Climate change and the spatial representation of the environment

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1. BACKGROUND

Warming of the climate system is "unequivocal" (Intergovernmental Panel on Climate Change [IPCC], 2023). This could lead to the drying up of large portions of land with negative impacts on all living things, as also shown by the increase in individual anxiety about climate change (Schwartz et al., 2022). However, the impacts of climate change on fundamental cognitive abilities, such as the ability to perceive and represent environmental spatial information, remain largely unexplored.

Several studies have shown our body state and surroundings work together to shape how we understand space (Tversky, 2009) and act accordingly (Damasio, 1995). For instance, tired or sad people perceive hills as steeper than those feeling happy or well-rested (Riener et al., 2011). Similarly, fear can make distances seem larger, like judging a balcony as farther from the ground than it actually is (Stefanucci & Storbeck 2009). It is therefore possible that spatial representations of the same environment, but modified by the effects of climate change, may also be affected.

2. RESEARCH QUESTION

Does the experience of climate change effects (e.g., desertification) influence the way people represent spatial information of the environment?

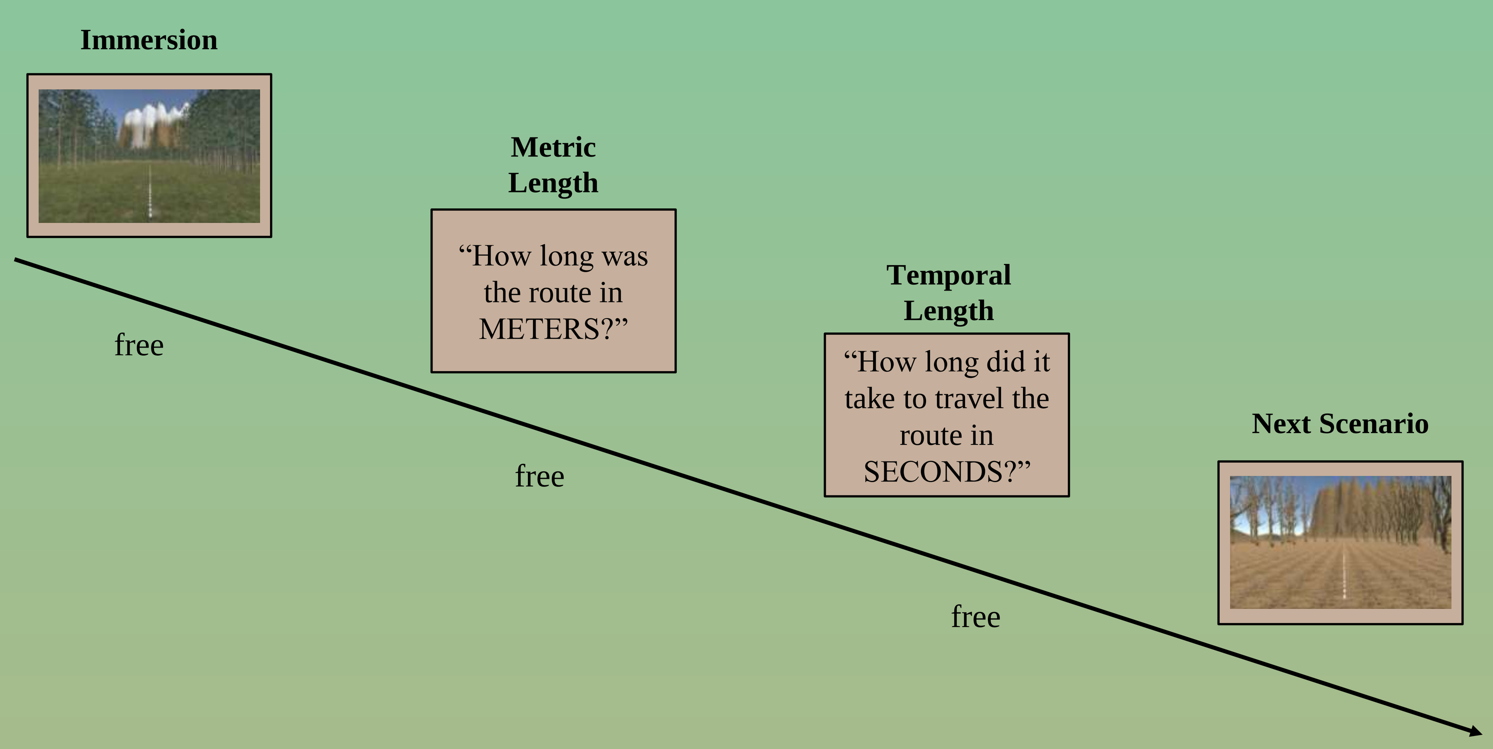
To answer this question, we asked participants to walk the same paths in both a verdant virtual environment and the same environment made arid by desertification. Following each path, participants estimated both the metric length (in meters) and temporal length (in seconds) it took to complete the path.

