Impacts of urban green landscapes on citizens' mental health & well-being

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HKURBAN Lab
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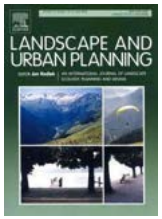

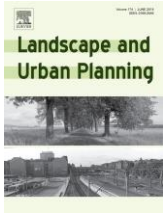

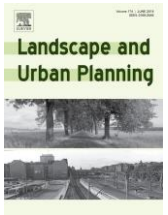

frontiers in Psychology

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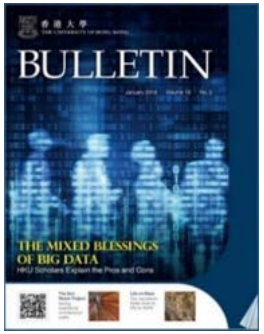
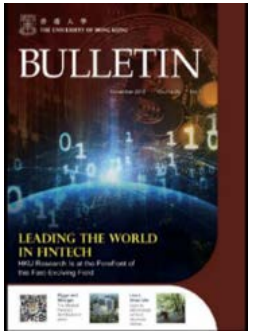




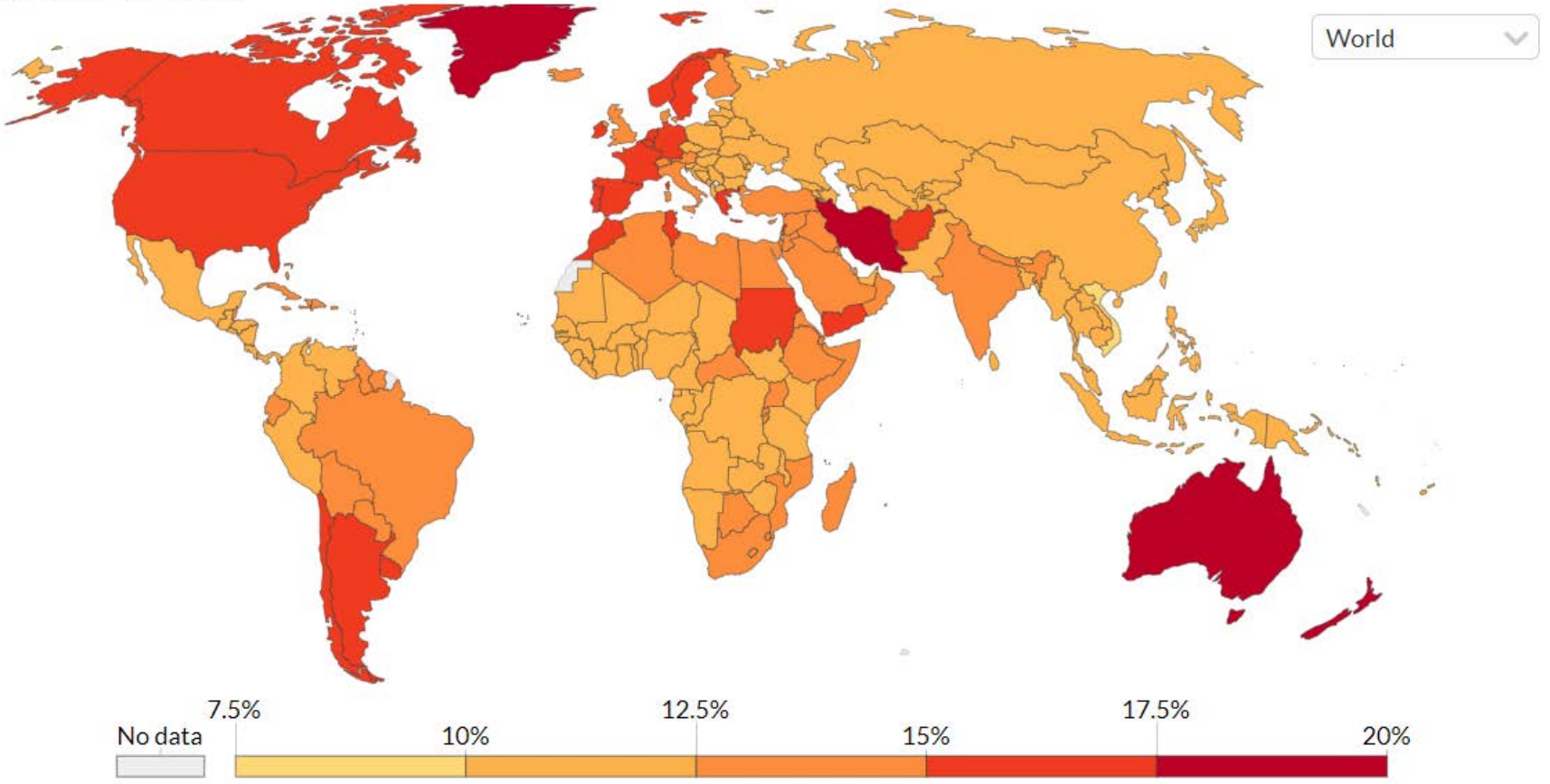
TREES are the key to keeping calm: Researchers found those who watched 3D video of tree lined streets 'significantly improved' their state of mind

- Just six minutes of watching 3D video of tree lined streets had major effect
- Researchers say study shows importance of green spaces in cities

Share of population with mental health and substance use disorders, 2017

Our World in Data

Share of population with any mental health or substance use disorder; this includes depression, anxiety, bipolar, eating disorders, alcohol or drug use disorders, and schizophrenia. Due to the widespread under-diagnosis, these estimates use a combination of sources, including medical and national records, epidemiological data, survey data, and meta-regression models.



Source: IHME, Global Burden of Disease

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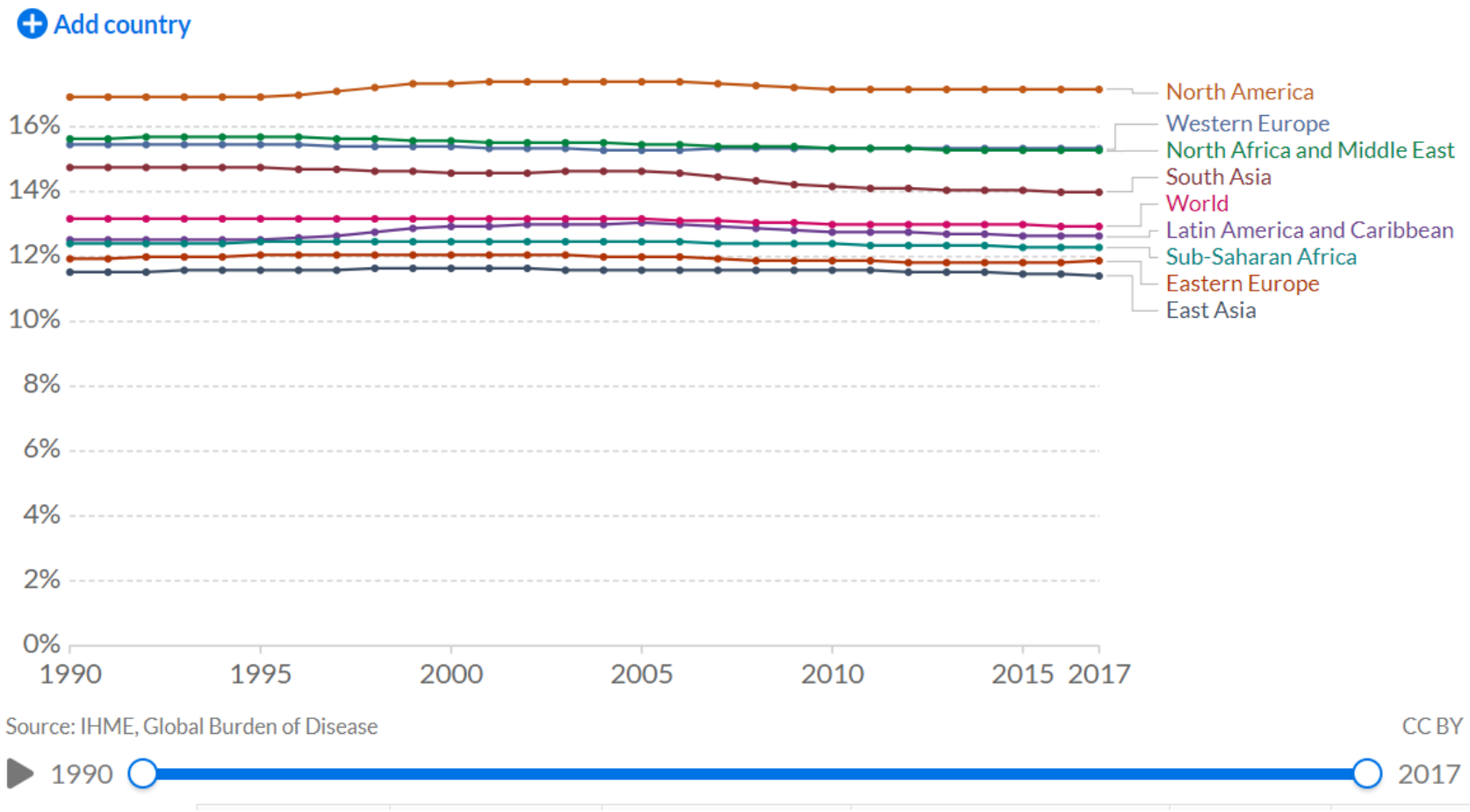
1990 2017

Source: https://ourworldindata.org/mental-health

Share of population with mental health and substance use disorders, 1990 to 2017

Our World in Data

Share of population with any mental health or substance use disorder; this includes depression, anxiety, bipolar, eating disorders, alcohol or drug use disorders, and schizophrenia. Due to the widespread under-diagnosis, these estimates use a combination of sources, including medical and national records, epidemiological data, survey data, and meta-regression models.



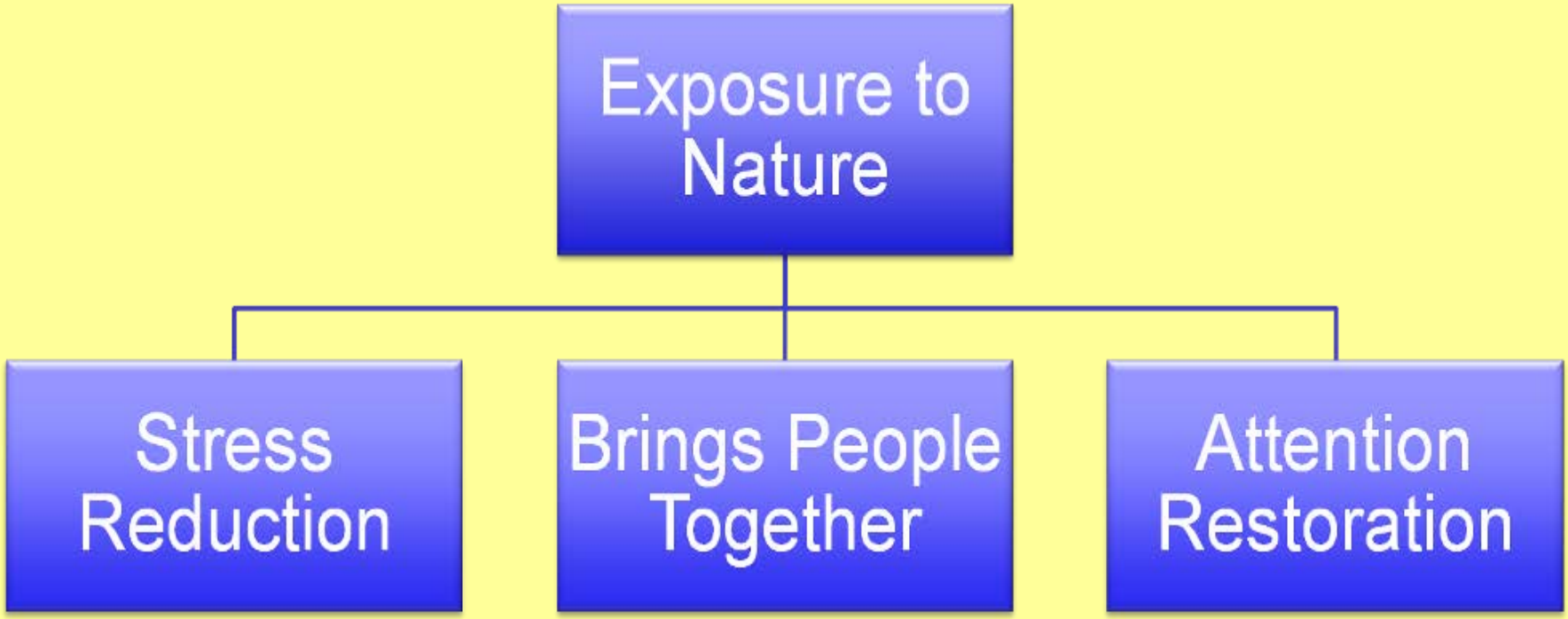
Source: https://ourworldindata.org/mental-health

Urban Green & Mental Health

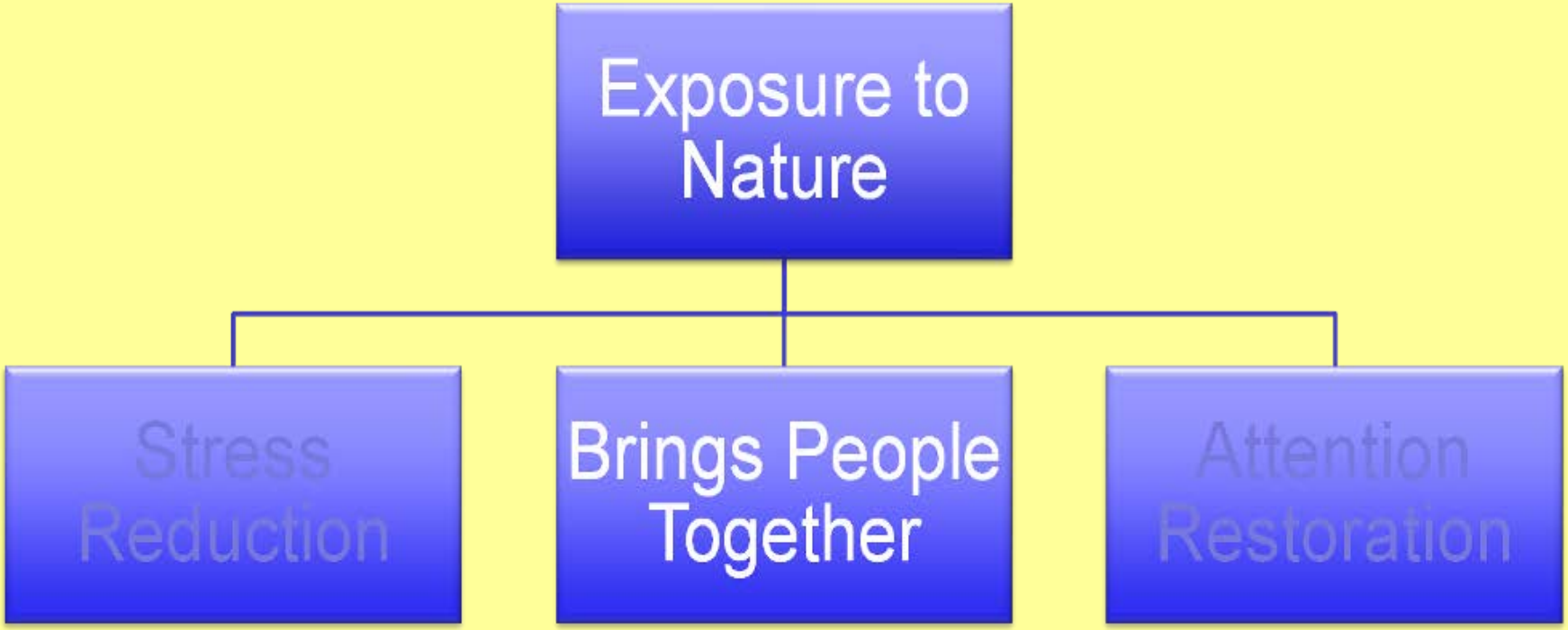
Three mechanisms (3 studies)

Ten actions

Three Mechanisms



Mechanism 1. Social Justice



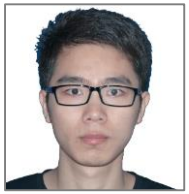
Green spaces
make people have more trust and love

Study A

Provision of green landscapes significantly mitigates racial disparity in COVID-19 infection rate:
A nationwide study

Research Team

Yi Lu



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CSH Cold Spring Harbor Laboratory BMJ Yale

Comment on this paper

A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States

Yi Lu, Long Chen, Xueming Liu, Yuwen Yang, Wenyan Xu, Chris Webster, William C. Sullivan, Bin Jiang

doi: https://doi.org/10.1101/2020.11.11.20228130

Highlights

- The first study to identify significant relationships between green spaces and the racial disparity of SARS-CoV-2 infection rates.
- A nationwide study of the 135 most urbanized counties of the United States.
- A within-subject study: The black-white racial disparity of SARS-CoV-2 infection rates was measured within each county.
- A higher ratio of green spaces in a county is associated with a lower racial disparity of SARS-CoV-2 infection rates after controlling for socio-economic, demographic, pre-existing chronic disease, and built-up area factors.
- Four green space factors are significantly associated with a lower racial disparity of SARS-CoV-2 infection rates.

Lu, Y., Chen, L., Liu, X., Yang, Y., Xu, W., Webster, C., Sullivan, W. C., Jiang, B. (2020) A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. medRxiv 2020.11.11.20228130; doi: https://doi.org/10.1101/2020.11.11.20228130.

