

SESSION 3: CASE STUDIES HEALTHCARE DESIGN

**Design
& Health**
International Academy for Design and Health

Milano, Italy 11-14 April 2024

Design & Health

13TH WORLD CONGRESS & EXHIBITION

REVITALIZING HEALTH BY SALUTOGENIC DESIGN

Healthy environment | Healthy people

Impact of Urban Park Design on Recovery from Stress: *An Experimental Approach using Physiological Biomarkers*

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Impact of Urban Park Design on Recovery from Stress:

An Experimental Approach using Physiological Biomarkers

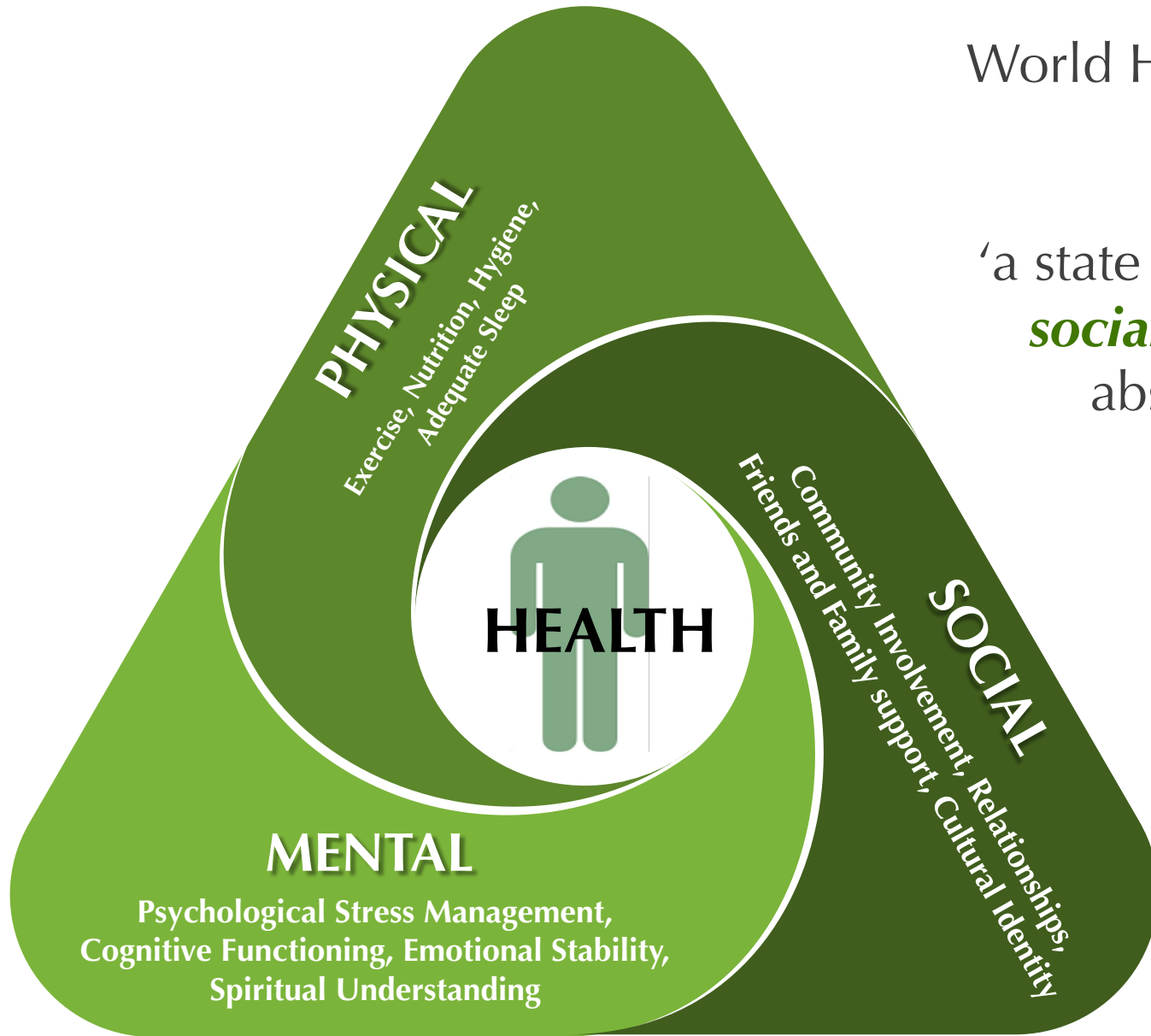
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World Health Organization (WHO, 1946)
defines **HEALTH** as:

‘a state of complete *physical, mental and social well-being* and not merely the absence of disease or infirmity.’



WHY URBAN ENVIRONMENTS?

75% of the Population lives in Dense Urban Areas
(Central Intelligence Agency, 2007)

Ever increasing demands of Modern Life including traffic, phones, conversations, problems at work, and complex decisions (Abbott, 2012)

Rise of chronic health conditions such as obesity, asthma, diabetes, heart disease, and depression
(Anderson et al., 2014)

More Noise, More Crime and More Homelessness
(Kuo & Sullivan, 2001)

Loss of Habitat, and Fragmentation of Green space
(Jackson, 2003)

Increased aggression and violence
(Kuo & Sullivan, 2001)

Increased risk for mood disorders (by 39%)
(Lederbogen et al., 2011)

Increased risk for anxiety disorders (by 21%)
(Lederbogen et al., 2011)

Increased Social Stress
(van den Berg et al., 2007)

Living in a City can 'bring on' mental disorders
(Abbott, 2012)

Current Health Situation in Urban Environments



WHY URBAN PARKS?

Fulfil people's need for contact with nature, aesthetic preferences, recreation and social interactions (Cohen et al., 2007)

Provide opportunities for recreation, psychological wellbeing, and social support (Maller, Townsend, Brown, & St Leger, 2002)

Increase physical activity, reduce obesity (Maller et al., 2002)

Reduce noise, clear air and provide cooling (Maller et al., 2002)

Promote sense of community and identity (Matsuoka & Kaplan, 2008)



WHY SHOULD WE CARE?

‘Rural’ versus ‘Urban’ dichotomy (Velarde, Fry, & Tveit, 2007)

Exposure to Nature in Green space:

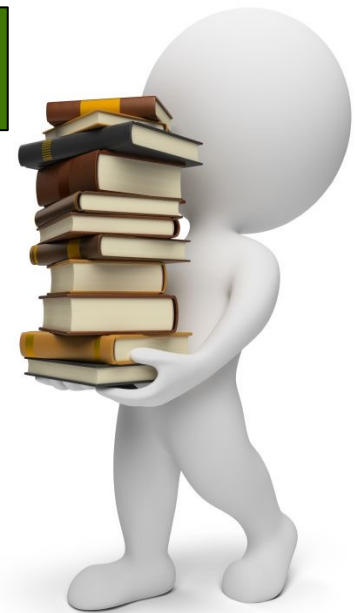
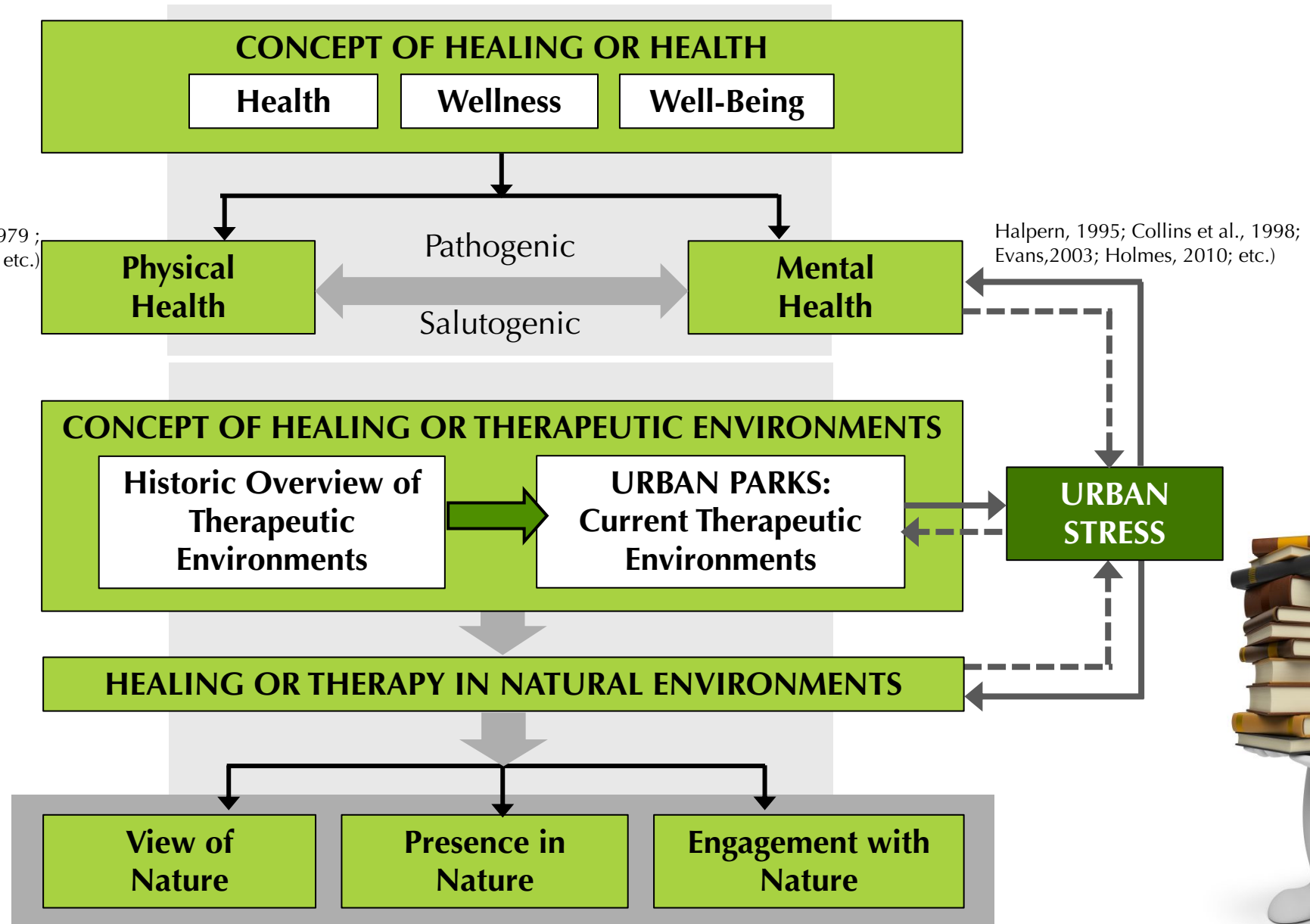
- Access to Green Space (Maas et al., 2009)
- Distance from Green Space (Ward et al., 2012)
- Duration of stay in Green Space (Barton & Pretty, 2010)
- Frequency of visit to Green Space (Barton & Pretty, 2010)

But what about the amount of Green in the Green Space?



