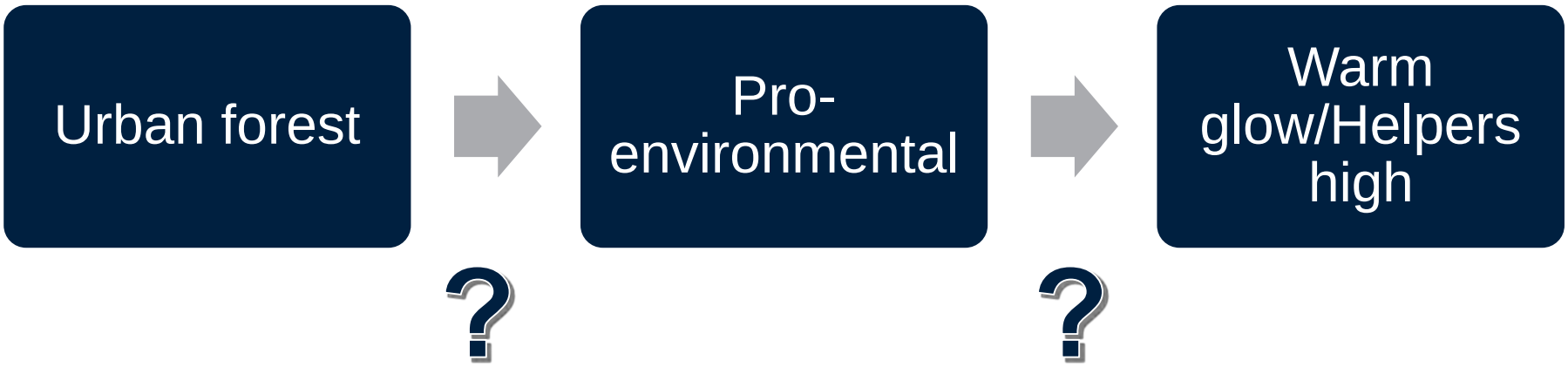
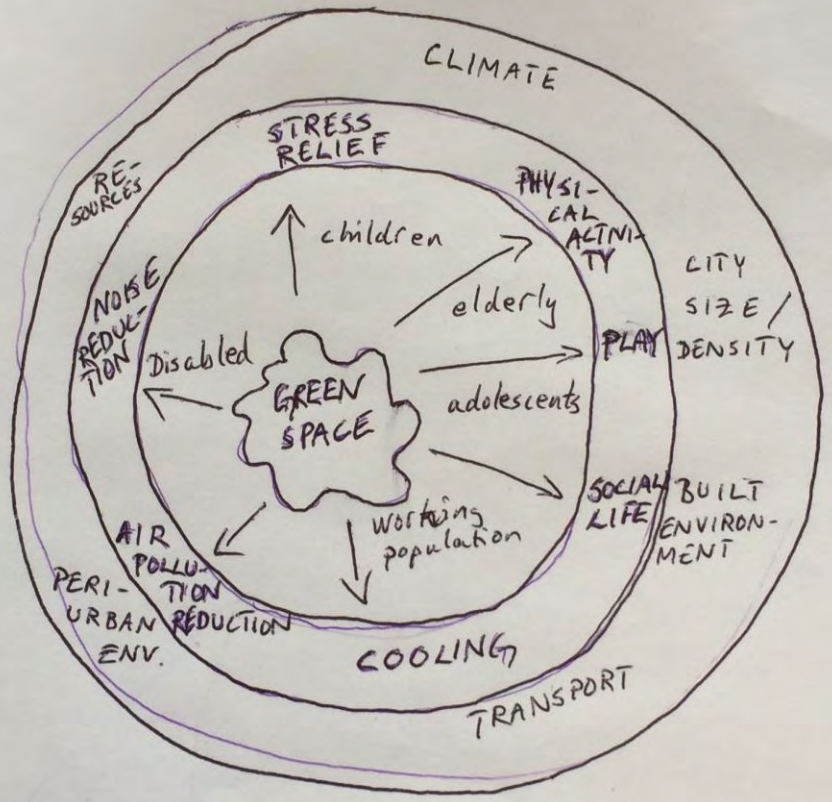

Urban forest
Pro-environmental
Warm glow/Helpers high
?
?

RESPIRATORY DISEASES

BIRTH WEIGHT

DEPRESSION



CANCER

COGNITIVE DEVELOPMENT

CARDIO-VASCULAR DISEASES

BEHAVIOURAL DISORDERS

HEAT STRESS / STROKE

WHAT?	**WHERE?**	**FOR WHOM?**
Health mediator	*Local conditions*	*Population*
Stress relief	Climate	Adolescents
Physical activity	Native flora	Working population
Play	Built environment	Unemployed
Social interactions	Infrastructure & transport	Disabled
Cooling	City size	Children
Reduced air pollution	Culture/traditions	Elderly
Reduced noise		Etc.
Etc.		

URBAN FORESTS AND STRESS REDUCTION

January 31, 2017

OBJECTIVES

UNDERSTAND

- Why stress is a major risk factor for many **diseases**
- Why it is important to **prevent** stress

DESCRIBE

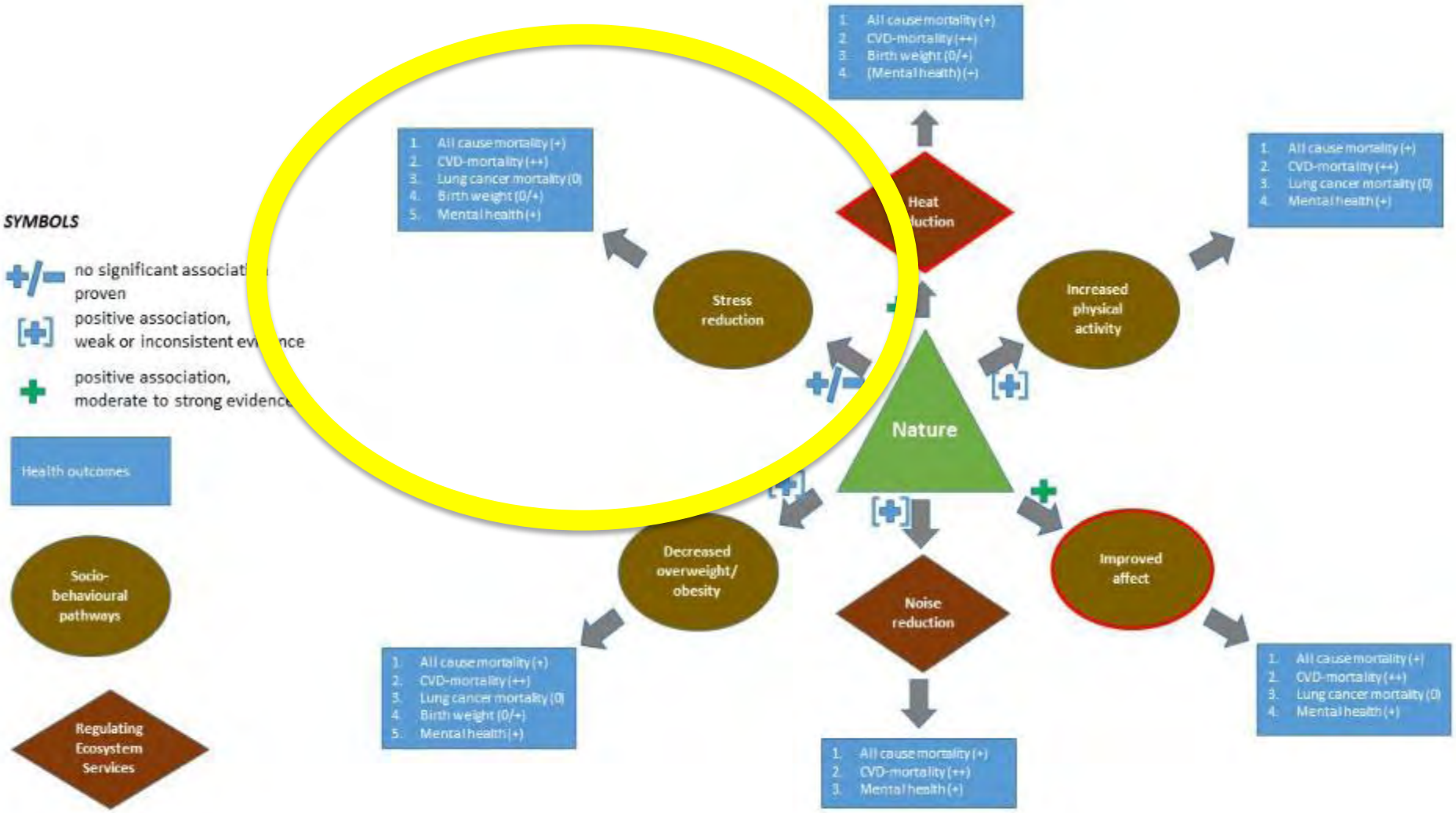
- What **effects** urban forests have on stress and give examples of **scientific evidence**

DISCUSS

- What **elements and qualities** of urban forests may provide stress relief

ARGUE FOR

- That urban forests shall be **implemented more** in healthy and sustainable urban planning



Van den Bosch & Ode Sang, 2017. *Urban natural environments as Nature based solutions for improved public health – a systematic review of reviews*. Environmental Research.

