Groups	435.067	220	1.978		
	Total	540.889	224			
E2	Between Groups	76.907	4	19.227	9.792	0.000
	Within Groups	431.956	220	1.963		
	Total	508.862	224			
E3	Between Groups	37.911	4	9.478	3.875	0.005
	Within Groups	538.089	220	2.446		
	Total	576.000	224			
E4	Between Groups	36.018	4	9.004	4.257	0.002
	Within Groups	465.378	220	2.115		
	Total	501.396	224			
F1	Between Groups	260.044	4	65.011	25.381	0.000
	Within Groups	563.511	220	2.561		
	Total	823.556	224			
F2	Between Groups	264.818	4	66.204	24.409	0.000
	Within Groups	596.711	220	2.712		
	Total	861.529	224			
F3	Between Groups	322.471	4	80.618	39.882	0.000
	Within Groups	444.711	220	2.021		
	Total	767.182	224			
F4	Between Groups	345.271	4	86.318	35.836	0.000
	Within Groups	529.911	220	2.409		
	Total	875.182	224			

F5	Between Groups	277.822	4	69.456	28.665	0.000
	Within Groups	533.067	220	2.423		
	Total	810.889	224			
C1	Between Groups	142.338	4	35.584	13.922	0.000
	Within Groups	562.311	220	2.556		
	Total	704.649	224			
C2	Between Groups	41.449	4	10.362	3.867	0.005
	Within Groups	589.467	220	2.679		
	Total	630.916	224			
C3	Between Groups	52.400	4	13.100	7.628	0.000
	Within Groups	377.822	220	1.717		
	Total	430.222	224			
C4	Between Groups	86.782	4	21.696	9.452	0.000
	Within Groups	504.978	220	2.295		
	Total	591.760	224			

2) Comparison within participants groups

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
B1-CM	Equal variances assumed	0.998	0.323	0.021	43	0.983	0.010	0.475	-0.948	0.968
	Equal variances not assumed			0.021	42.643	0.983	0.010	0.468	-0.934	0.954
B2-CM	Equal variances assumed	0.168	0.684	0.333	43	0.741	0.180	0.541	-0.910	1.270
	Equal variances not assumed			0.332	40.296	0.742	0.180	0.542	-0.916	1.276
B3-CM	Equal variances assumed	1.784	0.189	0.154	43	0.879	0.070	0.456	-0.849	0.989
	Equal variances not assumed			0.150	36.507	0.881	0.070	0.466	-0.875	1.015
E1-CM	Equal variances assumed	0.488	0.488	1.142	43	0.260	0.490	0.429	-0.375	1.355
	Equal variances not assumed			1.124	37.954	0.268	0.490	0.436	-0.392	1.372
E2-CM	Equal variances assumed	0.233	0.632	0.295	43	0.769	0.130	0.441	-0.759	1.019

	Equal variances not assumed			0.292	39.161	0.772	0.130	0.445	-0.770	1.030
E3-CM	Equal variances assumed	1.105	0.299	0.077	43	0.939	0.040	0.519	-1.006	1.086
	Equal variances not assumed			0.075	36.681	0.940	0.040	0.530	-1.034	1.114
E4-CM	Equal variances assumed	0.198	0.659	1.941	43	0.059	0.800	0.412	-0.031	1.631
	Equal variances not assumed			1.901	36.980	0.065	0.800	0.421	-0.053	1.653
F1-CM	Equal variances assumed	2.729	0.106	1.075	43	0.288	0.600	0.558	-0.525	1.725
	Equal variances not assumed			1.105	42.992	0.276	0.600	0.543	-0.496	1.696
F2-CM	Equal variances assumed	3.469	0.069	1.063	43	0.294	0.590	0.555	-0.529	1.709
	Equal variances not assumed			1.099	42.787	0.278	0.590	0.537	-0.493	1.673
F3-CM	Equal variances assumed	3.715	0.061	1.652	43	0.106	0.700	0.424	-0.155	1.555
	Equal variances not assumed			1.718	42.287	0.093	0.700	0.407	-0.122	1.522
F4-CM	Equal variances assumed	4.117	0.049	2.298	43	0.027	1.110	0.483	0.136	2.084
	Equal variances not assumed			2.375	42.785	0.022	1.110	0.467	0.167	2.053
F5-CM	Equal variances assumed	1.022	0.318	1.319	43	0.194	0.690	0.523	-0.365	1.745
	Equal variances not assumed			1.350	42.979	0.184	0.690	0.511	-0.341	1.721
C1-CM	Equal variances assumed	0.024	0.877	-0.754	43	0.455	-0.410	0.543	-1.506	0.686
	Equal variances not assumed			-0.762	42.121	0.450	-0.410	0.538	-1.496	0.676
C2-CM	Equal variances assumed	1.117	0.296	0.057	43	0.955	0.030	0.526	-1.030	1.090
	Equal variances not assumed			0.058	42.763	0.954	0.030	0.517	-1.012	1.072
C3-CM	Equal variances assumed	3.477	0.069	-0.237	43	0.814	-0.090	0.379	-0.855	0.675
	Equal variances not			-0.230	34.158	0.820	-0.090	0.392	-0.886	0.706

	assumed									
C4-CM	Equal variances assumed	1.777	0.190	0.270	43	0.788	0.130	0.482	-0.841	1.101
	Equal variances not assumed			0.264	36.283	0.794	0.130	0.493	-0.870	1.130
B1-LS	Equal variances assumed	0.003	0.955	-1.147	43	0.258	-0.600	0.523	-1.655	0.455
	Equal variances not assumed			-1.145	40.577	0.259	-0.600	0.524	-1.659	0.459
B2-LS	Equal variances assumed	0.478	0.493	-0.919	43	0.363	-0.490	0.533	-1.566	0.586
	Equal variances not assumed			-0.918	40.726	0.364	-0.490	0.534	-1.568	0.588
B3-LS	Equal variances assumed	0.510	0.479	-1.021	43	0.313	-0.470	0.460	-1.398	0.458
	Equal variances not assumed			-1.040	42.798	0.304	-0.470	0.452	-1.382	0.442
E1-LS	Equal variances assumed	1.310	0.259	0.110	43	0.913	0.050	0.454	-0.866	0.966
	Equal variances not assumed			0.107	35.944	0.915	0.050	0.466	-0.895	0.995
E2-LS	Equal variances assumed	0.043	0.837	0.692	43	0.493	0.310	0.448	-0.594	1.214
	Equal variances not assumed			0.702	42.550	0.487	0.310	0.442	-0.581	1.201
E3-LS	Equal variances assumed	0.264	0.610	0.527	43	0.601	0.280	0.532	-0.792	1.352
	Equal variances not assumed			0.533	42.283	0.597	0.280	0.526	-0.781	1.341
E4-LS	Equal variances assumed	1.166	0.286	1.989	43	0.053	0.920	0.463	-0.013	1.853
	Equal variances not assumed			2.037	42.991	0.048	0.920	0.452	0.009	1.831
F1-LS	Equal variances assumed	0.062	0.805	-0.844	43	0.403	-0.440	0.521	-1.491	0.611
	Equal variances not assumed			-0.845	40.896	0.403	-0.440	0.521	-1.492	0.612
F2-LS	Equal variances assumed	0.026	0.872	-1.349	43	0.185	-0.730	0.541	-1.822	0.362
	Equal variances not assumed			-1.351	41.086	0.184	-0.730	0.540	-1.821	0.361

F3-LS	Equal variances assumed	0.055	0.816	-0.646	43	0.522	-0.330	0.511	-1.361	0.701
	Equal variances not assumed			-0.642	39.804	0.525	-0.330	0.514	-1.370	0.710
F4-LS	Equal variances assumed	0.126	0.724	-0.037	43	0.971	-0.020	0.538	-1.106	1.066
	Equal variances not assumed			-0.037	40.693	0.971	-0.020	0.539	-1.108	1.068
F5-LS	Equal variances assumed	0.777	0.383	-0.258	43	0.798	-0.140	0.543	-1.235	0.955
	Equal variances not assumed			-0.254	38.011	0.801	-0.140	0.551	-1.256	0.976
C1-LS	Equal variances assumed	0.917	0.344	1.100	43	0.277	0.580	0.527	-0.483	1.643
	Equal variances not assumed			1.131	42.977	0.264	0.580	0.513	-0.454	1.614
C2-LS	Equal variances assumed	2.142	0.151	0.959	43	0.343	0.500	0.521	-0.551	1.551
	Equal variances not assumed			0.983	42.997	0.331	0.500	0.509	-0.526	1.526
C3-LS	Equal variances assumed	4.341	0.043	0.906	43	0.370	0.310	0.342	-0.380	1.000
	Equal variances not assumed			0.942	42.393	0.352	0.310	0.329	-0.354	0.974
C4-LS	Equal variances assumed	0.271	0.605	1.165	43	0.251	0.550	0.472	-0.402	1.502
	Equal variances not assumed			1.181	42.559	0.244	0.550	0.466	-0.389	1.489
B1-LL	Equal variances assumed	1.367	0.249	0.785	43	0.437	0.320	0.408	-0.502	1.142
	Equal variances not assumed			0.801	42.928	0.427	0.320	0.399	-0.485	1.125
B2-LL	Equal variances assumed	2.185	0.147	0.783	43	0.438	0.320	0.409	-0.504	1.144
	Equal variances not assumed			0.813	42.480	0.421	0.320	0.394	-0.474	1.114
B3-LL	Equal variances assumed	0.452	0.505	0.333	43	0.741	0.160	0.480	-0.808	1.128
	Equal variances not assumed			0.337	42.324	0.738	0.160	0.475	-0.798	1.118
E1-LL	Equal variances assumed	5.532	0.023	2.617	43	0.012	0.780	0.298	0.179	1.381

	Equal variances not assumed			2.748	41.033	0.009	0.780	0.284	0.207	1.353
E2-LL	Equal variances assumed	0.482	0.491	1.498	43	0.141	0.490	0.327	-0.170	1.150
	Equal variances not assumed			1.469	37.205	0.150	0.490	0.333	-0.186	1.166
E3-LL	Equal variances assumed	0.310	0.580	0.341	43	0.735	0.130	0.382	-0.640	0.900
	Equal variances not assumed			0.334	37.303	0.740	0.130	0.389	-0.658	0.918
E4-LL	Equal variances assumed	1.016	0.319	2.451	43	0.018	0.830	0.339	0.147	1.513
	Equal variances not assumed			2.490	42.654	0.017	0.830	0.333	0.158	1.502
E-LL	Equal variances assumed	0.073	0.788	1.908	43	0.063	######	######	######	######
	Equal variances not assumed			1.930	42.286	0.060	######	######	######	######
F1-LL	Equal variances assumed	0.556	0.460	1.124	43	0.267	0.460	0.409	-0.365	1.285
	Equal variances not assumed			1.146	42.829	0.258	0.460	0.402	-0.350	1.270
F2-LL	Equal variances assumed	1.186	0.282	1.530	43	0.133	0.670	0.438	-0.213	1.553
	Equal variances not assumed			1.560	42.861	0.126	0.670	0.429	-0.196	1.536
F3-LL	Equal variances assumed	1.986	0.166	1.796	43	0.080	0.610	0.340	-0.075	1.295
	Equal variances not assumed			1.838	42.979	0.073	0.610	0.332	-0.059	1.279
F4-LL	Equal variances assumed	0.749	0.391	1.538	43	0.131	0.520	0.338	-0.162	1.202
	Equal variances not assumed			1.557	42.414	0.127	0.520	0.334	-0.154	1.194
F5-LL	Equal variances assumed	1.951	0.170	2.318	43	0.025	0.760	0.328	0.099	1.421
	Equal variances not assumed			2.355	42.674	0.023	0.760	0.323	0.109	1.411
C1-LL	Equal variances assumed	0.038	0.846	1.004	43	0.321	0.430	0.428	-0.433	1.293
	Equal variances not			1.005	40.920	0.321	0.430	0.428	-0.434	1.294

	assumed									
C2-LL	Equal variances assumed	2.913	0.095	0.660	43	0.513	0.270	0.409	-0.555	1.095
	Equal variances not assumed			0.689	41.838	0.495	0.270	0.392	-0.521	1.061
C3-LL	Equal variances assumed	2.863	0.098	0.427	43	0.671	0.160	0.374	-0.595	0.915
	Equal variances not assumed			0.412	33.227	0.683	0.160	0.389	-0.630	0.950
C4-LL	Equal variances assumed	0.979	0.328	0.277	43	0.783	0.110	0.398	-0.692	0.912
	Equal variances not assumed			0.271	36.742	0.788	0.110	0.406	-0.713	0.933
B1-TO	Equal variances assumed	2.063	0.158	-1.114	43	0.271	-0.430	0.386	-1.208	0.348
	Equal variances not assumed			-1.131	42.595	0.265	-0.430	0.380	-1.197	0.337
B2-TO	Equal variances assumed	0.125	0.725	-1.055	43	0.297	-0.370	0.351	-1.077	0.337
	Equal variances not assumed			-1.052	40.499	0.299	-0.370	0.352	-1.080	0.340
B3-TO	Equal variances assumed	0.064	0.801	-0.522	43	0.604	-0.180	0.345	-0.876	0.516
	Equal variances not assumed			-0.525	41.624	0.603	-0.180	0.343	-0.873	0.513
E1-TO	Equal variances assumed	0.134	0.716	0.870	43	0.389	0.370	0.425	-0.488	1.228
	Equal variances not assumed			0.855	37.535	0.398	0.370	0.433	-0.507	1.247
E2-TO	Equal variances assumed	0.011	0.915	0.109	43	0.914	0.050	0.460	-0.877	0.977
	Equal variances not assumed			0.109	40.735	0.914	0.050	0.460	-0.879	0.979
E3-TO	Equal variances assumed	0.217	0.644	0.235	43	0.816	0.110	0.469	-0.836	1.056
	Equal variances not assumed			0.232	39.148	0.818	0.110	0.474	-0.848	1.068
E4-TO	Equal variances assumed	0.158	0.693	0.874	43	0.387	0.400	0.457	-0.523	1.323
	Equal variances not assumed			0.863	38.471	0.394	0.400	0.464	-0.538	1.338

F1-TO	Equal variances assumed	3.475	0.069	-1.512	43	0.138	-0.590	0.390	-1.377	0.197
	Equal variances not assumed			-1.569	42.534	0.124	-0.590	0.376	-1.349	0.169
F2-TO	Equal variances assumed	0.005	0.944	-0.525	43	0.602	-0.210	0.400	-1.016	0.596
	Equal variances not assumed			-0.521	39.395	0.605	-0.210	0.403	-1.025	0.605
F3-TO	Equal variances assumed	0.567	0.455	-0.628	43	0.533	-0.230	0.366	-0.968	0.508
	Equal variances not assumed			-0.634	42.079	0.529	-0.230	0.363	-0.962	0.502
F4-TO	Equal variances assumed	0.122	0.729	-0.184	43	0.855	-0.080	0.435	-0.956	0.796
	Equal variances not assumed			-0.183	39.406	0.856	-0.080	0.438	-0.966	0.806
F5-TO	Equal variances assumed	0.336	0.565	-0.025	43	0.980	-0.010	0.405	-0.826	0.806
	Equal variances not assumed			-0.024	36.437	0.981	-0.010	0.414	-0.850	0.830
C1-TO	Equal variances assumed	0.937	0.339	-1.291	43	0.204	-0.540	0.418	-1.383	0.303
	Equal variances not assumed			-1.308	42.468	0.198	-0.540	0.413	-1.373	0.293
C2-TO	Equal variances assumed	3.295	0.076	-0.149	43	0.882	-0.080	0.536	-1.160	1.000
	Equal variances not assumed			-0.145	35.609	0.885	-0.080	0.550	-1.196	1.036
C3-TO	Equal variances assumed	1.321	0.257	0.548	43	0.587	0.270	0.493	-0.724	1.264
	Equal variances not assumed			0.538	37.291	0.594	0.270	0.502	-0.747	1.287
C4-TO	Equal variances assumed	0.003	0.953	-0.506	43	0.615	-0.250	0.494	-1.246	0.746
	Equal variances not assumed			-0.505	40.527	0.616	-0.250	0.495	-1.250	0.750
B1-CP	Equal variances assumed	0.062	0.804	-0.725	43	0.472	-0.300	0.414	-1.134	0.534
	Equal variances not assumed			-0.718	39.068	0.477	-0.300	0.418	-1.145	0.545
B2-CP	Equal variances assumed	1.906	0.175	-0.321	43	0.750	-0.130	0.405	-0.947	0.687

	Equal variances not assumed			-0.314	36.953	0.755	-0.130	0.413	-0.968	0.708
B3-CP	Equal variances assumed	0.021	0.884	-0.459	43	0.649	-0.190	0.414	-1.025	0.645
	Equal variances not assumed			-0.456	39.744	0.651	-0.190	0.417	-1.033	0.653
E1-CP	Equal variances assumed	0.029	0.866	-2.644	43	0.011	-1.170	0.443	-2.063	-0.277
	Equal variances not assumed			-2.615	38.969	0.013	-1.170	0.447	-2.075	-0.265
E2-CP	Equal variances assumed	0.439	0.511	-1.927	43	0.061	-0.790	0.410	-1.617	0.037
	Equal variances not assumed			-1.919	40.171	0.062	-0.790	0.412	-1.622	0.042
E3-CP	Equal variances assumed	0.169	0.683	0.088	43	0.930	0.040	0.454	-0.876	0.956
	Equal variances not assumed			0.088	40.984	0.930	0.040	0.454	-0.877	0.957
E4-CP	Equal variances assumed	0.442	0.510	-0.655	43	0.516	-0.300	0.458	-1.224	0.624
	Equal variances not assumed			-0.652	40.132	0.518	-0.300	0.460	-1.230	0.630
F1-CP	Equal variances assumed	0.281	0.599	1.114	43	0.272	0.550	0.494	-0.446	1.546
	Equal variances not assumed			1.134	42.799	0.263	0.550	0.485	-0.428	1.528
F2-CP	Equal variances assumed	0.201	0.656	1.104	43	0.276	0.560	0.507	-0.463	1.583
	Equal variances not assumed			1.119	42.497	0.269	0.560	0.500	-0.450	1.570
F3-CP	Equal variances assumed	0.217	0.644	1.337	43	0.188	0.610	0.456	-0.310	1.530
	Equal variances not assumed			1.356	42.581	0.182	0.610	0.450	-0.297	1.517
F4-CP	Equal variances assumed	0.455	0.503	1.269	43	0.211	0.620	0.489	-0.365	1.605
	Equal variances not assumed			1.255	38.948	0.217	0.620	0.494	-0.379	1.619
F5-CP	Equal variances assumed	0.024	0.878	0.968	43	0.338	0.480	0.496	-0.520	1.480
	Equal variances not			0.982	42.542	0.332	0.480	0.489	-0.506	1.466

	assumed									
C1-CP	Equal variances assumed	0.054	0.817	-0.170	43	0.866	-0.080	0.472	-1.031	0.871
	Equal variances not assumed			-0.169	40.051	0.867	-0.080	0.474	-1.038	0.878
C2-CP	Equal variances assumed	0.089	0.767	0.658	43	0.514	0.310	0.471	-0.640	1.260
	Equal variances not assumed			0.657	40.527	0.515	0.310	0.472	-0.643	1.263
C3-CP	Equal variances assumed	0.107	0.745	-1.047	43	0.301	-0.390	0.373	-1.141	0.361
	Equal variances not assumed			-1.056	41.974	0.297	-0.390	0.369	-1.136	0.356
C4-CP	Equal variances assumed	0.012	0.913	0.137	43	0.891	0.060	0.437	-0.821	0.941
	Equal variances not assumed			0.138	41.339	0.891	0.060	0.435	-0.819	0.939

Appendix 6 Following-up interview results in the expectation pilot study

Interviewee 1

1. Any phrases hard to understand?
   Yes, the word 'restoration'. But anyway, I found it has nothing to do with later questions.
2. Is the imagination process hard for you?
   No, besides of comprehensive street. I cannot find a proper imagination.
3. Is it able for you to differentiate street types?
   Yes, I can differentiate most of them. To me, they only differentiate at frontage compositions. But still, comprehensive street is quite ambiguous.
4. Any specific street appeared?
   Yes, but only for the first four types.
5. Any more suggestions?
   I think it'll be more efficient if you can have a more accurate descriptions on five street types. Also, you'll need to have a clarification on restoration in the beginning. I certainly believe it's a quite new word for normal people.

Interviewee 2

1. Any phrases hard to understand?
   Yes. I don't really understand this sentence 'there is an accordance between what I like to do and this environment', particular the word accordance. If it is my ideal street, it certainly can match everything I'd like to do.
2. Is the imagination process hard for you?
   No, nothing difficult in this part.
3. Is it able for you to differentiate street types?
   Mostly yes. But I don't know what is the comprehensive street in your case. It feels like a combinative street to me.
4. Any specific street appeared?
   Yes, several. They are basis of my imagination.
5. Any more suggestions?
   I don't really understand the logic of your survey. Maybe you should tell me what you intend to do though this questionnaire.

Interviewee 3

1. Any phrases hard to understand?
   Not a single word. But the questions, or I should say, descriptions are hard to comprehend in a sentence.
2. Is the imagination process hard for you?
   Not really.
3. Is it able for you to differentiate street types?
   Yes, I can do that. But until I move to the second page, I realised what you want me to do in this survey. You want us to differentiate, don't you? So I have to go back again. Actually, I picture myself in different status in terms of different streets. That's much easier. For example, I think when I go to a LL street, I should be just wanting to relax and walk around. Based on this prerequisite, I gave out my ratings.
4. Any specific street appeared?
   Nothing in particular. I think my imaginations are more like a model rather than some real street.
5. Any more suggestions?

I can see it's a psychological questionnaire, but maybe you should use language that more common people could understand.

Interviewee 4

1. Any phrases hard to understand?
   Yes. Mostly the last section. I can't find the connections between these questions or descriptions and the streets you mentioned at the top.
2. Is the imagination process hard for you?
   No, it's not hard. To be honest, it's more like to imagine my emotional status on different streets rather than simply imagine different spaces.
3. Is it able for you to differentiate street types?
   Yes, it's easy for me to do this.
4. Any specific street appeared?
   Yes, but real streets are like a basic model, I use it to create my ideal ones.
5. Any more suggestions?
   Maybe you should state clearly the objective of each section in the questionnaire. That would be easier for us to give out correct ratings.

Interviewee 5

1. Any phrases hard to understand?
   Yes. Mainly my difficulties lie at different street types. Particularly, I don't understand streets like traffic-oriented and comprehensive streets.
2. Is the imagination process hard for you?
   For some of street types, yes, the others are not easy. Like I said, I cannot picture the difference clearly enough.
3. Is it able for you to differentiate street types?
   Still, only two or three in these five types. TO and CP are vague concepts.
4. Any specific street appeared?
   Yes! Speaks of commercial street, I remember a costal commercial avenue in las Vegas.
5. Any more suggestions?
   I think for a questionnaire, it's a little bit too long. I understand you want us to do differentiation, but is it possible for you to make all of them in on page? Otherwise, it seems intimidating psychologically.

Interviewee 6

1. Any phrases hard to understand?
   Not to me, no. I can understand the intention of it.
2. Is the imagination process hard for you?
   A little bit. Since I never paid too much attention on streets before, so my imagination has to rely on the environment that I currently live.
3. Is it able for you to differentiate street types?
   Some of them I feel like I have never met before. Hence when I gave out my ratings, I try to connect each type with a certain kind of landmarks. For example, CM means shopping mall, LL means hospitals etc., LL means parks and green lands, TO means vehicles and CP means it contains all.
4. Any specific street appeared?
   Yes, some streets close to where I live. For example, from my understandings, Dapu Road and Xujiahui Road should fall into the type of CP.
5. Any more suggestions?
   Maybe some illustrations, icons and examples could help me to imagine during the process.

Interviewee 7

1. Any phrases hard to understand?
   Some language you use in the questionnaire is more like written language. I think it can be more conveyable if you could use a more oral language.
2. Is the imagination process hard for you?
   It's ok for me. When I finish reading the description, I can find an appropriate street based on my personal understandings and experiences. One problem is you are not only asking to imagine different streets, you are asking us to imagine the ideal streets. That's tricky for those have not experienced any good streets. Imagination comes from personal experiences. If someone has not experienced such good street, how can he tell you his perceptions then.
3. Is it able for you to differentiate street types?
   No, for me it's easy. Because of my job, when I wander about in this city, on different streets, I notice a lot of differences. But I assume it'll be difficult for people that have not been trained in this way.
4. Any specific street appeared?
   Yes, of course. That is my base model to give out the ratings.
5. Any more suggestions?
   I think my answers for previous questions already contains some. So, more oral language, and maybe some illustrations for those who know nothing about urban design.

Interviewee 8

1. Any phrases hard to understand?
   Some, it's not a particular word. I think it's very abstract so each person you investigated might comprehend this in a very different way.
2. Is the imagination process hard for you?
   No, not for me. I can easily link your descriptions to certain streets I met and then based on that to have further imaginations.
3. Is it able for you to differentiate street types?
   Of course, I know you are trying to differentiate between frontages, surrounding environments etc. Maybe because I'm an architect, so it's easy for me to identify each type you mentioned.
4. Any specific street appeared?
   A lot. Normally one street, but for LL street, there are a lot of them appeared in my mind.
5. Any more suggestions?
   I do think you should consider more about how normal people can give out more accurate ratings. I think the only problem is the evaluation model cannot be easily understood, it's not common language. The whole objective is quite clear though. Everything else seems fine.

Interviewee 9

1. Any phrases hard to understand?
   It's not a single word but the way you express your questions. It's not the way people normally speak, it's more like a paperwork, very formal and written language.
2. Is the imagination process hard for you?
   A little bit. The boundary between several street types are quite blur.
3. Is it able for you to differentiate street types?
   Like I said, only some of them. I think LS street, CM and CP are hard to differentiate. I feel like LS and CP are combinative street type based on CM.
4. Any specific street appeared?
   Yes, some streets close to my neighbourhood. I used real situations to imagine the ideal one, like a baseline to create the ideal one.
5. Any more suggestions?

Maybe put the five streets on the same page so we could quickly know that it is a comparison results you are looking for. Because you are asking same set of questions for five times, it's a little bit boring. If you put them on one page, I still give out all answers, but I'd feel like I only did one set of questions.

Interviewee 10

1. Any phrases hard to understand?
   No, not to me. I mean, some words might take a few minutes to comprehend its meaning, but in general, it worked for me.
2. Is the imagination process hard for you?
   No, not really. This part is easy.
3. Is it able for you to differentiate street types?
   Yes, but I guess it could be difficult for people that have no professional knowledge.
4. Any specific street appeared?
   Not a single street. It's several parts of streets that appeared in my mind. A lot of sections. I think streets we met in daily life are mostly comprehensive streets.
5. Any more suggestions?
   I think you should test this on unprofessional people. I think it could be difficult for them to finish

Interviewee 11

1. Any phrases hard to understand?
   A lot. I mean I gave out these ratings based on my feelings and institute, not from my rationality. Questions are not common language and some sentences are too long.
2. Is the imagination process hard for you?
   No, this part is clear and easy. Ideal street is easy to imagine, but it's hard to connect them with your questions.
3. Is it able for you to differentiate street types?
   A little bit. Because I think there is no clear boundary between streets. Sometimes it feels like different parts of the same streets.
4. Any specific street appeared?
   Yes, a lot. Some near the place I lived, near my ex-boyfriend's house and some close to where I work.
5. Any more suggestions?
   I feel like your question set not fit to one street. I thought about one street when I did some questions, and suddenly my imagination jumps to another when I do some other questions.

Interviewee 12

1. Any phrases hard to understand?
   I think is … 'constitute a larger whole, to be specific'… I don't really understand what the larger whole is.
2. Is the imagination process hard for you?
   If one to five means not at all to very difficult, it should be 2.
3. Is it able for you to differentiate street types?
   Let's use rate again. CM (1), LL (2), LS (4), TO (5), CP (2).
4. Any specific street appeared?
   Yes, but not for TO street. I don't think I met them a lot in my daily life. I imagine something more like express way.
5. Any more suggestions?
   Not really.

Interviewee 13

1. Any phrases hard to understand?
   The first is I don't really understand the connection between streets and daily work and responsibilities, so I understand it as anxiousness and comfort; second, I don't know what you mean by asking about 'coherent' and 'go together', so I understand it as mixes and multi-function of streets; the third is 'I can handle the kinds of problems that arise here', what does this mean? My purse was stolen, or I was bitten by snake?
2. Is the imagination process hard for you?
   It's fine for me.
3. Is it able for you to differentiate street types?
   Yes, of course.
4. Any specific street appeared?
   Yes, such as some streets close to my neighbourhood and some I used to take a walk.
5. Any more suggestions?
   Nothing I can think of at this moment.

Interviewee 14

1. Any phrases hard to understand?

I think different person has different understandings, but in general, I feel this questionnaire is a little bit abstract.

2. Is the imagination process hard for you?

This works for me. But it could be difficult for those who have no professional background.

3. Is it able for you to differentiate street types?

No, it's not a problem for me. For CM streets I imagines streets such as Nanjing West Road with commercial block along both sides; fot LL streets, one type I imagined some streets along Suzhou River, and the other one is close to Yangtzi River with a lot of green landscape, near the Dragon museum etc.; LS street I imagined something close to residential block with mixed use frontages, small-scale shop that are mainly service to residents and people who work in surrounding office buildings; TO I imagined trunks in Shanghai, like Wusong Road border roads with very little shops along both sides, only some entrance for residential neighbourhoods and some green landscape.

4. Any specific street appeared?

Yes, of course. I think I answered this one already.

5. Any more suggestions?

The first thing you can give your own definitions to every professional word you use; the second is you should think about adding some illustrations for each street types.

Interviewee 15

1. Any phrases hard to understand?

I think two sentences, one is the elements in this environment constitutes a larger whole, it's not the normal way we speak, I guess. The other one is I feel I can handle problems here. This sentence is unclear, is that I can fix my former issues here or I met some problems here and fixed it here?

2. Is the imagination process hard for you?

Yes, it's hard for me. I'm not good at imagination.

3. Is it able for you to differentiate street types?

For most of them, yes. I think the five streets have some overlaps, like the CP-street should have traffic and commercial functions in it, doesn't it?

4. Any specific street appeared?
Yes, like Tongming street near where I lived, that's an apparent LS street.

5. Any more suggestions?
Not really, no.

Interviewee 16

1. Any phrases hard to understand?
All lot, I mean the same question set should not apply for all streets. I think for CM or LL streets, I'm able to get rest and forget some life trouble. But if I just walk pass a TO street or run an errand along a LS street, it's not possible for me to forget my duty.

2. Is the imagination process hard for you?
That's not hard. But for some types, like TO, I don't which state is its ideal one. I don't have a standard for it.

3. Is it able for you to differentiate street types?
Yes, for me it's ok.

4. Any specific street appeared?
No, I live in a limited scale of environment. I rated based on some blur ideas and flashes, not a particular street.

5. Any more suggestions?
I think you should slightly alter the question set according to street types, and maybe add some illustrations for each street type.

Interviewee 17

1. Any phrases hard to understand?
Well, given that I have no professional knowledge, I feel like that they are quite similar.

2. Is the imagination process hard for you?
I can only imagine certain types like CM, and LL, but I don't have an imagine for the other three.

3. Is it able for you to differentiate street types?
One a part of them. I think only some streets along shopping malls, along river sides and some along famous bar streets would influence my emotional status.

4. Any specific street appeared?
Yes, like Xiangyang Road, South Shanxi Road etc.

5. Any more suggestions?
No, not really.

Interviewee 18

1. Any phrases hard to understand?
I think it feels ok in general. It's just there are too many streets for me to imagine and I don't recognise enough difference between them. So it's hard to discern how my expectations vary.

2. Is the imagination process hard for you?
Yes, this part is hard.

3. Is it able for you to differentiate street types?
Yes, I can do this.

4. Any specific street appeared?
No, I don't think so. Just some very blur ideas and imagines.

5. Any more suggestions?
No.

Interviewee 19

1. Any phrases hard to understand?
No, I can easily get your point in this questionnaire.

2. Is the imagination process hard for you?
It's not hard to imagine a ideal street. It has to be clean, safe and I should be able to find everything I need. Also, I like bright environment. So it will be important to have good light system during night time.

3. Is it able for you to differentiate street types?
I think some streets cannot be categorised in to one certain type. My hard part is to imagine some street that are purely commercial or landscape or traffic-oriented.

4. Any specific street appeared?
Since I live in Yangpu district, I'm more familiar with streets there. For living streets, I thought about some streets in Anshanxincun, which have a lot of small shop along both sides. LL street, I remembered University Road near WUJIAOCHANG with a lot of bars, restaurants etc; CM street, I thought about some streets in Wujiaochang area. That area contains diverse shopping malls.

5. Any more suggestions?
Maybe some illustrations for each street type would be helpful.

Interviewee 20

1. Any phrases hard to understand?
The most difficult part is I cannot imagine what a CP STREET is. It feels like some combination. But I cannot have a clear imagination for it.

2. Is the imagination process hard for you?
Only for the CP street. The other four types are easy, based on my former experiences.

3. Is it able for you to differentiate street types?
Yes, I know the difference among them.

4. Any specific street appeared?
No specific street, but some pictures, imagines flashed.

5. Any more suggestions?
No.

Interviewee 21

1. Any phrases hard to understand?
Yes, a lot. I can understand every word, but not when they are formed into a sentence.

2. Is the imagination process hard for you?
Yes, I feel like there isn't any common standard for the ideal states.

3. Is it able for you to differentiate street types?
Yes, I can do that given my background is in transport planning.

4. Any specific street appeared?
Of course, a lot of streets, diverse of streets.

5. Any more suggestions?
No.

Interviewee 22

1. Any phrases hard to understand？
I feel like the language has a large distance with normal life. If you could change the way you ask questions, like change 'please imagine…' to 'now you are standing on a street …". And for each question requires to rate, some sentences can be misleading. It might be helpful to make up details for each one， for example, 'free from stress and trouble of daily work and routine'. Also, some questions in the same section seem to be quite similar.

2. Is the imagination process hard for you?
No, that's not hard for me.

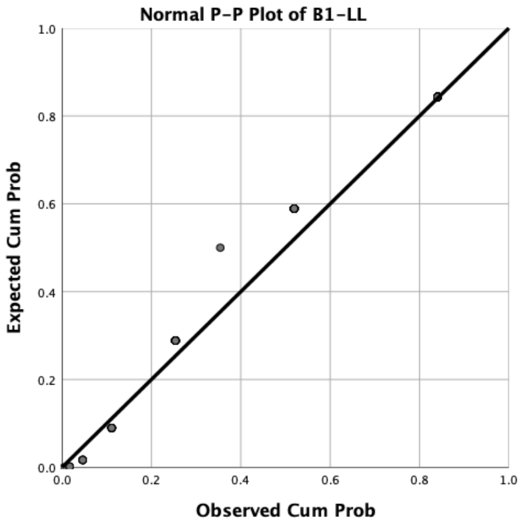
3. Is it able for you to differentiate street types?
Of course.

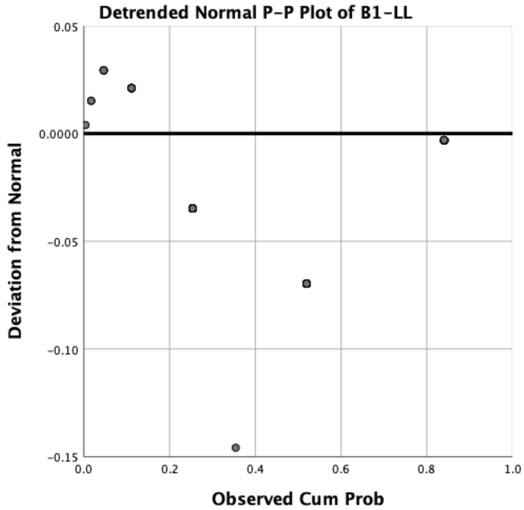
4. Any specific street appeared?
Yes, for me, the way I do this is I find an appropriate street for each type, imagine that I walk along this street and then rate accordingly.

5. Any more suggestions?
Consider add some illustrations for each street type, that could help people with no professional background to understand what you mean.