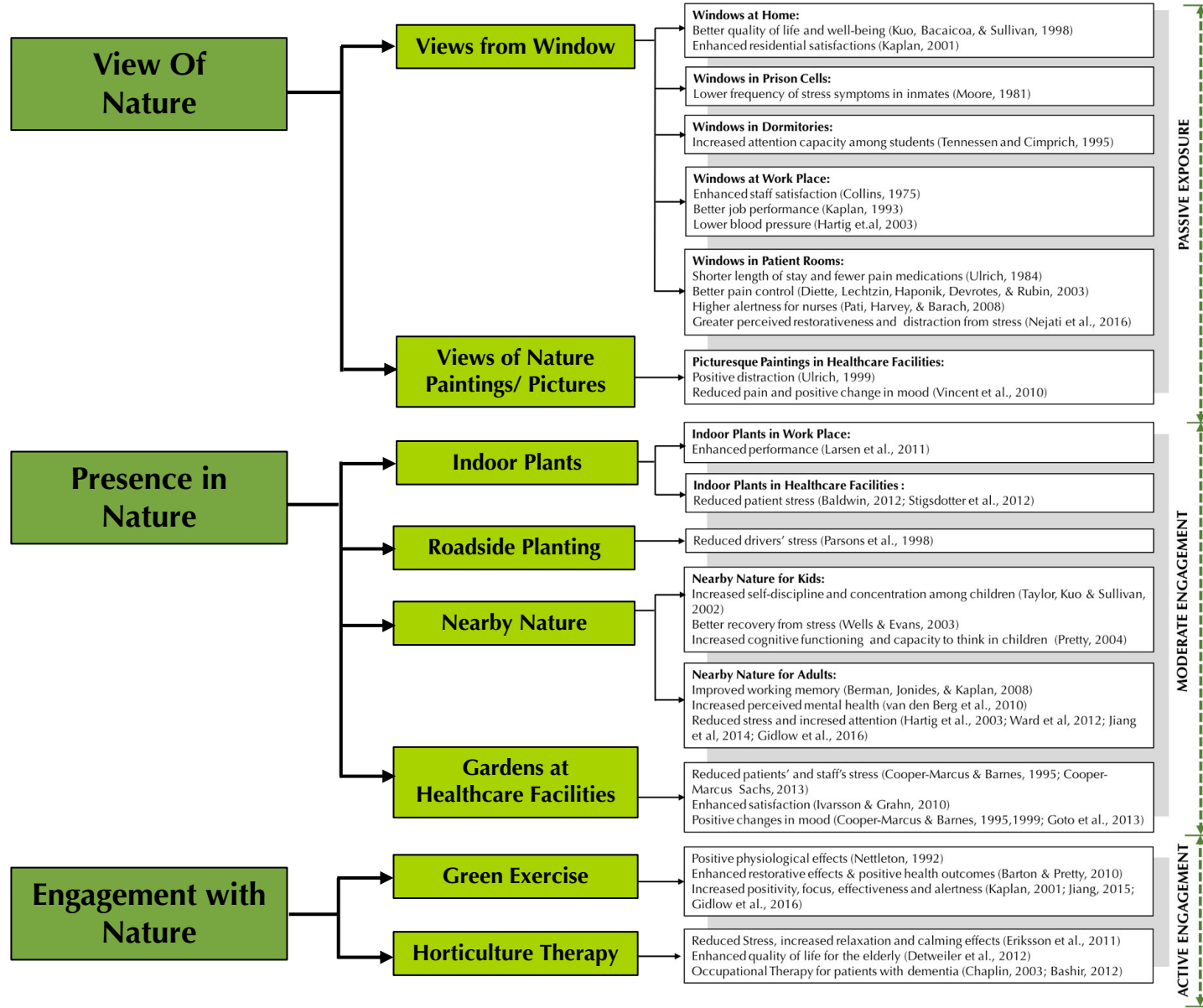
SUPPORTING LITERATURE

(WHO, 1946; Antonovsky, 1979 ;
Stokols, 1992 ; Harper, 1996; etc.)

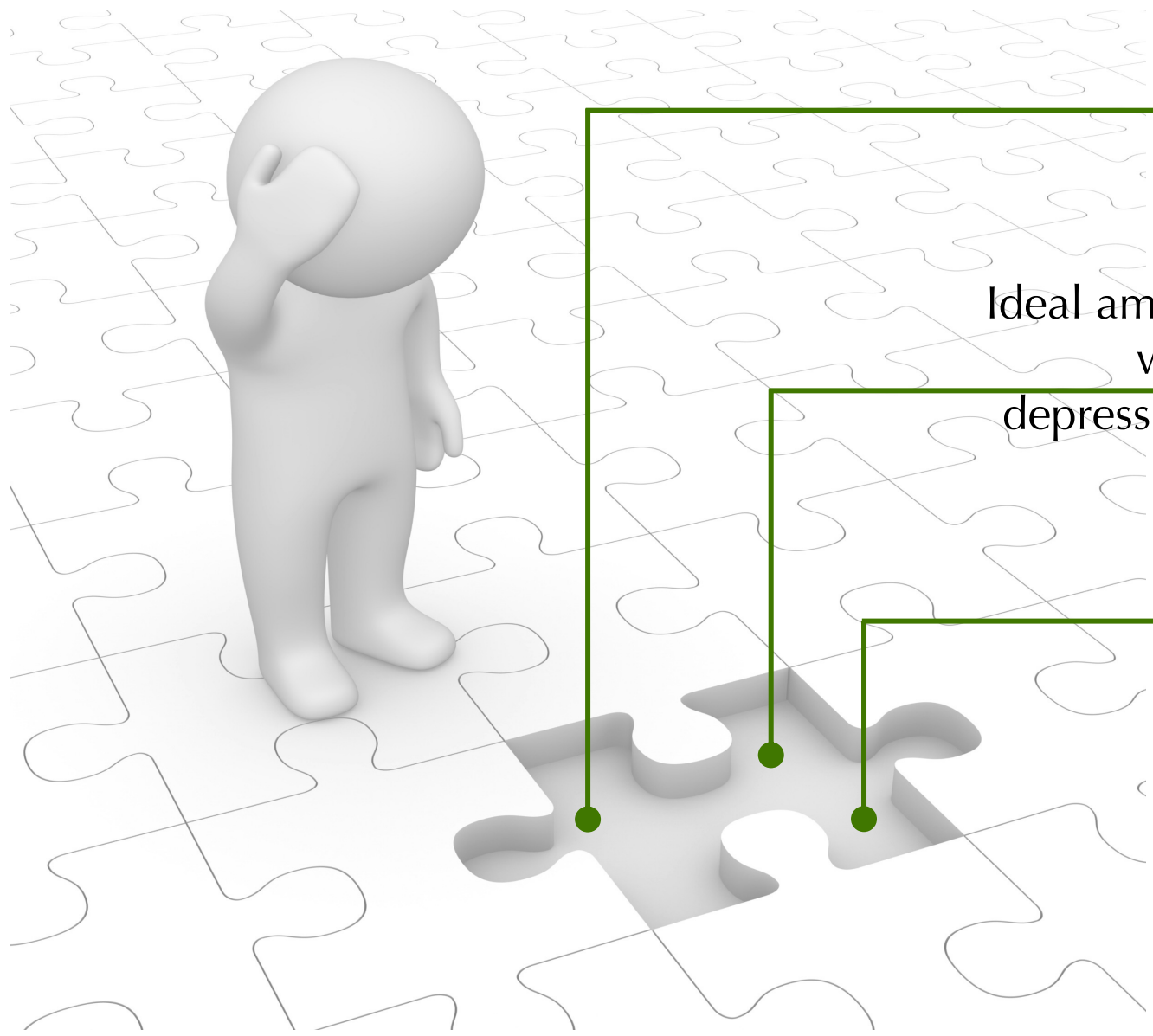


BENEFITS OF CONTACT WITH NATURE

Empirical Findings on How Nature Nurtures:



KNOWLEDGE GAP IN LITERATURE



Precise design characteristics of Natural Restorative Environments

Ideal amount of Green Exposure that help people with recovery from daily stress, cope with depression and trigger optimistic mood changes

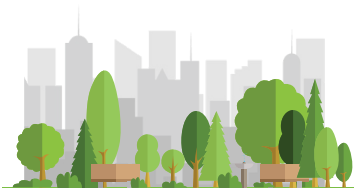
Empirical evidence from physiological biomarkers



MAIN RESEARCH GOAL

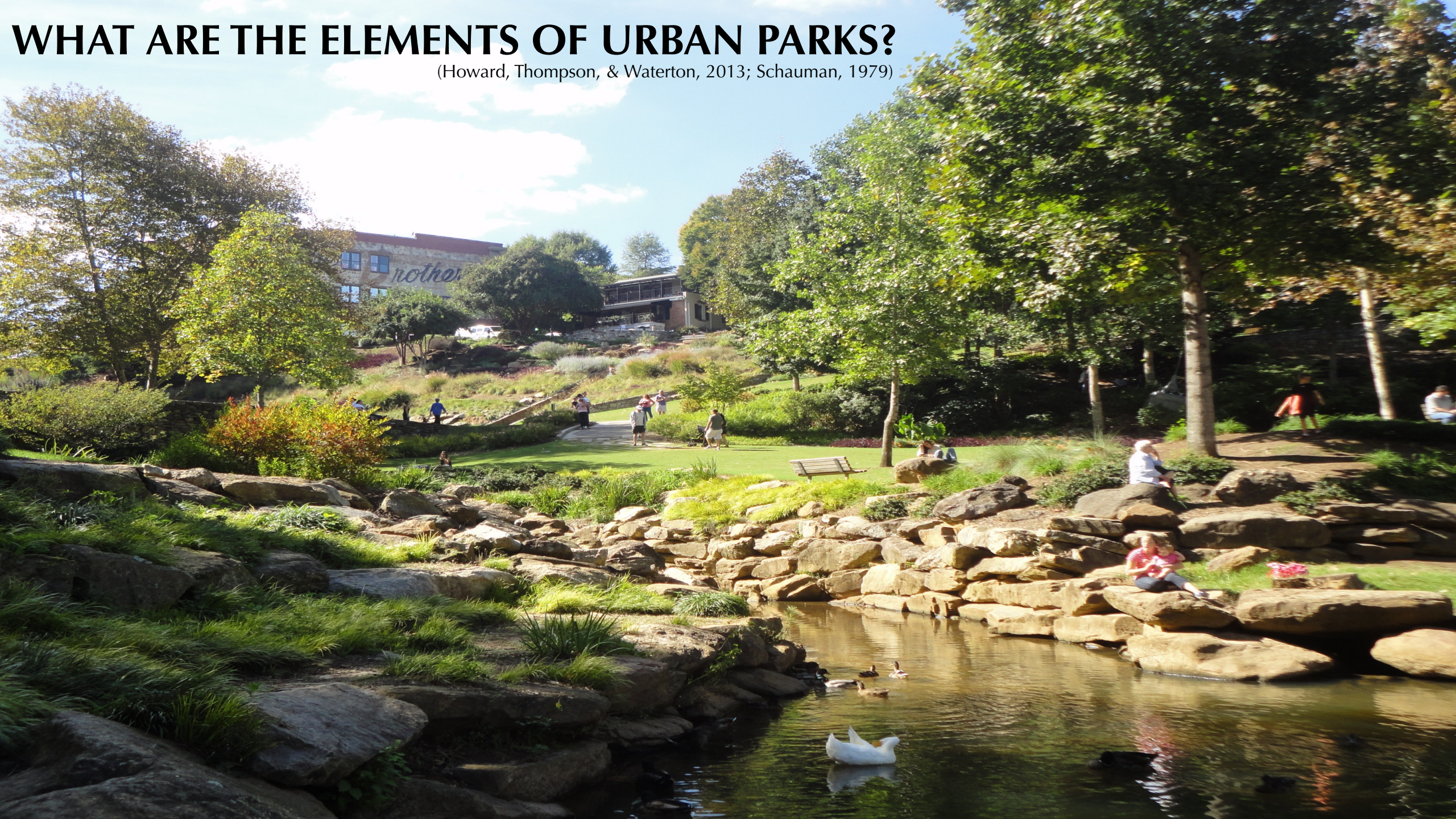


To explore and evaluate the design attributes of urban parks that lead to maximum stress reduction among urban residents.



WHAT ARE THE ELEMENTS OF URBAN PARKS?