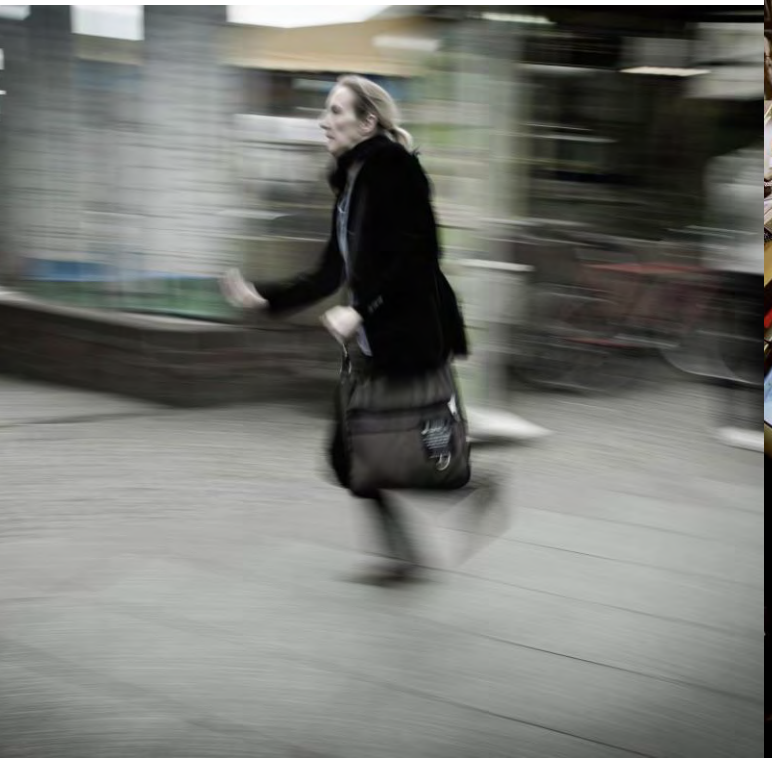
Non-communicable diseases (NCDs) –

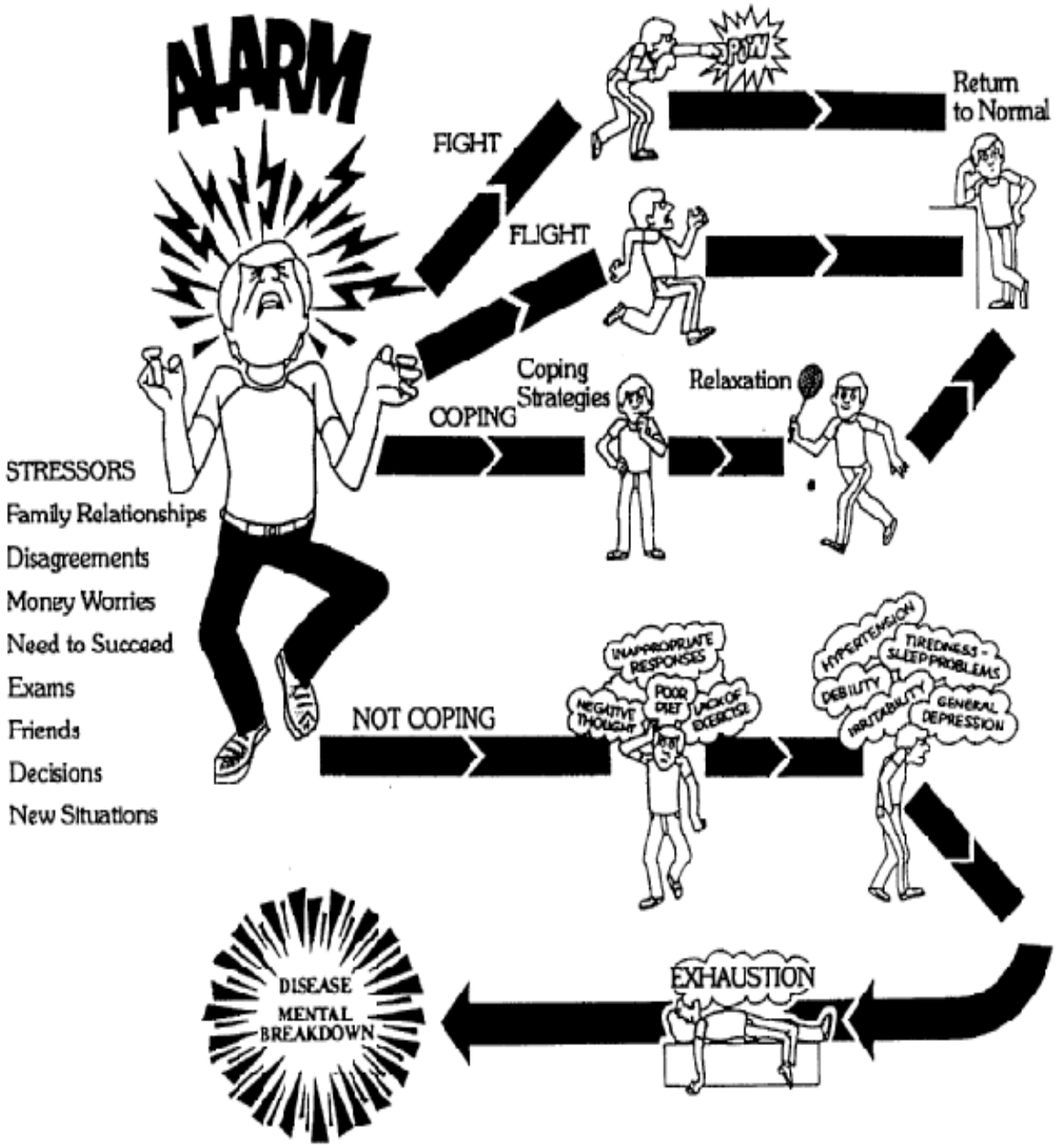
Life-style related and depend on living environments

- Diabetes
- Cardiovascular diseases
- Obesity
- Chronic respiratory diseases
- Cancer
- *Mental disorders*

RISK FACTORS

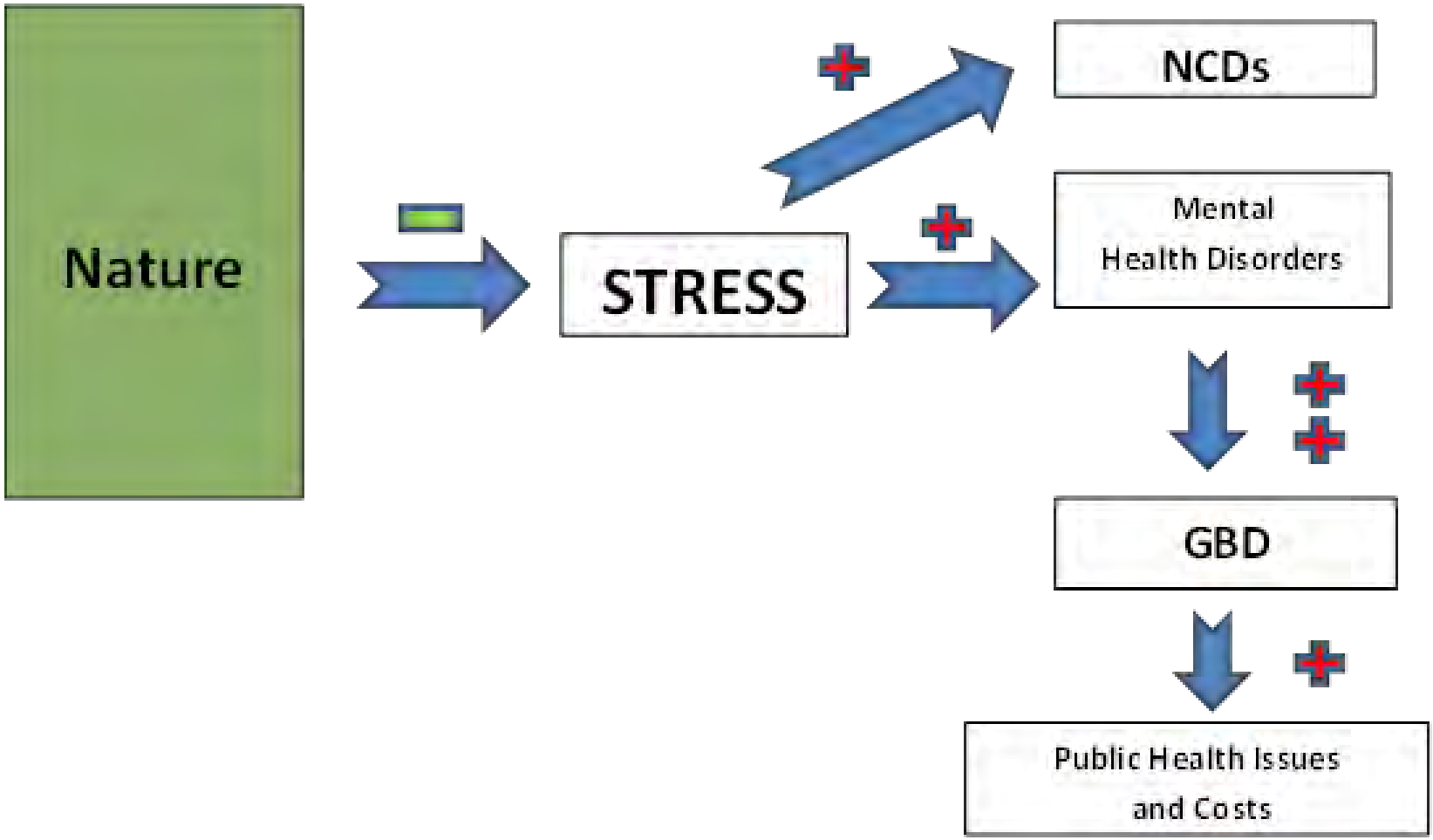
- **Stress**
- Physical inactivity
- Loneliness
- Socioeconomic inequalities





