IEEE World Haptics Conference 2021

BENTLEY UNIVERSITY

Affective Haptics for Enhanced XR

Organizer: Dr. Mounia Ziat

Bentley University

July 12th

Join us on Wonder for the break

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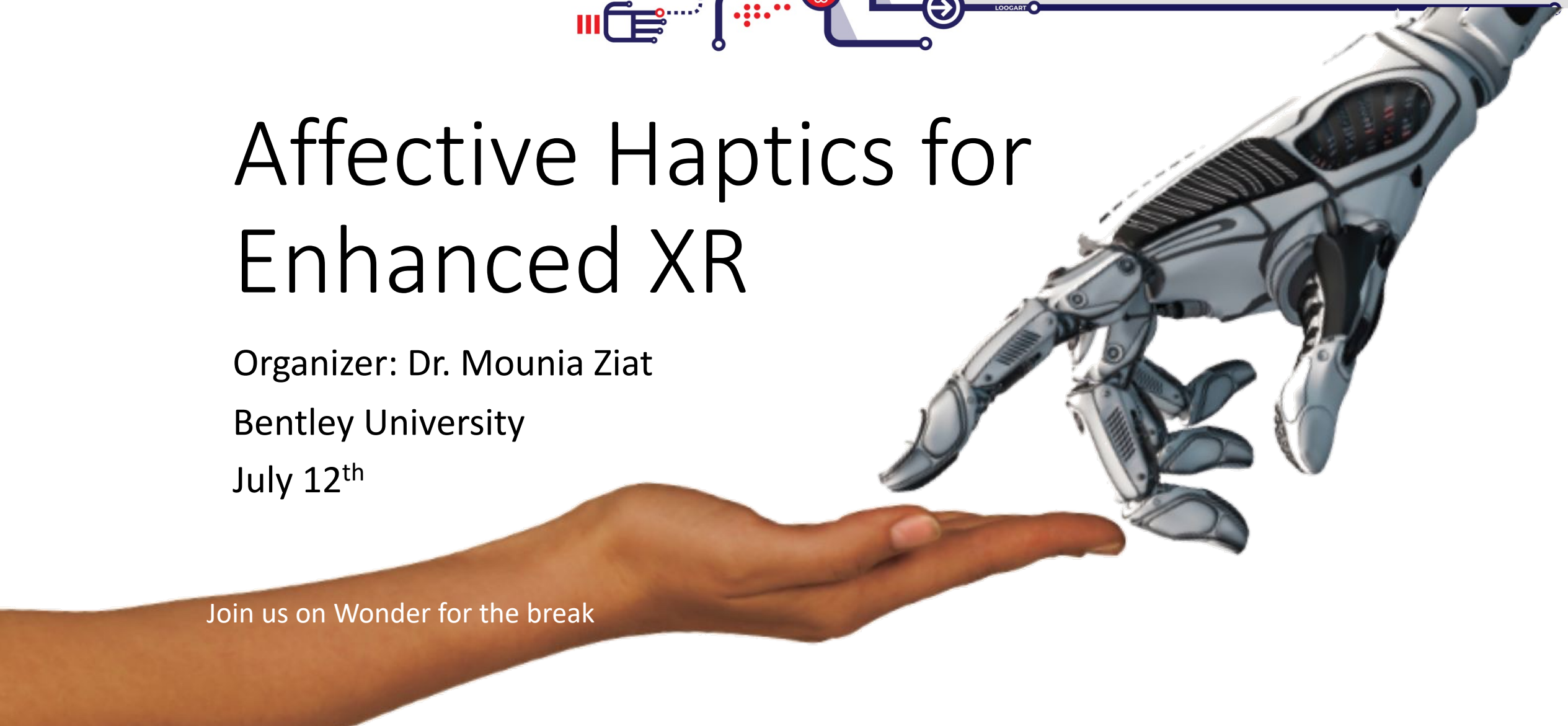
Affective Haptics for Enhanced XR