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)





SKY

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)



BUILT FORM/ STRUCTURE

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)



VEGETATION

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)



LANDFORM

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)



WATER

(Howard, Thompson, & Waterton, 2013; Schauman, 1979)

VEGETATION

Nature = Sky + Vegetation + Water + Landform

Though all these elements can be ultimately be modified by human action, landform, water and vegetation can be readily controlled by human decisions within urban park settings. (Dee, 2005)

Trees and other forms of vegetation provide greater flexibility for design control to Landscape Designers, who can 'bring nature into cities and create spaces that provide restorative benefits to urban residents.' (Hunter & Askarinejad, 2015)





Vegetation Canopy

(Hunter & Askarinejad, 2015)



Vegetation Understory

(Hunter & Askarinejad, 2015)

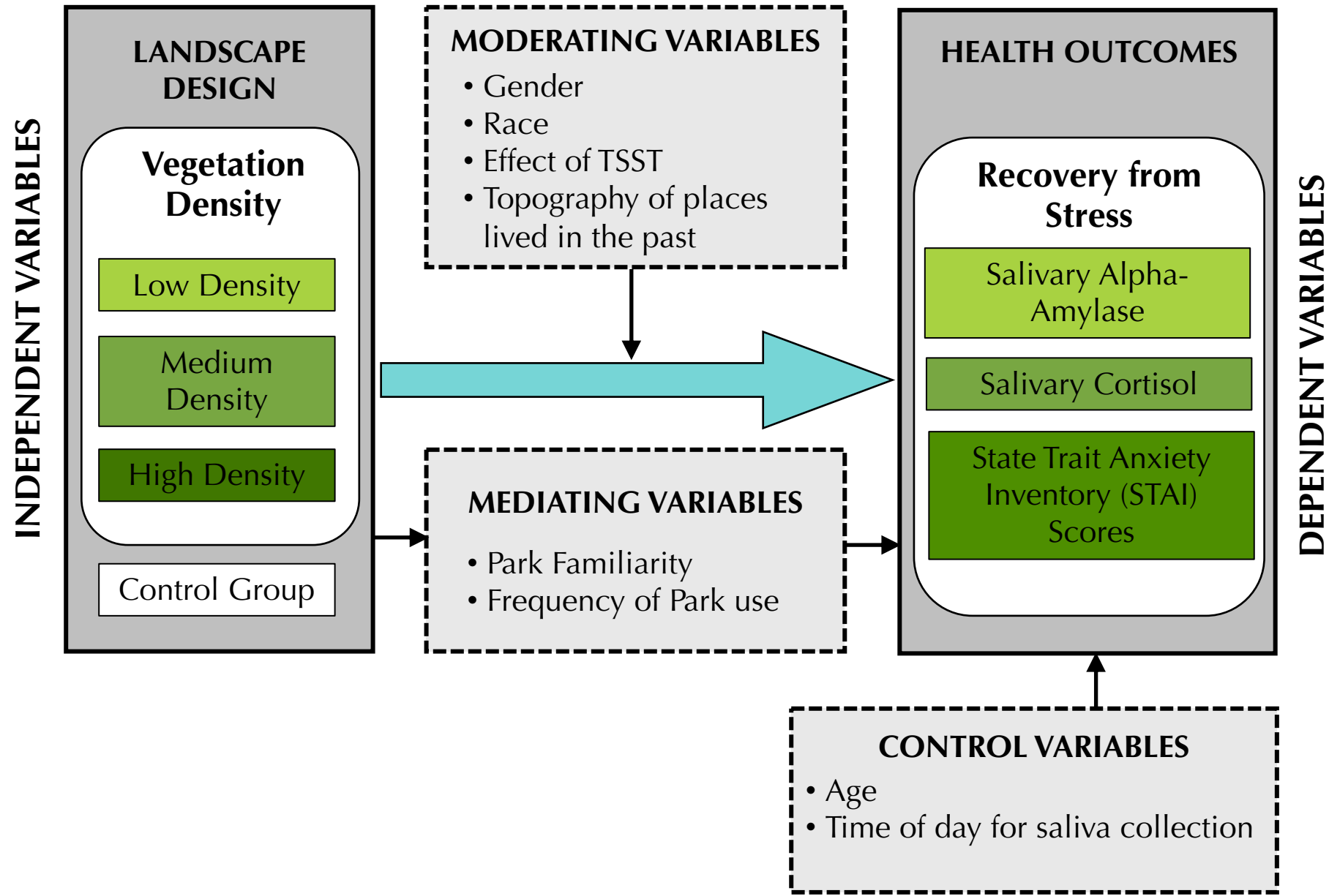


Vegetation Groundcover

(Hunter & Askarinejad, 2015)



CONCEPTUAL FRAMEWORK



RESEARCH METHODOLOGY

Method 1: Experimental Design

Method 2: Immersive Virtual Environment (IVE)

Method 3: Stress Induction using Trier Social Stress Test (TSST)

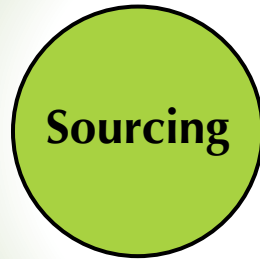
Method 4: Salivary Cortisol/Alpha-Amylase Measurement

Method 5: Structured Interview



IMAGE SELECTION FOR THE EXPERIMENT

Photographic Survey of eight Urban Parks in North Carolina,
South Carolina and Georgia



Sourcing

400 Images



IMAGE SELECTION FOR THE EXPERIMENT

Shortlisting and filtering of images with Committee Chair, to be distributed to experts in the field of Landscape Design

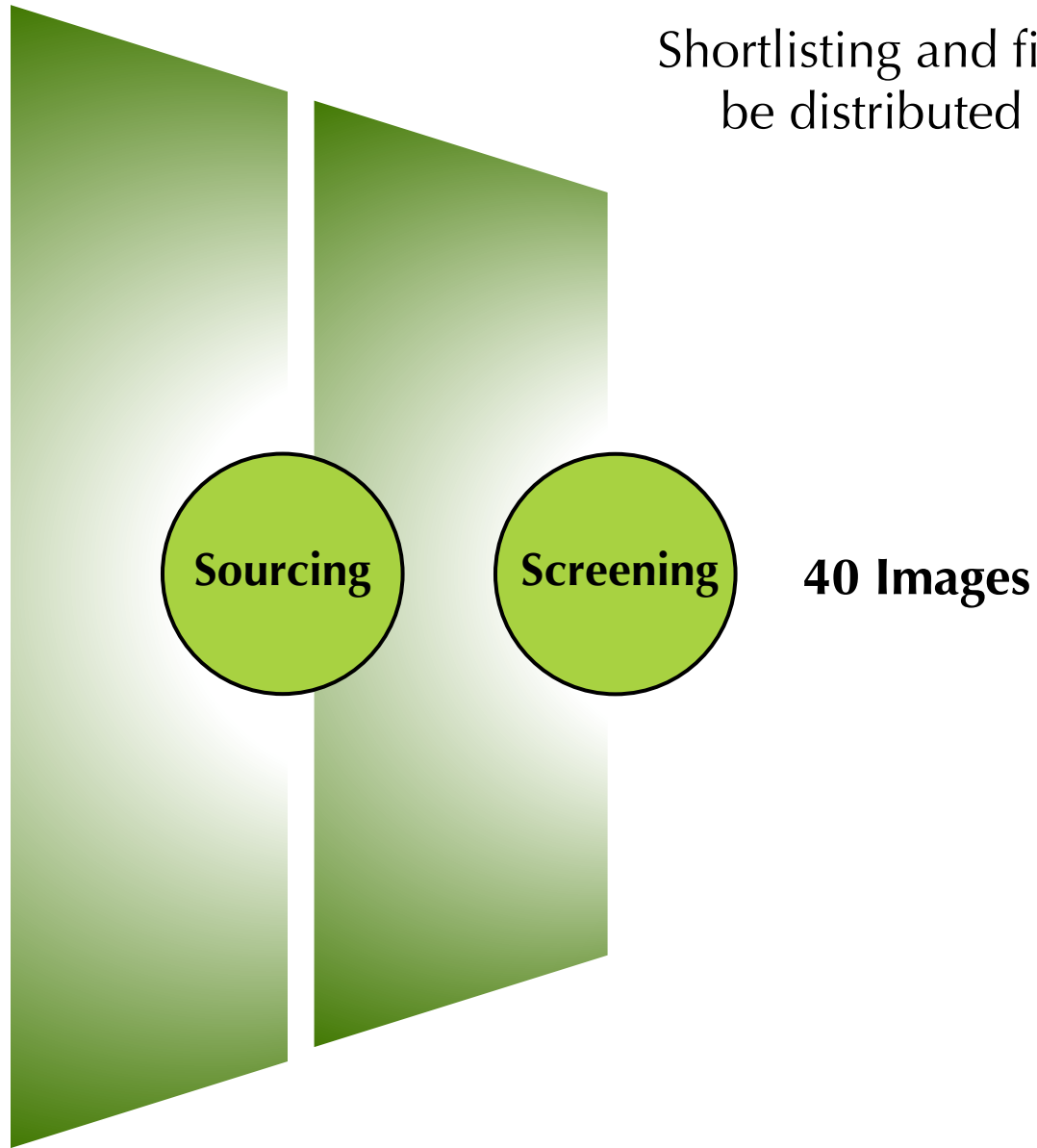


IMAGE SELECTION FOR THE EXPERIMENT

Top five ranked images by students, professors and experts in Landscape Design

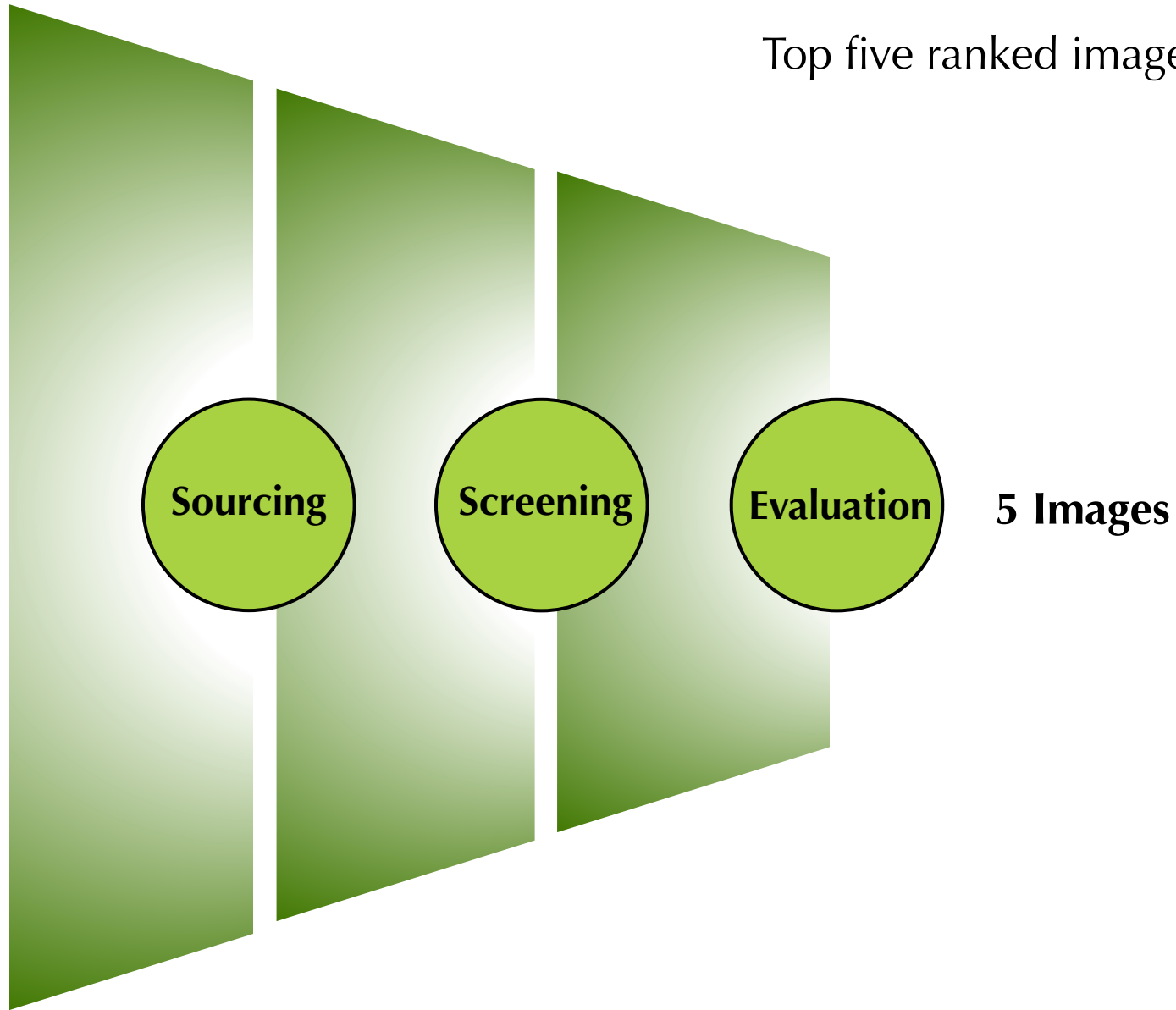
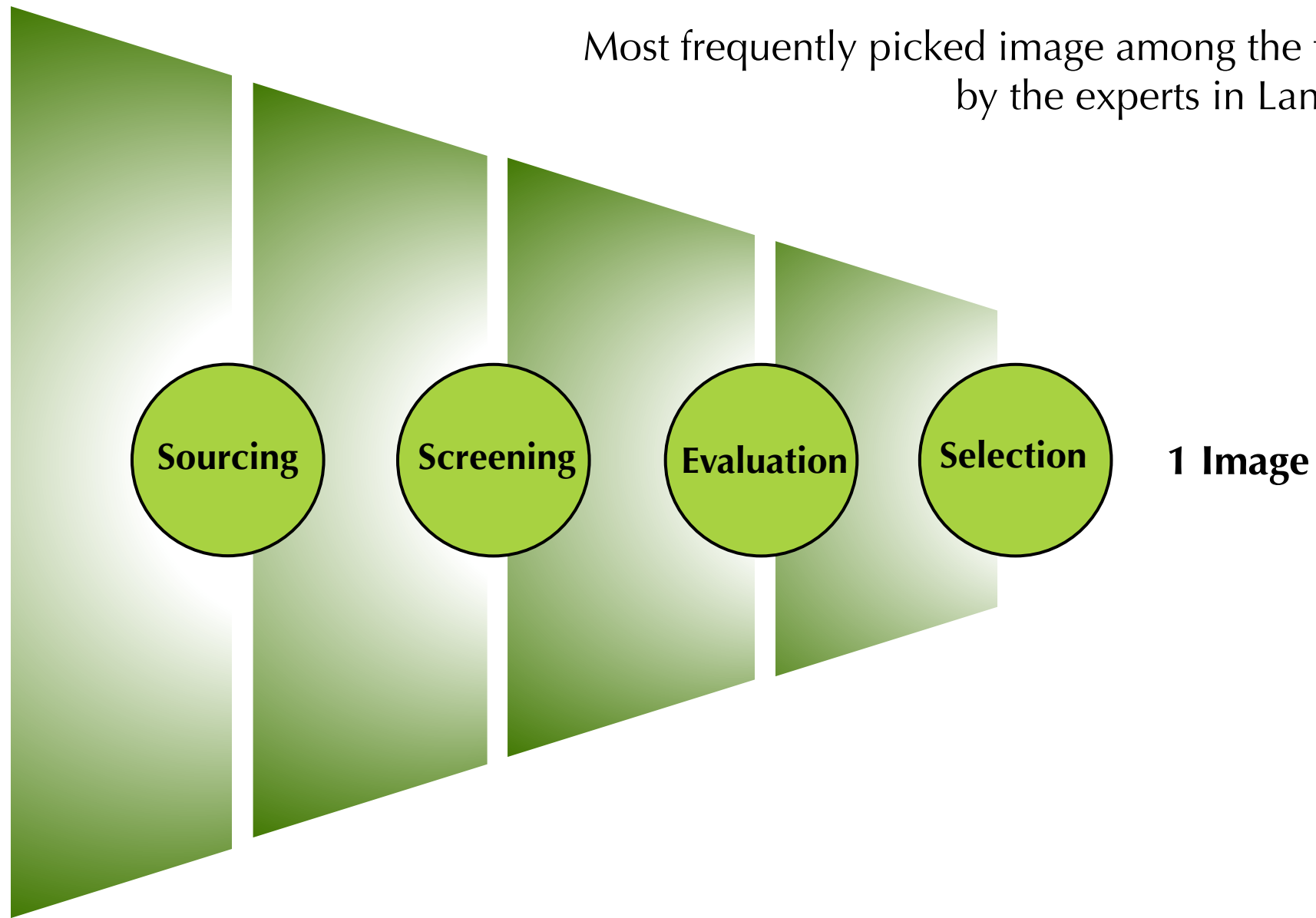