Racial disparity

Racial disparity

Socioeconomic Disparity

Health Disparity

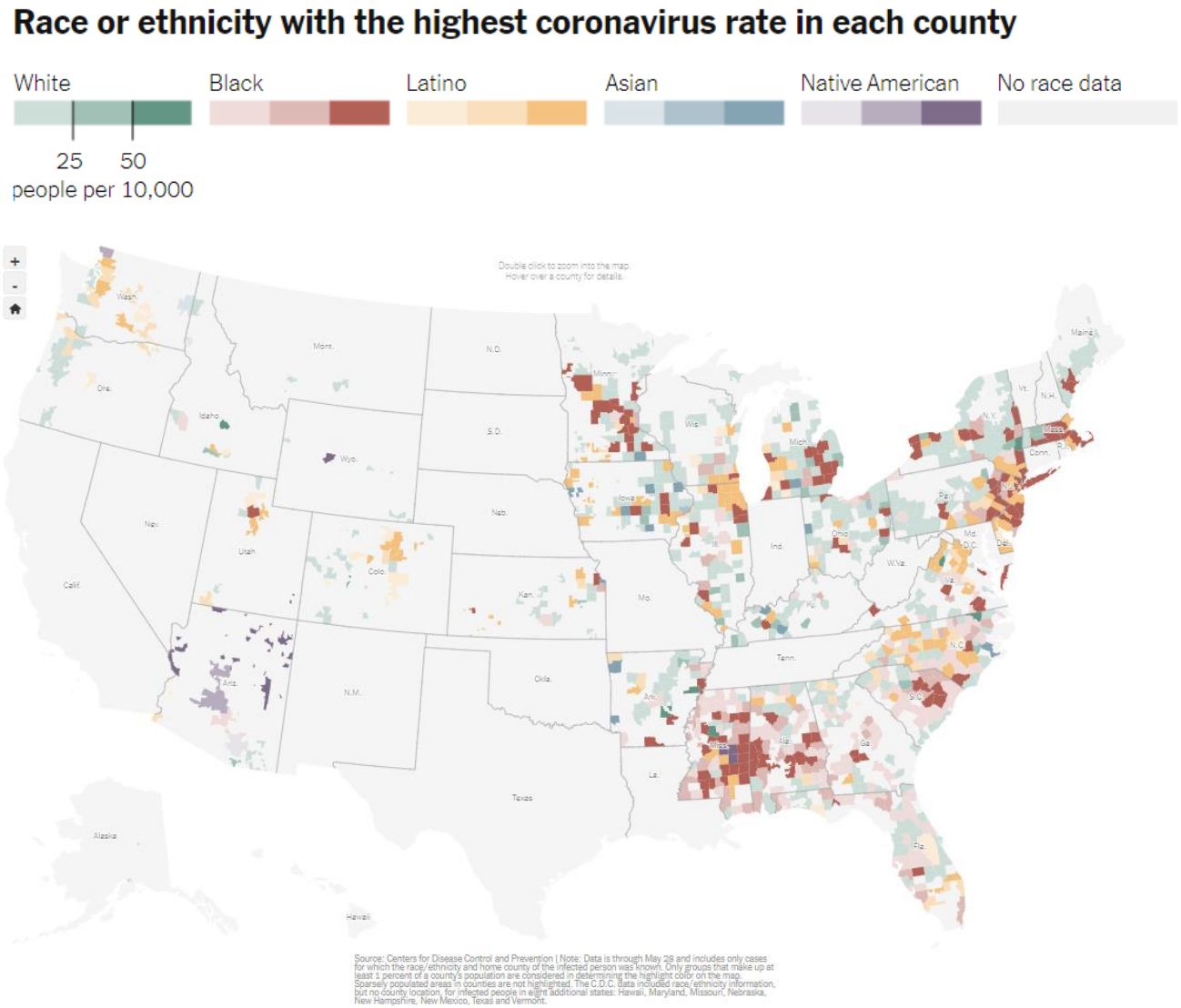
Racial disparity

Socioeconomic Disparity

Environmental Disparity

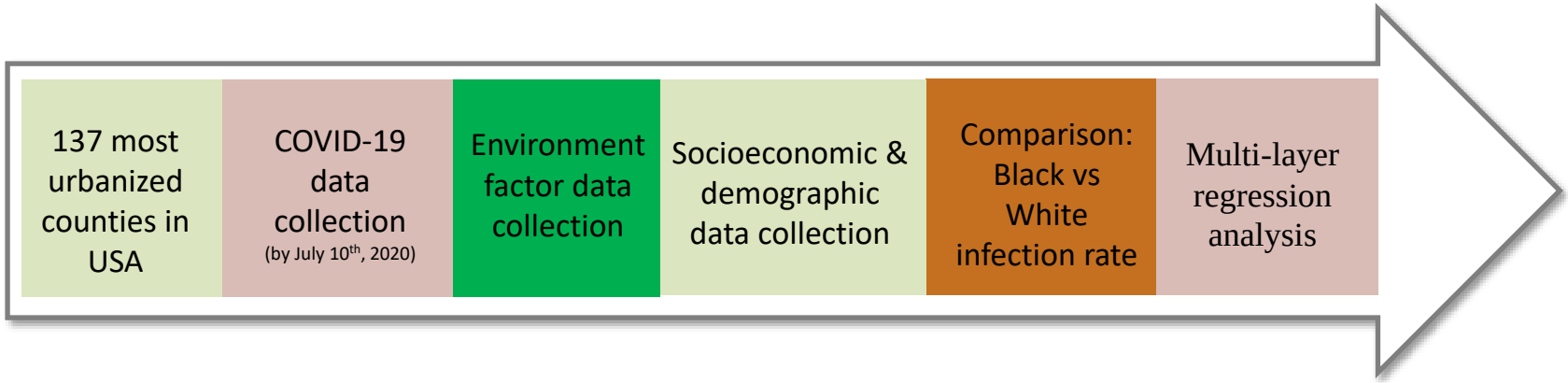
Health Disparity

Racial disparity in COVID-19 infection rate



Source: https://www.nytimes.com/interactive/2020/07/05/us/coronavirus-latinos-african-americans-cdc-data.html

Procedure

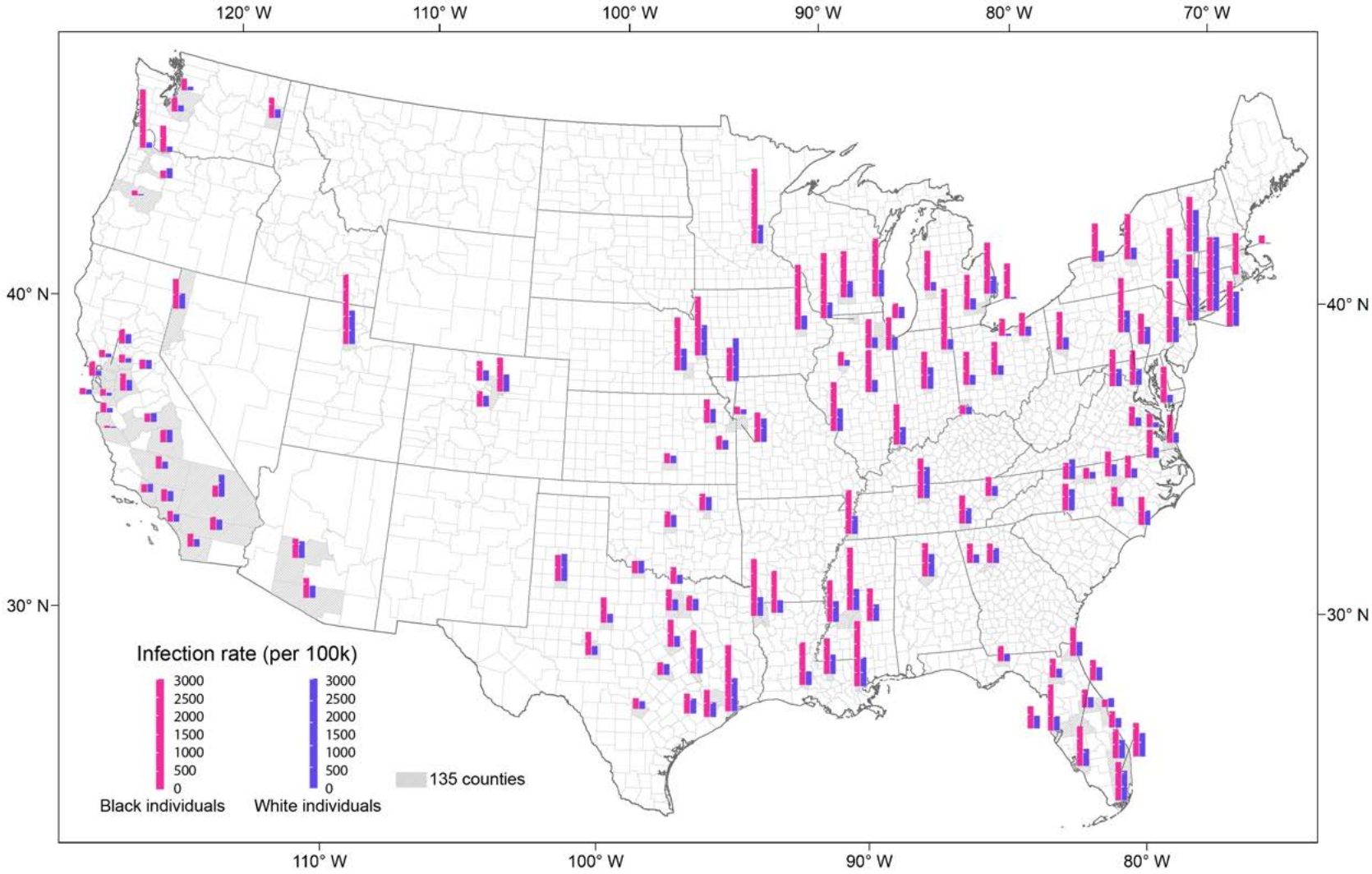


Within-County Comparison Study

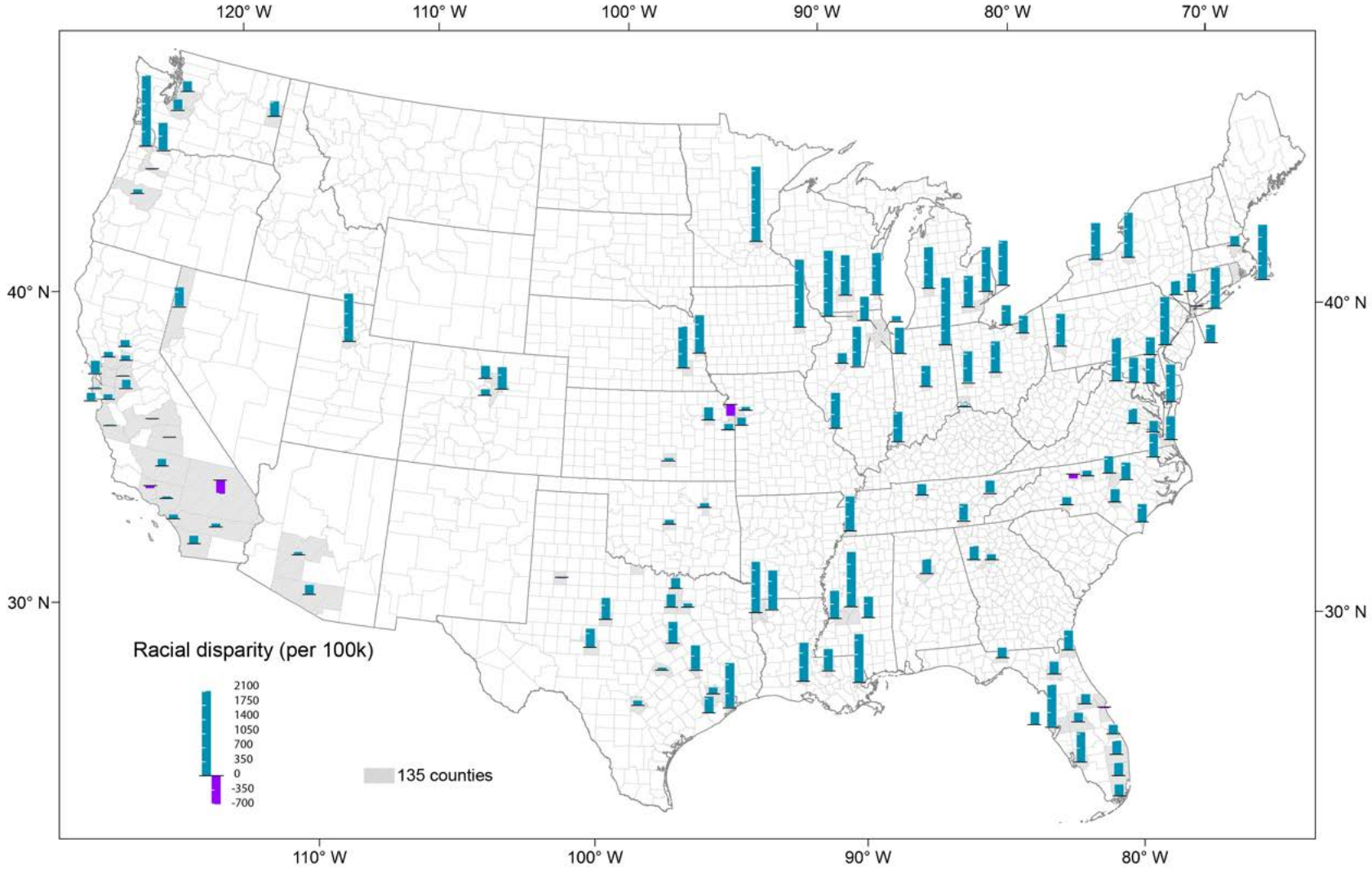
The paired t-test was conducted to examine the difference between Black infection rate and White infection rate

There is a significant difference of infection rate (per 100k individuals) between Black and White (t=13.241, p<0.001). The error bar: 1 Standard Deviation.

