Empathic Collaboration in Extended Reality

ARINDAM DEY

EMPATHIC EXTENDED REALITY AND PERVASIVE COMPUTING LAB

UNIVERSITY OF QUEENSLAND

A.DEY@UQ.EDU.AU

https://medium.com/@humancapitalmagazine10/the-power-of-workplace-empathy-2c055ebe6c1f

Empathy

"Seeing with the Eyes of another,
Listening with the Ears of another,
and Feeling with the Heart of another …"

Alfred Adler

Experiencing the reality of another

Empathic Computing

The University Of Queensland
AUSTRALIA

Sensors

Understanding

Systems that can understand your feeling and emotions

Extended Reality

Experiencing

Systems that can help you better experience the world

Sharing

Systems that help you better share your experiences with others

“Virtual Reality is the ultimate empathy machine …”

- Chris Milk

Empathic XR

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

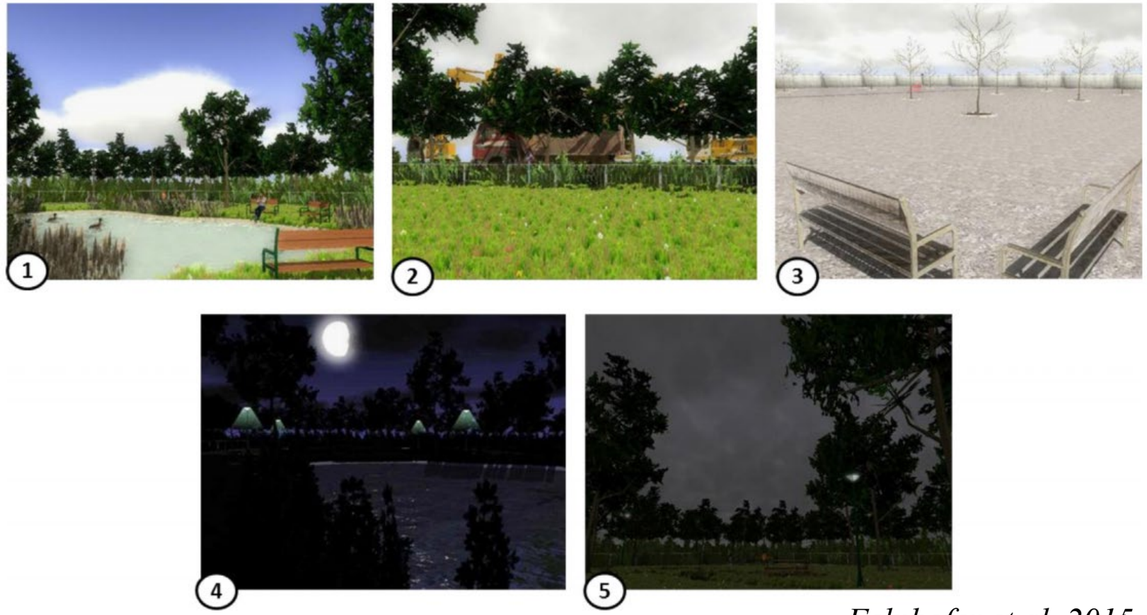
Extended Reality Systems that can

Measure | Share | Adapt to | Manipulate

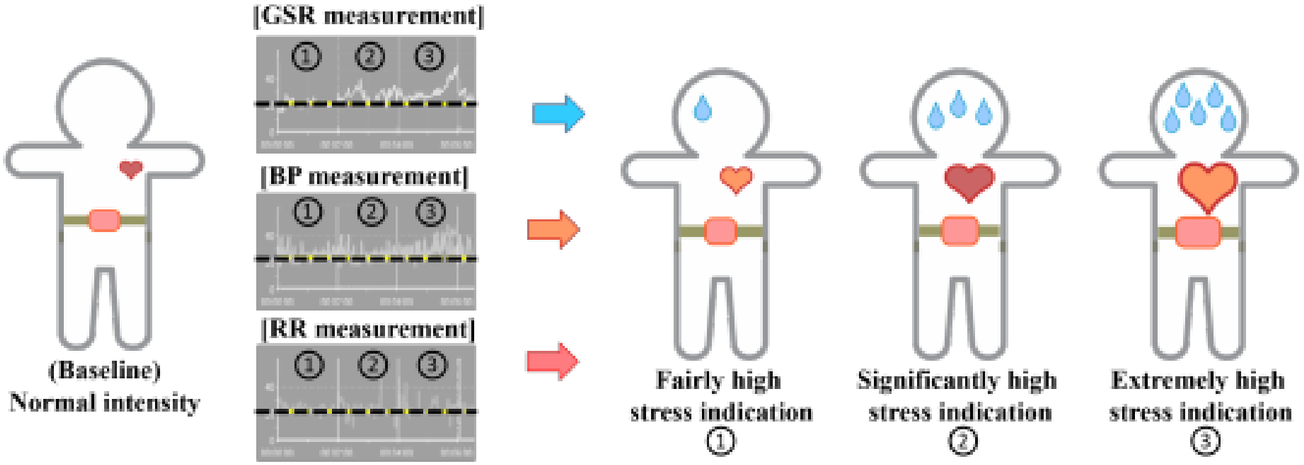
Emotion and *Cognition* in real time

-Physiological (ECG, EDA, EMG, Pupil)
-Neurological (EEG)
-Behavioural (Speech, Posture, Movement)