IMAGE SELECTION FOR THE EXPERIMENT

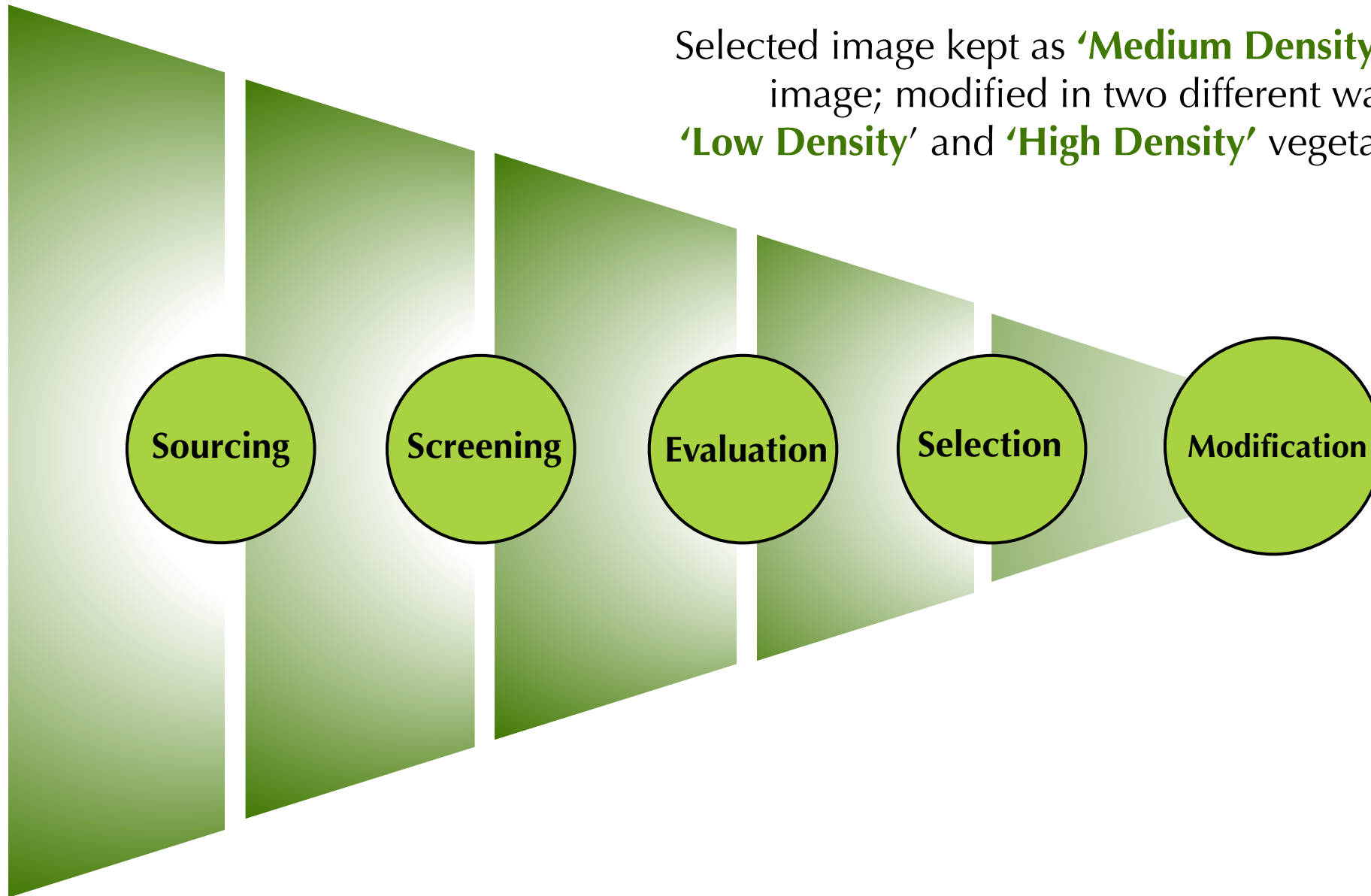




Selected Park Setting

IMAGE SELECTION FOR THE EXPERIMENT

Selected image kept as **'Medium Density'** vegetation image; modified in two different ways to create **'Low Density'** and **'High Density'** vegetation images



Medium Density Vegetation (50% Green Cover)

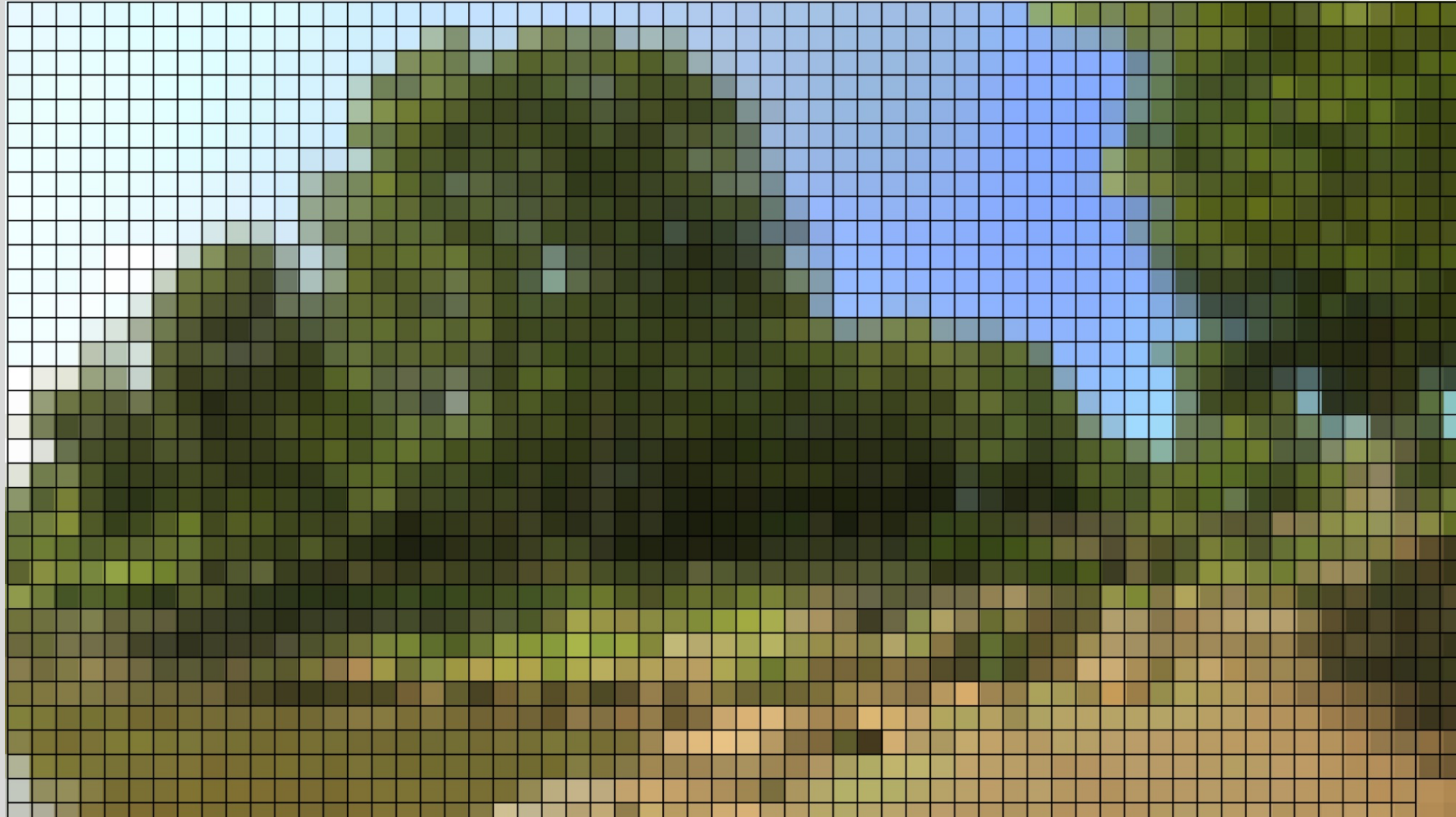


IMAGE MANIPULATION

The equirectangular image was modified as per requirements for the experiment.