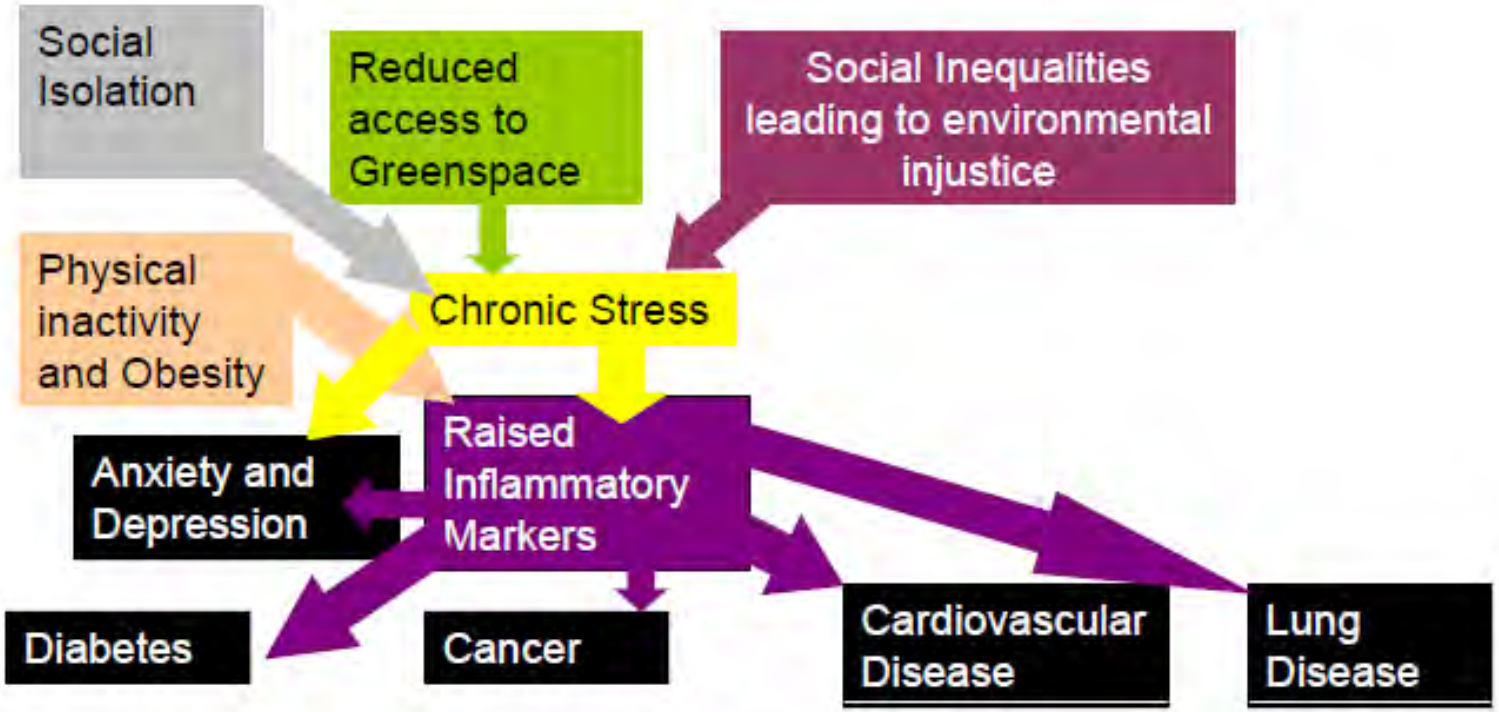
Risk factor: stress

URBAN FORESTS – STRESS – MENTAL HEALTH



- The prevalence of mental disorders is lower in urban green areas (*van den Berg et al. 2015*)
- Exposure to nature significantly increases happiness (*McMahan & Estes, 2015*)

How Stress can be seen as a major public Health Problem



Slide courtesy of William Bird

Why might green spaces make us less stressed?

Biophilia
The direct effects of nature on the brain

Less bad things
Noise, pollution, excess heat, poor aesthetics

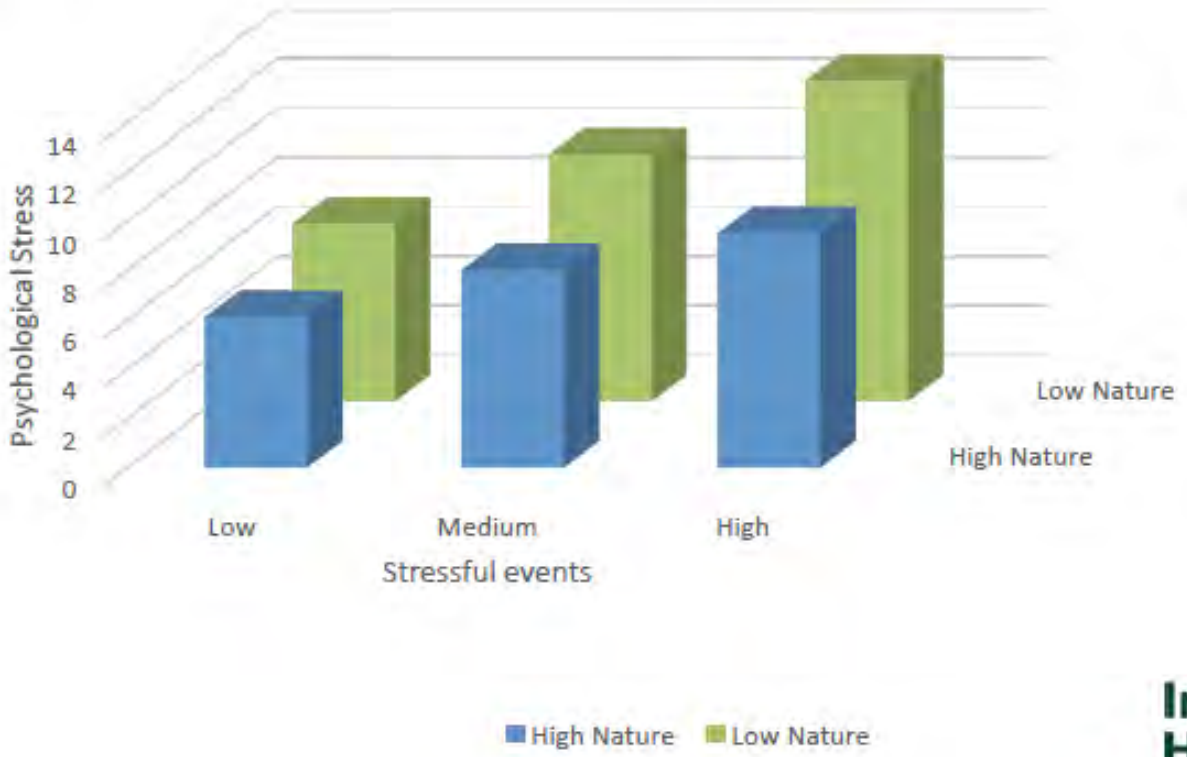
More good things
Physical activity, social interaction

Intelligent Health

Direct effects on the brain
Neural processing, fractal patterns

Place: Green Space moderates the effect of stressful events in children

Nearby Nature
A Buffer of Life
Stress among
Rural Children
NM Wells, GW
Evans
Environment and
Behavior May
2003vol. 35 no.
3 311-33

