Angular vs Curved, 2021 (#58999)

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1) Have any data been collected for this study already?
It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

2) What's the main question being asked or hypothesis being tested in this study?
The main goal of the study is to examine the influence of contour lines of living space on emotion, cognition and behavior, using Virtual Reality (VR). Building on the findings of previous studies [1, 2, 3], we will investigate the psychological and physiological response to two conditions presented in the visuo-spatial environment: angular and curved contours. We will study how those two conditions impact:
- Emotional and spatial experience
- Perceived restorativeness of the environment
- Working memory capacity.

By exposing participants to fully controlled virtual environments we expect the curved condition to positively affect emotion and spatial experience, working memory capacity and feeling of restorativeness.


3) Describe the key dependent variable(s) specifying how they will be measured.
The main interest are the differences in response to the two contour conditions, observed behaviorally during and after immersion in VR. All participants have to complete all parts of the experimental paradigm. The main part consists of a VR session with 5 randomized rooms. In each room, participants perform a 3-minute exploration task, and a 2-minute cognitive task, and respond to a set of questions. Pre and post-VR session, participants answer multiple questionnaires.
The affective and spatial experience is assessed using an in-VR questionnaire consisting of 20-items related to subjective perception of emotional and spatial dimensions [4, 5, 6], and 11-items about momentary affective state [7]. Post-VR, a PC-based questionnaire is administered to evaluate other aspects of the spatial and cognitive experience.

Perceived restorative attention is measured with a 12-item version of the German Perceived Restorativeness Scale [8].

So as to working memory capacity, a backward counting task [9] is performed after the exploration task (increments of 13 from a 4-digits number). We also assess physiological measures including electrodermal activity (EDA), blood volume pulse (BVP), heart rate variability (HRV), and abdominal/thoracic expansion and contraction while breathing (RSP), collected during all the VR session using BIOPAC MP160 data acquisition system with wireless wearable bio-monitoring sensors.

Self-reports on emotions are also collected pre-VR to control for the baseline affective state. All in/post-VR measures are collected for all conditions.


4) How many and which conditions will participants be assigned to?
Participants are presented with two pairs of virtual rooms each contrasting in contour geometry (angular and curved). The pairs also differ in style (classic and modern) and in how many “green features” they included. At the beginning of the VR session, participants start with a baseline room (resembling the...
actual physical lab) in order to familiarize with the VR settings and the different tasks to be performed in each of the simulated conditions. All participants are tested under all conditions (R1= angular modern, R2= curved modern, R3= angular classic, R4 =curved classic) in a randomized sequence, always starting with the baseline room as condition 0. Using counterbalancing through a Latin square design, and after eliminating sequences where rooms of the same pair are shown successively, four groups were identified, to which participants were randomly assigned.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
We will perform a repeated measure ANOVA on behavioral, cognitive and physiological data, in which we compare (curved vs. angular) conditions. Individual differences, including demographics and SES, growing up and actual living conditions, interest and expertise in architecture, personality traits, experience with VR, and motivation, were also acquired, and will serve as covariates in the analyses, in addition to cybersickness and presence.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
Sessions with technical software/hardware errors, where participants have requested breaks, or have shown severe symptoms of simulation sickness will be excluded. Sessions with errors in physiological data acquisition that are limited to one or two of the measures will be included, since those measures are considered exploratory. For the behavioral data, we will exclude participants if they scored 3 SD above or below the mean.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
Due to the high potentiality of technical errors, and the increasing rate of cancelled sessions as a result of the pandemic and lock down restrictions, we decided to keep recruiting participants until reaching an N of 36, inclusive of individuals who provide usable data for the present study (details on exclusions in section above).

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
Secondary analysis
We will additionally perform an exploratory analysis to examine whether style (classic vs. modern) and green features in the rooms are related to the working memory and mood.

Other variables
With the purpose of evaluating the overall VR experience, and in order to control for specific undesired effects, we are measuring Presence using Igroup Presence Questionnaire [10], and cybersickness using Simulation Sickness Questionnaire [11].


Variables collected for exploratory purposes
We will also attempt to explore the Head Mounted Display data including position and head rotation, in order to extract behavioral maps and gaze patterns (time/feature), in order to correlate them with the dependent variables.

Data collection
Data collection has started, but not analyzed, except for basic, initial preprocessing.