Background



Felnhofer et al. 2015



Tan et al. 2014

Physiological cues = higher sense of co-presence

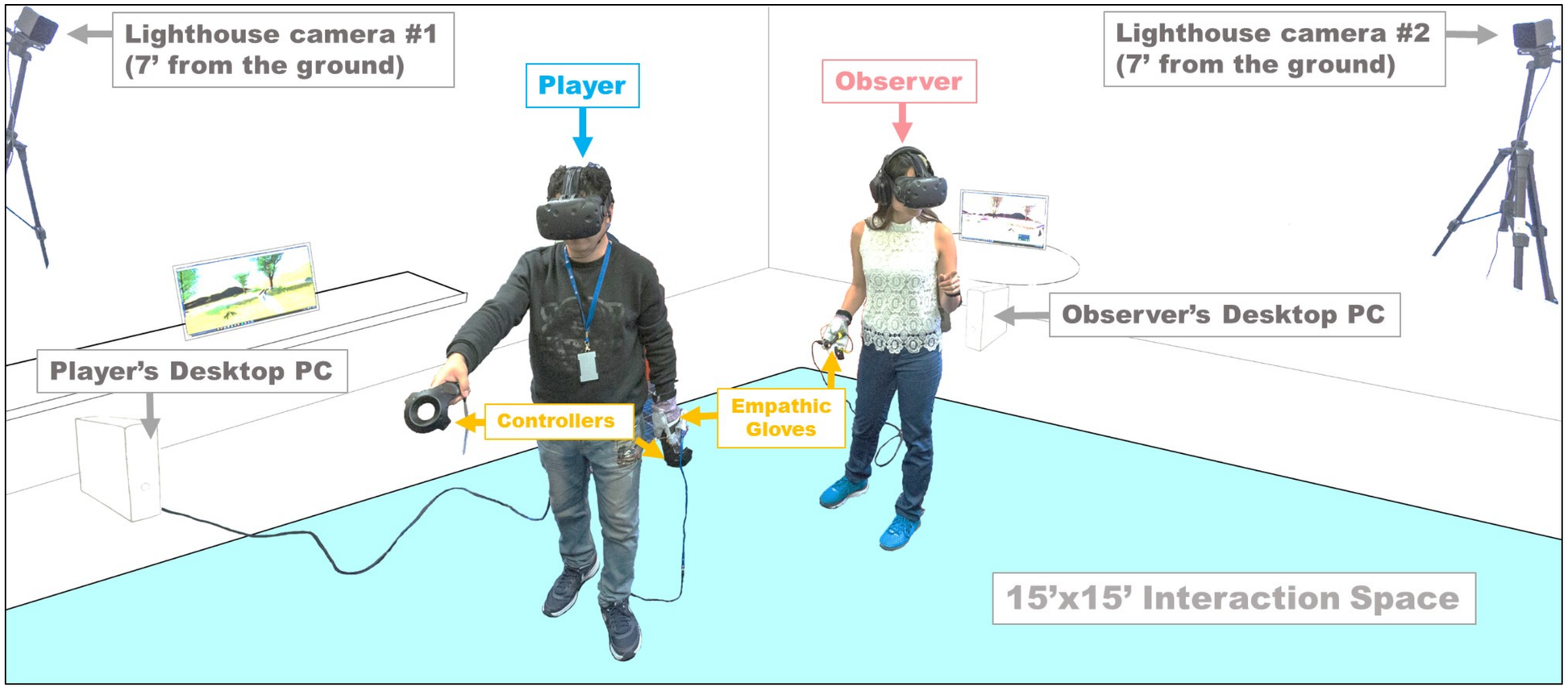
VEs can cause emotional change

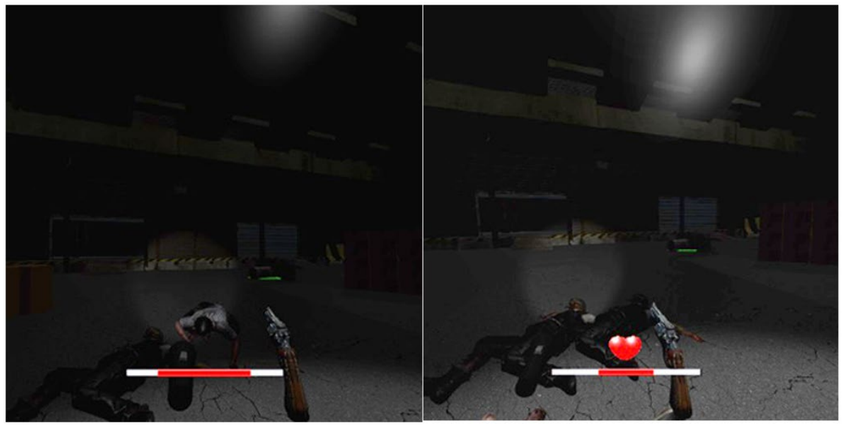
Bernal and Maes; ACM CHI 2017

Emotional expression in VE cause enjoyment

Sharing Physiological States in Collaborative VR

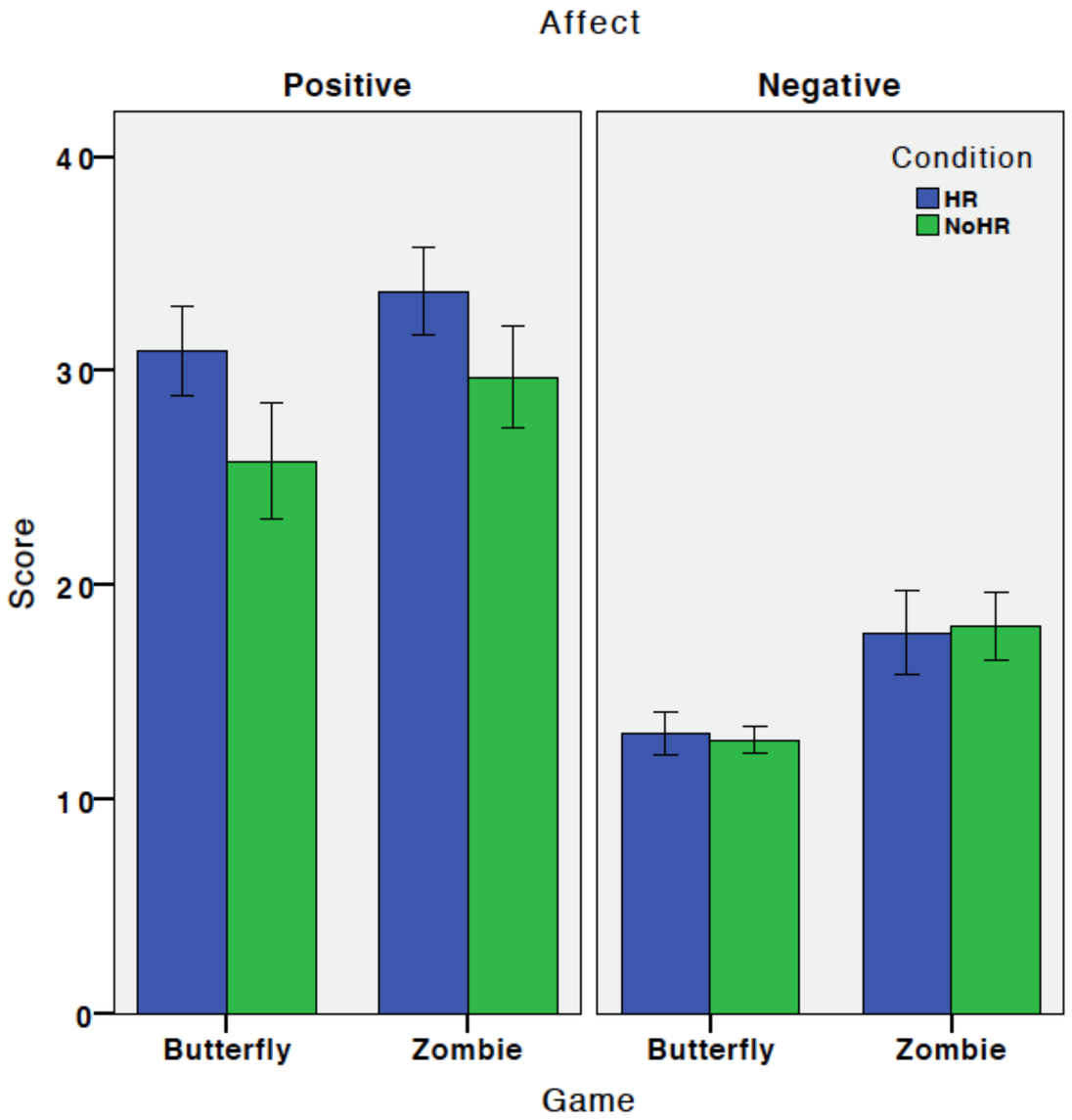
The University Of Queensland
AUSTRALIA





ACM CHI'17

Sharing Physiological States in Collaborative VR



Data Collected

- Raw heart-rate
- Positive and negative affect schedule (PANAS)
- Relative head orientation

Results

- Higher positive affect
- More communication between collaborators
- Observer interaction needed

