THE UNIVERSITY OF MELBOURNE

Effects of exposure to immersive videos and photo slideshows of forest and urban environments

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Changfa FU

We acknowledge and pay respect to the Traditional Owners of the lands upon which our campuses are situated

Do you want nature or urban?

Artificial stimulation (human-generated environments)

- Mental fatigue (Kaplan, 1982)
- Loss of vitality and health (Katcher & Beck, 1987)

Reduced negative effects by interactions with nature (Keniger et al., 2013)

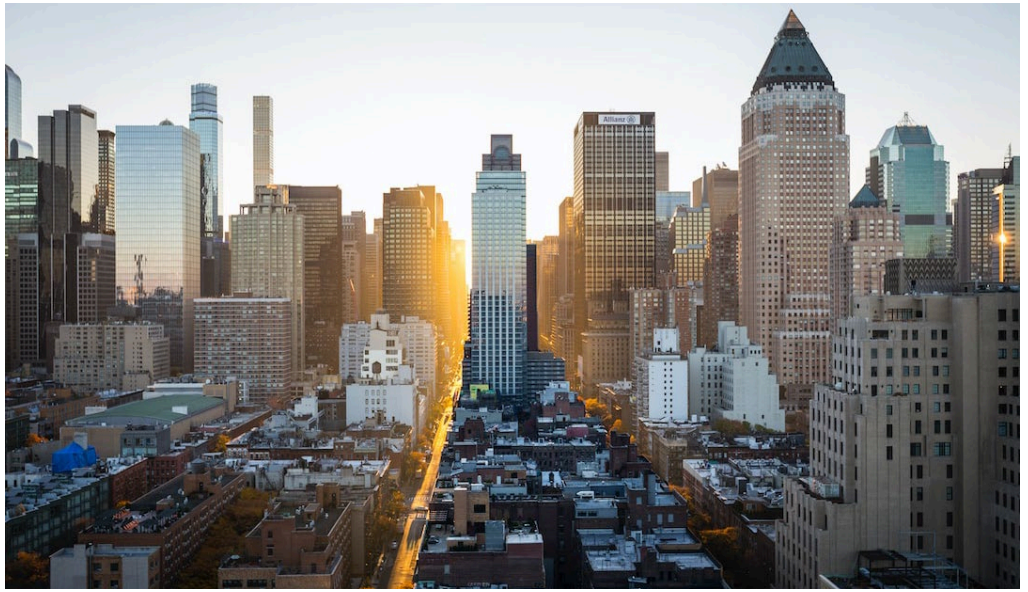
- Physiological Benefits (Jo et al., 2019)

Attention Restoration Theory (Ohly et al., 2016; Stevenson et al., 2018)

- Less cognitive resources
- Interruption of attention-grabbing
- Elicit attention restoration and mental fatigue recovery

Forests has their positive effects on human body and mind

- Psychological relief (Shin et al., 2010)
- Lower stress levels (Wang et al., 2019)
- Lower depression levels (Morita et al., 2007)



If you cannot go out freely, what will you do?

Research Question

VR (Immersive Virtual Reality)

Higher Sense of Presence

Positive Impacts of Virtual Nature Exposure

Mood, stress, physiological reactions and cognition

Hypothesis

Environment and the **immersion** level, as well as their **interaction**, have an influence on mood, stress recovery, and cognitive performance.

It is expected that the forest environment would produce a more positive effect than the urban environment

It is expected that more immersive presentations create a higher sense of presence and consequently have greater effects

- More realistic environments would lead to realistic behavior and trigger corresponding responses

Experiment: Material Preparation

Visual stimuli

Forest environment: northern German mixed forest (focus on vegetation, other natural elements avoided e.g., water and animals or humans)

Urban environment: old town of northern Germany (focus on buildings, no vegetation, animals or humans) => still /no movement

Auditory stimuli

Sound of wind breeze

Filming

Each 360◦ video was a 6 min video consisting of three 2 min single stationary videos

The result is a composition of three stationary single shots in which the tripod, per single shot, was placed firmly in one place.