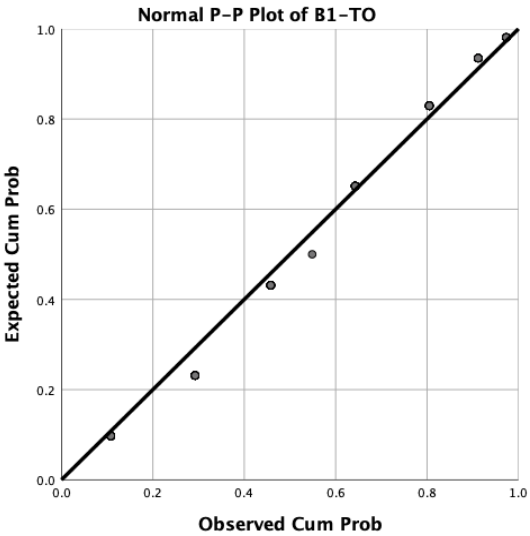
Appendix 7 P-P Plot of RCS expectation results in the formal survey

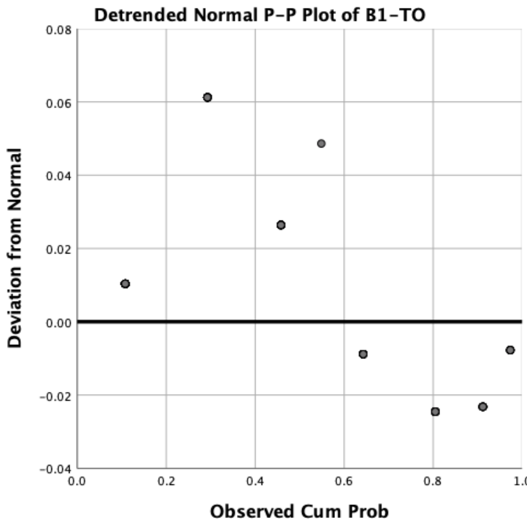
B1-LL



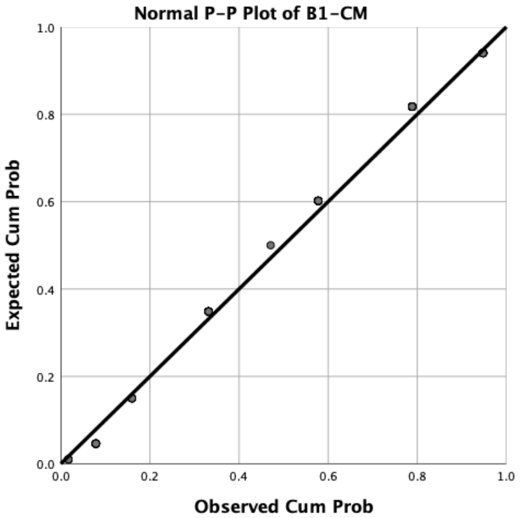


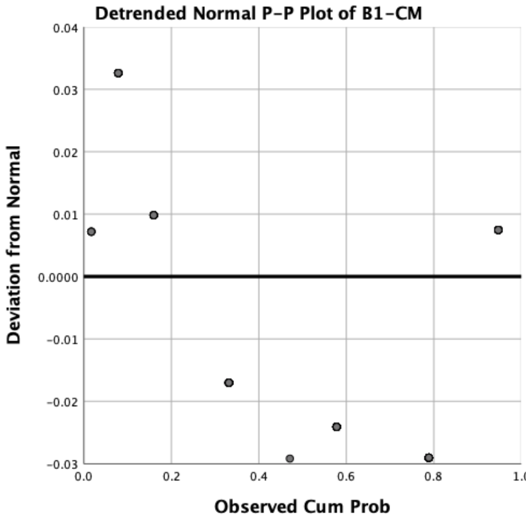
B1-TO



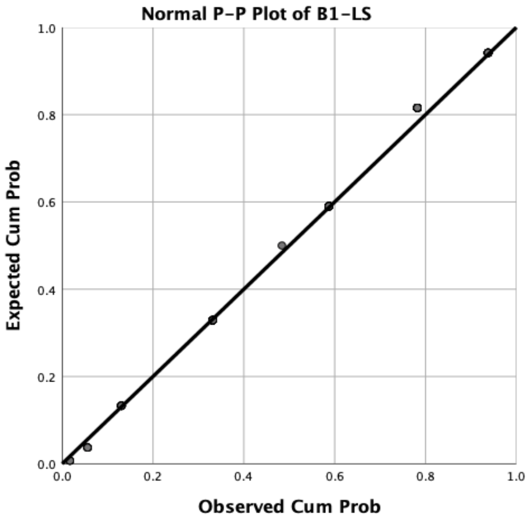


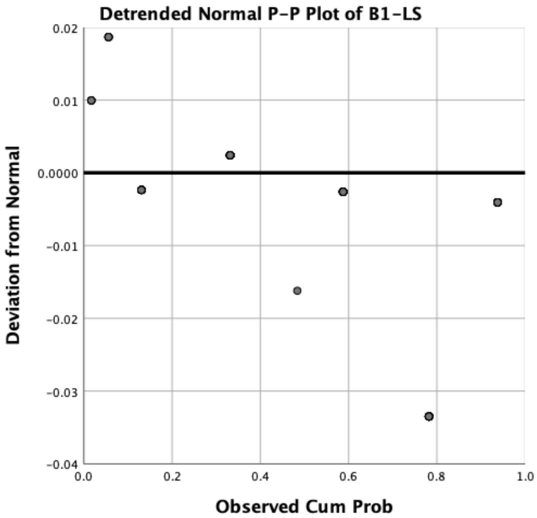
B1-CM


Normal P-P Plot of B1-CM
Expected Cum Prob
Observed Cum Prob

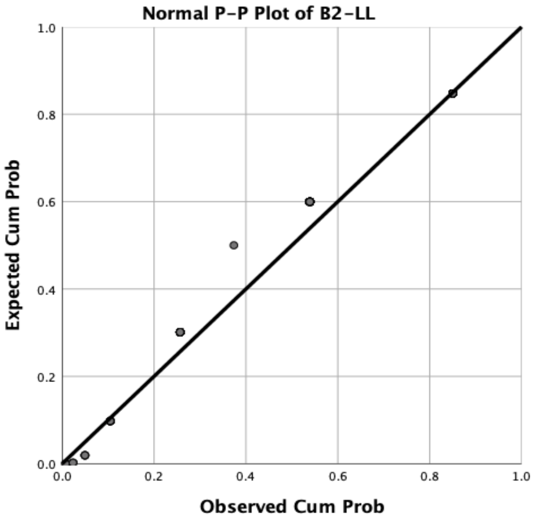

Detrended Normal P-P Plot of B1-CM
Deviation from Normal
Observed Cum Prob

B1-LS

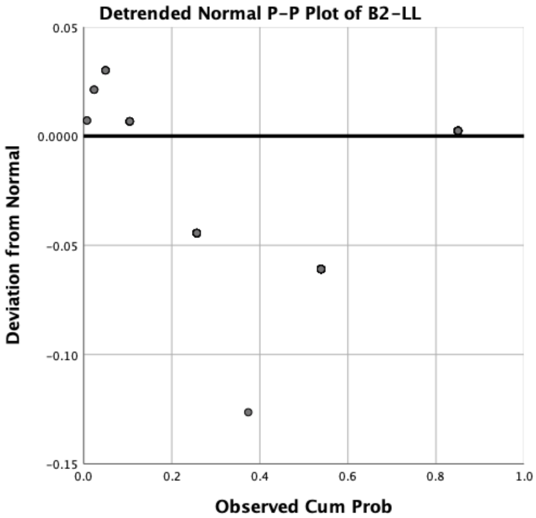

Normal P-P Plot of B1-LS
Expected Cum Prob
Observed Cum Prob


Detrended Normal P-P Plot of B1-LS
Deviation from Normal
Observed Cum Prob

B2-LL

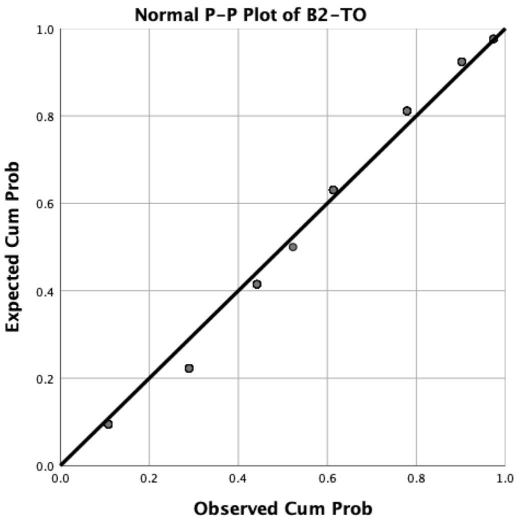


Normal P-P Plot of B2-LL
Expected Cum Prob
Observed Cum Prob

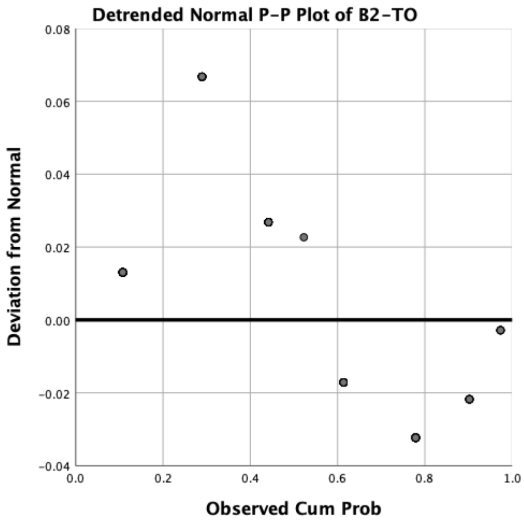


Detrended Normal P-P Plot of B2-LL
Deviation from Normal
Observed Cum Prob

B2-TO

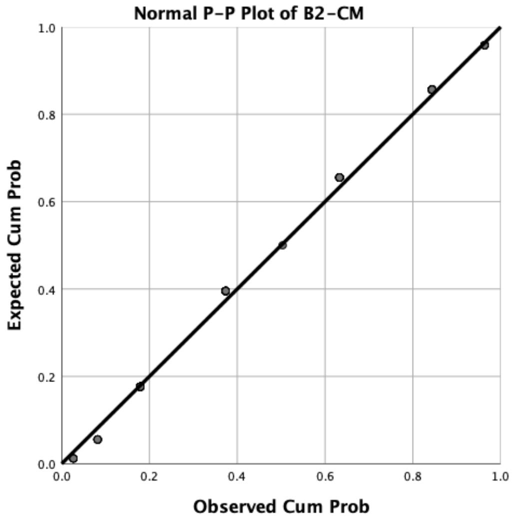


Normal P-P Plot of B2-TO
Expected Cum Prob
Observed Cum Prob

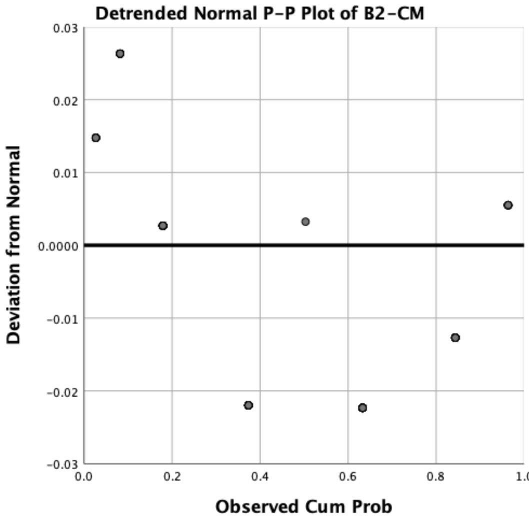


Detrended Normal P-P Plot of B2-TO
Deviation from Normal
Observed Cum Prob

B2-CM

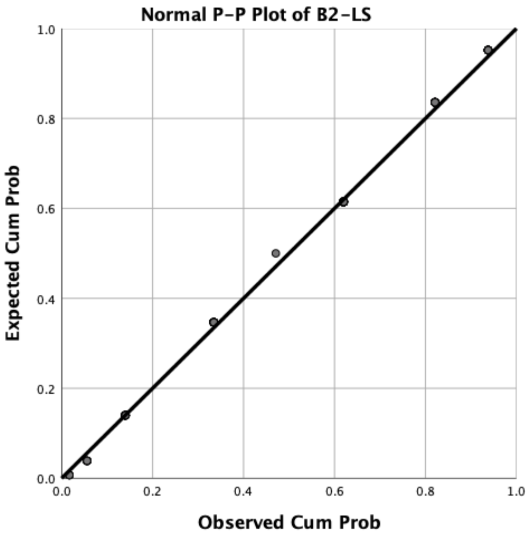


Normal P-P Plot of B2-CM
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



Detrended Normal P-P Plot of B2-CM
Deviation from Normal
Observed Cum Prob
0.03
0.02
0.01
0.0000
−0.01
−0.02
−0.03

B2-LS



Normal P-P Plot of B2-LS
Expected Cum Prob
Observed Cum Prob
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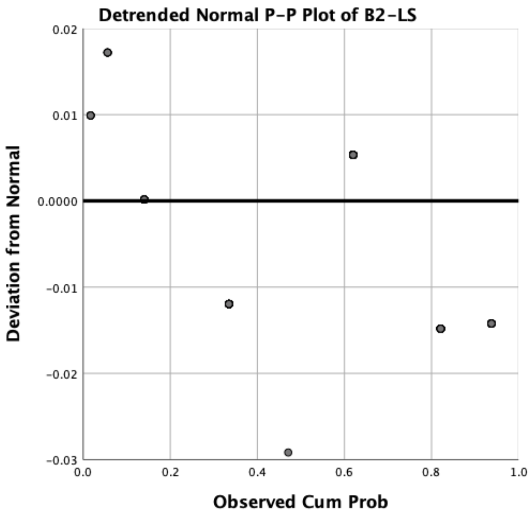
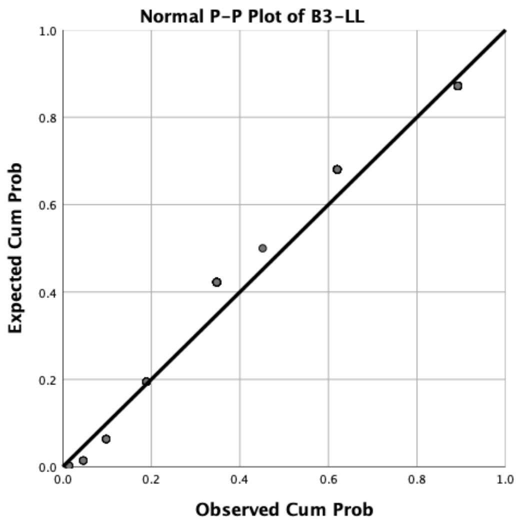
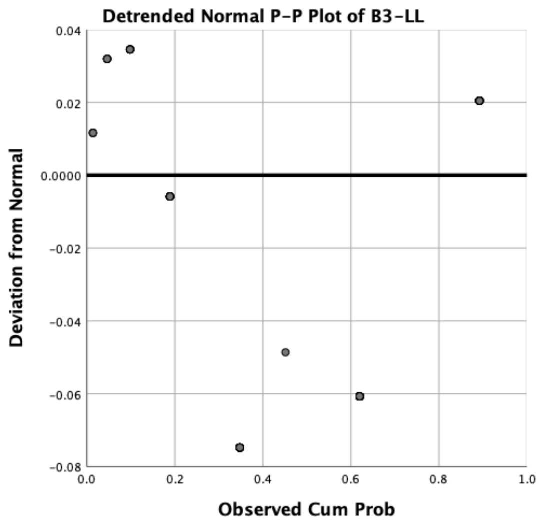
0.2
0.4
0.6
0.8
1.0



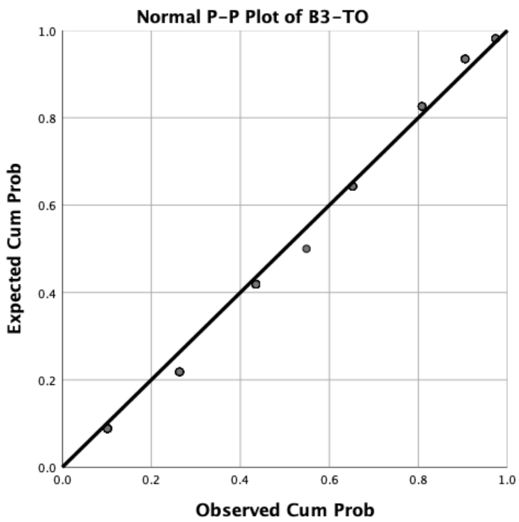
Detrended Normal P-P Plot of B2-LS
Deviation from Normal
Observed Cum Prob
0.02
0.01
0.0000
−0.01
−0.02
−0.03

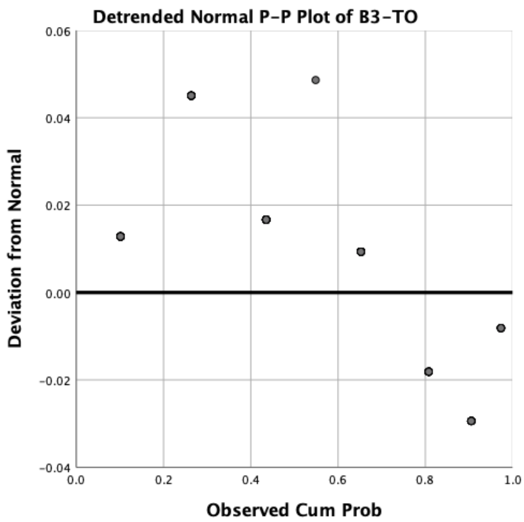
B3-LL


Normal P-P Plot of B3-LL
Expected Cum Prob
Observed Cum Prob

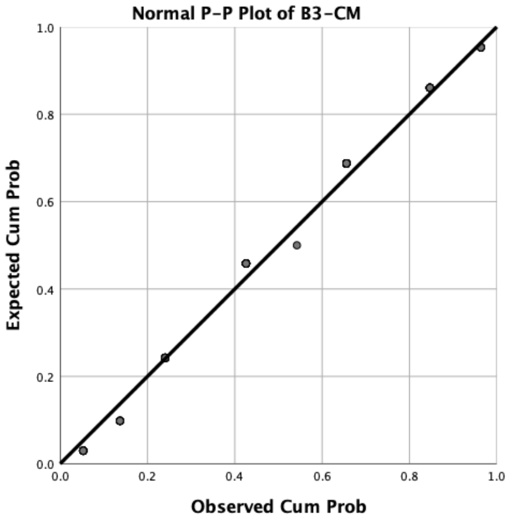

Detrended Normal P-P Plot of B3-LL
Deviation from Normal
Observed Cum Prob

B3-TO


Normal P-P Plot of B3-TO
Expected Cum Prob
Observed Cum Prob


Detrended Normal P-P Plot of B3-TO
Deviation from Normal
Observed Cum Prob

B3-CM


Normal P-P Plot of B3-CM
Expected Cum Prob
Observed Cum Prob
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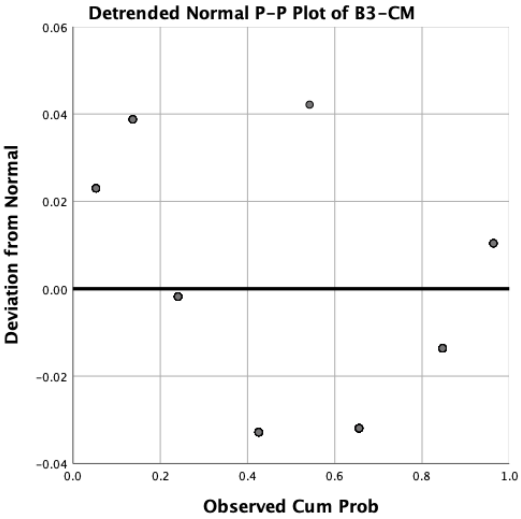
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of B3-CM
Deviation from Normal
Observed Cum Prob
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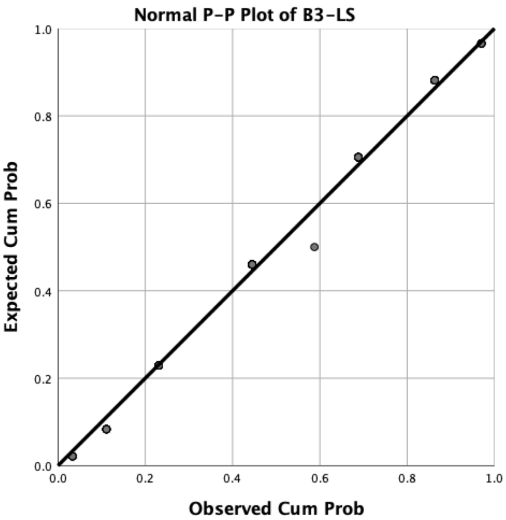
0.04
0.02
0.00
-0.02
-0.04

B3-LS


Normal P-P Plot of B3-LS
Expected Cum Prob
Observed Cum Prob
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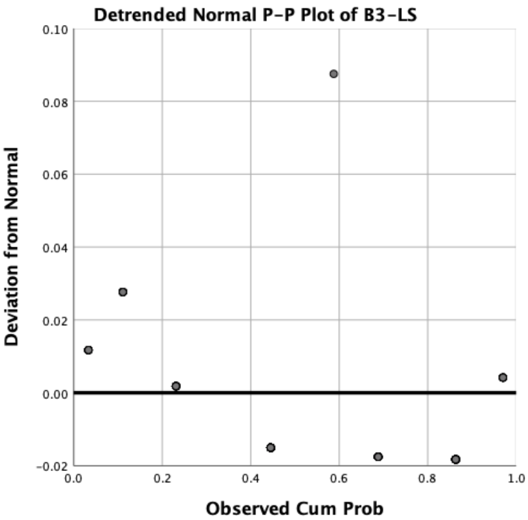
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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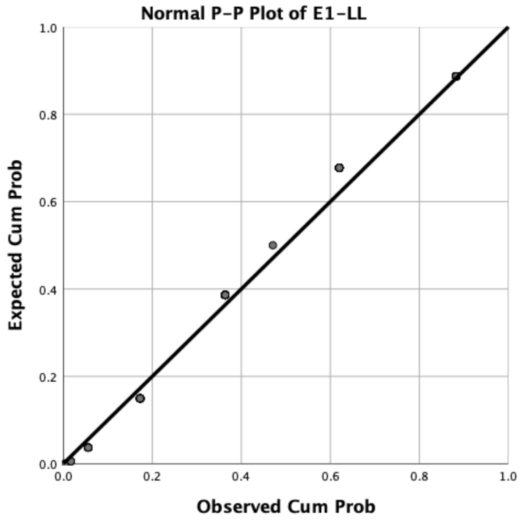
0.08
0.06
0.04
0.02
0.00
-0.02

E1-LL


Normal P-P Plot of E1-LL
Expected Cum Prob
Observed Cum Prob
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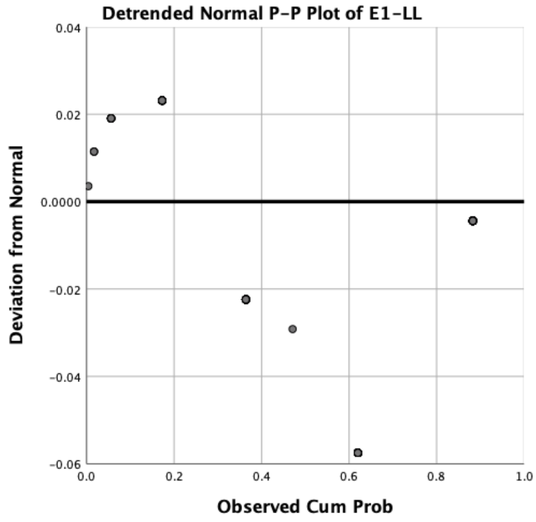
0.2
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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0.02
0.0000
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-0.04
-0.06
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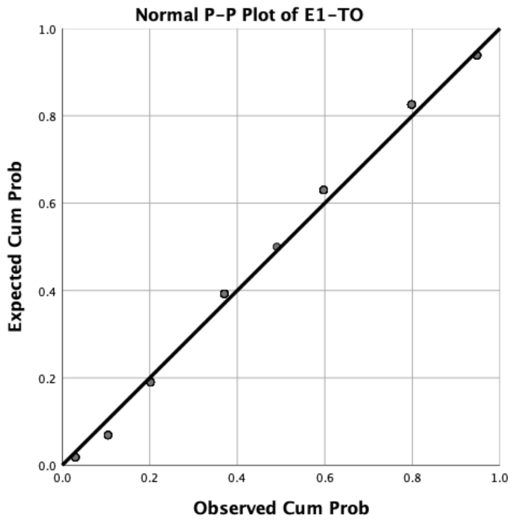
0.4
0.6
0.8
1.0

E1-TO


Normal P-P Plot of E1-TO
Expected Cum Prob
Observed Cum Prob
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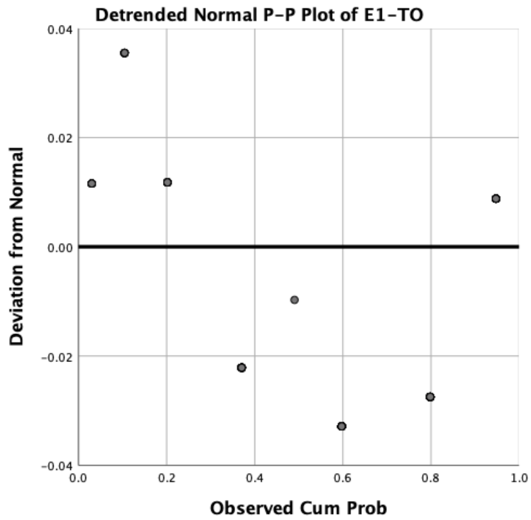
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of E1-TO
Deviation from Normal
Observed Cum Prob
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0.02
0.00
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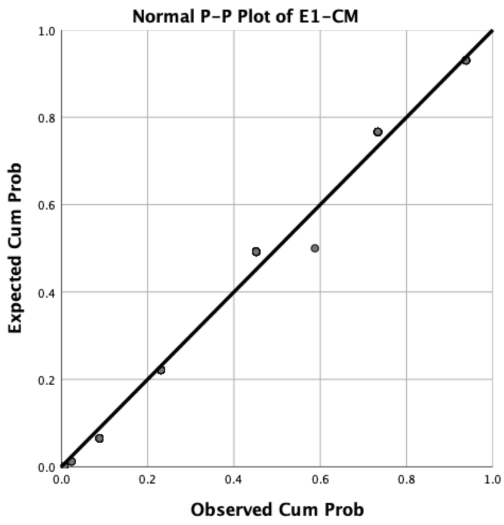
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

E1-CM


Normal P-P Plot of E1-CM
Expected Cum Prob
Observed Cum Prob
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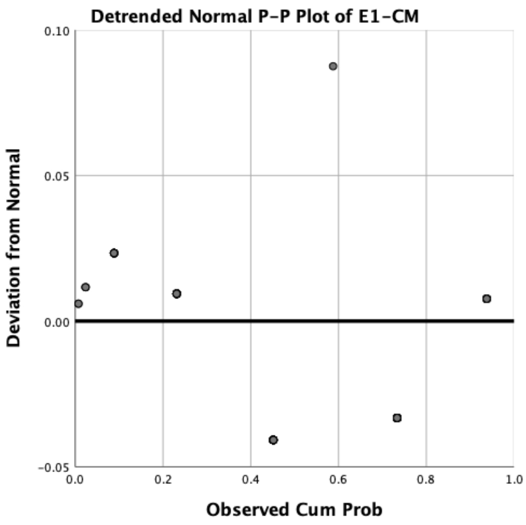
0.2
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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0.00
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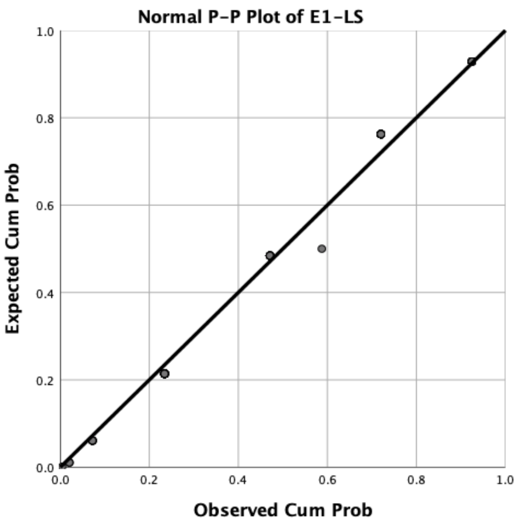
0.2
0.4
0.6
0.8
1.0

E1-LS


Normal P-P Plot of E1-LS
Expected Cum Prob
Observed Cum Prob
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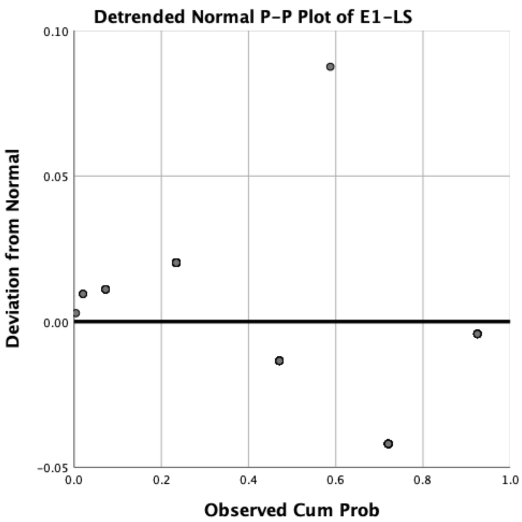
0.2
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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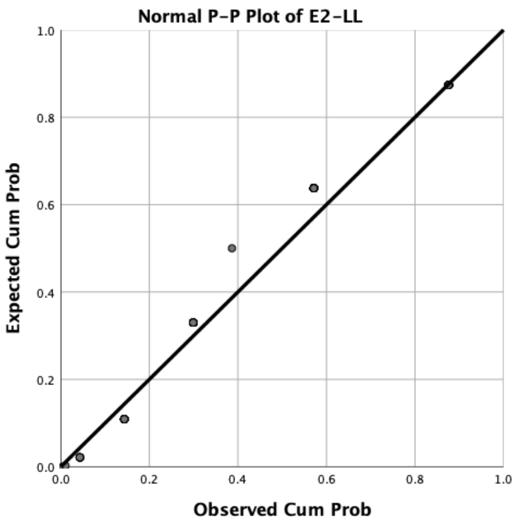
0.4
0.6
0.8
1.0

E2-LL


Normal P-P Plot of E2-LL
Expected Cum Prob
Observed Cum Prob
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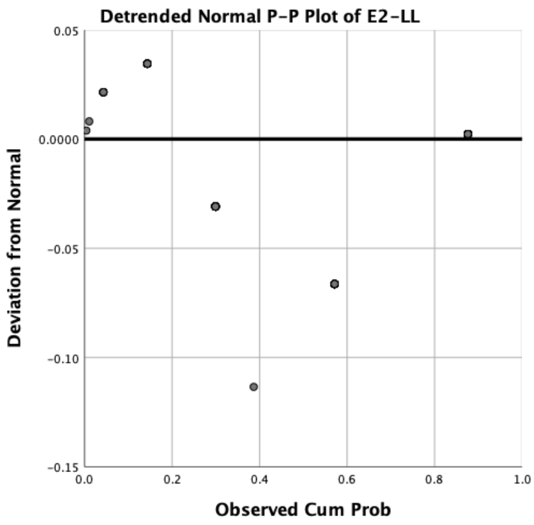
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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0.0000
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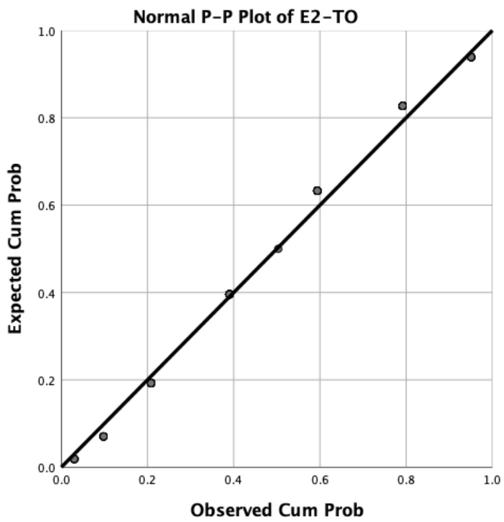
0.0
0.2
0.4
0.6
0.8
1.0

E2-TO


Normal P-P Plot of E2-TO
Expected Cum Prob
Observed Cum Prob
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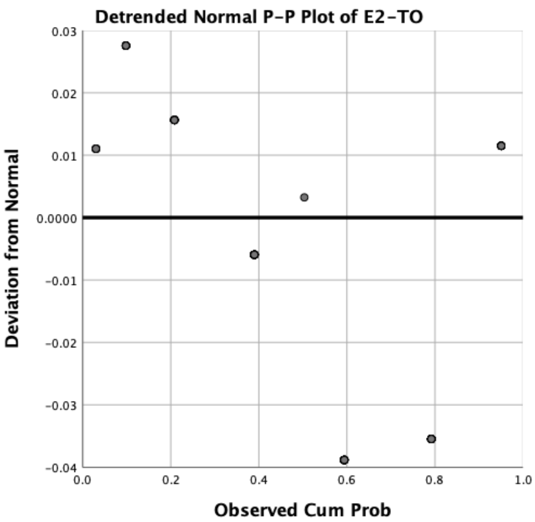
0.4
0.6
0.8
1.0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Deviation from Normal
Observed Cum Prob
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0.01
0.0000
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-0.03
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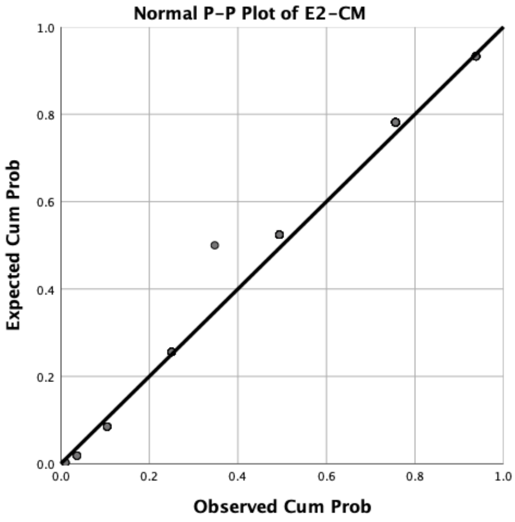
0.6
0.8
1.0

E2-CM


Normal P-P Plot of E2-CM
Expected Cum Prob
Observed Cum Prob
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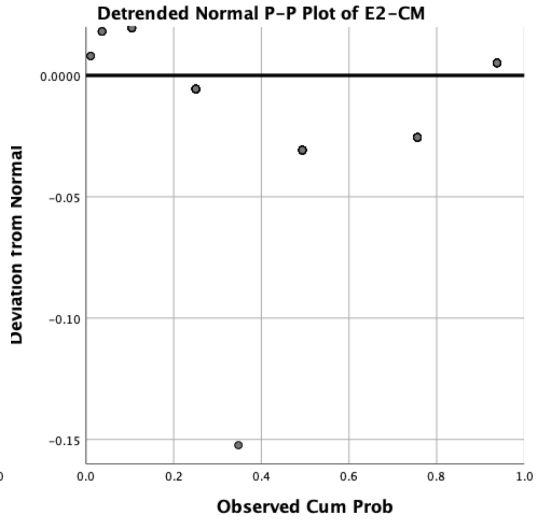
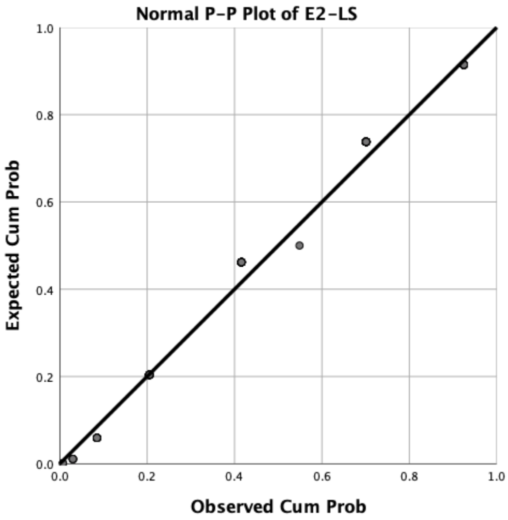
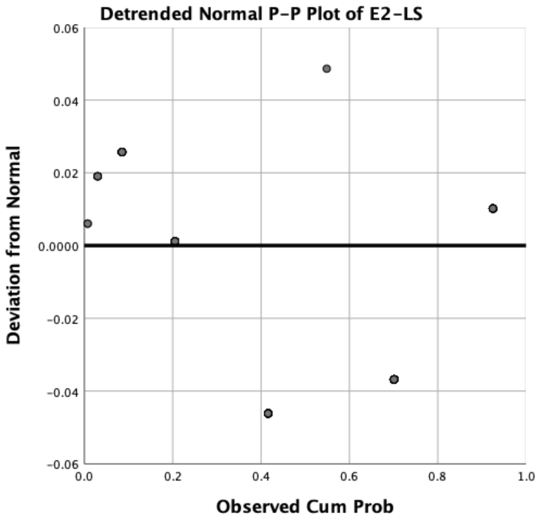
0.2
0.4
0.6
0.8
1.0