Multi-Sensory Heart Rate Feedback in Collaborative VR

(a) Escape Room

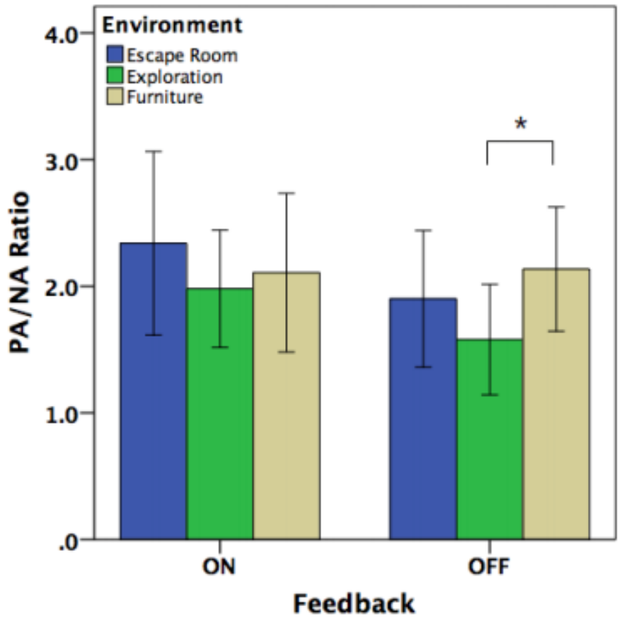
(b) Exploration

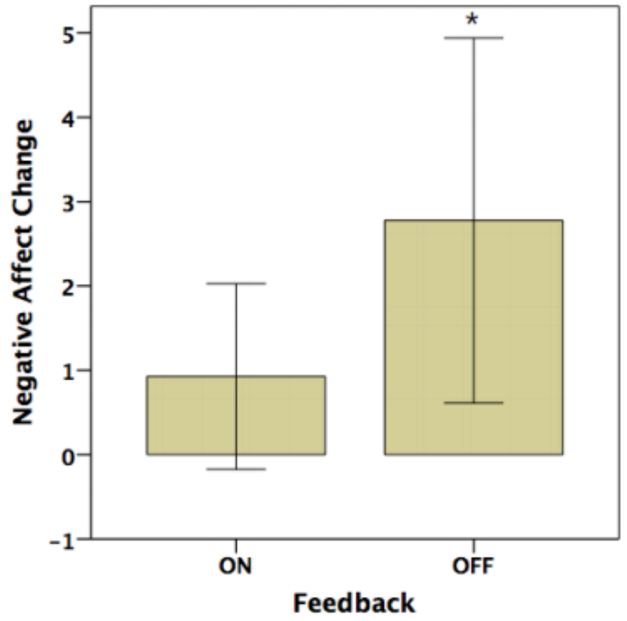
(c) Furniture Arrangement

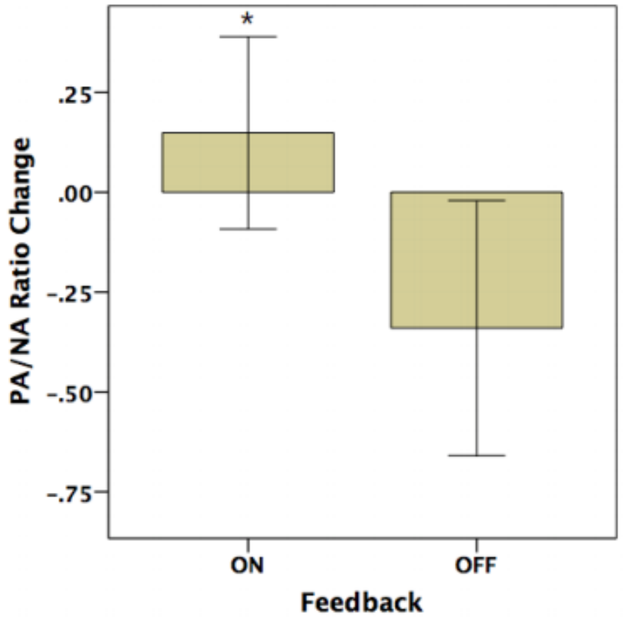
Multi-Sensory Heart Rate Feedback in Collaborative VR

