

Who can touch my virtual body where?

Psycho-physiological reactivity to touches on different body regions of an embodied avatar

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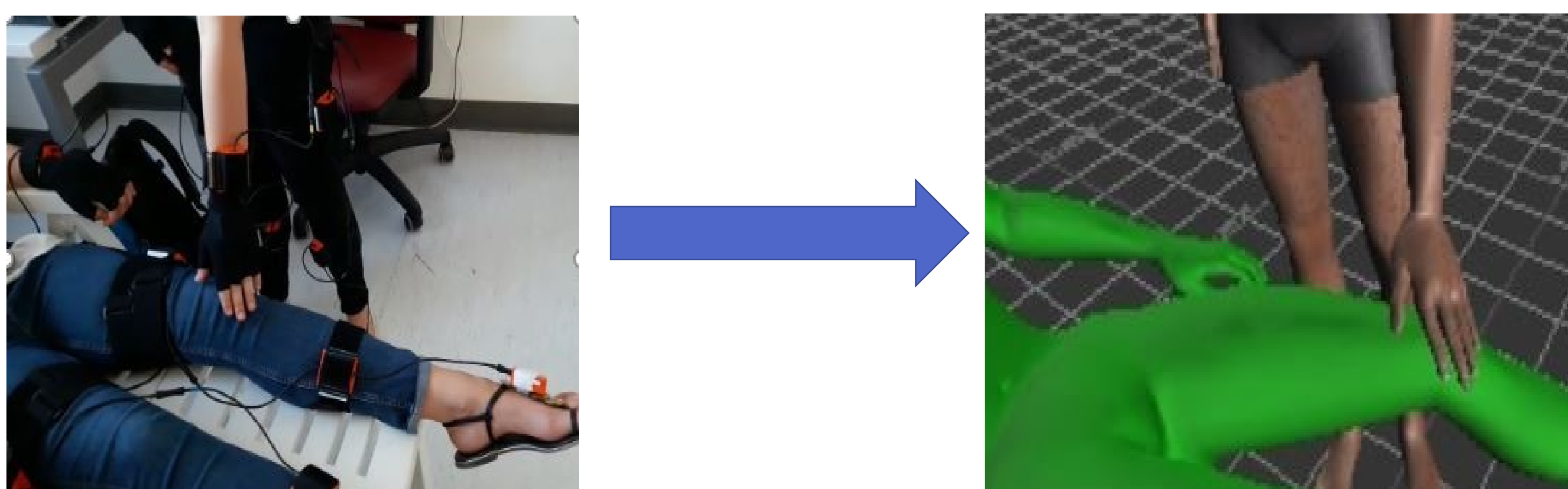
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Introduction

- Using Immersive Virtual Reality (IVR) it is possible to induce the feeling of ownership over a virtual body. Passive observation of the virtual body seen from a first-person perspective (1PP) is a sufficient and necessary condition to elicit the illusion¹.
- Owning a virtual body in IVR may lead to feel somatosensory stimuli on one's body which are in fact never delivered².
- Whether the vicarious touch in IVR reflects the basic individual and social features of real-life interpersonal interactions is currently unclear.