The distribution of Black and white infection rate per 100k

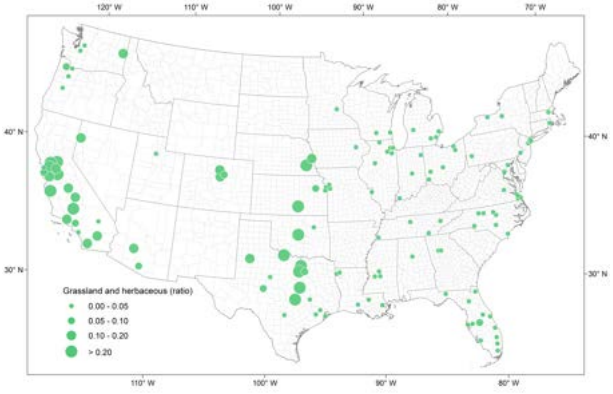


The distribution of Black minus White infection rate per 100k



The distribution of four significant green landscape factors in the Model 3

Urban Open Space %

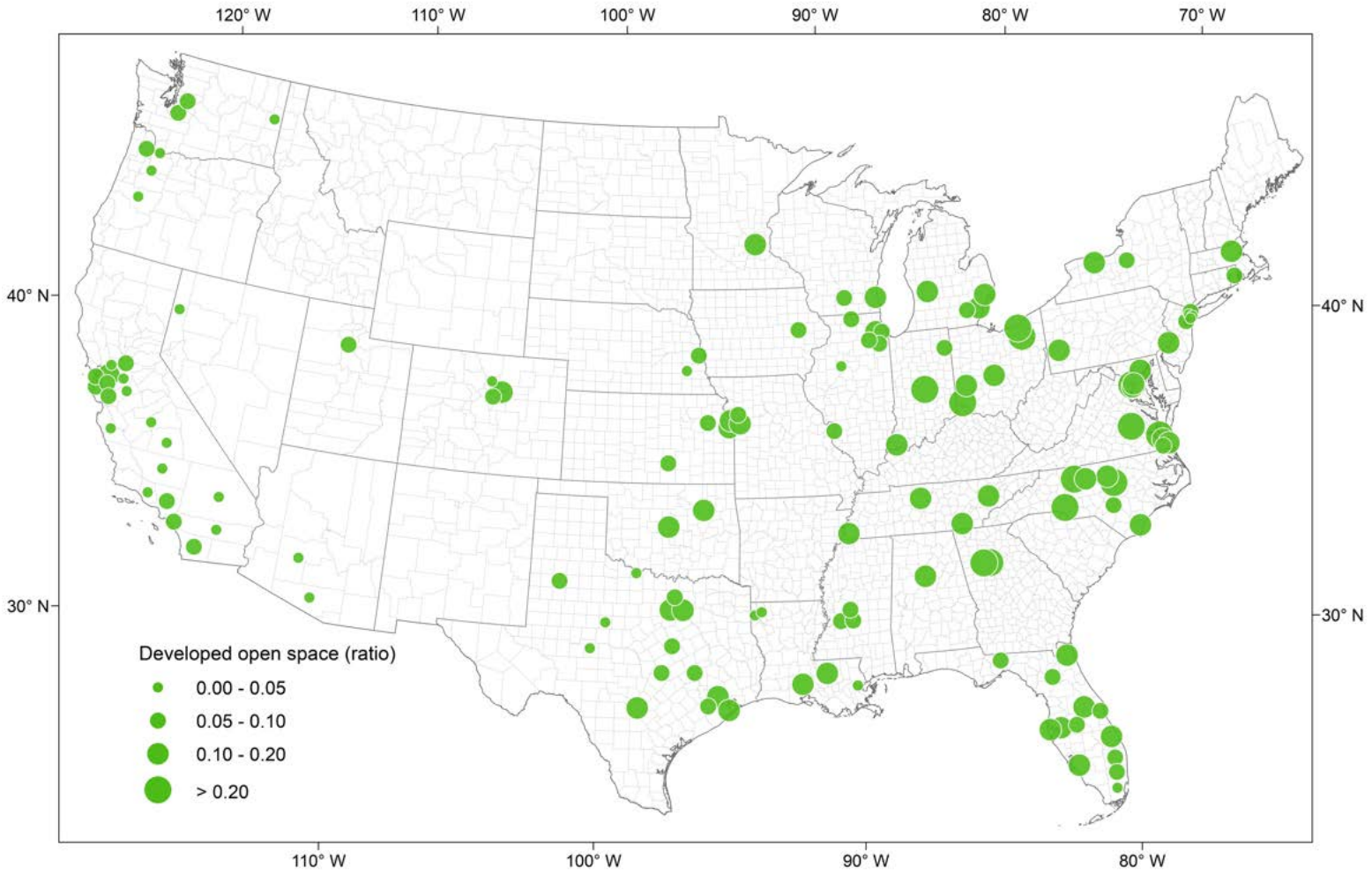


Grasslands and Herbaceous %

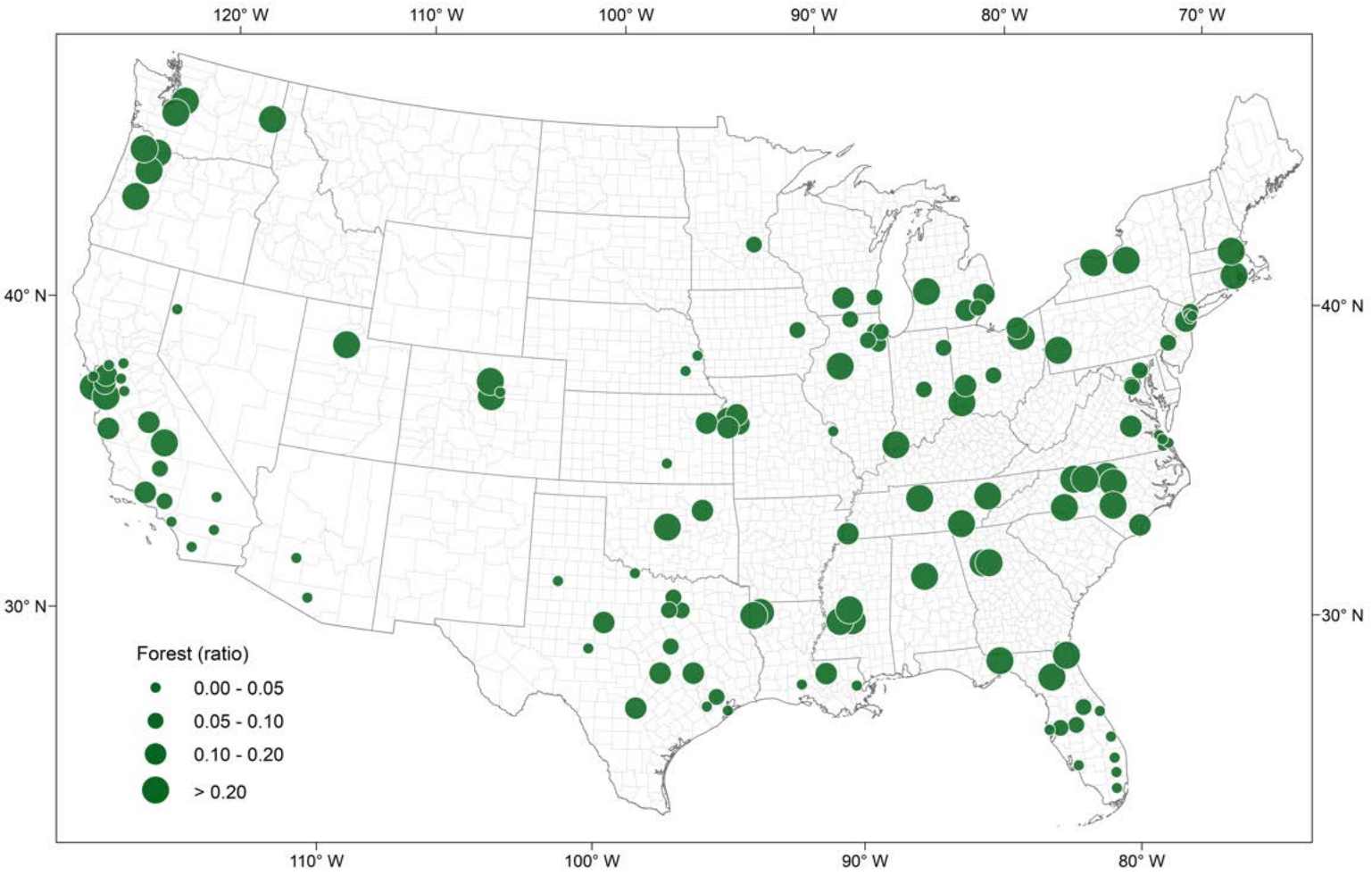
Forest %

Shrub and Scrub %

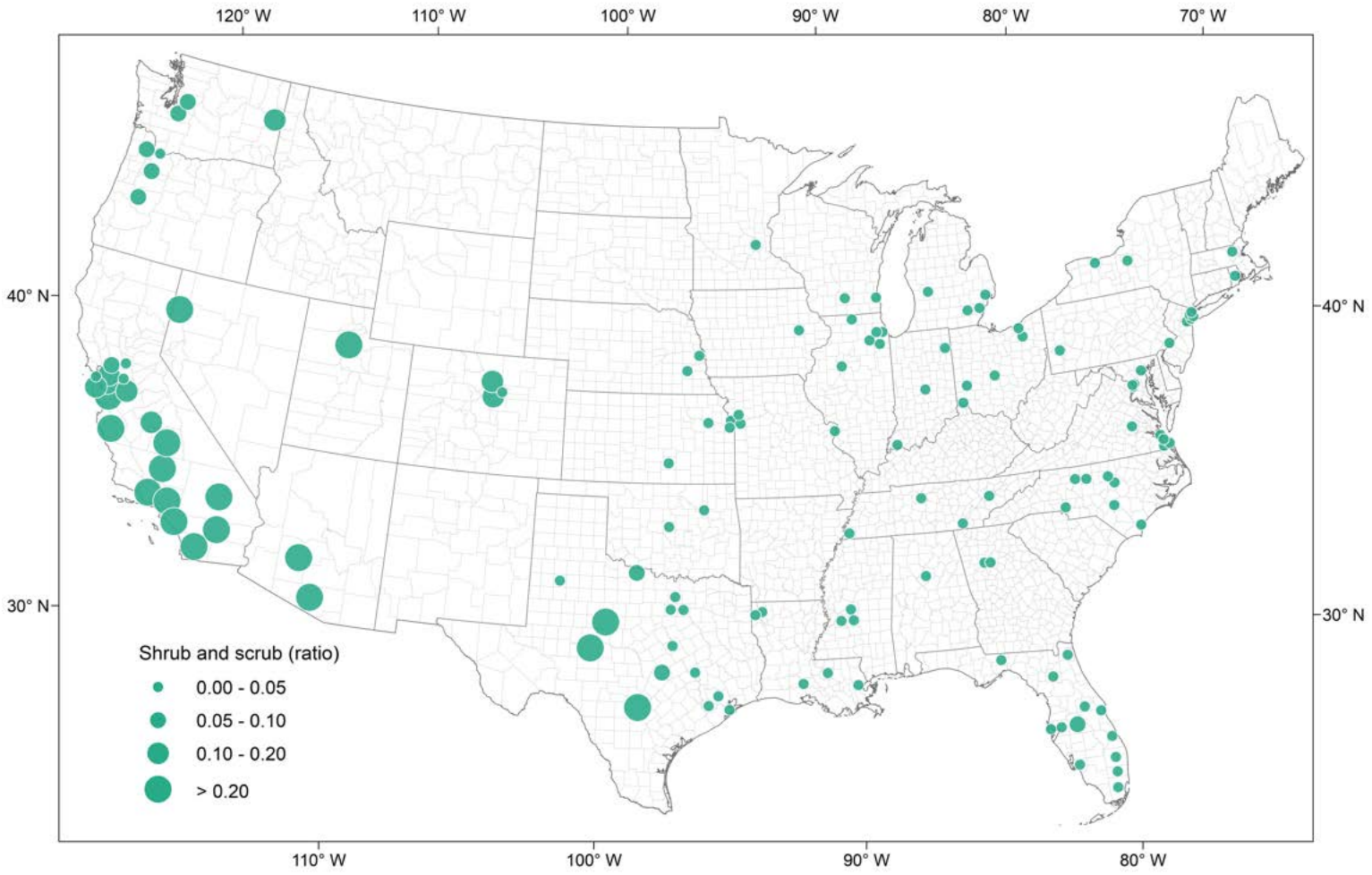
The distribution of urban green open space percentage



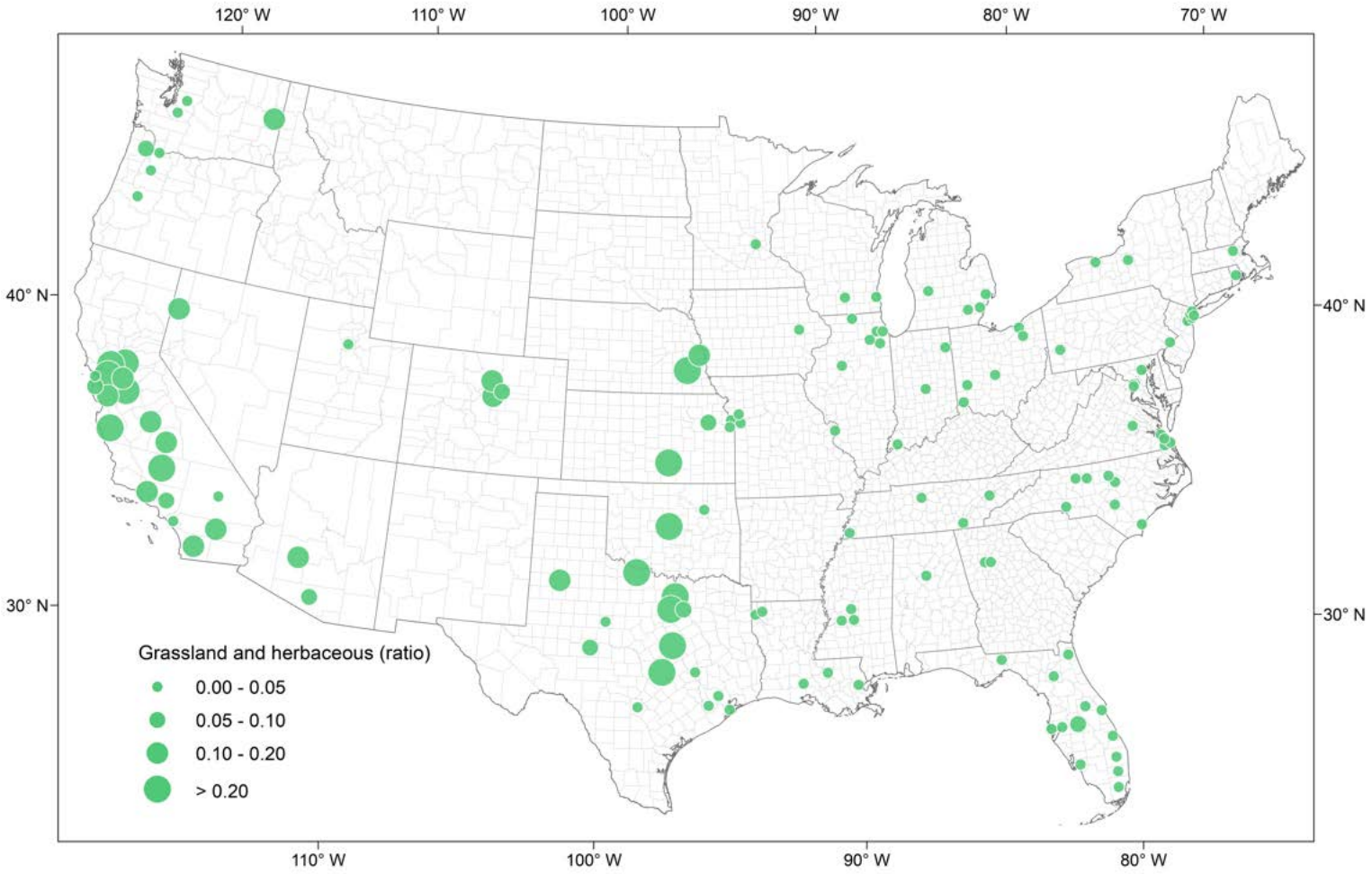
The distribution of forest percentage



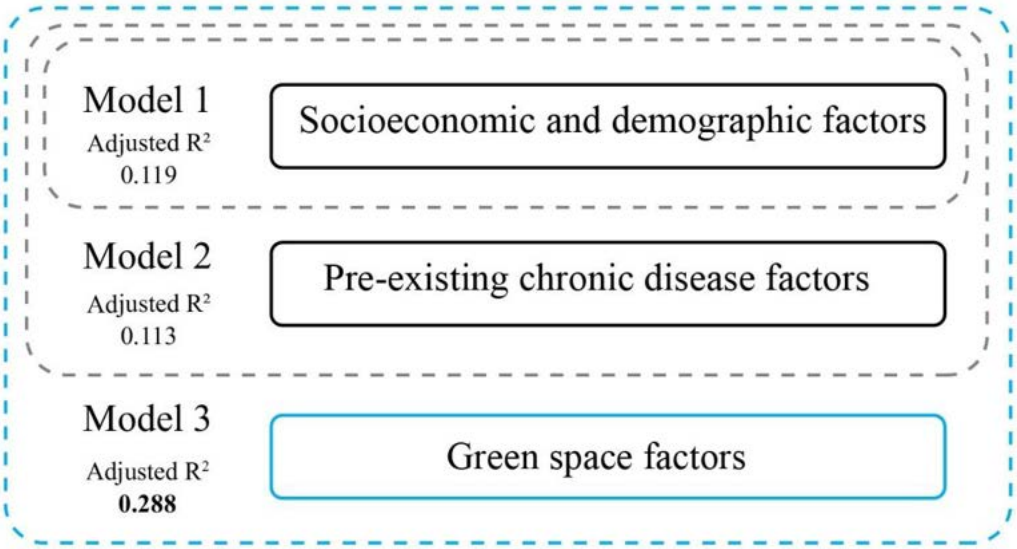
The distribution of shrub and scrub percentage



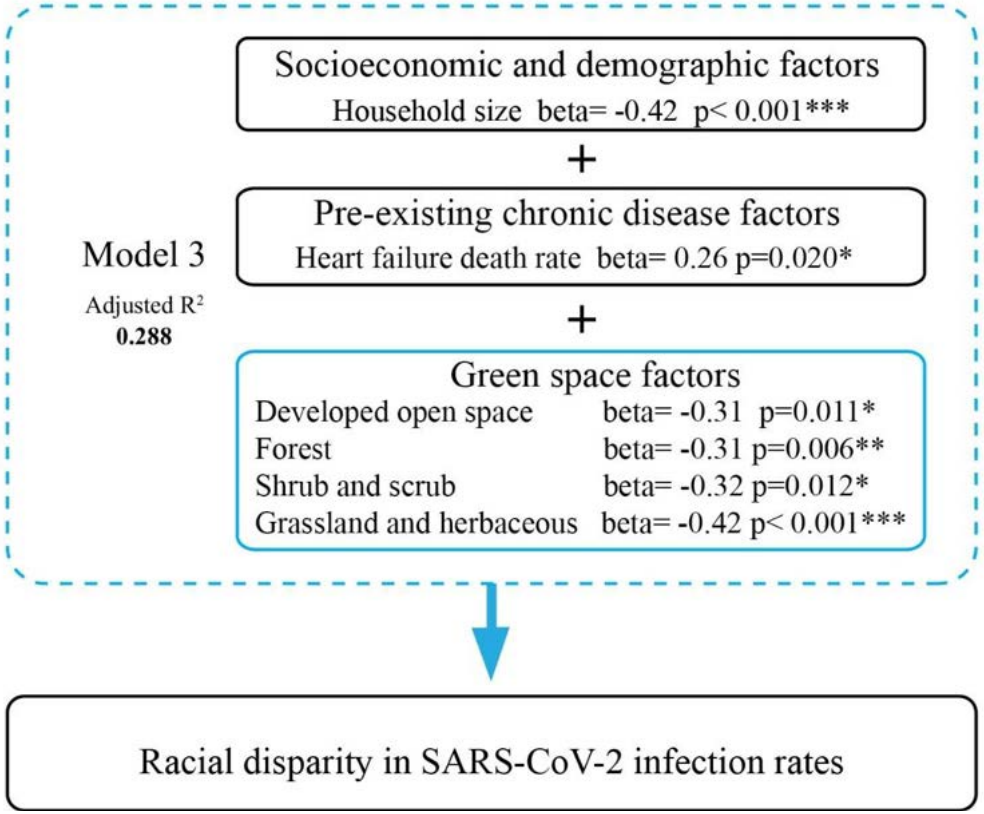
The distribution of grasslands and herbaceous percentage



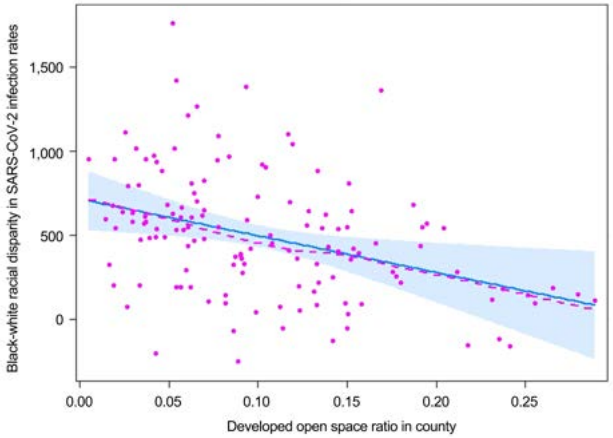
Three-layer Linear Regression Results



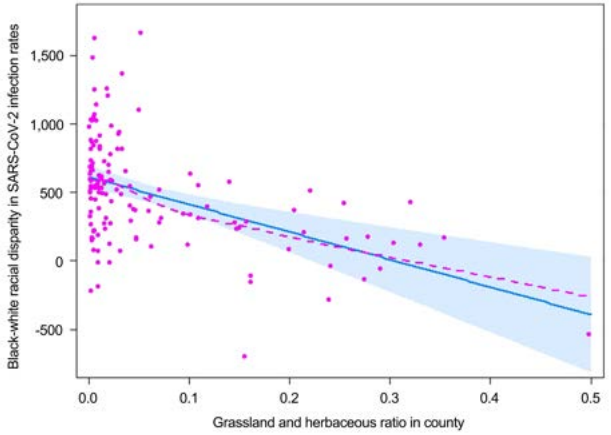
Three-layer Linear Regression Results



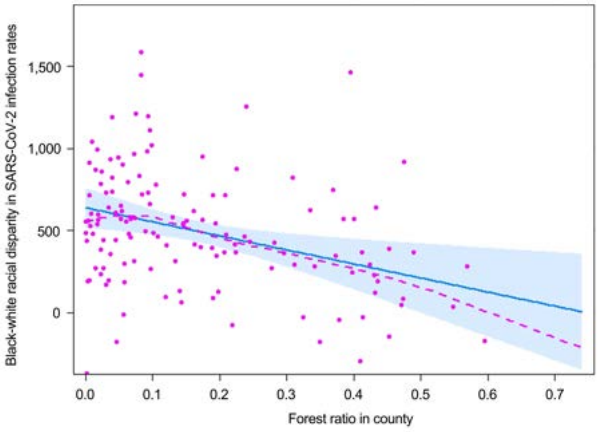
Racial Disparity of Infection Rate & Significant Green Space Factors