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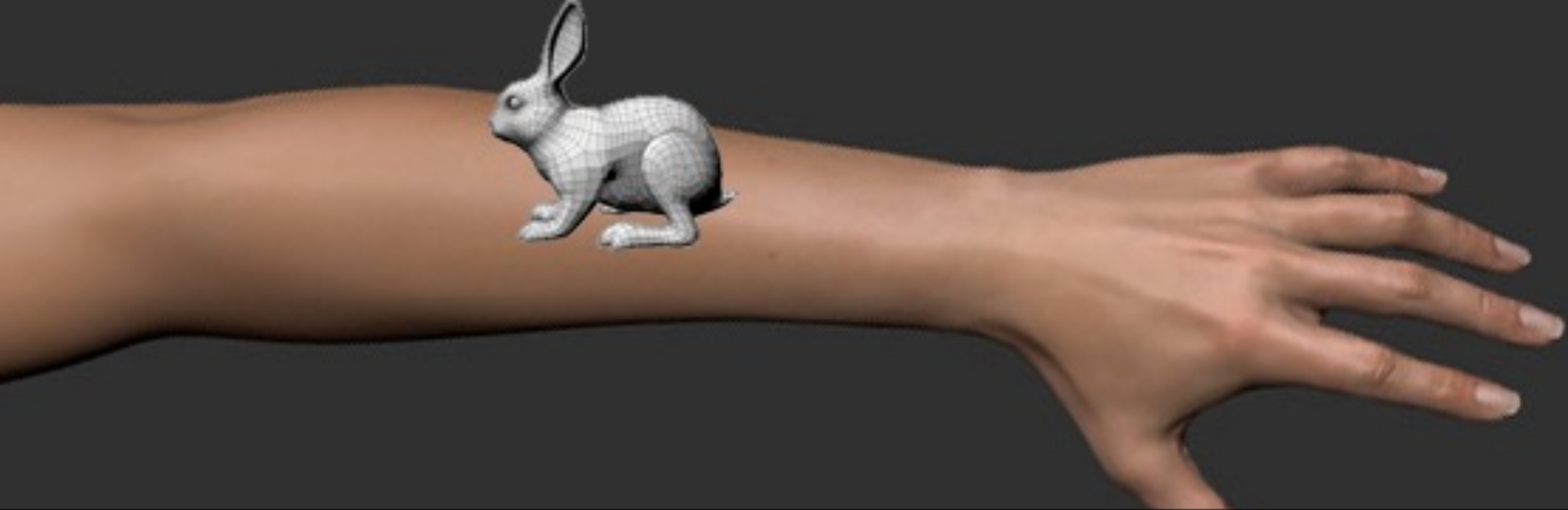
Speakers

David Parisi

Associate Professor
College of Charleston

David Parisi is an Associate Professor of Emerging Media at the College of Charleston whose research explores the past, present, and possible futures of touch technologies. His book Archaeologies of Touch: Interfacing with Haptics from Electricity to Computing (https://www.upress.umn.edu/book-division/books/archaeologies-of-touch) (University of Minnesota Press, 2018) shows how electric shock, experimental psychology, cybernetics, aesthetics, telemanipulation robotics, and virtual reality each participated in a reconceptualization of touch necessary for its integration into contemporary computing technologies. His writing on tactility has appeared in publications such as Logic, TechCrunch, Open!, ROMchip: A Journal of Game Histories, New Media & Society, Convergence, and Game Studies. Parisi is also a member of the recently established Haptics Industry Forum.