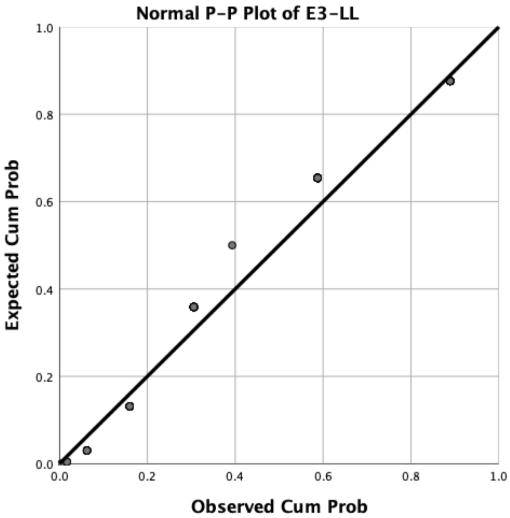

Detrended Normal P-P Plot of E2-CM
Deviation from Normal
Observed Cum Prob
0.0000
-0.05
-0.10
-0.15
0.0
0.2
0.4
0.6
0.8
1.0

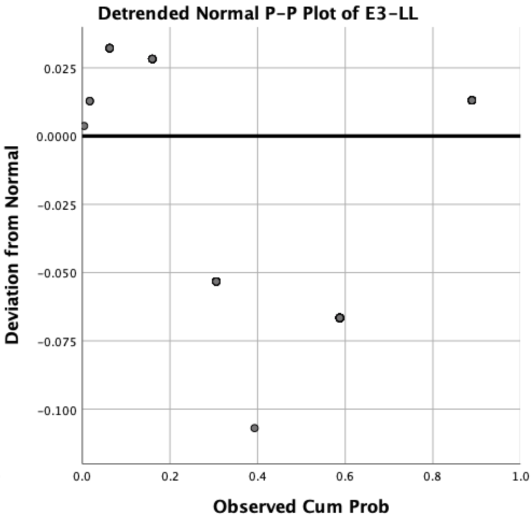
E2-LS


Normal P-P Plot of E2-LS
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

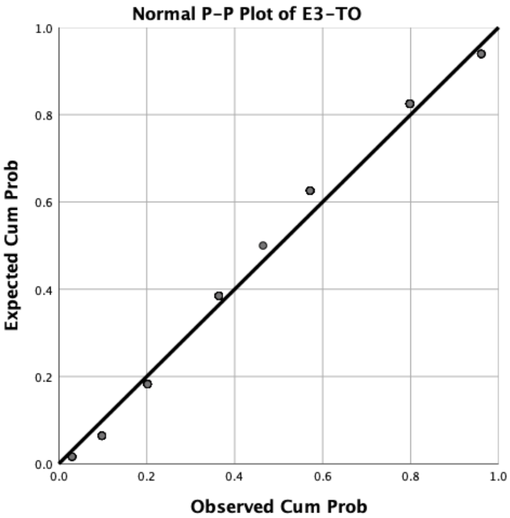

Detrended Normal P-P Plot of E2-LS
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.0000
-0.02
-0.04
-0.06
0.0
0.2
0.4
0.6
0.8
1.0

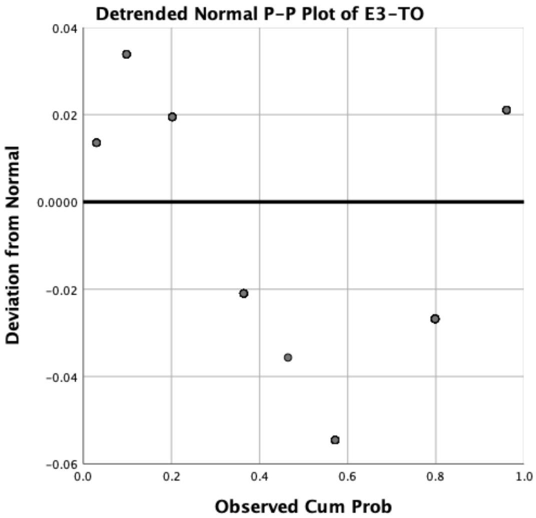
E3-LL


Normal P-P Plot of E3-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

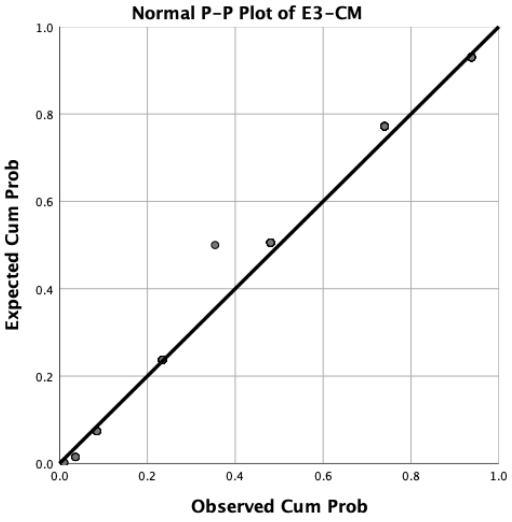

Detrended Normal P-P Plot of E3-LL
Deviation from Normal
Observed Cum Prob
0.025
0.0000
-0.025
-0.050
-0.075
-0.100
0.0
0.2
0.4
0.6
0.8
1.0

E3-TO

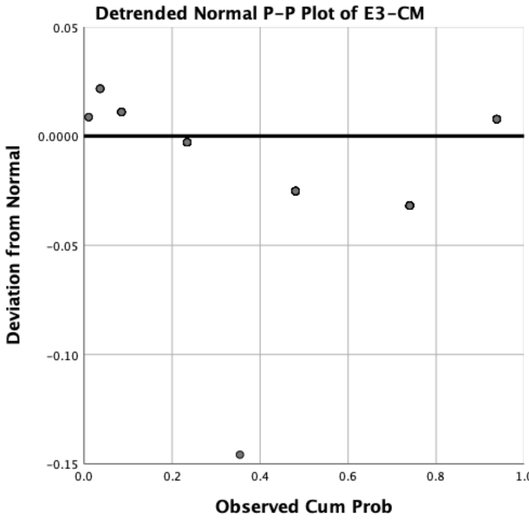

Normal P-P Plot of E3-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of E3-TO
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
-0.02
-0.04
-0.06
0.0
0.2
0.4
0.6
0.8
1.0

E3-CM

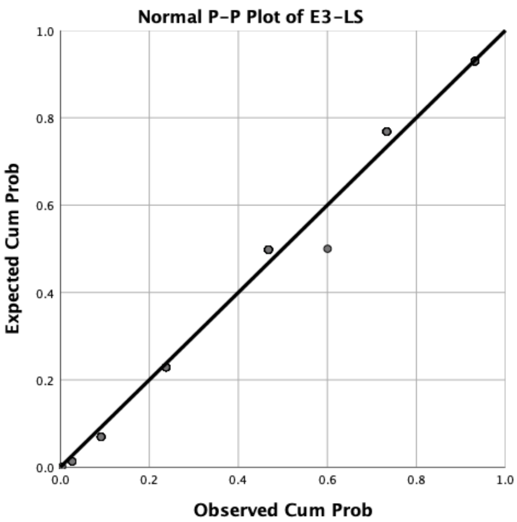


Normal P-P Plot of E3-CM
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0

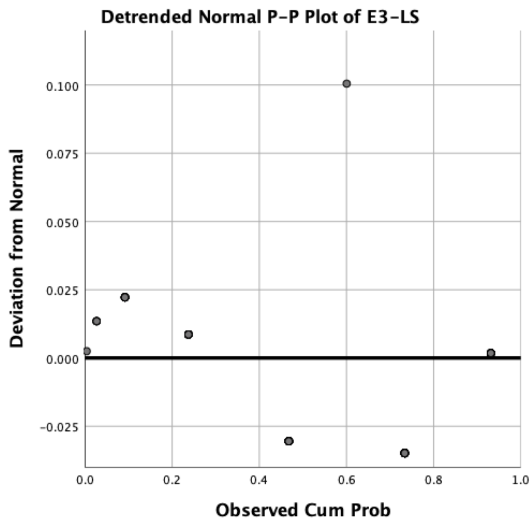


Detrended Normal P-P Plot of E3-CM
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15

E3-LS

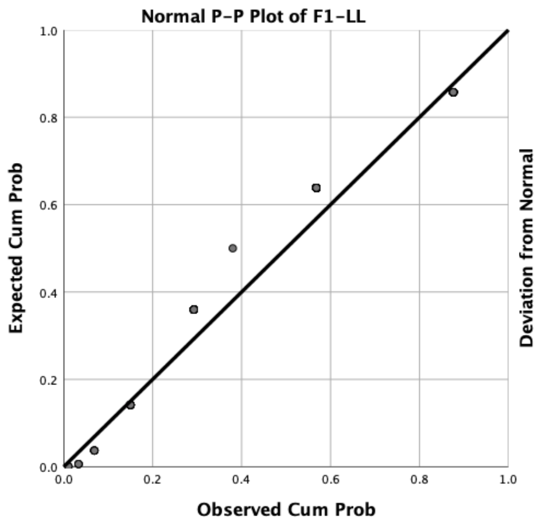


Normal P-P Plot of E3-LS
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0

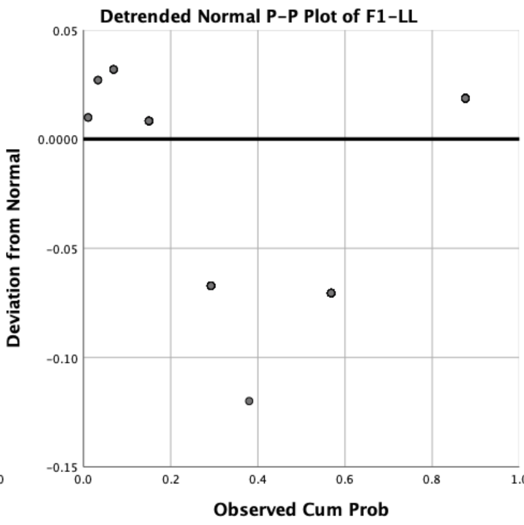


Detrended Normal P-P Plot of E3-LS
Deviation from Normal
Observed Cum Prob
0.100
0.075
0.050
0.025
0.000
-0.025

F1-LL

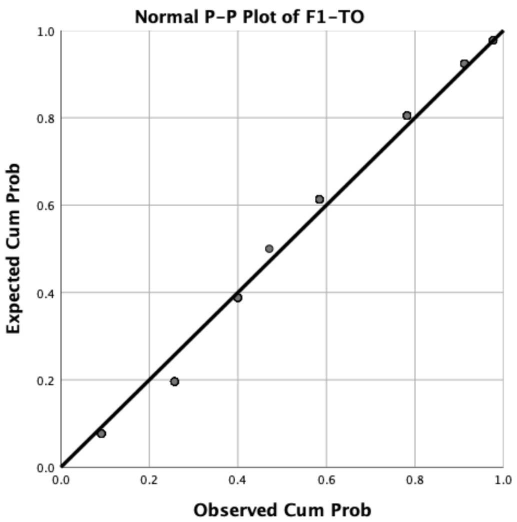


Normal P-P Plot of F1-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

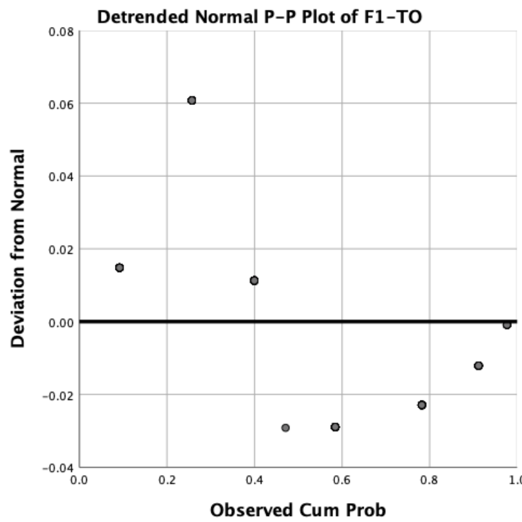


Detrended Normal P-P Plot of F1-LL
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15
0.0
0.2
0.4
0.6
0.8
1.0

F1-TO

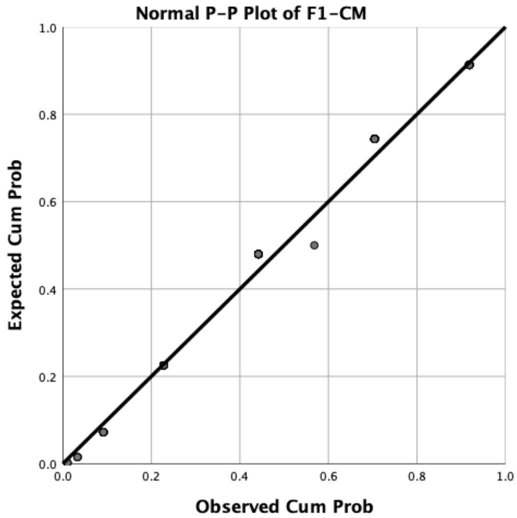


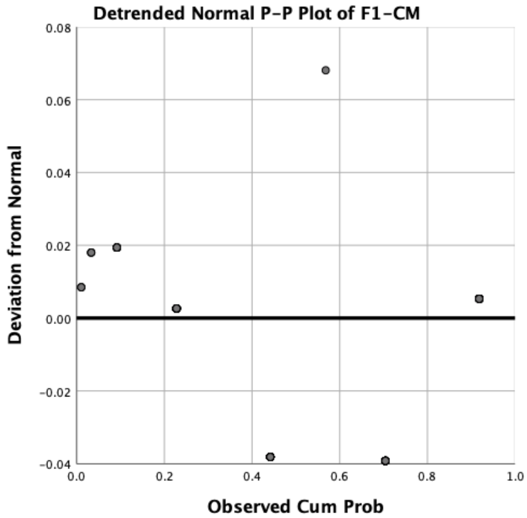
Normal P-P Plot of F1-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



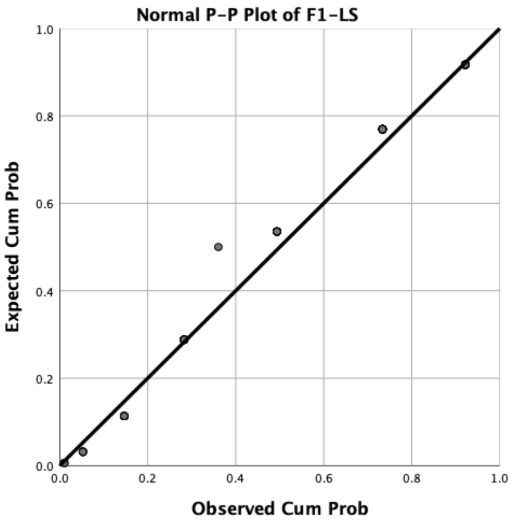
Detrended Normal P-P Plot of F1-TO
Deviation from Normal
Observed Cum Prob
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

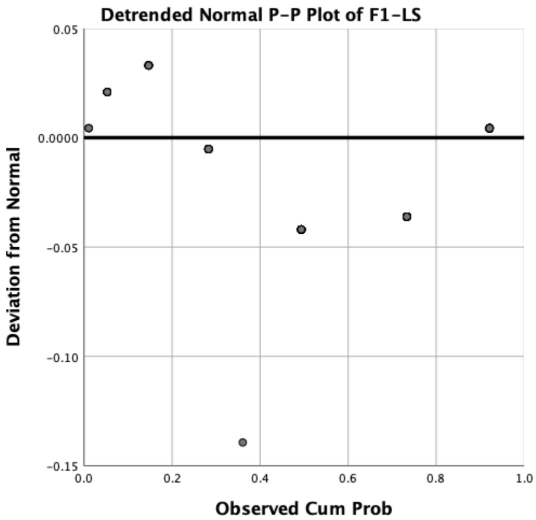
F1-CM


Normal P-P Plot of F1-CM
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

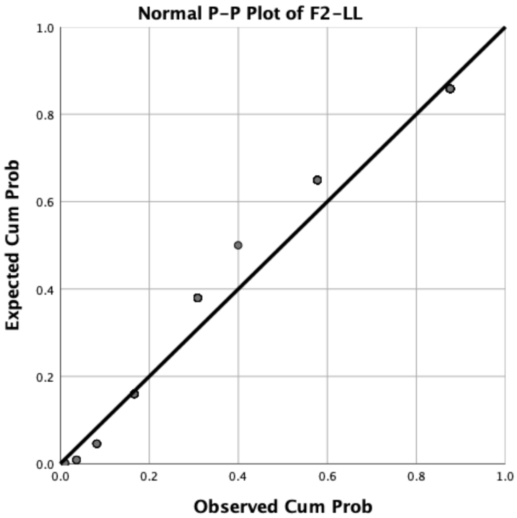

Detrended Normal P-P Plot of F1-CM
Deviation from Normal
Observed Cum Prob
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

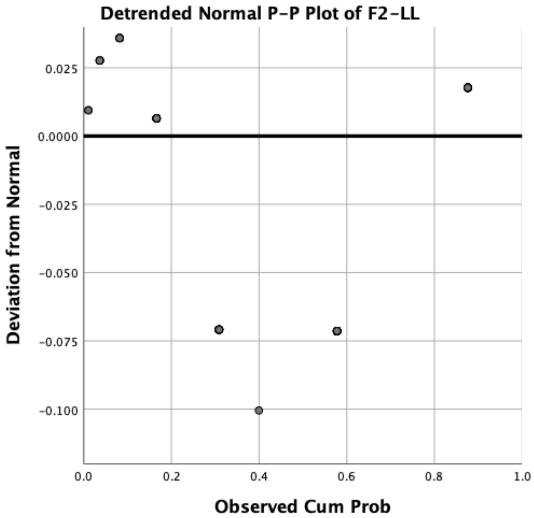
F1-LS


Normal P-P Plot of F1-LS
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0

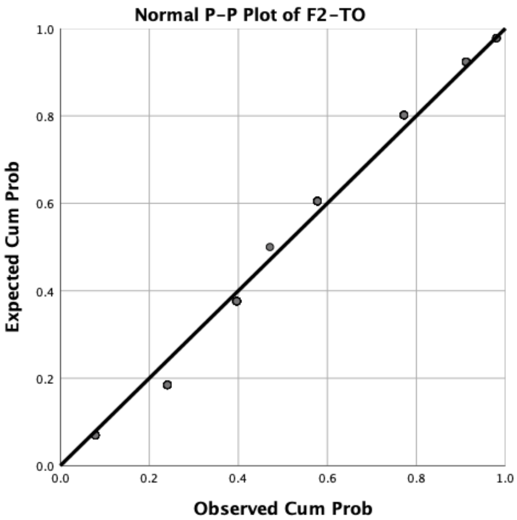

Detrended Normal P-P Plot of F1-LS
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15
0.0
0.2
0.4
0.6
0.8
1.0

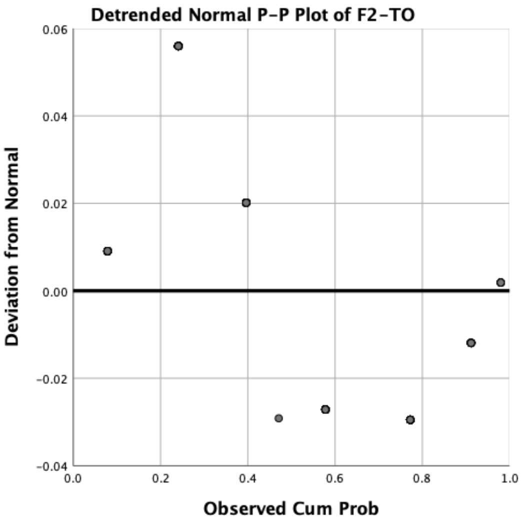
F2-LL


Normal P-P Plot of F2-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

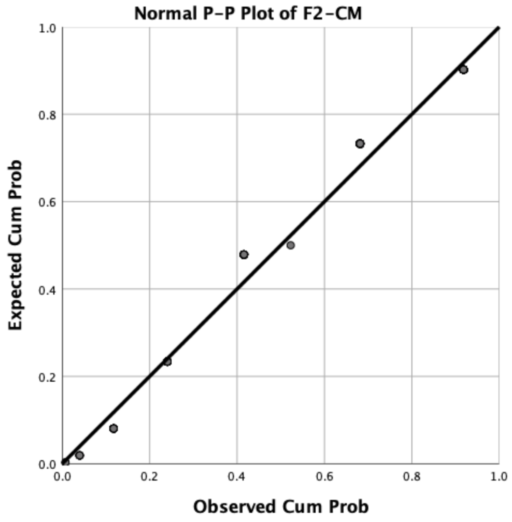

Detrended Normal P-P Plot of F2-LL
Deviation from Normal
Observed Cum Prob
0.025
0.0000
-0.025
-0.050
-0.075
-0.100
0.0
0.2
0.4
0.6
0.8
1.0

F2-TO

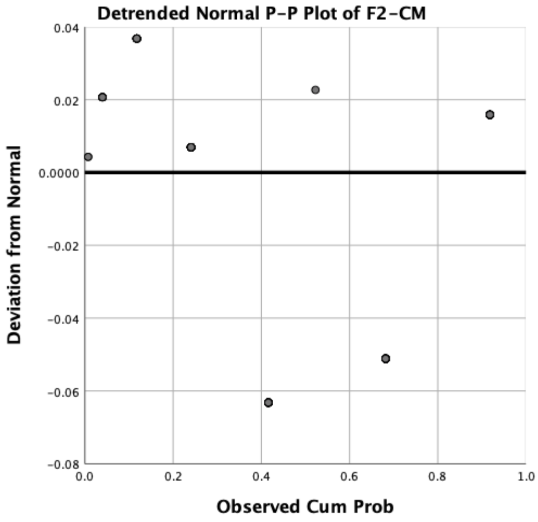

Normal P-P Plot of F2-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of F2-TO
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

F2-CM

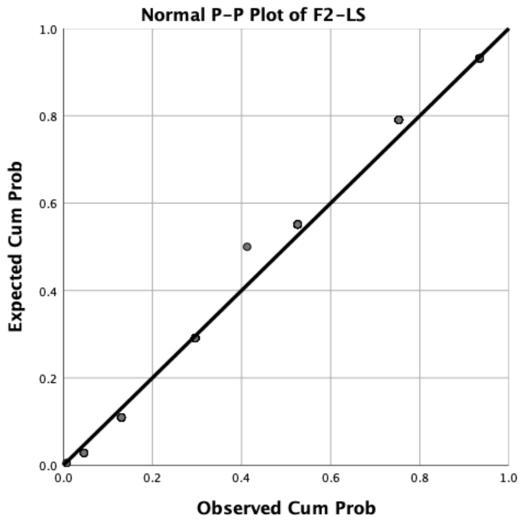


Normal P-P Plot of F2-CM
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

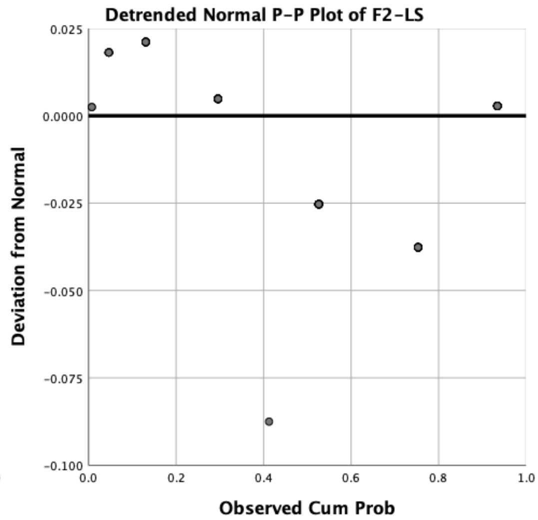


Detrended Normal P-P Plot of F2-CM
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
−0.02
−0.04
−0.06
−0.08

F2-LS

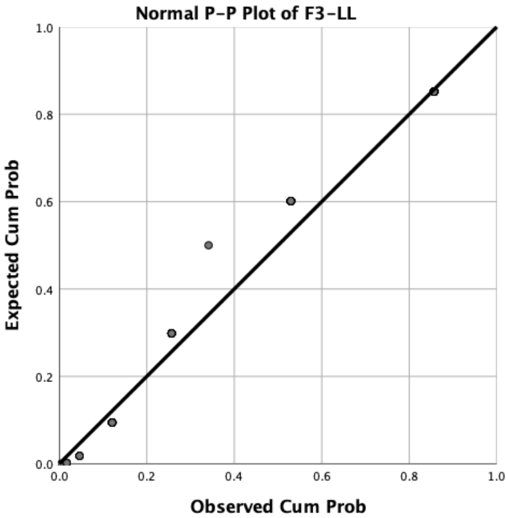


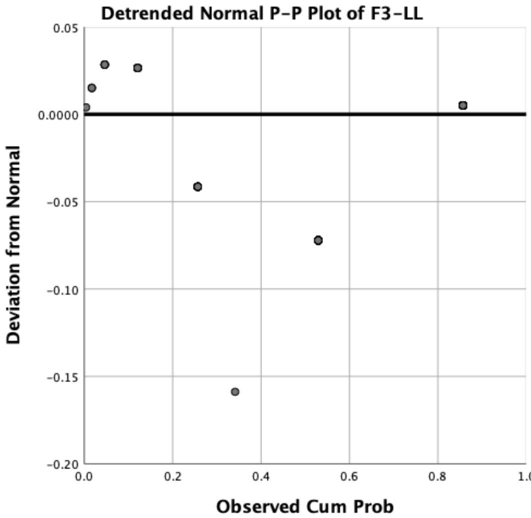
Normal P-P Plot of F2-LS
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0



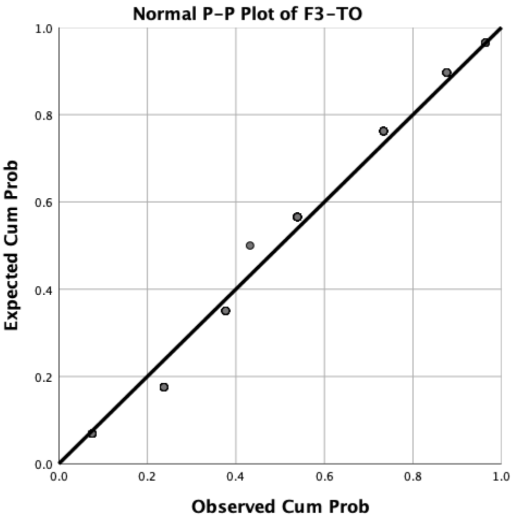
Detrended Normal P-P Plot of F2-LS
Deviation from Normal
Observed Cum Prob
0.025
0.0000
−0.025
−0.050
−0.075
−0.100

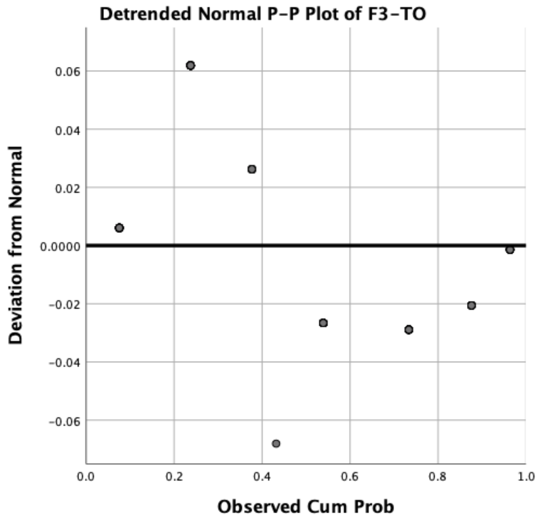
F3-LL


Normal P-P Plot of F3-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

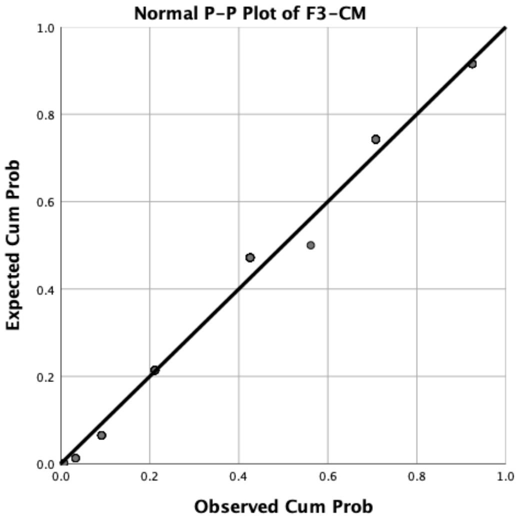

Detrended Normal P-P Plot of F3-LL
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15
-0.20
0.0
0.2
0.4
0.6
0.8
1.0

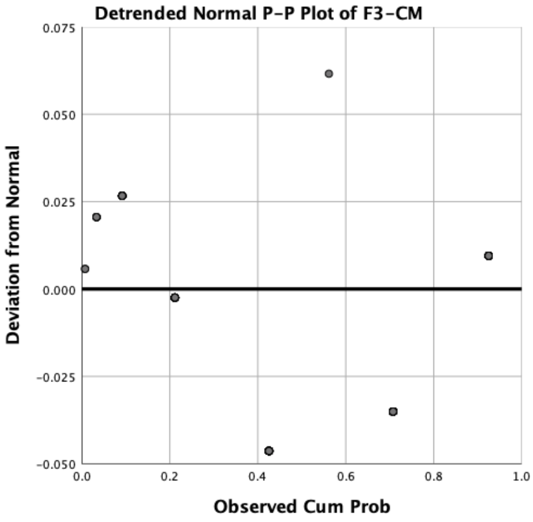
F3-TO


Normal P-P Plot of F3-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

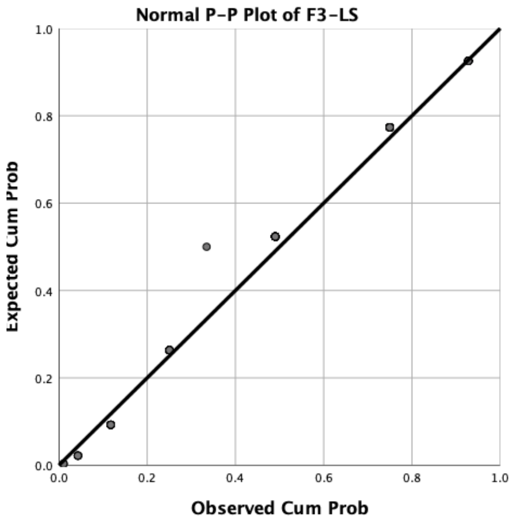

Detrended Normal P-P Plot of F3-TO
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.0000
-0.02
-0.04
-0.06
0.0
0.2
0.4
0.6
0.8
1.0

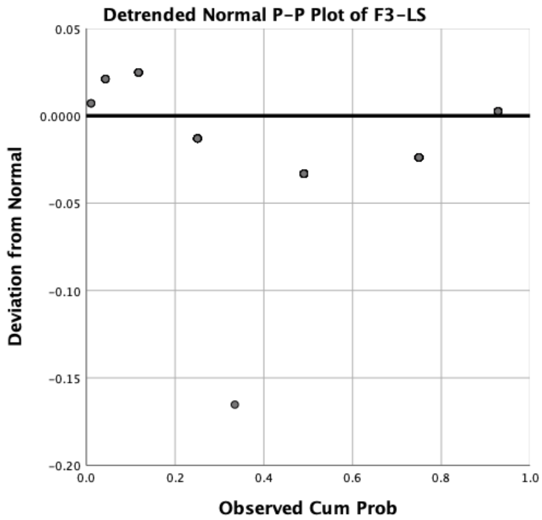
F3-CM


Normal P-P Plot of F3-CM
Expected Cum Prob
Observed Cum Prob

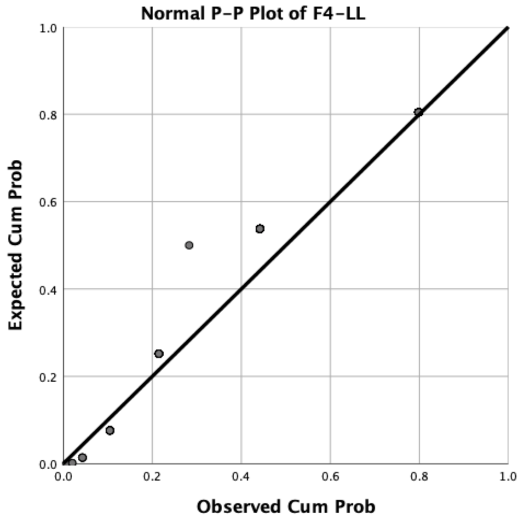

Detrended Normal P-P Plot of F3-CM
Deviation from Normal
Observed Cum Prob

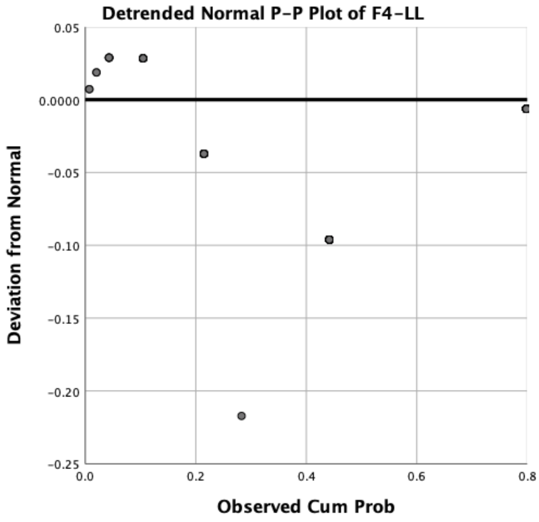
F3-LS


Normal P-P Plot of F3-LS
Expected Cum Prob
Observed Cum Prob

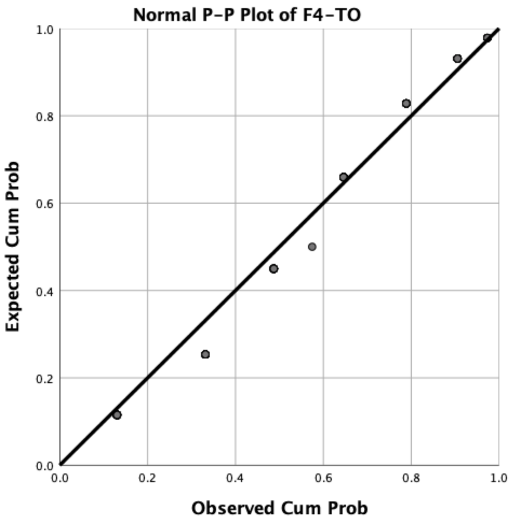

Detrended Normal P-P Plot of F3-LS
Deviation from Normal
Observed Cum Prob

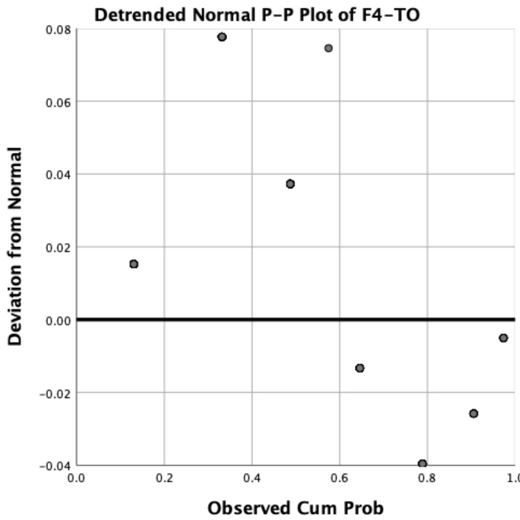
F4-LL


Normal P-P Plot of F4-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

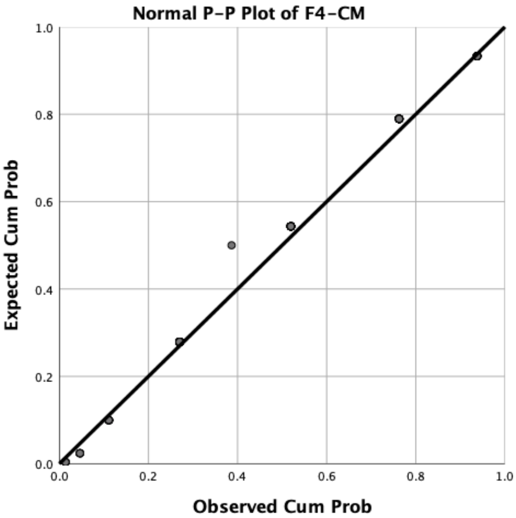

Detrended Normal P-P Plot of F4-LL
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15
-0.20
-0.25
0.0
0.2
0.4
0.6
0.8