IMAGE MODIFICATION



Medium Density Vegetation (50% Green Cover)



Low Density Vegetation (15% Green Cover)

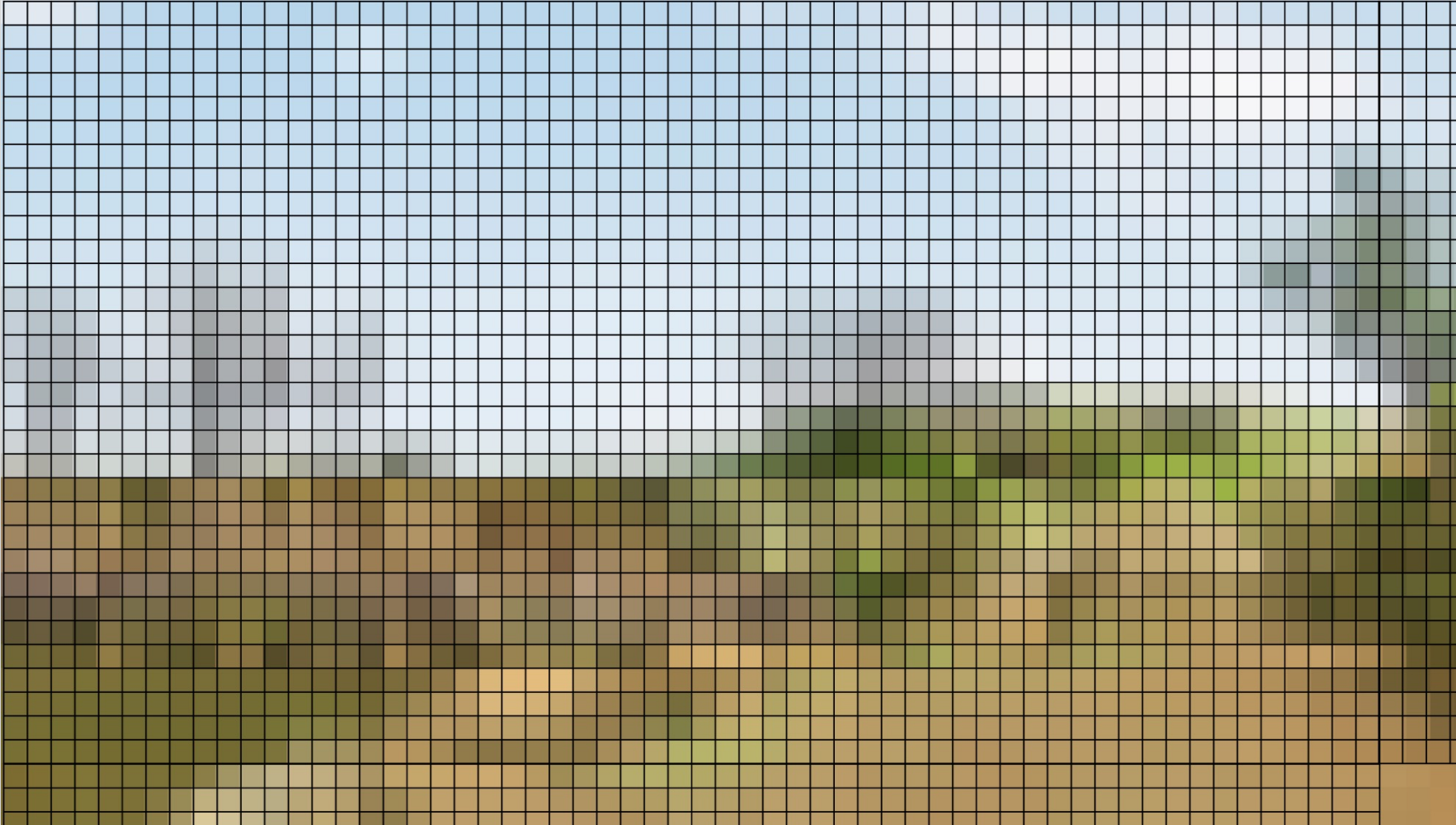


IMAGE MANIPULATION

The equirectangular image was modified as per requirements for the experiment.



IMAGE MODIFICATION



Low Density Vegetation (15% Green Cover)



High Density Vegetation (70% Green Cover)

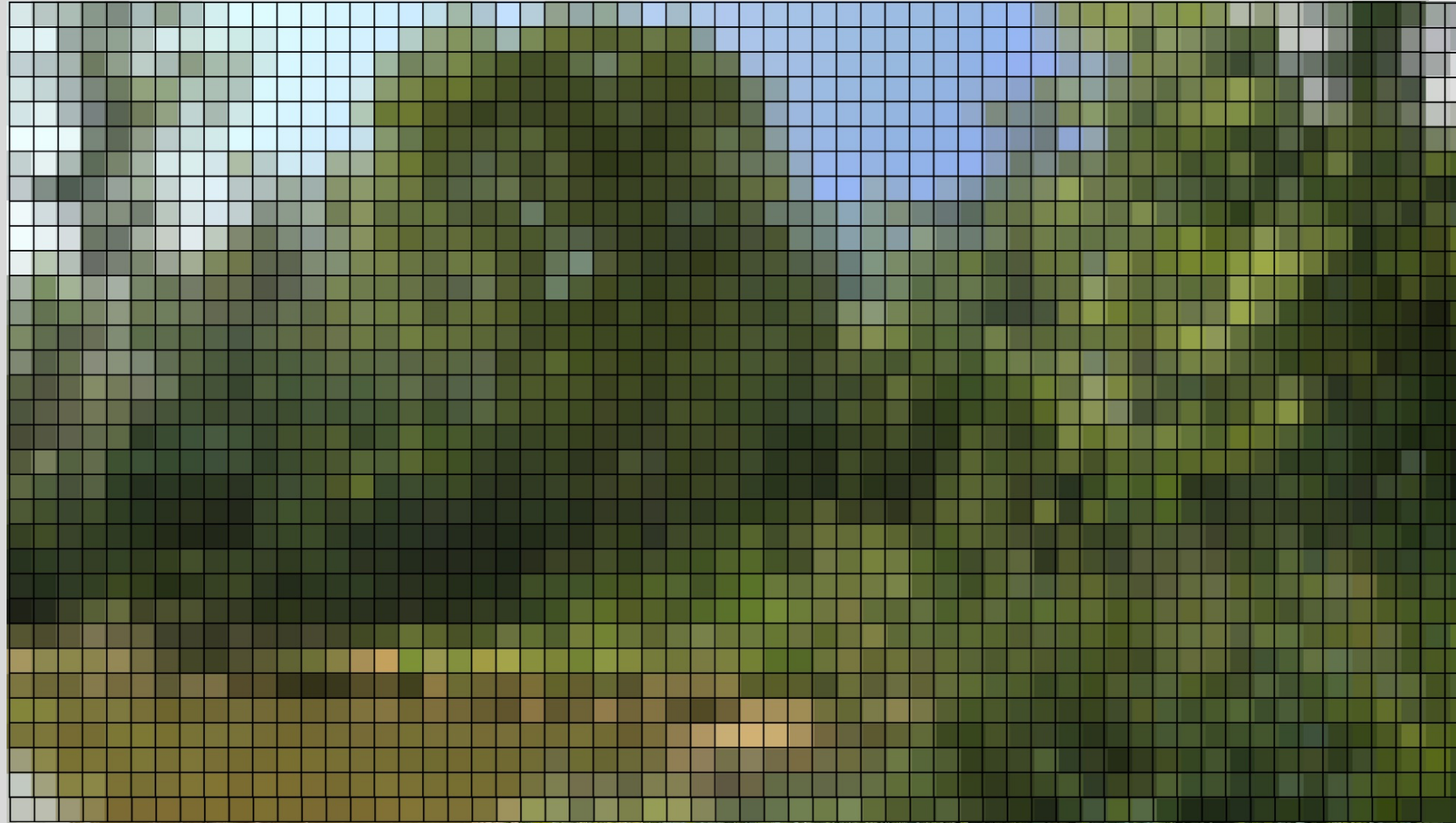


IMAGE MANIPULATION

The equirectangular image was modified as per requirements for the experiment.



IMAGE MODIFICATION



High Density Vegetation (70% Green Cover)



No Vegetation/ No Nature/ Control (0% Green Cover)



IMAGE MANIPULATION

The equirectangular image was modified as per requirements for the experiment.



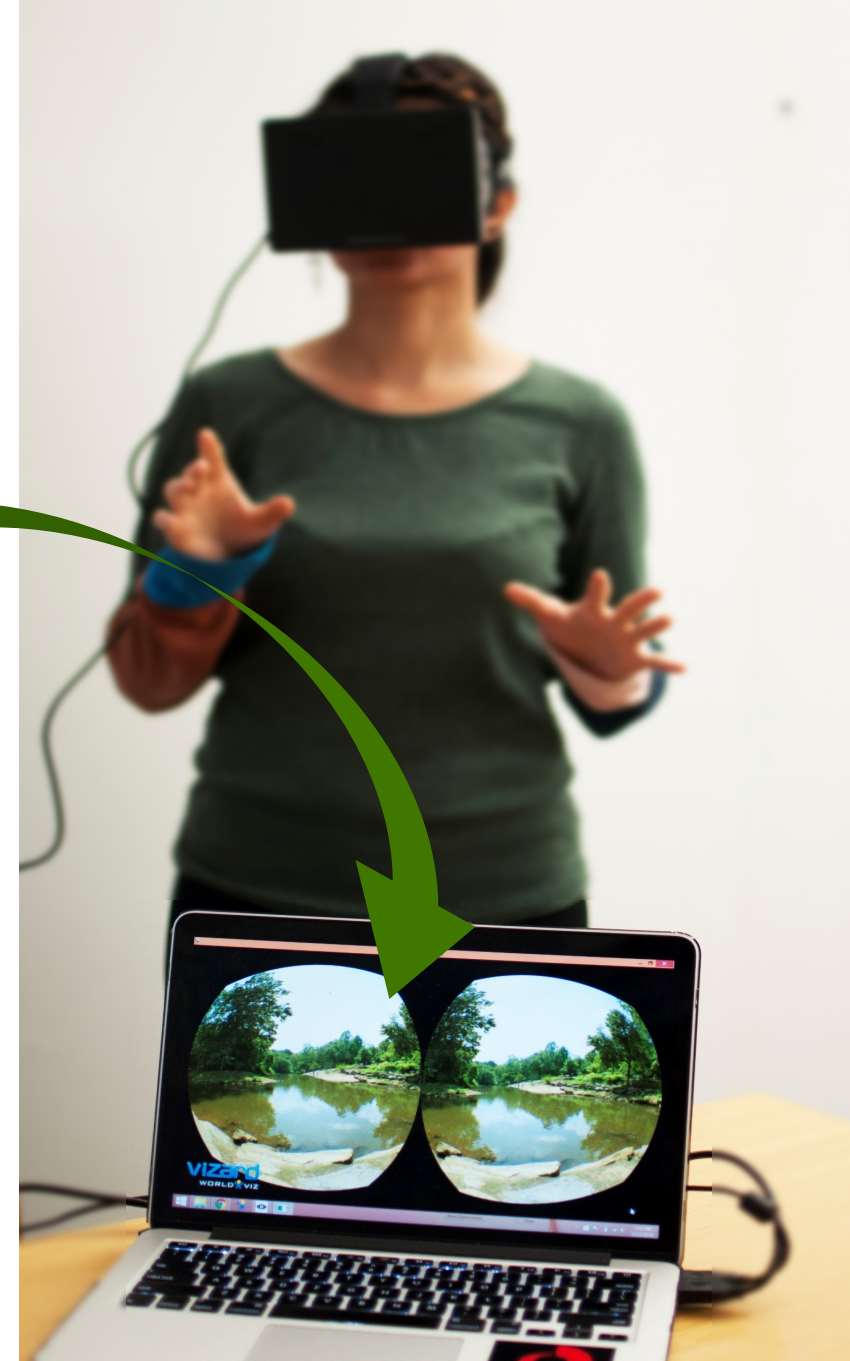
IMAGE CONVERSION FOR VIRTUAL ENVIRONMENT

Original and manipulated equirectangular images were then mapped to six sides of a virtual cube, known as cube-mapping. Each face of the cube was saved as a separate image and read by the dedicated virtual reality software. (Smith,2015)

