Health Promoting Qualities Framework for Blue and Green Landscapes: Applying Perceived Restorativeness on a Case Study of Nile Riverfront in Greater Cairo Region

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Health Promoting Qualities Framework for Blue and Green Landscapes: Applying Perceived Restorativeness on a Case Study of Nile Riverfront in Greater Cairo Region

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Abstract- **Blue and green landscapes contribute to the quality of life of cities in different positive ways. It has environmental, social, and visual benefits that affect directly the physical and psychological health of city residents in one way or another, in addition to providing ecological benefits for their surroundings. There are plenty of previous studies that investigated the different health characteristics of blue and green spaces. However, there is still a need for more interdisciplinary studies to measure the long-term effect of blue and green landscapes together on the health of their users. Therefore, the presented study aims to investigate and measure the direct impact of blue and green landscapes on the health and wellbeing using Perceived sensory dimensions (PSDs) and perceived restorativeness scales (PRS). The research adopts both qualitative and quantitative analysis as a methodological approach. It follows a methodology that consists of three parts. First a critical review of relevant literature focusing on different theories related to health qualities of landscapes. Then the second part is identifying different health-promoting aspects and qualities of waterfront green areas. Finally, investigating the concluded qualities empirically and their impact on the health of its users using a case study research design for selected areas on the riverfront of the Nile in Greater Cairo Region (GCR). Accordingly, the study develops a framework to adopt and assess the health benefits of riverfront green areas. The work points out the potential of blue and green landscapes for achieving restorative qualities and enhancing health of residents in contemporary cities.**

Keywords: **Blue and green landscapes; Riverfront; Perceived Restrictiveness Scale; Perceived Sensory Dimensions; Attention Restoration Theory; Supportive Environment Theory**.

I. INTRODUCTION

Nowadays more than 50 % of the population live in cities and by the year 2050, it is expected that it will be 70% of population [1]. Compared to rural areas; urban city areas are known with its negative impact on mental health issues due to the different existing stressors which leads to anxiety, depression, stress and various mental health disorders. Around 970 million people suffer from mental disorders around the world, and 13 million cases approximately in Egypt [2]. Fig. 1 shows the distribution for the global population affected by mental health disorders and. This is considered a major challenge for public health the world faces this century due to its major physical and psychological risks.
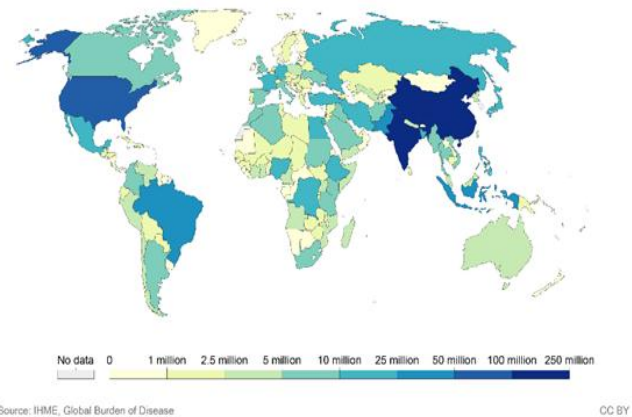

Figure 1: Distribution of population affected by mental health issues in 2019 [2].

One of the major potential responses to mental health issues and stress problems is being exposed to nature. It reduces people exposure to stress factors and is proven to be a stress relief factor. Moreover, it might enhance the psychological health of different city residents. Integrating nature in the urban structure of cities is presented in enhancing blue and green landscape usage and awareness. This includes enhancing the quality of different blue and green landscapes, such as waterfronts, parks, and green areas, guarantees the encouragement of healthy behavior [3]. Also it will boost the quality of life for megacities, which already face major challenges related to environmental health like air pollution, water pollution, climate change, and stressful lifestyle; which has been widely proven to increase the incidence of chronic diseases [4]–[6]. Previous studies investigated the different characteristics of blue and green spaces, especially the ones that are related to psychological health. However, there is still a need for more interdisciplinary studies to measure the long-term effect of blue and green landscapes together on the health of their users[7]–[9].

The main objective of the presented study is to investigate the impact of blue and green urban areas as natural environments on the health and wellbeing of people in megacities. The research investigates the restorative and health qualities of nature, and how it is perceived by different users, as well as investigating its restorative impact on city

residents. In order to achieve the mentioned objective, the research followed a mixed-method approach combining both qualitative and quantitative techniques, correlating landscape design elements and characteristics of waterfront areas with the health qualities of blue and green landscapes. In addition to measuring health and restorative potential of selected cases representing rich green waterfront areas in Greater Cairo Region (GCR). Fig. 2 illustrates the research structure and contents, showing the main reviewed theories, the tools and measures, and the contribution of the presented study.

The presented study answers two main research questions, namely; RQ (1) what are the main dimensions and attributes for healthy landscapes? RQ (2) to what extent do green riverfronts promote health qualities? Accordingly, the paper encompasses three main parts in addition to this introduction and the conclusion. Part one presents a concise review of selected literature, introducing different theories related to healthy landscape design and the restorative benefits of nature. Moreover, it recalls and represents the different elements used in landscape design in order to investigate their relationship to the health qualities of blue and green landscapes.

Part two presents an exploratory investigation for identifying the restorative potential of blue and green spaces by adopting a case study design methodological approach [10]. This part aims to identify the interrelation ship between space characteristics and its restorative potential, through adopting different scales for measuring health qualities in three selected spaces on Nil Cornish as a waterfront area. Finally, the paper ends by proposing a framework for activating healthy blue and green spaces to enhance health qualities for cities and achieve healthy urban life.

II. THEORIES AND CONCEPTS OF HEALTH QUALITIES IN LANDSCAPE DESIGN

There are many theories that were established highlighting the restorative power of nature and its healing effect on human beings [11], [12]. Most of the recent established theories focus on restoration which is defined as the recovering and renewal process for human being to meet the new challenges and demands [13]. The most popular theories according to previous literature are Attention Restoration Theory (ART), Stress Reduction Theory (SRT), Theory of Biophilia, Theory of Supportive environment (SET), and Prospect-Refuge theory (also known by Environmental aesthetics). The presented study highlights the main ideas of ART, SRT and SET to investigate health qualities of natural landscapes.

A. Attention Restoration Theory (ART)

Attention Restoration Theory concentrates on restoration advantages and benefits achieved through nature integration in life. This theory was introduced in 1989 based on two types of attention that individuals possess, namely; direct attention and fascination/spontaneous attention [14], [15]. Direct attention is more related to the brain cognitive functions, and used in daily activities depending on concentration. Fascination/spontaneous attention is related to the section of memories, reminiscences and impressions in the human brain, this section is known for its unlimited capacity and size, it can be provoked by natural surroundings [16], [17]. Accordingly, nature and natural settings are proven to reduce stress, support spontaneous attention, and enhance relaxation mode for different users [18], [19]. According to ART there are four requirements of restoration, Being away, Fascination, Extent and Compatibility [18], [19] explained in Fig. 3.