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

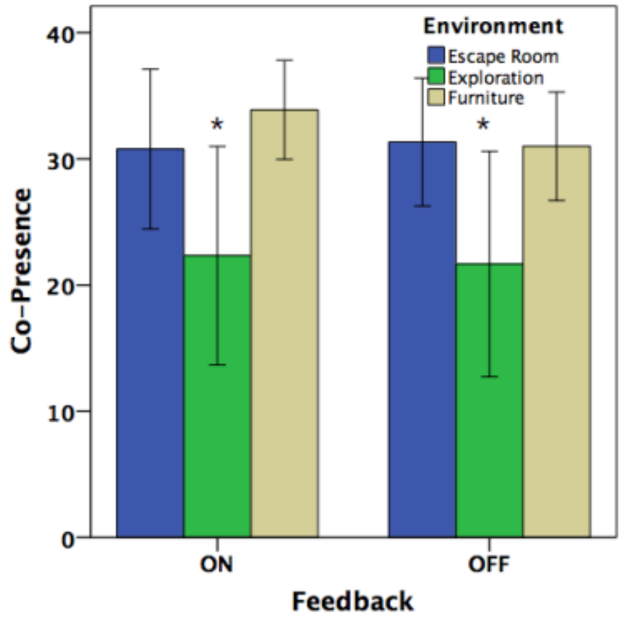
PANAS

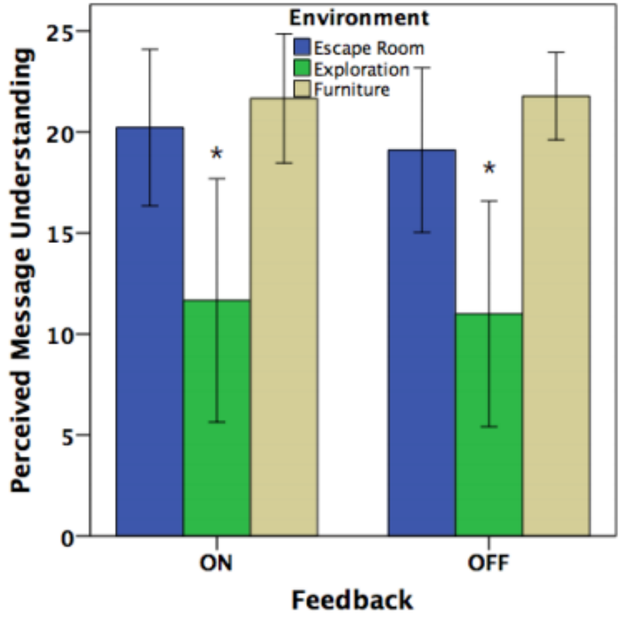


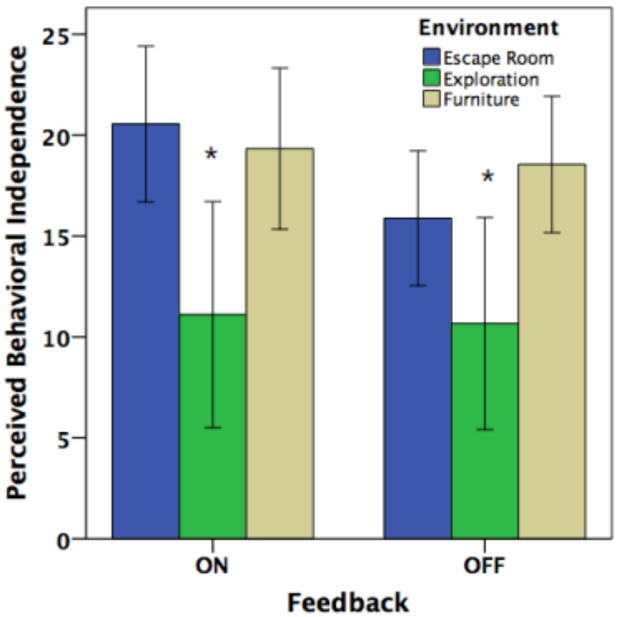




Social Presence





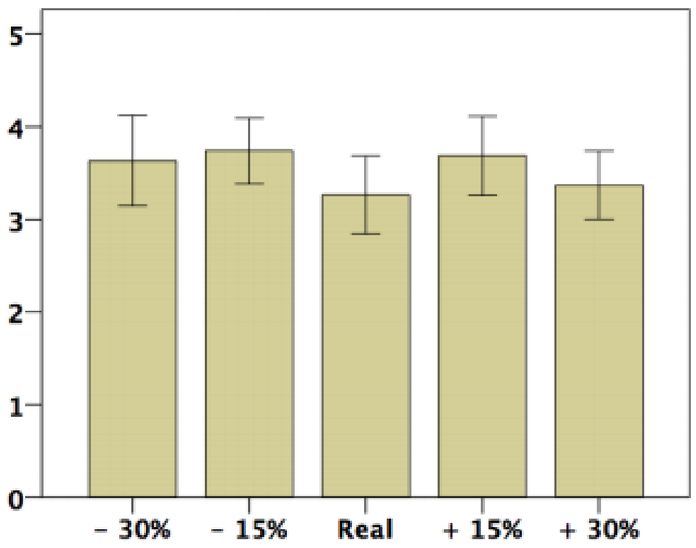


IEEE ISMAR'18

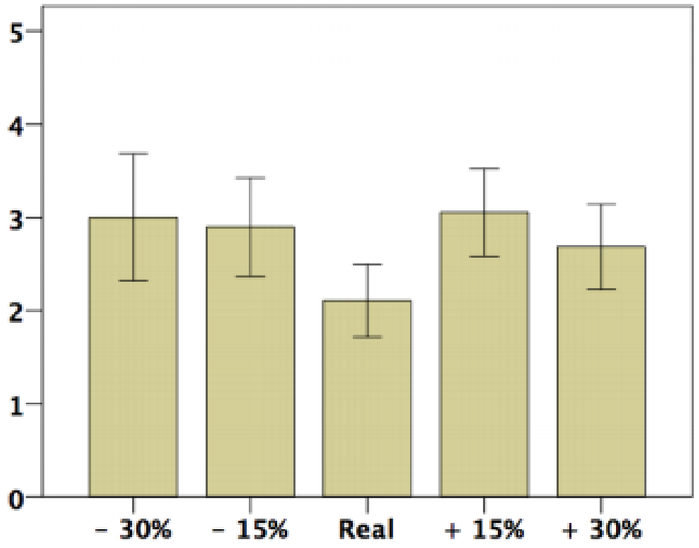
Manipulating Heart Rate Feedback in VR

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

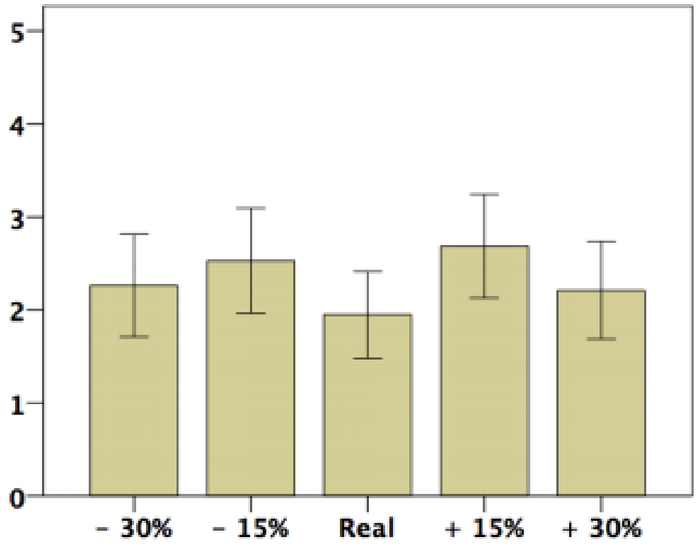
PANAS



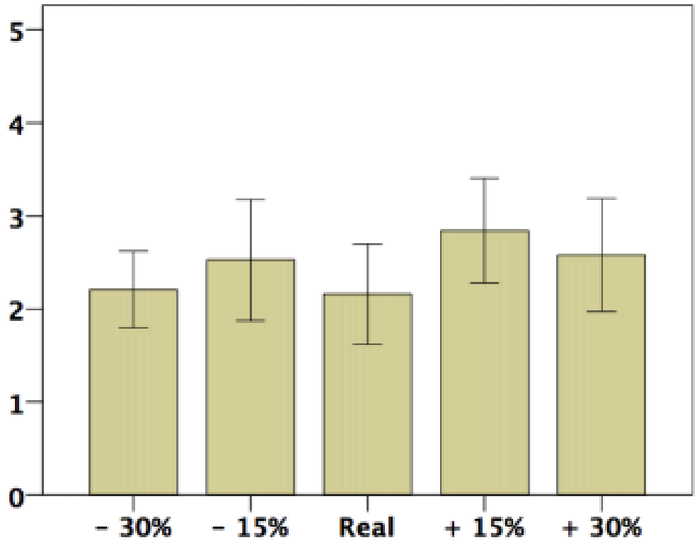
(a) Interested



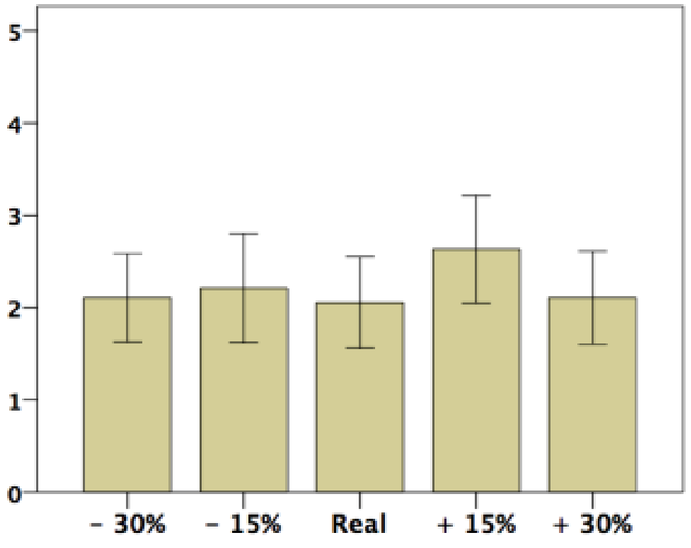
(b) Excited



(c) Scared



(d) Nervous



(e) Afraid

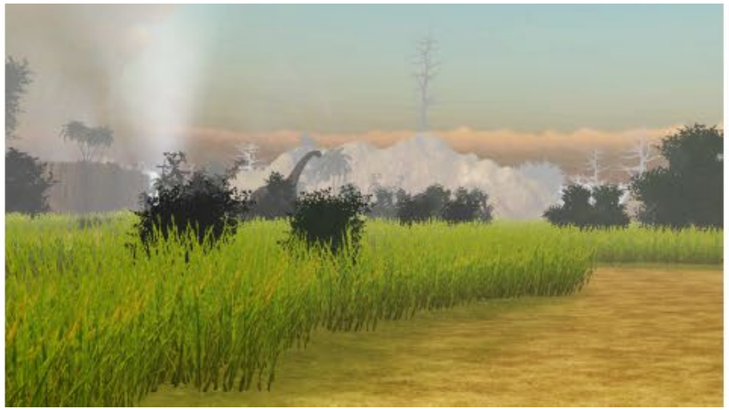
ACM CHI Play'18

Shared and Manipulated Heartrate Feedback in VR

The University Of Queensland
AUSTRALIA

Active

Passive



Manipulation

-20%, 0%, +20%

Dependent Variables

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

For self and collaborator

- Positive and negative affect schedule (PANAS)
- Self-assessment manikin

Only for self

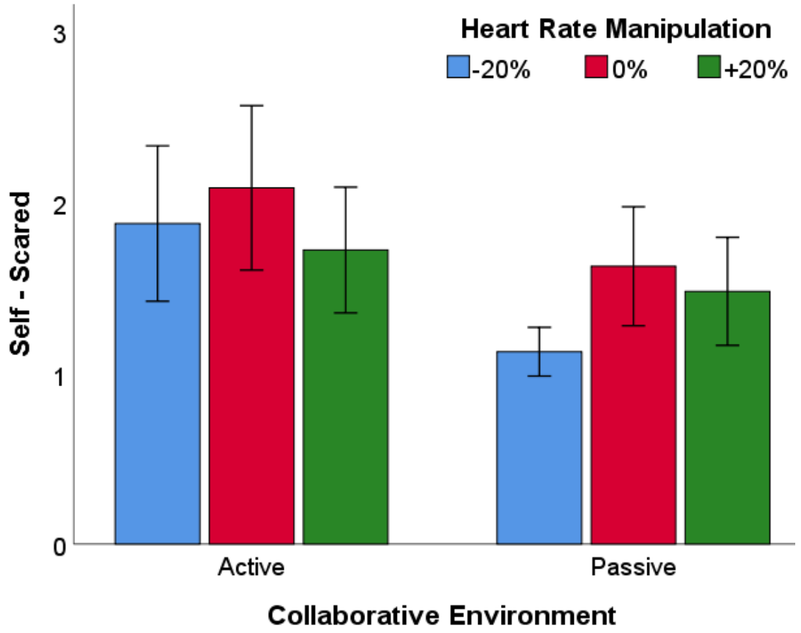
- Social presence
- Inclusion of the other in self scale
- Other questionnaire
- Real heart rate