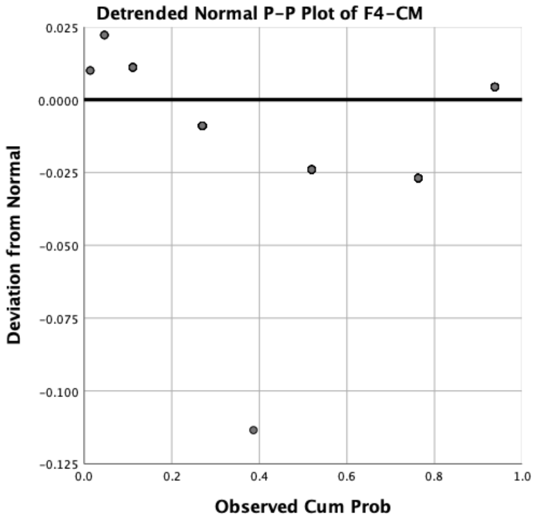
F4-TO


Normal P-P Plot of F4-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

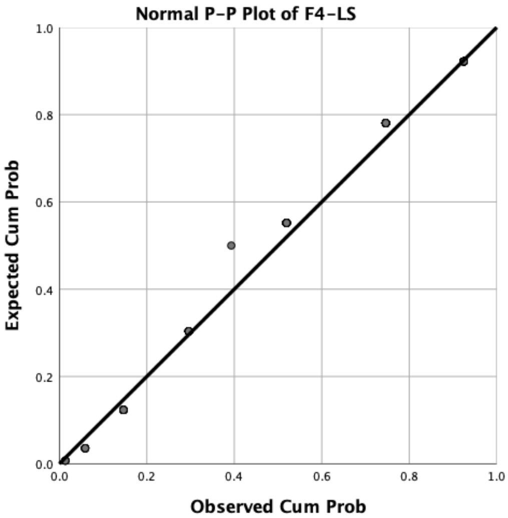

Detrended Normal P-P Plot of F4-TO
Deviation from Normal
Observed Cum Prob
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

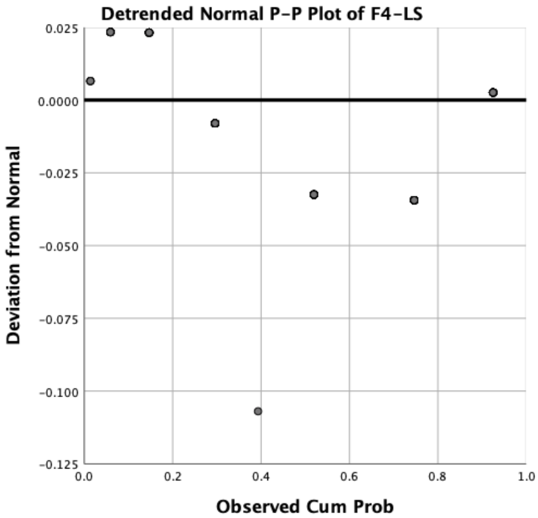
F4-CM


Normal P-P Plot of F4-CM
Expected Cum Prob
Observed Cum Prob

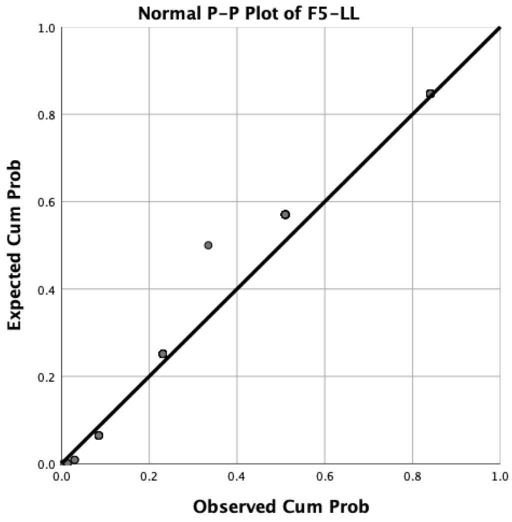

Detrended Normal P-P Plot of F4-CM
Deviation from Normal
Observed Cum Prob

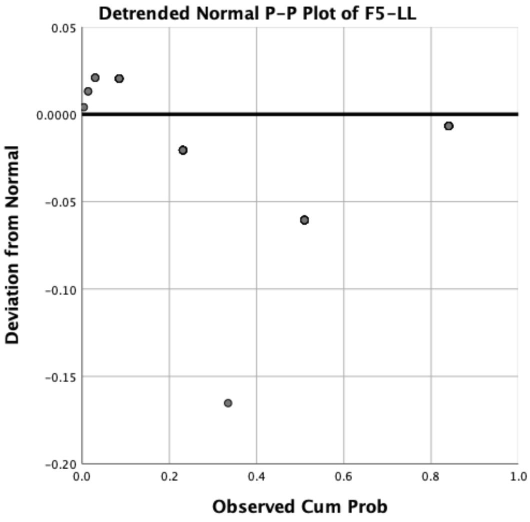
F4-LS


Normal P-P Plot of F4-LS
Expected Cum Prob
Observed Cum Prob

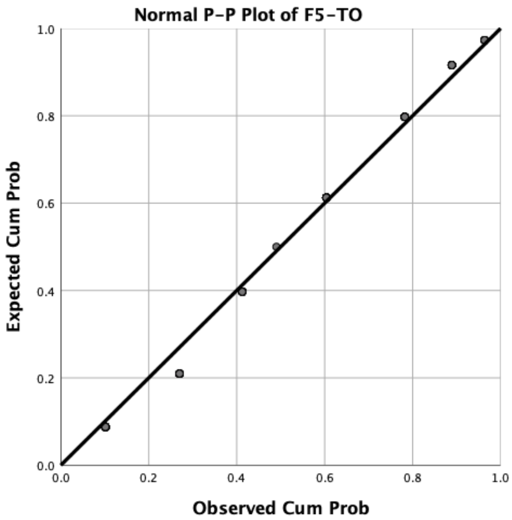

Detrended Normal P-P Plot of F4-LS
Deviation from Normal
Observed Cum Prob

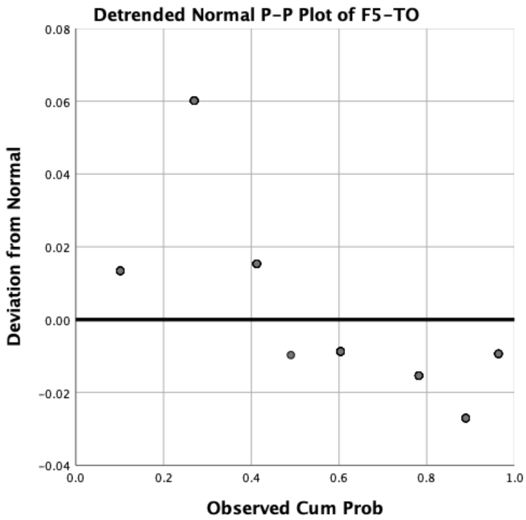
F5-LL


Normal P-P Plot of F5-LL
Expected Cum Prob
Observed Cum Prob

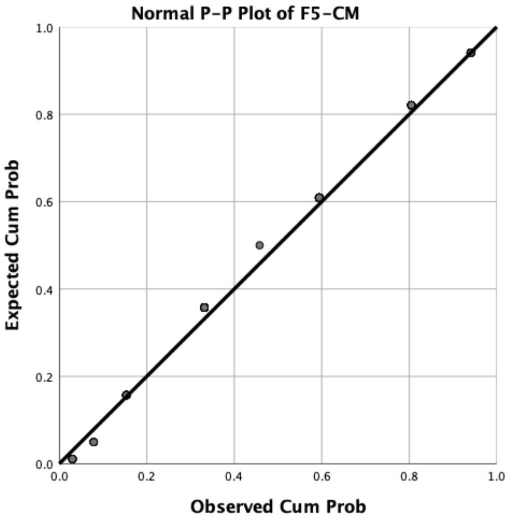

Detrended Normal P-P Plot of F5-LL
Deviation from Normal
Observed Cum Prob

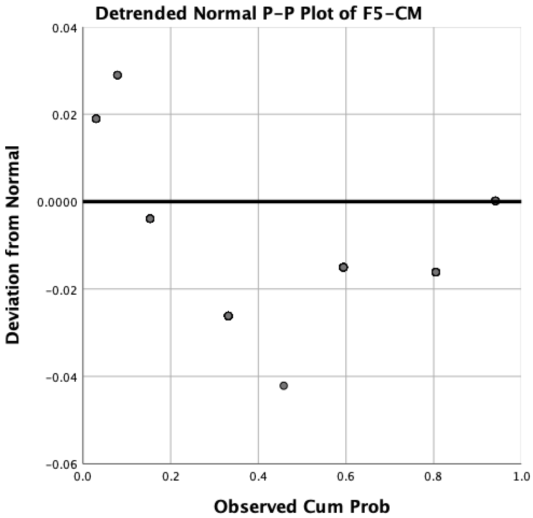
F5-TO


Normal P-P Plot of F5-TO
Expected Cum Prob
Observed Cum Prob

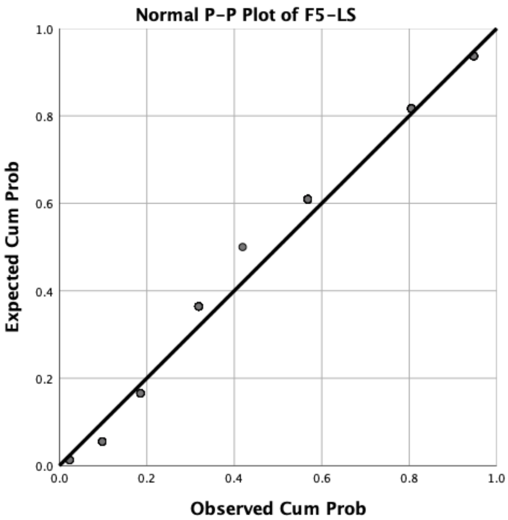

Detrended Normal P-P Plot of F5-TO
Deviation from Normal
Observed Cum Prob

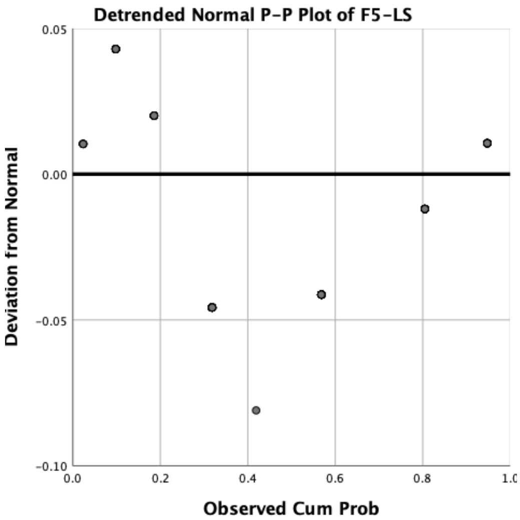
F5-CM


Normal P-P Plot of F5-CM
Expected Cum Prob
Observed Cum Prob

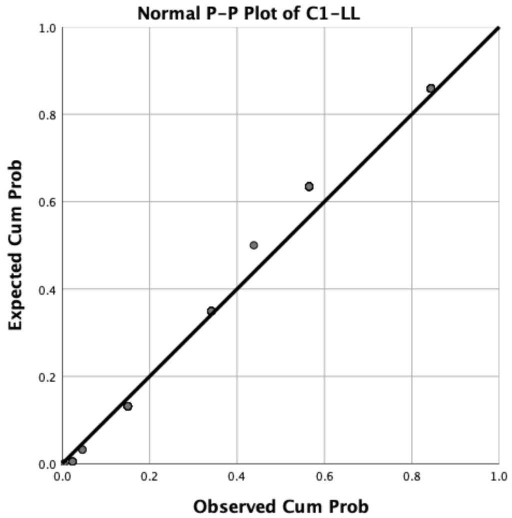

Detrended Normal P-P Plot of F5-CM
Deviation from Normal
Observed Cum Prob

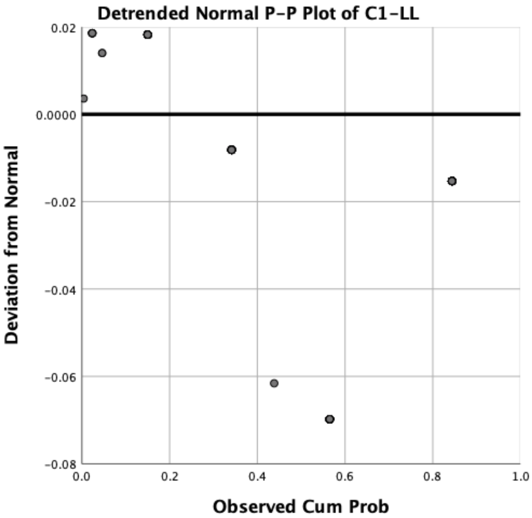
F5-LS


Normal P-P Plot of F5-LS
Expected Cum Prob
Observed Cum Prob

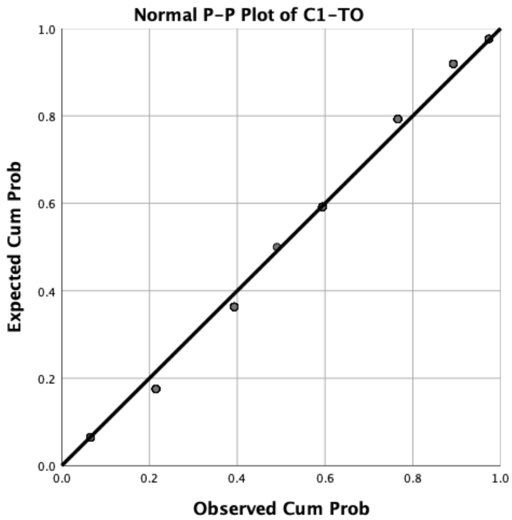

Detrended Normal P-P Plot of F5-LS
Deviation from Normal
Observed Cum Prob

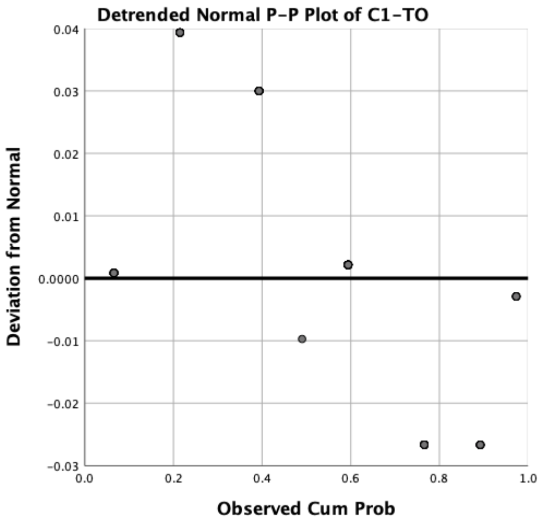
C1-LL


Normal P-P Plot of C1-LL
Expected Cum Prob
Observed Cum Prob

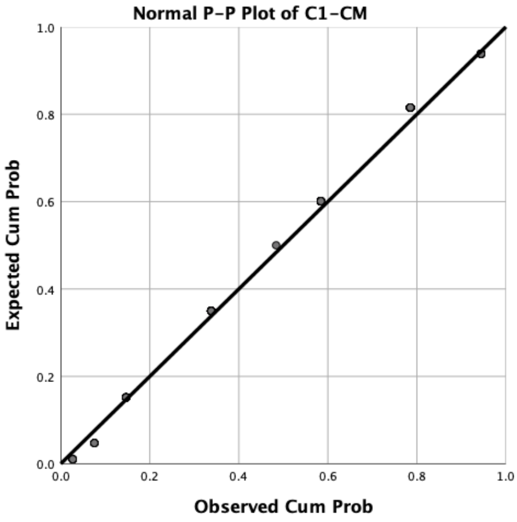

Detrended Normal P-P Plot of C1-LL
Deviation from Normal
Observed Cum Prob

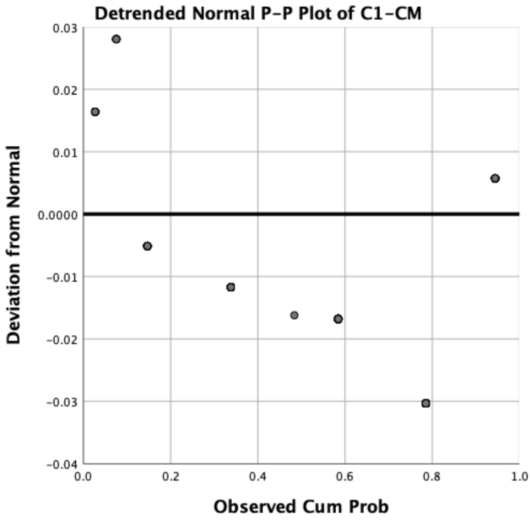
C1-TO


Normal P-P Plot of C1-TO
Expected Cum Prob
Observed Cum Prob

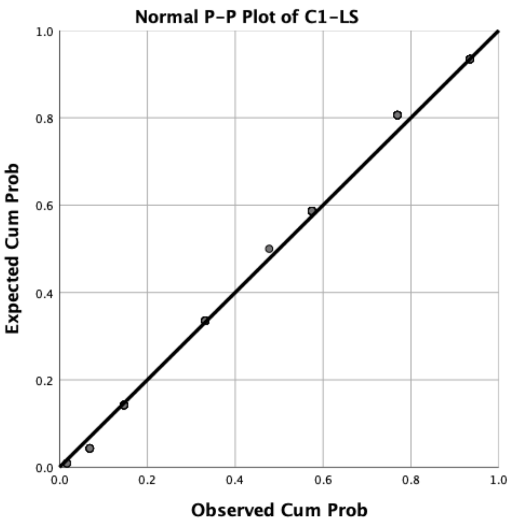

Detrended Normal P-P Plot of C1-TO
Deviation from Normal
Observed Cum Prob

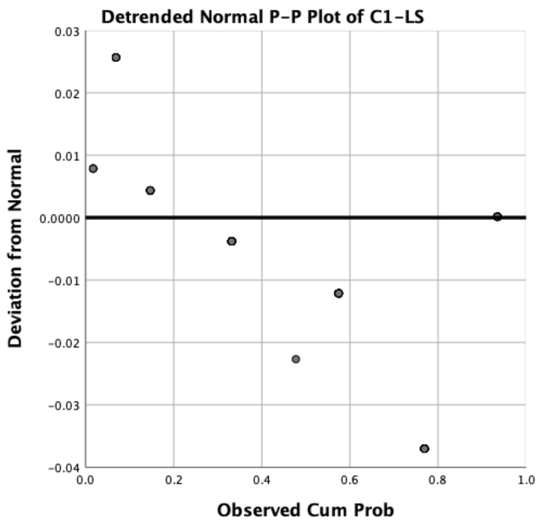
C1-CM


Normal P-P Plot of C1-CM
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

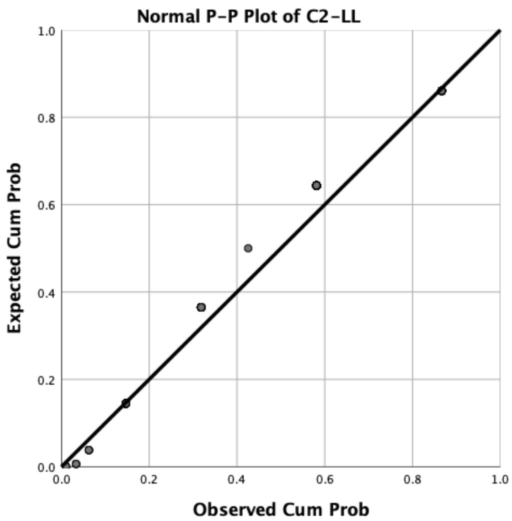

Detrended Normal P-P Plot of C1-CM
Deviation from Normal
Observed Cum Prob
0.03
0.02
0.01
0.0000
-0.01
-0.02
-0.03
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

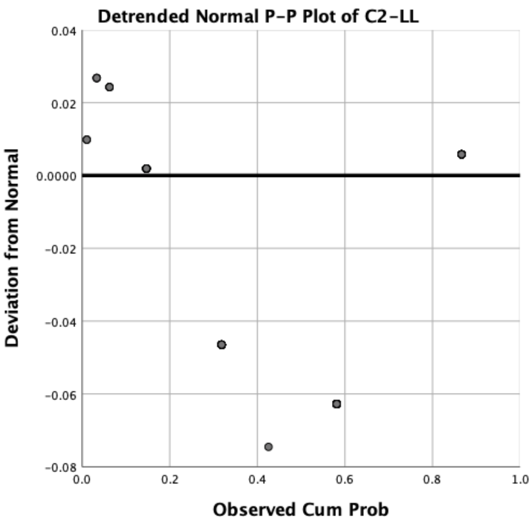
C1-LS


Normal P-P Plot of C1-LS
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

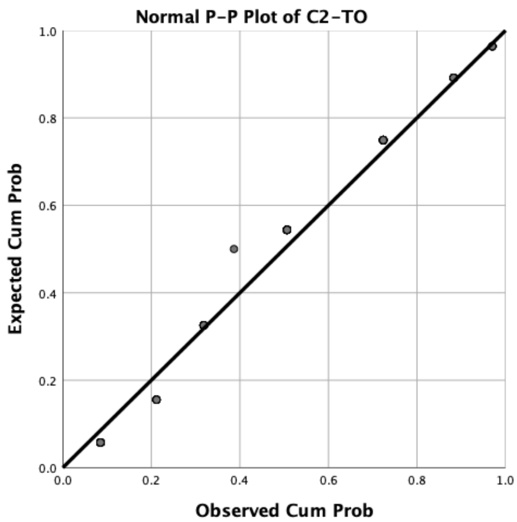

Detrended Normal P-P Plot of C1-LS
Deviation from Normal
Observed Cum Prob
0.03
0.02
0.01
0.0000
-0.01
-0.02
-0.03
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

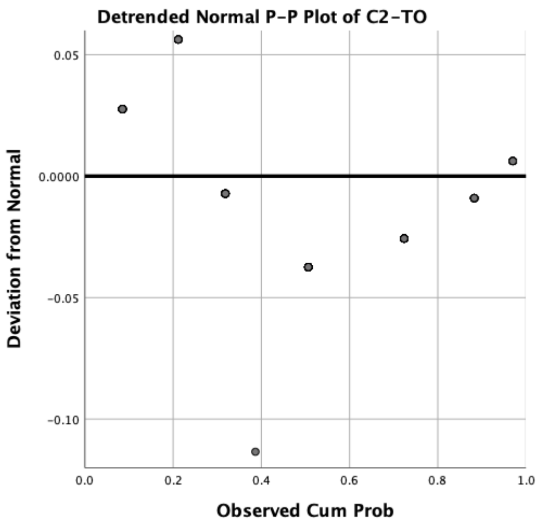
C2-LL


Normal P-P Plot of C2-LL
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

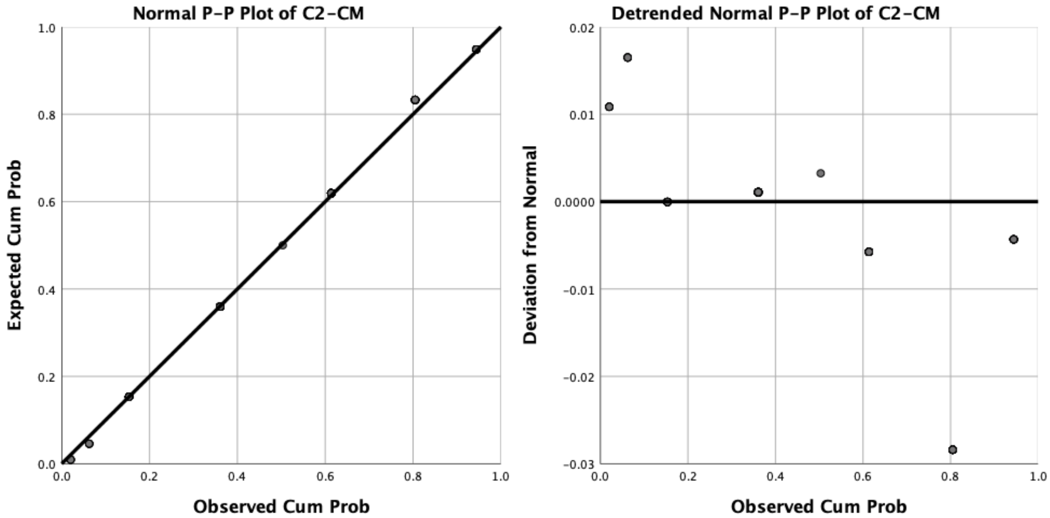

Detrended Normal P-P Plot of C2-LL
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
-0.02
-0.04
-0.06
-0.08
0.0
0.2
0.4
0.6
0.8
1.0

C2-TO

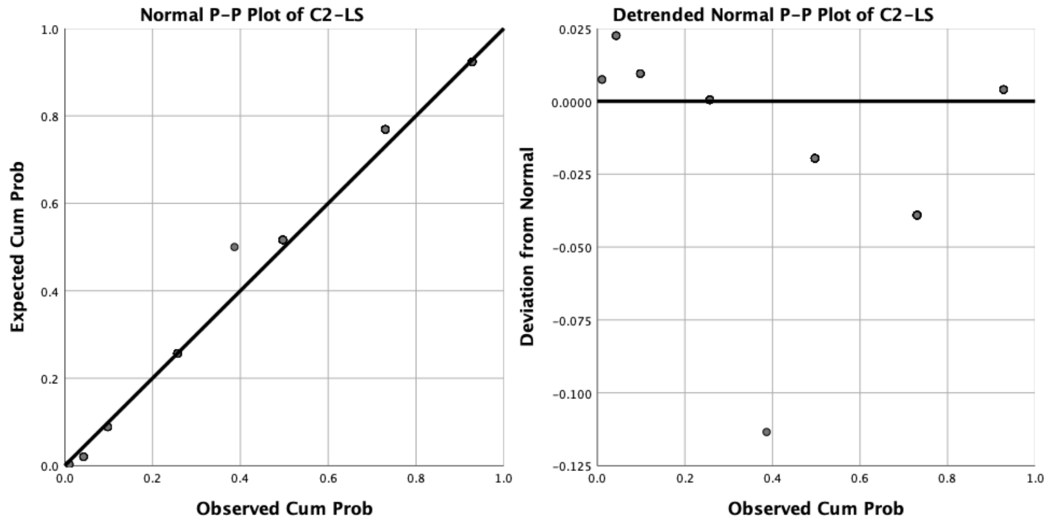

Normal P-P Plot of C2-TO
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of C2-TO
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
0.0
0.2
0.4
0.6
0.8
1.0

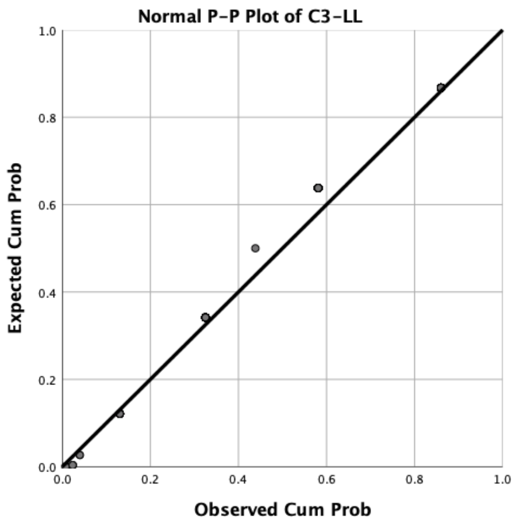
C2-CM

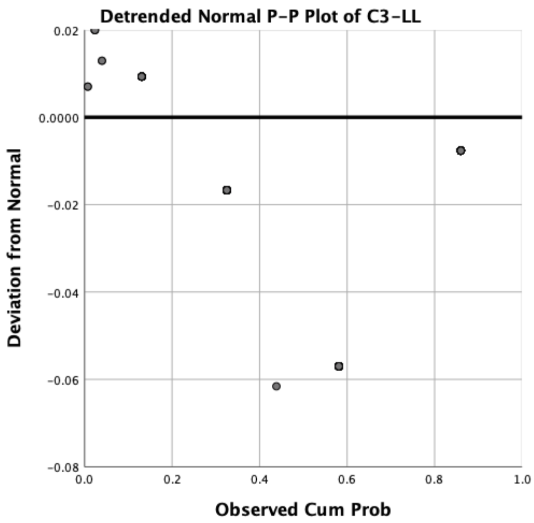

Normal P-P Plot of C2-CM
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
Detrended Normal P-P Plot of C2-CM
Deviation from Normal
0.02
0.01
0.0000
-0.01
-0.02
-0.03

C2-LS

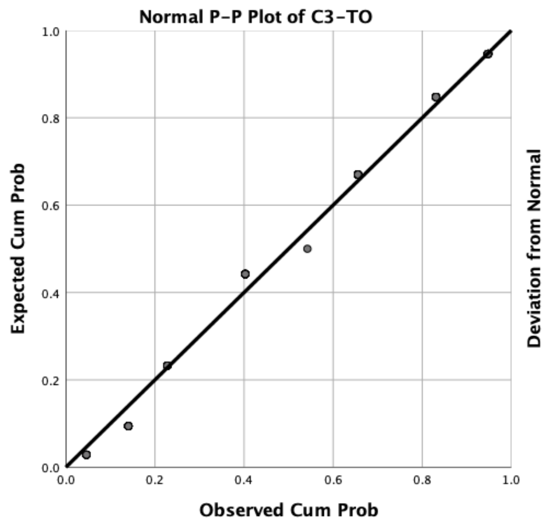

Normal P-P Plot of C2-LS
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
Detrended Normal P-P Plot of C2-LS
Deviation from Normal
0.025
0.0000
-0.025
-0.050
-0.075
-0.100
-0.125

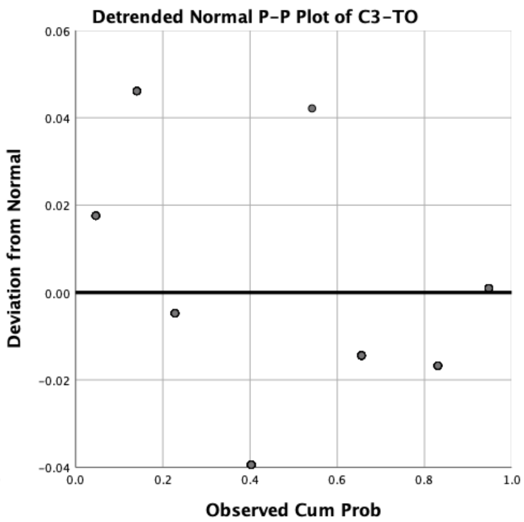
C3-LL


Normal P-P Plot of C3-LL
Expected Cum Prob
Observed Cum Prob

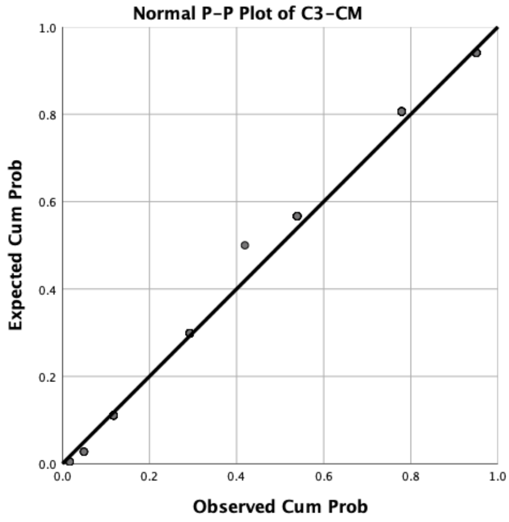

Detrended Normal P-P Plot of C3-LL
Deviation from Normal
Observed Cum Prob

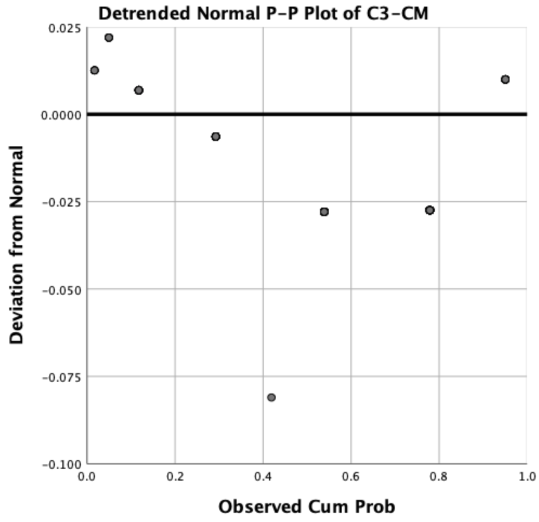
C3-TO


Normal P-P Plot of C3-TO
Expected Cum Prob
Observed Cum Prob

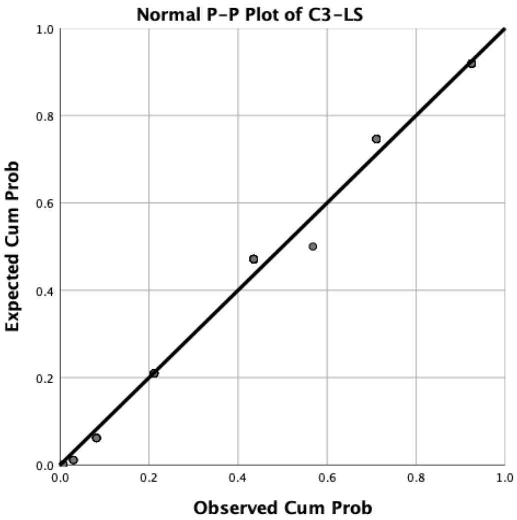

Detrended Normal P-P Plot of C3-TO
Deviation from Normal
Observed Cum Prob

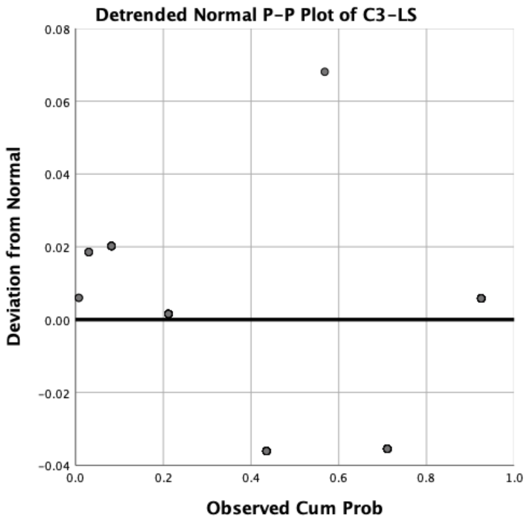
C3-CM


Normal P-P Plot of C3-CM
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

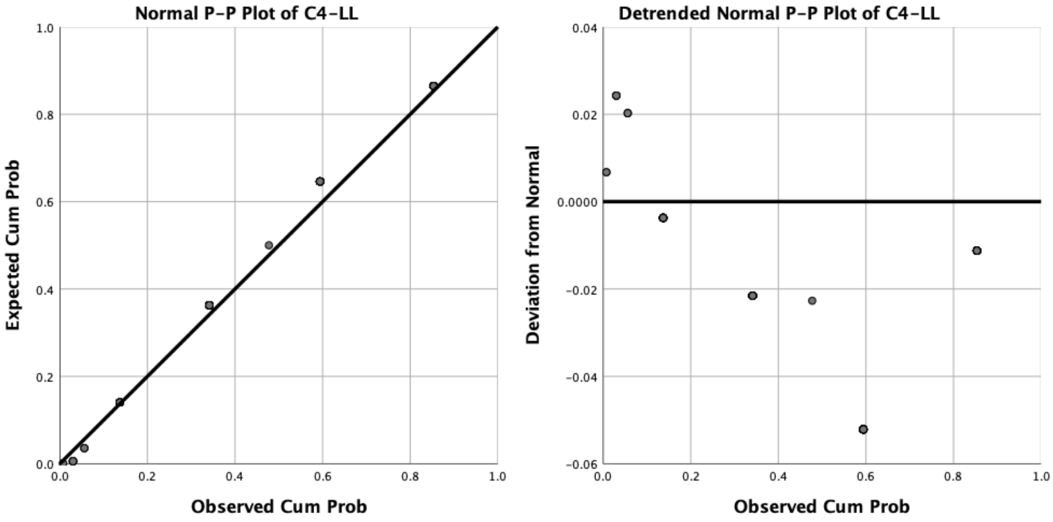

Detrended Normal P-P Plot of C3-CM
Deviation from Normal
Observed Cum Prob
0.025
0.0000
-0.025
-0.050
-0.075
-0.100
0.0
0.2
0.4
0.6
0.8
1.0