B. Stress Reduction Theory (SRT)

Stress Reduction Theory introduces the restorative impact of nature on people, in both psychological and physiological manners. SRT was introduced by Roger Ulrich in 1991, and was supported by systematic reviews from different researchers. The theory states the idea of looking into natural elements generates positive emotions such as pleasure, happiness, calm and interest [20]. Moreover, this ease the state of stress people might be experiencing during their day and enhance a restorative effect that reduces their stressful state.
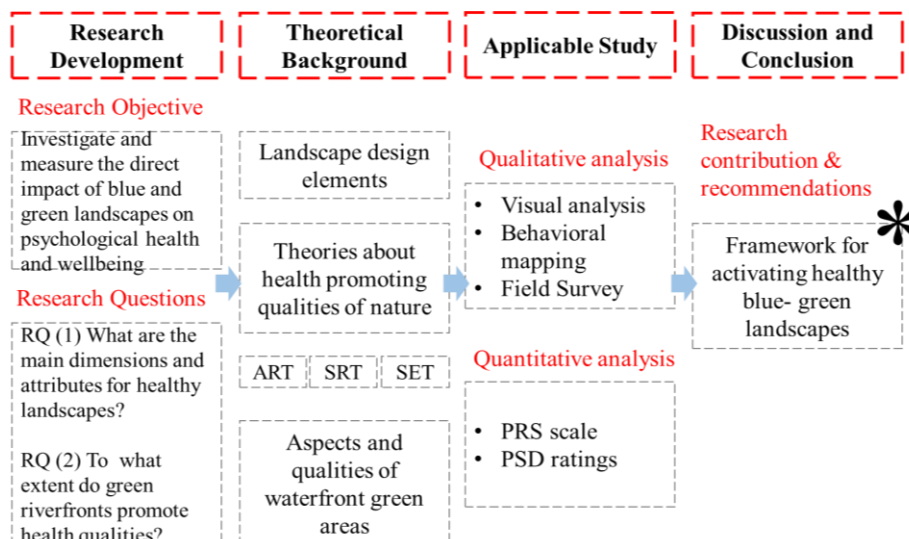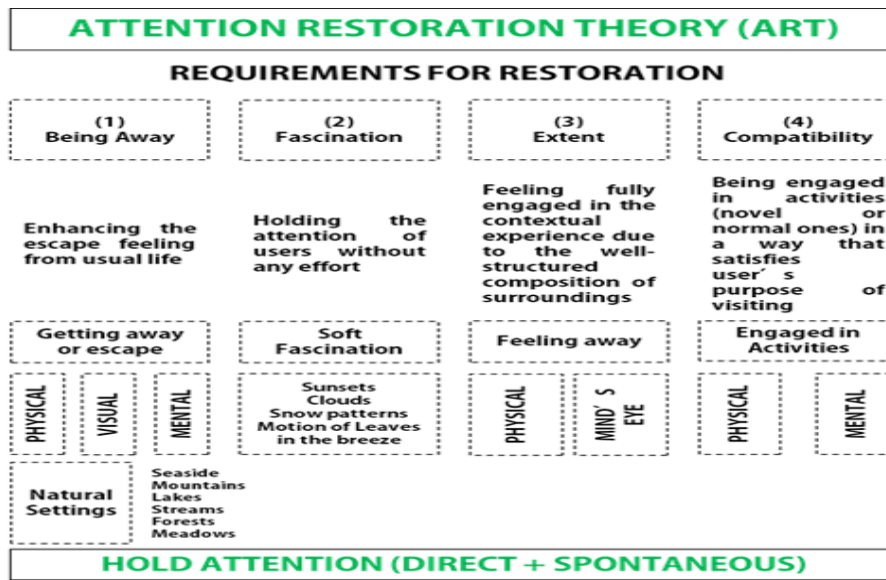

Figure 2: Research Structure

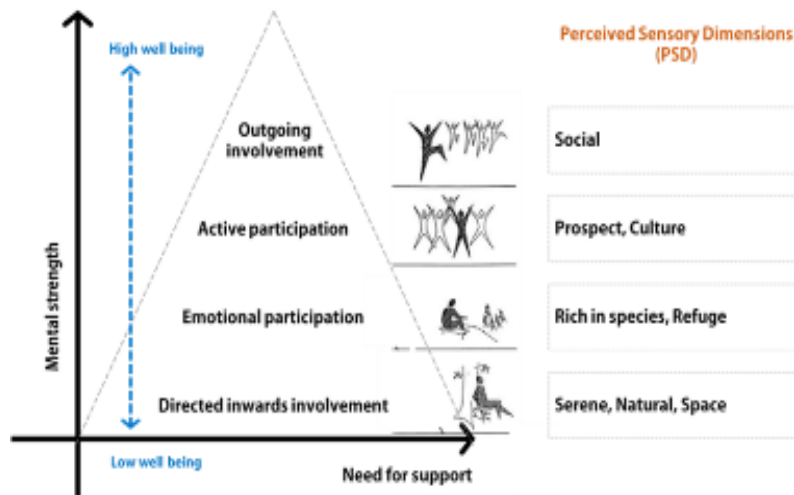**Figure 3 : Requirements of restoration adopted from [14], [17].**

Figure 4 : Supportive environments model [23], [29]–[31] (Presented by author).

The theory also proposes a psychological framework where natural landscape reduces stress by developing a spontaneous unconscious response to natural environment and decreasing stress through being exposed to nature [21]. It also raised different interpretations for human preferences for landscape settings depending on their psychological impact. Ulrich postulates the idea that environments that encompass vegetation and water elements are essential for human survival, as it provides the essential setting to anticipate predatory influences that threatens human being (in other words people health and life) [22]. Such settings have the positive impact to help in the reduction of psychological and physiological stress symptoms. This also was proven by various research studies that investigated managed landscapes and their relationship with lower blood pressure levels, reduced levels of stress hormone (Cortisol) and accordingly decreased stress levels and increased positive mood.

C. Supportive Environment Theory (SET)

Supportive environment theory it states that there are precise qualities that promote stress reduction in natural environments [23]. These qualities are correspondent to the need for support in human nature. It is considered an integrative theory that combines cultural, evolutionary and social factors to illustrate the positive interrelationship between nature and human health [23]. A Supportive environment (SE) offers a comprehensive, meaningful, accessible, and safe setting for its users. Human beings need SE for physical benefits like senses and muscle development, in addition to mental benefits like thinking and feeling to support their psychological health. Fig. 4 illustrates the hierarchy of executive functions (EF) in a form of SET model, presenting the relationships among users' mental scheme. The model shows the lowest level of the needs hierarchy is the "directed inwards involvement". The second level shows "emotional participation" the third level reflects "active

participation" and the top level is the "outgoing involvement". The impact of the environment depends on the characteristics of different user groups, such as mood, age, gender, special abilities …etc. [24]–[26].

D. Perceived Sensory Dimensions (PSDs)

As mentioned previously there have been different theories and studies to investigate and understand the impact of nature on health promotion and stress reduction. Accordingly, there has been an evolving need to develop different scales and experiments to highlight the relationship between nature, preferences and stress reduction as a representative for health qualities of natural environment [27], [28].