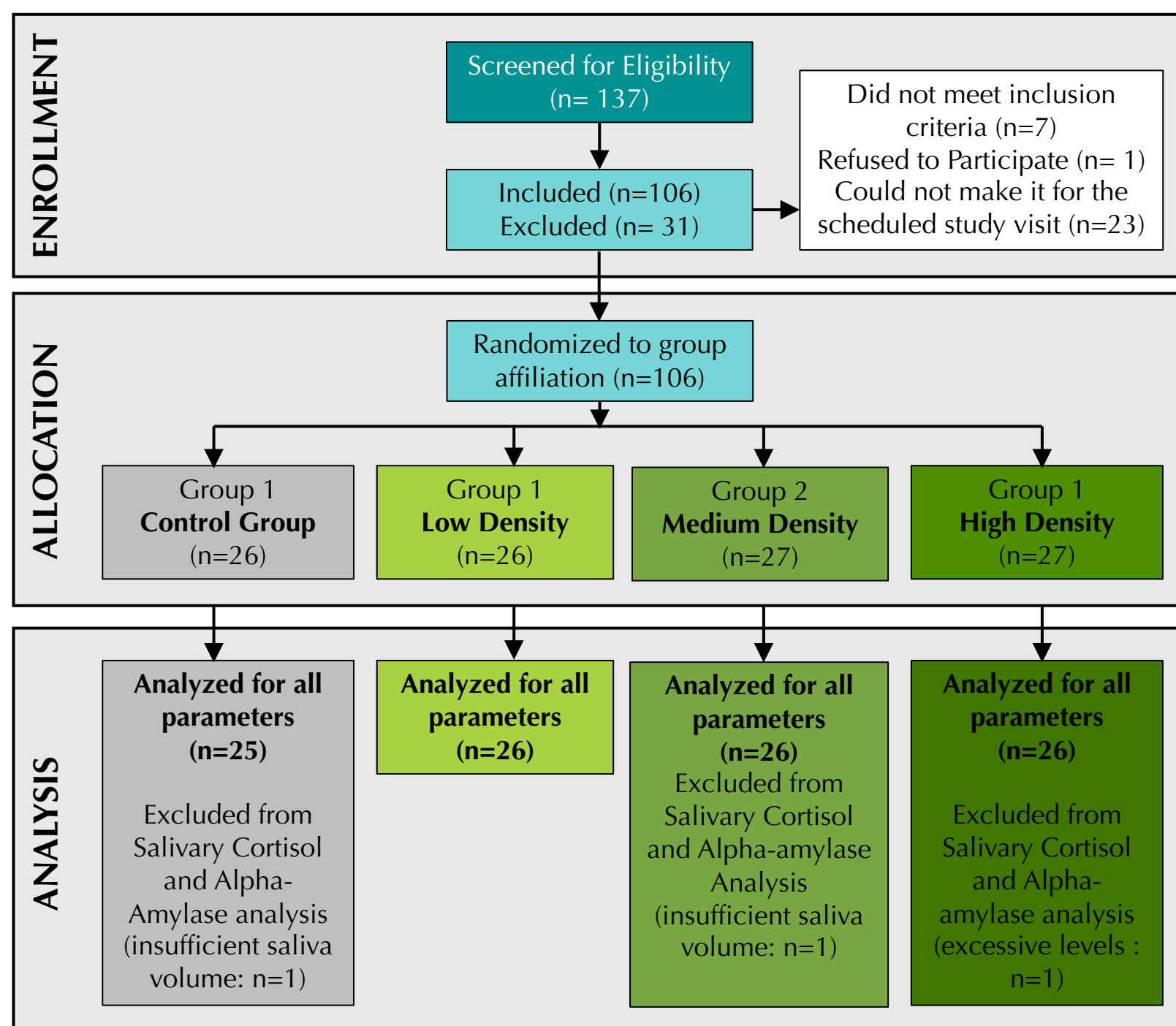


IMAGE PROJECTION USING OCULUS

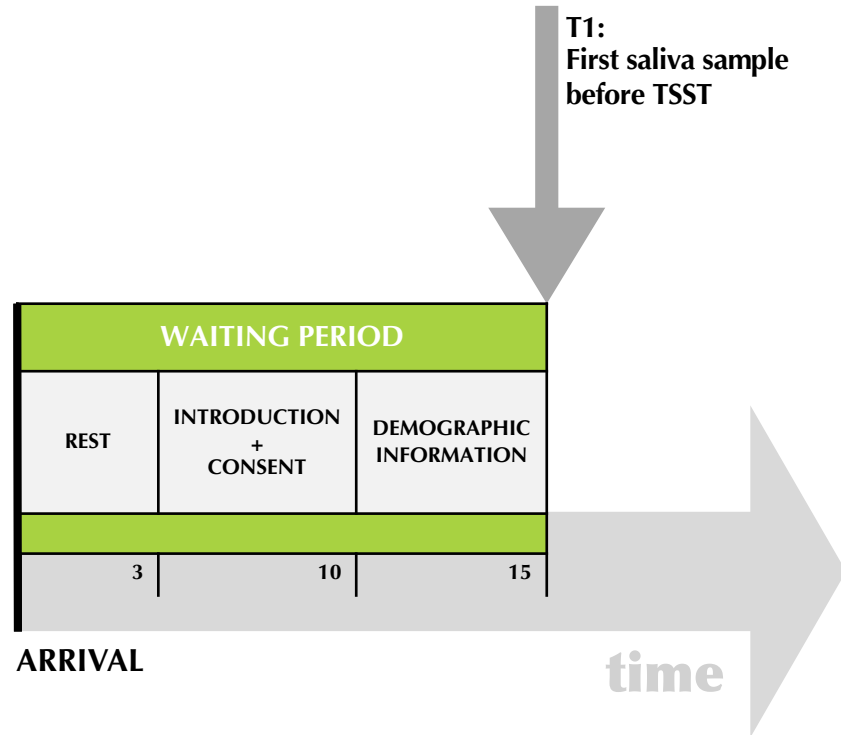
The Immersive Virtual Environment created was displayed using a head-mounted device, Oculus Rift and participants were allowed to experience this image for 3 minutes.



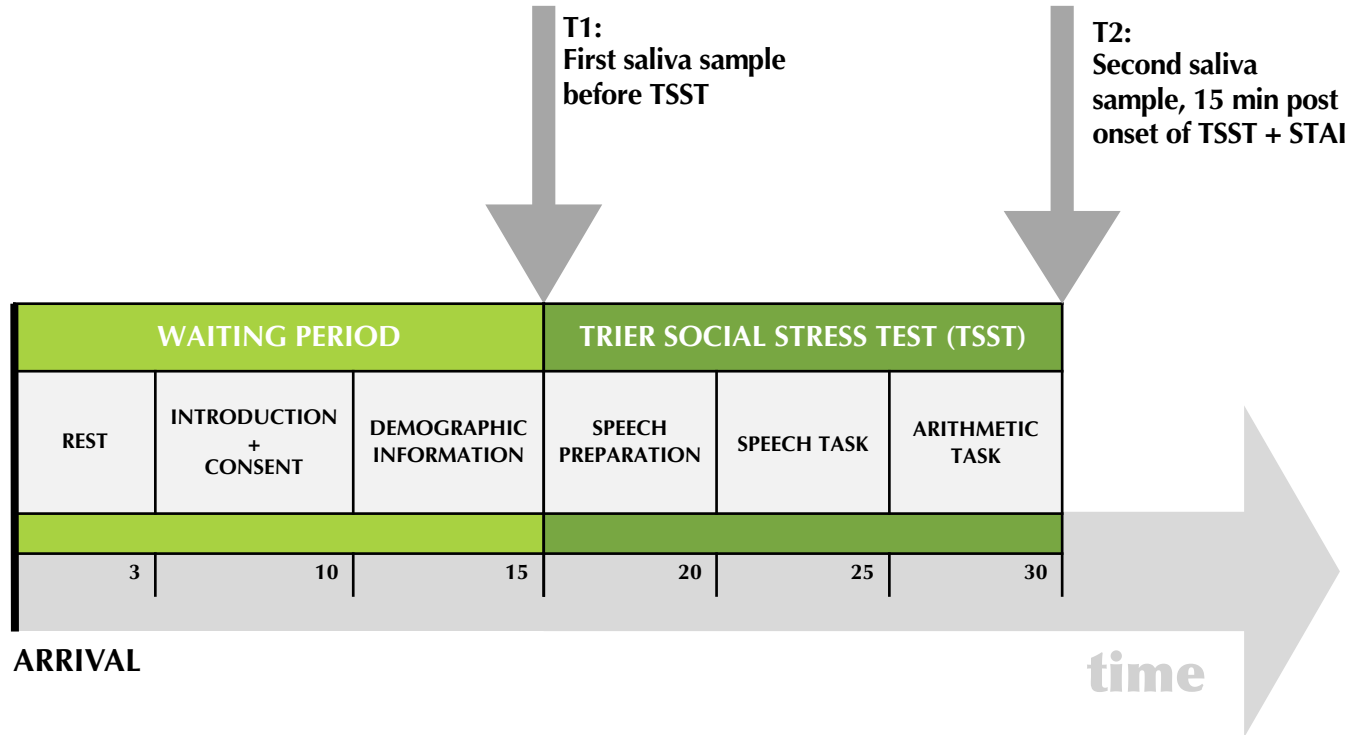
PARTICIPANT SAMPLE



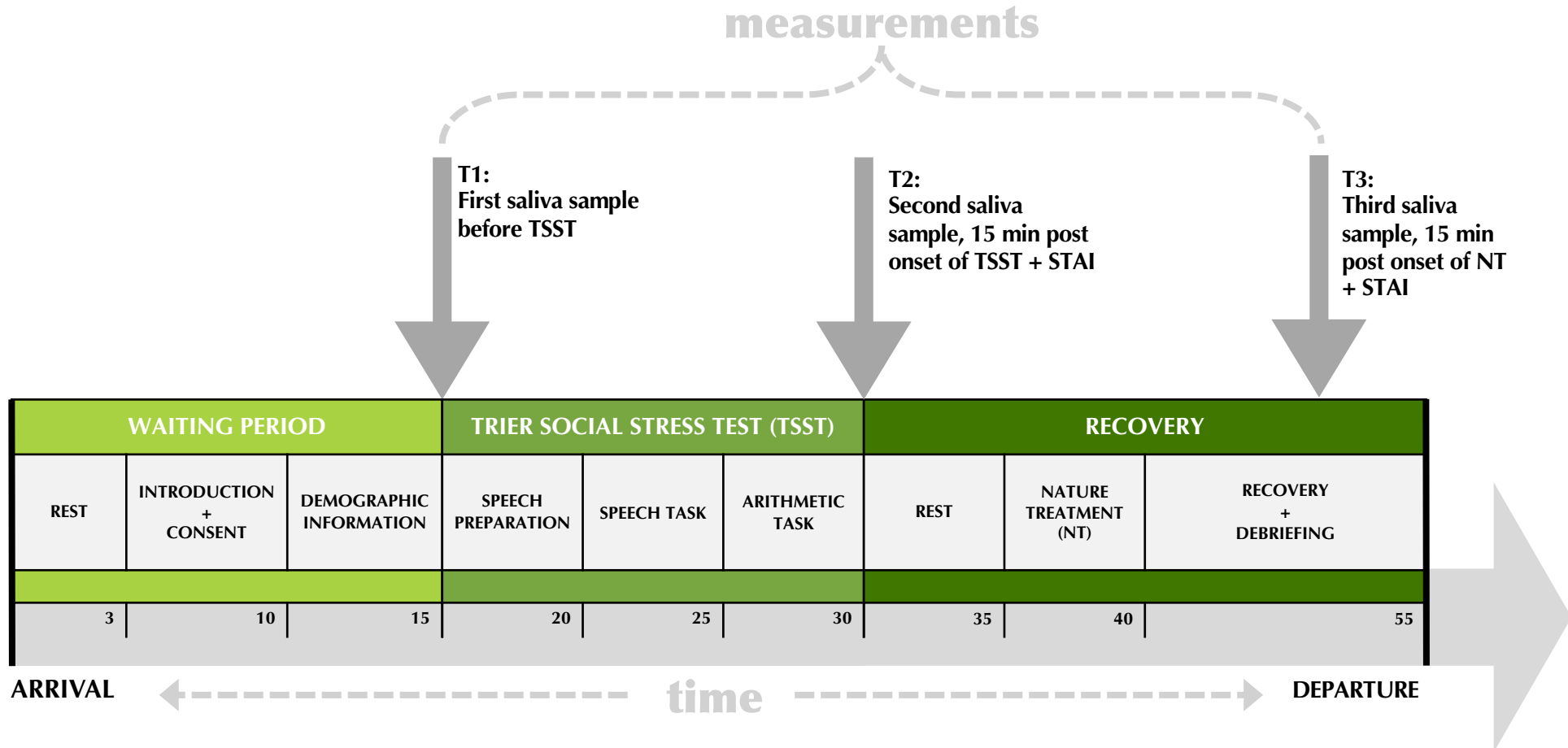
EXPERIMENTAL PROCEDURE:



EXPERIMENTAL PROCEDURE:

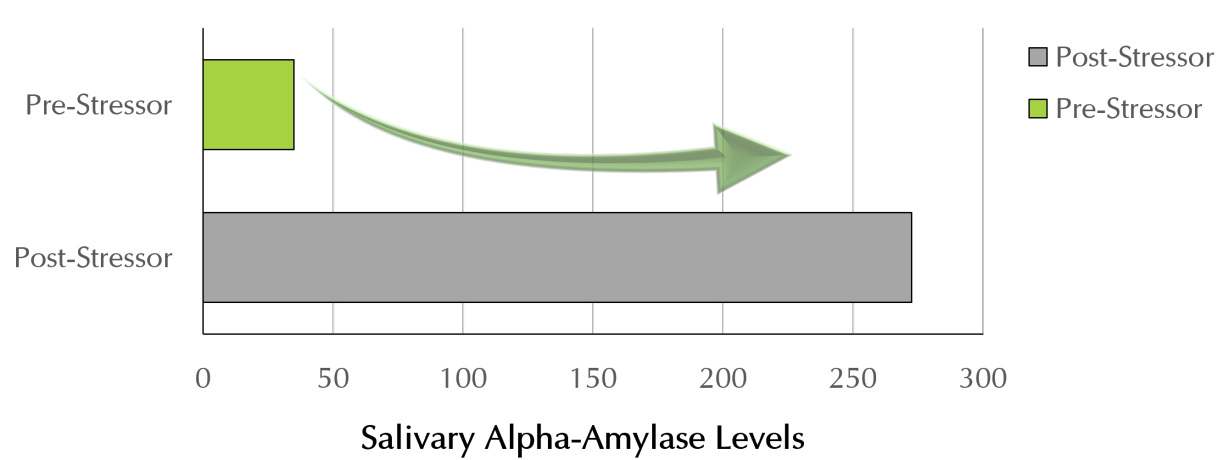


EXPERIMENTAL PROCEDURE:

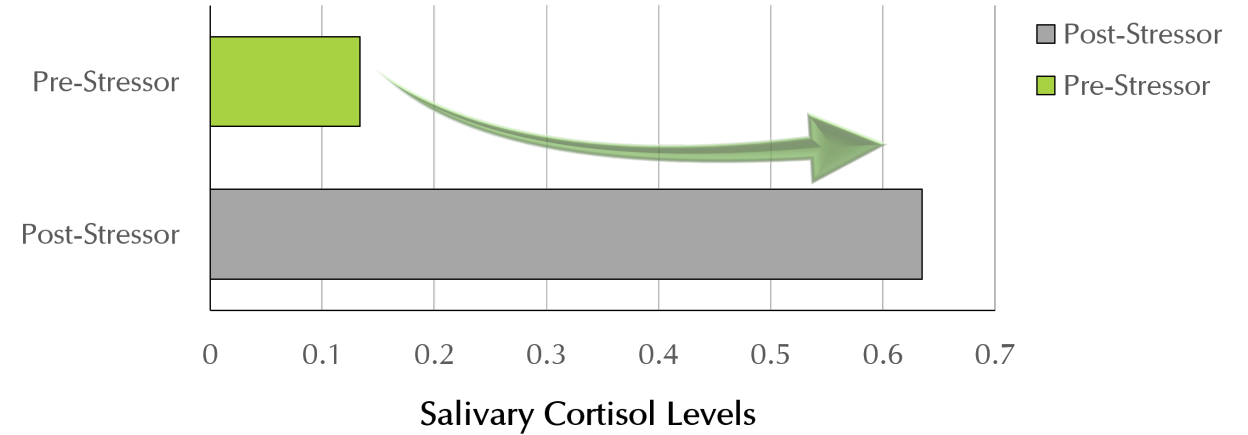


Research Question 1:

Can Trier Social Stress Test (TSST) serve as an effective tool for moderate stress induction in laboratory settings in Psychobiological and Human-Behavior studies?



More than 300% increase from T1 to T2



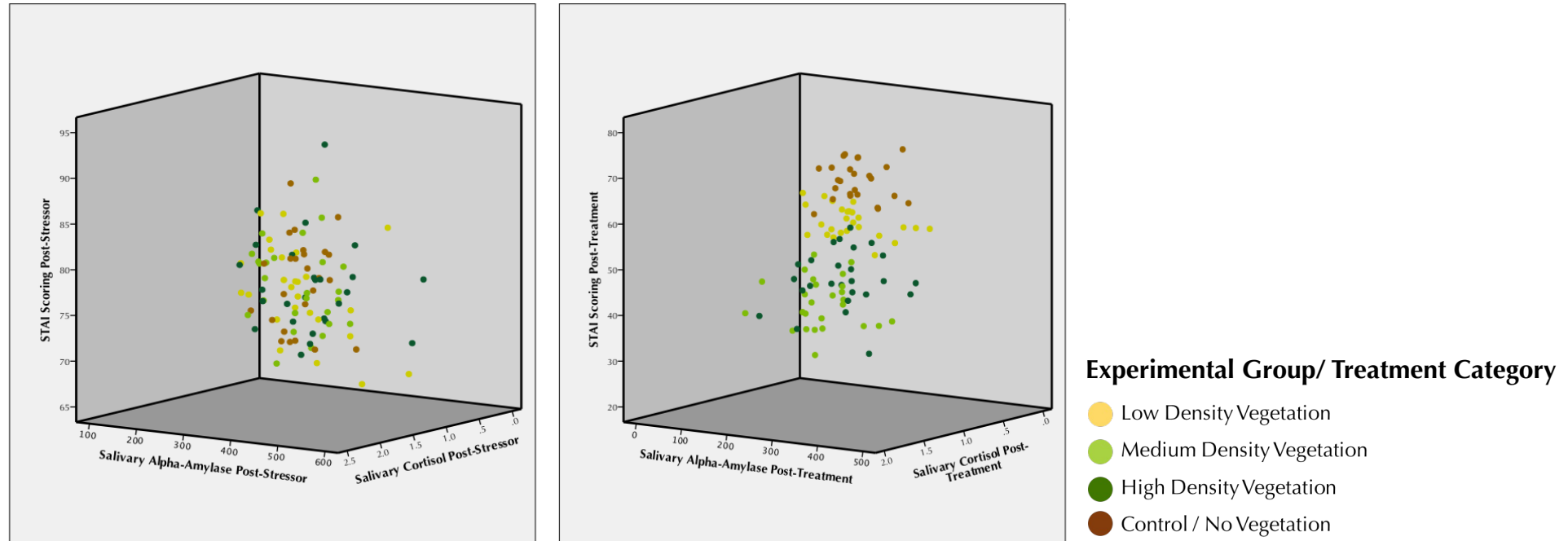
More than 55% increase from T1 to T2

Trier Social Stress Test (TSST) is a very effective and reliable tool for inducing moderate amount of psychological stress within a laboratory setting.



Research Question 2:

Does the stress measurement through Self-Reports complement the findings from Biomarkers of stress measurement including Salivary Alpha-Amylase and Cortisol?

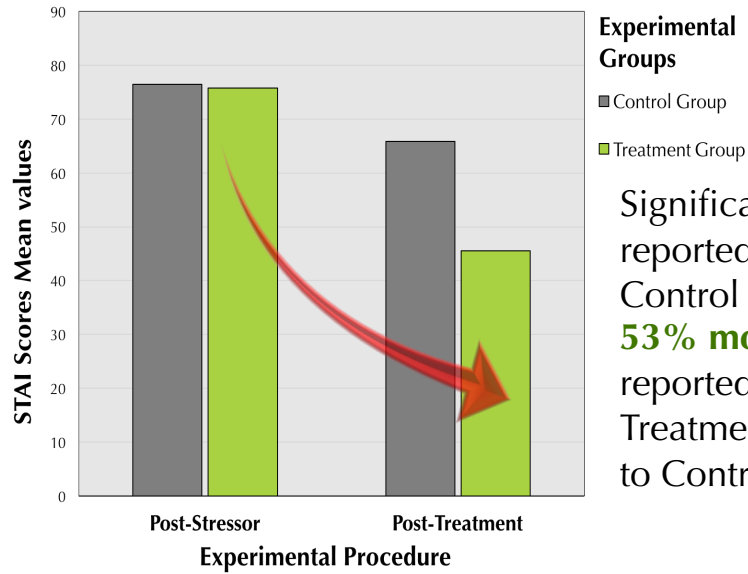


Physiological measures including Salivary Alpha-Amylase and Salivary Cortisol are reliable for quantifying Stress in Design Studies.
Self-reports also complement the findings from Biomarkers of stress measurements.

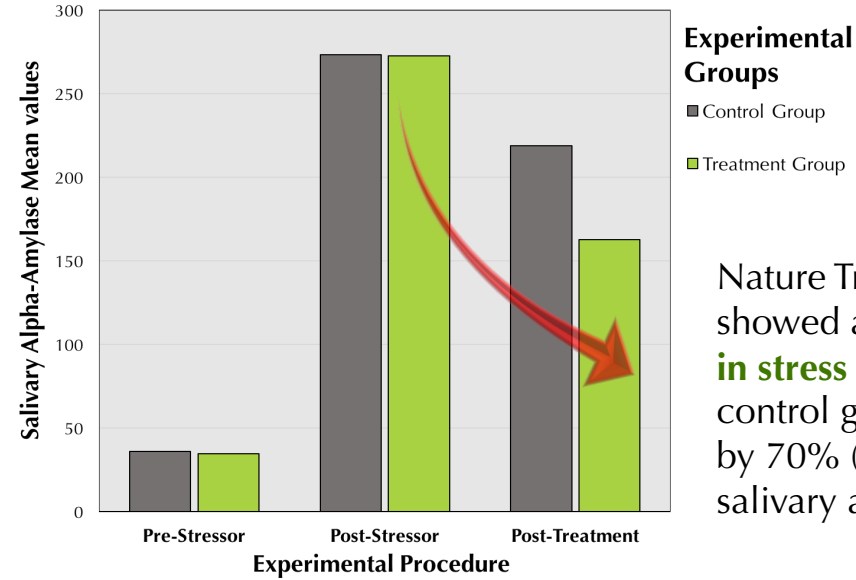


Research Question 3:

Is brief exposure to nature enough to produce a significant calming effect from a stressful event?



Significant difference in self-reported stress levels between Control and Treatment Groups. **53% more reduction** in self-reported stress levels in Treatment Group as compared to Control Group.



Nature Treatment participants showed a **110% (d= 1.10) reduction in stress levels** as compared to the control group that recovered by only 70% (d= 0.70) as measured from salivary alpha-amylase levels.

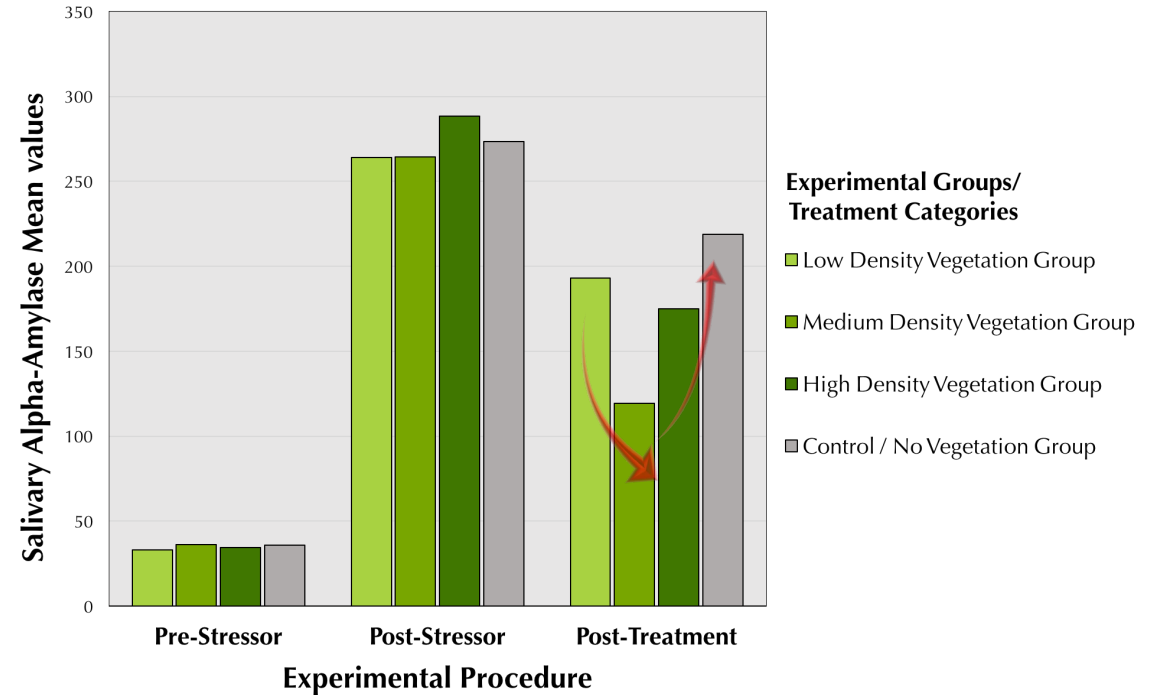
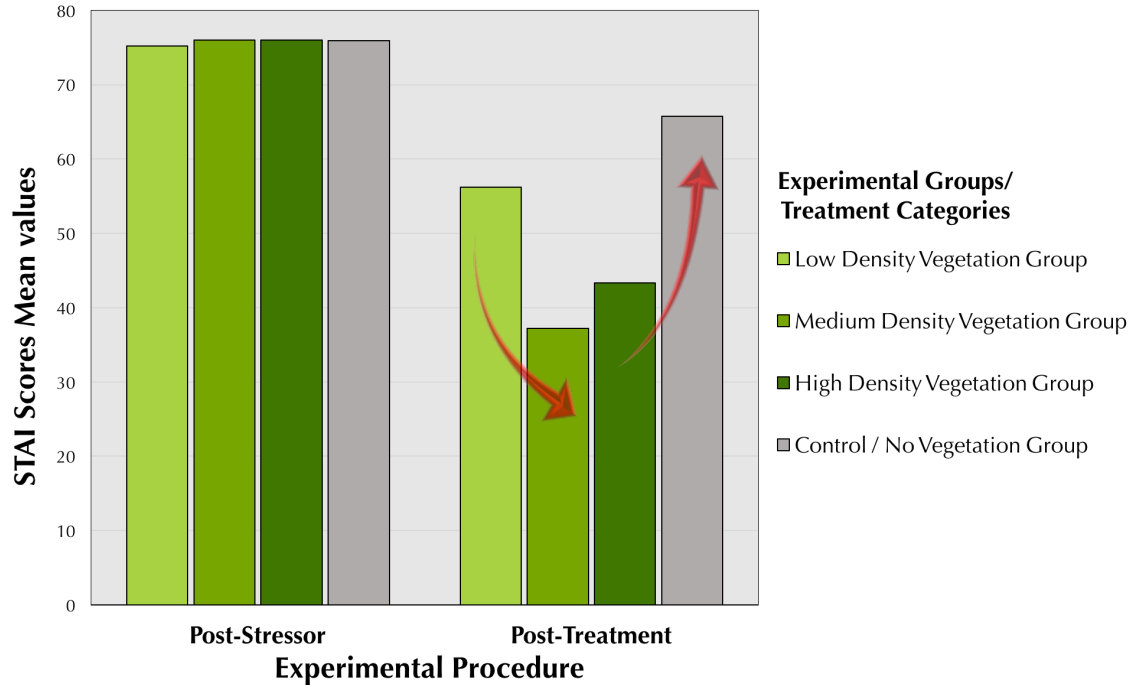
Exposure to nature aids faster recovery from stress.

