Studying the Influence of Single Social Interactions on Approach and Avoidance Behavior

A Multimodal Investigation in Immersive Virtual Reality

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1 BACKGROUND

- Adaptive social behavior is crucial for functioning in groups and for preventing social exclusion [1].
- Humans, as a highly social species, learn from rewarding or aversive social experiences and develop individual social approach and avoidance tendencies [2, 3].
- An imbalance in these social approach and avoidance tendencies may constitute a risk factor for the etiology and maintenance of mental illness such as social anxiety [4, 5].
- Immersive virtual environments provide high ecological validity with concomitant high experimental control making virtual reality a useful tool to investigate social approach and avoidance behavior [6, 7].

2 METHODS

- We combined a *social conditioning* procedure [8-10] with a *social approach-avoidance test* [11, 12].
- Participants were placed in a virtual flat. They could explore the virtual environment using an omnidirectional treadmill.

Living Room | Office | Dining Room | Terrace
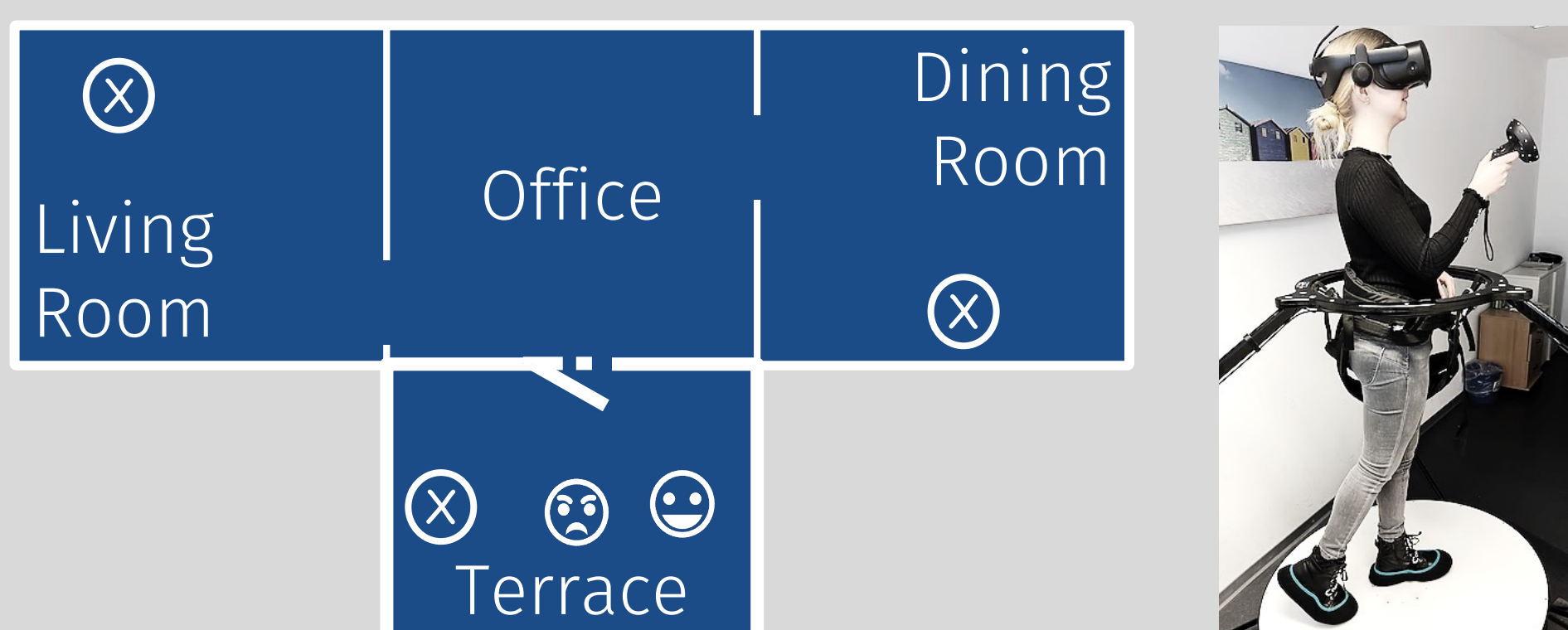
- In the *Habituation Phase*, participants freely explored the rooms of the flat without any virtual agent being present.
- In the *Acquisition Phase*, participants encountered three virtual agents. Approaching them elicited either a positive reaction (smile, positive utterance), a negative reaction (aggressive facial expression, negative utterance) or a neutral reaction (short look).
- During the *Social Approach-Avoidance (sAA-)Test*, participants again freely explored the flat. In one of the rooms, the negatively conditioned virtual agent sat, in the other room the positively conditioned virtual agent.