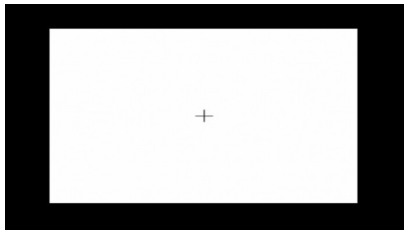
Final video created from impression of teleportation between these three shots.

Experiment: Participants & Places

35 subjects participated (Student at University of Hamburg)

1. 1 excluded due to deuteranopia (green blindness)
2. Thus, 34 subjects (11 female) were between 21 and 34 years old (M=27.26,SD=4.144)
3. Compensated with course credits.

Three different environments (Within Subject)



1. Black room with a white screen with black fixation cross in center (control condition)
2. Black room with a white screen with slideshows played (slideshow condition)
3. 360◦ videos played on the inner side of a virtual sphere with a virtual camera placed in the center , creating the impression of being inside the 360◦ VR environments.

Lab Room Setting

1. Seated on a firm chair at fixed position
2. Equipped with HTC Vive Pro HMD (VR) , Neulog Pulse (HR) and Galvanic Skin Response (GSR) sensors.

Measuring with Questionnaires

State Trait Anxiety Depression Inventory-State (STADI-S) (Bergner-Köther, 2014)

- Measures the current state of anxiety and depression of a person

Profiles of Mood States (POMS) (Shacham, 1983)

- Assesses mood with value for the total mood disturbance was determined.

Short Stress State Questionnaire (SSSQ) (Helton & Naswall, 2014, 2015)

- Records the status of engagement, distress and worry after a given task.

Perceived Stress Scale (PSS) (Cohen et al., 1994)

- Measures the perception of stress (over one month)

Igroup Presence Questionnaire (IPQ) (Schubert, Friedmann & Regenbrecht, 2001

- Measures the perceived sense of presence in VR.

Simulator Sickness Questionnaire (SSQ) (Schubert, Friedmann & Regenbrecht, 1993)

- Measures 16 symptoms that may occur during or after VR exposure.

Experiment Procedure (Within-Subject)

			Control Condition			Experimental Conditions				
Sequence	Start	Baseline	Coognitive Test	Exposure	Questionnaires	Coognitive Test	Exposure	Questionnaires	Coognitive Test	End
VR Control	SSQ				Except SSQ			Except SSQ		SSQ
HR & GSR										

Trier Social Stress Test (TSST): serially subtract 13 from a given starting number (correct & fast); if gives wrong answer, restart
Measurement: number of correct and incorrect answers, the total number of answers as well as HR and GSR values

Results 1: Questionnaire Data

STADI-S (Current Anxiety)

- No significant effect
- Magnitude of disturbance is not strong enough to be detected (one explanation)

POMS (Current Mood)

- 360◦ videos of forest decreased the feeling of fatigue significantly more than videos of urban

SSSQ (Status of Engagement, Distress and Worry after Tasks)

- No significant interaction effect

PSS (Perception of Stress)