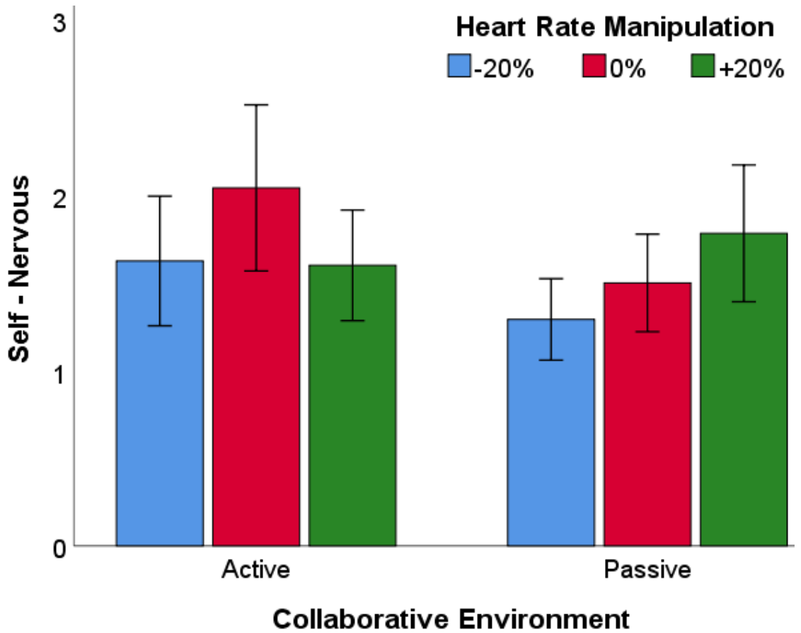
Procedure & Setup

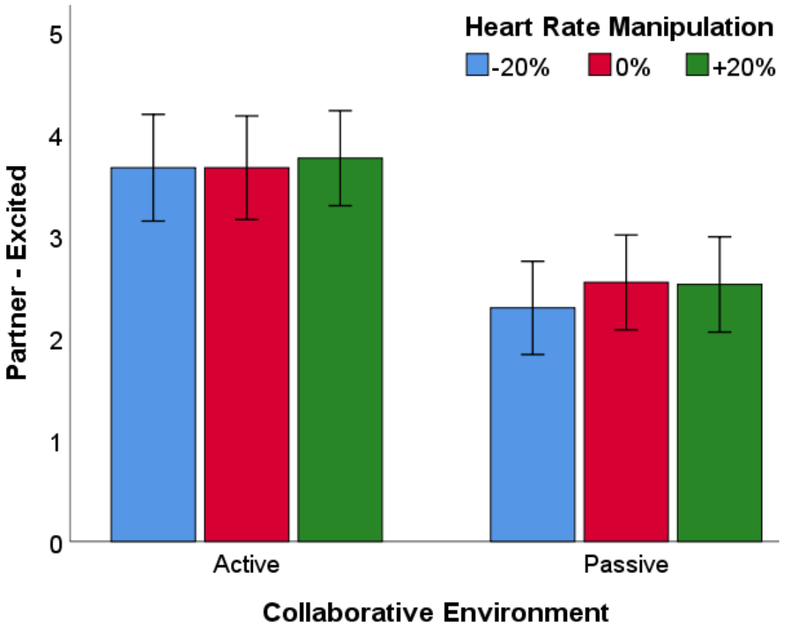
- 24 Participants (12 groups)
- 2 hours per pair
- $20 gift vouchers

- Received each other’s heart rate feedback
- Audio-haptic feedback
- Participants were unaware of manipulation
- 6 virtual environments (counterbalanced)