3. HYPOTHESES

We expect that the paths in the arid environment versus the verdant ones will be perceived as longer both metrically and temporally

4. METHOD

- **Participants:** 34 (12 males) aged 18-27 (M = 20.87, SD = 1.88)
- **Stimuli: Scenarios:** Virtual reality scenarios were created that simulated a naturalistic environment in two versions: **verdant** or **arid**. Each environment contained either a **38-metre** or **48-metre path**, for a total of four scenarios (*see Figure 1*).
- **Procedure and Task:** Using Immersive Virtual Reality and an omni-directional VR treadmill, participants walked the path in each scenario in a counterbalanced order. After each scenario, participants judged how long was the path in meters and in seconds (*see Figure 2*).
- **Experimental Flow** (Figure 2):



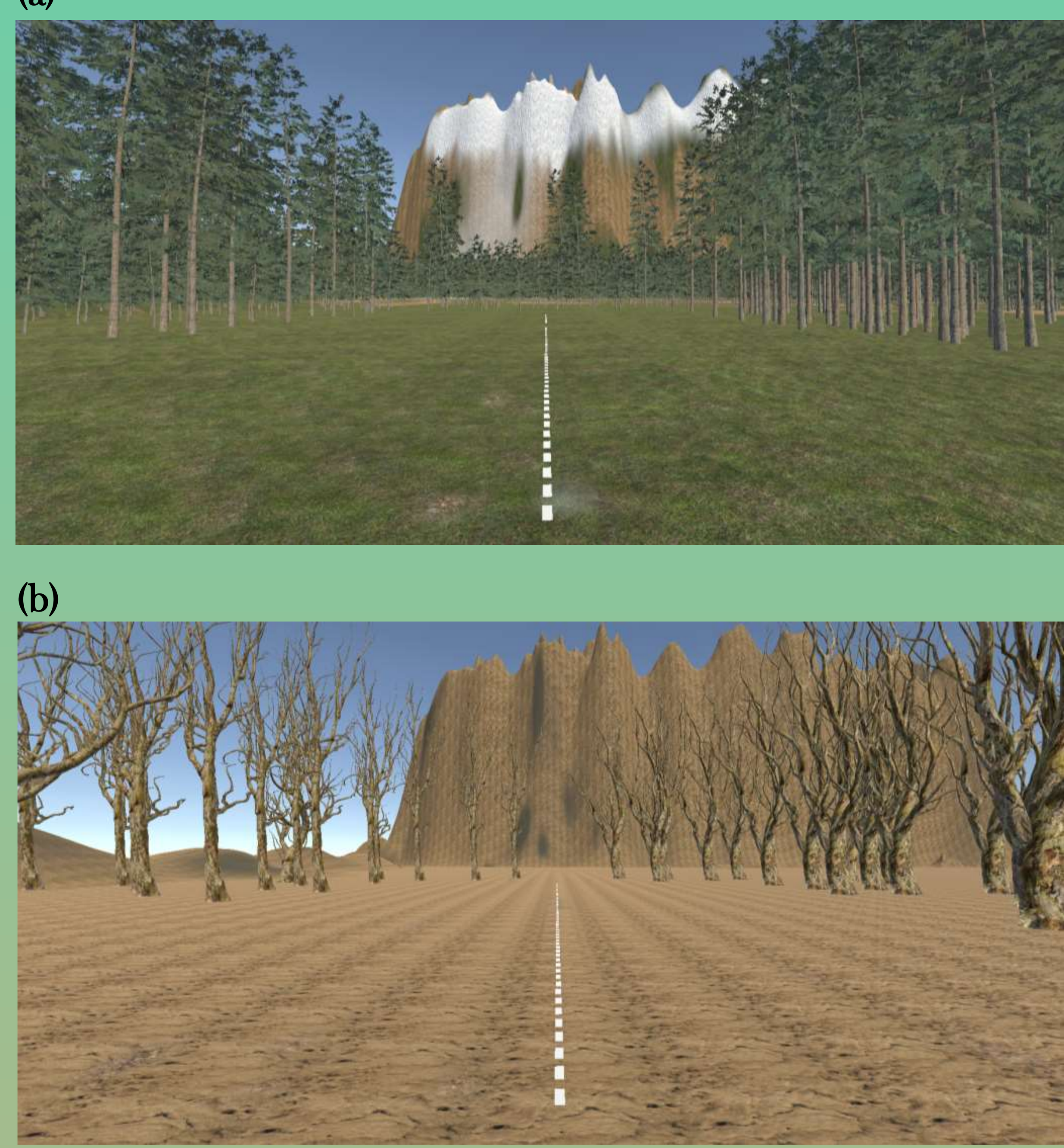


Figure 1. The figure shows an example of a (short) path in the verdant environment **(a)** and the arid environment **(b)**. Participants, via the treadmill, moved along the white dashed line to a stopping point indicated by a red horizontal line.