- No significant interaction effects

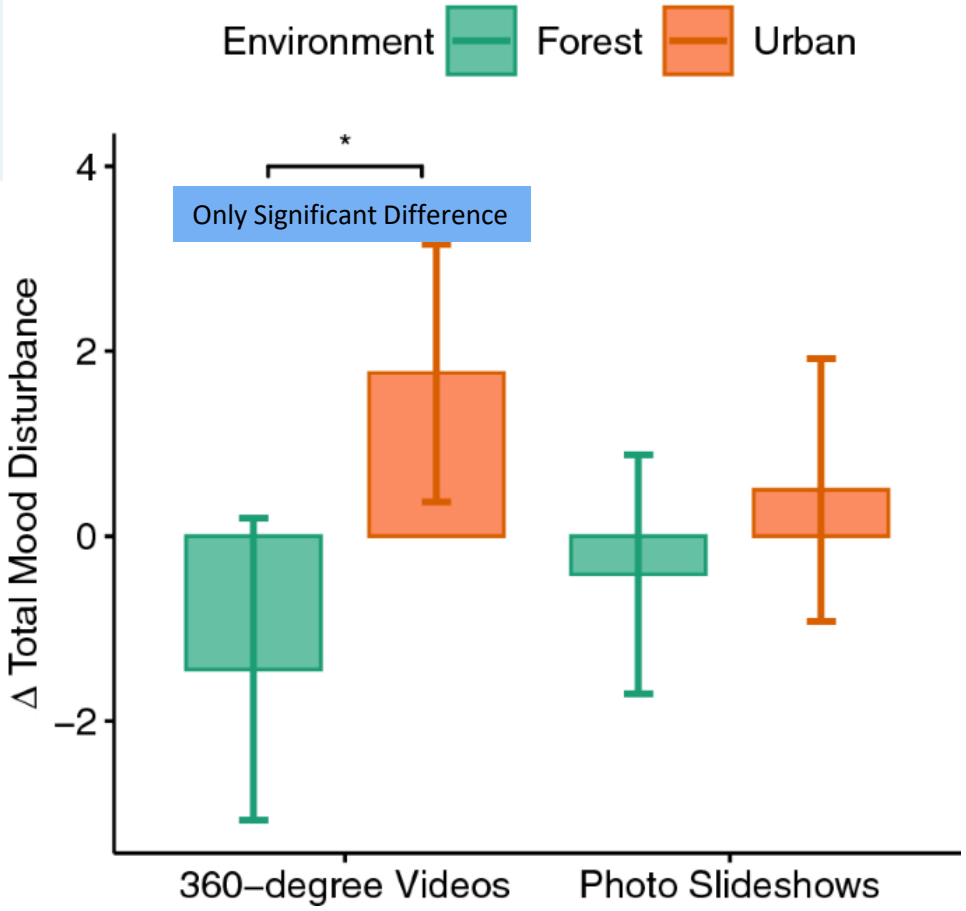
IPQ (Perceived Sense of Presence)

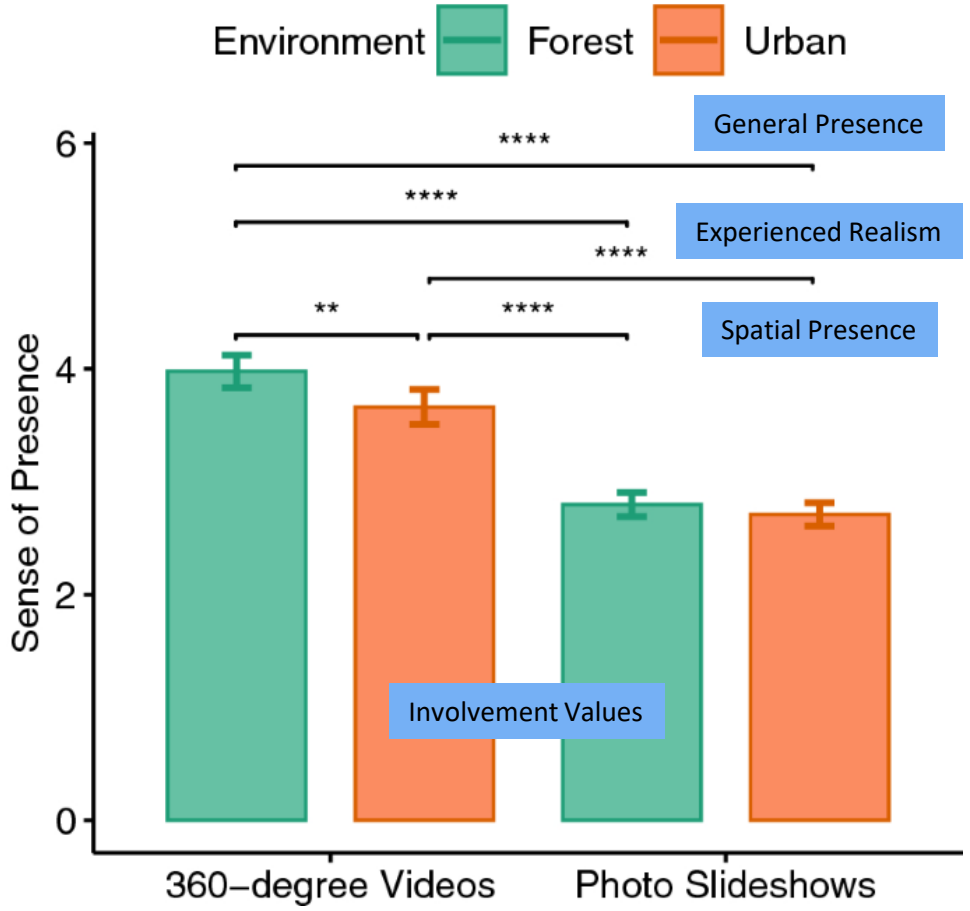
- Significant main effect of immersion level for the sense of presence
  - General presence / spatial presence / involvement values / experienced realism

