Implementation of a cardio-visual full-body illusion to investigate its effects on embodiment

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Introduction

Aim: explore variations of heartbeat synchronicity and asynchronicity

Cardio-visual full-body illusion: multisensory illusion arising from the integration of exteroceptive (flash) and interoceptive (heartbeat) signals to induce embodiment and ownership of a virtual body (1)

The feeling of embodiment decreases **skin temperature** due to the "disownership" of one's real body and increases **skin conductance** (2, 3)

Hypotheses

H1: Synchronous heartbeat feedback leads to higher levels of avatar embodiment

H2: Embodiment levels are the highest in 200 ms condition

H3: Skin temperature decreases with rising levels of embodiment

H4: Skin conductance level varies based on different delays

Methods

Participants

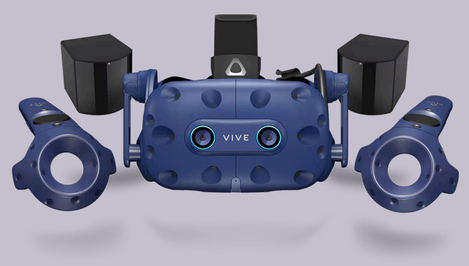
N = 17 (M = 21.53 +/- 2.88 years; 53% male)

Procedure

Screening interview → Resting state recording → STAI (4) → Free viewing + Embodiment (5), Body Satisfaction → 7 conditions + Embodiment (5), Body Satisfaction → STAI (4) & VRSQ (6)