C3-LS

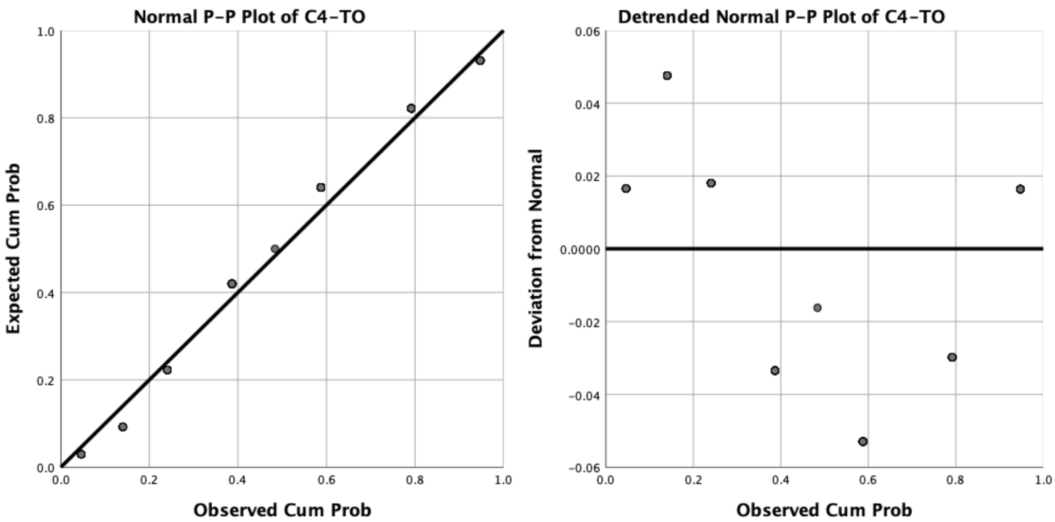

Normal P-P Plot of C3-LS
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of C3-LS
Deviation from Normal
Observed Cum Prob
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

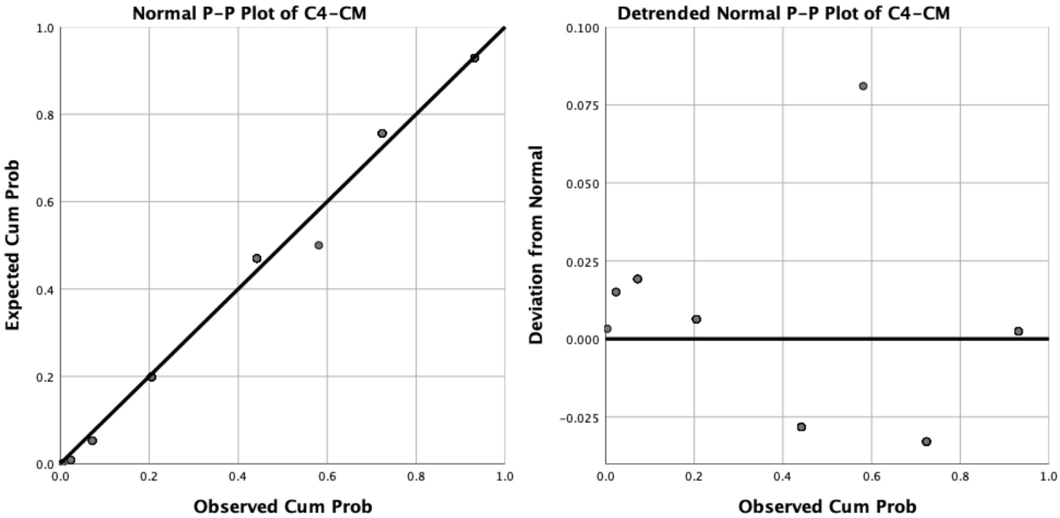
C4-LL


Normal P-P Plot of C4-LL
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of C4-LL
Deviation from Normal
Observed Cum Prob

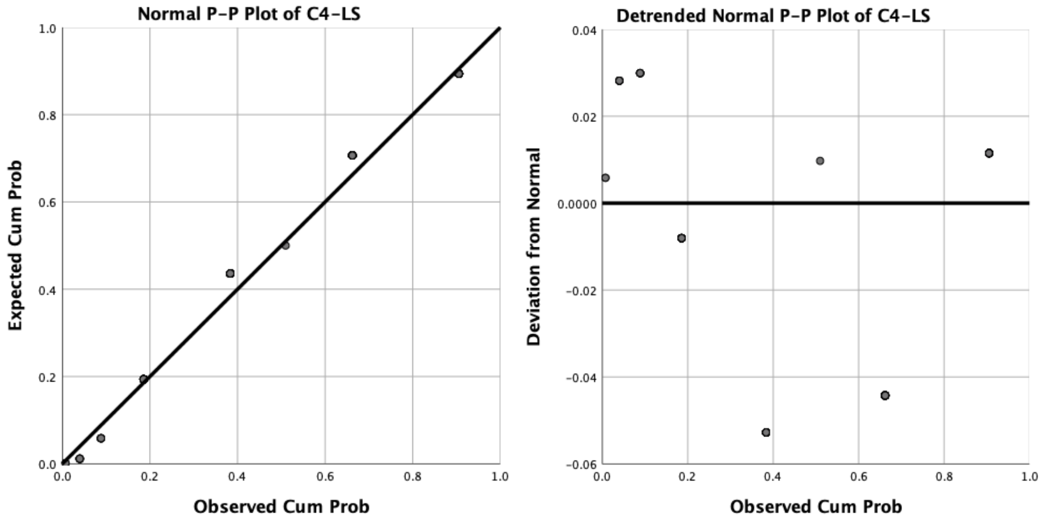
C4-TO


Normal P-P Plot of C4-TO
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of C4-TO
Deviation from Normal
Observed Cum Prob

C4-CM


Normal P-P Plot of C4-CM
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Detrended Normal P-P Plot of C4-CM
Deviation from Normal
Observed Cum Prob
0.100
0.075
0.050
0.025
0.000
-0.025

C4-LS


Normal P-P Plot of C4-LS
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0
Detrended Normal P-P Plot of C4-LS
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
-0.02
-0.04
-0.06

Appendix 8 One way ANOVA results of expectation rating in the formal survey

1) Comparison within street types

One way ANOVA with LSD post-hoc test								
Dependent Variable				Mean difference (I-J)	Standard error	Significance	95% CI	
							Lower limits	Upper limits
B1	LSD	LL	CM	1.11111*	0.17589	0.000	0.7657	1.4565
			LS	1.05229*	0.17589	0.000	0.7069	1.3977
			TO	2.40523*	0.17589	0.000	2.0598	2.7506
		CM	LS	-0.05882	0.17589	**0.738**	-0.4042	0.2866
			TO	1.29412*	0.17589	0.000	0.9487	1.6395
		LS	TO	1.35294*	0.17589	0.000	1.0075	1.6984
B2	LSD	LL	CM	1.27451*	0.17572	0.000	0.9294	1.6196
			LS	1.09804*	0.17572	0.000	0.7529	1.4431
			TO	2.28105*	0.17572	0.000	1.9360	2.6261
		CM	LS	-0.17647	0.17572	**0.316**	-0.5216	0.1686
			TO	1.00654*	0.17572	0.000	0.6614	1.3516
		LS	TO	1.18301*	0.17572	0.000	0.8379	1.5281
B3	LSD	LL	CM	1.11765*	0.18660	0.000	0.7512	1.4841
			LS	1.13725*	0.18660	0.000	0.7708	1.5037
			TO	1.93464*	0.18660	0.000	1.5682	2.3011
		CM	LS	0.01961	0.18660	**0.916**	-0.3468	0.3861
			TO	.81699*	0.18660	0.000	0.4505	1.1834
		LS	TO	.79739*	0.18660	0.000	0.4309	1.1638
E1	LSD	LL	CM	.35948*	0.16286	0.028	0.0396	0.6793
			LS	.33333*	0.16286	0.041	0.0135	0.6532
			TO	.93464*	0.16286	0.000	0.6148	1.2545
		CM	LS	-0.02614	0.16286	**0.873**	-0.3460	0.2937
			TO	.57516*	0.16286	0.000	0.2553	0.8950
		LS	TO	.60131*	0.16286	0.000	0.2815	0.9211
E2	LSD	LL	CM	.64052*	0.16372	0.000	0.3190	0.9620
			LS	.42484*	0.16372	0.010	0.1033	0.7464
			TO	1.11765*	0.16372	0.000	0.7961	1.4392
		CM	LS	-0.21569	0.16372	**0.188**	-0.5372	0.1058
			TO	.47712*	0.16372	0.004	0.1556	0.7986
		LS	TO	.69281*	0.16372	0.000	0.3713	1.0143
E3	LSD	LL	CM	.49673*	0.16330	0.002	0.1760	0.8174
			LS	.47059*	0.16330	0.004	0.1499	0.7913

			TO	1.00000*	0.16330	0.000	0.6793	1.3207
		CM	LS	-0.02614	0.16330	**0.873**	-0.3468	0.2945
			TO	.50327*	0.16330	0.002	0.1826	0.8240
		LS	TO	.52941*	0.16330	0.001	0.2087	0.8501
F1	LSD	LL	CM	.43137*	0.17600	0.015	0.0857	0.7770
			LS	.64052*	0.17600	0.000	0.2949	0.9862
			TO	2.00654*	0.17600	0.000	1.6609	2.3522
		CM	LS	0.20915	0.17600	**0.235**	-0.1365	0.5548
			TO	1.57516*	0.17600	0.000	1.2295	1.9208
		LS	TO	1.36601*	0.17600	0.000	1.0204	1.7117
F2	LSD	LL	CM	.36601*	0.17610	0.038	0.0202	0.7118
			LS	.63399*	0.17610	0.000	0.2882	0.9798
			TO	1.90196*	0.17610	0.000	1.5561	2.2478
		CM	LS	0.26797	0.17610	**0.129**	-0.0779	0.6138
			TO	1.53595*	0.17610	0.000	1.1901	1.8818
		LS	TO	1.26797*	0.17610	0.000	0.9221	1.6138
F3	LSD	LL	CM	.57516*	0.17158	0.001	0.2382	0.9121
			LS	.75817*	0.17158	0.000	0.4212	1.0951
			TO	1.97386*	0.17158	0.000	1.6369	2.3108
		CM	LS	0.18301	0.17158	**0.287**	-0.1539	0.5200
			TO	1.39869*	0.17158	0.000	1.0617	1.7356
		LS	TO	1.21569*	0.17158	0.000	0.8787	1.5526
F4	LSD	LL	CM	1.03268*	0.17833	0.000	0.6825	1.3829
			LS	1.07843*	0.17833	0.000	0.7282	1.4286
			TO	2.64052*	0.17833	0.000	2.2903	2.9907
		CM	LS	0.04575	0.17833	**0.798**	-0.3045	0.3960
			TO	1.60784*	0.17833	0.000	1.2576	1.9581
		LS	TO	1.56209*	0.17833	0.000	1.2119	1.9123
F5	LSD	LL	CM	1.22222*	0.17891	0.000	0.8709	1.5736
			LS	1.23529*	0.17891	0.000	0.8839	1.5866
			TO	2.31373*	0.17891	0.000	1.9624	2.6651
		CM	LS	0.01307	0.17891	**0.942**	-0.3383	0.3644
			TO	1.09150*	0.17891	0.000	0.7401	1.4429
		LS	TO	1.07843*	0.17891	0.000	0.7271	1.4298
C1	LSD	LL	CM	.92810*	0.17813	0.000	0.5783	1.2779
			LS	.86928*	0.17813	0.000	0.5195	1.2191
			TO	1.92810*	0.17813	0.000	1.5783	2.2779

		CM	LS	-0.05882	0.17813	**0.741**	-0.4086	0.2910
			TO	1.00000*	0.17813	0.000	0.6502	1.3498
		LS	TO	1.05882*	0.17813	0.000	0.7090	1.4086
C2	LSD	LL	CM	.94118*	0.17649	0.000	0.5946	1.2878
			LS	.54248*	0.17649	0.002	0.1959	0.8891
			TO	1.67974*	0.17649	0.000	1.3331	2.0263
		CM	LS	-.39869*	0.17649	0.024	-0.7453	-0.0521
			TO	.73856*	0.17649	0.000	0.3920	1.0852
		LS	TO	1.13725*	0.17649	0.000	0.7907	1.4839
C3	LSD	LL	CM	.77778*	0.16784	0.000	0.4482	1.1074
			LS	.43791*	0.16784	0.009	0.1083	0.7675
			TO	1.28758*	0.16784	0.000	0.9580	1.6172
		CM	LS	-.33987*	0.16784	0.043	-0.6695	-0.0103
			TO	.50980*	0.16784	0.002	0.1802	0.8394
		LS	TO	.84967*	0.16784	0.000	0.5201	1.1793
C4	LSD	LL	CM	.38562*	0.16986	0.024	0.0520	0.7192
			LS	0.25490	0.16986	**0.134**	-0.0787	0.5885
			TO	1.12418*	0.16986	0.000	0.7906	1.4578
		CM	LS	-0.13072	0.16986	**0.442**	-0.4643	0.2029
			TO	.73856*	0.16986	0.000	0.4050	1.0721
		LS	TO	.86928*	0.16986	0.000	0.5357	1.2029
*. The significance level of the mean difference was 0.05.								

2) Comparison within participants groups

Comparison between professional (N=24) and lay (n=129) participants										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the	
									Lower	Upper
B1-LL	Equal variances assumed	0.000	0.992	-2.124	151	0.035	(0.60)	0.28	(1.15)	(0.04)
	Equal variances not assumed			-2.146	32.447	0.039	(0.60)	0.28	(1.17)	(0.03)
B1-TO	Equal variances assumed	2.805	0.096	-3.257	151	0.001	(1.25)	0.38	(2.01)	(0.49)
	Equal variances not assumed			-3.801	37.817	0.001	(1.25)	0.33	(1.92)	(0.59)
B1-CM	Equal variances assumed	0.013	0.908	-0.491	151	0.624	(0.17)	0.35	(0.85)	0.51
	Equal variances not assumed			-0.497	32.473	0.623	(0.17)	0.34	(0.86)	0.53
B1-LS	Equal variances assumed	1.901	0.170	-1.619	151	0.107	(0.54)	0.33	(1.19)	0.12
	Equal variances not assumed			-1.784	35.347	0.083	(0.54)	0.30	(1.15)	0.07
B2-LL	Equal variances assumed	1.244	0.266	-1.577	151	0.117	(0.45)	0.29	(1.02)	0.11
	Equal variances not assumed			-1.864	38.441	0.070	(0.45)	0.24	(0.94)	0.04
B2-TO	Equal variances assumed	3.979	0.048	-3.314	151	0.001	(1.31)	0.39	(2.08)	(0.53)
	Equal variances not assumed			-3.982	39.297	0.000	(1.31)	0.33	(1.97)	(0.64)
B2-CM	Equal variances assumed	0.050	0.823	-1.413	151	0.160	(0.47)	0.33	(1.13)	0.19
	Equal variances not assumed			-1.372	31.365	0.180	(0.47)	0.34	(1.18)	0.23
B2-LS	Equal variances assumed	0.671	0.414	-2.121	151	0.036	(0.68)	0.32	(1.32)	(0.05)
	Equal variances not assumed			-2.284	34.503	0.029	(0.68)	0.30	(1.29)	(0.08)
B3-LL	Equal variances assumed	0.530	0.468	-1.942	151	0.054	(0.65)	0.33	(1.30)	0.01
	Equal variances not assumed			-1.791	30.142	0.083	(0.65)	0.36	(1.38)	0.09
B3-TO	Equal variances assumed	1.439	0.232	-3.357	151	0.001	(1.27)	0.38	(2.01)	(0.52)
	Equal variances not assumed			-3.670	35.057	0.001	(1.27)	0.35	(1.97)	(0.57)
B3-CM	Equal variances assumed	1.032	0.311	-0.951	151	0.343	(0.36)	0.38	(1.10)	0.39
	Equal variances not assumed			-0.874	30.068	0.389	(0.36)	0.41	(1.19)	0.48
B3-LS	Equal variances assumed	0.110	0.741	-1.104	151	0.271	(0.38)	0.35	(1.07)	0.30
	Equal variances not assumed			-1.128	32.780	0.268	(0.38)	0.34	(1.08)	0.31
E1-LL	Equal variances assumed	0.015	0.904	-1.375	151	0.171	(0.41)	0.30	(0.99)	0.18
	Equal variances not assumed			-1.300	30.704	0.203	(0.41)	0.31	(1.05)	0.23
E1-TO	Equal variances assumed	0.180	0.672	-2.428	151	0.016	(0.88)	0.36	(1.60)	(0.16)
	Equal variances not assumed			-2.341	31.186	0.026	(0.88)	0.38	(1.65)	(0.11)

E1-CM	Equal variances assumed	0.034	0.853	-0.434	151	0.665	(0.13)	0.30	(0.72)	0.46
	Equal variances not assumed			-0.425	31.591	0.674	(0.13)	0.31	(0.75)	0.49
E1-LS	Equal variances assumed	5.561	0.020	-1.044	151	0.298	(0.31)	0.30	(0.89)	0.28
	Equal variances not assumed			-1.322	42.359	0.193	(0.31)	0.23	(0.78)	0.16
E2-LL	Equal variances assumed	0.043	0.835	-1.290	151	0.199	(0.36)	0.28	(0.92)	0.19
	Equal variances not assumed			-1.323	32.895	0.195	(0.36)	0.27	(0.92)	0.19
E2-TO	Equal variances assumed	0.071	0.791	-2.662	151	0.009	(0.96)	0.36	(1.68)	(0.25)
	Equal variances not assumed			-2.522	30.758	0.017	(0.96)	0.38	(1.74)	(0.18)
E2-CM	Equal variances assumed	0.005	0.945	-0.152	151	0.879	(0.05)	0.31	(0.66)	0.57
	Equal variances not assumed			-0.141	30.236	0.889	(0.05)	0.34	(0.74)	0.64
E2-LS	Equal variances assumed	1.526	0.219	-0.670	151	0.504	(0.20)	0.31	(0.81)	0.40
	Equal variances not assumed			-0.714	34.147	0.480	(0.20)	0.29	(0.79)	0.38
E3-LL	Equal variances assumed	3.242	0.074	-2.468	151	0.015	(0.71)	0.29	(1.29)	(0.14)
	Equal variances not assumed			-2.213	29.559	0.035	(0.71)	0.32	(1.37)	(0.05)
E3-TO	Equal variances assumed	0.017	0.896	-2.699	151	0.008	(0.96)	0.36	(1.66)	(0.26)
	Equal variances not assumed			-2.693	32.094	0.011	(0.96)	0.36	(1.69)	(0.23)
E3-CM	Equal variances assumed	0.194	0.661	-0.085	151	0.932	(0.03)	0.31	(0.63)	0.58
	Equal variances not assumed			-0.078	29.842	0.939	(0.03)	0.34	(0.71)	0.66
E3-LS	Equal variances assumed	0.213	0.645	-0.515	151	0.607	(0.16)	0.30	(0.75)	0.44
	Equal variances not assumed			-0.515	32.181	0.610	(0.16)	0.30	(0.77)	0.46
F1-LL	Equal variances assumed	5.117	0.025	-2.257	151	0.025	(0.70)	0.31	(1.30)	(0.09)
	Equal variances not assumed			-1.794	27.514	0.084	(0.70)	0.39	(1.49)	0.10
F1-TO	Equal variances assumed	2.910	0.090	-3.115	151	0.002	(1.18)	0.38	(1.93)	(0.43)
	Equal variances not assumed			-3.671	38.298	0.001	(1.18)	0.32	(1.83)	(0.53)
F1-CM	Equal variances assumed	0.999	0.319	-0.113	151	0.910	(0.04)	0.32	(0.66)	0.59
	Equal variances not assumed			-0.117	33.220	0.908	(0.04)	0.31	(0.66)	0.59
F1-LS	Equal variances assumed	0.169	0.682	-0.244	151	0.807	(0.08)	0.35	(0.77)	0.60
	Equal variances not assumed			-0.263	34.540	0.794	(0.08)	0.32	(0.73)	0.57
F2-LL	Equal variances assumed	1.026	0.313	-2.271	151	0.025	(0.72)	0.32	(1.36)	(0.09)
	Equal variances			-2.069	29.881	0.047	(0.72)	0.35	(1.44)	(0.01)

	not assumed									
F2-TO	Equal variances assumed	2.512	0.115	-2.769	151	0.006	(1.04)	0.38	(1.78)	(0.30)
	Equal variances not assumed			-3.199	37.365	0.003	(1.04)	0.32	(1.70)	(0.38)
F2-CM	Equal variances assumed	0.088	0.767	0.913	151	0.363	0.30	0.33	(0.35)	0.96
	Equal variances not assumed			0.941	33.058	0.353	0.30	0.32	(0.35)	0.96
F2-LS	Equal variances assumed	0.104	0.748	0.684	151	0.495	0.22	0.33	(0.42)	0.87
	Equal variances not assumed			0.722	33.814	0.476	0.22	0.31	(0.41)	0.86
F3-LL	Equal variances assumed	5.510	0.020	-2.508	151	0.013	(0.70)	0.28	(1.25)	(0.15)
	Equal variances not assumed			-2.089	28.223	0.046	(0.70)	0.33	(1.39)	(0.01)
F3-TO	Equal variances assumed	1.811	0.180	-3.231	151	0.002	(1.27)	0.39	(2.05)	(0.49)
	Equal variances not assumed			-3.804	38.263	0.000	(1.27)	0.33	(1.95)	(0.60)
F3-CM	Equal variances assumed	0.474	0.492	-0.695	151	0.488	(0.22)	0.31	(0.83)	0.40
	Equal variances not assumed			-0.615	29.282	0.544	(0.22)	0.35	(0.93)	0.50
F3-LS	Equal variances assumed	0.012	0.912	-0.300	151	0.765	(0.10)	0.32	(0.74)	0.54
	Equal variances not assumed			-0.298	32.007	0.768	(0.10)	0.33	(0.76)	0.57
F4-LL	Equal variances assumed	0.932	0.336	-1.189	151	0.236	(0.35)	0.29	(0.92)	0.23
	Equal variances not assumed			-1.141	31.065	0.263	(0.35)	0.30	(0.97)	0.27
F4-TO	Equal variances assumed	9.058	0.003	-3.006	151	0.003	(1.22)	0.41	(2.02)	(0.42)
	Equal variances not assumed			-3.914	44.287	0.000	(1.22)	0.31	(1.85)	(0.59)
F4-CM	Equal variances assumed	0.133	0.716	1.043	151	0.299	0.33	0.32	(0.30)	0.97
	Equal variances not assumed			0.920	29.229	0.365	0.33	0.36	(0.41)	1.08
F4-LS	Equal variances assumed	0.048	0.826	0.550	151	0.583	0.19	0.35	(0.49)	0.88
	Equal variances not assumed			0.539	31.592	0.594	0.19	0.35	(0.53)	0.91
F5-LL	Equal variances assumed	0.027	0.870	-1.696	151	0.092	(0.44)	0.26	(0.96)	0.07
	Equal variances not assumed			-1.742	32.943	0.091	(0.44)	0.25	(0.96)	0.07
F5-TO	Equal variances assumed	0.004	0.948	-1.146	151	0.254	(0.47)	0.41	(1.27)	0.34
	Equal variances not assumed			-1.098	31.030	0.281	(0.47)	0.43	(1.33)	0.40
F5-CM	Equal variances assumed	0.261	0.610	0.760	151	0.448	0.26	0.35	(0.42)	0.95
	Equal variances not assumed			0.762	32.239	0.451	0.26	0.35	(0.44)	0.97

F5-LS	Equal variances assumed	1.733	0.190	0.230	151	0.818	0.08	0.36	(0.63)	0.79
	Equal variances not assumed			0.270	38.086	0.789	0.08	0.31	(0.54)	0.70
C1-LL	Equal variances assumed	1.772	0.185	-1.746	151	0.083	(0.53)	0.30	(1.13)	0.07
	Equal variances not assumed			-1.874	34.374	0.069	(0.53)	0.28	(1.10)	0.04
C1-TO	Equal variances assumed	7.291	0.008	-1.482	151	0.141	(0.56)	0.38	(1.32)	0.19
	Equal variances not assumed			-1.837	41.073	0.073	(0.56)	0.31	(1.19)	0.06
C1-CM	Equal variances assumed	0.059	0.809	0.365	151	0.716	0.13	0.35	(0.56)	0.81
	Equal variances not assumed			0.374	32.902	0.711	0.13	0.34	(0.56)	0.82
C1-LS	Equal variances assumed	3.741	0.055	0.735	151	0.463	0.25	0.35	(0.43)	0.94
	Equal variances not assumed			0.925	41.975	0.360	0.25	0.28	(0.30)	0.81
C2-LL	Equal variances assumed	0.584	0.446	-1.526	151	0.129	(0.47)	0.31	(1.09)	0.14
	Equal variances not assumed			-1.637	34.353	0.111	(0.47)	0.29	(1.06)	0.11
C2-TO	Equal variances assumed	1.511	0.221	-0.658	151	0.511	(0.26)	0.40	(1.05)	0.52
	Equal variances not assumed			-0.724	35.303	0.474	(0.26)	0.36	(0.99)	0.47
C2-CM	Equal variances assumed	5.171	0.024	0.584	151	0.560	0.20	0.34	(0.47)	0.86
	Equal variances not assumed			0.753	43.657	0.455	0.20	0.26	(0.33)	0.72
C2-LS	Equal variances assumed	4.786	0.030	0.988	151	0.325	0.32	0.32	(0.32)	0.95
	Equal variances not assumed			1.283	44.121	0.206	0.32	0.25	(0.18)	0.81
C3-LL	Equal variances assumed	2.436	0.121	-1.159	151	0.248	(0.34)	0.29	(0.92)	0.24
	Equal variances not assumed			-1.323	36.811	0.194	(0.34)	0.26	(0.86)	0.18
C3-TO	Equal variances assumed	0.001	0.970	-1.295	151	0.197	(0.49)	0.38	(1.24)	0.26
	Equal variances not assumed			-1.310	32.494	0.199	(0.49)	0.38	(1.26)	0.27
C3-CM	Equal variances assumed	0.367	0.546	-0.491	151	0.624	(0.16)	0.32	(0.79)	0.48
	Equal variances not assumed			-0.553	36.221	0.583	(0.16)	0.29	(0.74)	0.42
C3-LS	Equal variances assumed	0.493	0.484	0.105	151	0.917	0.03	0.30	(0.57)	0.63
	Equal variances not assumed			0.117	35.919	0.907	0.03	0.27	(0.52)	0.58
C4-LL	Equal variances assumed	0.468	0.495	-3.076	151	0.002	(0.92)	0.30	(1.51)	(0.33)
	Equal variances not assumed			-2.782	29.733	0.009	(0.92)	0.33	(1.59)	(0.24)
C4-TO	Equal variances assumed	0.207	0.650	-2.483	151	0.014	(0.97)	0.39	(1.74)	(0.20)

	Equal variances not assumed			-2.365	30.883	0.025	(0.97)	0.41	(1.81)	(0.13)
C4-CM	Equal variances assumed	0.027	0.870	0.622	151	0.535	0.18	0.29	(0.39)	0.75
	Equal variances not assumed			0.670	34.511	0.508	0.18	0.27	(0.37)	0.73
C4-LS	Equal variances assumed	2.665	0.105	0.079	151	0.937	0.03	0.32	(0.60)	0.65
	Equal variances not assumed			0.099	41.369	0.922	0.03	0.26	(0.49)	0.54

Comparison between male (N=71) and female (n=82) participants										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the	
									Lower	Upper
B1-LL	Equal variances assumed	0.438	0.509	0.685	151	0.495	0.14	0.21	(0.27)	0.55
	Equal variances not assumed			0.676	137.963	0.500	0.14	0.21	(0.27)	0.56
B1-TO	Equal variances assumed	3.757	0.054	0.652	151	0.516	0.19	0.29	(0.38)	0.76
	Equal variances not assumed			0.643	136.367	0.521	0.19	0.29	(0.39)	0.77
B1-CM	Equal variances assumed	0.213	0.645	-0.804	151	0.423	(0.20)	0.25	(0.70)	0.29
	Equal variances not assumed			-0.801	144.762	0.425	(0.20)	0.25	(0.70)	0.30
B1-LS	Equal variances assumed	1.327	0.251	0.555	151	0.580	0.13	0.24	(0.35)	0.62
	Equal variances not assumed			0.550	141.950	0.583	0.13	0.25	(0.35)	0.62
B2-LL	Equal variances assumed	3.440	0.066	-0.349	151	0.728	(0.07)	0.21	(0.49)	0.34
	Equal variances not assumed			-0.341	124.608	0.734	(0.07)	0.22	(0.50)	0.35
B2-TO	Equal variances assumed	2.744	0.100	1.168	151	0.245	0.35	0.30	(0.24)	0.93
	Equal variances not assumed			1.158	141.868	0.249	0.35	0.30	(0.24)	0.94
B2-CM	Equal variances assumed	0.273	0.602	0.502	151	0.616	0.12	0.25	(0.36)	0.61
	Equal variances not assumed			0.501	145.914	0.617	0.12	0.25	(0.36)	0.61
B2-LS	Equal variances assumed	0.047	0.828	-0.313	151	0.754	(0.07)	0.24	(0.54)	0.40
	Equal variances not assumed			-0.312	145.870	0.755	(0.07)	0.24	(0.55)	0.40
B3-LL	Equal variances assumed	0.001	0.973	1.415	151	0.159	0.34	0.24	(0.14)	0.83
	Equal variances not assumed			1.415	148.001	0.159	0.34	0.24	(0.14)	0.83
B3-TO	Equal variances assumed	0.466	0.496	1.248	151	0.214	0.35	0.28	(0.21)	0.91
	Equal variances not assumed			1.242	144.095	0.216	0.35	0.29	(0.21)	0.92
B3-CM	Equal variances assumed	0.103	0.749	1.686	151	0.094	0.46	0.27	(0.08)	1.00
	Equal variances not assumed			1.687	148.318	0.094	0.46	0.27	(0.08)	1.00

B3-LS	Equal variances assumed	0.840	0.361	1.336	151	0.184	0.34	0.25	(0.16)	0.84
	Equal variances not assumed			1.333	146.556	0.185	0.34	0.25	(0.16)	0.84
E1-LL	Equal variances assumed	2.282	0.133	-0.046	151	0.964	(0.01)	0.22	(0.44)	0.42
	Equal variances not assumed			-0.045	137.981	0.964	(0.01)	0.22	(0.45)	0.43
E1-TO	Equal variances assumed	0.225	0.636	-1.774	151	0.078	(0.47)	0.27	(1.00)	0.05
	Equal variances not assumed			-1.771	146.669	0.079	(0.47)	0.27	(1.00)	0.05
E1-CM	Equal variances assumed	0.240	0.625	-0.223	151	0.823	(0.05)	0.22	(0.48)	0.38
	Equal variances not assumed			-0.224	148.165	0.823	(0.05)	0.22	(0.48)	0.38
E1-LS	Equal variances assumed	1.643	0.202	-2.310	151	0.022	(0.49)	0.21	(0.91)	(0.07)
	Equal variances not assumed			-2.278	135.897	0.024	(0.49)	0.22	(0.92)	(0.06)
E2-LL	Equal variances assumed	0.403	0.526	0.326	151	0.745	0.07	0.21	(0.34)	0.47
	Equal variances not assumed			0.323	140.300	0.747	0.07	0.21	(0.34)	0.48
E2-TO	Equal variances assumed	0.873	0.352	-1.181	151	0.239	(0.32)	0.27	(0.85)	0.21
	Equal variances not assumed			-1.175	144.183	0.242	(0.32)	0.27	(0.85)	0.22
E2-CM	Equal variances assumed	0.481	0.489	-0.922	151	0.358	(0.21)	0.23	(0.66)	0.24
	Equal variances not assumed			-0.929	150.647	0.355	(0.21)	0.23	(0.65)	0.24
E2-LS	Equal variances assumed	0.026	0.872	-1.218	151	0.225	(0.27)	0.22	(0.71)	0.17
	Equal variances not assumed			-1.216	146.601	0.226	(0.27)	0.22	(0.71)	0.17
E3-LL	Equal variances assumed	0.645	0.423	0.259	151	0.796	0.06	0.22	(0.37)	0.48
	Equal variances not assumed			0.257	141.978	0.797	0.06	0.22	(0.37)	0.48
E3-TO	Equal variances assumed	0.365	0.547	-0.780	151	0.437	(0.21)	0.27	(0.73)	0.32
	Equal variances not assumed			-0.783	149.790	0.435	(0.21)	0.26	(0.73)	0.32
E3-CM	Equal variances assumed	0.047	0.828	-0.307	151	0.759	(0.07)	0.22	(0.51)	0.37
	Equal variances not assumed			-0.308	149.232	0.759	(0.07)	0.22	(0.51)	0.37
E3-LS	Equal variances assumed	0.175	0.676	-1.371	151	0.172	(0.30)	0.22	(0.74)	0.13
	Equal variances not assumed			-1.366	145.591	0.174	(0.30)	0.22	(0.74)	0.13

F1-LL	Equal variances assumed	0.479	0.490	0.837	151	0.404	0.19	0.23	(0.26)	0.64
	Equal variances not assumed			0.831	141.879	0.407	0.19	0.23	(0.26)	0.65
F1-TO	Equal variances assumed	0.814	0.368	-0.025	151	0.980	(0.01)	0.29	(0.57)	0.56
	Equal variances not assumed			-0.025	143.772	0.980	(0.01)	0.29	(0.57)	0.56
F1-CM	Equal variances assumed	3.163	0.077	-1.731	151	0.086	(0.40)	0.23	(0.85)	0.06
	Equal variances not assumed			-1.747	150.974	0.083	(0.40)	0.23	(0.85)	0.05
F1-LS	Equal variances assumed	1.512	0.221	-1.393	151	0.166	(0.35)	0.25	(0.84)	0.15
	Equal variances not assumed			-1.386	144.889	0.168	(0.35)	0.25	(0.84)	0.15
F2-LL	Equal variances assumed	1.217	0.272	0.494	151	0.622	0.12	0.24	(0.35)	0.58
	Equal variances not assumed			0.490	141.394	0.625	0.12	0.24	(0.35)	0.59
F2-TO	Equal variances assumed	1.752	0.188	0.514	151	0.608	0.14	0.28	(0.41)	0.70
	Equal variances not assumed			0.510	141.053	0.611	0.14	0.28	(0.41)	0.70
F2-CM	Equal variances assumed	0.003	0.960	-1.262	151	0.209	(0.30)	0.24	(0.78)	0.17
	Equal variances not assumed			-1.257	145.300	0.211	(0.30)	0.24	(0.78)	0.17
F2-LS	Equal variances assumed	1.504	0.222	-2.286	151	0.024	(0.54)	0.24	(1.01)	(0.07)
	Equal variances not assumed			-2.273	143.621	0.025	(0.54)	0.24	(1.01)	(0.07)
F3-LL	Equal variances assumed	3.537	0.062	-0.101	151	0.920	(0.02)	0.21	(0.43)	0.39
	Equal variances not assumed			-0.100	137.623	0.921	(0.02)	0.21	(0.44)	0.39
F3-TO	Equal variances assumed	0.726	0.396	-0.058	151	0.954	(0.02)	0.30	(0.60)	0.57
	Equal variances not assumed			-0.057	143.927	0.954	(0.02)	0.30	(0.61)	0.57
F3-CM	Equal variances assumed	0.575	0.449	-1.877	151	0.062	(0.42)	0.22	(0.86)	0.02
	Equal variances not assumed			-1.860	140.403	0.065	(0.42)	0.23	(0.87)	0.03
F3-LS	Equal variances assumed	1.998	0.160	-1.683	151	0.095	(0.39)	0.23	(0.86)	0.07
	Equal variances not assumed			-1.663	138.338	0.099	(0.39)	0.24	(0.86)	0.07
F4-LL	Equal variances assumed	4.649	0.033	-1.009	151	0.314	(0.22)	0.21	(0.64)	0.21

	Equal variances not assumed			-0.995	135.410	0.322	(0.22)	0.22	(0.64)	0.21
F4-TO	Equal variances assumed	0.047	0.829	0.025	151	0.980	0.01	0.30	(0.59)	0.61
	Equal variances not assumed			0.025	146.775	0.980	0.01	0.30	(0.59)	0.61
F4-CM	Equal variances assumed	2.213	0.139	-2.028	151	0.044	(0.47)	0.23	(0.93)	(0.01)
	Equal variances not assumed			-2.003	137.511	0.047	(0.47)	0.23	(0.93)	(0.01)
F4-LS	Equal variances assumed	0.073	0.787	-1.316	151	0.190	(0.33)	0.25	(0.83)	0.17
	Equal variances not assumed			-1.315	147.471	0.190	(0.33)	0.25	(0.83)	0.17
F5-LL	Equal variances assumed	0.502	0.480	0.116	151	0.908	0.02	0.19	(0.36)	0.40
	Equal variances not assumed			0.115	142.696	0.909	0.02	0.19	(0.36)	0.41
F5-TO	Equal variances assumed	0.513	0.475	-0.077	151	0.939	(0.02)	0.30	(0.61)	0.57
	Equal variances not assumed			-0.077	144.729	0.939	(0.02)	0.30	(0.62)	0.57
F5-CM	Equal variances assumed	0.957	0.330	-0.349	151	0.728	(0.09)	0.25	(0.59)	0.41
	Equal variances not assumed			-0.351	150.536	0.726	(0.09)	0.25	(0.59)	0.41
F5-LS	Equal variances assumed	0.124	0.725	-0.751	151	0.454	(0.20)	0.26	(0.71)	0.32
	Equal variances not assumed			-0.753	149.289	0.453	(0.20)	0.26	(0.71)	0.32
C1-LL	Equal variances assumed	1.719	0.192	0.284	151	0.777	0.06	0.22	(0.38)	0.50
	Equal variances not assumed			0.281	137.335	0.779	0.06	0.23	(0.38)	0.51
C1-TO	Equal variances assumed	0.003	0.960	-0.159	151	0.874	(0.04)	0.28	(0.60)	0.51
	Equal variances not assumed			-0.159	148.520	0.874	(0.04)	0.28	(0.60)	0.51
C1-CM	Equal variances assumed	0.166	0.684	-2.612	151	0.010	(0.65)	0.25	(1.14)	(0.16)
	Equal variances not assumed			-2.600	144.800	0.010	(0.65)	0.25	(1.14)	(0.16)
C1-LS	Equal variances assumed	0.422	0.517	-1.984	151	0.049	(0.50)	0.25	(0.99)	(0.00)
	Equal variances not assumed			-1.969	142.303	0.051	(0.50)	0.25	(0.99)	0.00
C2-LL	Equal variances assumed	1.408	0.237	0.306	151	0.760	0.07	0.23	(0.38)	0.52

	Equal variances not assumed			0.302	137.078	0.763	0.07	0.23	(0.39)	0.53
C2-TO	Equal variances assumed	0.211	0.647	-1.466	151	0.145	(0.42)	0.29	(0.99)	0.15
	Equal variances not assumed			-1.468	148.548	0.144	(0.42)	0.29	(0.99)	0.15
C2-CM	Equal variances assumed	0.423	0.517	-2.003	151	0.047	(0.49)	0.24	(0.97)	(0.01)
	Equal variances not assumed			-1.985	140.846	0.049	(0.49)	0.25	(0.97)	(0.00)
C2-LS	Equal variances assumed	0.022	0.883	-1.218	151	0.225	(0.28)	0.23	(0.75)	0.18
	Equal variances not assumed			-1.214	145.909	0.227	(0.28)	0.23	(0.75)	0.18
C3-LL	Equal variances assumed	0.174	0.677	0.977	151	0.330	0.21	0.21	(0.21)	0.63
	Equal variances not assumed			0.974	145.474	0.332	0.21	0.21	(0.22)	0.63
C3-TO	Equal variances assumed	0.082	0.775	-0.911	151	0.364	(0.25)	0.28	(0.80)	0.30
	Equal variances not assumed			-0.909	146.385	0.365	(0.25)	0.28	(0.80)	0.30
C3-CM	Equal variances assumed	0.416	0.520	-0.880	151	0.380	(0.21)	0.23	(0.67)	0.26
	Equal variances not assumed			-0.875	144.563	0.383	(0.21)	0.24	(0.67)	0.26
C3-LS	Equal variances assumed	1.115	0.293	-1.424	151	0.156	(0.31)	0.22	(0.75)	0.12
	Equal variances not assumed			-1.408	138.084	0.161	(0.31)	0.22	(0.76)	0.13
C4-LL	Equal variances assumed	0.156	0.694	1.016	151	0.311	0.23	0.22	(0.21)	0.67
	Equal variances not assumed			1.019	149.112	0.310	0.23	0.22	(0.21)	0.67
C4-TO	Equal variances assumed	0.213	0.645	-1.321	151	0.189	(0.38)	0.29	(0.95)	0.19
	Equal variances not assumed			-1.316	145.262	0.190	(0.38)	0.29	(0.95)	0.19
C4-CM	Equal variances assumed	0.354	0.553	-2.662	151	0.009	(0.55)	0.21	(0.96)	(0.14)
	Equal variances not assumed			-2.633	138.665	0.009	(0.55)	0.21	(0.96)	(0.14)
C4-LS	Equal variances assumed	0.233	0.630	-1.979	151	0.050	(0.45)	0.23	(0.91)	(0.00)
	Equal variances not assumed			-1.957	138.738	0.052	(0.45)	0.23	(0.91)	0.00

Appendix 9 Questionnaire of SRMS and RCS in the pilot study

您好，感谢您参与该项社会调查。这项问卷由三部分组成，第一部分将调查关于您个人的一些背景信息；第二部分是一个用于测量您对于街道疗愈性感知的的心理学量表；第三部分是一个用于测量您对街道环境质量评价的设计学量表。第二及第三部分的详细介绍将在后续每个部分开始之前加以说明。填写问卷过程中如果您有任何问题，请随时咨询调研人员。我们承诺您提供的所有信息和回答将严格保密。

Hello, many thanks for participating. This questionnaire is composed of three parts. Please start with filling in some of your personal information. The second part is a psychometric scale used to investigate your perceptions on street restorativeness and the last part is a street design model used to understand your assessment on streets. Instructions of the latter two parts will be provided before each part start. If you have any questions during completing the questionnaire, please don't hesitate to contact our surveyors. We promise that all your information and your answers will be kept in anonymous and in confidential.