Baseline | Orientation | Habituation | Acquisition | Social Approach-Avoidance Test | Questionnaires

- To minimize bias, the roles (friendly, unfriendly, neutral) and the rooms in which the virtual agents were sitting were assigned in a counterbalanced order.
- 64 participants were invited; 16 had to be excluded because of technical issues ($n = 5$), motion sickness ($n = 9$) or false memory ($n = 2$) resulting in the pre-registered sample size of $N = 48$ (mean age = 23.1 years (18–32); all female).
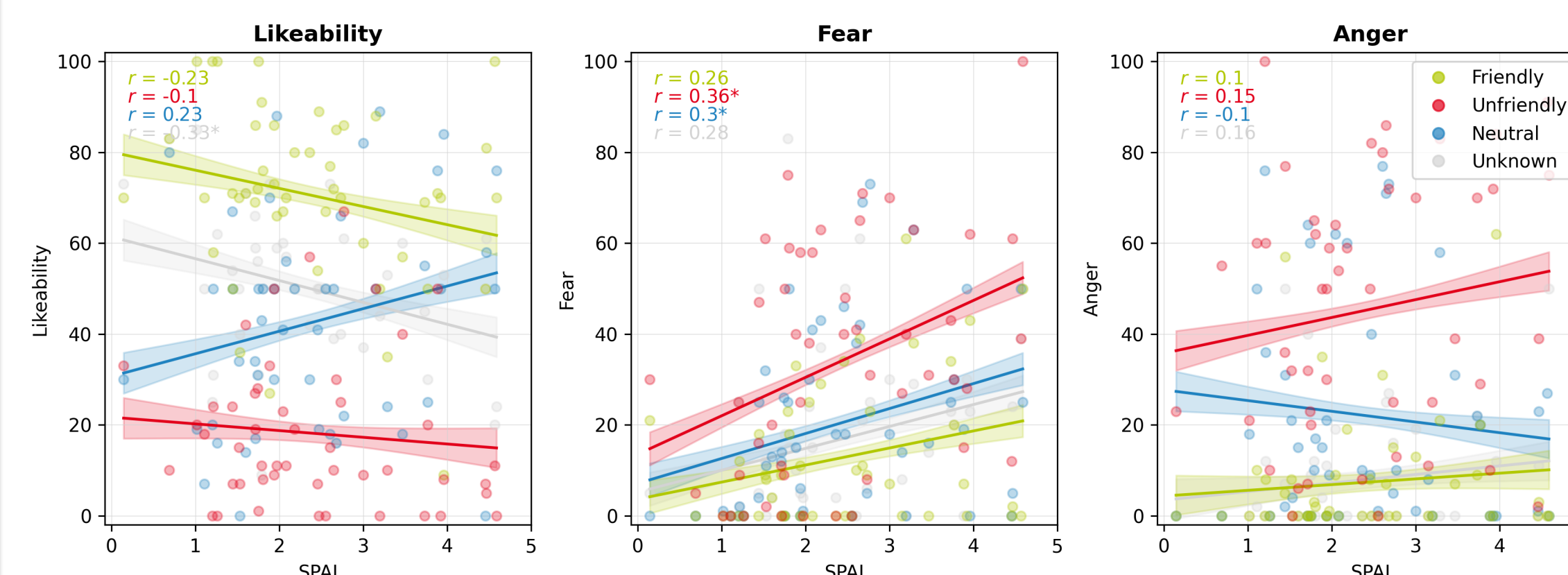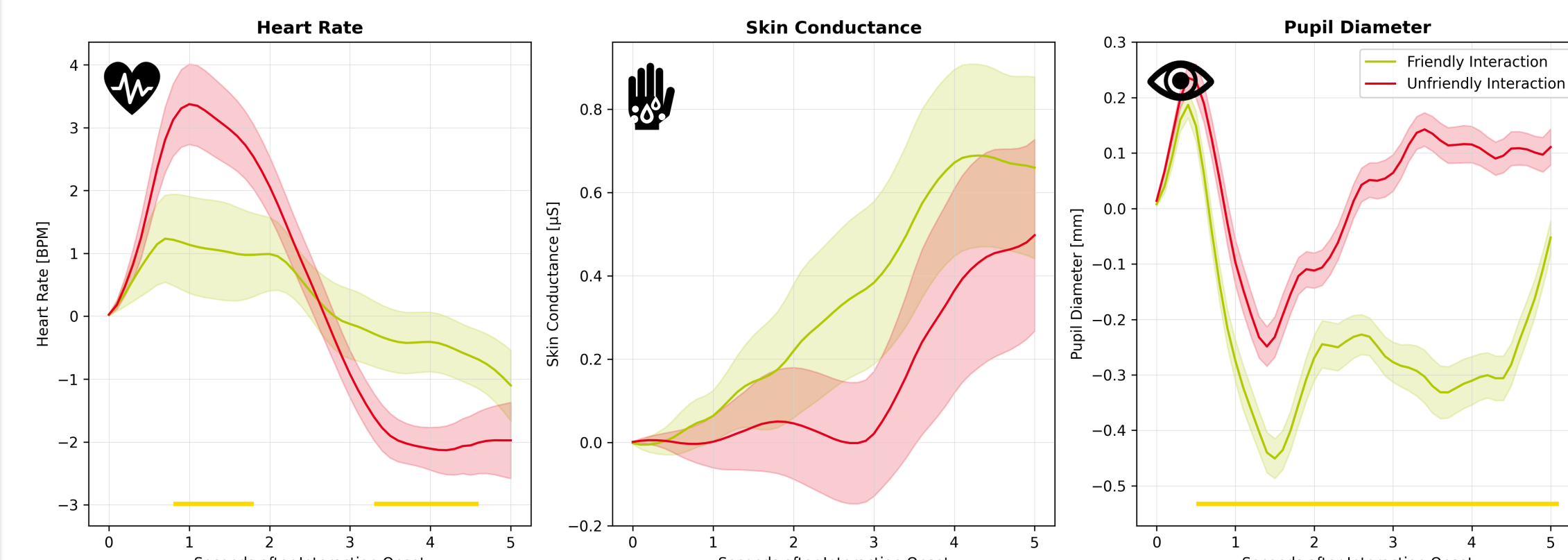
Social Conditioning (Acquisition)