Even brief contact with nature (3 minutes) is enough to produce significant calming effects after a stressful event.



Research Question 4:

When recovering from a stressful event, what amount of vegetation density produces maximum calming effect or fosters fastest recovery from stress?



Low Density Group = 77% (Cohen's $d=0.772$)
Medium Density Group = 177% (Cohen's $d=1.769$)
High Density Group = 115% (Cohen's $d=1.157$)
Control Group = 70% (Cohen's $d=0.701$)

Levels of Stress change with changes in Vegetation Densities.

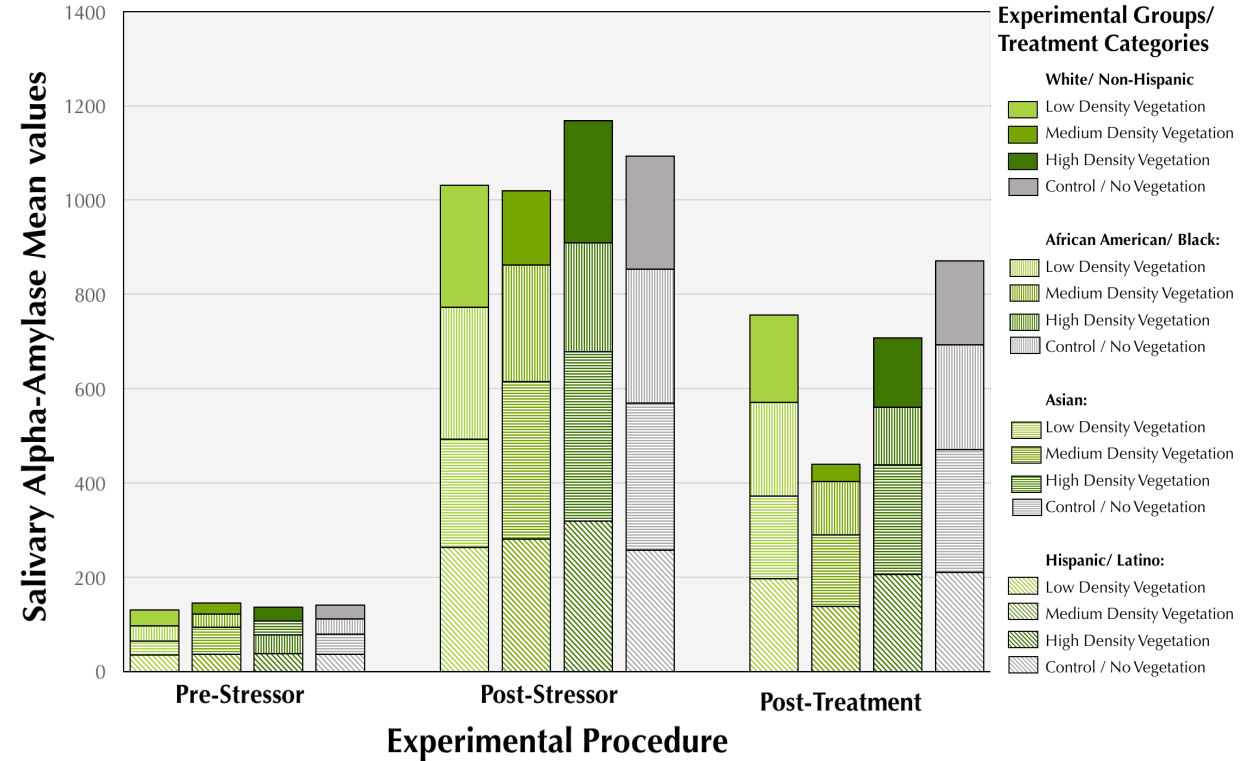
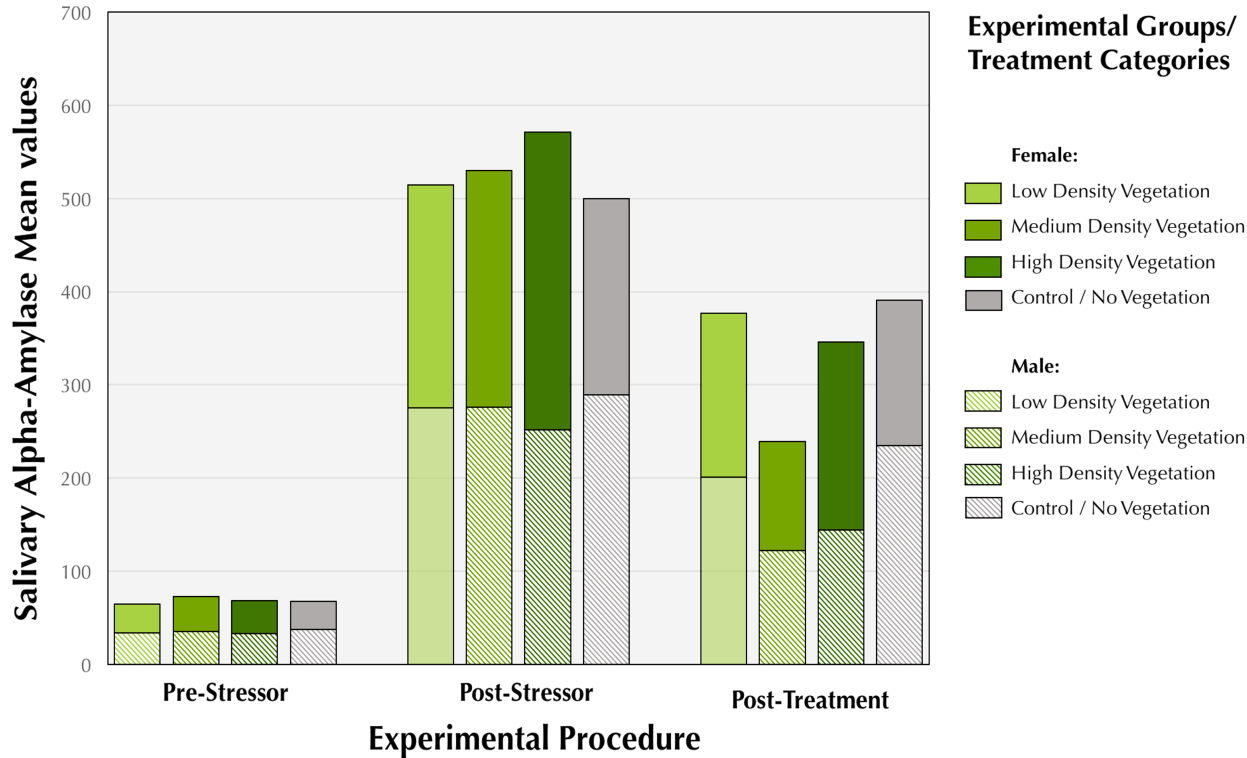
As the percentage of vegetation cover increases from barren to greener scenes, there is a rapid decrease in stress until the density of vegetation reaches about 50% of the visible space; higher densities predict higher stress.



Research Question 5:

Does gender and race/ ethnicity lead to any differences in the relationship between exposure to nature and stress recovery when controlling for age?

Post-Hoc Analysis of Group Differences by Gender & Race/ Ethnicity



Levels of Stress change were consistent across all Gender and Race/ Ethnicity groups.



Research Question 6:

Apart from vegetation densities, what other design attributes of urban parks support restoration, provide calming effects and help in recovery from acute urban stress in people?

Visual Appeal of the Urban Park Images



Low Density Vegetation

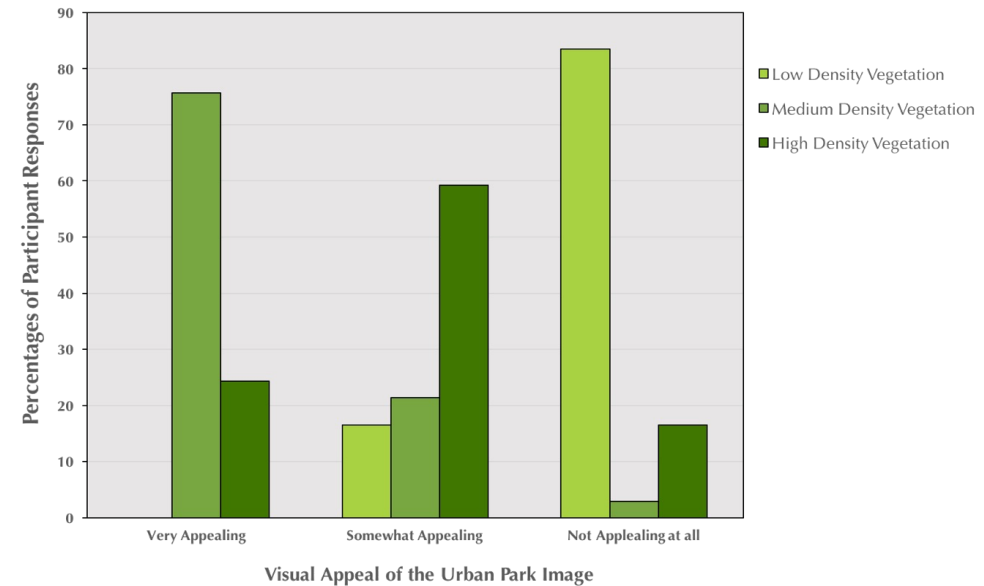


Medium Density Vegetation



High Density Vegetation

How appealing are the images?					
		Very Appealing	Somewhat Appealing	Not Appealing	Total
Low Density	Frequency	0	17	86	103
	Percentage	0	16.5	83.5	100
Medium Density	Frequency	78	25	3	103
	Percentage	75.7	21.4	2.9	100
High Density	Frequency	25	61	17	103
	Percentage	24.3	59.2	16.5	100





Too Structured = Limited Choice



Too Complex = Scary



Too Open = Boring/ Unexciting



Moderate Complexity= Legible, Controlled
Balanced Structure = Not overwhelming, Not over determined
Semi-Open= Engaging, Interesting, Simulating

Strengths of the Study:



- Contribution to Environment- Behavior Research
- Methodological Innovation

Limitations of the Study:



- Statistical Limitation
- Methodological Instrument Limitation
- Outcome Measurement Limitation
- Challenge of Defining Less Measurable Attributes
- Lack of External Validity

Implications for Future Policy, Design and Research:



Policy/ Decision Markers:

Findings identify some elements that impart maximum restoration and can be transported to downtowns and similar effects of the natural landscapes can be obtained even within the limited green space in the urban environments.

Designers:

Findings can be translated to park design practice in order to design parks and green spaces that support restoration and enhance mental well-being within the urban context.

Researchers:

The study protocol established in this research to systematically examine and distinguish urban design features in association with stress recovery also has potential in both fields of design and research.



Thank You

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