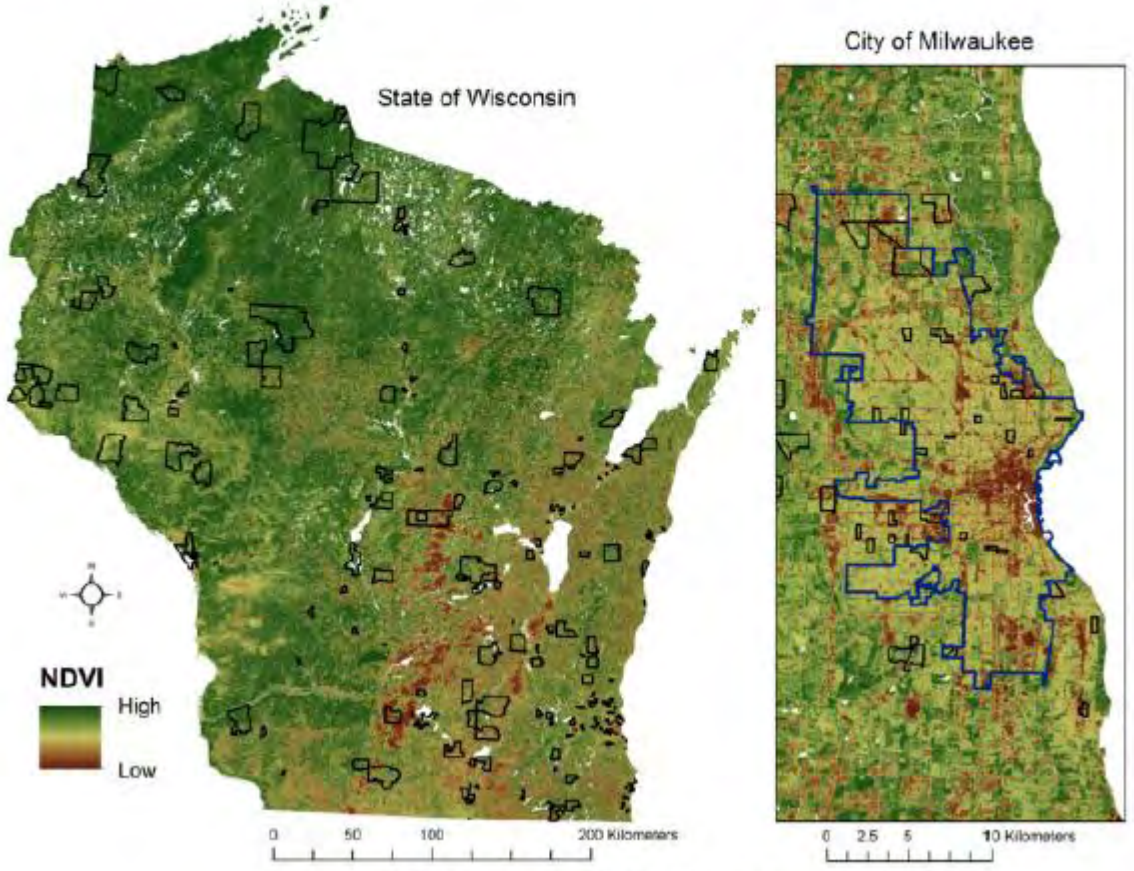


Intelligent Health

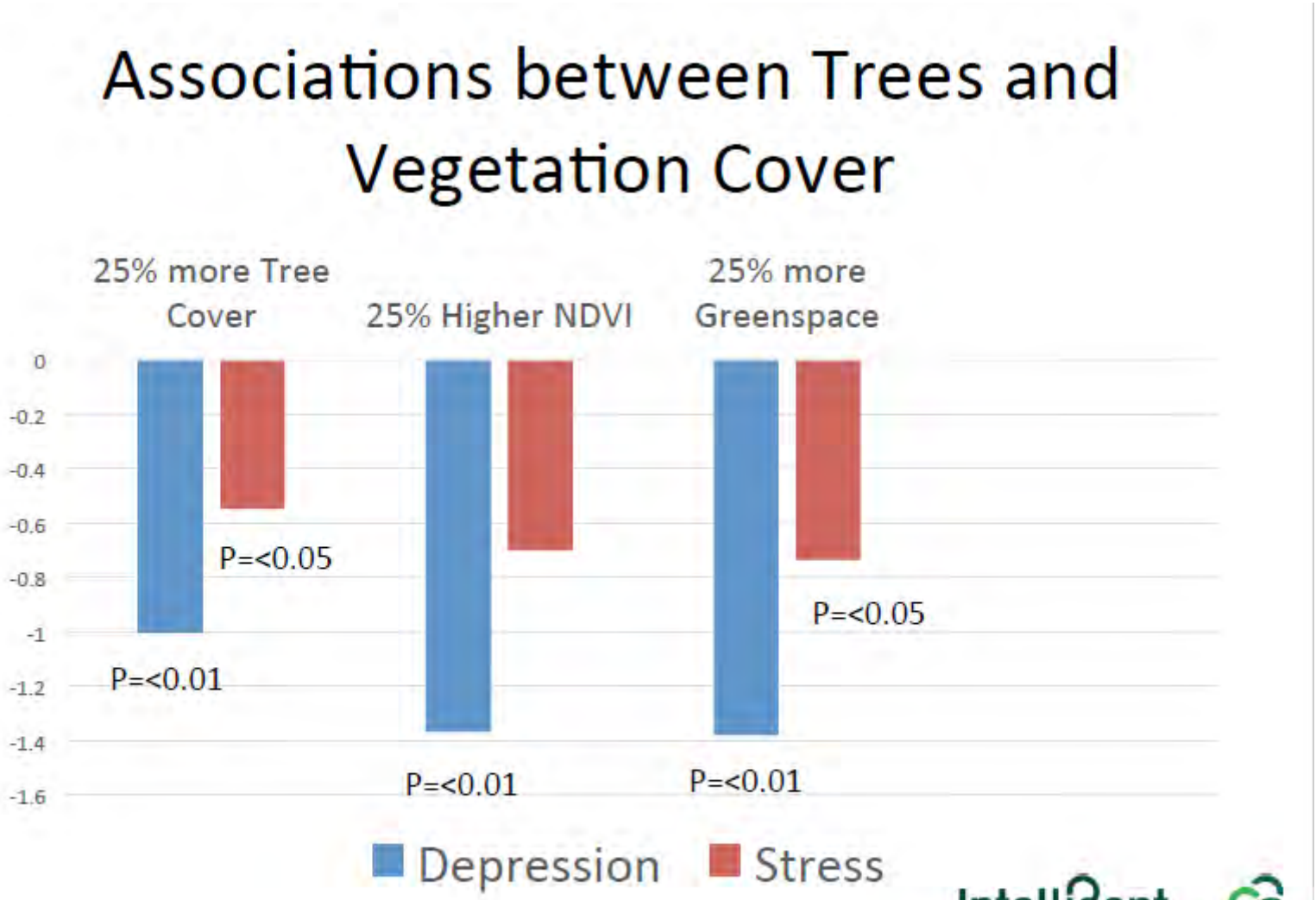
Slide courtesy of William Bird

Beyer et al. 2014. IJERPH

Exposure to Neighbourhood Green Space and Mental Health: Evidence from the Survey of the Health of Wisconsin



“Higher levels of neighborhood green space were associated with significantly lower levels of symptomology for **depression, anxiety and stress**, after controlling for a wide range of confounding factors.”