Perceived Sensory Dimensions (PSDs) is an eight-dimensioned framework, combining eight qualities to support restoration in natural settings [27]. These qualities were based on quantitative experimental studies started from the mid 1980's and supported with qualitative studies as well [29].

SET is considered the helpful framework for establishing PSDs, the four levels of needs in SET model reflects the eight needs/dimensions for a supportive environment, namely; serenity, nature, space (shelter), rich in species (diversity), refuge, prospect (openness), culture and social [29]. Fig. 4 shows the required needs from the eight dimensions in relation to SET model.

PSDs are considered an effective method to identify characteristics of nature settings in terms of health and restoration. It became essential in the design process of green areas and natural landscapes in addition to healthcare facilities, where it is possible to take the preferences of stressed individuals into consideration[30], [32]. There are many studies that proven the direct effect of the integration between PSDs of natural areas and specific outdoor activities on the stress restoration levels of users [33], [34].

E. Landscape elements of blue and green space

"Blue spaces" are known to be spaces that encompasses water surfaces in their structure, also it is defined as the places where the land surface meets the water surface [35], [36]. Water spaces are proved to be the most preferred spaces for city residents especially residents of megacities which is characterized by dense urban structure [37], [38]. On the other hand, "Green spaces" are known to be spaces covered with green elements like trees and vegetation [39], [40]. Combining blue and green spaces together is beneficial for contemporary urban life namely; heat and urban temperature reduction, urban revitalization, increasing social connection, reducing stress for different users, and many other benefits [39], [41].

There are a variety of urban landscape elements that are used in different waterfronts and lake sides. It could be divided in two categories; softscape (natural landscape elements) and hardscape (man-made landscape elements). Table 1 shows the both categories of landscape elements and its classifications. Softscapes are presented in landform, vegetation and greens in addition to water features. Integrating water as a part of the urban space's structure gives it a recreational layer and makes it more enjoyable, aside from

its environmental and health benefits. Hardscape elements can be found in the pavements, pathways, vertical elements like walls and fences, in addition to furniture used in the space. Accordingly, the presented research addressed twenty different elements that enrich waterfront areas as blue spaces integrated with green areas [42], [43].

Table 1: Landscape elements (adopted from [38], [39])

Softscapes Elements	Hardscape Elements
Landform	Pavements
Vegetation and greens	Pathways
Trees	Steps
Shrubs	Ramps
Lawns	Vertical elements
Buffers	Walls
Planting beds	Fences
Water features	Furniture
Static	Benches / seats
Flowing / fountains	Outdoor lights
Water jets	Shaded structures
Falling	Art features

III.METHOD AND PROCEDURES

To investigate the impact of blue and green landscapes on activities, mood and mental state of different users; the presented study adopted multi-method data gathering technique. The investigation involved visual analysis, behavioral observation and semi-structured interviews. Visual analysis was performed to identify the different landscape design elements in the selected spaces in addition to its qualities and characteristics. Behavior observation was important to identify and figure out diverse and special patterns of activities and perception of different users. Interviews were held with selected participants to investigate their frequencies for visiting the spaces, their duration of using the spaces, and to understand more the impact of the spaces' qualities on their activities. Most importantly participants were interviewed to measure the perceived restorativeness scale (PRS) to give an indicator for the restorative potential of the selected study areas. Additionally, PSDs were rated by selected experts in an attempt to relate between the restoration requirements and the restorative dimensions in the selected areas as adopted from [33], [44]. The study was conducted during late spring and mid-summer seasons, from May till July 2022. Qualitative approach was adopted to analyze observational data and quantitative approach was adopted to analyze the survey responses.

A. Study areas

Study areas were selected based on their location: it should be facing Nile riverfront in urban/formal areas, site structure: they should encompass green zones, and activities: sites should include two or more activity patterns and surrounded by multiple land uses to ensure its diversity and vitality. Accordingly, three selected areas on Nile Cornish, nearby Zamalek Island and El-Manial Island were included in the presented study.

Sara Tarek: Health Promoting Qualities Framework for Blue and Green Landscape

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Figure 5: Locations for the study areas (developed by author, 2022).

Figure 6: Photos from the three study areas (author, 2022).

Fig. 5 shows the exact locations of the selected areas. All selected spaces encompass green areas and elements as a part of its structure, but in different proportions and distribution. Fig. 6 shows selected photos for the three contexts. The selected spaces were representative for the most popular spaces on Nile Cornish, where people visit in different occasions, they are named as follows: **Space 01- Kasr EL-Nil bridge area**, where the famous Bridge of Kasr El-Nil is located and different users target it as destination for recreation. **Space 02- El-Manial bridge area**, different users visit this area for walking and fishing activities. **Space 03- EL Manasterly bridge area**, which is recently constructed and famous for the existence of small recreational zones.

B. Data collection and measurement

For a better reading and understanding for the potential of the space structure and elements in relevance with the healthy, restorative qualities and potentials, the study included three data collection techniques. First, a visual analysis applied in the three selected areas aimed at identifying the existence of landscape elements and its quality. This helped in identifying the relationship between the interactions of users and activities with the space elements and the restorative potential of the different spaces. Accordingly, photos, explanatory sketches were used at this stage.

Second, behavior mapping (BM) was conducted to help locating the distribution of users among different spaces and their interaction with the spaces elements, in addition to counting these activities occurrences [45], [46]. Consequently, Activity maps were established showing different behavior units' distribution in the study areas. During weekdays, weekends and official holidays; the three spaces were visited seven times for three BM sessions in each day (morning, noon and evening); each session lasted for 90 minutes. For further understanding to the space characteristics PSDs were rated by five landscape experts with more than 7 years of experience inspired from [33] on three points Liker scale (0-3) where 0 means doesn't exist at all and 3 means strongly exist.

Finally, a designed questionnaire survey was established to investigate users' experience in the spaces in addition to the restorativeness potentials for the three different locations, the survey was designed inspired form previous researches [47], [48], it consisted of four main sections in addition to an introductory statement explaining the scope and objective of the study and asking the participants to sign for their agreement to participate in the survey. The first section is asking about the sample's demographic information like gender, age, and educational background, if they live nearby, their frequency of visits to the space, and the purpose of their visit, this part encompassed eight multiple choice questions.

The second section asks about their experience in the site regarding the elements and if they find it safe and friendly to use the site. This was measured through fourteen questions using five points Likert scale (1= Strongly disagree and 5 = Strongly agree). The fourth section started by a question about their current mood on a ten points scale (1 = very sad and 10 = very happy) [49].

Then the Perceived Restorativeness Scale (PRS) in order to measure restorative experience and potential of the three spaces (Table 2) [50]–[52]. PRS is based on the Attention Restoration Theory (ART), it measures the four requirements of restoration using twenty-six items [53] shown in Table 2 that target measuring the perception of users for the four restoration requirements [54]. Participants were asked to rate how much they perceive each one of the 26 items on a seven points scale (0= Not at all and 6 = Completely)[54].