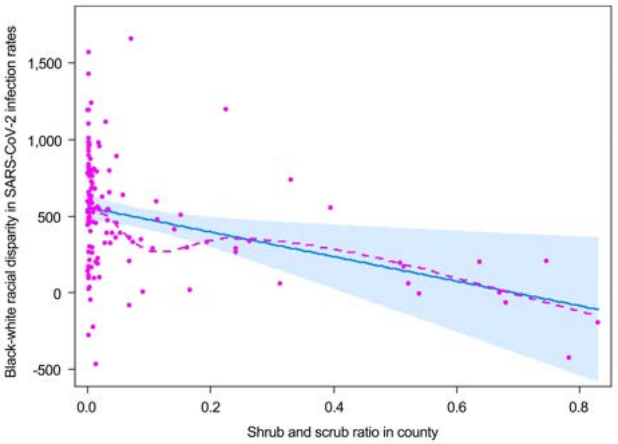
Urban Green Open Space Percentage



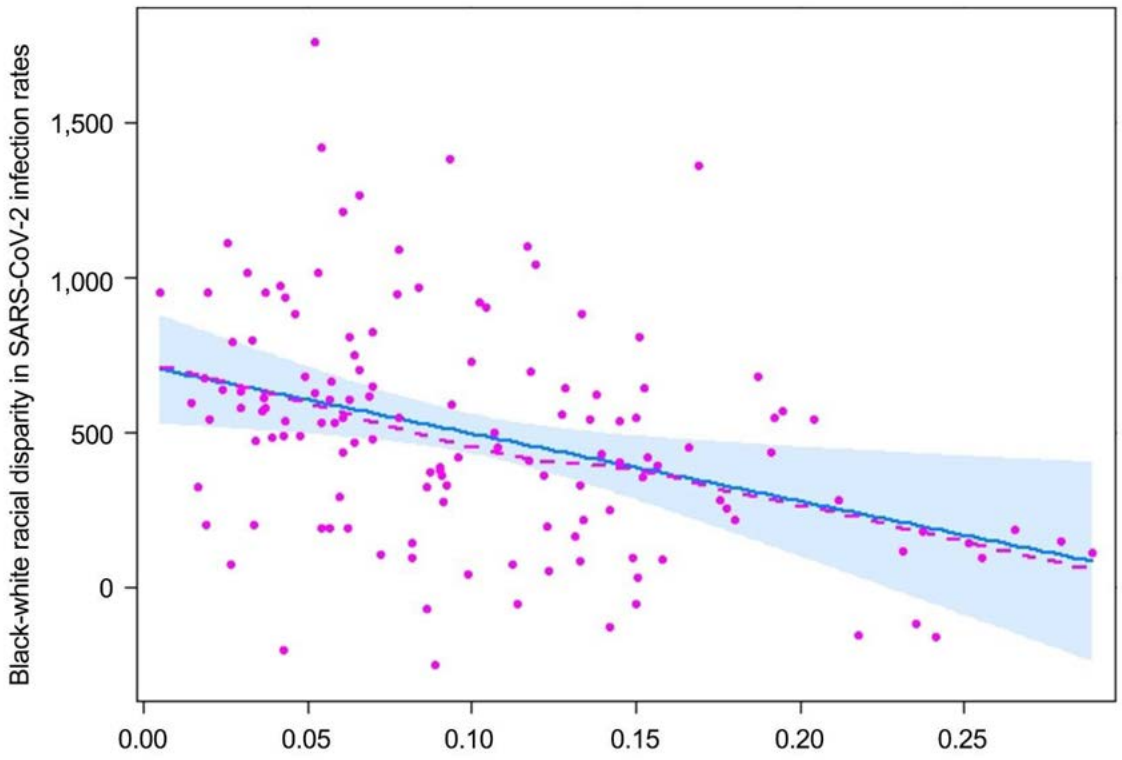
Grasslands and Herbaceous Percentage

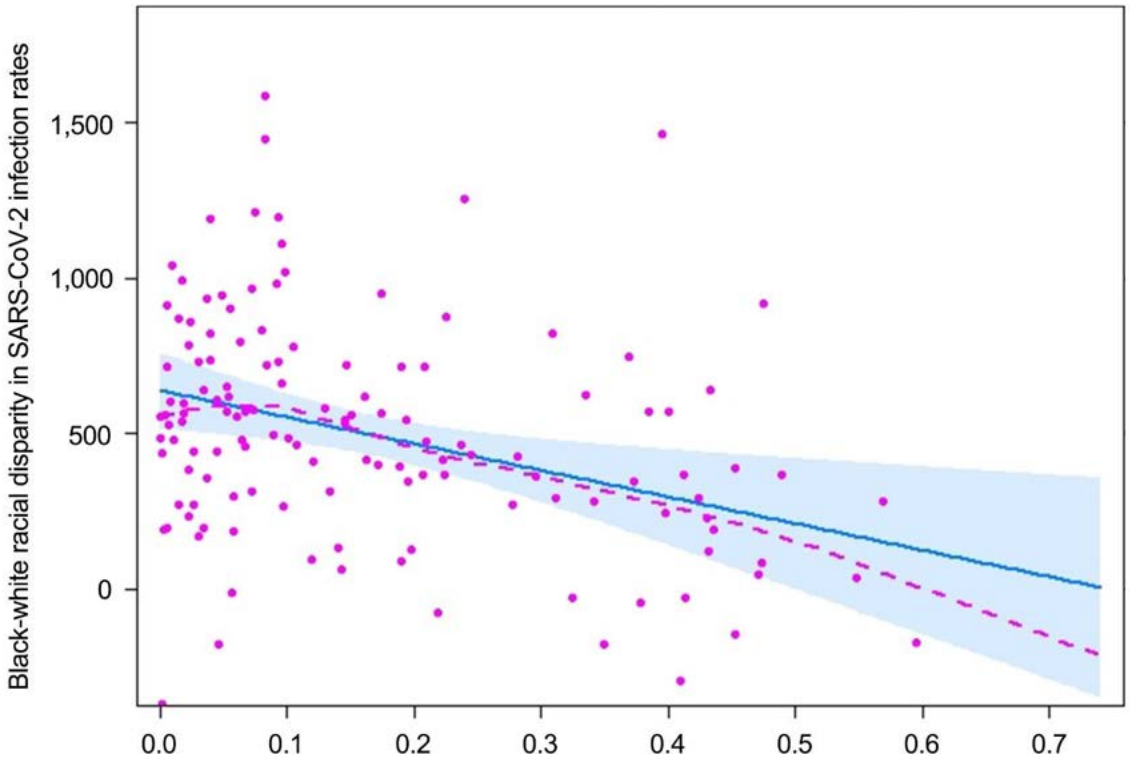


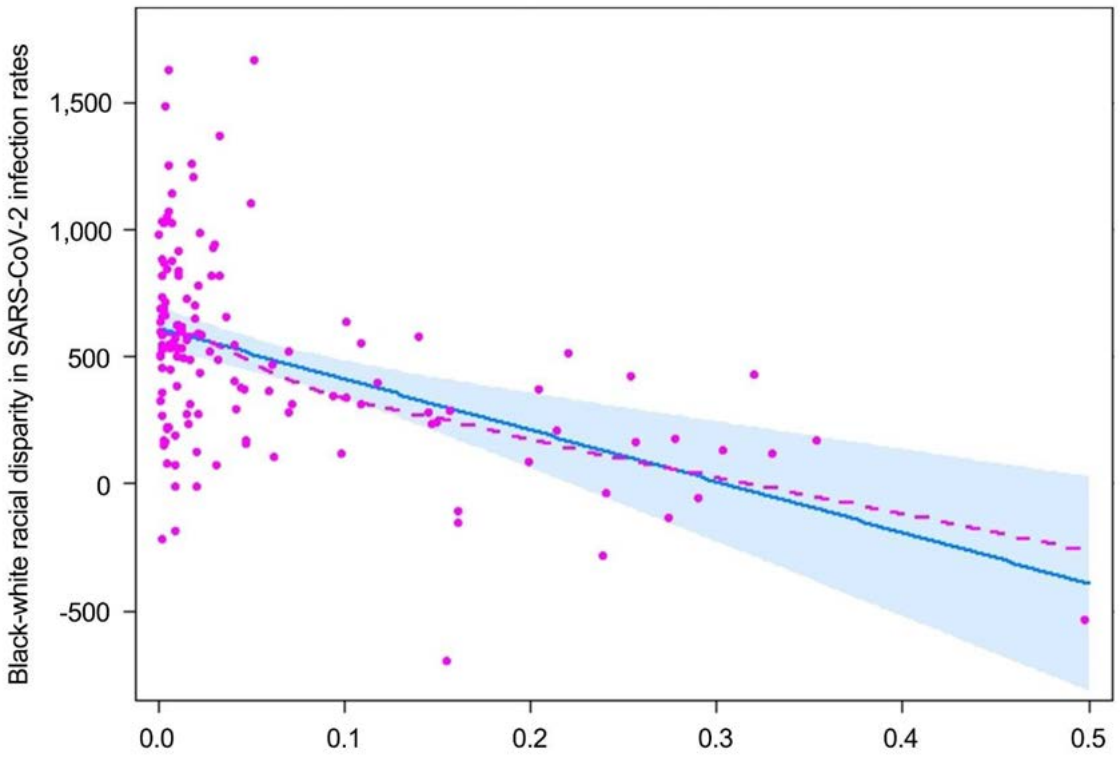
Forest Percentage



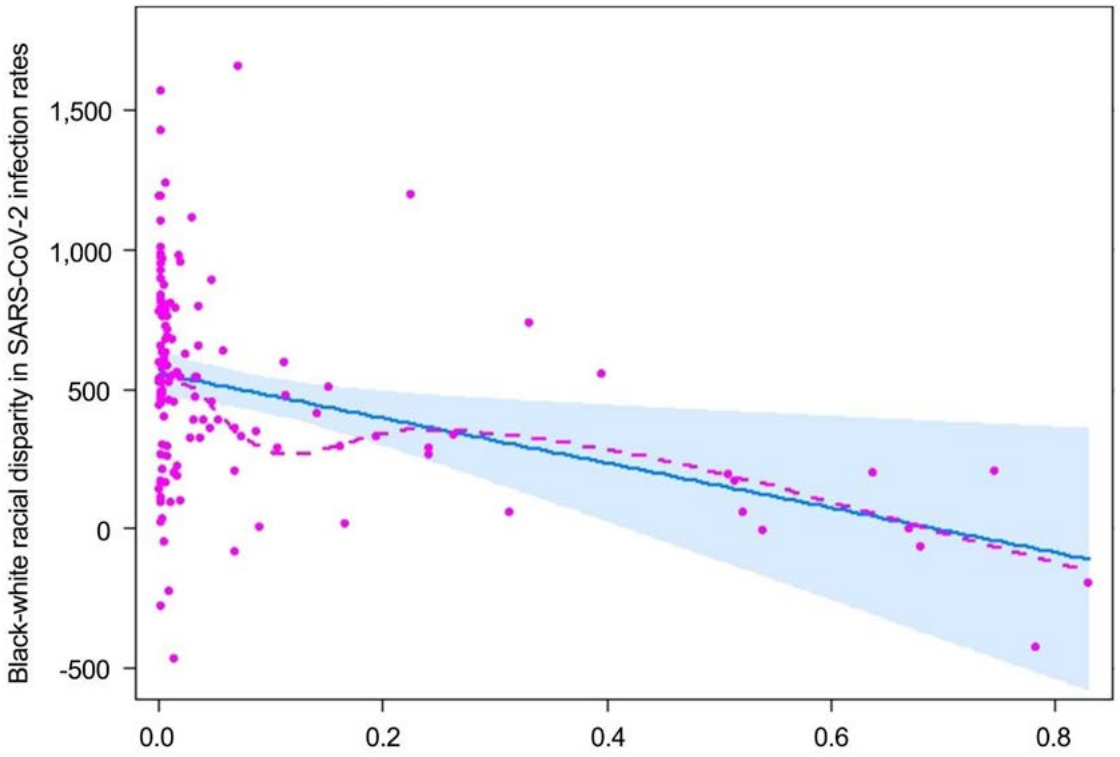
Shrub and Scrub Percentage


Black-white racial disparity in SARS-CoV-2 infection rates
1,500
1,000
500
0
0.00
0.05
0.10
0.15
0.20
0.25
Urban Green Open Space Percentage


Black-white racial disparity in SARS-CoV-2 infection rates
1,500
1,000
500
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Forest Percentage



Grasslands and Herbaceous Percentage



Shrub and Scrub Percentage

Interpretation 1

Larger portions of green space provided greater access to residents of all racial groups and promoted physical activity before and during the pandemic.

Lu, Y., Chen, L., Liu, X., Yang, Y., Xu, W., Webster, C., Sullivan, W. C., Jiang, B. (2020) A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. medRxiv 2020.11.11.20228130; doi: https://doi.org/10.1101/2020.11.11.20228130.

https://www.medicalnewstoday.com/articles/322734

Interpretation 2

Proportionately more green spaces in a county may result in enhanced mental and social health regardless of race before and during the pandemic.

Lu, Y., Chen, L., Liu, X., Yang, Y., Xu, W., Webster, C., Sullivan, W. C., Jiang, B. (2020) A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. medRxiv 2020.11.11.20228130; doi: https://doi.org/10.1101/2020.11.11.20228130.

https://image.freepik.com/free-photo/buddhist-couple-black-white-meditate-park_74216-283.jpg

Interpretation 3

Having access to green spaces that pull people outdoors.

Being outdoors makes it easier than indoors to maintain safe social distance.

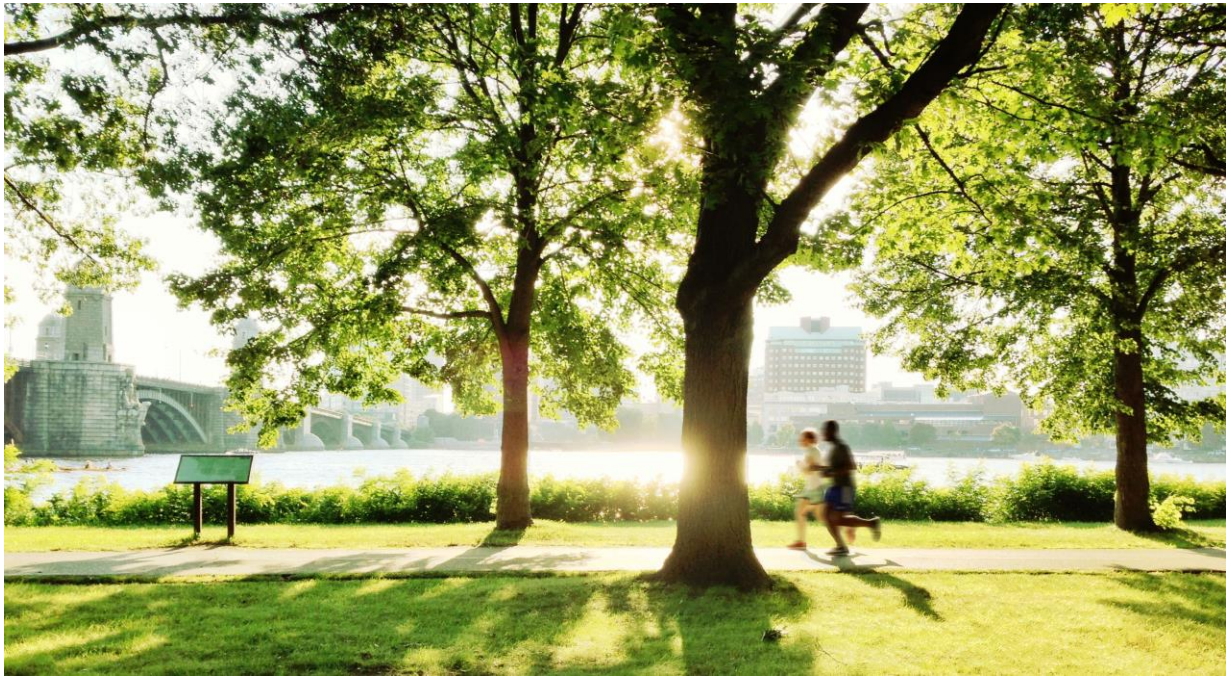
Lu, Y., Chen, L., Liu, X., Yang, Y., Xu, W., Webster, C., Sullivan, W. C., Jiang, B. (2020) A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. medRxiv 2020.11.11.20228130; doi: https://doi.org/10.1101/2020.11.11.20228130.

https://www.kansascity.com/latest-news/e0hjcb/picture242317996/alternates/FREE_768/KCM_SOCIALDISTANCING042620_

Interpretation 4

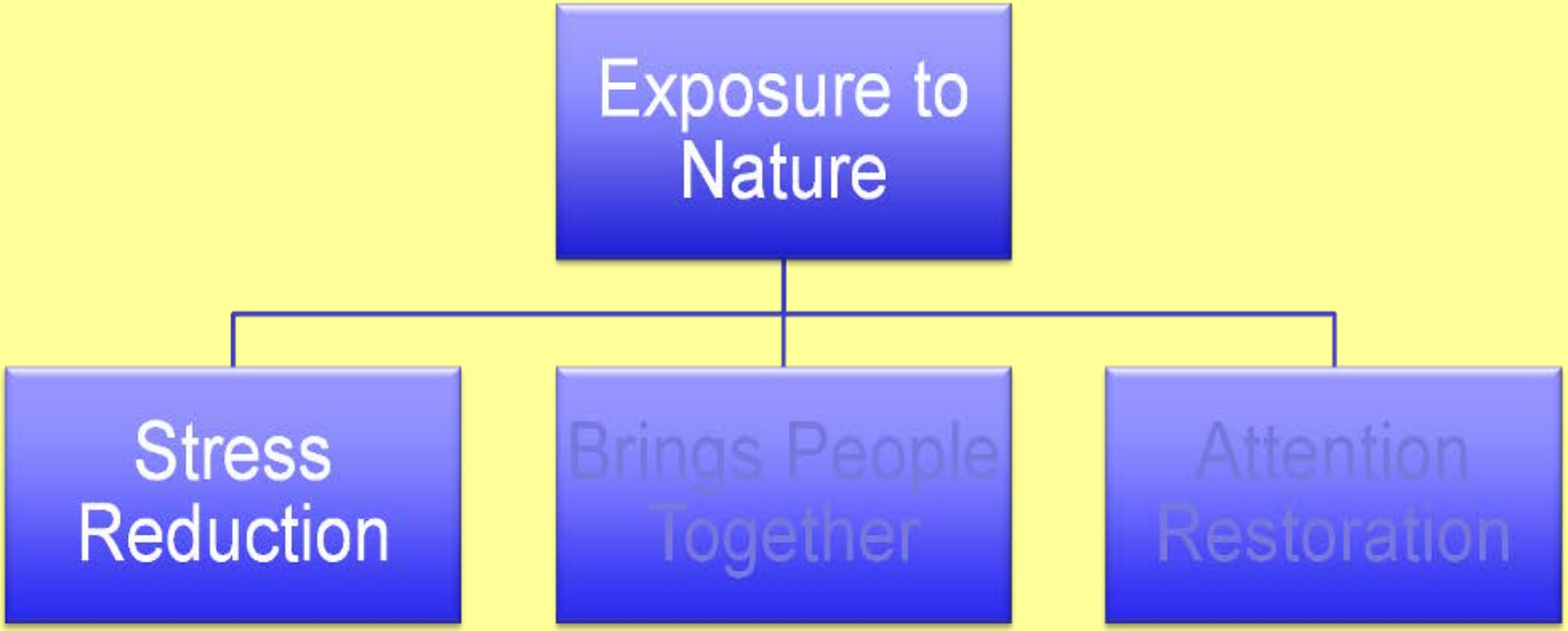
More green spaces may decrease the SARS-CoV-2 infection risk by improving air quality and decreasing exposure to air pollutants.