Intelligent Health

Stress provocation

Trier Social Stress Test (TSST):

1. Presentation
2. Arithmetic task: 1671-13-13-13-13…..0

Real TSST

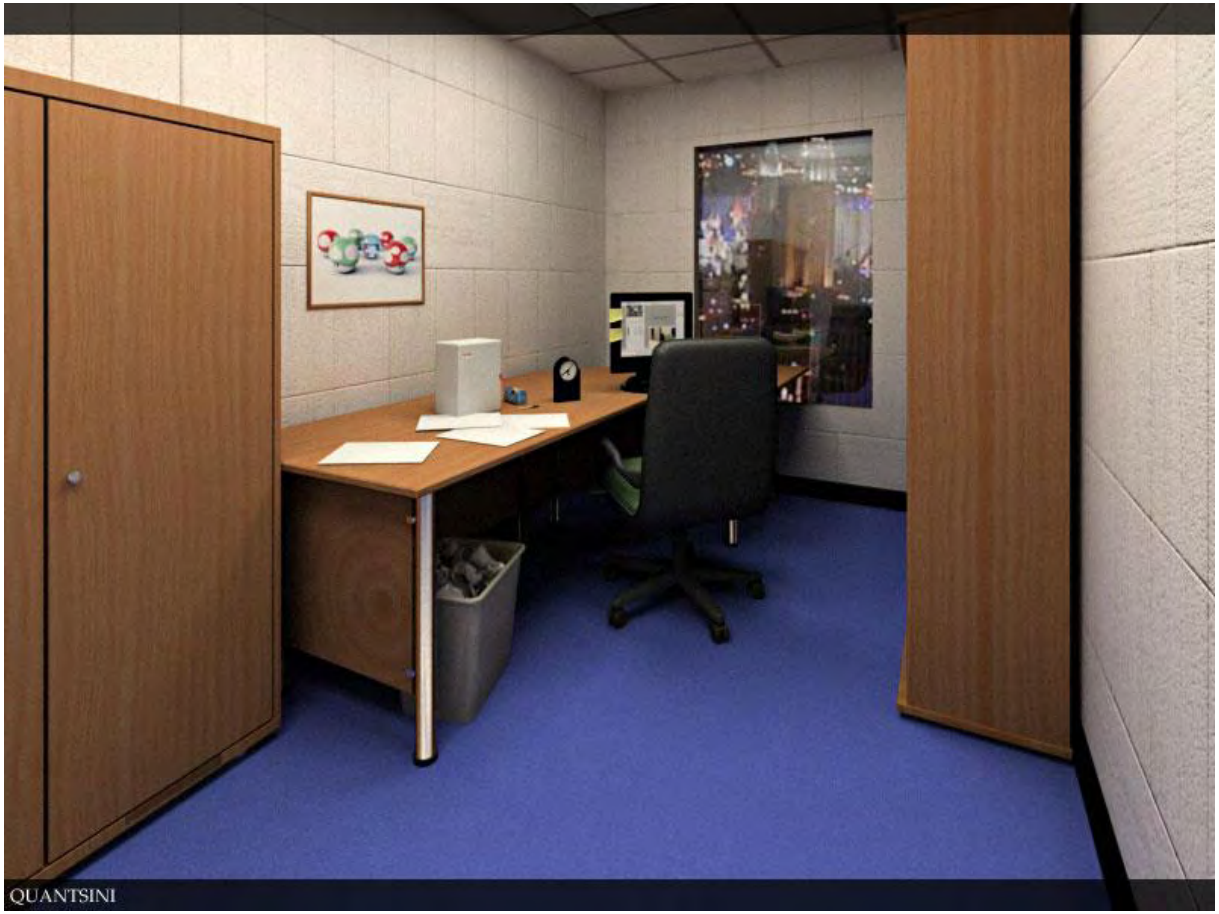
Virtual TSST

Stress indicators

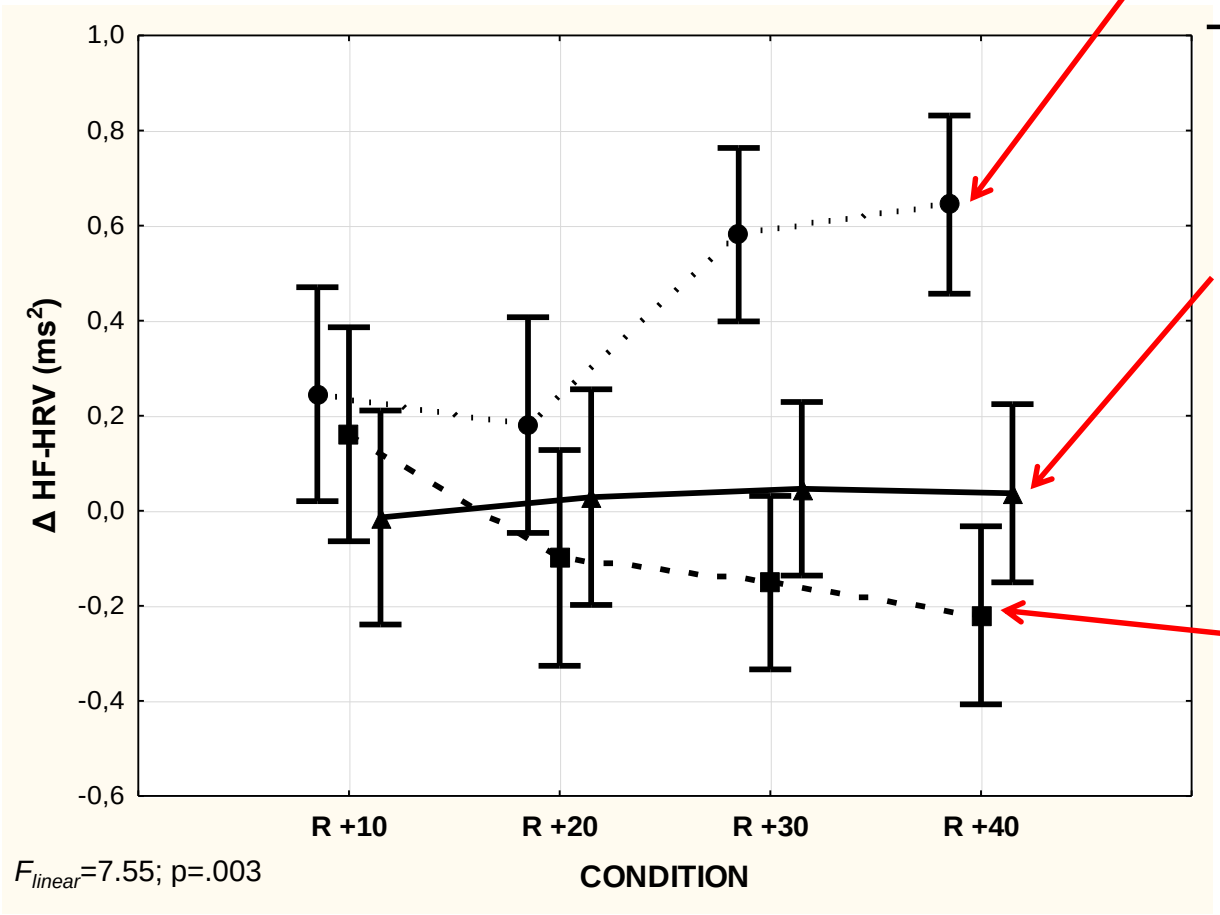
- Cortisol in saliva
- Heart Rate (HR)
- T-wave amplitude (TWA)
- Heart Rate Variability (HF-HRV)