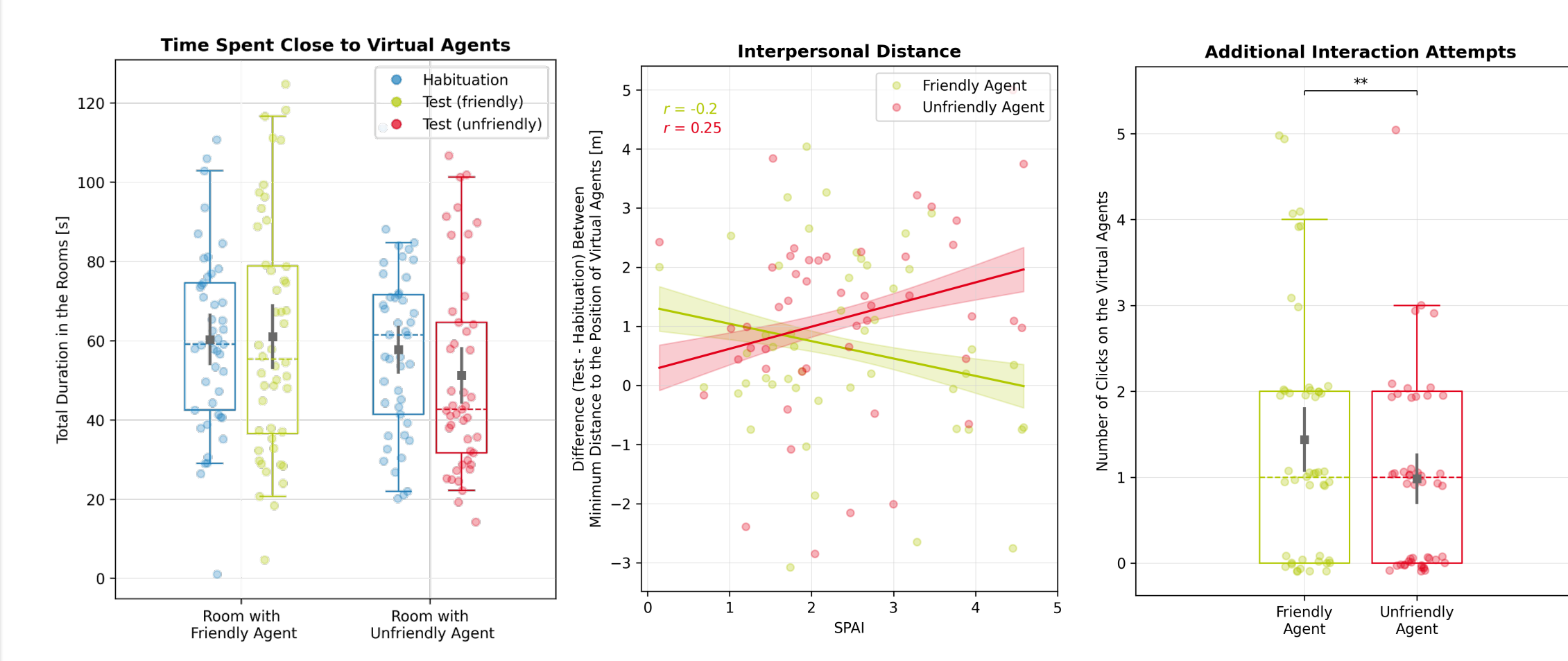### Social Approach-Avoidance Test

🖥 Subjective Experience

Likeability | Fear | Anger

Friendly | Unfriendly | Neutral | Unknown

Physiology

Heart Rate | Skin Conductance | Pupil Diameter

Friendly Interaction | Unfriendly Interaction

🤚 Behavior