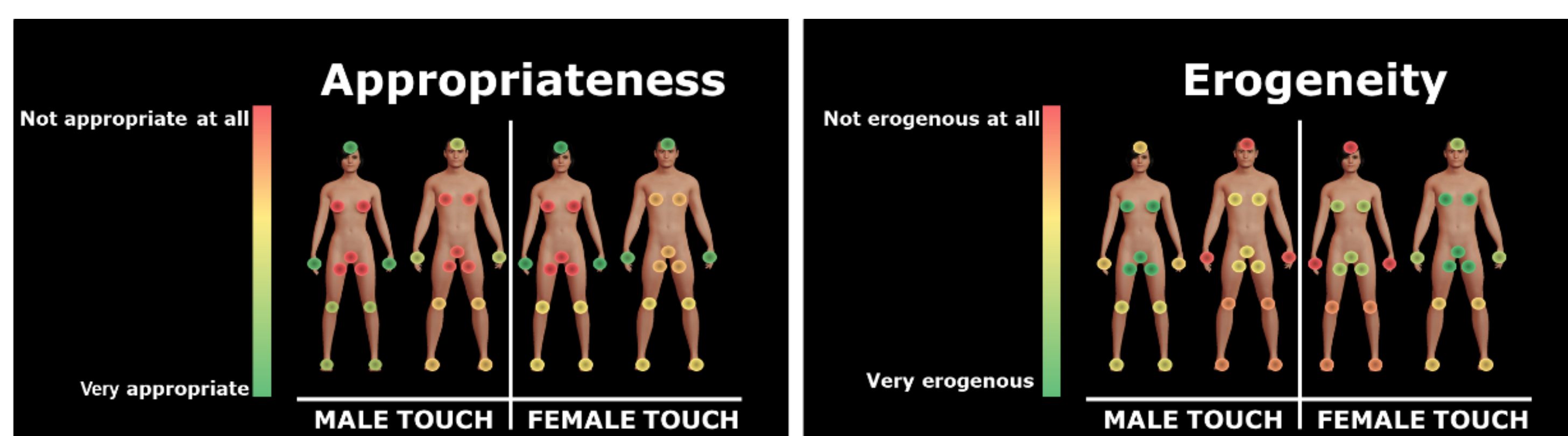
Materials and Methods



- Human kinematics of caresses (3 cm/s) performed by a real actor were recorded with a motion capture system (Xsense).
- The kinematics were implemented into a male and a female touching avatars.
- Click 'Play' to watch the virtual scenario and stimuli.
- In two appropriately powered studies (n=42 for each study, age range 18-40), women and men who self-defined themselves as heterosexual, gay, or lesbian saw a 1PP gender-matched virtual body in the same position of their real body through a Head Mounted Display (HMD, Oculus).
- The embodied avatars were caressed on 10 body parts (see the figure below) by a female or male avatar. There was one block for each avatar. In each block, two touches for each body part, one coming from the left and one from the right, were delivered by the touching avatars.
- The participants' behavioral (Appropriateness, Erogenicity, Arousal and Unpleasantness on a 0-100 Visual Analogue Scale) and psychophysiological (skin conductance responses-SCRs, heart rate-HR) reactions to each virtual touch were recorded.
- We also obtained ratings of body ownership and vicarious touch sensations at the end of each block (on a 0-100 Visual Analogue Scale).
- 74 respondents (37 men, age range 18-40) classified the body parts in three areas: intimate, social, neutral.
- The side figure shows the areas significantly associated (p<.0001) with the body parts, as revealed by the Chi-Square Test of Independence: Red (Intimate), Green (Social), Blue (Neutral), Grey (not significantly associated with any of the three possible categories).
- The body parts colored in Grey were excluded from the final analyses.