SSQ (Simulator Sickness)

- Significant increase of the total simulator sickness score from pre to post measurements (side effect of VR)
- Side effect of VR

Results 1: Questionnaire Data





Results 2: Physiological Measures

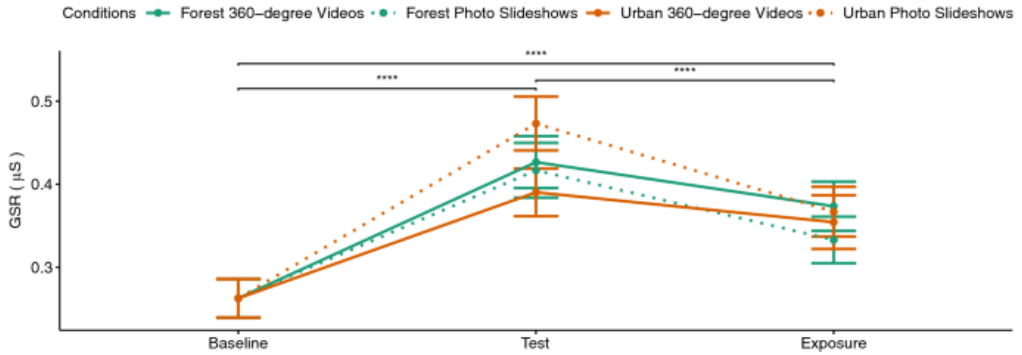
Cognitive test as a stress induction task prior to exposure

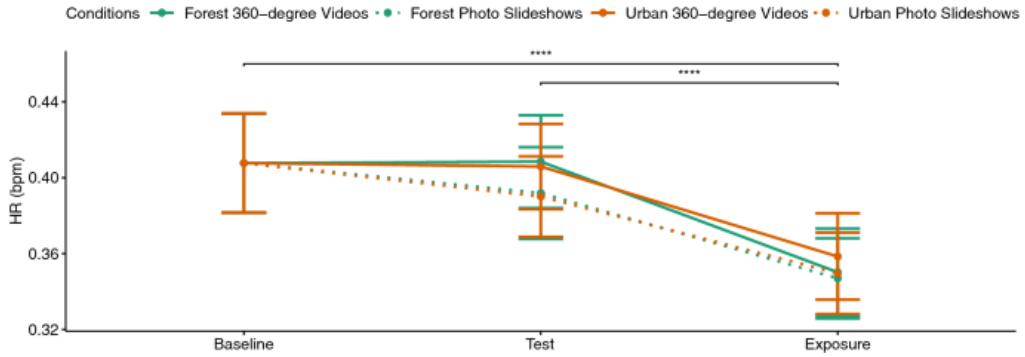
Gygalvanic skin response (GSR)