Time Spent Close to Virtual Agents | Interpersonal Distance | Additional Interaction Attempts

Habituation | Test (friendly) | Test (unfriendly) | Friendly Agent | Unfriendly Agent

👁 Gaze

Acquisition Phase | Acquisition Phase | Test Phase

Friendly Agent | Unfriendly Agent
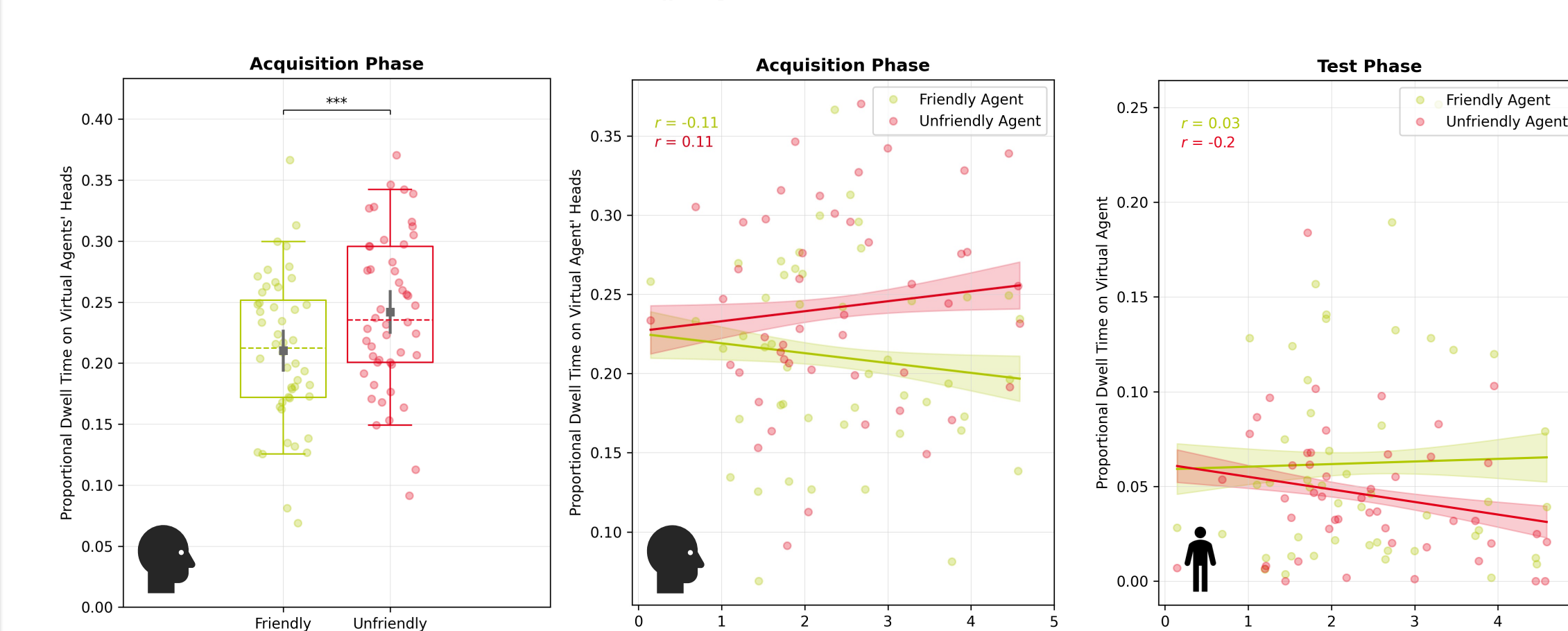
3 RESULTS