July 12th, 2021

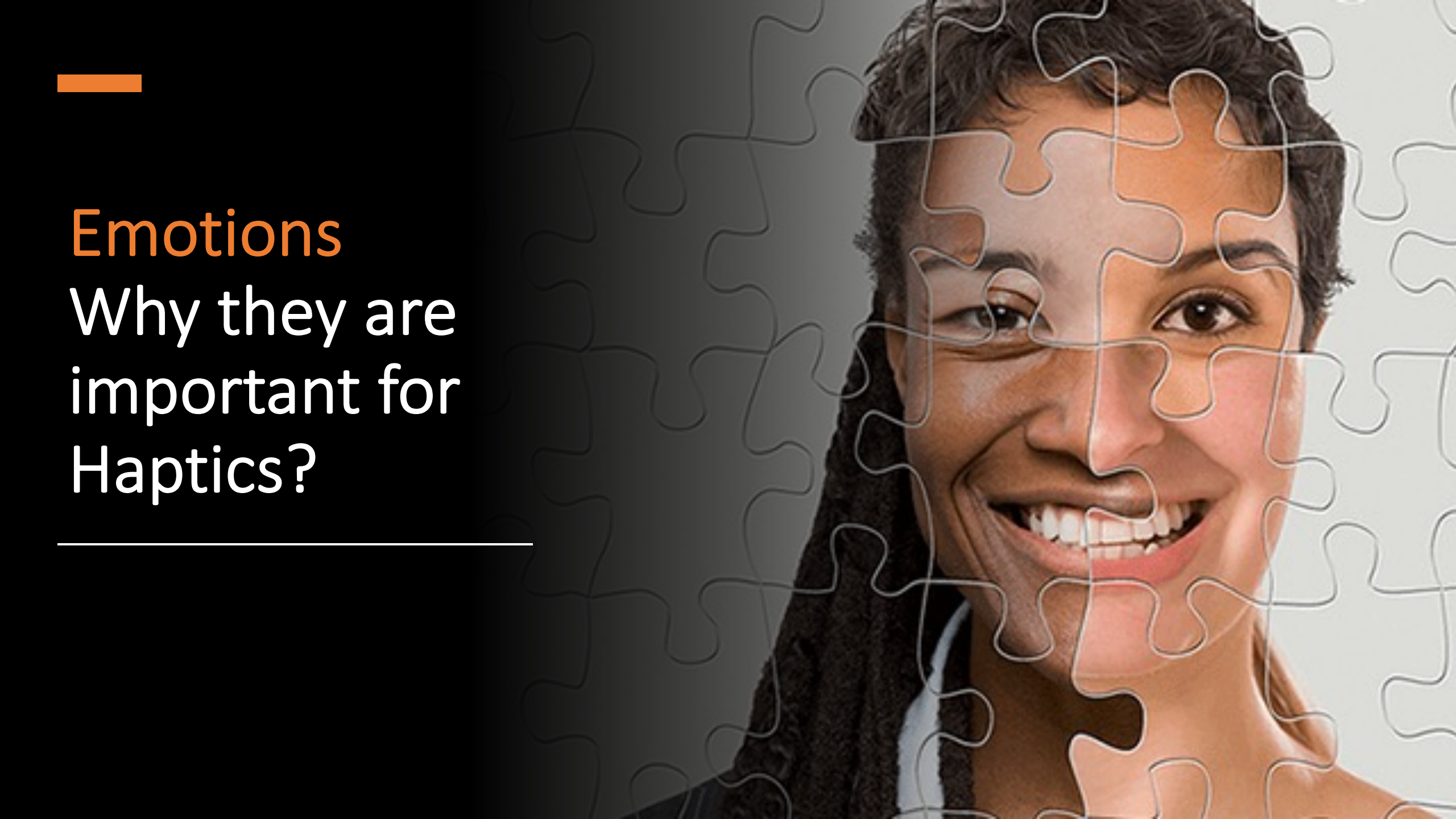
Understanding Affective Touch for a Better VR Experience