- Increased during the cognitive test phase prior to the exposure
- Decreased during the exposure

Heart rate HR

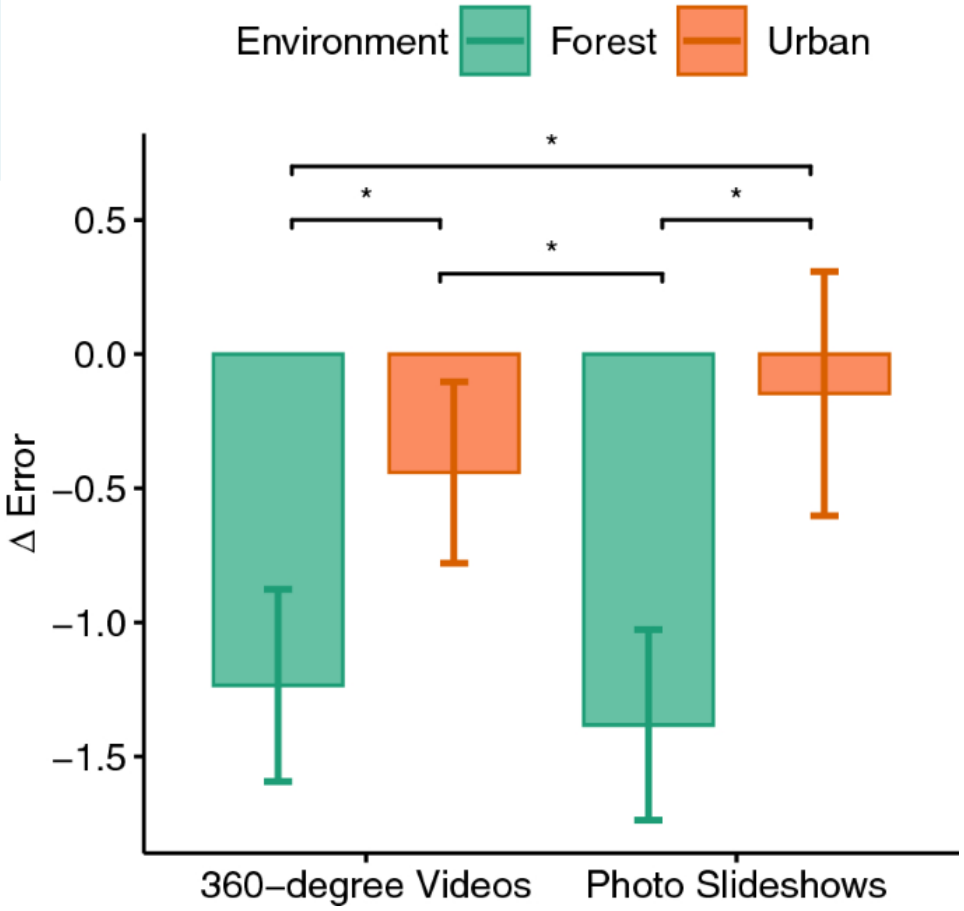
- No significant difference between the baseline and the cognitive test
  - Probably due to ceiling effects
  - No additional resting phase before the baseline started
- Decreased during exposure