Lu, Y., Chen, L., Liu, X., Yang, Y., Xu, W., Webster, C., Sullivan, W. C., Jiang, B. (2020) A higher ratio of green spaces means a lower racial disparity in severe acute respiratory syndrome coronavirus 2 infection rates: A nationwide study of the United States. medRxiv 2020.11.11.20228130; doi: https://doi.org/10.1101/2020.11.11.20228130.

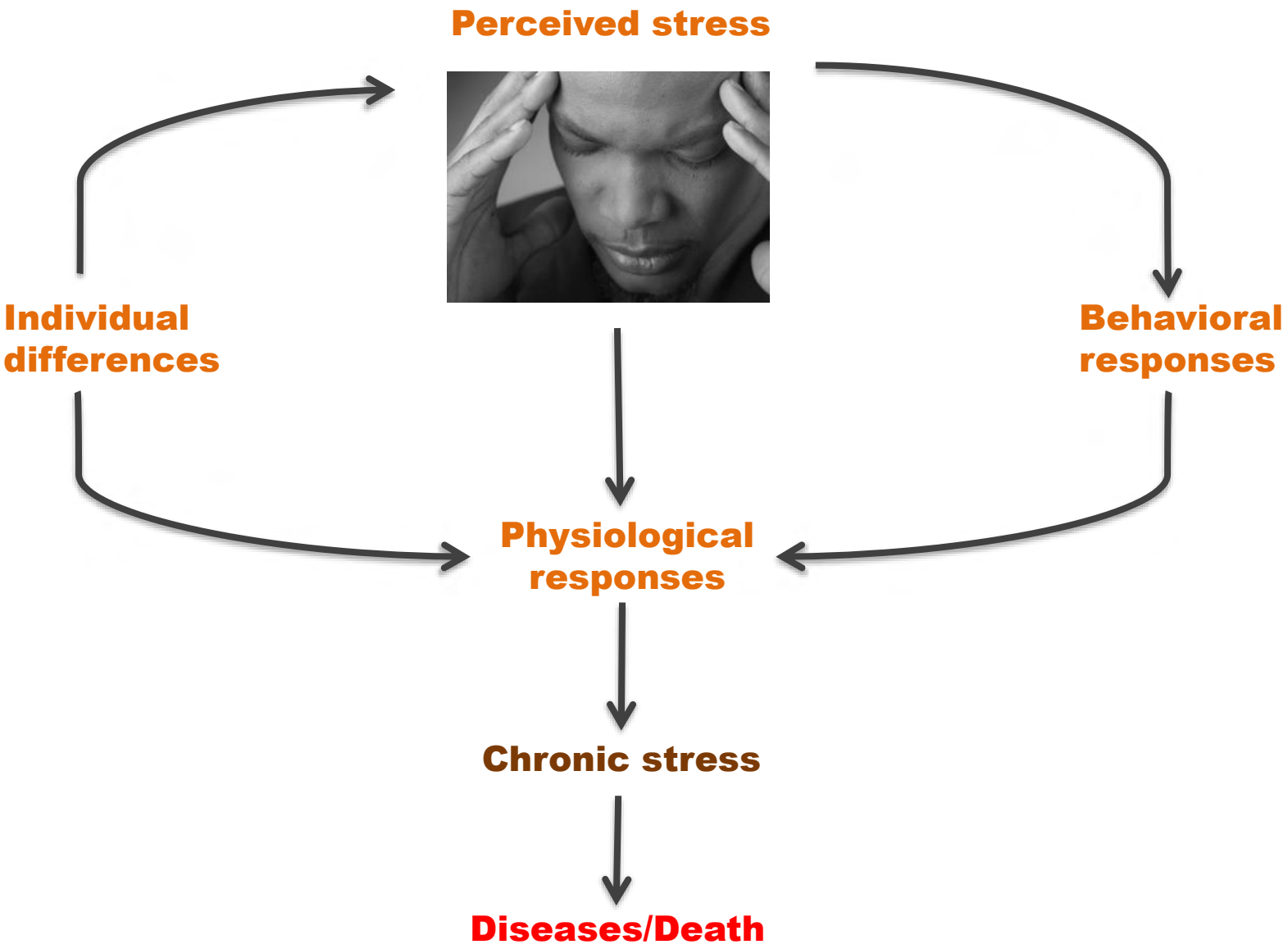


https://natureconservancy-h.assetsadobe.com/is/image/content/dam/tnc/nature/en/photos/Cover-Charles-River-Boston-MA.jpg?crop=0,0,4000,2200&wid=4000&hei=2200&scl=1.0

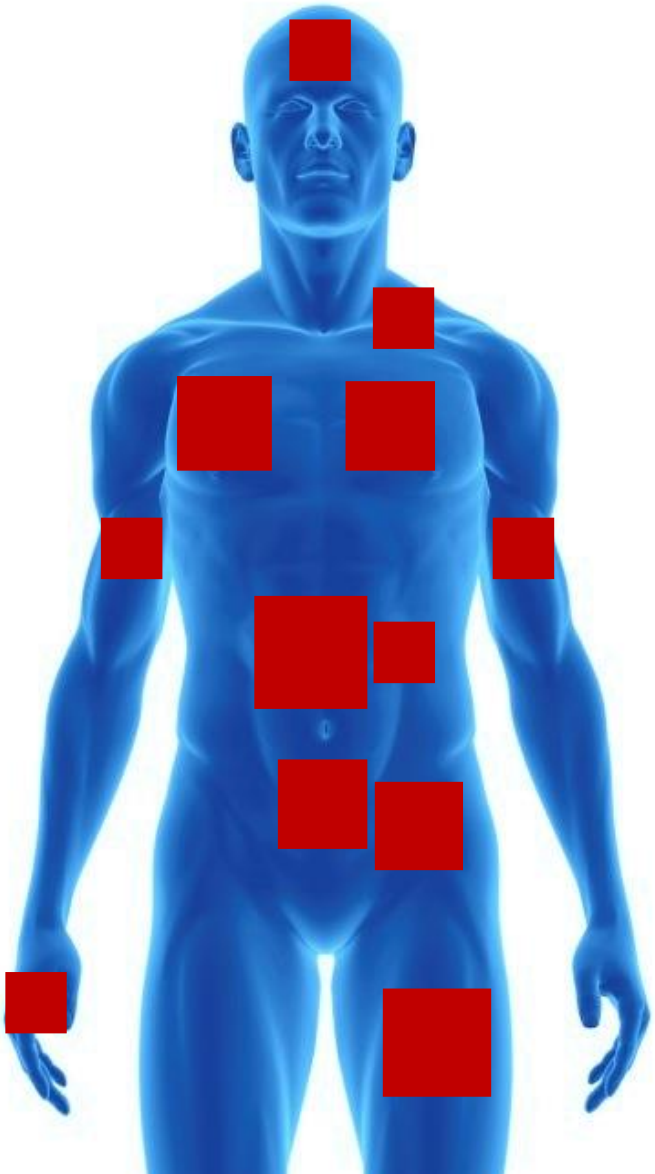
Mechanism 2. Stress Reduction



Why stress is harmful?



Chronic stress



Nervous system

Respiratory

Cardiovascular

Endocrine

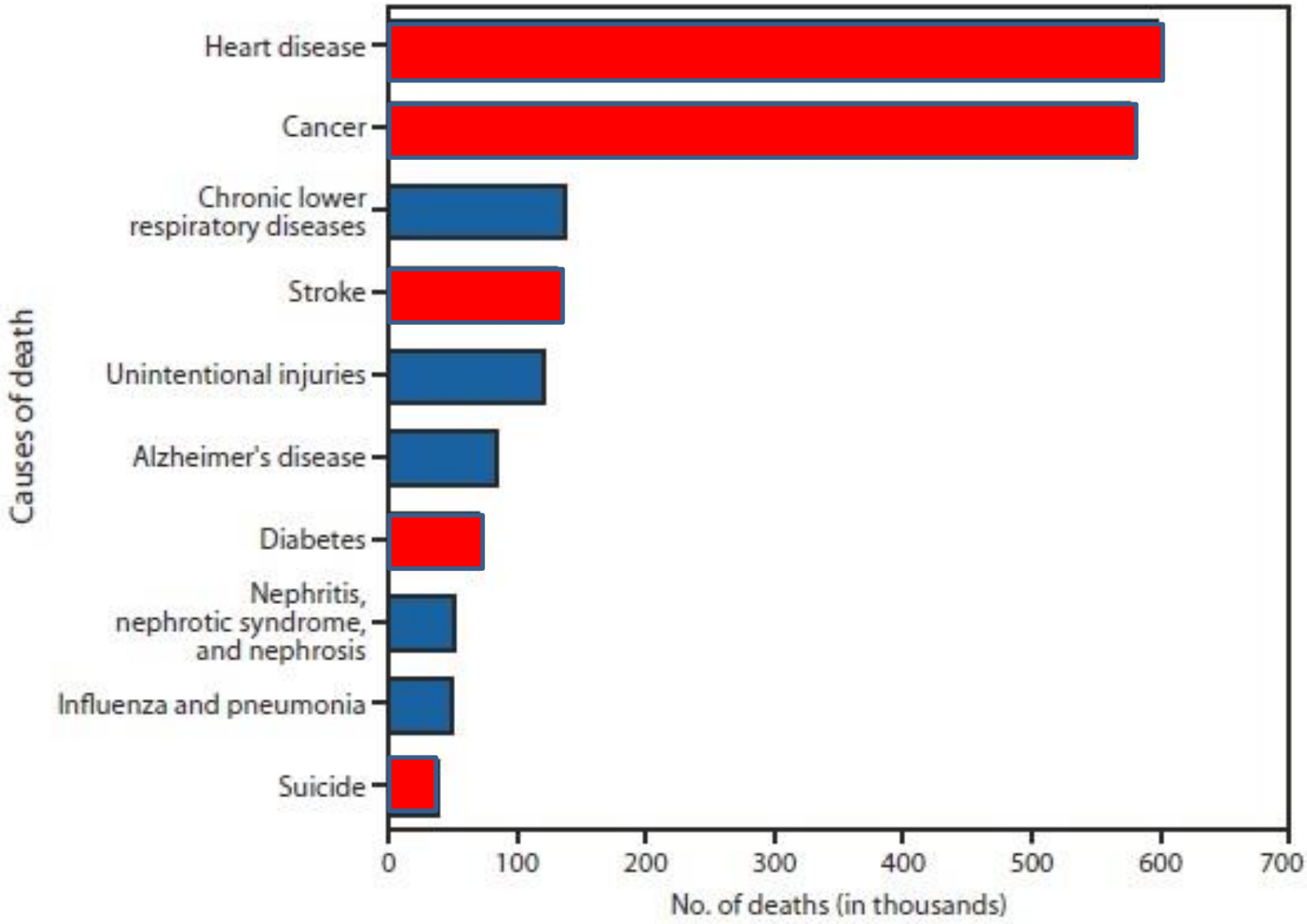
Gastrointestinal

Reproductive

Immune

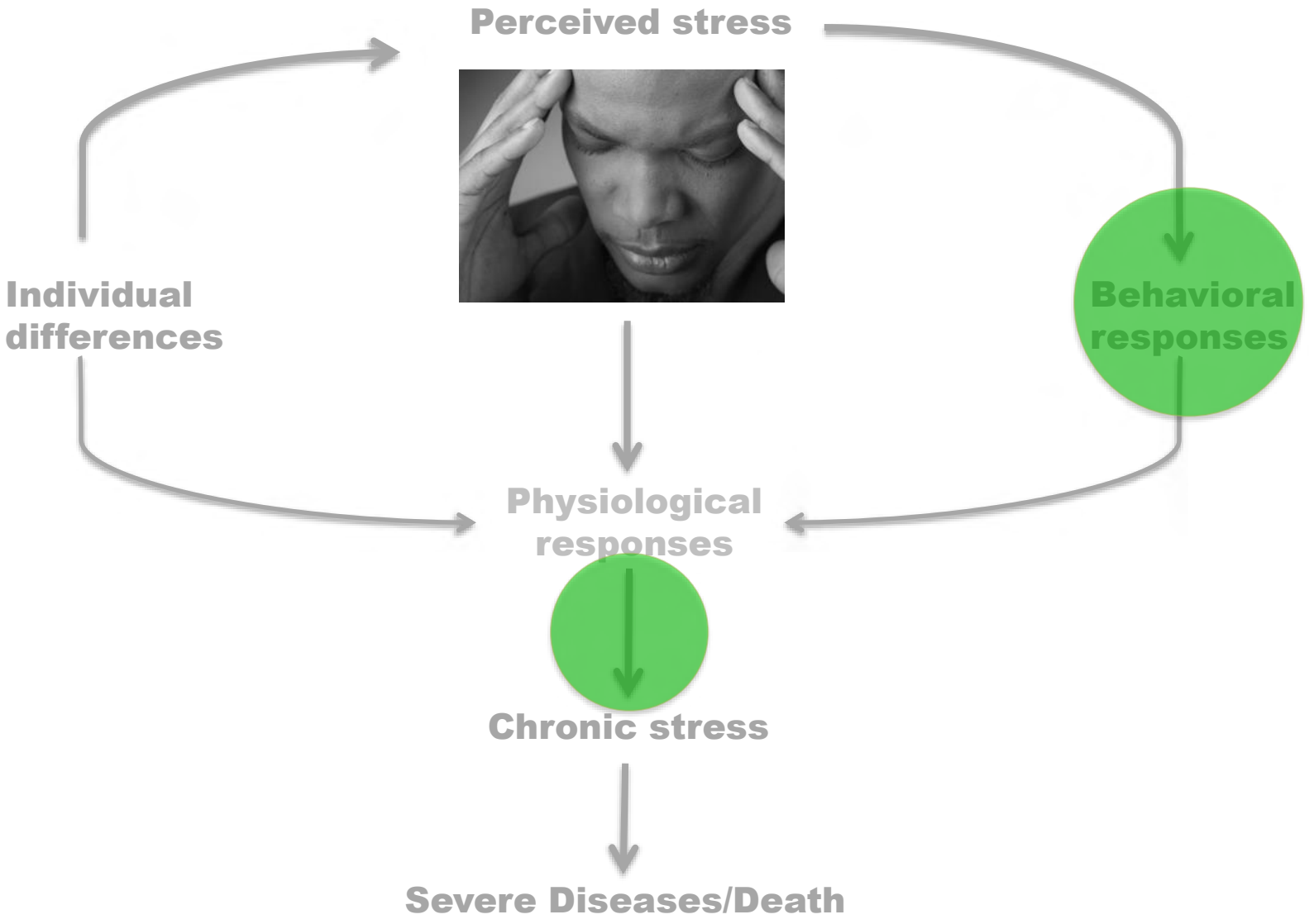
Musculoskeletal

Stress & Leading cause of death, U.S. 2010



Source: Centers for Disease Control and Prevention.

Opportunity for environmental interventions



Study B

Dose of nature and stress recovery

Jiang, Chang, & Sullivan, 2013-2018

Landscape and Urban Planning 132 (2014) 26–36

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research Paper

A dose of nature: Tree cover, stress reduction, and gender differences

Bin Jiang[a,1], Chun-Yen Chang[b,2], William C. Sullivan[c,*]

[a] Landscape Architecture, University of Hong Kong, Hong Kong
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[c] Department of Landscape Architecture, University of Illinois at Urbana-Champaign, 611 E. Taft Drive, 101 Buell Hall, Champaign, IL 61820, USA

HIGHLIGHTS

- We describe the dose–response curve for the impact of tree cover density on stress reduction.
- We employed 6-min, 3-D videos of community street scenes as the nature treatment.
- We measured skin conductance and salivary cortisol levels as measures of participants' stress.
- For men, the dose–response curve was an inverted-U shape.
- For women, we found no relationship between tree cover density and stress reduction.

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Salivary cortisol
Skin conductance
Tree cover density
3-D visual media

ABSTRACT

Although it is well established that exposure to nearby nature can help reduce stress in individuals, the shape of the dose–response curve is entirely unclear. To establish this dose–response curve, we recruited 160 individuals for a laboratory experiment. Participants engaged in the Trier Social Stress Test (TSST) to induce psychological stress, and were then randomly assigned to view one of ten, 6-min, 3-D videos of neighborhood streets. The density of tree cover in the videos varied from 1.7% to 62.0%. We measured their stress reactions by assessing salivary cortisol and skin conductance levels. Results show a clear disparity between women and men. For women, we found no relationship between varying densities of tree cover and stress recovery. For men, the dose–response curve was an inverted-U shape: as tree cover density increased from 1.7% to 24%, stress recovery increased. Tree density between 24% to 34% resulted in no change in stress recovery. Tree densities above 34% were associated with slower recovery times. A quadratic regression using tree cover density as the independent variable and a summary stress index as the dependent variable substantiated these results [$R^2 = .22$, $F(2, 68) = 9.70$, $p < .001$]. The implications for our understanding of the impacts of nearby nature, and for the practice of planning and landscape architecture are discussed.

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1. Introduction

1.1 Background

The demands and pressures of modern life are precursors to some of the most threatening medical problems we face today. Chronic stress can suppress the immune system (Cohen, Miller, & Rabin, 2001) and trigger cardiovascular disease, stroke, depression, asthma, and other critical health problems (e.g., Childs & Wit, 2009; Dimsdale, 2008; Gump et al., 2011; Russ et al., 2012; Steptoe & Brydon, 2009). There is mounting evidence, however, that exposure to nature enhances the resources necessary to manage the demands and pressures of modern life. Settings that include tress, grass, and open spaces have been shown to aid physiological stress reduction (e.g., Chang & Chen, 2005; Hartig, Mang, & Evans, 1991; Ulrich et al., 1991; van den Berg, Hartig, & Staats, 2007).