C. Sampling and participants

Before starting to collect answers for the designed survey a pilot study was conducted including 15 participants who were not involved in the study sample. Feedback was collected from the participants and slight edits was done to the survey form. Accordingly, a random sample of 126 participants; 42 in each one of the three spaces was selected.

45

Table 2 : PRS measured restorative qualities [54]

Four Restoration Requirements	Measured Restorative Qualities	
1- Being Away	PRS01	Being here is an escape experience.
	PRS02	Spending time here gives me a break from my day-to-day routine.
	PRS03	It is a place to get away from it all.
	PRS04	Being here helps me to relax my focus on getting things done.
	PRS05	Coming here helps me to get relief from unwanted demands on my attention.
2-Fascination	PRS06	This place has fascinating qualities.
	PRS07	My attention is drawn to many interesting things.
	PRS08	I want to get to know this place better.
	PRS09	There is much to explore and discover here.
	PRS10	I want to spend more time looking at the surroundings.
	PRS11	This place is boring.
	PRS12	The setting is fascinating.
	PRS13	There is nothing worth looking at here.
3-Extent	PRS14	There is too much going on.
	PRS15	It is a confusing place.
	PRS16	There is a great deal of distraction.
	PRS17	It is chaotic here.
4-Compatibility	PRS18	Being here suits my personality.
	PRS19	I can do things I like here.
	PRS20	I have a sense that I belong here.
	PRS21	I can find ways to enjoy myself here.
	PRS22	I have a sense of oneness with this setting.
	PRS23	There are landmarks to help me get around.
	PRS24	I could easily form a mental map of this place.
	PRS25	It is easy to find my way around here.
	PRS26	It is easy to see how things are organized.

Table 3: Demographic data summary for the sample

		01- Kasr EL-Nil bridge area N=42		02- El-Manial bridge area N=42		03- El-Manasterly bridge area N=42	
Gender	Male	22	52%	26	62%	21	50%
	Female	20	48%	16	38%	21	50%
Age	<20	5	12%	5	12%	3	7%
	21-30	9	21%	9	21%	12	29%
	31-40	10	24%	10	24%	15	36%
	41-60	13	31%	13	31%	10	24%
	>60	5	12	5	12%	2	5%
Educational Background	Uneducated	0	0%	2	5%	4	10%
	Average education	5	12%	8	19%	7	17%
	Above average education	12	29%	11	26%	9	21%
	Higher education	25	60%	21	50%	22	52%

The size of the sample was considered adequate in this phase of study (as a qualitative one) to support initial findings and conclusions [55], [56]. Participants were asked to participate in the study after spending 30 minutes in the space. They were first introduced to the objective of the study then the different questions in the survey. The questionnaire was answered face to face and participants were welcomed to inquire and ask for any clarification in the survey form. A Google form was designed to make the data collection process easier, participants were given the choice either to answer on a hardcopy (paper questionnaire) or scan a QR code (shown to them by the author) for activating the form link using their smart phone. Table 3 presents the demographic summary for the sample of the survey participants selected in the three spaces. The sample age ranged from 17 to 68 years old with 54.7% males (69 participants) and 45.3% females (57 participants).

D. Reliability test

In order to check the ratings' consistency in the established survey reliability test was performed using Cronbach's Alpha coefficient. Cronbach's Alpha was 0.85, 0.94, 0.95 for space-01 Kasr EL-Nil bridge area, space-03 El-Manial bridge area and space-03 El- Manasterly bridge area respectively, the values were larger than 0.7. Accordingly, the measures are reliable and have a good consistency, therefore, it could be used to draw out conclusions using further statistical analysis [57].

IV.   RESULTS

This part highlights the collected data analysis in addition to the findings, then discussing them in relevance to the presented theories. Simple descriptive statistics were conducted and presented in mean ratings and standard deviation calculations using Statistical Package for Social Sciences (SPSS) software for data analysis. In addition to calculating Cronbach's Alpha for conducting validity check.

A. Visual analysis

Visual analysis for the visited sites facilitated the documentation an/d reading of the existence of different landscape elements as well as its conditions. El-Manasterly bridge area scored the highest existence of landscape elements as shown in Table 4. Also, Fig. 7 shows a sample for the existence of landscape design elements in the three spaces.

B. Activities and behaviour

Behavior observations were held on eight clear and sunny days, with temperature ranged from 22 ^{0}C to 35 ^{0}C during day and a relatively moderate humidity. Moreover, the observations were held on three weekdays, three week-ends and two official holidays (Eid holiday during July, 2022). Table 5 shows the number of users recorded during the behavior observations sessions, and Fig. 8 shows the behavior observation map for El-Manasterly bridge area on a week day during noon as a sample, and Fig. 9 shows a sample for users' patterns of activities and behavior.

It has been observed that during weekends the number of visitors increase through the day but mostly in the evening. Most of the observed users of Kasr El-Nil bridge area are teenagers and adults (age 15-40 years old approximately). While the most observed people at El-Manial bridge area are adults and elders (ag3 30–60 years old approximately).

Figure 7: Landscape elements existence in the three spaces (author,2022)

Table 5: Number of users during the three behavior observation sessions

	March		May		June		July	
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
Temp.	24^0C 16^0C	26^0C 16^0C	32^0C 19^0C	34^0C 19^0C	35^0C 22^0C	35^0C 21^0C	33^0C 21^0C	35^0C 23^0C
Humid.	47%	45%	45%	45%	48%	48%	57%	58%
State	Clear & sunny		Clear & sunny		Clear & sunny		Clear & sunny	
Area 01 users	15	21	13	24	12	31	123	112
Area 02 users	25	30	9	82	11	94	57	54
Area 03 users	22	43	13	67	10	41	143	167
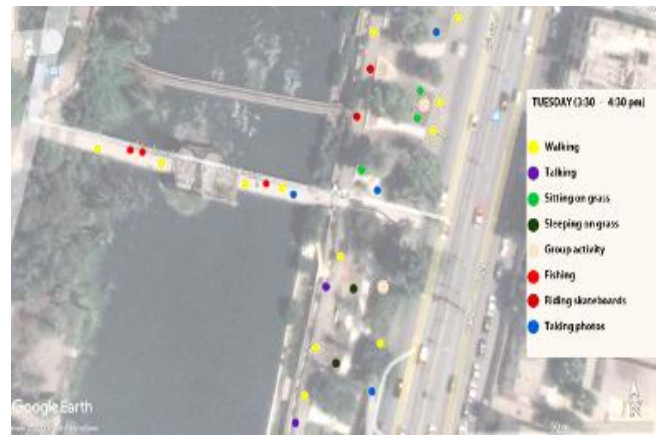
Figure 8: Behavior mapping for El-Manasterly bridge area (author, 2022)