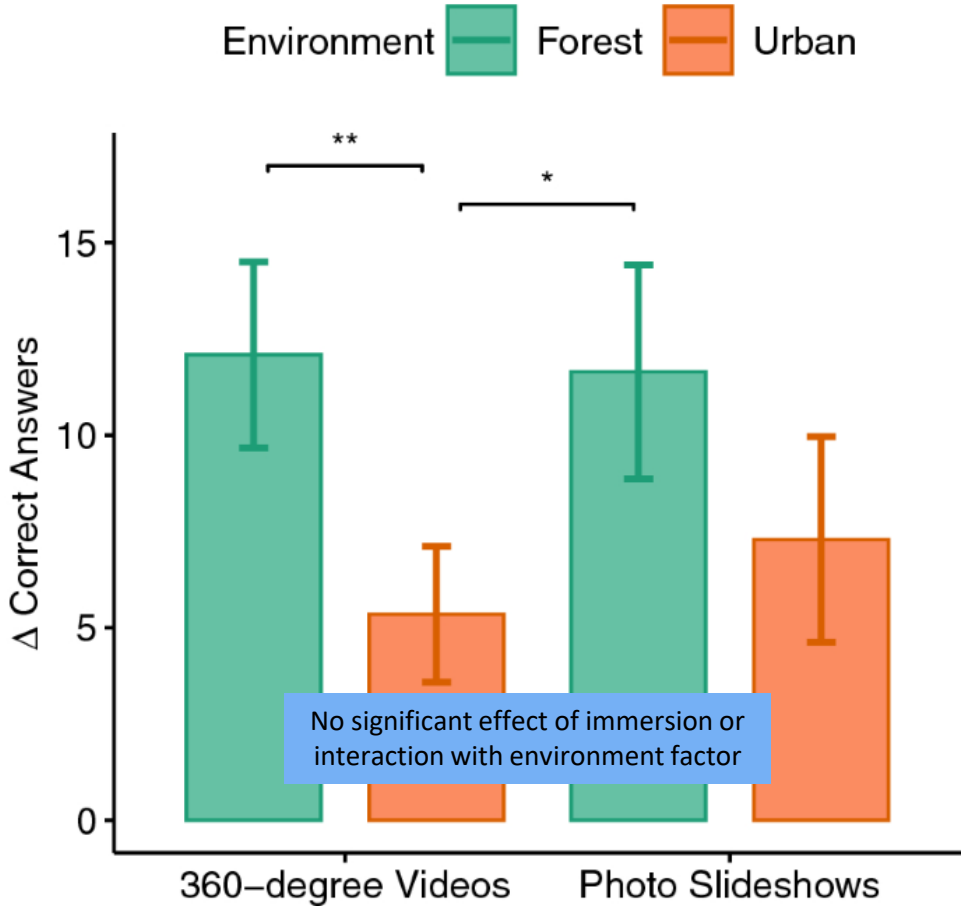




The exposure to any conditions was able to reduce the HR significantly, regardless of the type of environment or the level of immersion.

Results 3: Cognitive test





Cognitive test is a dependent variable measuring the cognitive performance after the exposure phase

Conclusions

1. **Exposure to VR nature improves mood and reduce negative affect**
   - The **feeling of fatigue (disturbed mood)** was increased after exposure to the urban environment regardless of type of presentation and was reduced by exposure to the 360◦ videos of forest
2. **Conventional photos more effectively reduce physiological arousal caused by psycho-social stressors.**
   - Higher immersion level prevented 360◦ videos from being highly effective in arousal reduction
3. **All stimuli could reduce the induced stress, but non-immersive stimuli were more effective**
4. Exposure to forest environment improves cognition regardless of type of presentation
5. The hypothesis that the immersive 360◦ videos can facilitate the positive effects of nature onto mood, recovery after stress and cognition **could not be demonstrated** in this experimental setup.

Implications for Further Studies

Which underlying elements in forest environment contribute more to positive impact

Prospect-Refuge Theory, why forest is preferred regarding evolution

Urban scene with a comparable **level of movement** as the forest.

Disentanglement of functions of cognitive test: stress induction task a dependent variable measuring the cognitive performance

Monoscopic images lack cues of depth perception that affect the sense of spatial perception

Potentially associated **simulator sickness** prevented the positive effects of nature to occur

Further Studies

Mostajeran, F., Fischer, M., Steinicke, F. *et al.* Effects of exposure to immersive computer-generated virtual nature and control environments on affect and cognition. *Sci Rep* **13**, 220 (2023). https://doi.org/10.1038/s41598-022-26750-6

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Thank you