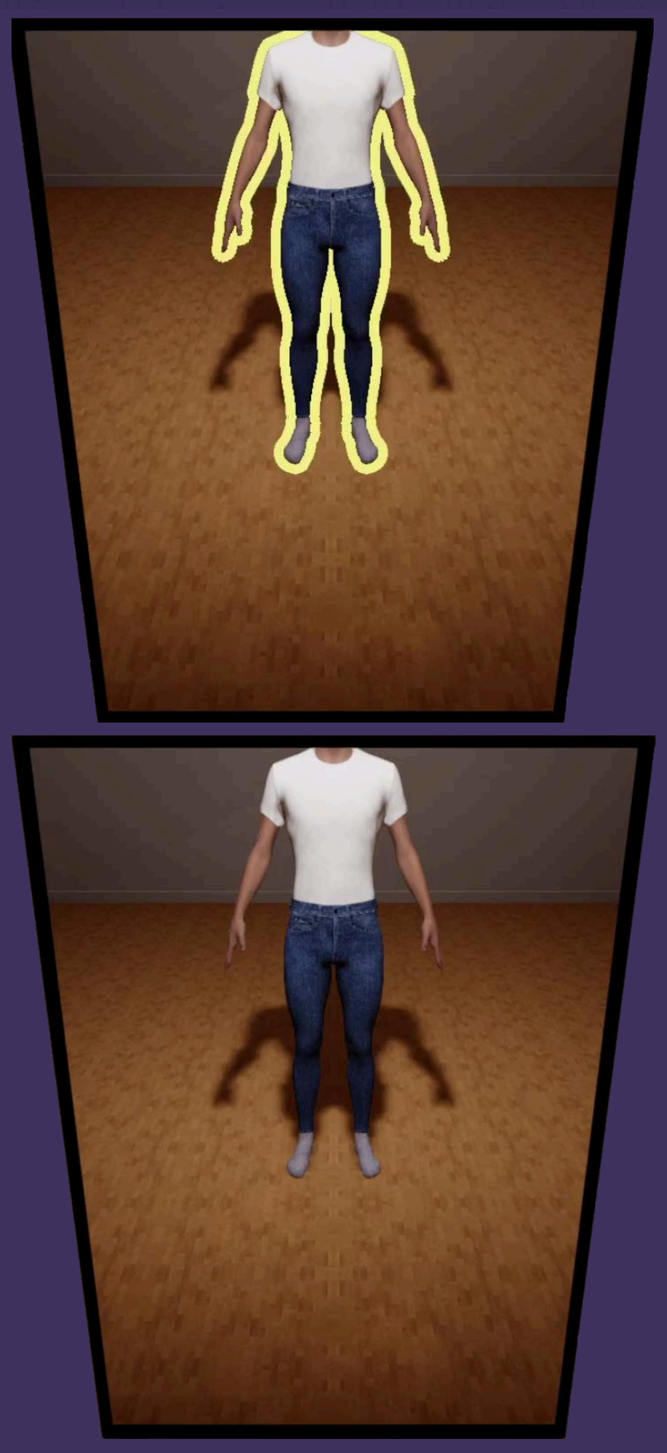
Physiological data

- ECG
- Skin temperature arm & back
- EDA

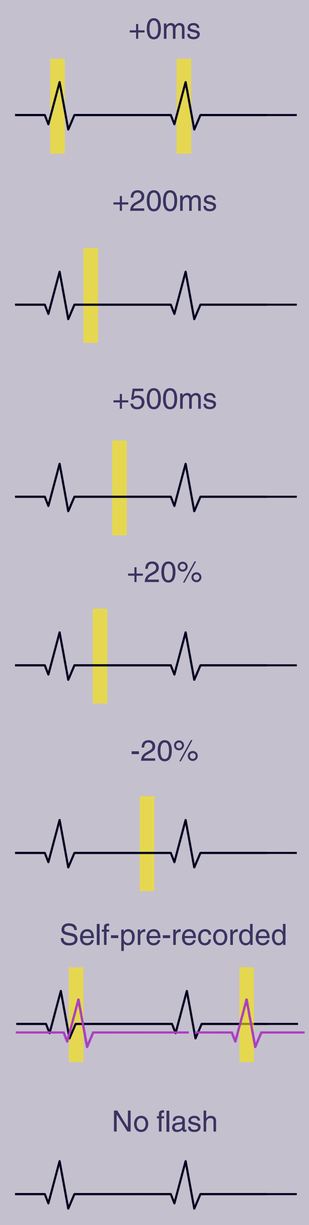


VR device

- HTC Vive Pro Eye



Conditions



Results

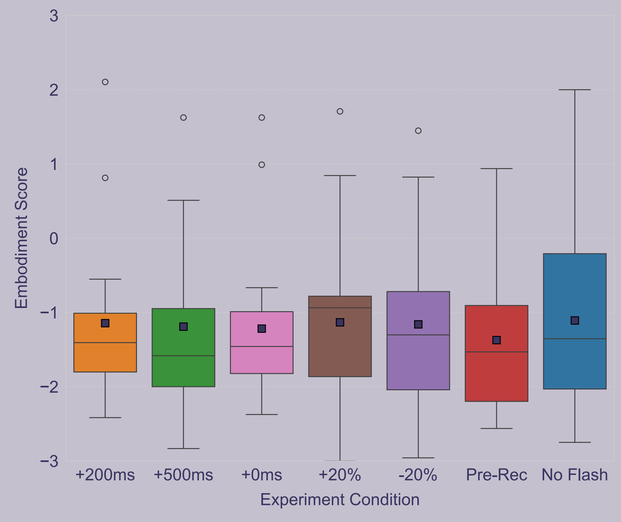


Fig. 1. Boxplot embodiment scores across conditions

Fig. 2. Correlation between embodiment scores and arm skin temperature difference

H1+H2: No significant differences, $\chi2(6) = 2.672$, $p = 0.849$ (fig. 1)

H3: Correlation with arm temperature, $r_s = 0.22$, $p = 0.02$ (fig. 2)

No significant differences between conditions for

arm temperature, $\chi2(6) = 5.849$, $p = 0.44$

back temperature, $\chi2(6) = 2.748$, $p = 0.84$

H4: No significant differences, $\chi2(6) = 5.471$, $p = 0.485$

Discussion

- The weak positive correlation between embodiment and arm temperature challenges the use of temperature as a reliable indicator of embodiment
- Individual differences are not robust enough to show significant results

Limitations

- Small sample size
- Length of the study
- Agency of avatar not fulfilled

References: **(1)** Aspell JE, Heydrich L, Marillier G, Lavanchy T, Herbelin B, Blanke O. Turning Body and Self Inside Out: Visualized Heartbeats Alter Bodily Self-Consciousness and Tactile Perception. Psychol Sci. 2013;24(12):2445–53. doi:10.1177/0956797613498395. **(2)** Salomon R, Lim M, Pfeiffer C, Gassert R, Blanke O. Full body illusion is associated with widespread skin temperature reduction. Front Behav Neurosci. 2013;7:65. doi:10.3389/fnbeh.2013.00065. **(3)** D'Alonzo M, Mioli A, Formica D, Di Pino G. Modulation of Body Representation Impacts on Efferent Autonomic Activity. Journal of Cognitive Neuroscience. 2020;32(6):1104–16. doi:10.1162/jocn_a_01532. **(4)** Spielberger CD, Gorsuch RL, Lushene RE. Manual for the State-Trait Anxiety Inventory. Consulting Psychologists Press. 1970. Available from: https://ubir.buffalo.edu/xmlui/handle/10477/2895. **(5)** Peck TC, Gonzalez-Franco M. Avatar Embodiment. A Standardized Questionnaire. Front Virtual Real. 2021;1:575943. doi:10.3389/frvir.2020.575943. **(6)** Kim HK, Park J, Choi Y, Choe M. Virtual reality sickness questionnaire (VRSQ): Motion sickness measurement index in a virtual reality environment. Appl Ergon. 2018;69:66-73. doi:10.1016/j.apergo.2017.12.016.

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