- There were significant differences in subjective ratings of sympathy, fear and anger regarding the differently conditioned virtual agents. Highly socially anxious participants indicated more fear.
- In the acquisition phase, participants showed an initial acceleration followed by a deceleration in heart rate and they exhibited an increased pupil dilation following the rude reaction compared to the friendly reaction. We did not find any physiological adaptations that persisted during the sAA-test.
- There were no effects of the social conditioning on the time participants spent in the same room with the virtual agents, but we saw an interaction effect of the conditioning with trait social anxiety on the minimal interpersonal distance.

Test (Option 1) | Test (Option 2) | HSA | LSA
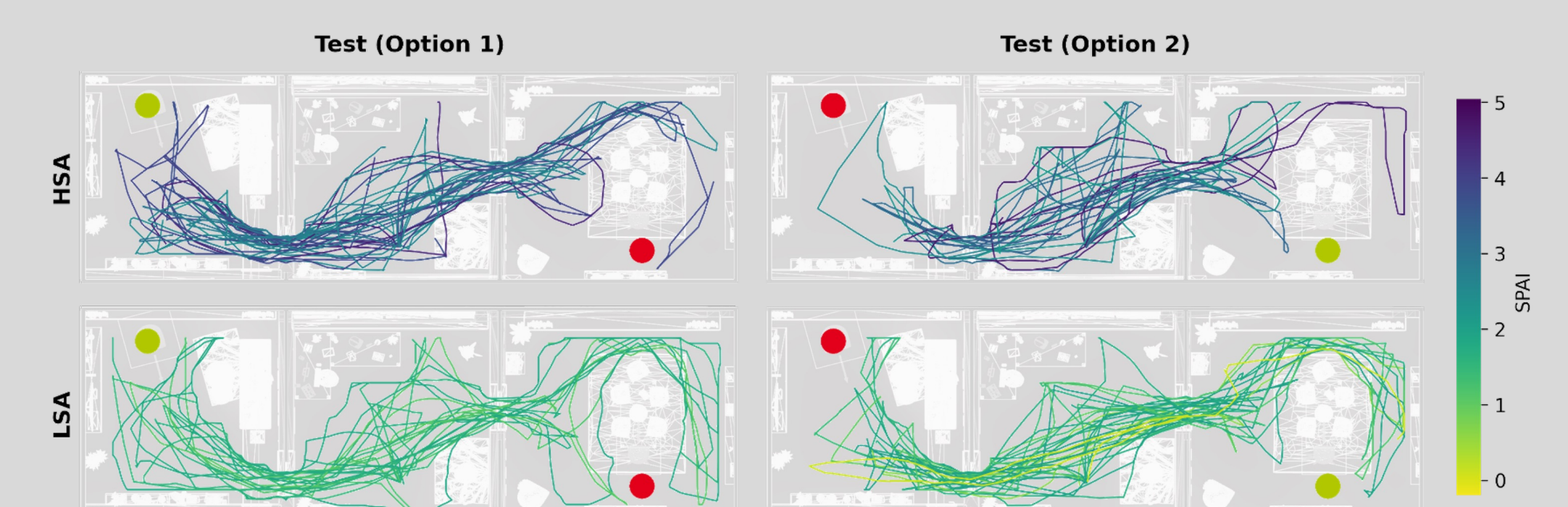
- During the interaction, participants focused predominantly on the virtual agents' faces and hereby spent more time looking at the unfriendly compared to the friendly virtual agent.
During the sAA-Test, participants showed a significantly longer proportional dwell time on the friendly compared to the unfriendly virtual agent. Both effects are mainly driven by participants with higher social anxiety levels.

4 CONCLUSION

- For this study we adapted social conditioning procedures and sAA-tests from the animal literature and implemented them in an immersive virtual environment with unrestricted movement.
- Our dependent variables allow a cross-species identification of threat-related defensive states based on exploration behavior and autonomic reactions.
- We demonstrated that humans adapt their subjective perception of another (virtual) person as well as their social approach- and avoidance behavior promptly after having just one social learning experience.
- In addition, we provided further evidence for the crucial influence of trait social anxiety on these adaptations.

Acknowledgements

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