Part 1：基本信息/*Background Information*

1. 性别/*Gender:*　　（）男/*Male*　　（）女/ *Female*
2. 年龄/*Age:* （）22-29（）30-39（）40-49（）50 以上
3. 教育背景/*Education Background:*（）本科以下（）本科（）硕士（）硕士以上
4. 职业相关性/*Professional Background:*
   （）您曾经学习过或曾经有过城市规划、城市设计、景观、建筑等相关领域的工作经验。
   （）您从未学习过或曾经有过城市规划、城市设计、景观、建筑等相关领域的工作经验。
4. 收入水平（ 月）/*Income (per month):*
   （）10k 以下　（）10-15k　（）15-20k　（）20-30k　（）30k 以上
5. 当您感到疲倦的时候，您会选择去上海的哪条街道走一走?请写下这些街道的名字。
   When you feel tried, which street in Shanghai would you choose to take a walk? Please write the name of these streets.

接下来请您根据您所在的街道做出判断，完成以下第二、第三部分的内容。

Next, you are going to answer questions in the next two parts based on your understandings of the environment you are staying.

Part 2 ： 街道感知/*Perceptions of Streets*

我们准备了以下问题帮助我们了解您关于上海街道环境的体验。 请仔细阅读每个下列每一个陈述句的内容，然后回答以下问题：这句话的陈述内容与我的体验相符程度是多少？请在问题后的数字刻度后面的横线上打✔来表明您的答案。下面给出了关于刻度数字含义的解释以方便您的作答。

To help us understand your experience of Shanghai streets, we have provided the following statements for you to respond to. Please read each statement carefully, then ask yourself, 'How much does this statement apply to my experience here? To indicate your answer, tick on the blanket after the numbers on the scale beside it. A sample of the scale with verbal descriptions for the values is given at the bottom of this page.

这里让我能够暂时忘记工作和日常的生活的烦恼；

0__1__2__3__4__5__6__

When I am here I feel free from work and daily routine.

这里让我能够暂时忘记他人的要求和期望带来的压力；

0__1__2__3__4__5__6__

When I am here I feel free from other peoples' demand and expectations.

这里让我能够暂时的忘记我所承担的责任与义务。

0__1__2__3__4__5__6__

When I am here I do not need to think of my responsibility and obligations.

这里的所有东西都是互相联系的。

0__1__2__3__4__5__6__

The elements here go together.

这里的所有东西都是属于这里的。

0__1__2__3__4__5__6__

The existing elements belong here.

这里的所有东西组成了一个更大的整体。

0__1__2__3__4__5__6__

All the elements constitute a larger whole.

周围的环境是连贯的。

0__1__2__3__4__5__6__

The surroundings are coherent.

这里有很多我想要探索的东西。

0__1__2__3__4__5__6__

There is plenty to discover here.

这里有很多我感到好奇的东西。

0__1__2__3__4__5__6__

This setting has many things that I wonder about.

这里有很多吸引我的东西。

0__1__2__3__4__5__6__

There are many objects here that attract my attention.

我想要花更长的时间在这里。

0__1__2__3__4__5__6__

There is plenty that I want to linger on here.

我感到深深的沉浸在周围的环境中。

0__1__2__3__4__5__6__

I am absorbed in these surroundings.

这里让我有机会去做我喜欢做的事情。

0___1___2___3___4___5___6___

The environment gives me the opportunity to do activities that I like.

在这里，我能够解决出现的一些问题。

0___1___2___3___4___5___6___

I can handle the kinds of problems that arise here.

我能够很快的适应到周围的环境中。

0___1___2___3___4___5___6___

I rapidly adapt to this setting.

这里能够让我去做我想做的事。

0___1___2___3___4___5___6___

There is an accordance between what I like to do and this environment.

整体疗愈性评价/*Overall restorativeness* （当前环境能够帮助我缓解心理疲劳，舒缓一些负面情绪）	0___1___2___3___4___5___6___

Part 3 ：街道评价/*Evaluations of Streets*

我们想知道您对上海街道环境的一些评价，请对下列每一项内容进行打分来告诉我们您的感受。请在问题后的“ □ ”打“✔”来表明您的答案。

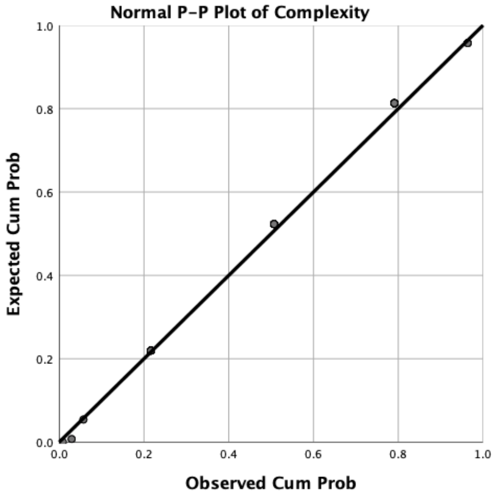
We are interested in your opinion about the design quality of Shanghai street. Please rate on each predictor suggesting your judgement. To indicate your answer, tick on the box on the left of predictors.

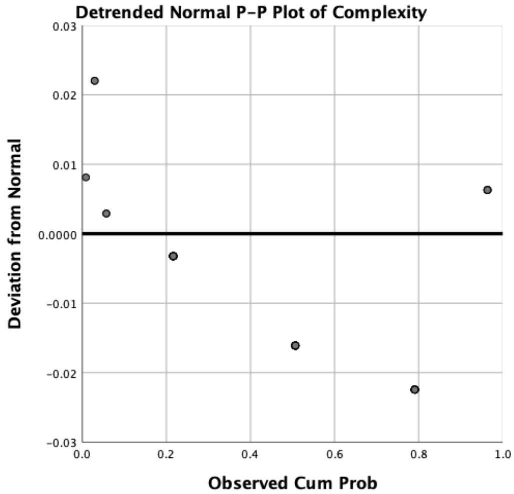
总体偏好程度/Overall Preference – 您对这条街道的喜爱程度。
愉悦感/Sense of Pleasure – 您在这个街道环境中所能获得的愉悦感。 安全感/Sense of Safety - 您在这个街道环境中所能获得安全感。
丰富度/Complexity – 您所在的街道环境中所包含的内容的丰富程度。 开阔度/Openness - 您所在的街道环境的开阔程度。 围合感/Enclosure – 您所在街道视觉上被其他垂直元素（墙、树等）定义的程度。 有序性/Order - 您所在的街道环境所体现出的结构性和有序程度。 神秘性/Mystery - 您所在的街道环境带来的神秘感。 视觉深度/Visual Depth - 您所在的街道环境的视觉深度。 辨识度/Identifiability - 您所在的街道环境给您带来的熟悉感。 维护状态/Upkeep – 您所在的街道环境的维护状况。 一致性/Unity - 您所在的街道环境的整体性和一致性。 可读性/Legibility – 您所在的街道环境能够被理解和掌握的难易程度。 历史性/Historic - 您所在的街道环境中保存良好的历史建筑的数量。 典型性/Typicality – 您所在的街道环境对于这一类别街道的代表性。
自然性/Naturalness -您所在街道中自然元素（树木、花草、灌木等）的数量。 水景/Waterscape - 您所在的街道环境里水景的数量。 设施/Facilities - 您所在的街道环境里周围设施的便利程度。 地标/Landmarks - 您所在的街道环境里是否有标志物。 他人活动/Human Activities - 您所在的街道环境里他人活动的密集程度。 地面铺装/Pavement - 您所在的街道环境路面铺装的平整状况。 日间采光/Lighting - 您所在的街道环境里光线（自然光照/人工光照）是否充足。 沿街界面/Frontages - 您所在的街道环境沿街界面的吸引力。 交通量/Traffic Volume - 您所在的街道环境里车辆活动的密集程度。 噪音/Noise - 您在这条街道中所感受到的噪音情况。 地势变化/Typographic Variation - 您所在的街道里是否存在地势变化（台阶等）。
请写下其他有助于帮助您恢复疲劳的街道元素/Please write other elements that might help with your restoration：

再次感谢您的参与！Thanks again for your participation!

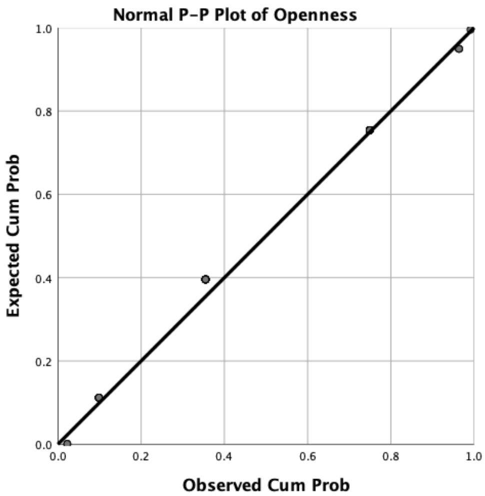
Appendix 10 PP-Plot of SRMS results in the pilot study