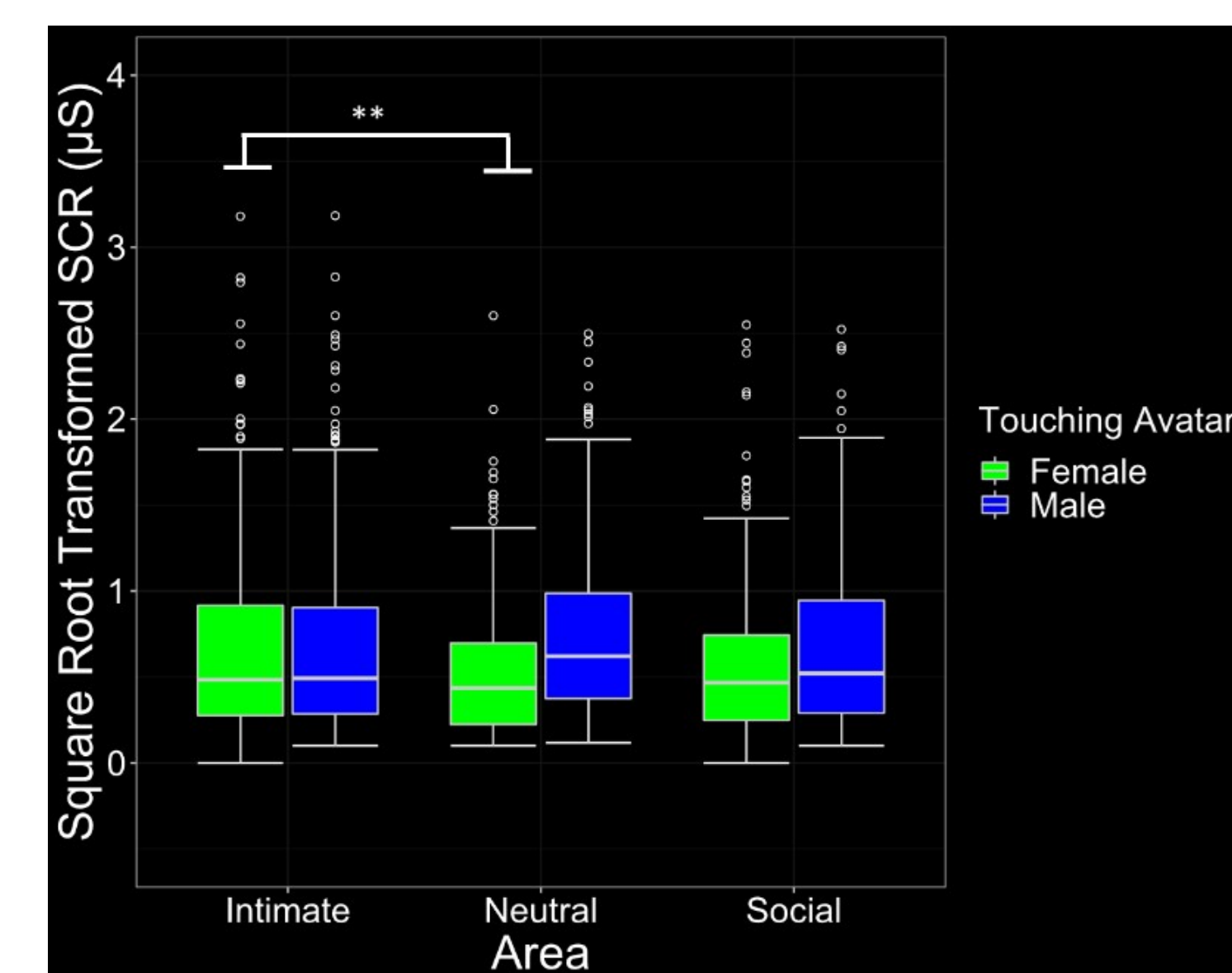


Results: Study 1 (Heterosexual Men and Women)