Table 4: Landscape elements existence and condition in the three spaces

		01- Kasr EL-Nil bridge area	02- El-Manial bridge area	03- El-Manasterly bridge area
Softscape elements	Landform	x	●	●
	Vegetation and greens			
	Trees	●	●●	●●●
	Shrubs	x	x	●●●
	Lawns	x	x	●●
	Buffers	x	●	●●●
	Planting beds	●	●	●●●
	Water features			
	Static	●●●	●●●	●●●
	Flowing	x	x	x
	Water jets	x	x	x
	Falling	x	x	x
Hardscape elements	Pavements	●●	●●	●●●
	Pathways	●●●	●●●	●●●
	Steps	x	x	●●
	Ramps	x	x	x
	Vertical elements			
	Walls	●	x	●●
	Fences	●●	●●	●●
	Furniture			
	Benches / seats	●	●●	●●
	Outdoor lights	●	●	●●●
	Shaded structures	●	●	●●
	Art features	●	x	●●

x	No existence	●	Weak existence	●●	Moderate existence	●●●	Strong existence

Figure 9: Activities & behavior in the three spaces (author, 2022)

On the other hand, El-Manasterly bridge area is observed to be visited mostly by a wide variety of age groups; children, teenagers, adults and elders, large number of families are observed there letting their children enjoy the area. Also, EL-Manasterly bridge area showed the highest number of visitors

due to the existence of various landscape design elements and attractive features. Moreover, it recorded high number of users (especially users who do not live nearby) during official holidays due to the attractive features it encompasses.

Observations also showed that El-Manial bridge area is mostly visited by the surrounding residents -especially the elders- in the morning to practice fishing, it is a famous activity there. The three spaces are confirmed to have a rich social experience. Same at El-Manasterly bridge area where residents usually go there for fishing during weekdays and weekends. Users of Kasr EL-Nil bridge area prefer enjoying the view and take different photos with the waterfront background during noon and evenings.

But the main activity attraction there is riding horse carts users prefer enjoying it during Eid holidays and weekends. Also, a significant number of users were noticed preferring to sit and relax enjoying the view during the morning and noon time in the three spaces.

C. Experience of users

Results of the survey showed that the average mood score for participants was 7 which mean that they are relatively happy. As shown in Table 6, most of the visitors of El-Manial bridge area live nearby (57%), but for Kasr El-Nil and El-Manasterly bridge areas most of the users do not live nearby (60% for both).

Most of the visits for El-Manial area were daily (43%), and weekly for Kasr El-Nil and bridge area (36%) and monthly for El-Manasterly bridge area (31%). El- Manial bridge area is visited more in the morning (45%) and during the spring (38%) for fishing purposes, running and chatting with friends, while Kasr El-Nil and El-Manasterly bridge areas are preferred to be visited in the evening (52% and 43%) during spring season (52% and 33%), and the purpose of the visit for Kasr El-Nil

area is running and exercising and for El-Manasterly bridge is entertainment.

Regarding the questions related to users' experience, survey results (Fig. 10) showed that El-Manasterly bridge area scored the highest sufficient number of activities (mean=3.36). This is due to the existence of a sufficient parking area and pedestrians bridge to help crossing the main road to reach the area. It is also the easies area for accessing the different activities and the transitions between activities (mean=4.05 & 4.1). El-Manial bridge area and Kasr el-Nil bridge area scored higher mean rating in finding their entrance easily (mean=4.12 4.05) this is due to their exposure on smaller roads.

El-Manasterly bridge area is the highest in terms of furniture amount and practicality in addition to interesting flooring design (mean =3.07, 3.36 and 3.40). Flooring elements' convenience for walking scored the highest in El-Manasterly bridge area and Kasr el-Nil bridge area (mean =3.131 and 3.01) and this returns to the variations in flooring materials used in both areas and the separation between pedestrians and vehicles movement.

El-Manasterly bridge area scored the highest in being used during the evening (mean =4.24), due to the existence of lighting units and convenient lighting design, in addition to its open exposure. Kasr EL-Nil bridge and EL-Manasterly bridge areas scored the highest attractive place (mean =3.69 and 3.55), due to the attractive features and surrounding context. El-Manasterly bridge area scored the highest in integration between different landscape elements (softscape and hardscape) (mean= 3.36) this appears in its richness of landscape elements at the first place, which forms a strong point of attraction to different users. Table 6 shows the mean scores for the survey questions related to users' experience.

Table 6: Answers to users experience survey

|		01- Kasr EL-Nil bridge area		02- El-Manial bridge area		03- El- Manasterly bridge area	
Do you live nearby	Yes	17	40%	24	57%	17	40%
	No	25	60%	18	43%	25	60%
How often do you come to this area	Daily	9	21%	18	43%	6	14%
	Weekly	15	36%	15	36%	10	24%
	Monthly	13	31%	3	7%	13	31%
	Every now and then	5	12%	6	14%	13	31%
When do you come to this area	Morning	6	14%	19	45%	7	17%
	Noon	5	12%	2	5%	5	12%
	Afternoon	9	21%	5	12%	12	29%
	Evening	22	52%	16	38%	18	43%
Do you prefer coming in	Summer	7	17%	13	31%	10	24%
	Winter	8	19%	5	12%	10	24%
	Autumn	5	12%	8	19%	8	19%
	Spring	22	52%	16	38%	14	33%
Why do you come here	Walking	12	29%	12	29%	5	12%
	Running/exercising	8	19%	15	36%	3	7%
	Walking your dog	2	5%	2	5%	0	0%
	Socializing	1	2%	1	2%	12	29%
	Entertainment	12	29%	5	12%	22	52%
	Other	7	17%	7	17%	0	0%