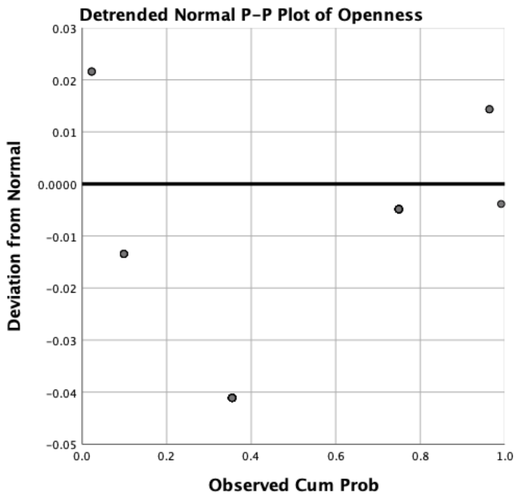
Complexity



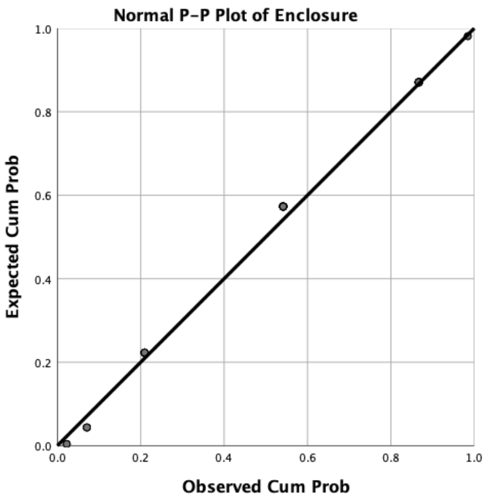


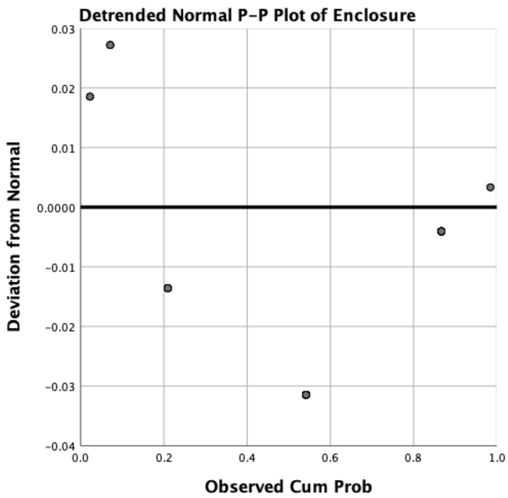
Openness



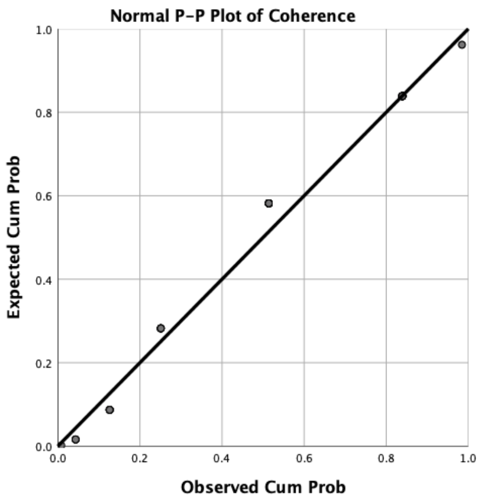


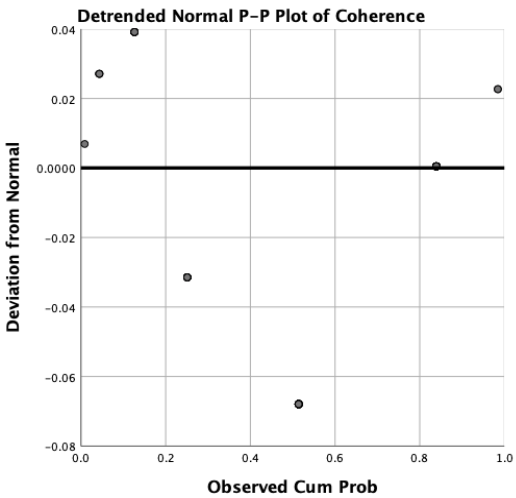
Enclosure



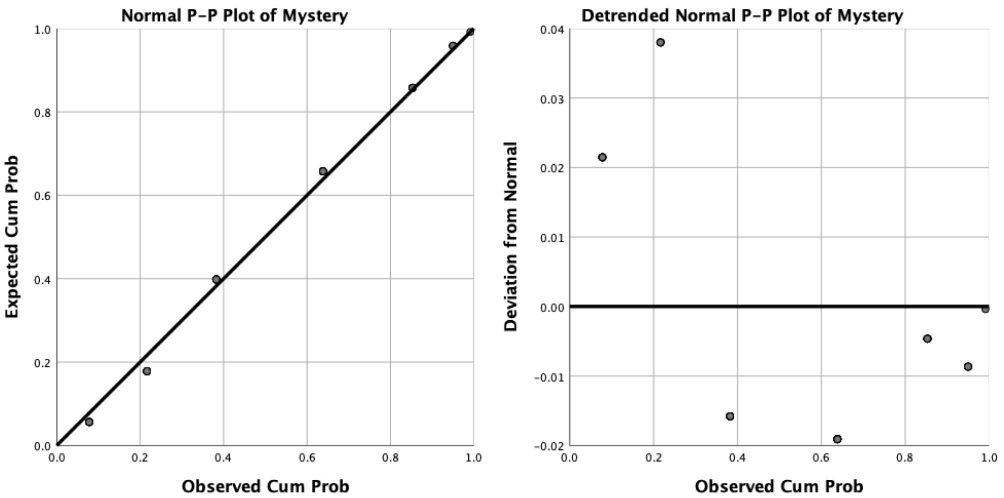


Coherence

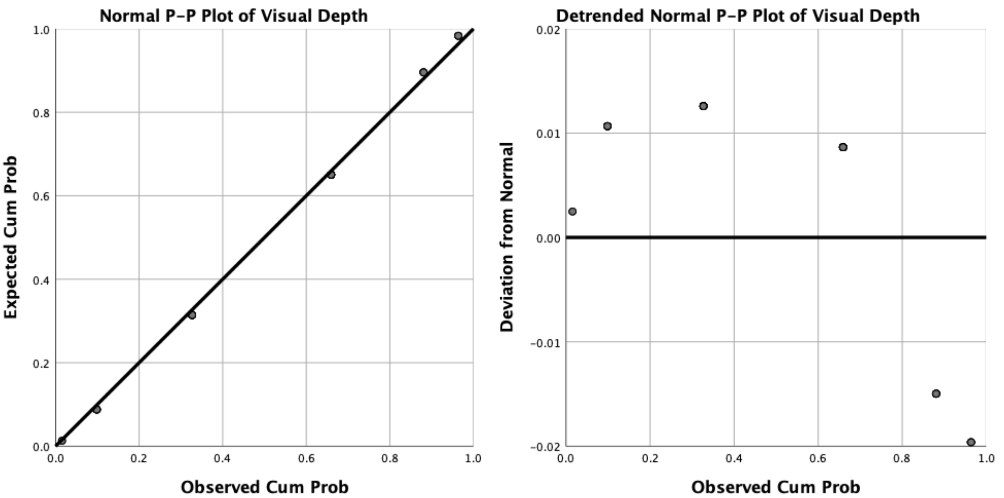




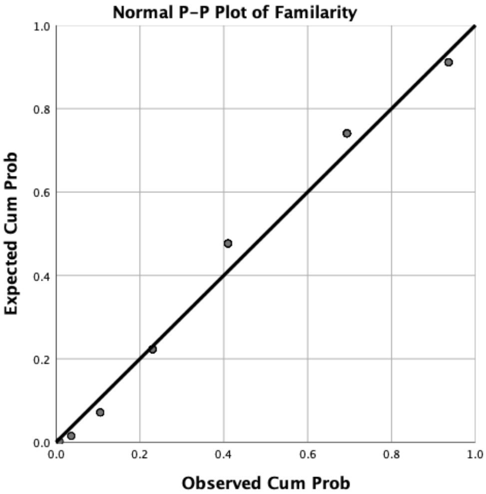
Mystery

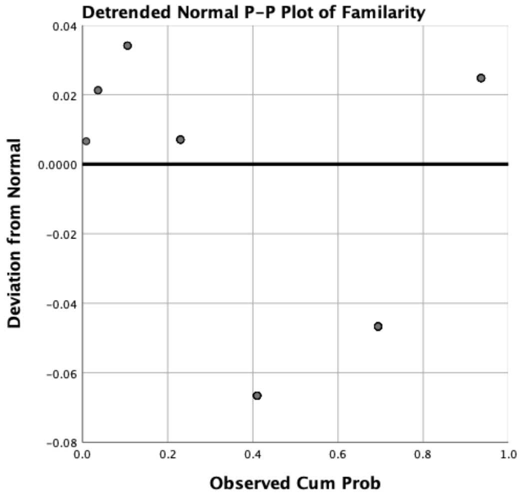


Visual Depth

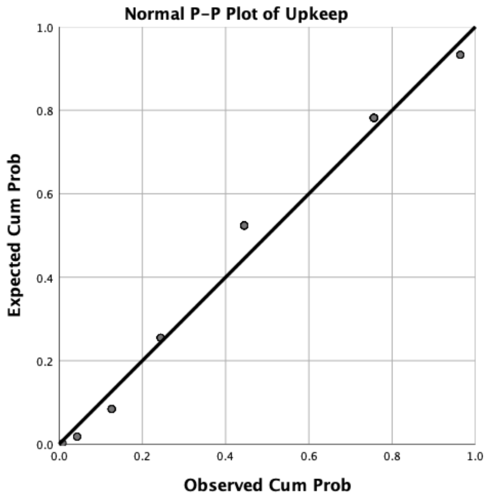


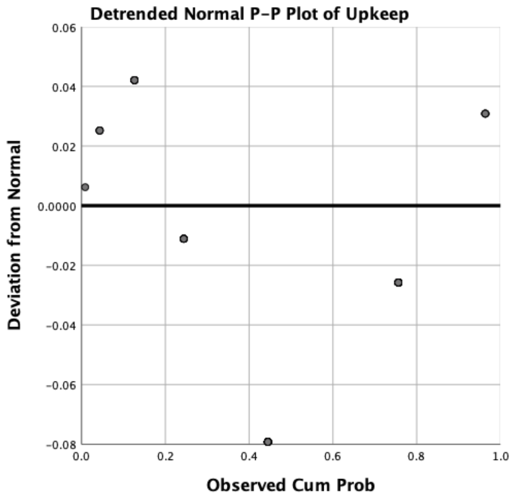
Familiarity



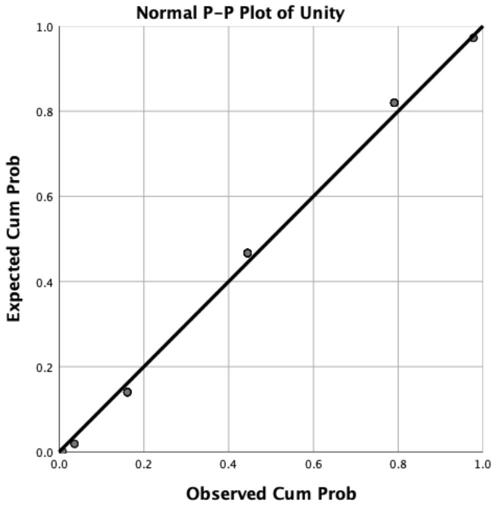


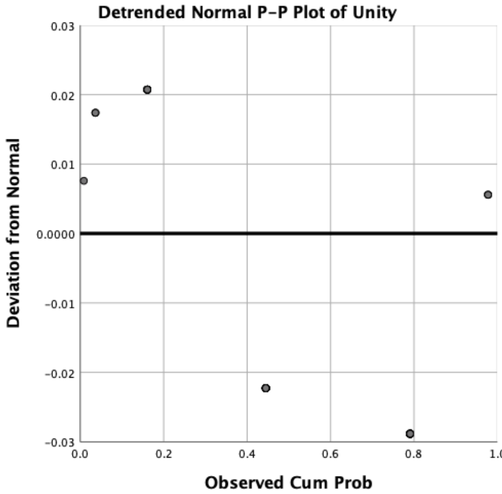
Upkeep



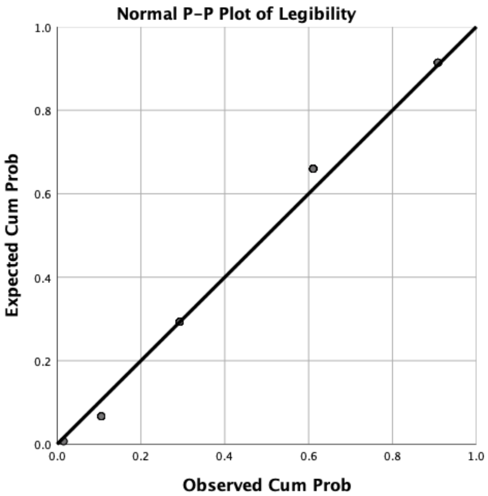


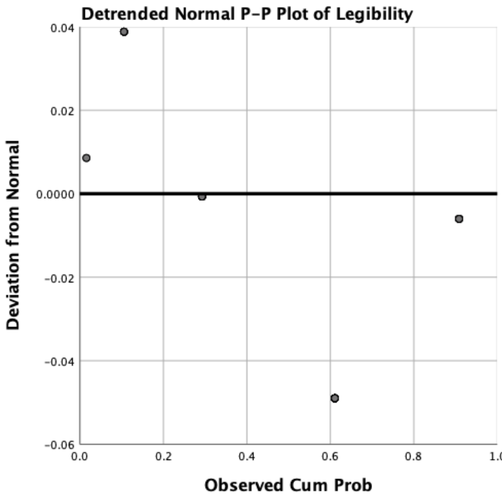
Unity



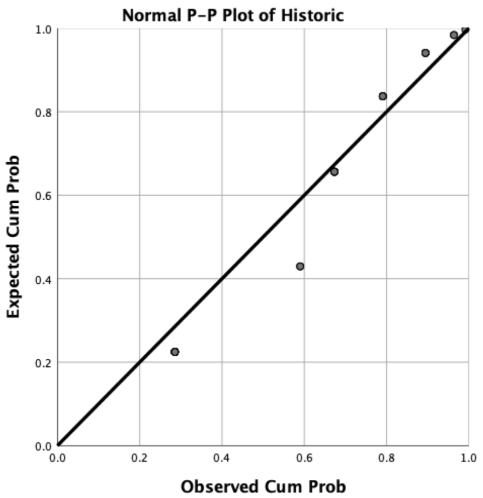


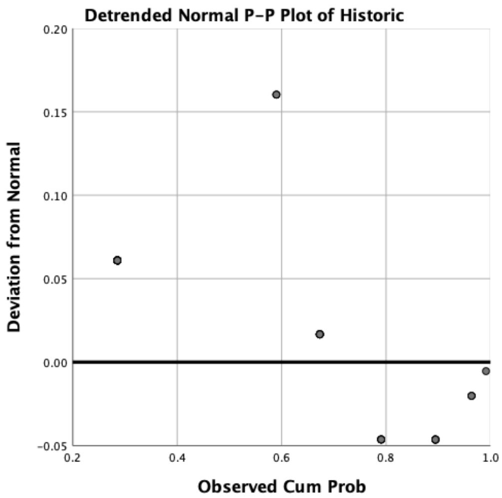
Legibility



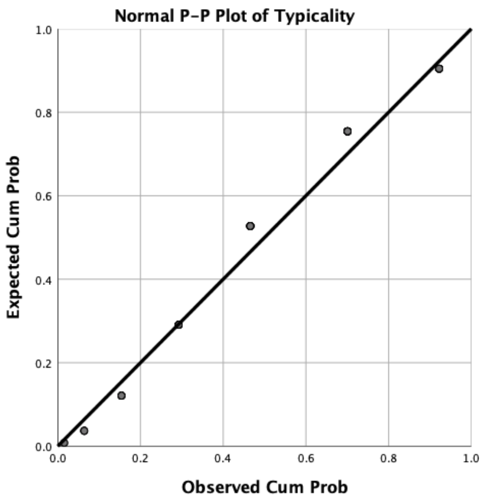


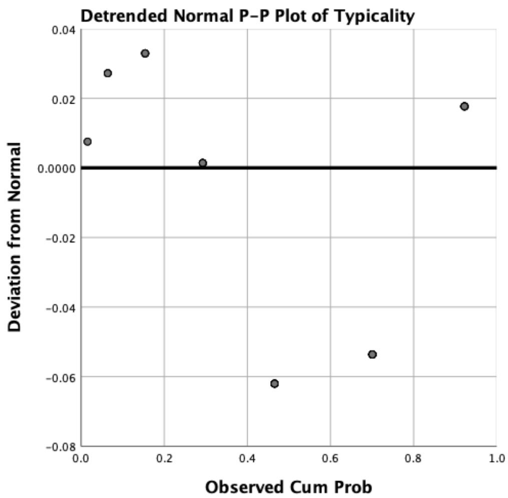
Historic



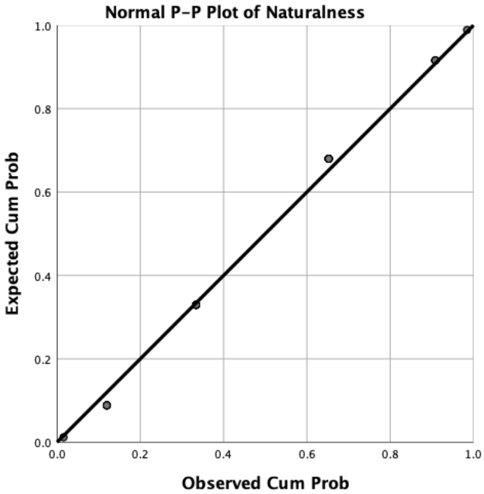


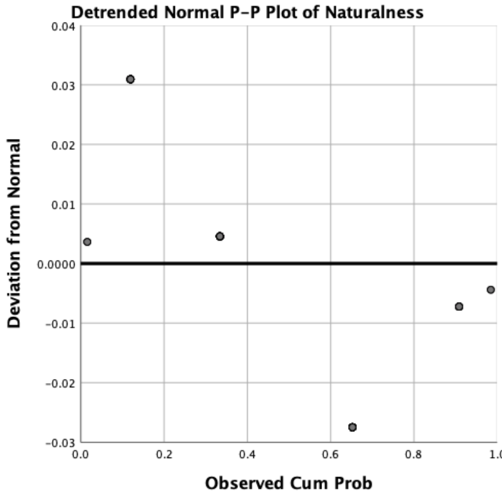
Typicality



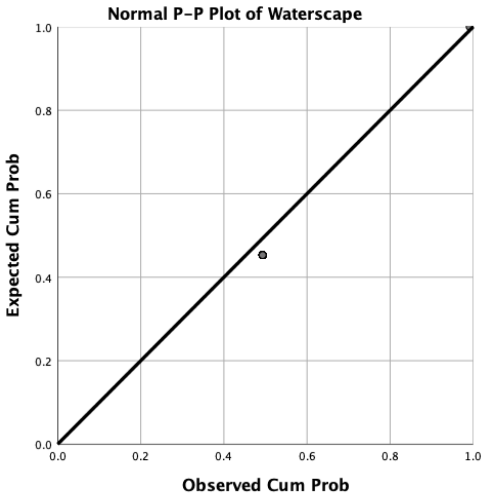


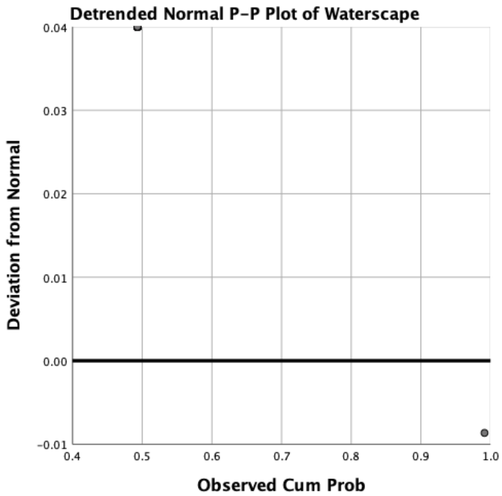
Naturalness



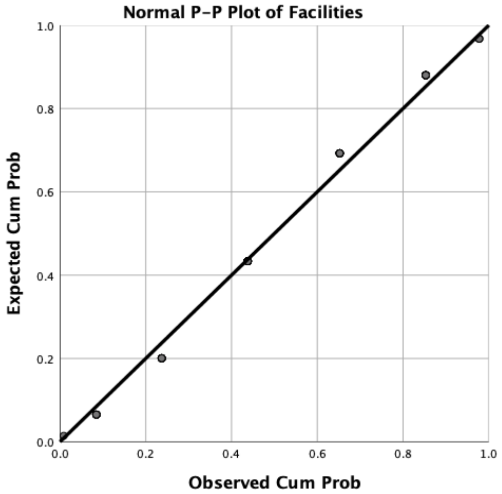


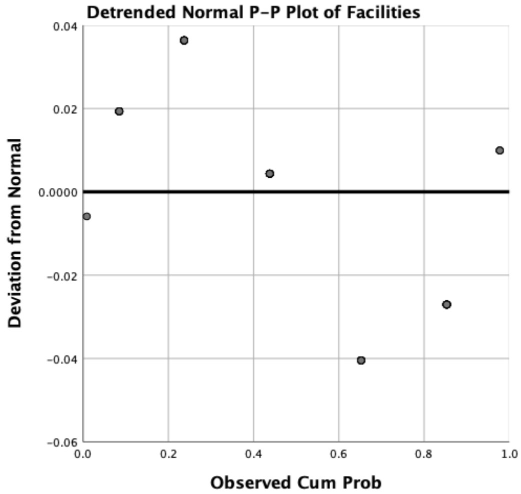
Waterscape



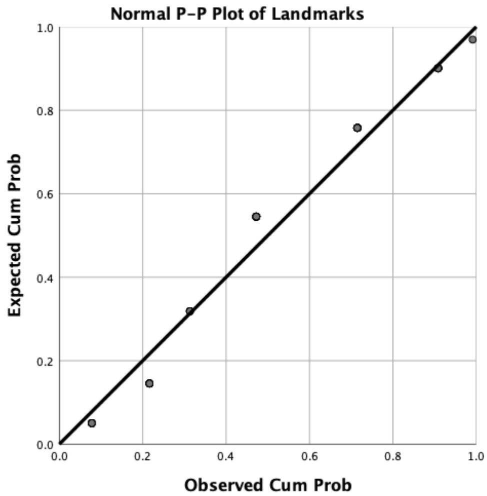


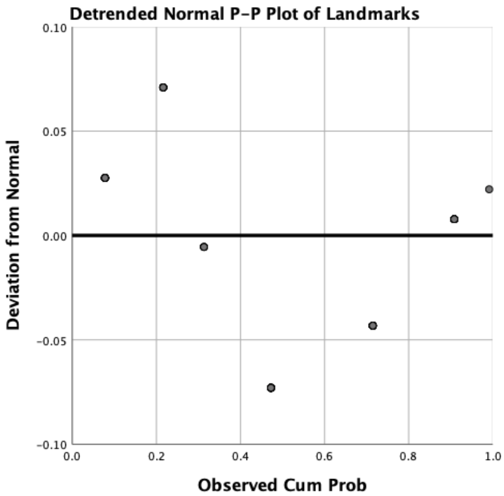
Facilities



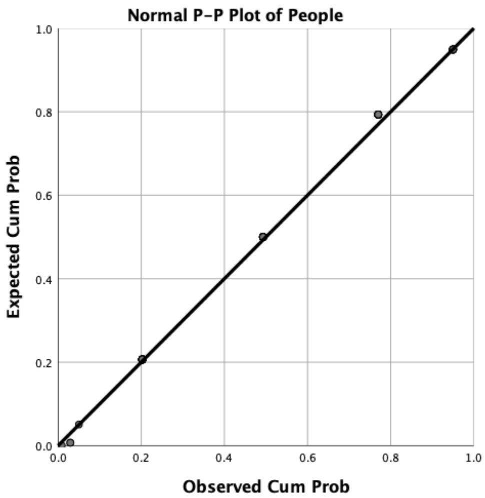


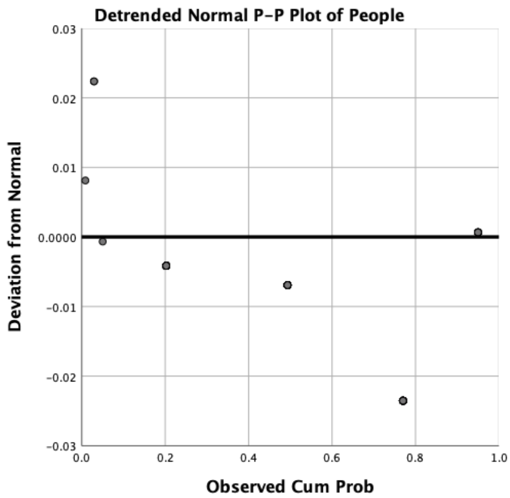
Landmarks



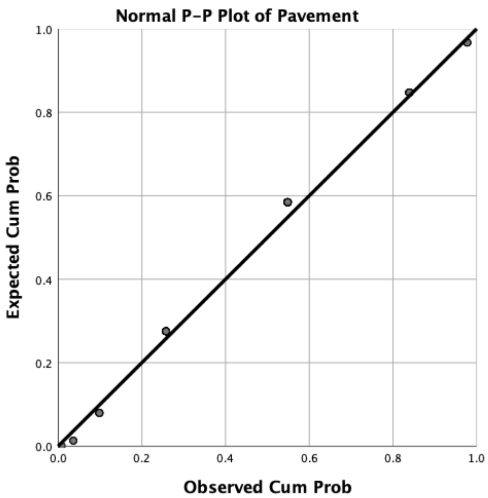


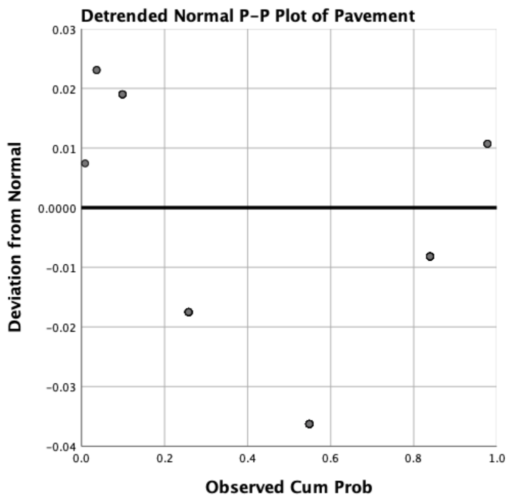
People



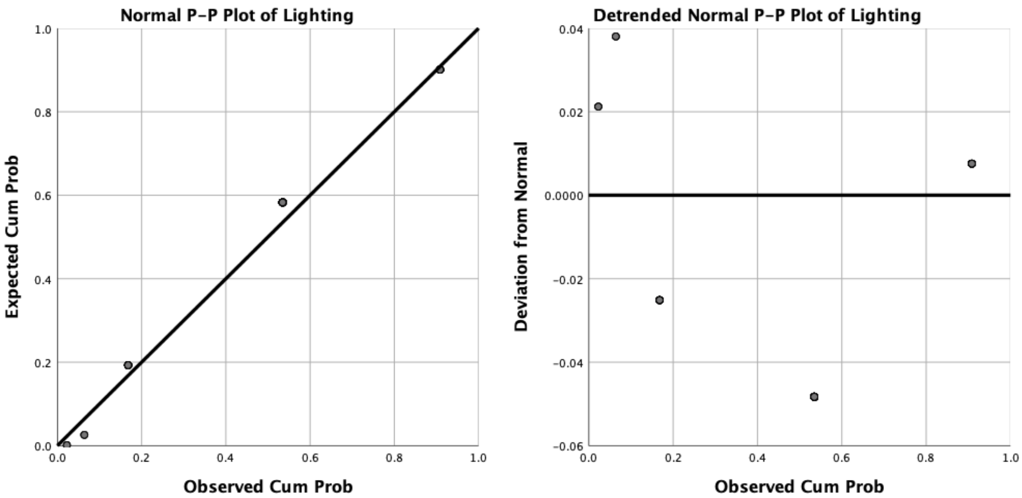


Pavement

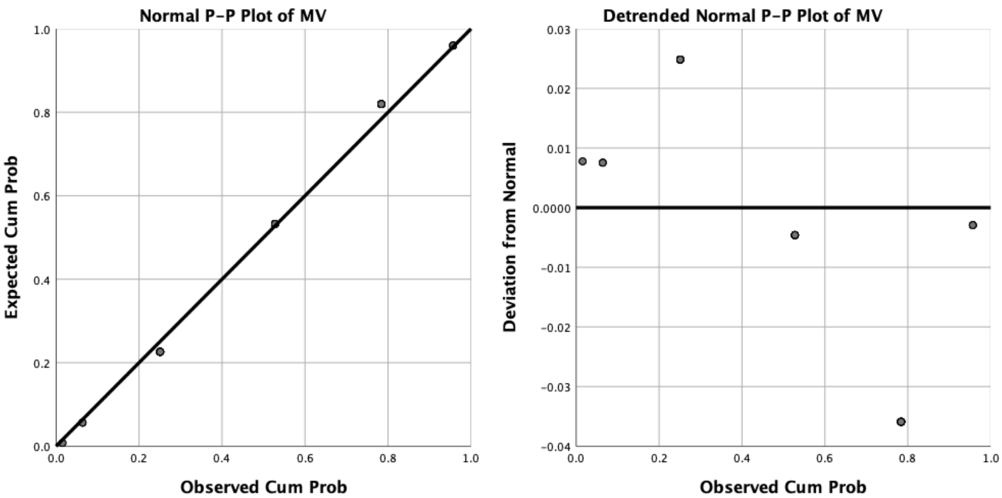




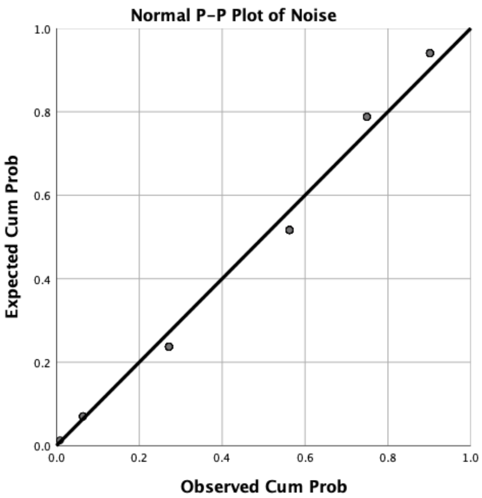
Lighting

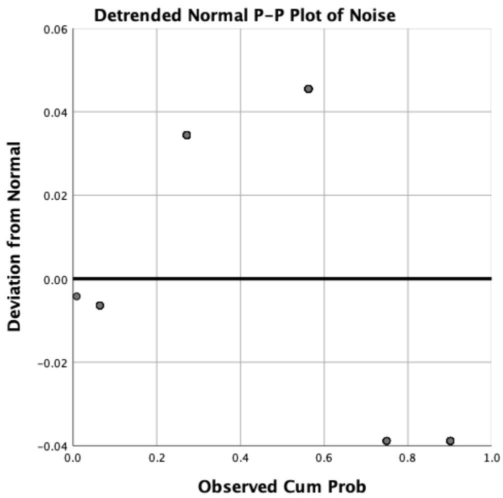

Normal P-P Plot of Lighting
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of Lighting
Deviation from Normal
Observed Cum Prob

MV

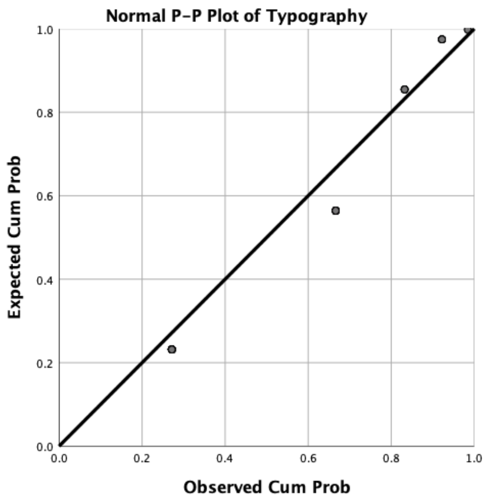

Normal P-P Plot of MV
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of MV
Deviation from Normal
Observed Cum Prob

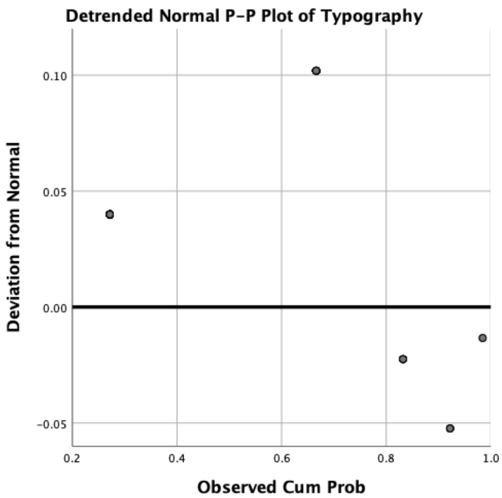
Noise





Typography





Appendix 11 Questionnaire of SRMS and RCS in the formal survey

您好，感谢您参与该项社会调查。这项问卷由三部分组成，第一部分是一个用于测量您对于街道疗愈性感知的的心理学量表；第二部分是一个用于测量您对街道环境质量评价的设计学量表，第三部分将调查关于您个人的一些背景信息。详细介绍将在后续每个部分开始之前加以说明。填写问卷过程中如果您有任何问题，请随时咨询调研人员。我们承诺您提供的所有信息和回答将严格保密。

Hello, many thanks for participating. This questionnaire is composed of three parts. Please start with filling in some of your personal information. The second part is a psychometric scale used to investigate your perceptions on street restorativeness and the last part is a street design model used to understand your assessment on streets. Instructions of the latter two parts will be provided before each part start. If you have any questions during completing the questionnaire, please don't hesitate to contact our surveyors. We promise that all your information and your answers will be kept in anonymous and in confidential.

Part 1 ： 街道感知/*Perceptions of Streets*

我们准备了以下问题帮助我们了解您关于上海街道环境的体验。 请仔细阅读每个下列每一个陈述句的内容，然后回答以下问题：这句话的陈述内容与我的体验相符程度是多少？请在问题后的数字刻度后面的横线上打✔来表明您的答案。页脚给出了关于刻度数字含义的解释以方便您的作答。

To help us understand your experience of Shanghai streets, we have provided the following statements for you to respond to. Please read each statement carefully, then ask yourself, 'How much does this statement apply to my experience here? To indicate your answer, tick on the blanket after the numbers on the scale beside it. A sample of the scale with verbal descriptions for the values is given at the bottom of this page.

这里让你能够暂时忘记工作和日常的生活中的烦恼；

0__1__2__3__4__5__6__

When I am here I feel free from work and daily routine.

这里让你能够暂时忘记他人的要求和期望带来的压力；

0__1__2__3__4__5__6__

When I am here I feel free from other peoples' demand and expectations.

这里让你能够暂时的忘记我所承担的责任与义务。

0__1__2__3__4__5__6__

When I am here I do not need to think of my responsibility and obligations.

这里的所有东西都是互相联系的。

0__1__2__3__4__5__6__

The elements here go together.

这里的所有东西都很好的融入于这里的。

0__1__2__3__4__5__6__

The existing elements belong here.

周围的环境整体上是连贯的。

0__1__2__3__4__5__6__

The surroundings are coherent.

这里有很多你想要探索的东西。

0__1__2__3__4__5__6__

There is plenty to discover here.

这里有很多你感到好奇的东西。

0__1__2__3__4__5__6__

This setting has many things that I wonder about.

这里有很多吸引你的东西。

0__1__2__3__4__5__6__

There are many objects here that attract my attention.

你想要花更长的时间在这里。

0__1__2__3__4__5__6__

There is plenty that I want to linger on here.

你感到深深的沉浸在周围的环境中。

0___1___2___3___4___5___6___

I am absorbed in these surroundings.

这里让你有机会去做我喜欢做的事情。

0___1___2___3___4___5___6___

The environment gives me the opportunity to do activities that I like.

在这里，你能够解决出现的一些问题。

0___1___2___3___4___5___6___

I can handle the kinds of problems that arise here.

你能够很快的适应到周围的环境中。

0___1___2___3___4___5___6___

I rapidly adapt to this setting.

这里对你出行需求的满足程度。

0___1___2___3___4___5___6___

There is an accordance between what I like to do and this environment.

Part 2： 街道评价/*Evaluations of Streets*

我们想知道您对上海街道环境的一些评价，请对下列每一项内容进行打分来告诉我们您的感受。请在问题后的 6 个方格内（0-6 分）打✔来表明您的答案。页脚给出了关于刻度数字含义的解释以方便您的作答。

We are interested in your opinion about the design quality of Shanghai street. Please rate on each predictor suggesting your judgement. To indicate your answer, tick on the box on the left of predictors.

总体偏好程度/Overall Preference – 您对这条街道的喜爱程度。
丰富度/Complexity – 您所在的街道环境中所包含内容的丰富性。 0__1__2__3__4__5__6__ 开阔度/Openness - 您所在的街道环境的在视觉和空间上体现的开阔程度。 0__1__2__3__4__5__6__ 围合感/Enclosure - 您所在街道视觉上体现出的空间感。 0__1__2__3__4__5__6__ 神秘性/Mystery - 您所在的街道环境给您带来的神秘感。 0__1__2__3__4__5__6__ 视觉深度/Visual Depth - 您所在的街道环境的视觉深度。 0__1__2__3__4__5__6__ 熟悉程度/Familiarity - 您对所在的街道环境的熟悉程度。 0__1__2__3__4__5__6__ 维护状态/Upkeep – 您所在的街道环境的维护状况。 0__1__2__3__4__5__6__ 可读性/Legibility – 您所在的街道环境容易被理解的程度。 0__1__2__3__4__5__6__ 典型性/Typicality – 您所在的街道对于它所属于的这一类别街道的代表性 0__1__2__3__4__5__6__ 安静/Quietness - 您所在这个街道环境的安静程度。 0__1__2__3__4__5__6__ 街道设施/Street Facilities - 您所在的街道环境里街道设施的便利程度。 0__1__2__3__4__5__6__ 日间采光/Light - 您所在的街道环境里光线是否充足。 0__1__2__3__4__5__6__ 沿街界面/Frontages - 您所在的街道两侧沿街界面的吸引力。 0__1__2__3__4__5__6__

地标/Landmarks - 您所在的街道环境里标志物的数量。 -3___-2___-1___0___1___2___3___ 自然性/Naturalness -您所在街道中自然元素的数量。 -3___-2___-1___0___1___2___3___ 历史性/Historic - 您在街道环境中历史建筑的数量。 -3___-2___-1___0___1___2___3___ 他人活动/Human Activities - 您所在的街道环境里他人活动的密集程度 -3___-2___-1___0___1___2___3___ 交通量/Traffic Volume - 您所在的街道环境里车辆活动的密集程度。 -3___-2___-1___0___1___2___3___ 地势变化/Typographic Variation - 您所在的街道环境里地势变化的数量 -3___-2__-1___0___1___2___3___
请写下其他有助于帮助您恢复疲劳的街道元素/Please write other elements that might help with your restoration：

Part 3：基本信息/*Background Information*

1. 性别/*Gender:* （） 男/*Male* （）女/ *Female*
2. 年龄/*Age:* （）26-35 周岁 （） 36-45 周岁 （）46-55 周岁
3. 教育背景/*Education Background:* （）本科以下（）本科（）硕士（）硕士以上
4. 职业相关性/*Professional Background：*

( )您曾经学习过或曾经有过城市规划、城市设计、景观、建筑等相关领域的工作经验。

（）您从未学习过或曾经有过城市规划、城市设计、景观、建筑等相关领域的工作经验。

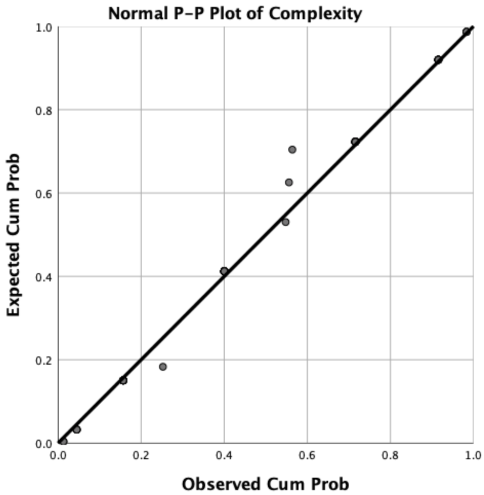
5. 收入水平（ 月）/*Income (per month)：*

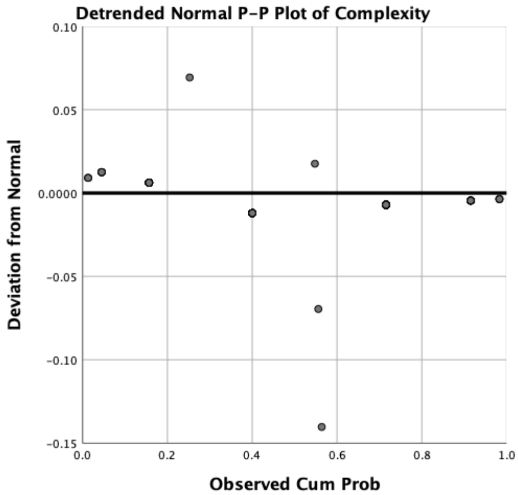
（）10k 以下 （）10-15k （）15-20k （）20-30k （）30k 以上

再次感谢您的参与！Thanks again for your participation!

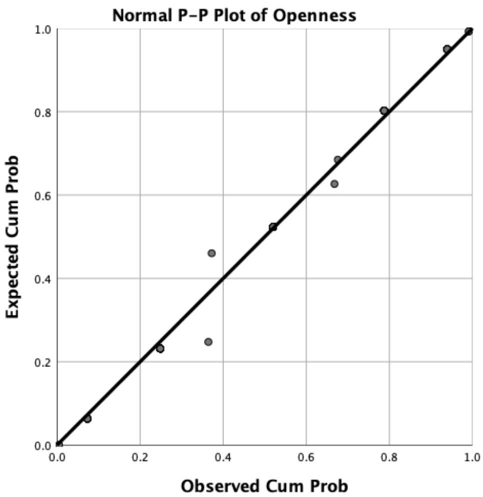
Appendix 12 PP-Plot of SRMS results in the formal survey