PANAS



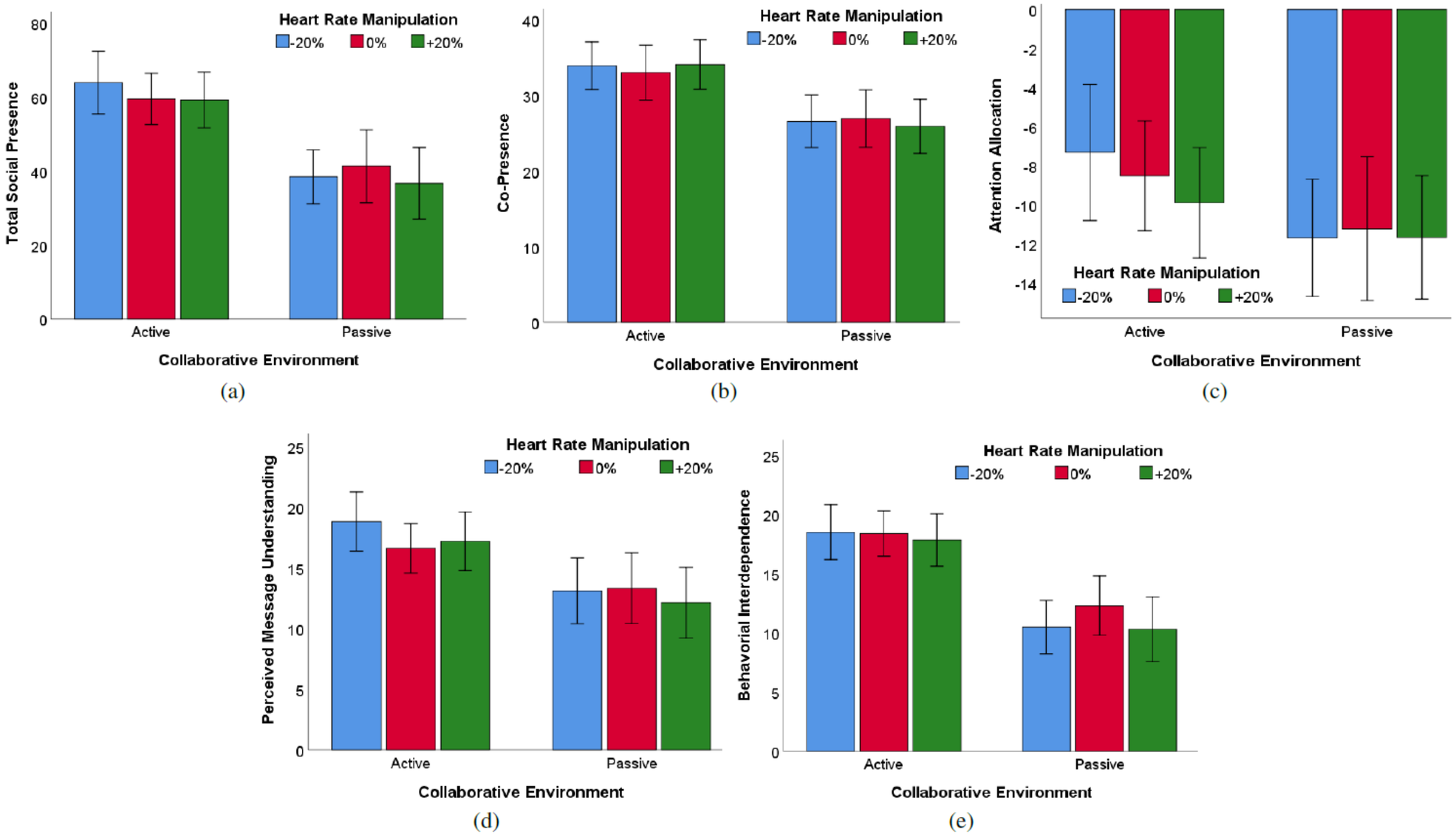




Passive VE: +20% caused more scariness and nervousness than -20% in *self*

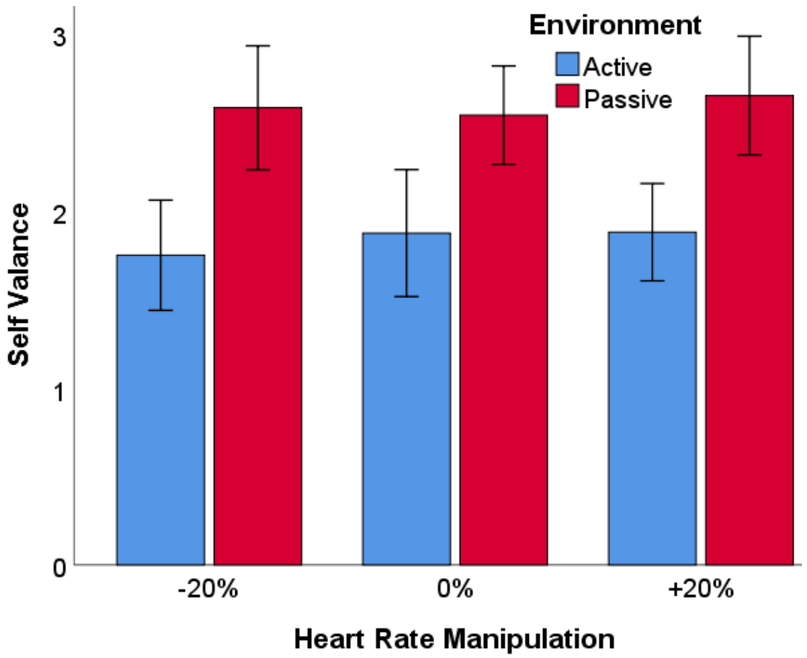
Active VE: *Partner* perceived to be more excited