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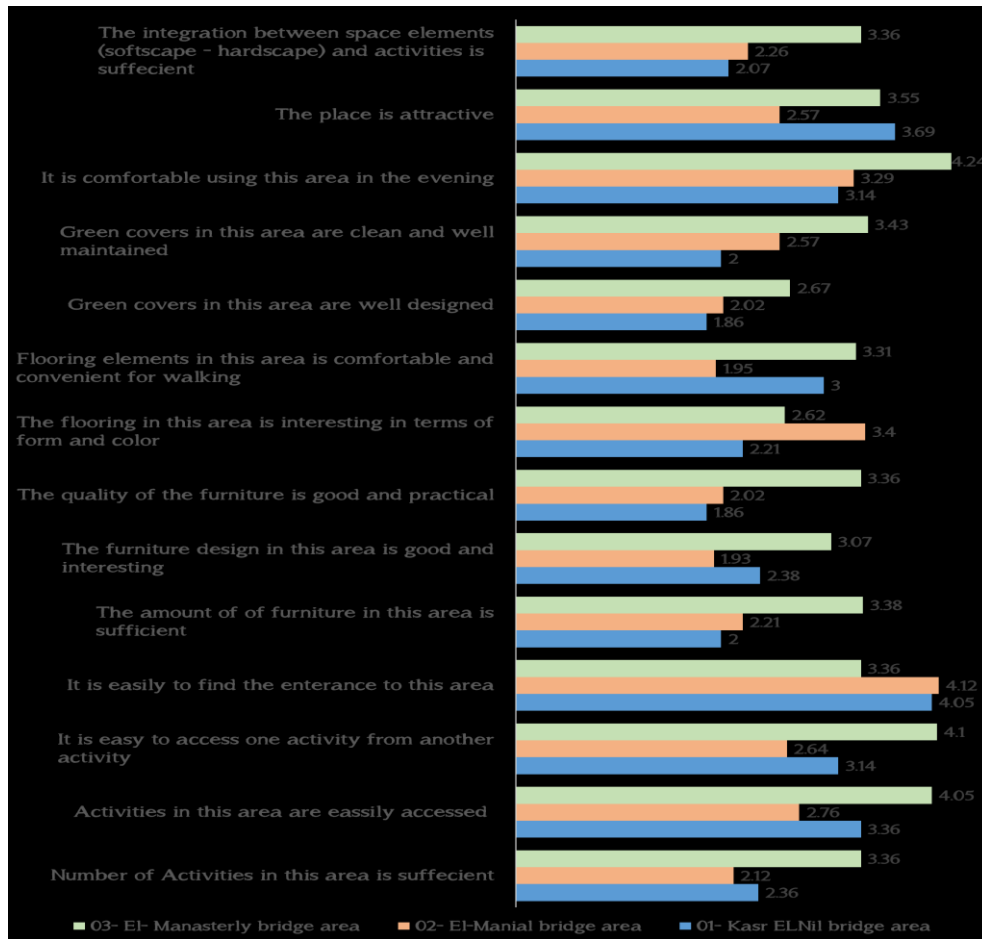
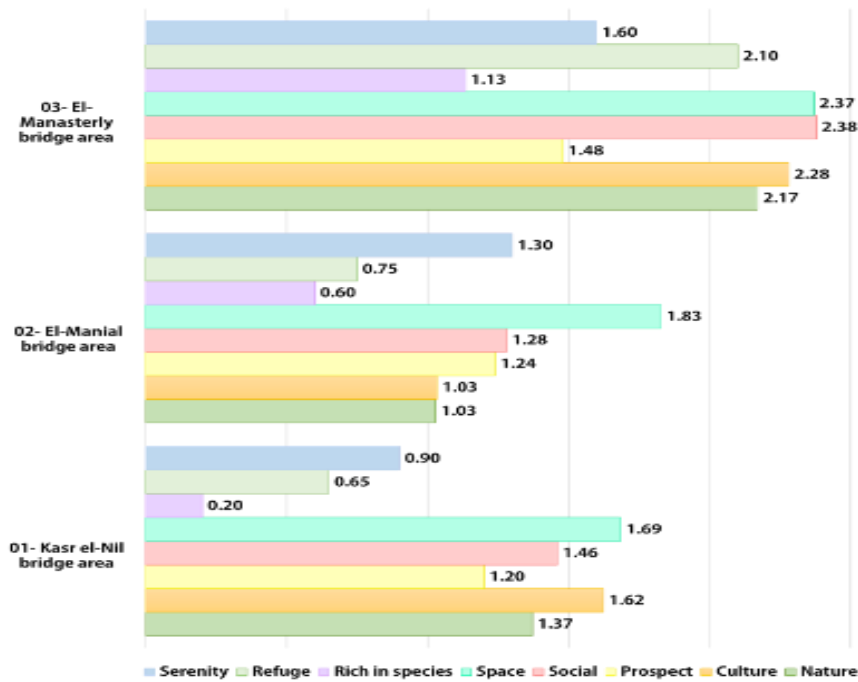**Figure 10: Mean ratings for users' experience in the three spaces (Author, 2022)**

Figure 11: Mean ratings for PSDs in the three spaces (author,2022)

49

D. Perceived Sensory Dimensions (PSDs)

Evaluating PSDs in this study depended on a qualitative approach. Ratings were based on discussions with experts as volunteering participants about the degree of the existence of the mentioned PSDs in each one of the three spaces, after watching a small video captured by the author showing the space. Ratings showed that all the eight dimensions existed in the three spaces, as illustrated in Fig. 11.

However, El-Manasterly bridge area is the highest in mean score for each one of the eight dimensions. Yet, mean ratings were close in values in Kasr El-Nil bridge area and EL-Manial bridge area, except for prospect since all three ratings were close in values 1.20, 1.24 and 1.48 for Kasr El-Nil bridge, El-Manial bridge and El-Manasterly bridge areas. Also, Serenity mean rating value was close for El-Manasterly bridge area and Kasr El-Nil bridge area (1.48 and 1.24). Fig. 12 shows sample photos for the eight PSDs in the three spaces.

Table 7: PSDs mean ratings for the three spaces

	01- Kasr EL-Nil bridge area	02- El-Manial bridge area	03- El-Manasterly bridge area
Nature	1.37	1.03	2.17
Culture	1.62	1.03	2.28
Prospect	1.20	1.24	1.48
Social	1.46	1.28	2.38
Space	1.69	1.83	2.37
Rich in species	0.20	0.60	1.13
Refuge	0.65	0.75	2.10
Serenity	0.90	1.30	1.60

Figure 12: Photos for PSDs in the three spaces (author, 2022)
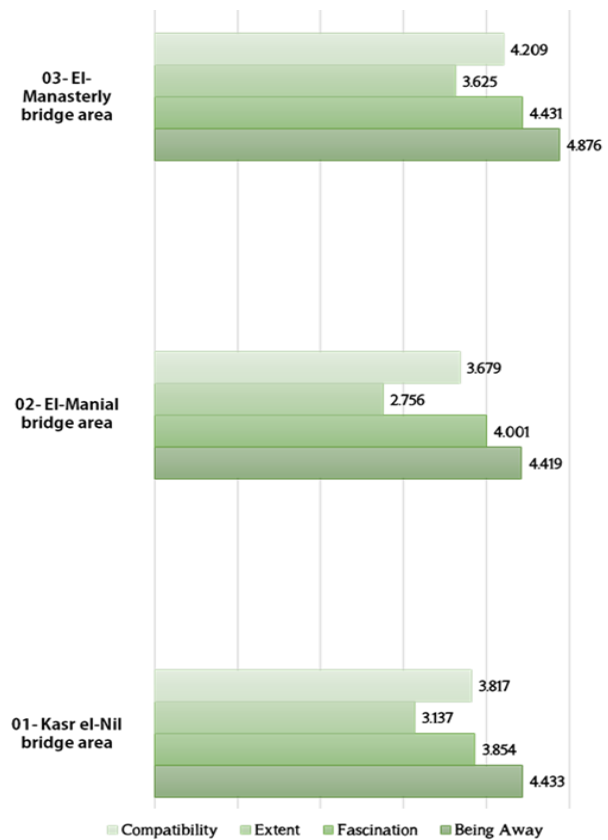
Figure 13: Mean ratings for the four requirements of restoration in the three spaces (author, 2022)

F. Perceived Restrictiveness Scale (PRS)

The total PRS average score for the three selected spaces was calculated, El-Manasterly bridge area scored the highest perceived restoration (mean =4.285) while Kasr EL-Nil bridge area scored and El-Manial bridge area scored a close value for perceived restorativeness (mean =3.812 and 3.712).