Stress recovery in a virtual forest

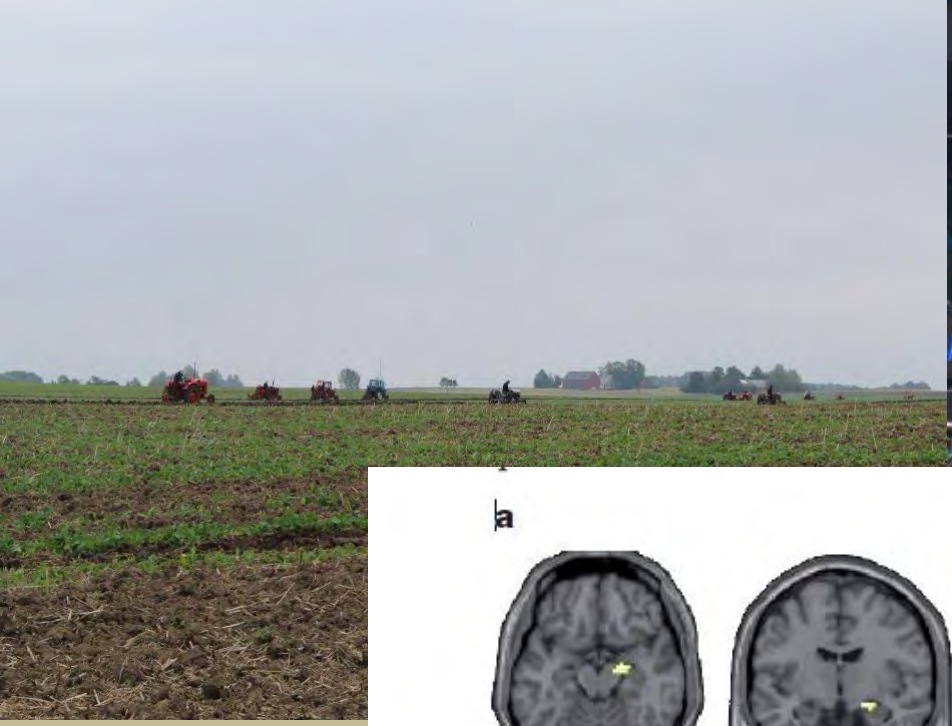
Control

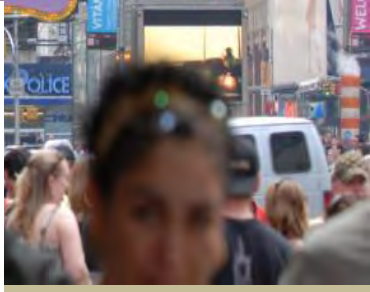


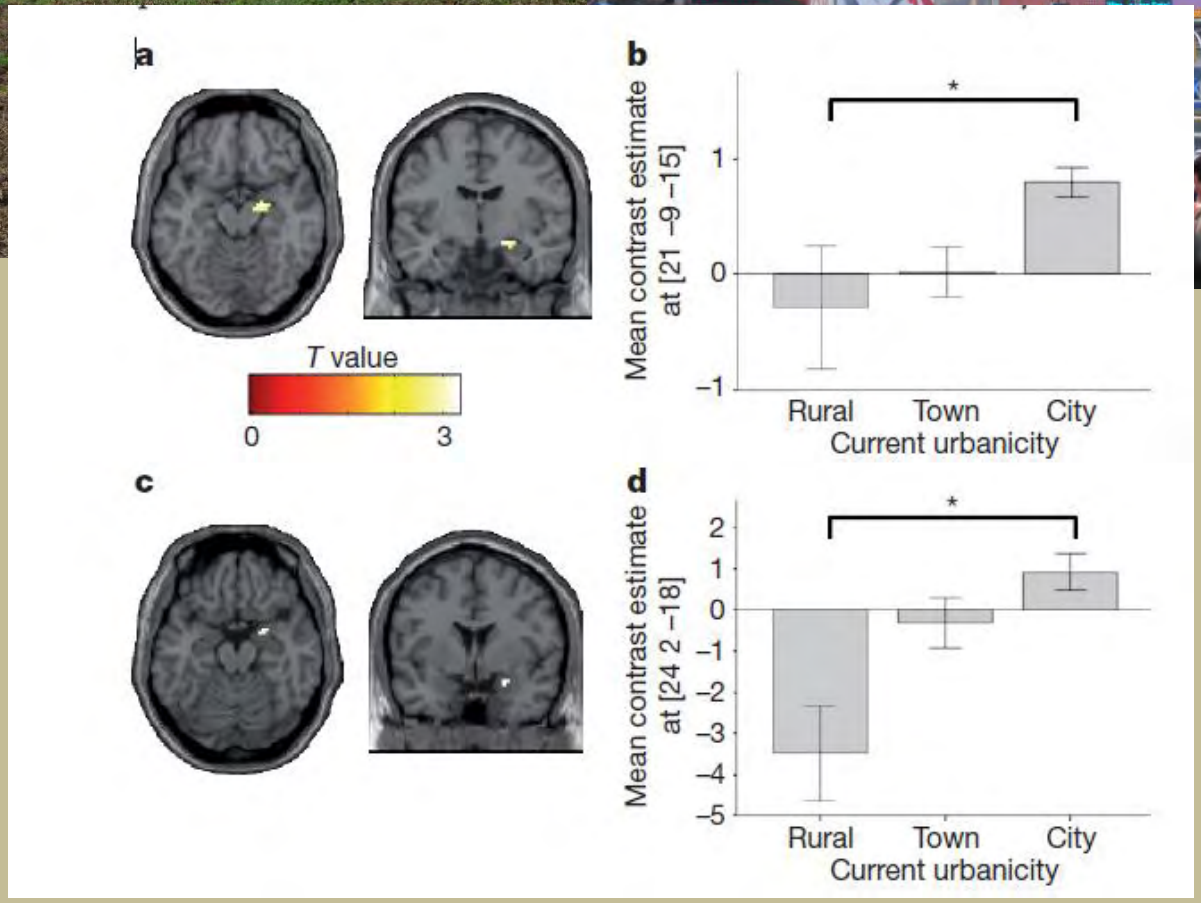
Parasympathetic activation



Annerstedt et al. 2013. *Inducing physiological stress recovery with sounds of nature in a virtual reality forest — Results from a pilot study*. Physiology and Behavior 118:240-50







Lederbogen et al. 2011. Nature. 474(7352):498-501

Bratman et al. 2015. Nature experience reduces rumination and subgenual prefrontal cortex activation. *PNAS. 112(28):8567-8572*

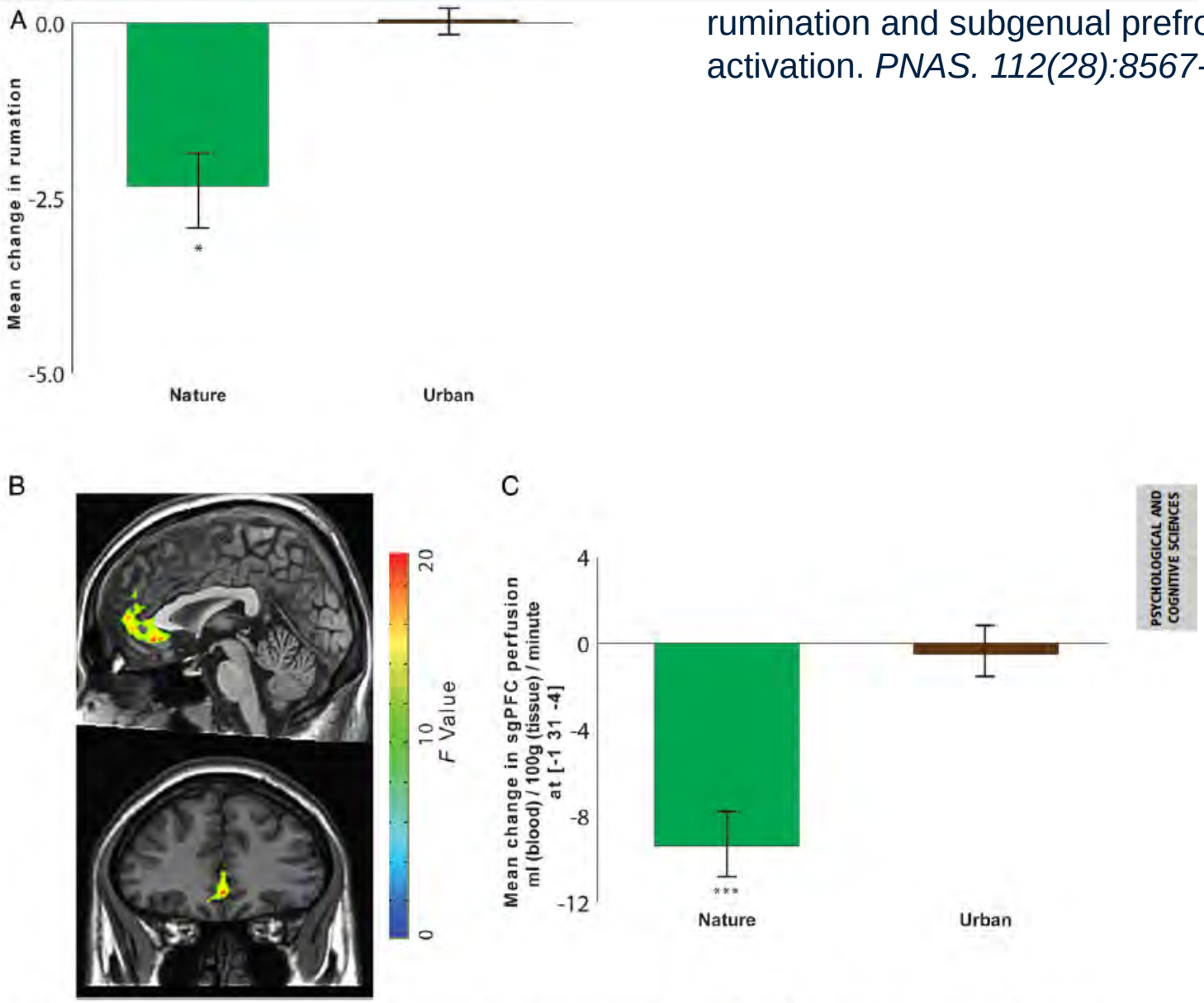
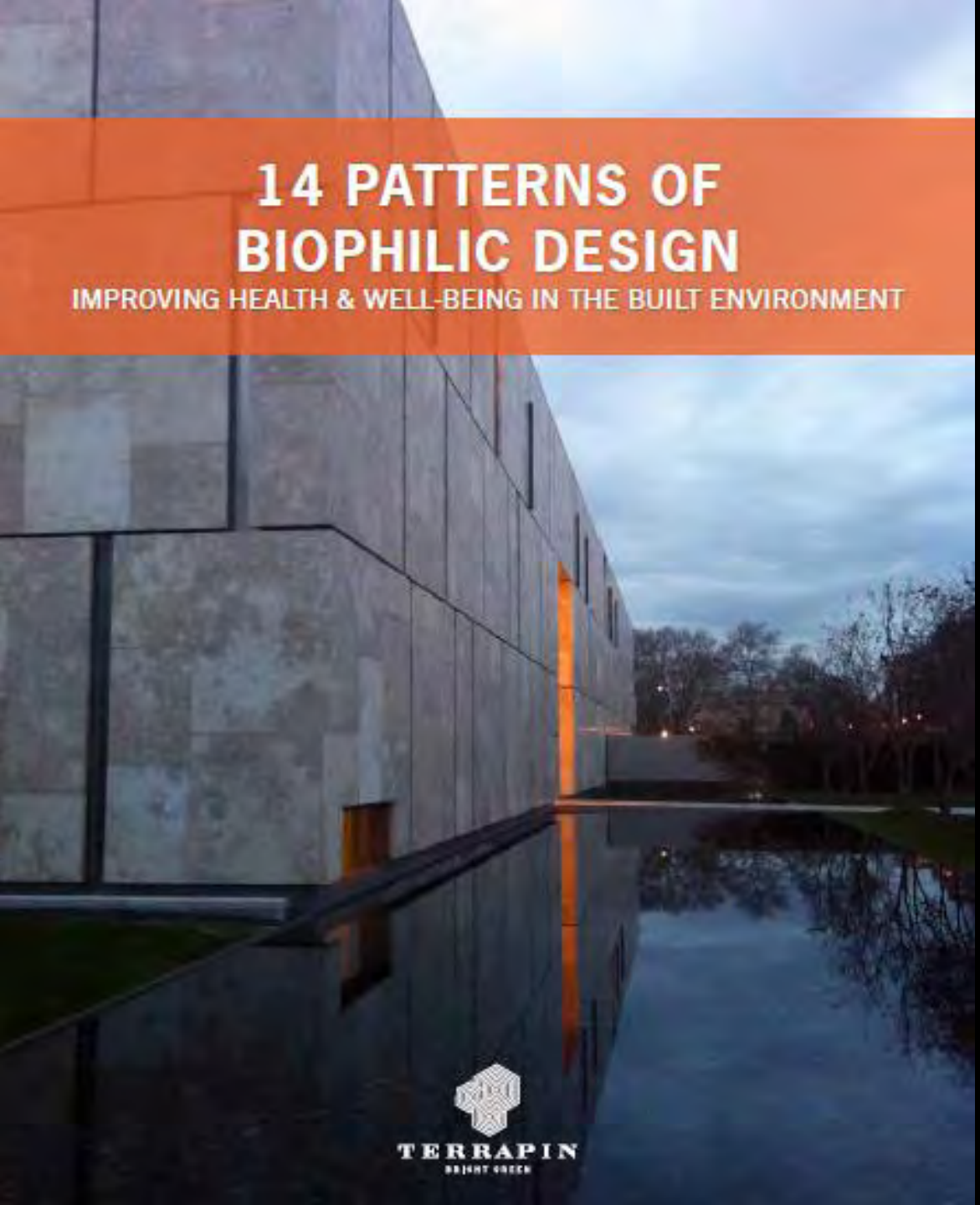