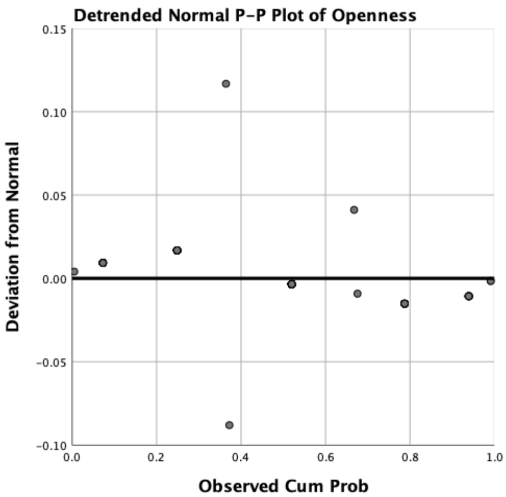
Complexity



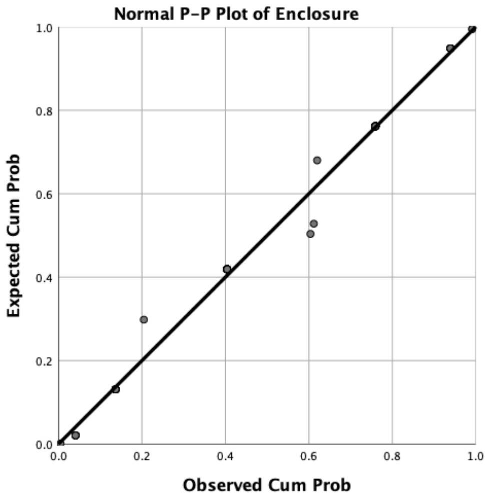


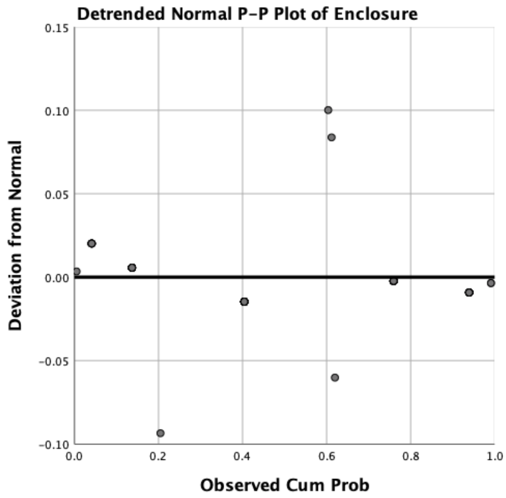
Openness



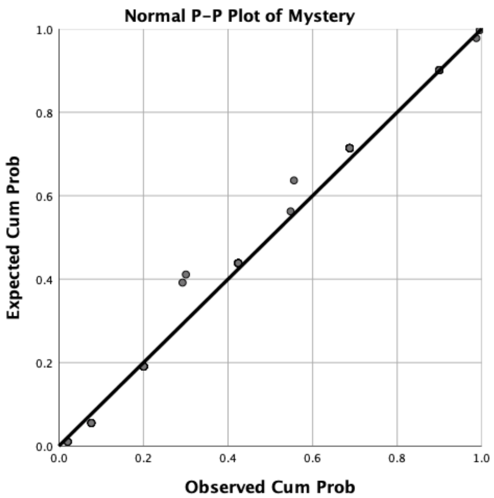


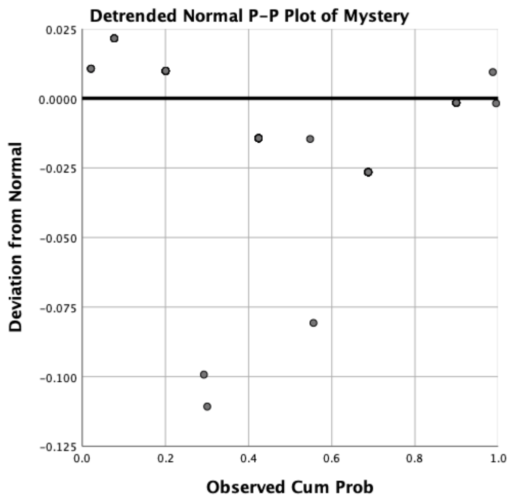
Enclosure



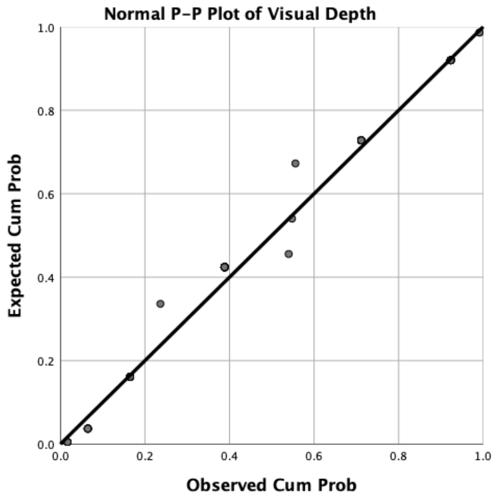


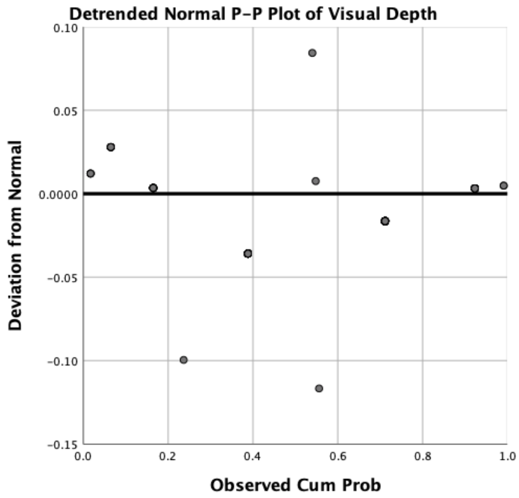
Mystery



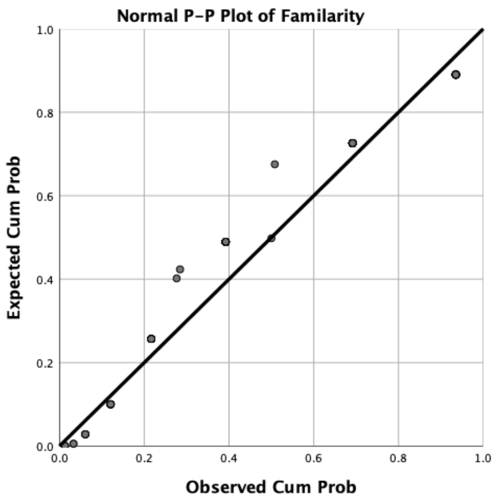


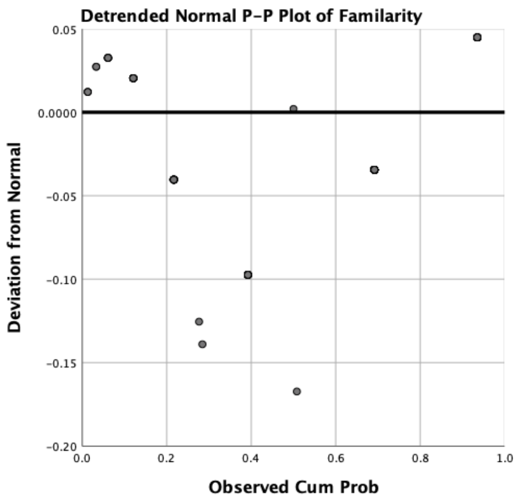
Visual Depth



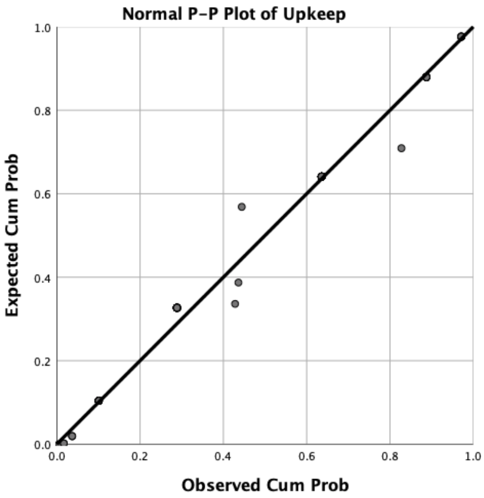


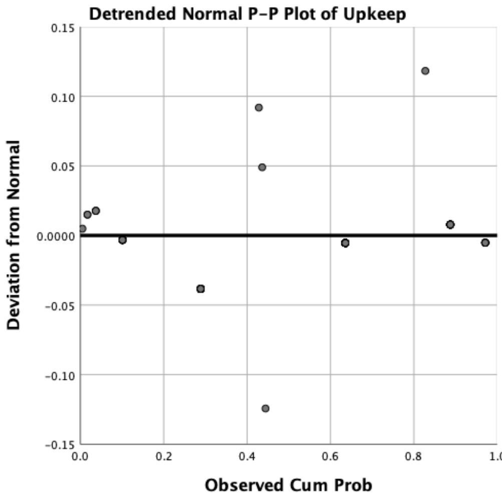
Familarity



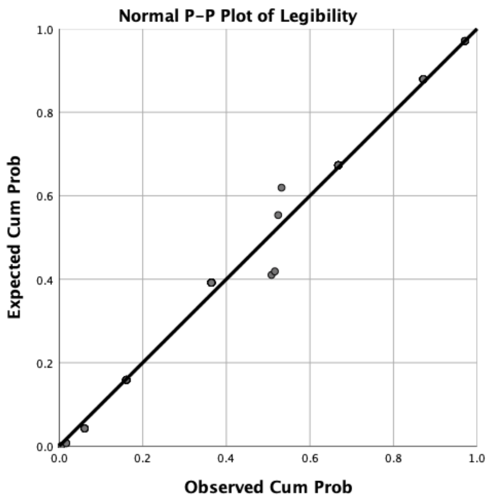


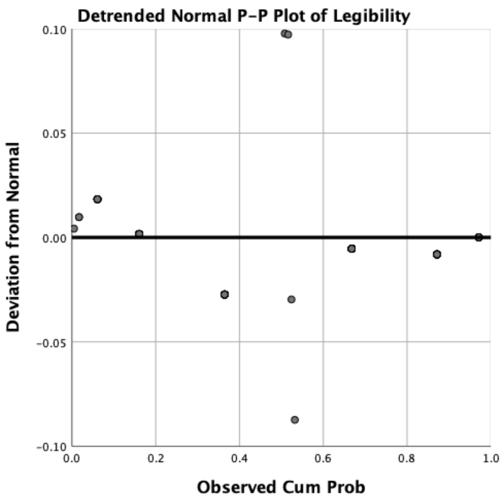
Upkeep



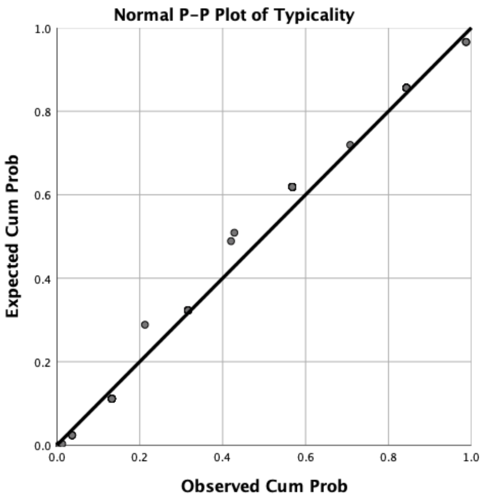


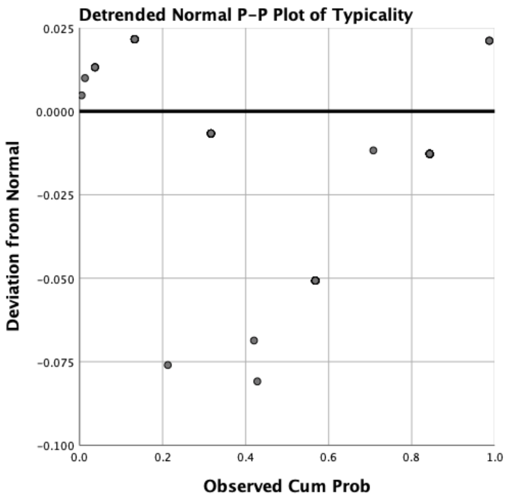
Legibility



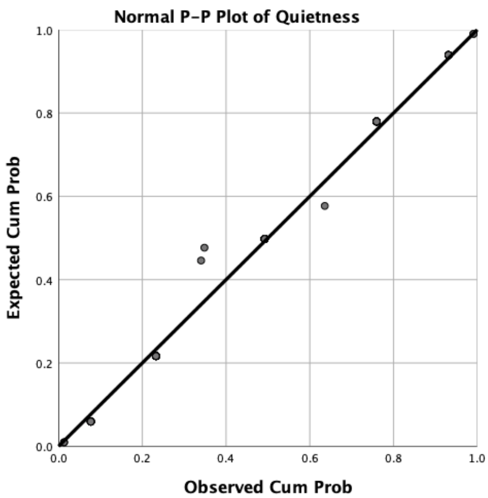


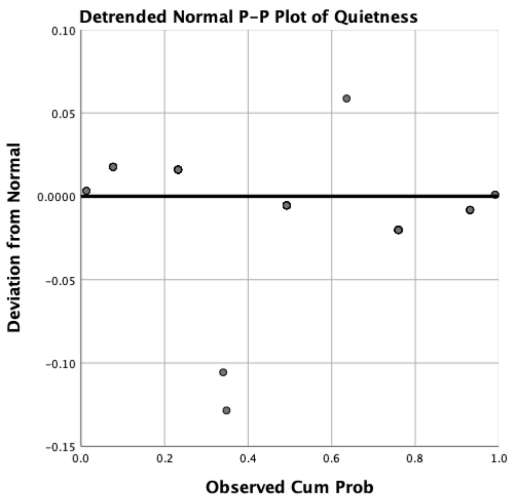
Typicality



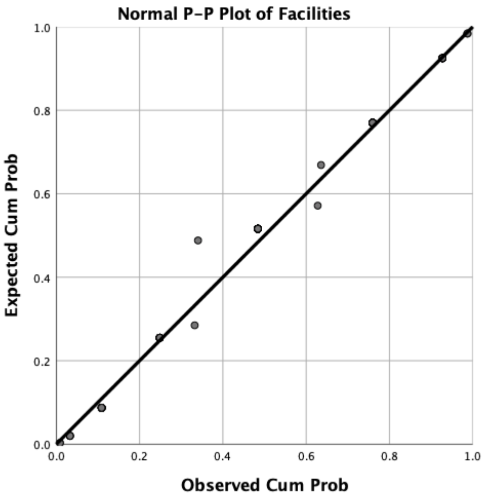


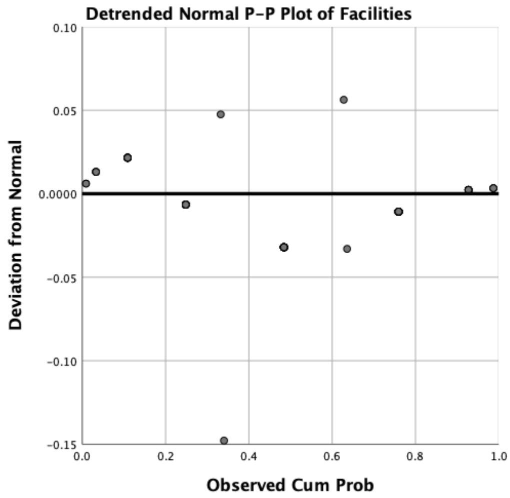
Quietness



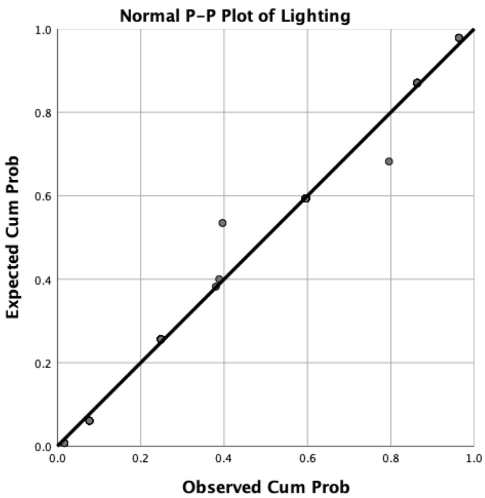


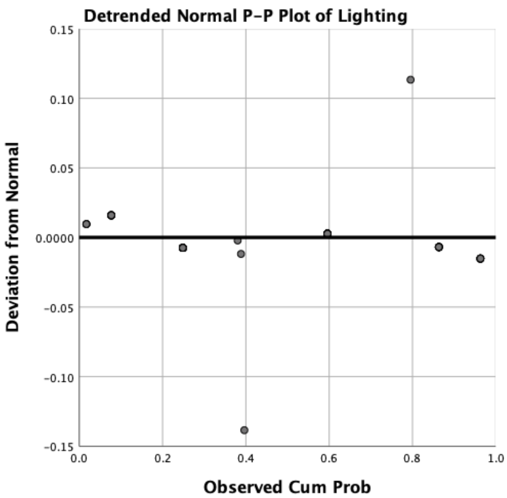
Facilities



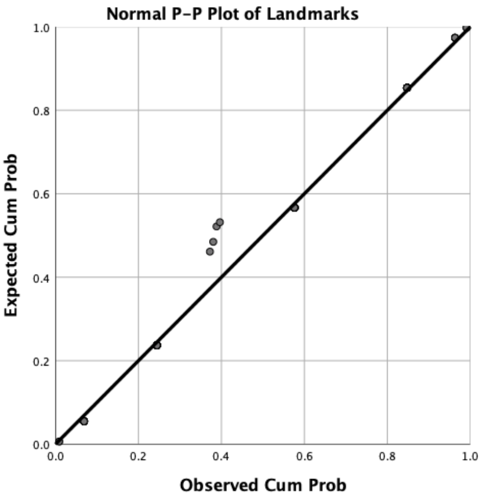


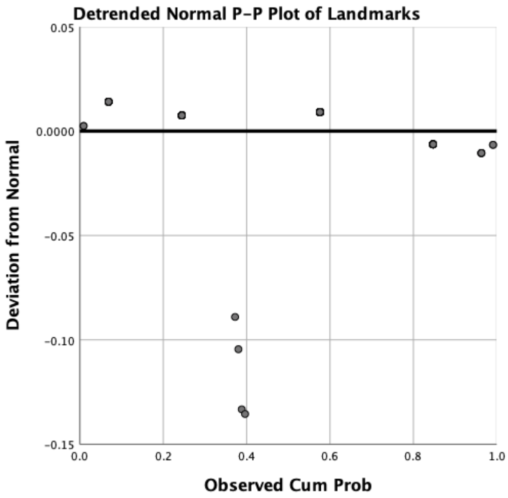
Lighting



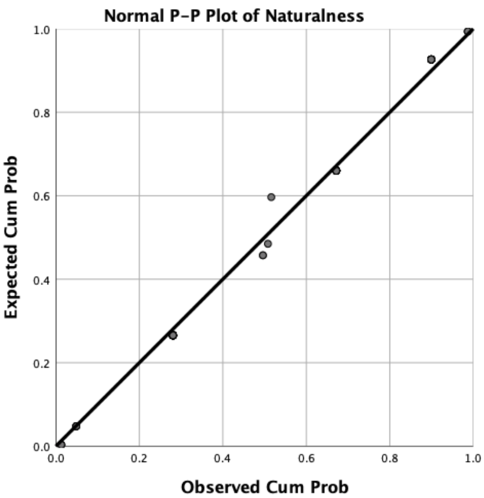


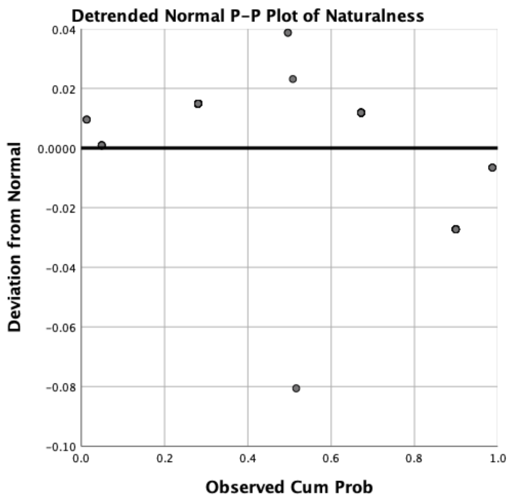
Landmarks



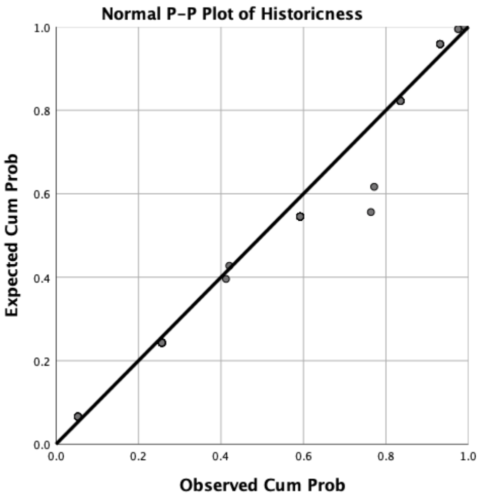


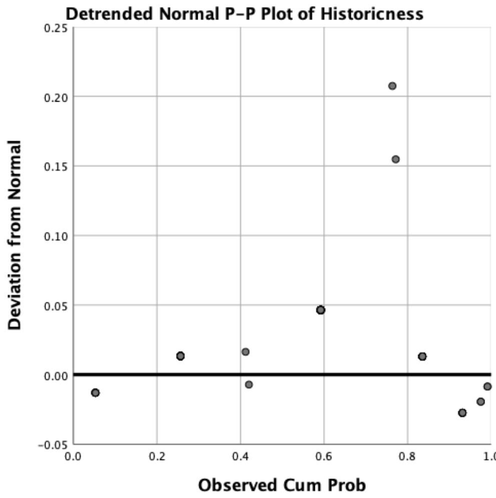
Naturalness



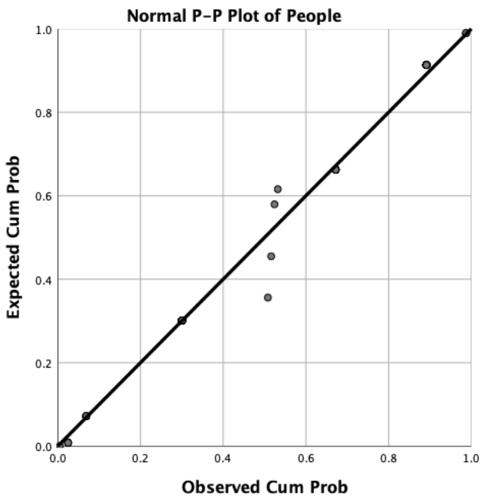


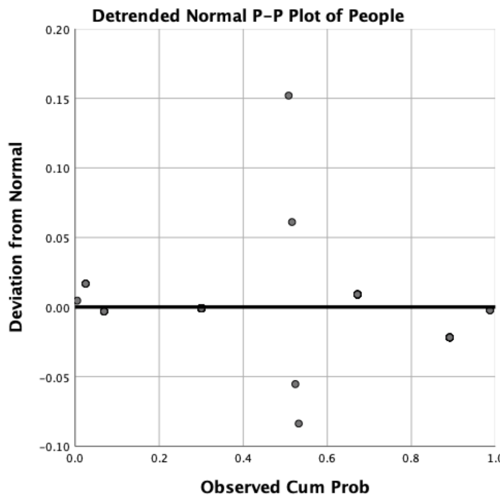
Historicness



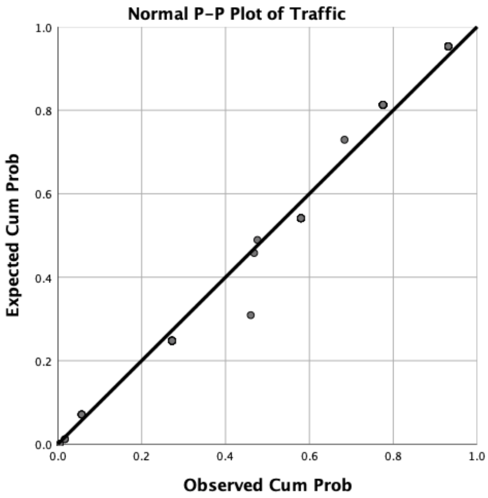


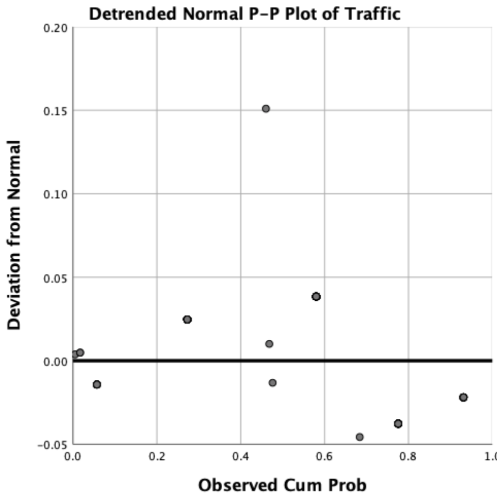
People



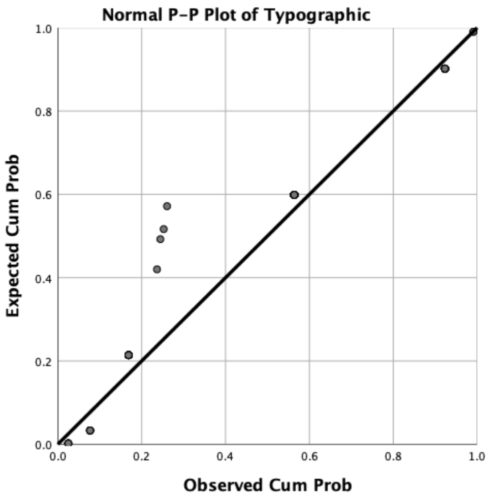


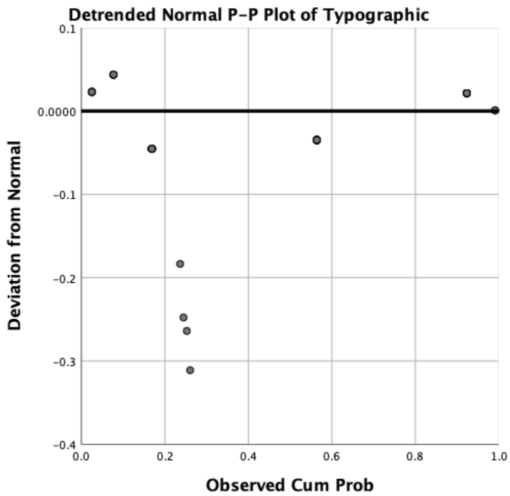
Traffic





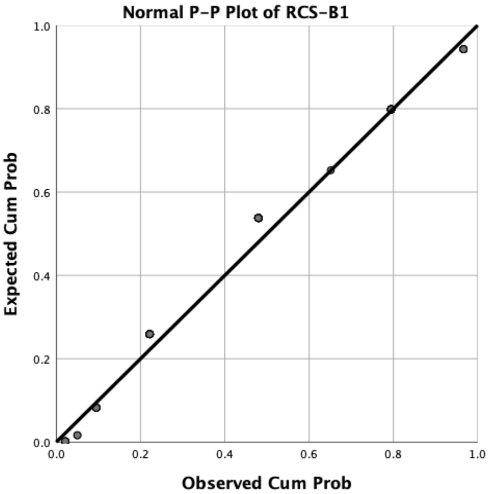
Typographic

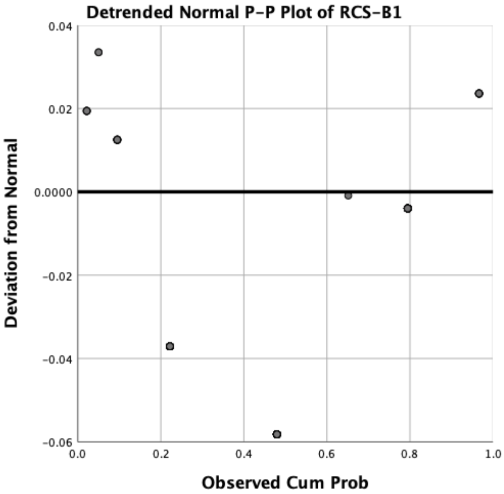




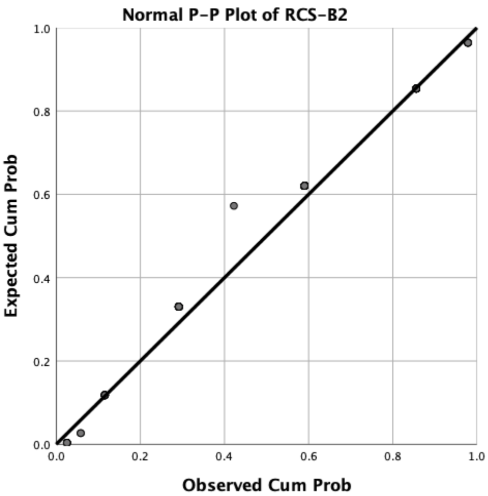
Appendix 13 PP-Plot of RCS results in the formal survey

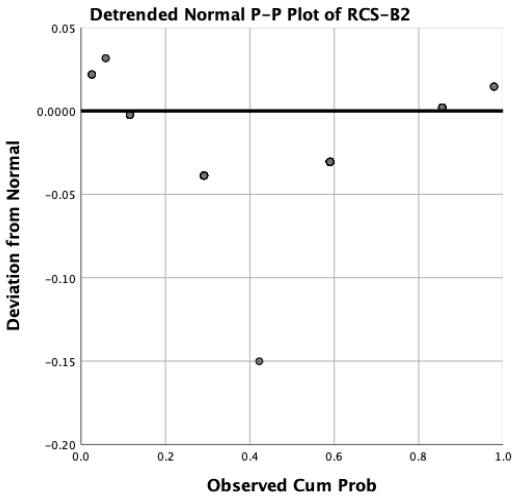
RCS-B1



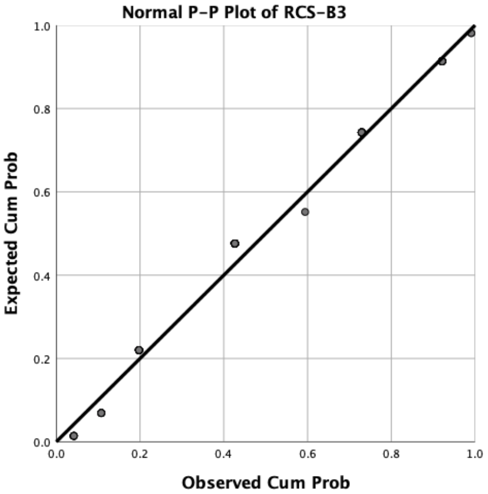


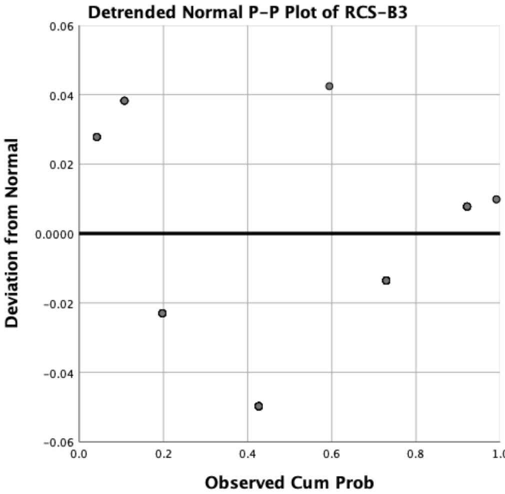
RCS-B2



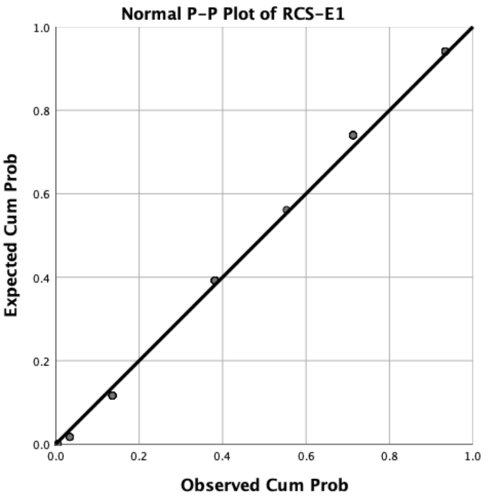


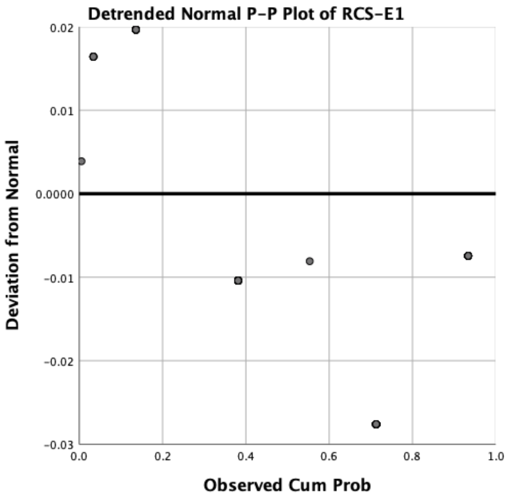
RCS-B3


Normal P-P Plot of RCS-B3
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

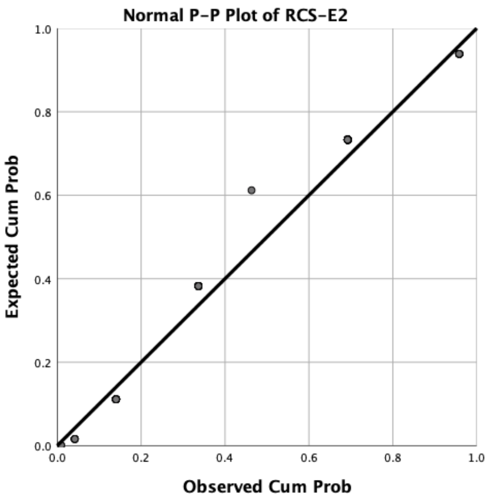

Detrended Normal P-P Plot of RCS-B3
Deviation from Normal
Observed Cum Prob
0.06
0.04
0.02
0.0000
−0.02
−0.04
−0.06
0.0
0.2
0.4
0.6
0.8
1.0

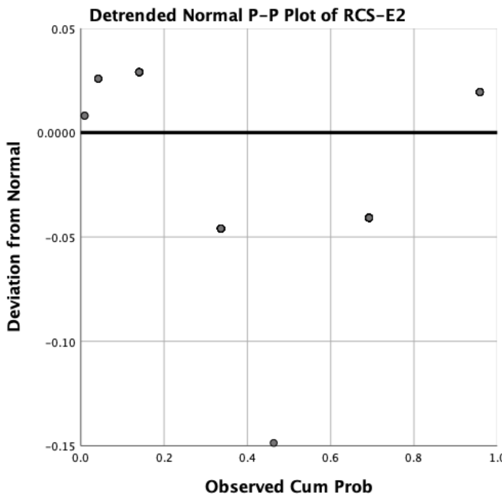
RCS-E1


Normal P-P Plot of RCS-E1
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

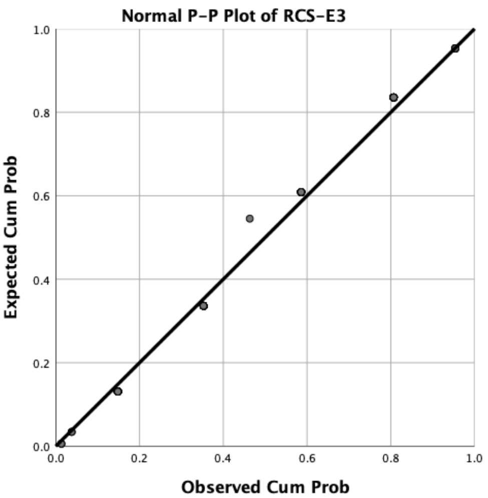

Detrended Normal P-P Plot of RCS-E1
Deviation from Normal
Observed Cum Prob
0.02
0.01
0.0000
−0.01
−0.02
−0.03
0.0
0.2
0.4
0.6
0.8
1.0

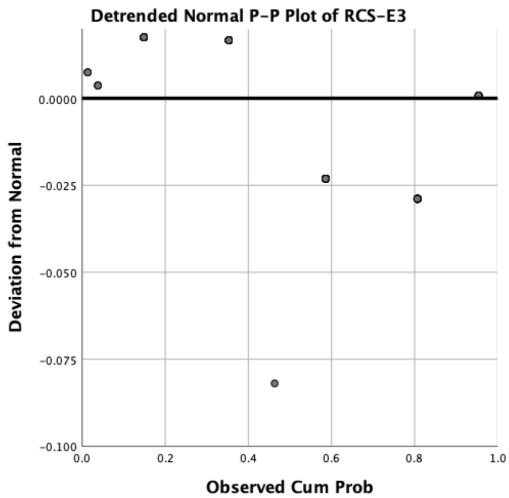
RCS-E2


Normal P-P Plot of RCS-E2
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0

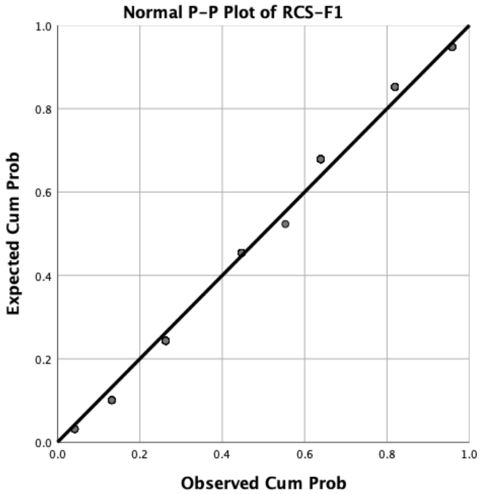

Detrended Normal P-P Plot of RCS-E2
Deviation from Normal
Observed Cum Prob
0.05
0.0000
-0.05
-0.10
-0.15

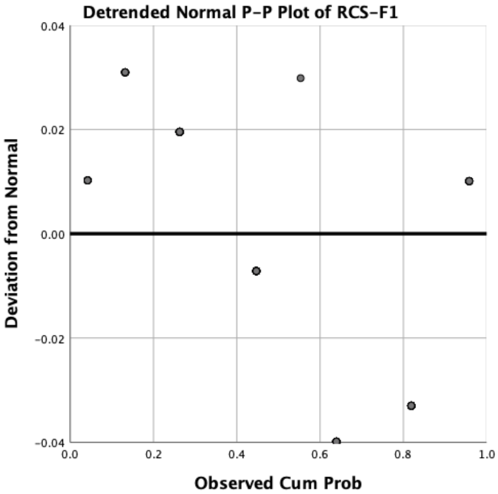
RCS-E3


Normal P-P Plot of RCS-E3
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0

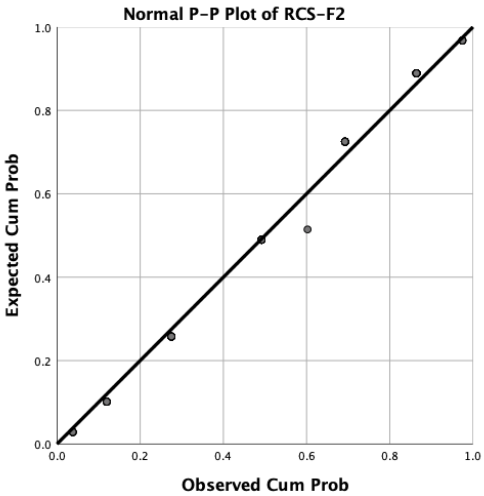

Detrended Normal P-P Plot of RCS-E3
Deviation from Normal
Observed Cum Prob
0.0000
-0.025
-0.050
-0.075
-0.100

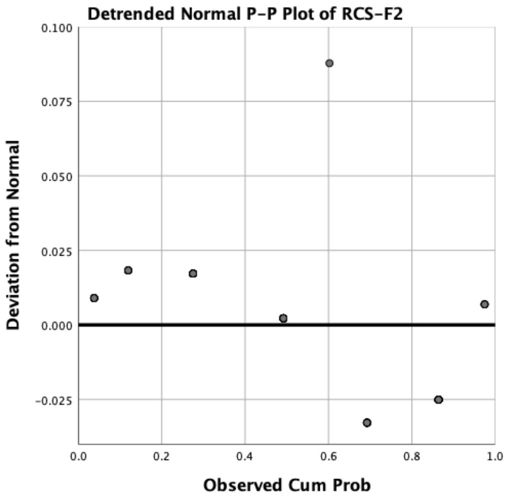
RCS-F1


Normal P-P Plot of RCS-F1
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

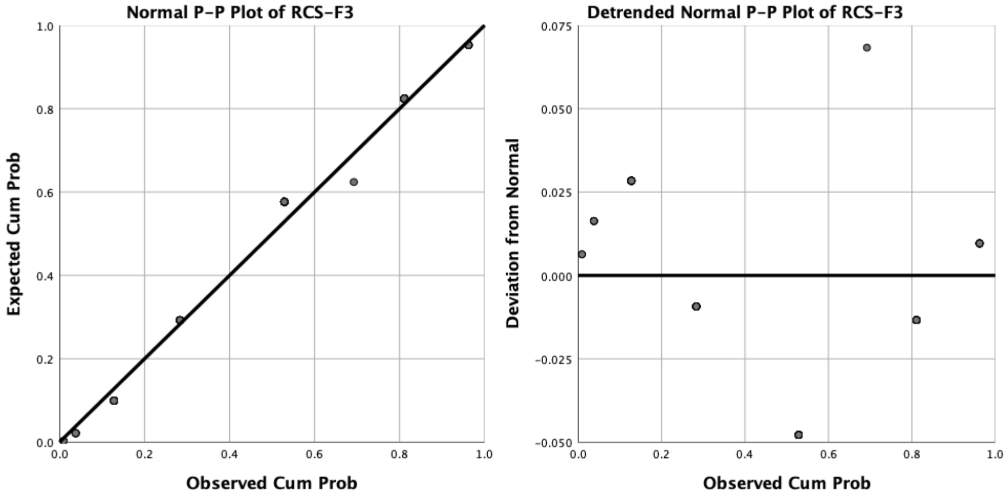

Detrended Normal P-P Plot of RCS-F1
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.00
-0.02
-0.04
0.0
0.2
0.4
0.6
0.8
1.0

RCS-F2

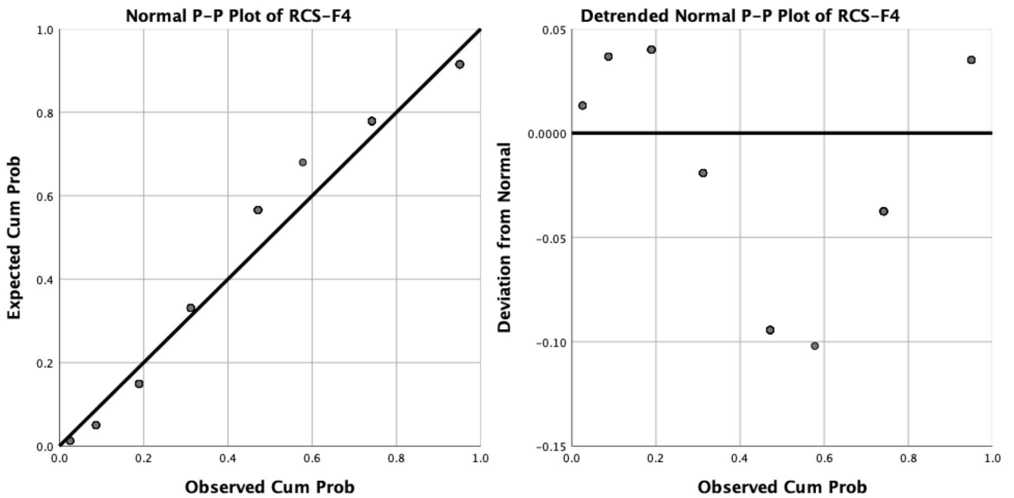

Normal P-P Plot of RCS-F2
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of RCS-F2
Deviation from Normal
Observed Cum Prob
0.100
0.075
0.050
0.025
0.000
-0.025
0.0
0.2
0.4
0.6
0.8
1.0

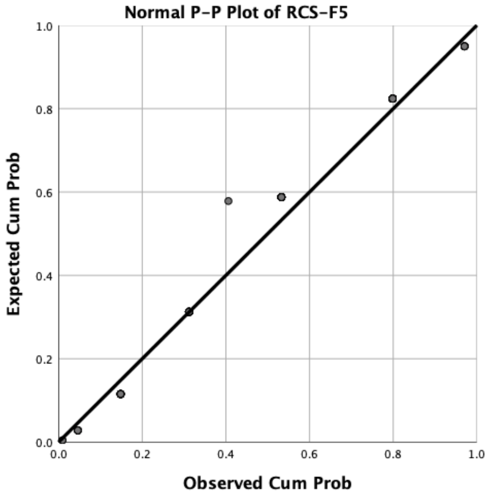
RCS-F3

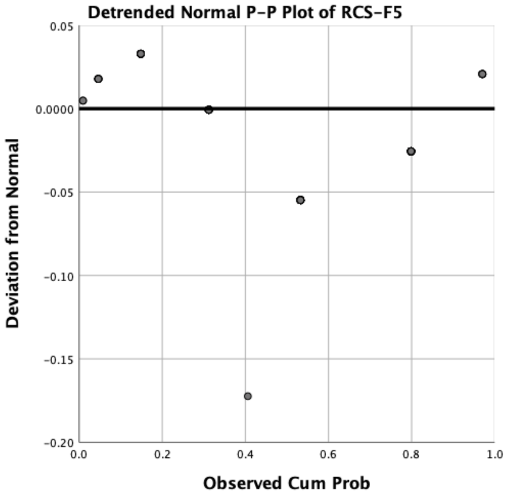

Normal P-P Plot of RCS-F3
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of RCS-F3
Deviation from Normal
Observed Cum Prob

RCS-F4

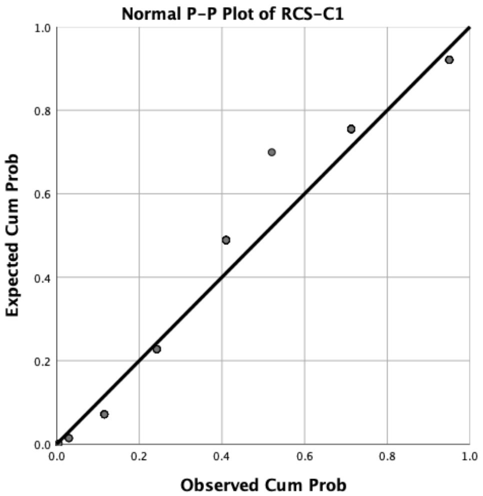

Normal P-P Plot of RCS-F4
Expected Cum Prob
Observed Cum Prob
Detrended Normal P-P Plot of RCS-F4
Deviation from Normal
Observed Cum Prob

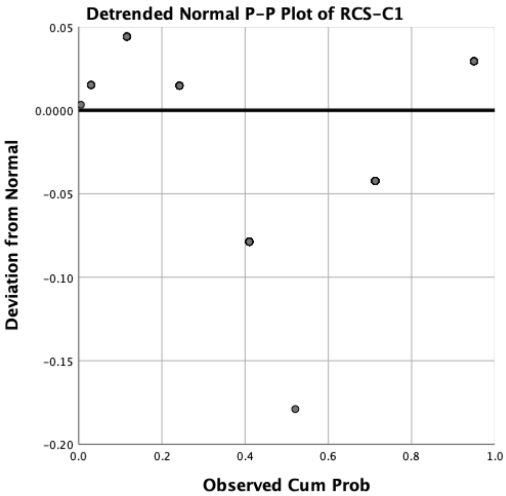
RCS-F5


Normal P-P Plot of RCS-F5
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

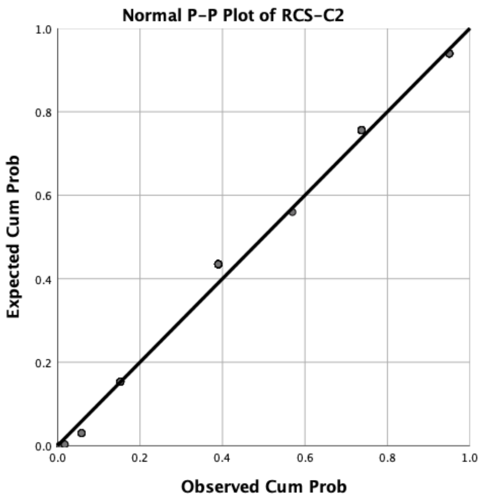

Detrended Normal P-P Plot of RCS-F5
Deviation from Normal
Observed Cum Prob
0.05
0.0000
−0.05
−0.10
−0.15
−0.20
0.0
0.2
0.4
0.6
0.8
1.0

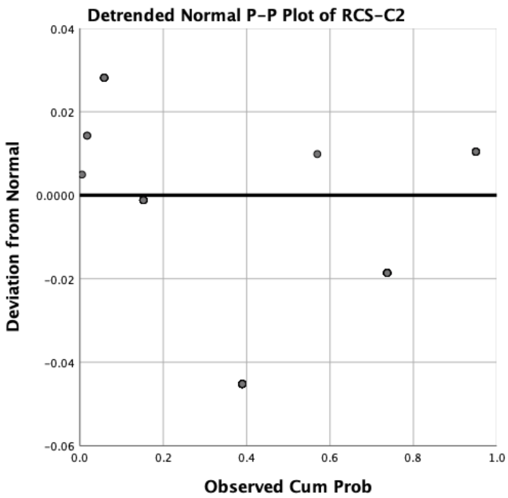
RCS-C1


Normal P-P Plot of RCS-C1
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

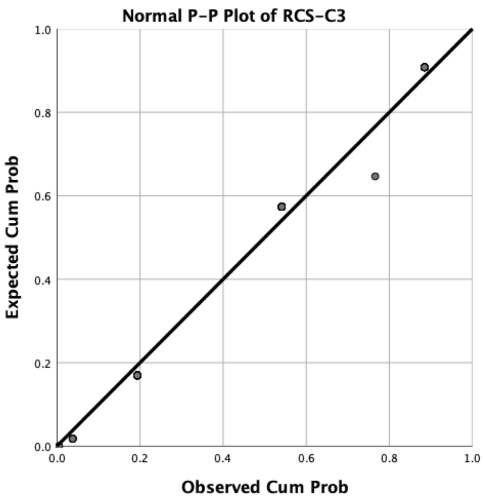

Detrended Normal P-P Plot of RCS-C1
Deviation from Normal
Observed Cum Prob
0.05
0.0000
−0.05
−0.10
−0.15
−0.20
0.0
0.2
0.4
0.6
0.8
1.0

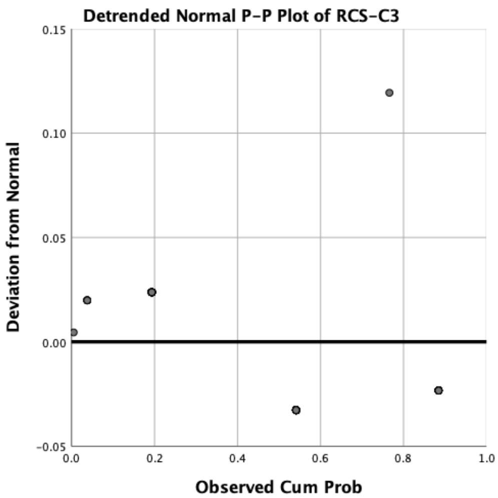
RCS-C2


Normal P-P Plot of RCS-C2
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0

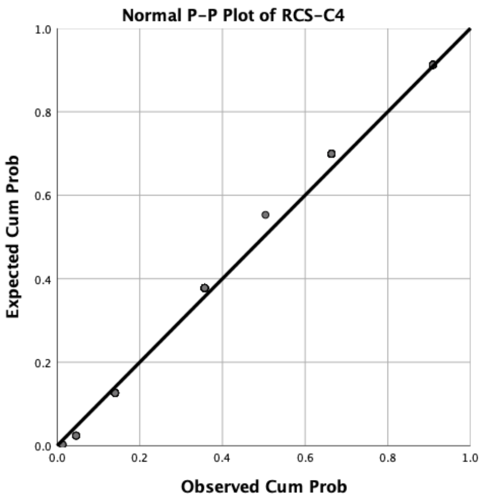

Detrended Normal P-P Plot of RCS-C2
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
−0.02
−0.04
−0.06
0.0
0.2
0.4
0.6
0.8
1.0

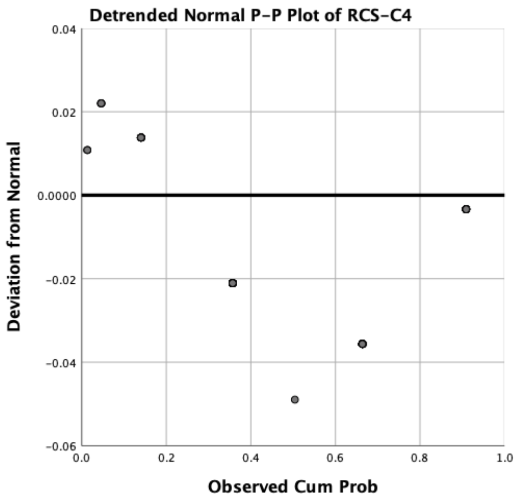
RCS-C3


Normal P-P Plot of RCS-C3
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of RCS-C3
Deviation from Normal
Observed Cum Prob
0.15
0.10
0.05
0.00
−0.05
0.0
0.2
0.4
0.6
0.8
1.0

RCS-C4


Normal P-P Plot of RCS-C4
Expected Cum Prob
Observed Cum Prob
0.0
0.2
0.4
0.6
0.8
1.0


Detrended Normal P-P Plot of RCS-C4
Deviation from Normal
Observed Cum Prob
0.04
0.02
0.0000
−0.02
−0.04
−0.06
0.0
0.2
0.4
0.6
0.8
1.0