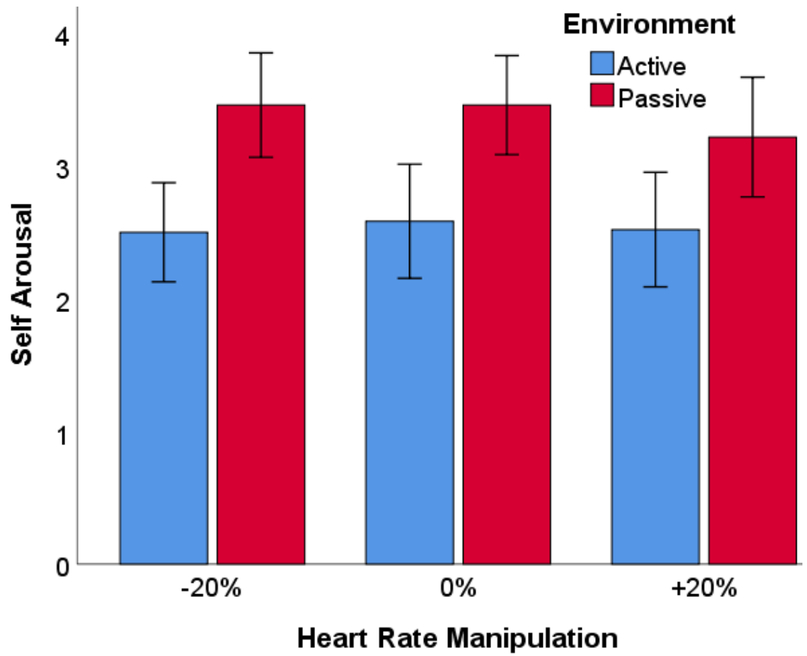
Social Presence

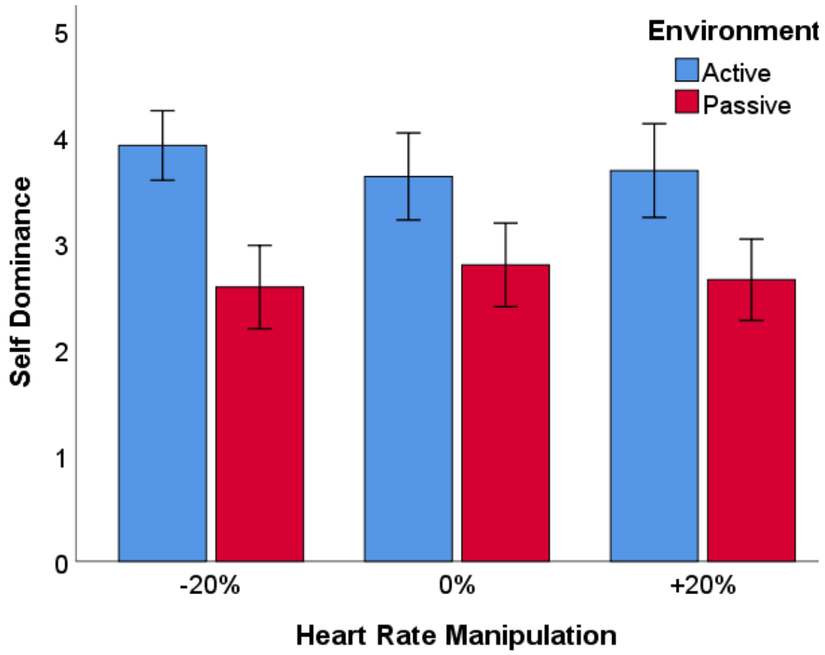


Active environment causes higher social presence

SAM - Self



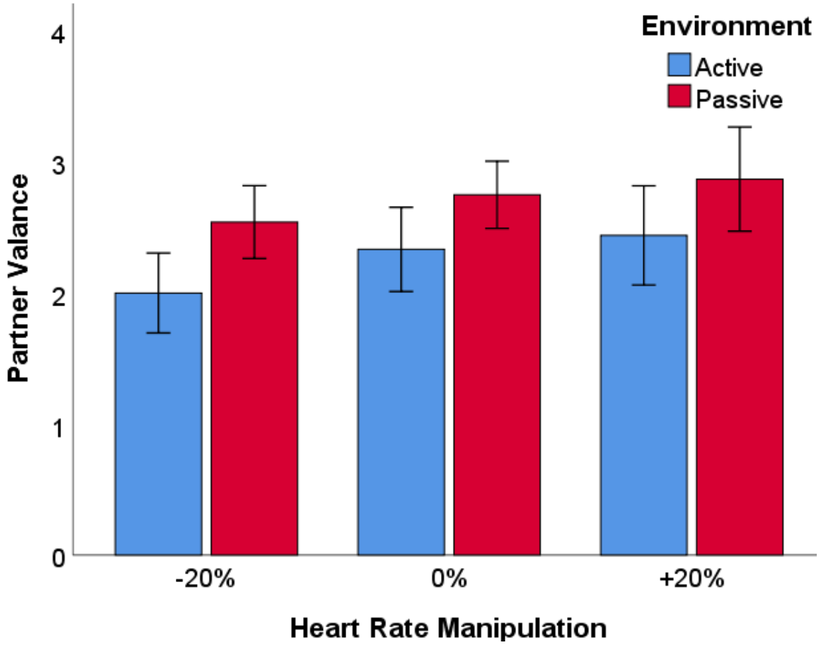


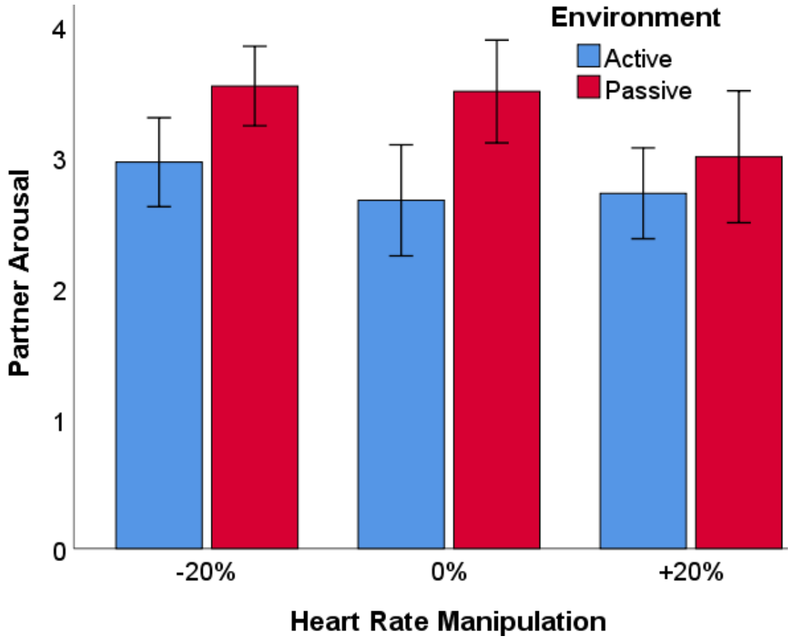


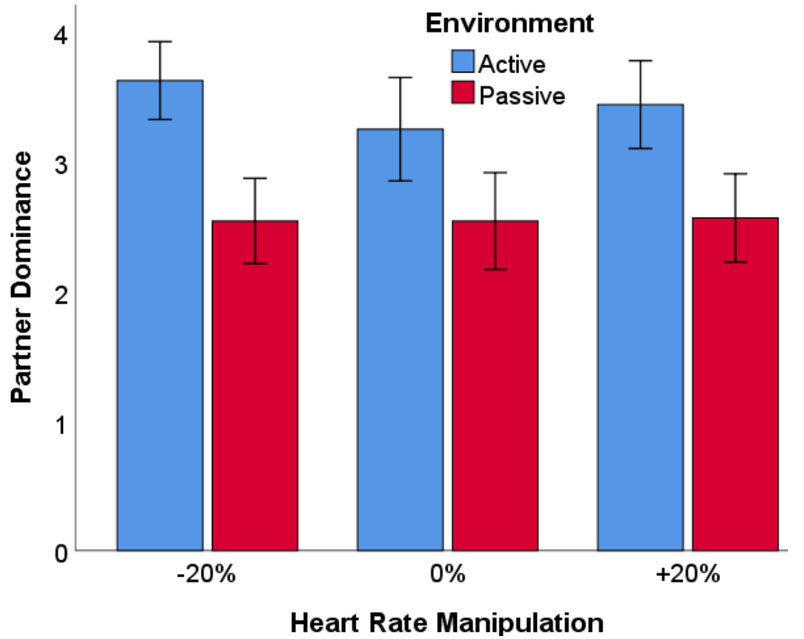
Passive VE: rated higher for valance and arousal