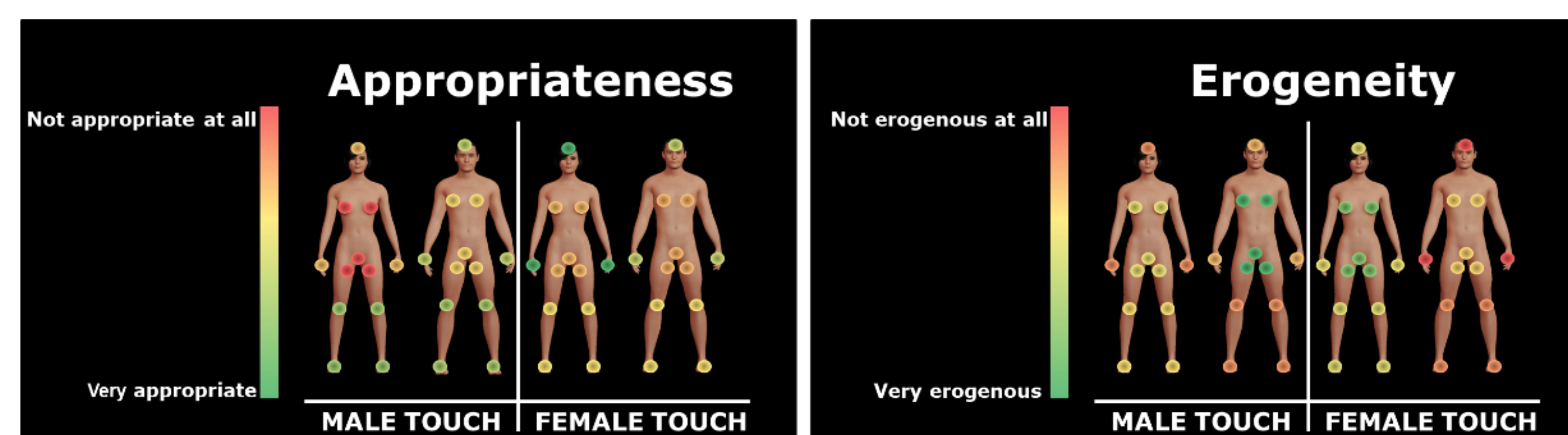


- Mixed effect analysis showed that heterosexual men (depicted by the male silhouettes) rated the female avatar's touch as more appropriate (p<.001) and erogenous (p<.001) than the male avatar's touch.
- Heterosexual women (depicted by the female silhouettes) rated female and male avatar touches as equally appropriate, with the latter being most erogenous (p<.001).

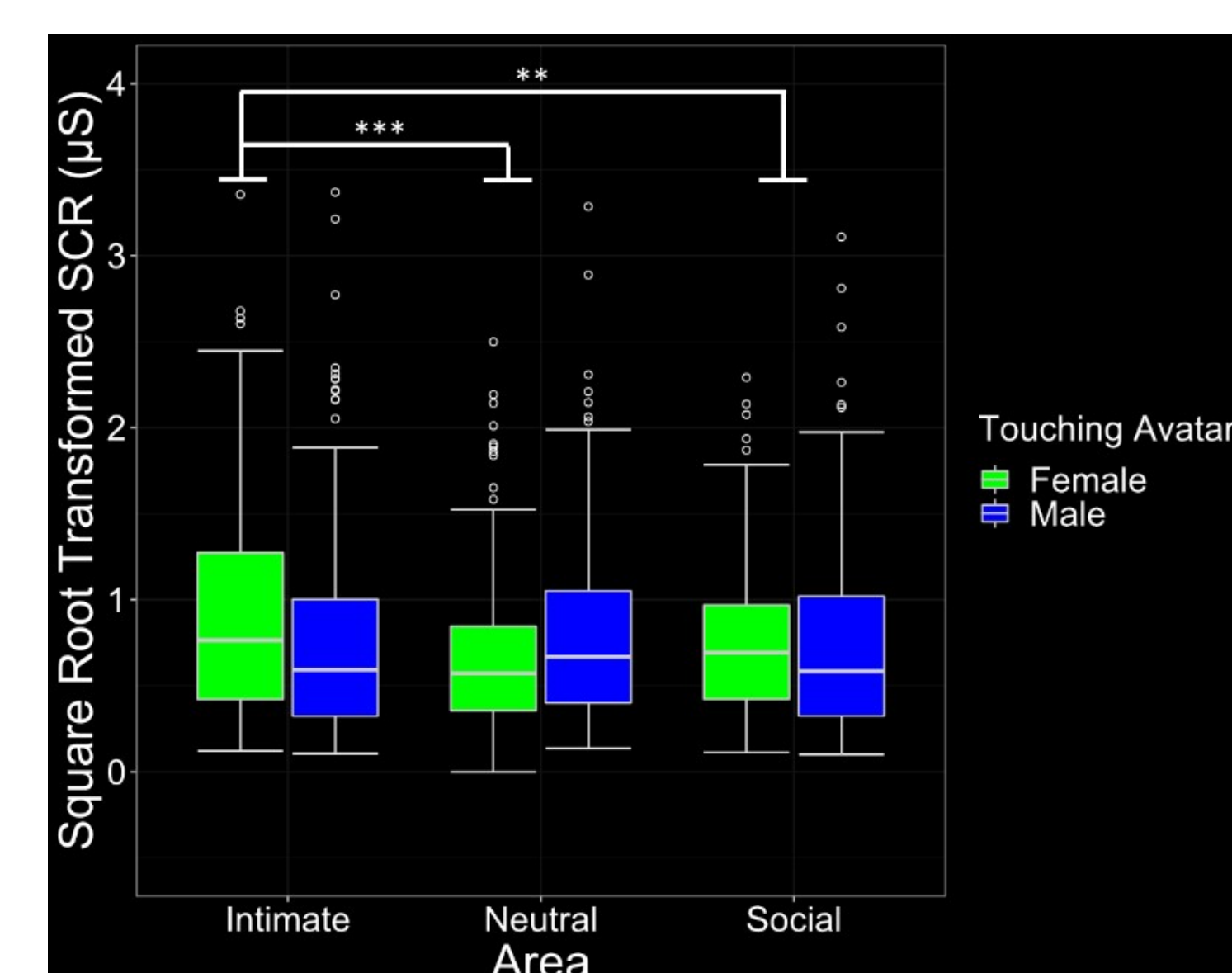
- SCRs and HR were analyzed in the time window of 6 seconds following the onset of the touching avatar's movement.
- When touched by a female avatar, touches on the virtual body's intimate areas elicited higher SCRs compared to the neutral (p=.001) ones, regardless of the participant's gender.
- No effect was found for the HR signals.