Although it is well established that exposure to nature enhances stress reduction, the shape of the dose–response curve is entirely unclear. We do not know if exposure to a small amount of green space is enough to induce calming effects, whether increase in the density of vegetation produce additional calming effects, or even if the relationship between exposure to nature and stress reduction is linear. Lack of this knowledge prevents landscape architects

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[1] Tel.: +1 217 721 5415
[2] Tel.: +886 2 3366 4859

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SAGE

A Dose-Response Curve Describing the Relationship Between Urban Tree Cover Density and Self-Reported Stress Recovery

Bin Jiang[1,2], Dongying Li[1], Linda Larsen[1], and William C. Sullivan[1]

Abstract

Although it is well established that viewing nature can help individuals recover from a stressful experience, the dose-response curve describing the relationship between tree cover density and stress recovery is totally unclear. A total of 160 participants engaged in a standard Trier Social Stress Test to induce stress. Participants were then randomly assigned to watch 1 of 10 three-dimensional videos of street scenes that varied in the density of tree cover (from 2% to 62%). Participants completed a Visual Analog Scale questionnaire at three points in the experiment. Analysis revealed a positive, linear association between the density of urban street trees and self-reported stress recovery, adjusted $R^2 = .05$, $F(1, 149) = 8.53$, $p < .01$. This relationship holds after controlling for gender, age, and baseline stress levels. A content analysis of participants' written narratives revealed a similar but even stronger association. These findings suggest that viewing

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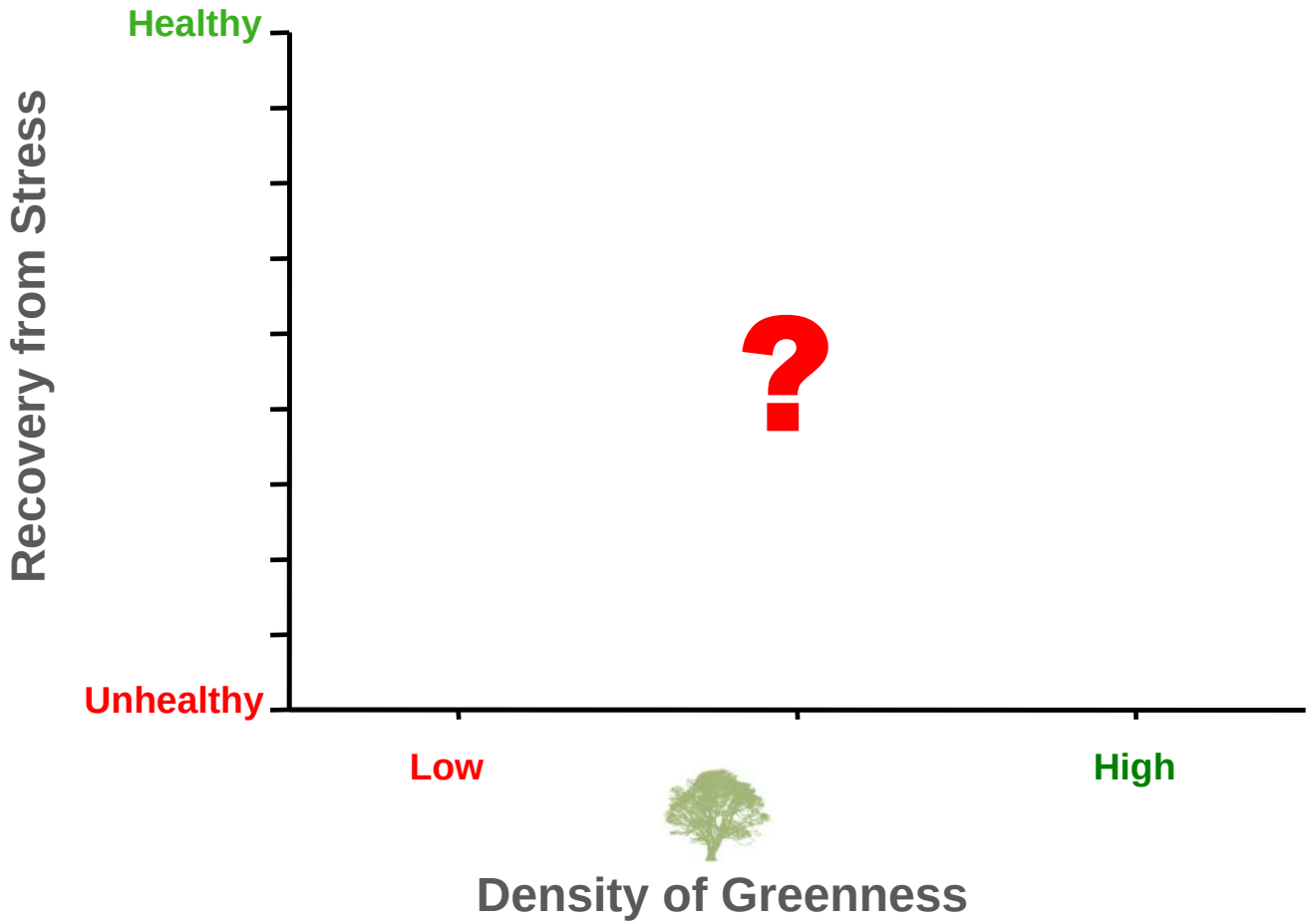
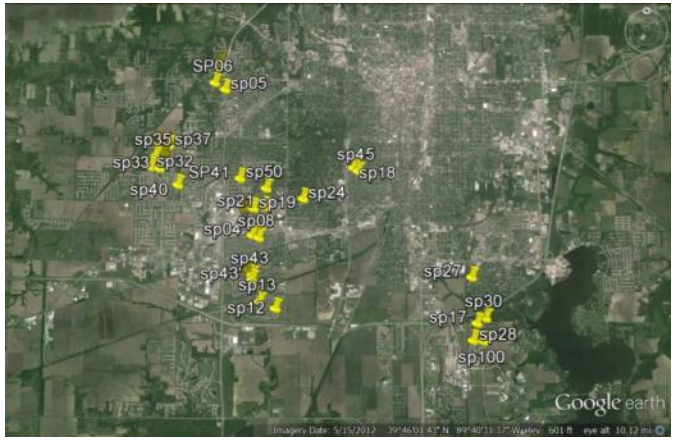
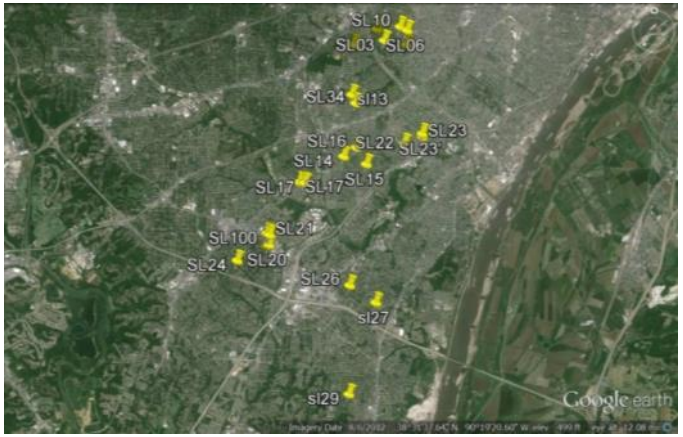
Shape of dose-response curve



3D Video of Community Streets

Four mid-west urban areas
Medium annual income $50,000-75,000
255 sites, selected 50
Ordinary street scenes

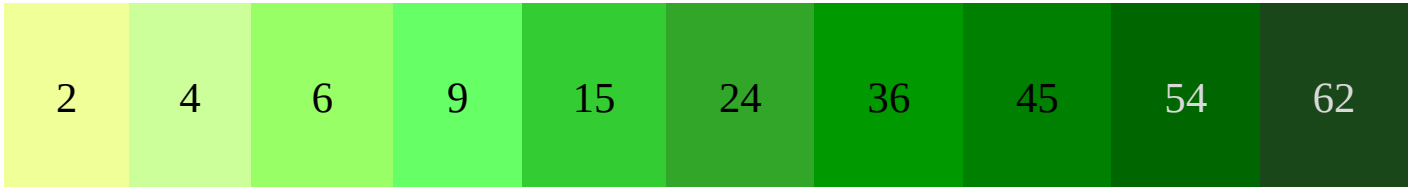




3D video camera

Tree cover density (%)

10 videos with 10 levels of tree cover density (6’/video)



Multiple measures

1st Visual Analog Scale

2nd VAS

3rd VAS

Narratives

Subjective

3'rest & 7' introduction | 3' rest | 13' stressor | 6' nature treatment | 3' rest | 30' rest/Survey