Active VE: rated higher for dominance

SAM - Partner





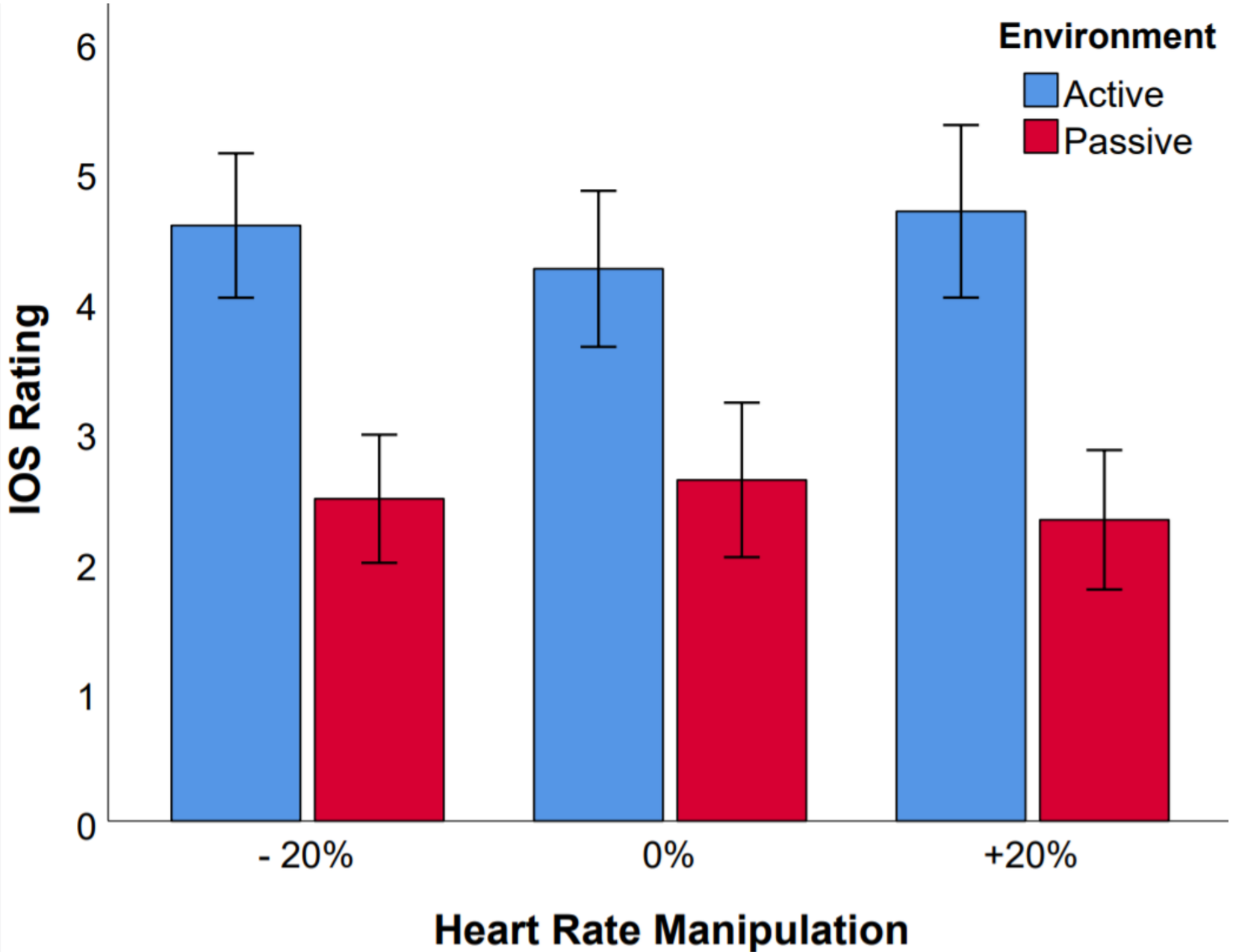


Passive VE: rated higher for valance and arousal

Partner perceived to have higher valance

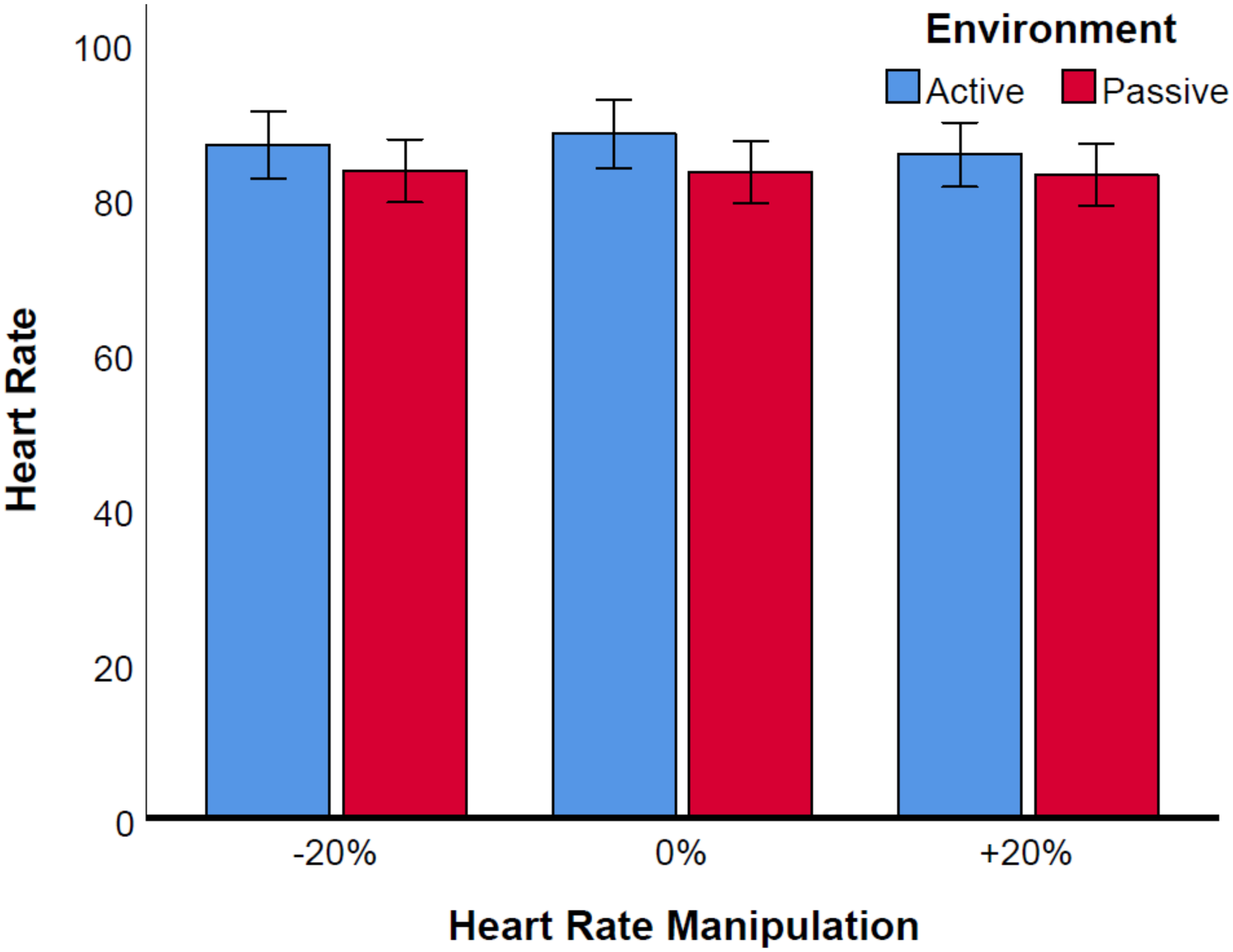
Active VE: rated higher for dominance

Inclusion of the other in self scale



Active VE caused higher connection

Heart rate



Active VE caused higher heart rate

+20% manipulation had lowest heartrate (trend)

Discussion

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

Collaborative environments affect

- social presence
- emotional awareness
- raw heart rate
- subjective connection

Heart rate manipulation affects

- self emotional awareness in passive VE
- raw heart rate

Lessons Learned

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Social presences increases with

- Shared awareness cues
- Higher interaction

Shared physiological feedback can

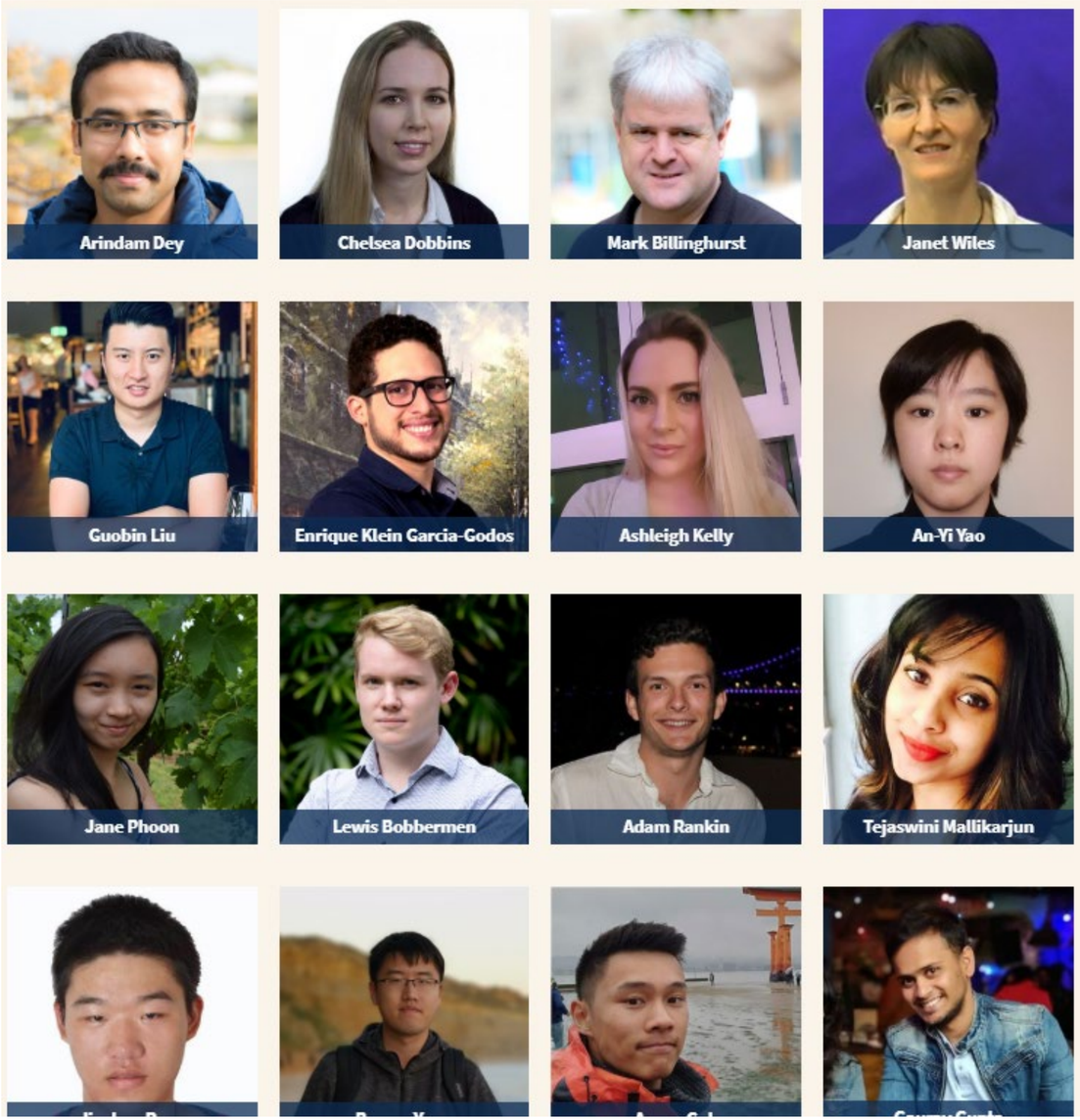
- Increase communication
- Alter emotions but not real signals
- Increase awareness but may not change action

Next steps: Using EEG and other physiological sensors

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

- Emotionally and cognitively adapt interfaces for collaborative learning, training, and social interactions
- Understand how brain synchronization works in collaborative XR
- Effectively share emotional and cognitive states to create empathy in collaborative XR

Thank You!



Arindam Dey

Empathic Extended Reality and Pervasive Computing Lab

Co-Innovation Group | University of Queensland

http://empathicxr.org | a.dey@uq.edu.au