Fig. 1. The impact of nature experience on self-reported rumination and blood perfusion to the sgPFC. (*A*) Change in self-reported rumination (postwalk minus prewalk) for participants randomly assigned to take a 90-min walk either in a natural setting or in an urban setting. (*B*) A time-by-environment interaction in blood perfusion was evident in the sgPFC. *F* map of significant interactions at a threshold of $P < 0.05$, FWE corrected for multiple comparisons. (*C*) Change in blood perfusion (postwalk minus prewalk) for participants randomly assigned to take a 90-min walk either in a natural setting or in an urban setting. Error bars represent SE within subjects: $*P < 0.05$, $***P < 0.001$.

HOW DO WE DESIGN URBAN GREEN SPACES FOR THE MOST EFFICIENT STRESS RELIEF?


14 PATTERNS OF
BIOPHILIC DESIGN
IMPROVING HEALTH & WELL-BEING IN THE BUILT ENVIRONMENT
TERRAPIN

Nature in the Space: seven biophilic design patterns

- 1. **Visual Connection with Nature.** A view to elements of nature, living systems and natural processes.
- 2. **Non-Visual Connection with Nature.** Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes.
- 3. **Non-Rhythmic Sensory Stimuli.** Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely.
- 4. **Thermal & Airflow Variability.** Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.
- 5. **Presence of Water.** A condition that enhances the experience of a place through seeing, hearing or touching water.
- 6. **Dynamic & Diffuse Light.** Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.
- 7. **Connection with Natural Systems.** Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosystem.

NATURE IN THE SPACE

Nature in the space

By Böhringer Friedrich - Lastno delo, CC BY-SA 2.5,

Non-rhythmic stimuli:
Dockside Green Community, Vancouver Island

Biophilic design patterns & Biological Responses

14 PATTERNS		STRESS REDUCTION
NATURE IN THE SPACE		
Visual Connection with Nature	* * *	**Lowered blood pressure and heart rate** (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)
Non-Visual Connection with Nature	* *	**Reduced systolic blood pressure and stress hormones** (Park, Tsunetsugu, Kasetani et al., 2009; Hartig, Evans, Jamner et al., 2003; Orsega-Smith, Mowen, Payne et al., 2004; Ulrich, Simons, Losito et al., 1991)
Non-Rhythmic Sensory Stimuli	* *	**Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity** (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)
Thermal & Airflow Variability	* *	**Positively impacted comfort, well-being and productivity** (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)
Presence of Water	* *	**Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure** (Alvarsson, Wiens, & Nilsson, 2010; Pheasant, Fisher, Watts et al., 2010; Biederman & Vessel, 2006)
Dynamic & Diffuse Light	* *	**Positively impacted circadian system functioning** (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) **Increased visual comfort** (Elyezadi, 2012; Kim & Kim, 2007)
Connection with Natural Systems		

Natural Analogues: three patterns of biophilic design:

8. **Biomorphic Forms & Patterns.** Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.

9. **Material Connection with Nature.** Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.

10. **Complexity & Order.** Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.

Natural analogue

Waves by Aslai_CC BY-NC-SA 2.0

NATURE OF THE SPACE: FOUR BIOPHILIC PATTERNS OF DESIGN

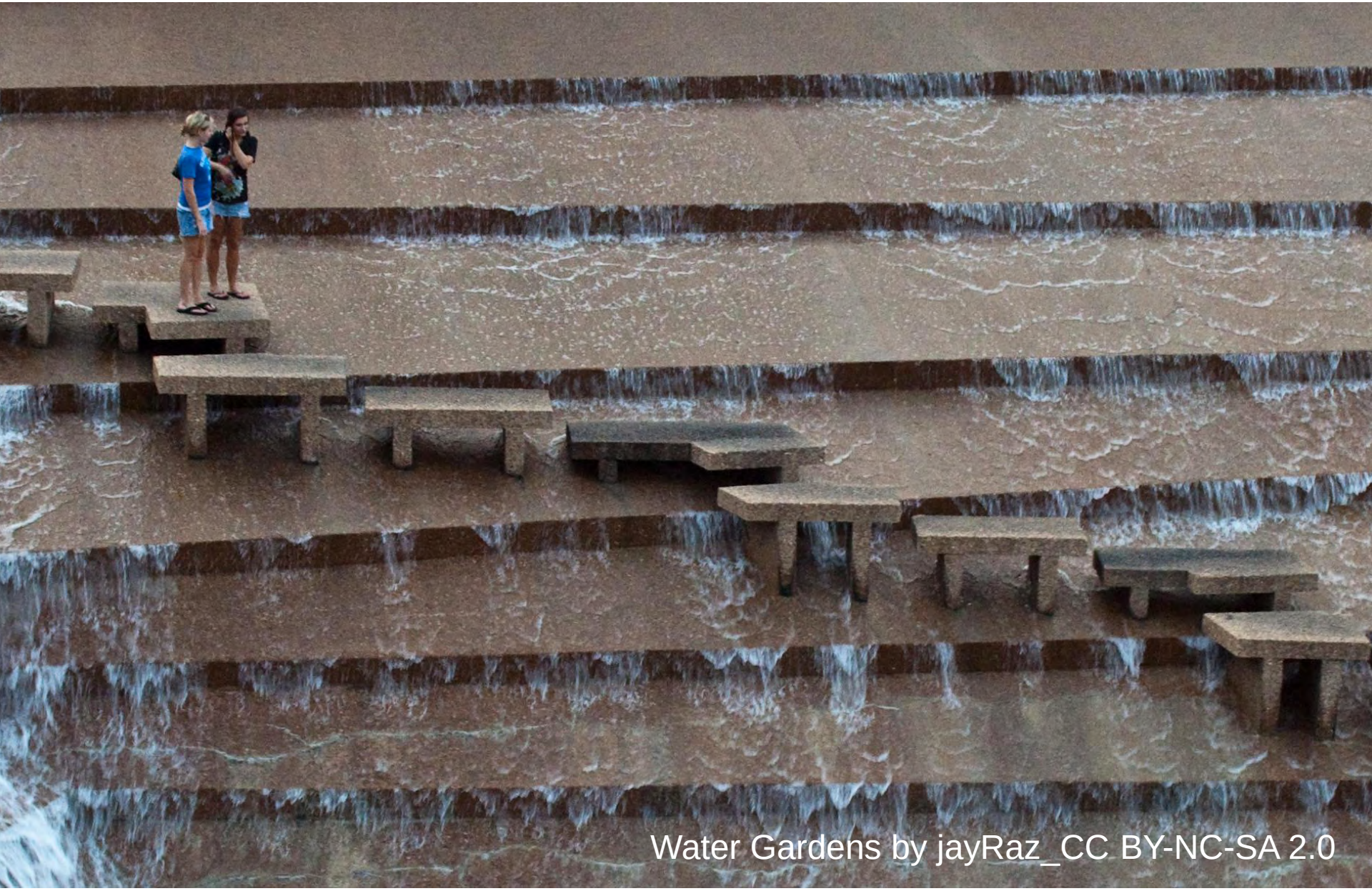
11. **Prospect.** An unimpeded view over a distance, for surveillance and planning.