All the scored values are greater than the midpoint therefore they can be used to describe the spaces and offer a guide for measuring the perceived restoration levels for the various users [48], [58]. Table 7 and Fig. 13 shows the means (M) and standard deviations (SD) for each one of the 26 indicators in the three selected areas, in addition to the mean score of each one of the four restoration requirements. EL-Manasterly bridge area scored the highest values for the requirements of restoration; being away, compatibility, fascination, and extent (mean 4.876, 4.431, 3.625, and 4.209 respectively). According to the ratings PRS01 'being here is an escape experience' turned out to be the highest item (mean = 5.36) for "being away" restoration requirement. PRS07 'My attention is drawn to many interesting things' was the highest

50

item for "fascination" (mean 5.31) and PRS17 'it is chaotic in here' was the highest item for "extent" restoration requirement, moreover, PRS26 'It is easy to see how things are organized' as an item for extent (mean =4.71).

Kasr EL-Nil and El-Manial bridge areas both perceived the four requirements of restoration similarly. According to the ratings for Kasr EL-Nil bridge area; PRS01 'being here is an escape experience' turned out to be the highest item for "being away" (mean =4.86) and PRS10 'I want to spend more time looking at the surroundings' was the highest item for "fascination" (mean =5.31). However, PRS16 'there is a great deal of distraction' was the highest item in "extent" (mean =4.07), and PRS23 'There are landmarks to help me get around' was the highest item in "compatility" (mean =4.55).

And for El-Manial bridge area; PRS01 'being here is an escape experience' and PRS02 'Spending time here gives me a break from my day-to-day routine' turned out to have almost the same mean rating for achieving "being away" restoration requirement (mean =5.05 and 5.02). PRS07 'My attention is drawn to many interesting things' was the highest item for "fascination" (mean =4.62). Furthermore, PRS16 'there is a great deal of distraction' was the highest item in "extent" (mean =2.83). PRS25 'it is easy to find my way around here' was the highest item in "compatibility" (mean=4.33).

The ratings in Table 8 shows an indicator for how the restoration potential is influenced by contextual qualities, mainly the landscape design elements in the space in addition to the surrounding land uses, road network which impact its accessibility, and characteristics of the place which was introduced using PSDs.

V. DISCUSSION

The study illustrates how nature could contribute to human health with regard to stress restoration. As shown in the results 126 participants responded to the questionnaire, this is considered suitable for a qualitative study. Moreover, this gives appropriate indications for the experience and restorative indicators for the Nile Cornish waterfront area and its health enhancement potential as blue-green landscapes.

In terms of mental health and restoration, the three selected spaces representing the Nile Cornish area are proven to provide a sense of relaxation and rejuvenation for its users. Results of the survey showed that living near natural landscapes encourages residents to exercise which increases their physical activities, this was compatible with [59], [60], which in turn leads to achieving healthy settings.

Table 8: PRS Mean rating scores for the selected spaces

Requirements for restoration		01- Kasr EL-Nil bridge area α = 0.771		02- El-Manial bridge area α = 0.933		03- El- Manasterly bridge area α = 0.806		Min	Max	N
		Mean	SD	Mean	SD	Mean	SD			
BEING AWAY	PRS01	4.86	2.001	5.05	1.147	5.36	0.958	0	6	42
	PRS02	4.60	0.977	5.02	1.179	5.17	0.935	0	6	42
	PRS03	4.48	1.270	3.95	1.912	5.19	1.087	0	6	42
	PRS04	4.19	1.518	4.12	1.742	4.14	1.555	0	6	42
	PRS05	4.05	1.671	3.95	1.794	4.52	1.311	0	6	42
	Mean	**4.433**		**4.419**		**4.876**				
FASCINATION	PRS06	4.83	1.738	4.79	1.523	4.74	1.594	0	6	42
	PRS07	4.76	1.462	4.62	1.464	5.31	1.115	0	6	42
	PRS08	3.81	1.838	4.07	1.827	4.62	1.637	0	6	42
	PRS09	3.83	1.666	4.10	1.764	4.55	1.611	0	6	42
	PRS10	5.31	.869	4.38	1.999	4.86	1.719	0	6	42
	PRS11	1.98	2.030	2.88	1.714	3.31	2.147	0	6	42
	PRS12	4.98	1.278	4.52	1.756	4.71	1.672	0	6	42
	PRS13	1.33	1.408	2.71	1.991	3.36	2.070	0	6	42
	Mean	**3.854**		**4.001**		**4.431**				
EXTENT	PRS14	3.88	3.88	3.36	1.961	4.17	1.545	0	6	42
	PRS15	1.86	1.86	2.48	1.864	3.12	1.877	0	6	42
	PRS16	4.07	4.07	2.83	2.163	4.45	1.517	0	6	42
	PRS17	2.74	2.74	2.36	1.708	2.76	2.116	0	6	42
	Mean	**3.137**		**2.756**		**3.625**				
COMPATABILITY	PRS18	3.95	1.365	3.50	1.714	4.29	1.367	0	6	42
	PRS19	3.81	1.676	3.45	1.915	4.05	1.378	0	6	42
	PRS20	3.45	1.583	3.31	1.944	4.02	1.554	0	6	42
	PRS21	4.38	2.037	3.81	2.003	4.36	1.635	0	6	42
	PRS22	2.95	1.209	3.21	1.828	3.71	1.729	0	6	42
	PRS23	4.55	1.534	3.67	2.160	4.29	1.612	0	6	42
	PRS24	3.07	1.109	3.88	1.797	3.81	1.756	0	6	42
	PRS25	4.10	1.147	4.33	2.103	4.64	1.722	0	6	42
	PRS26	4.10	1.577	3.95	2.230	4.71	1.566	0	6	42
	Mean	**3.817**		**3.679**		**4.209**				
Note:	α:	*Cronbach Alpha*		SD:	*Standard Deviation*					

51

It is noticed that restorative potentialities are quite related to space elements, characteristics, and qualities. This appears from the mean ratings of PRS which were the highest at el-Manasterly bridge area that is rich in landscape elements, this was similar to what was investigated and observed by [58]. Furthermore, responses showed no relationship between the age or gender of participants on PRS scores which is compatible with [61].

Results showed that El-Manasterly bridge area; is considered well designed, with a significant variation in softscape and hardscape elements that are well integrated together in addition to the variation in sceneries and landmarks, and it scored high mean ratings for PRS in addition to encompassing different patterns of uses and activities. Accordingly, this supports the idea that different sceneries have different values for restoration.

In terms of investigating PSDs impact on restoration using PRS scale and based on the findings of the presented study, it is obvious that integrating all the eight dimensions of PSDs as a whole in one setting enhance its restorative impact. Thus it is important to consider PSDs in healthy urban spaces design due to its potential to improve mental state for different users, this was compatible with the findings of [29].

Based on the previous fieldwork and qualitative assessment in addition to the literature review, a framework for designing healthy blue and green spaces could be proposed, presented in Fig. 14. The idea of the proposed framework is based on identifying four main qualities of urban landscapes namely; urban/physical, environmental, social, and cultural, based on the previous theories about urban design, sensory dimensions, and restoration. Then identifying the main indicators needed to achieve the previously stated qualities. These indicators were derived from the visual analysis and behavior observation with the help of the users' experience survey.