Continuously measured

- skin conductance
- finger temperature
- blood volume pulse
- heart responses

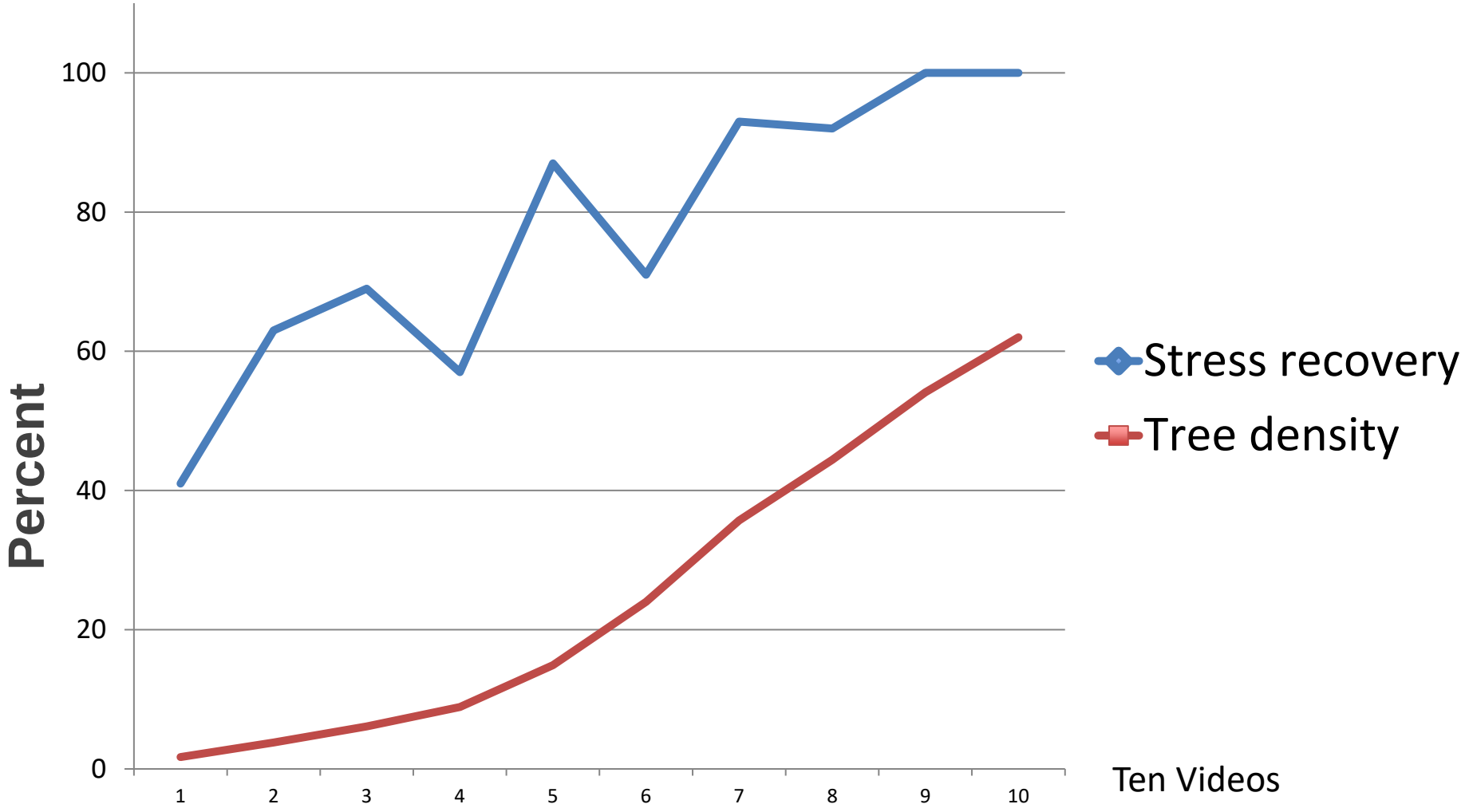
1st salivary cortisol sample

2nd sample

3rd sample

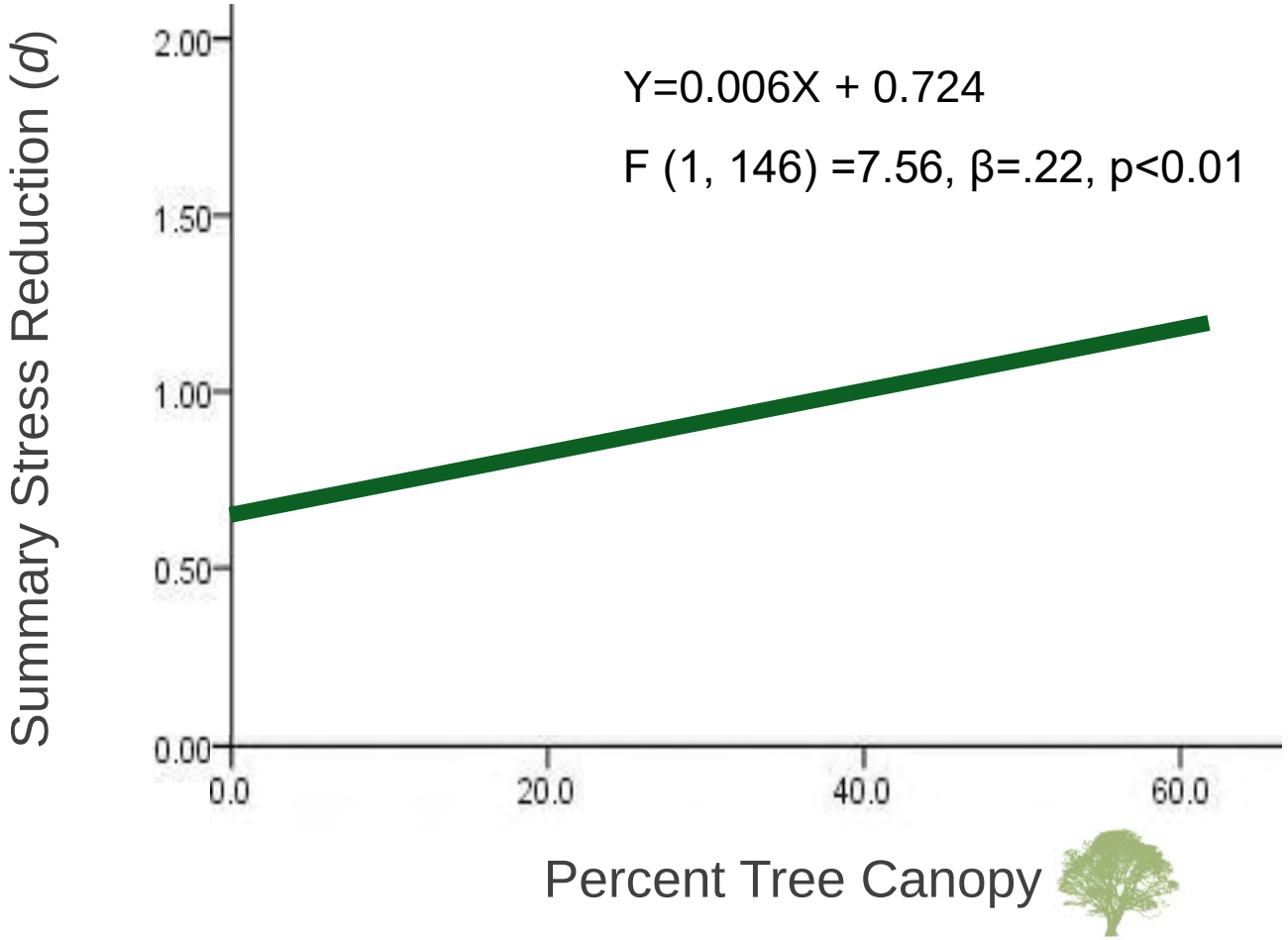
Objective

Narratives of recovery experience

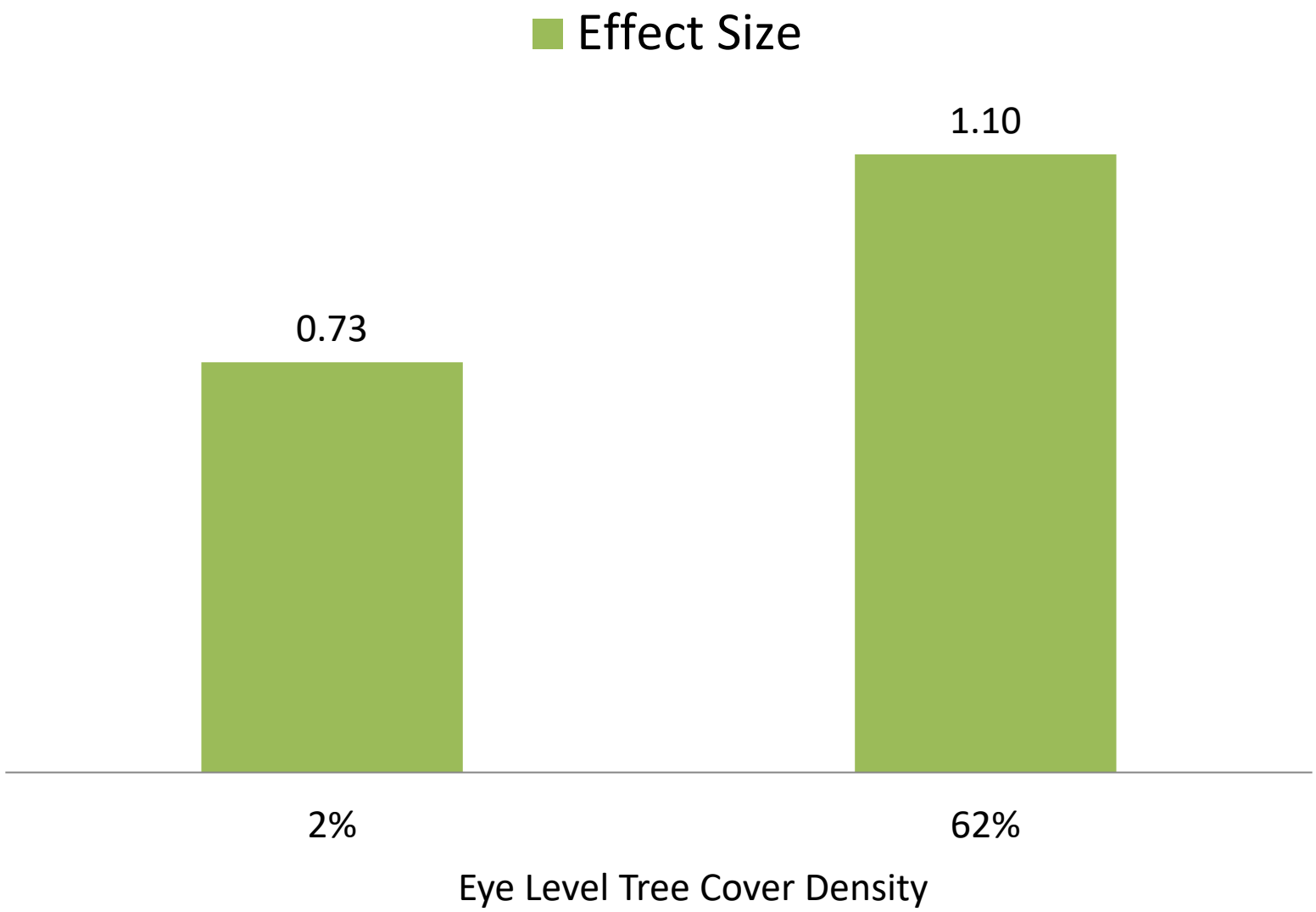


Percentage of reporting stress recovery increases **2.50** times

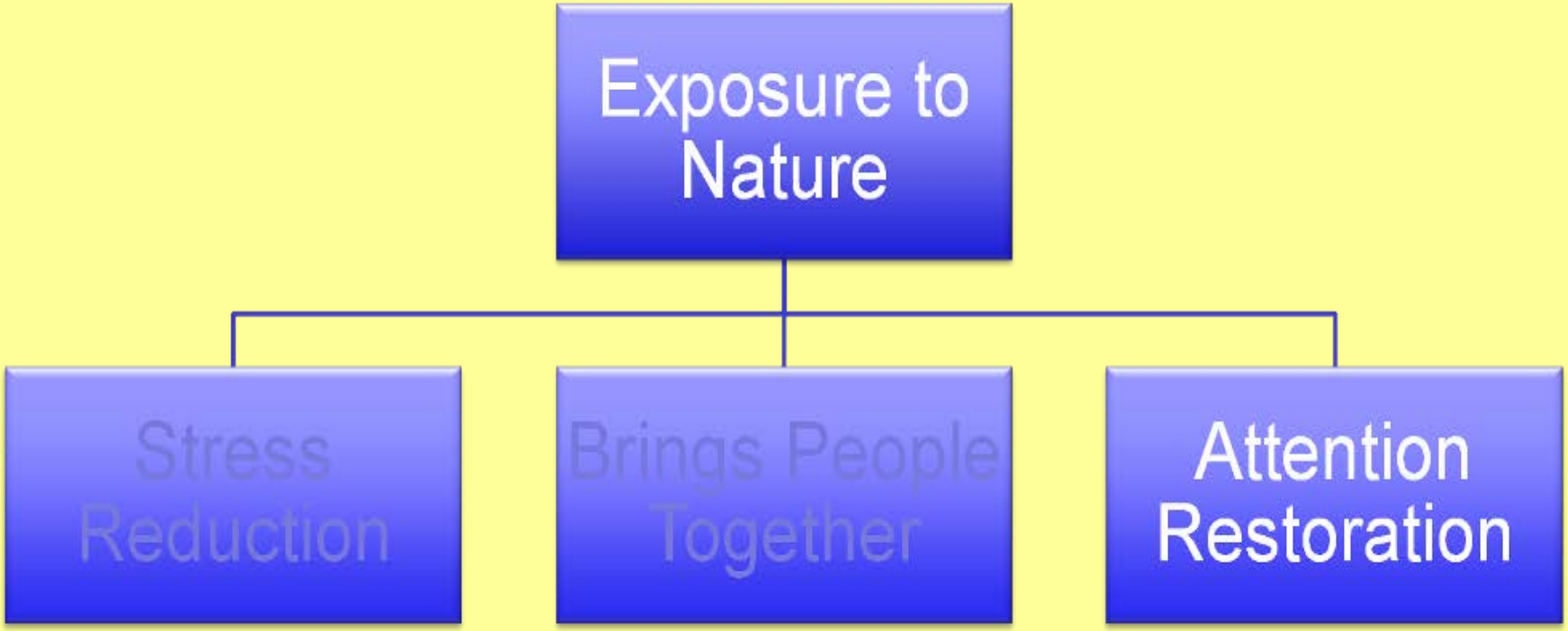
Dose-response curve



The effect size increases **1.51** times



Mechanism 3. Attention Restoration



Symptoms of Mental Fatigue

Inattentiveness

https://the-injury-lawyer-directory.com/driving-sleepy-becoming-leading-cause-fatal-crashes/

https://medium.com/@SumedhKasare/the-curious-case-of-learner-motivation-3971f1beb6db

Symptoms of Mental Fatigue

Irritability

https://www.researchgate.net/publication/258859204_Still_a_long_way_to_go_on_the_road_for_parallel_mechanisms/figures?lo=1

https://www.merkur.de/leben/karriere/chefs-beleidigt-muss-fristloser-kuendigung-rechnen-zr-8272935.html

Symptoms of Mental Fatigue

Impulsivity

http://www.ghanadailies.com/2019/09/10/800-000-people-die-from-suicide-yearly/

https://www.thesun.ie/news/2561722/what-is-arrhythmia-what-causes-heart-rythym-problems-what-are-the-different-types-and-what-are-the-symptoms/

Attention Restoration Theory

By Rachel Kaplan & Stephen Kaplan

Involuntary attention

https://www.6sqft.com/go-camping-among-the-trees-in-this-195night-treehouse-in-upstate-new-york/

Directed attention

https://www.airport-data.com/aircraft/photo/001063458.html

Nature uses **involuntary attention** but restores **directed attention**

Study C

https://www.courant.com/opinion/op-ed/hc-op-fresh-talk-sloane-millennials-electronic-romance-0517-20170516-story.html

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How to Waste a Break: Using Portable Electronic Devices Substantially Counteracts Attention Enhancement Effects of Green Spaces

Bin Jiang[1], Rose Schmillen[2], and William C. Sullivan[2]

Abstract

Overuse of portable electronic devices depletes one's attention capacity, a critical cognitive resource. Although contact with nature promotes attentional functioning, we do not know the extent to which exposure to nature and the use of electronic devices interact to promote or inhibit attentional functioning. In this study, 81 participants performed cognitive tasks and then were randomly assigned to one of four rest treatments: green settings with or without a laptop computer and barren settings with or without a laptop computer. Attention was measured three times. Analysis showed a significant effect for both setting and use of a laptop as well as a significant interaction between setting and laptop use. A further analysis controlling for time spent focused on the laptop screen produced similar results. The findings show that using an electronic device in green settings substantially counteracts the attention enhancement benefits of green spaces.

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When people are busy using technical devices, is the green landscape still effective for mental health recovery?

	Laptop	None
Barren Spaces	20 subjects	19 subjects
Green Spaces	18 subjects	19 subjects

Figure 1. The four barren settings to which participants were randomly assigned during the rest portion of the experiment.

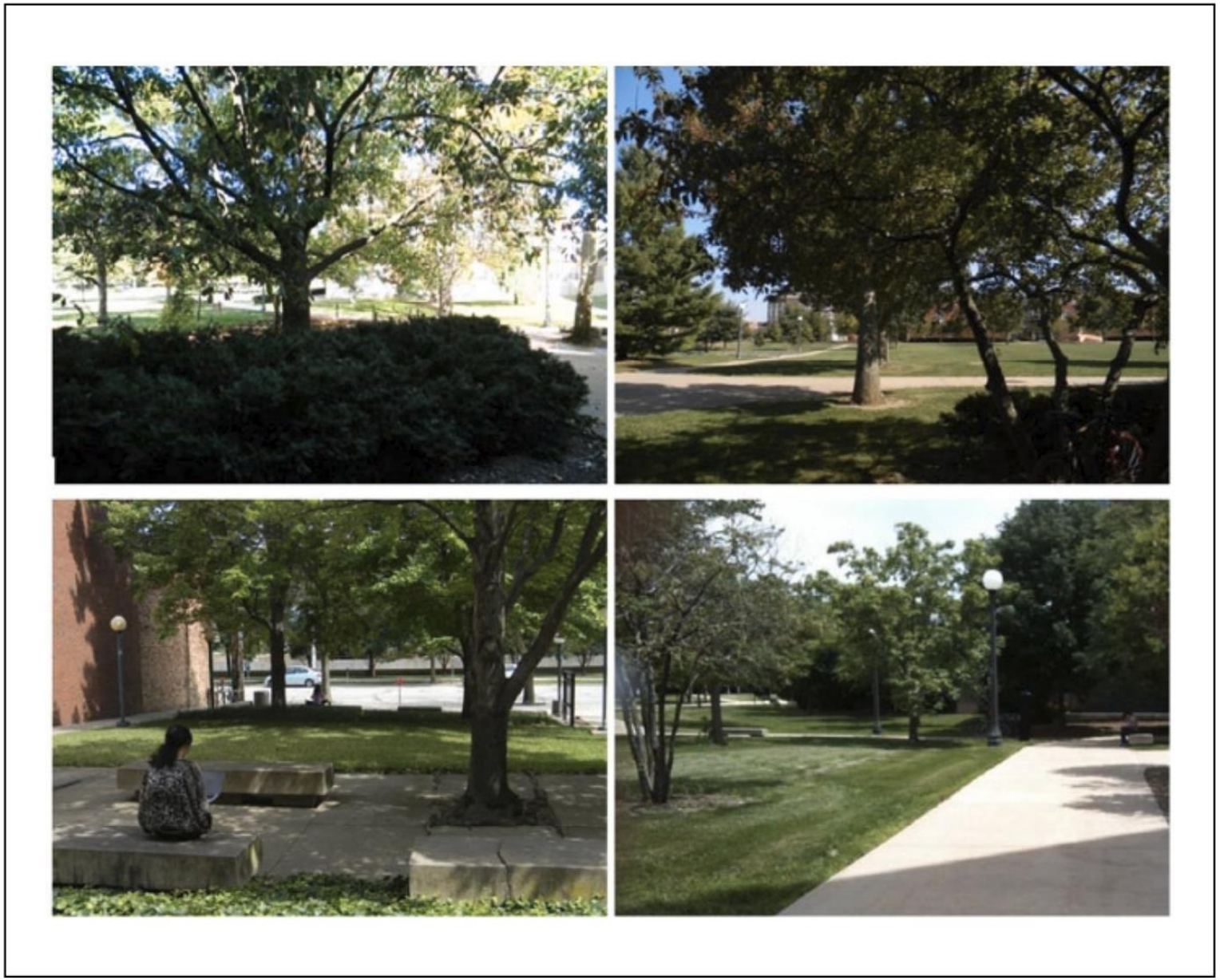


Figure 2. The four green settings to which participants were randomly assigned during the rest portion of the experiment.

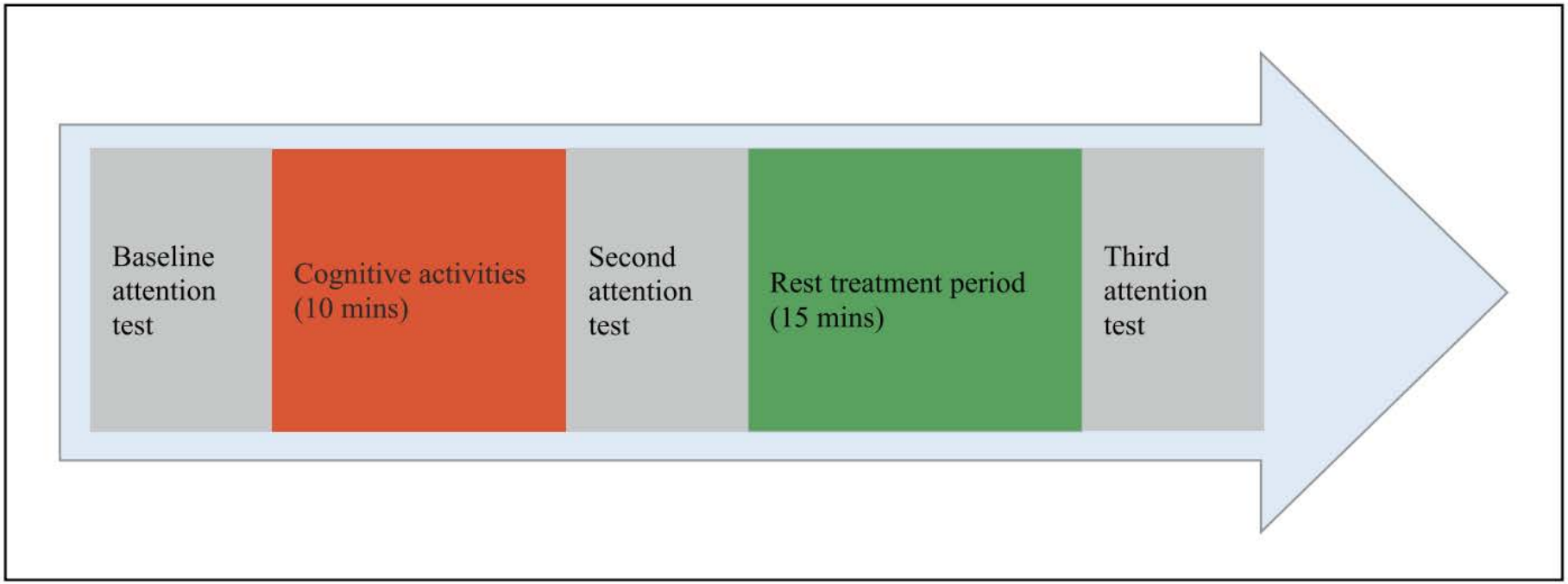


Figure 3. The procedure used in this experiment included five main activities.

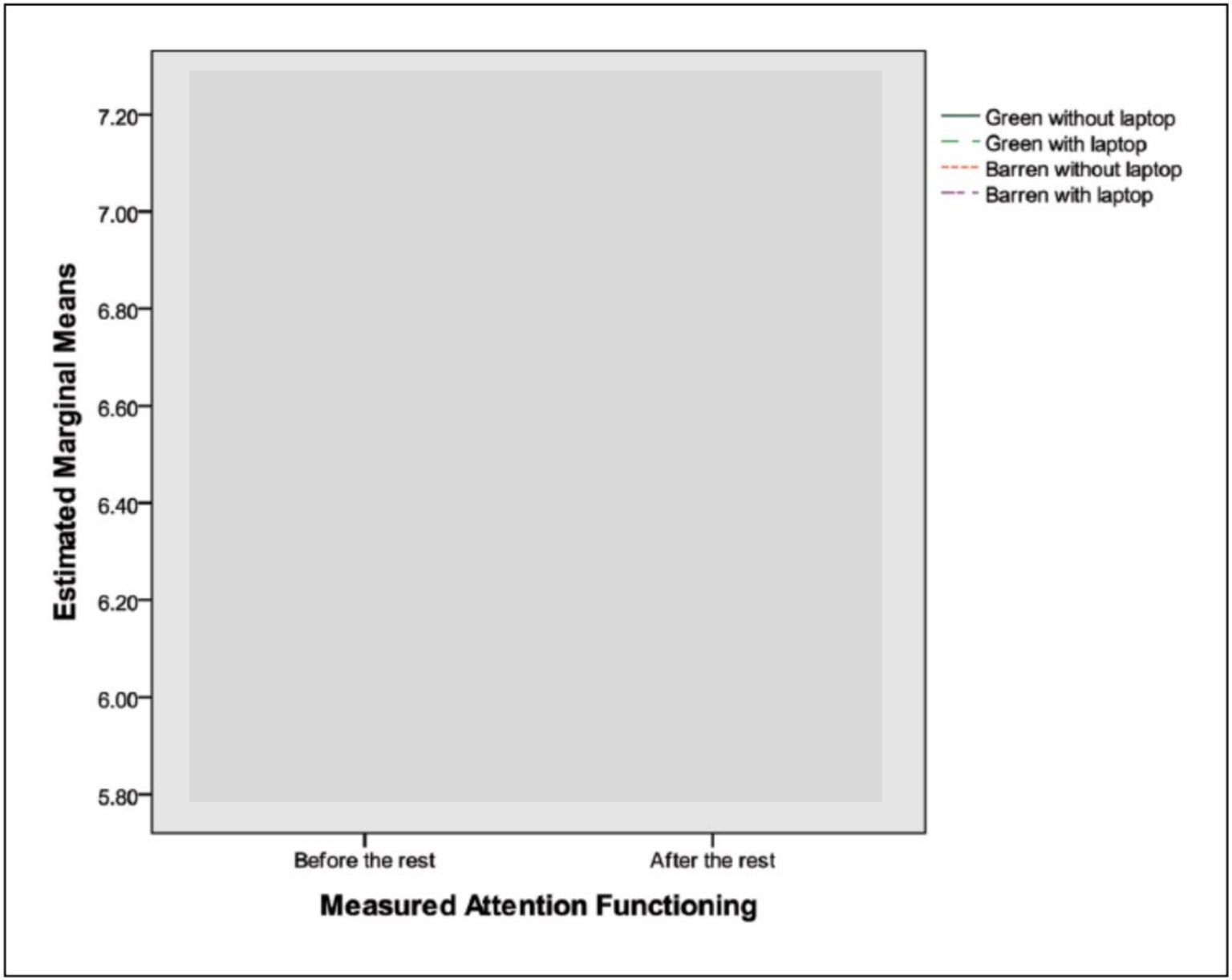


Figure 4. Changes in attentional functioning after the rest treatment for four conditions.