12. **Refuge**. A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.

13. **Mystery**. The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.

14. **Risk/Peril**. An identifiable threat coupled with a reliable safeguard.

Nature of the space



Water Gardens by jayRaz_CC BY-NC-SA 2.0

Vaux le Vicomte by Mark B. Schlemmer_CC BY 2.0

Risk, peril

Levitated Mass by Kate Dollarhyde_CC BY-NC 2.0

			Stress reduction	Cognitive performance	Emotion, mood, preference
NATURAL ANALOGUES	Biomorphic Forms & Patterns	*			**Observed view preference** (Vessel, 2012; Joye, 2007)
	Material Connection with Nature			**Decreased diastolic blood pressure** (Tsunetsugu, Miyazaki & Sato, 2007) **Improved creative performance** (Lichtenfeld et al., 2012)	**Improved comfort** (Tsunetsugu, Miyazaki & Sato 2007)
	Complexity & Order	* *	**Positively impacted perceptual and physiological stress responses** (Salingaros, 2012; Joye, 2007; Taylor, 2006; S. Kaplan, 1988)		**Observed view preference** (Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
NATURE OF THE SPACE	Prospect	* * *	**Reduced stress** (Grahn & Stigsdotter, 2010)	**Reduced boredom, irritation, fatigue** (Clearwater & Coss, 1991)	**Improved comfort and perceived safety** (Herzog & Bryce, 2007; Wang & Taylor, 2006; Petherick, 2000)
	Refuge	* * *		**Improved concentration, attention and perception of safety** (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
	Mystery	* *			**Induced strong pleasure response** (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)
	Risk/Peril	*			**Resulted in strong dopamine or pleasure responses** (Kohno et al., 2013; Wang & Tsien, 2011; Zald et al., 2008)

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Stress recovery and restorative effects of viewing different urban park scenes in Shanghai, China

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ABSTRACT

Objectives: Many studies have found that natural environments benefit human health and wellbeing, but few have measured restorativeness of specific landscape components, especially in Chinese settings. Because the rapid urbanization of China is accompanied by increasing predomination of hardscape components in cities, the restorative quality of urban green space is a crucial issue. This study explored the stress recovery effects of different videotaped scenes, using six urban parks and one urban roadway scene. Potentially restorative urban park scenes were controlled for nature-based vs. hardscape components, presence/absence of people, and level of openness.

ART, Stress reduction theory, Prospect-Refuge theory

- Openness and presence of water
- Nature-based components and hardscape components.
- Presence/absence of people

OUTCOMES

Stress,

Attentional level

Perceived restorativeness

1. Open,
   50-80 m sight distance

2. Open with people
   50-80 m sight distance

3. Open,
   50-60 m sight distance

4. Open with people
   50-60 m sight distance

5. Water,
   40-90 m sight distance

6. Semi-enclosed
   2-5 m sight distance

7. Open,
   50-80 m sight distance.

Many pedestrians,
View from many people’s homes

Table 3
Means and standard deviations for overall Perceived Restorativeness Scale (PRS) value and the four subscales of sites in urban parks.

Videotaped scenes	Overall PRS (perceived restorativeness)	Subscales			
		Being away	Fascination	Coherence	Compatibility
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)
Lawn w/people	4.63 (0.76)	5.34 (0.95)	4.81 (0.99)	4.21 (1.37)	4.15 (1.12)
Lawn w/o people	4.96 (0.75)	5.52 (0.77)	4.30 (1.06)	5.34 (0.96)	4.67 (1.12)
Plaza w/people	3.95 (0.83)	4.58 (1.02)	3.56 (1.02)	4.50 (1.32)	3.17 (1.09)
Plaza w/o people	3.96 (0.83)	4.19 (1.20)	3.61 (0.90)	4.74 (1.02)	3.29 (1.10)
Small Lake	4.95 (0.66)	5.47 (0.76)	4.59 (0.94)	5.09 (1.07)	4.64 (1.01)
Walkway	4.49 (0.64)	5.03 (1.13)	4.09 (0.97)	4.84 (0.92)	3.99 (0.93)
Urban Roadway	2.07 (0.52)	1.83 (0.87)	2.20 (0.92)	2.62 (0.95)	1.65 (0.74)

PRS based on 7-point scale, where lower values indicate lower levels of restorative experience. $N = 20$ for each scene.

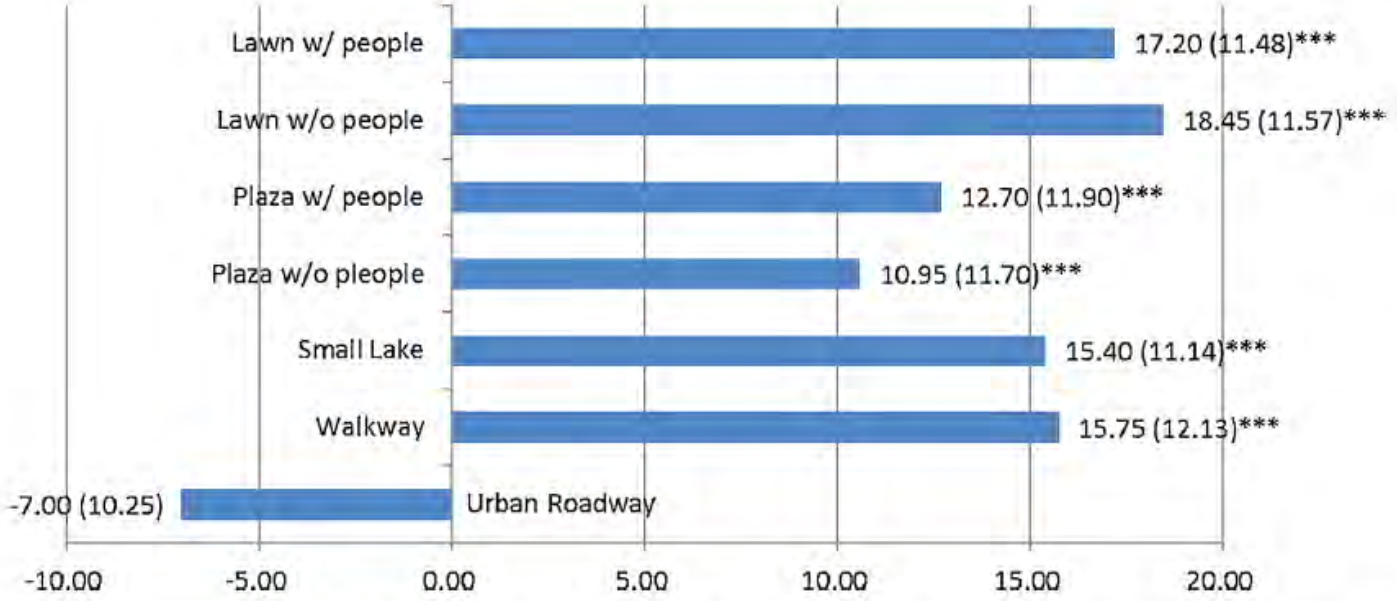

Fig. 9. Mean differences and standard deviations of the changes in state anxiety using the state part of the State-Trait Anxiety Inventory (STAI-S), where the values indicate the extent to which different videos relieved anxiety. *p*-Values show pairwise comparisons of each site condition, contrasted with Urban Roadway ($N = 20$): *** $p < 0.001$.

More nature-based

Less hardscape

Water

Reduced crowding

"*The findings can also help landscape architects design more effective landscape components in urban parks.*"

OBJECTIVES

UNDERSTAND

- Why stress is a major risk factor for many **diseases**
- Why it is important to **prevent** stress

DESCRIBE

- What **effects** urban forests have on stress and give examples of **scientific evidence**

DISCUSS

- What **elements and qualities** of urban forests may provide stress relief

ARGUE FOR

- That urban forests shall be **implemented more** in urban planning to prevent stress related diseases.