Results: Study 2 (Gay Men and Lesbian Women)



- Gay men (male silhouettes) rated female and male avatar touches as equally appropriate, with the latter being most erogenous (p<.001)
- Lesbian women (female silhouettes) rated as more appropriate (p>.001) and erogenous (p>.001) the touches of the female avatar.
- When touched by a female avatar, touches on the virtual body's intimate areas elicited higher SCRs compared to the neutral (p=.002) and social (p=.01) ones, regardless of the participant's gender.
- No effect was found for the HR signals.



- All participants rated the social area as the most appropriate and the intimate area as the most erogenous. Pleasantness and arousal had a similar pattern to appropriateness and erogeneity, respectively.
- In both studies, the scores in the ownership questions were higher than the scores in the control questions. The ownership levels were constant across conditions and groups.
- In both studies, men and women had similar levels of the vicarious touch illusion, regardless of the touching avatar's gender. The vicarious touch was linearly associated with the ownership illusion (Study 1: r= .45; Study 2, r=.56).
- The average vicarious touch illusion (around 40) was comparable to the one felt by people with mirror-touch synaesthesia when observing human touch³ (4 on a 0-10 scale).

Discussion

- The virtual caresses delivered to taboo regions of the embodied avatar elicited maximal reactivity of the autonomic system of the participants suggesting that they reacted as though they received the caresses in reality.
- Future studies are needed to better understand the mechanisms that trigger this type of vicarious perception.
- IVR could be used to induce first-hand vicarious sensations of intimate touch without any actual tactile stimulation on the real body and it could allow to explore the role of bottom-up and top-down factors that modulate behavioural, physiological, and neural reactivity to affective touch.
- These findings have potential important translational implications (for people with dysfunctional touching behavior and people with neurological dysfunctions).

References

- Tieri G. et al., (2015) *Experimental Brain Research*.
- Fusaro M. et al., (2016) *Journal of Neurophysiology*.
- Ward J. et al., (2018) *Cognitive Neuropsychology*.

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