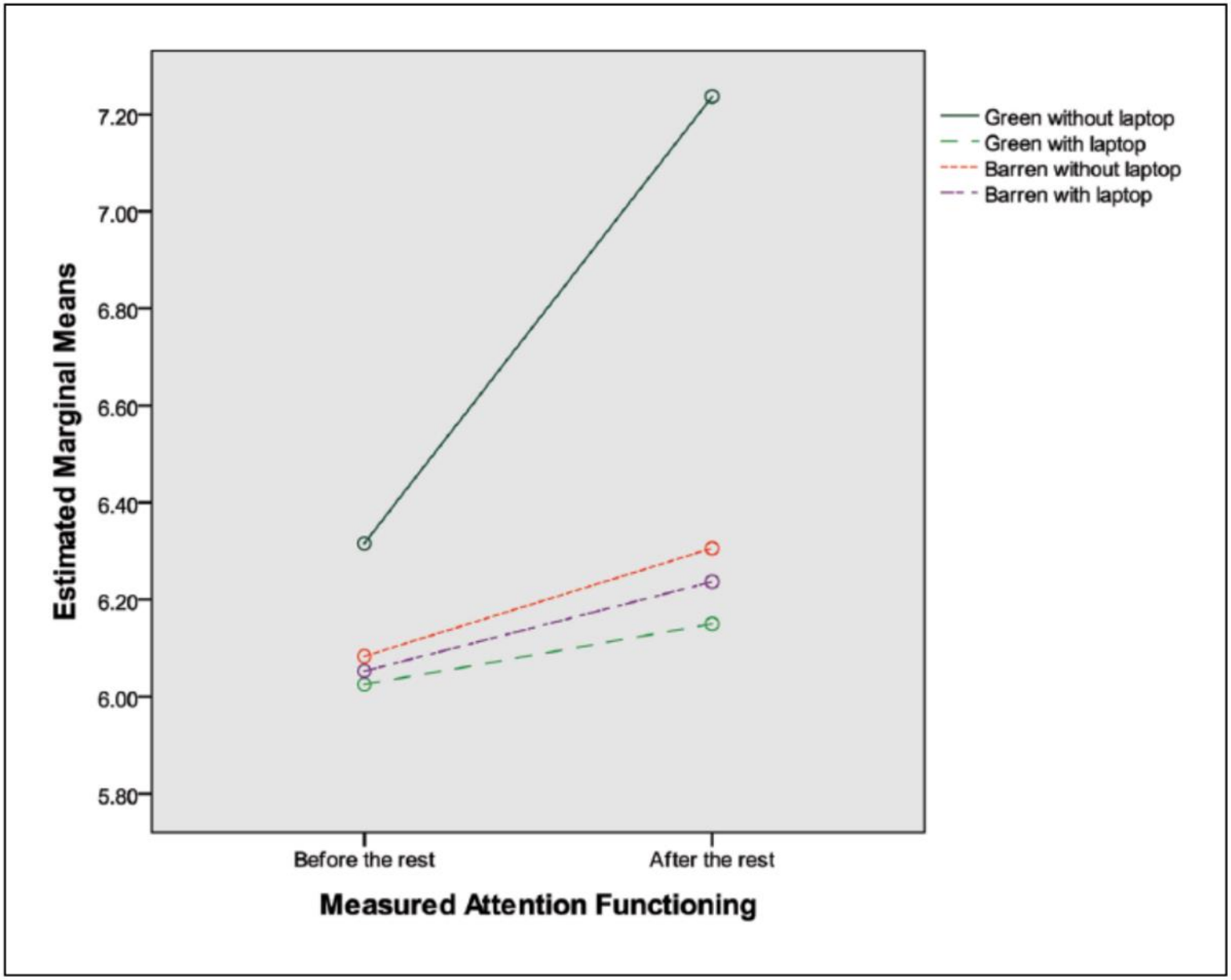


Figure 4. Changes in attentional functioning after the rest treatment for four conditions.

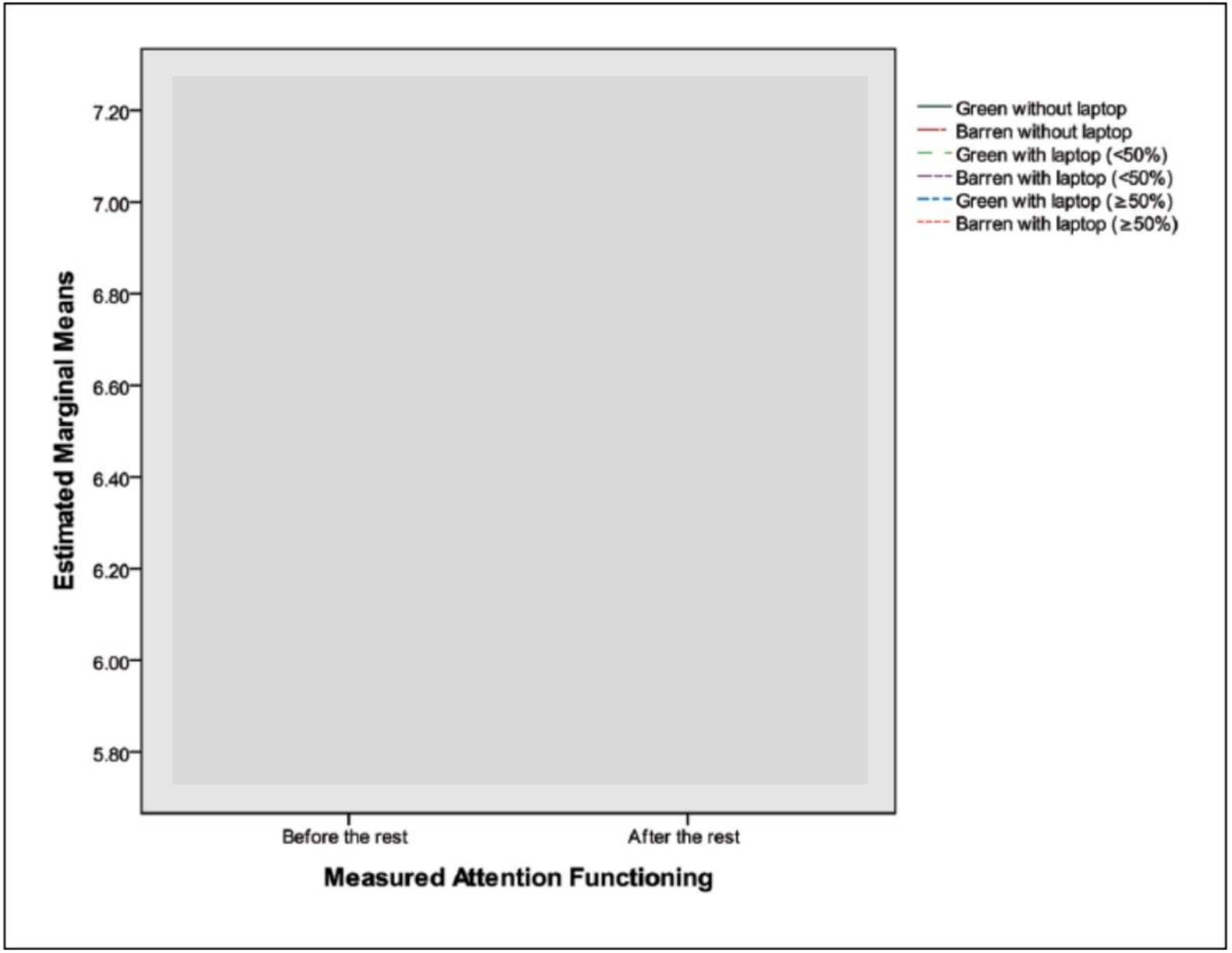


Figure 5. Changes in attentional functioning after the rest treatment for six conditions.

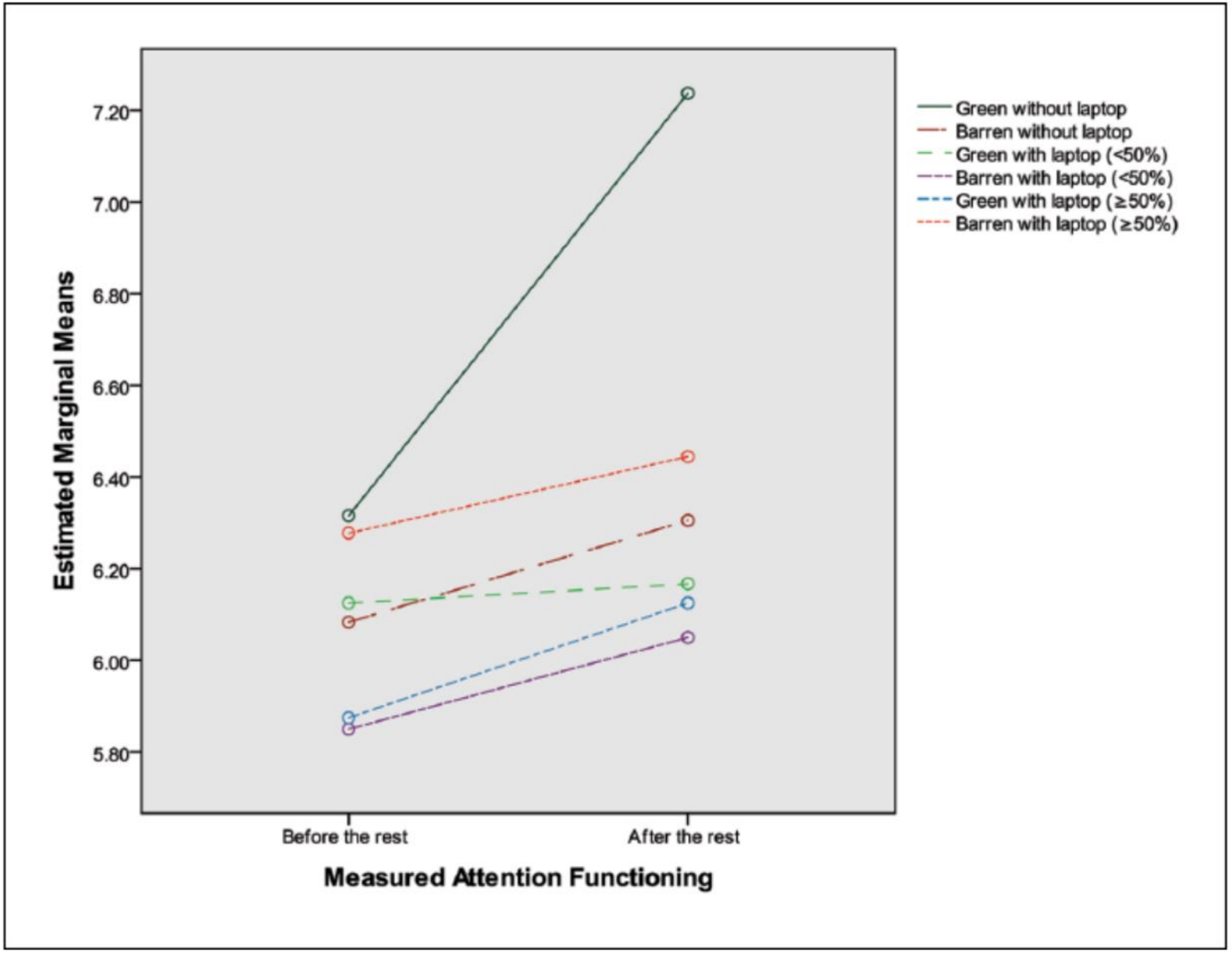
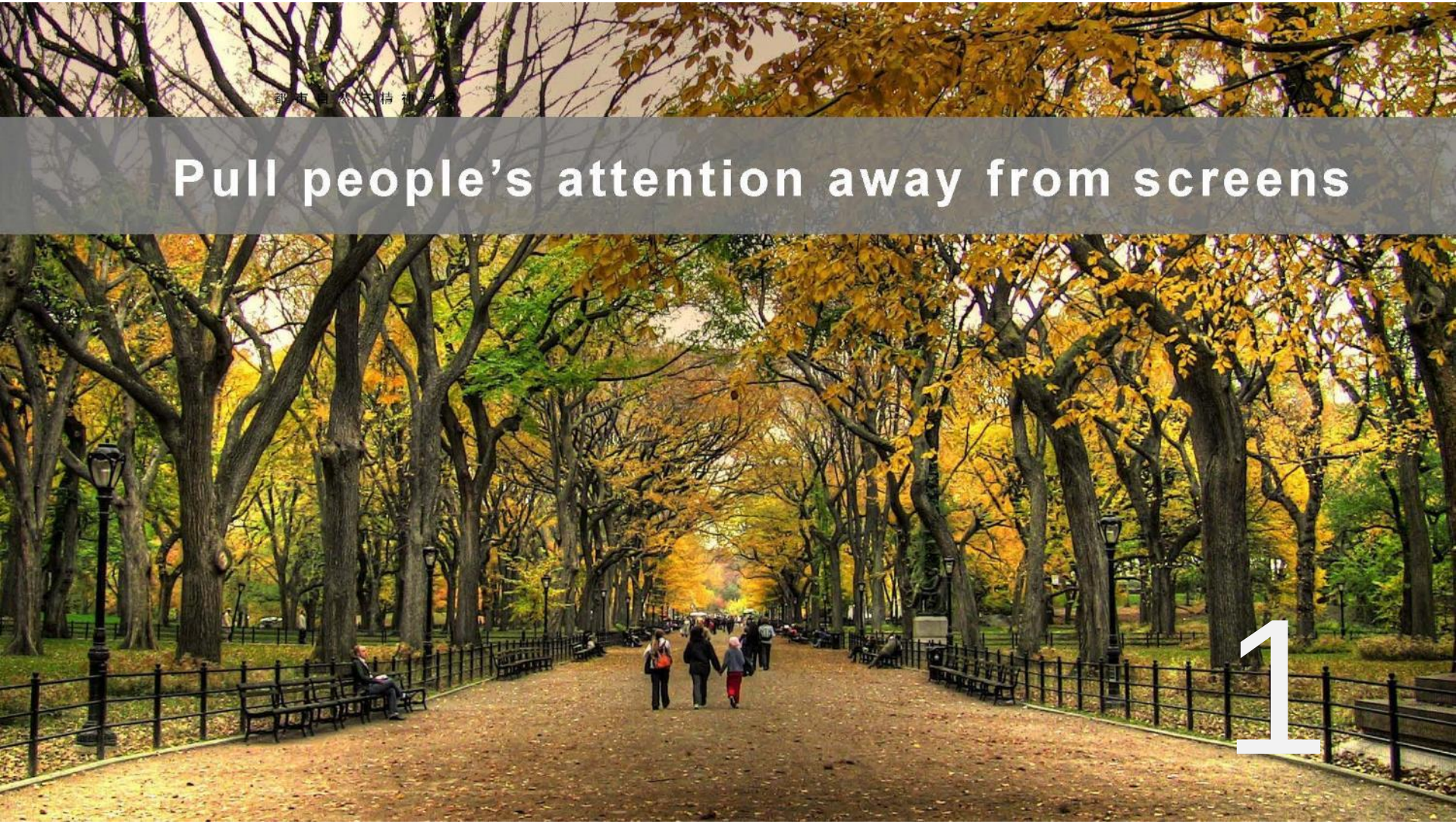


Figure 5. Changes in attentional functioning after the rest treatment for six conditions.

Healthy City & Healthy Landscape

Ten Actions

Pull people's attention away from screens



1

https://www.turismoeeuu.com/estados-unidos-en-otono/

Infrastructure to “Green+ Infrastructure”

2

https://friendsoftheearth.uk/climate/roads-ruin-uks-most-controversial-road-plans

Find the optimal density of built environments

3

https://hkpsychogeography.wordpress.com/page/3/

https://www.cabinlife.com/articles/6-easy-ways-to-create-shade

Green view for each working place

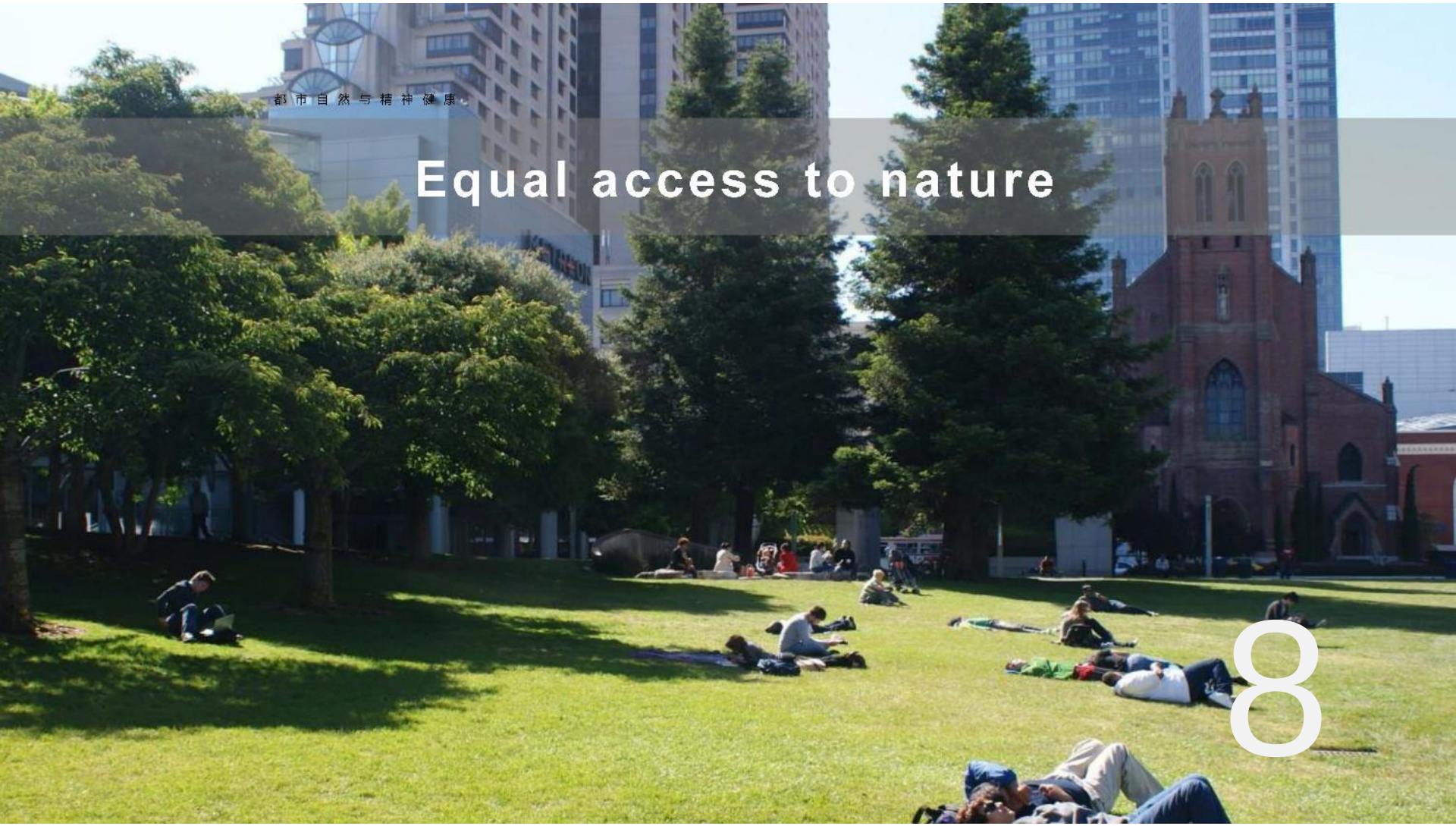
城市自然与精神健康

5

https://www.permacultureaction.org/?attachment_id=11360

http://www.ecodesenvolvimento.org/noticias/designer-cria-telhado-verde-para-onibus

Equal access to nature



Let children play in the green & nature

https://www.newsbreak.com/news/2067353993672/fall-break-fun

https://saportareport.com/ormewood-forest-opportunity-preserve-key-piece-atlantas-tree-canopy/

Thanks!

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Website of UEHH Lab

Bin Jiang's
Researchgate.com