5. DATA ANALYSIS

RM 2 x 2 ANOVAs: **IVs: Scenario** (verdant vs arid) **x Path** (short vs long); **DVs:** Metric and Temporal judgments

Post-hoc: Tukey

6. RESULTS

Metric Judgments:

- Main effect of **Path**: F (1, 33)= 19.573, **p = .0001**, η^2_p = .37

  Long (M: 38.53, SD: 28) **> Short** (M: 27.31, SD: 19.92)

- Interaction effect **Scenario X Path**: F (1, 33)= 4.365, **p= .044**, η^2_p = .12

  ➞ **Long Path: Arid > Verdant** (*see Table 1 and Figure 3*)

Table 1: Mean and Standard deviation of the metric judgments

Scenario	Path	Mean	St. Dev.
Verdant	Short	26.47	18.72
	Long	34.44	22.36
Arid	Short	28.14	21.30
	Long	42.63	32.51

Temporal Judgments: No significant effect

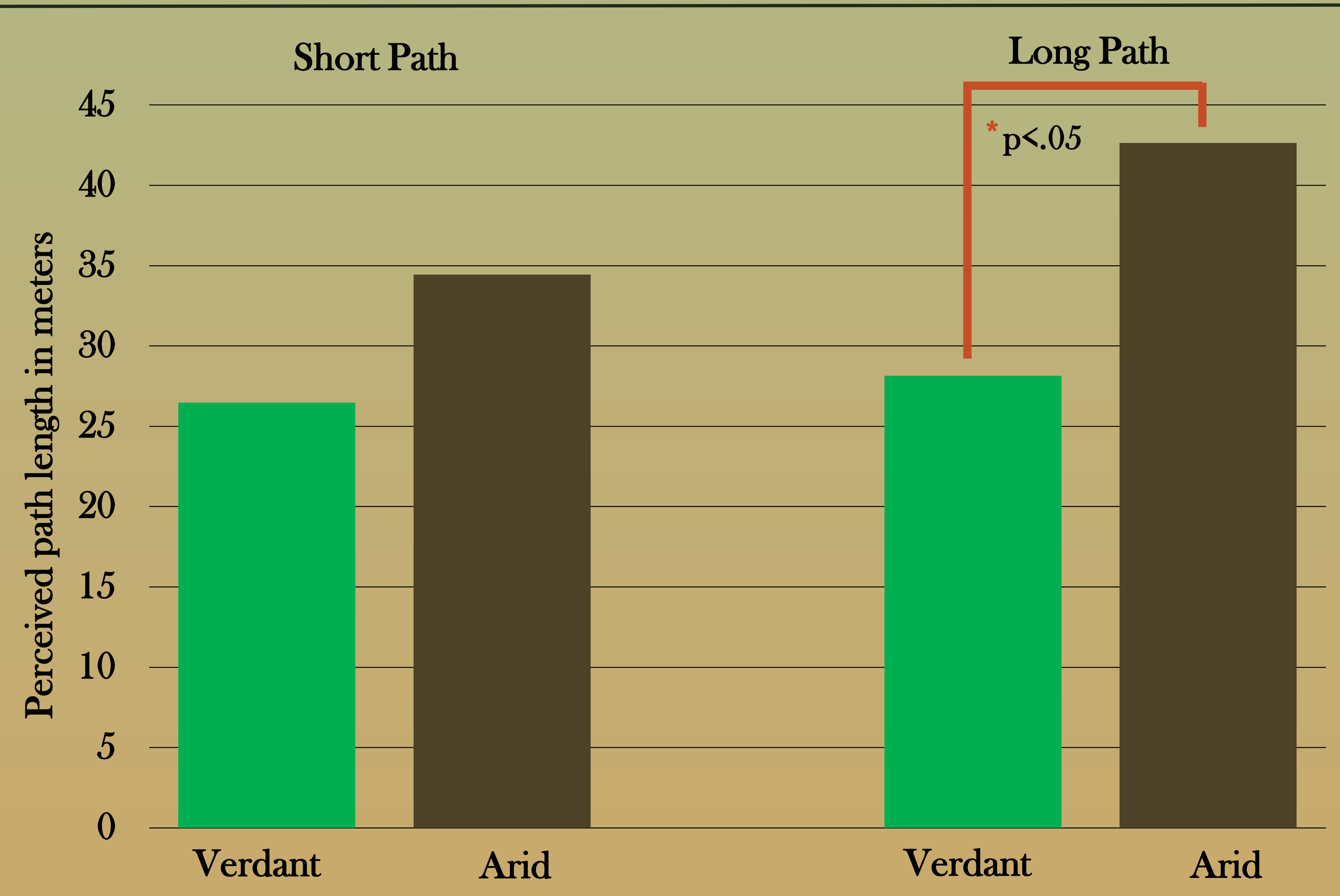


Figure 3. The graph shows the average metric ratings of short and long routes as a function of scenery (verdant or arid).

7. CONCLUSIONS

Participants perceived the same path as longer in the arid environment compared to the verdant environment. From an evolutionary perspective, overestimating distances in harsh environment might make us more cautious and less likely to venture too far from safety or resources. Interestingly, this was true for the perceived metric length and not for the temporal length of the path. This suggests that the effect is specific to our spatial perception, rather than a general distortion of time or effort. In conclusion, these results provide some evidence that climate change, through its effects on landscapes, can influence the way we perceive spatial information. Furthermore, these results can be used to develop effective strategies for communication, education and adaptation to the effects of climate change.

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SCAN ME!