Finally, as evidence of the presented study results it could be recommended to highlight the proposed indicators to each one of the restoration requirements that are inspired form the Attention Restoration Theory. This will help correlating the contribution of the qualities to the restoration requirements in the light of achieving healthy blue and green spaces. The framework will be helpful in designing or assessing blue-green spaces (waterfront green areas) that promote restorative benefits and enhances health in addition to wellbeing.

Based on the outcomes of the study, recommendations for developing healthy blue-green spaces were identified, namely:

- Boosting different activities and behavior pattern in waterfront green spaces through using a convenient variation in furniture and land from.
- Enhancing accessibility to the space by designing convenient entrances and providing sufficient parking areas.
- Using softscape combinations to form spaces and provide places for socializing, relaxing and rejuvenation.
- Designing inviting rich natural settings with flexible and comfortable spirit to enhance compatibility and fascination as a restoration requirement.
- Designing green areas that offer high sense of place to increase being away restorative quality.
- Providing openness to the spaces' design with large senses of security and less noise exposure.
- Enhancing the five senses through design to provide a sensory experience which increases people connection with nature.
- Providing appropriate lighting system.
- Enhancing flooring design to ease people movement through the space and transition between different activities.
- Enhancing place identity through different landscape elements like using art features to increase the sense of belonging to the space.
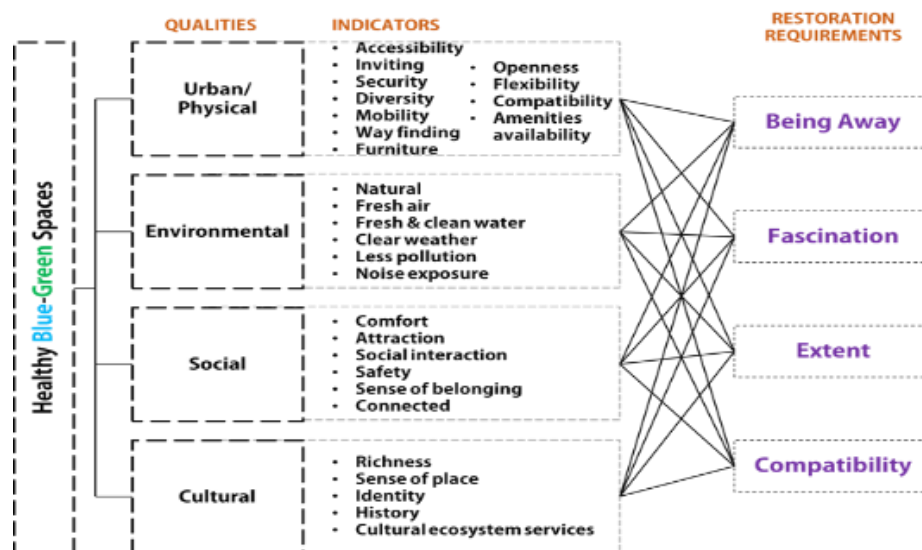

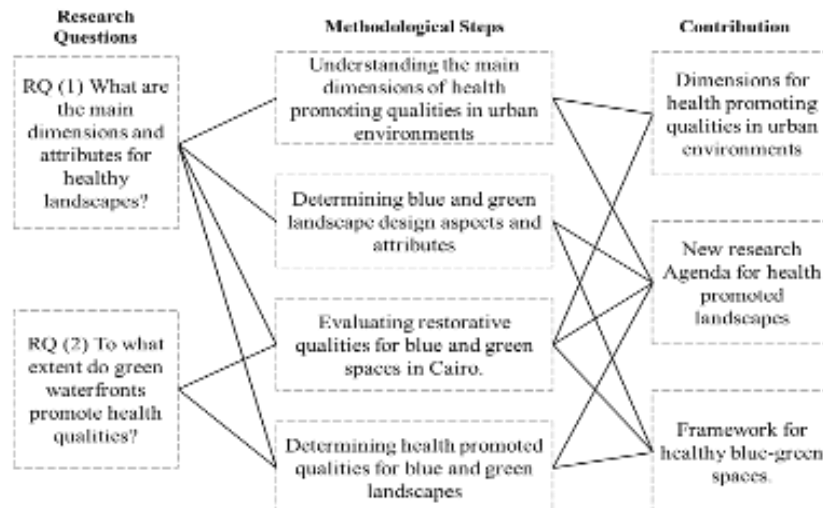Figure 14: Proposed framework for healthy blue-green spaces (author, 2022)

52

Figure 15: Research summary (author, 2022)

Fig. 15 presents a research summary for the presented study to illustrate the achieved research contribution. The study provides a glimpse of the interrelationship between the sensory dimensions of a certain place, people behavior and its restorative potential. It addressed the main qualities and dimensions for health promoting qualities in natural urban environments, mentioned in Supportive environment theory and its inspired PSDs in addition to the four requirements of restoration inspired from ART. Also, landscape design elements and investigating its relationship with restorative qualities through the case study research design method were identified and investigated which helped to answer the main research questions RQ1 "what are the main dimensions and attributes for healthy landscapes?"
Findings prove that there is a significant restorative potential in Nile Cornish waterfront area, in this context the study answered RQ2 "to what extent do green waterfronts promote health qualities?"

VI.   CONCLUSION

The presented work identified the likely relationship between qualities of restorative environments and healthy spaces design. It identified the possible impact of space's characteristics and reducing stress to help overcoming mental issues that became a global health problem nowadays.

The presented work investigated the health qualities of blue-green spaces – waterfront areas – in the case of Nile Cornish in Greater Cairo Region GCR. The contribution of this work to the knowledge in this field could be addressed as following; first after a deep literature review the study investigated the health restorative qualities for Nile Cornish in 3 different spaces in GCR. The spaces differed in landscape elements and design; the investigation highlighted an obvious relationship between the four restorative qualities and the quality of landscape design elements in each space. In addition to highlighting the impact of perceived sensory dimensions (PSDs) on perceived restorativeness (PRS).

Second, the study identified the qualities to achieve healthy blue-green urban spaces and established four sets of indicators to help achieving these qualities, in addition to the four

requirements of restoration from ART, all this was synthesized into a conceptual framework to help activate health qualities in blue-green urban spaces. Finally, the research proposed a set of recommendations based on its outcomes for developing healthy blue-green spaces.

The study addresses some limitations namely; the sample size used in the survey. It is a qualitative exploratory, so it is acceptable to use a small sample, however, it needs to increase if the study is quantitative in nature to confirm the current findings. Another limitation was the limited literature investigating the relationship between Perceived Sensory Dimensions and users' behavior in natural settings.

The research findings indicate directions for future research, like investigating further restorative measures to assess nature's relationship to mental health. Also, identifying sustainable health qualities based on ART, PRS, and PSDs and their relationship to sustainable development goals in terms of urban design strategies.

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55