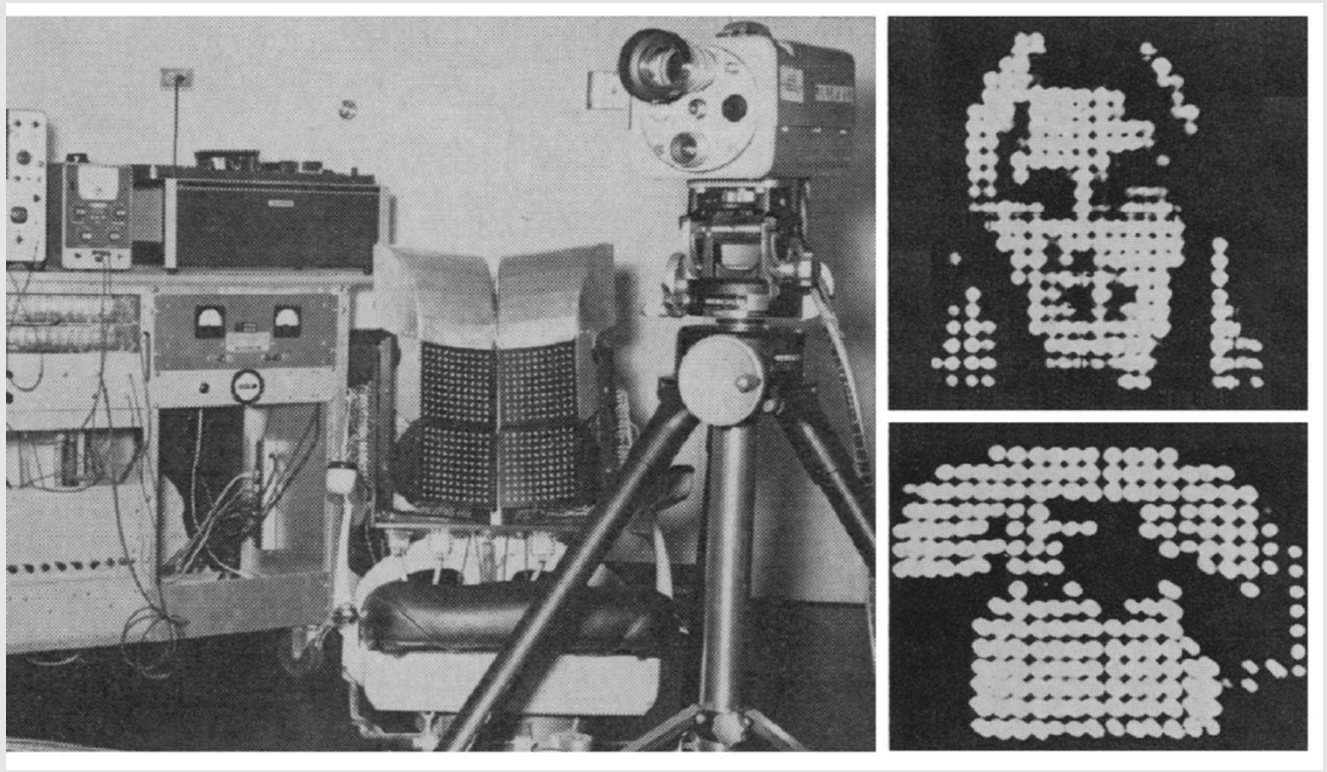
Mounia Ziat

BENTLEY UNIVERSITY

Emotions

Why they are important for Haptics?





TVSS (Tactile Vision Substitution System) - 1972

- Image of an object captured by a video camera
- Converted into Tactile Stimulation
- Transmitted on the skin through a matrix of 400 stimulators placed on the back, abdomen, forehead.

Bach-y-Rita, P. (1972). Brain mechanisms in sensory substitution. academic Press.

One reason for commercial failure

Emotional Qualia: Emotional quality of perceptual objects

Bach-y-Rita, P. (2002). Sensory substitution and qualia. Vision and mind, 497, 514.

Do affect and emotion differ in meaning?

- Yes
- No
- I am not sure / I do not know

Distinguish between Affect and Emotion

Affect: basic sense of feeling, usually measured on two- or three-dimensional scale (Valence, Arousal, and Dominance) – depends on interoception.

Emotions: the result of a conscious cognitive behavior such as reflecting, weighting up the odds: more complex mental construction.
Barrett, How Emotions are Made (2017)

Understanding emotions help you to consider whether the haptic device should trigger affect or reflection in the user.

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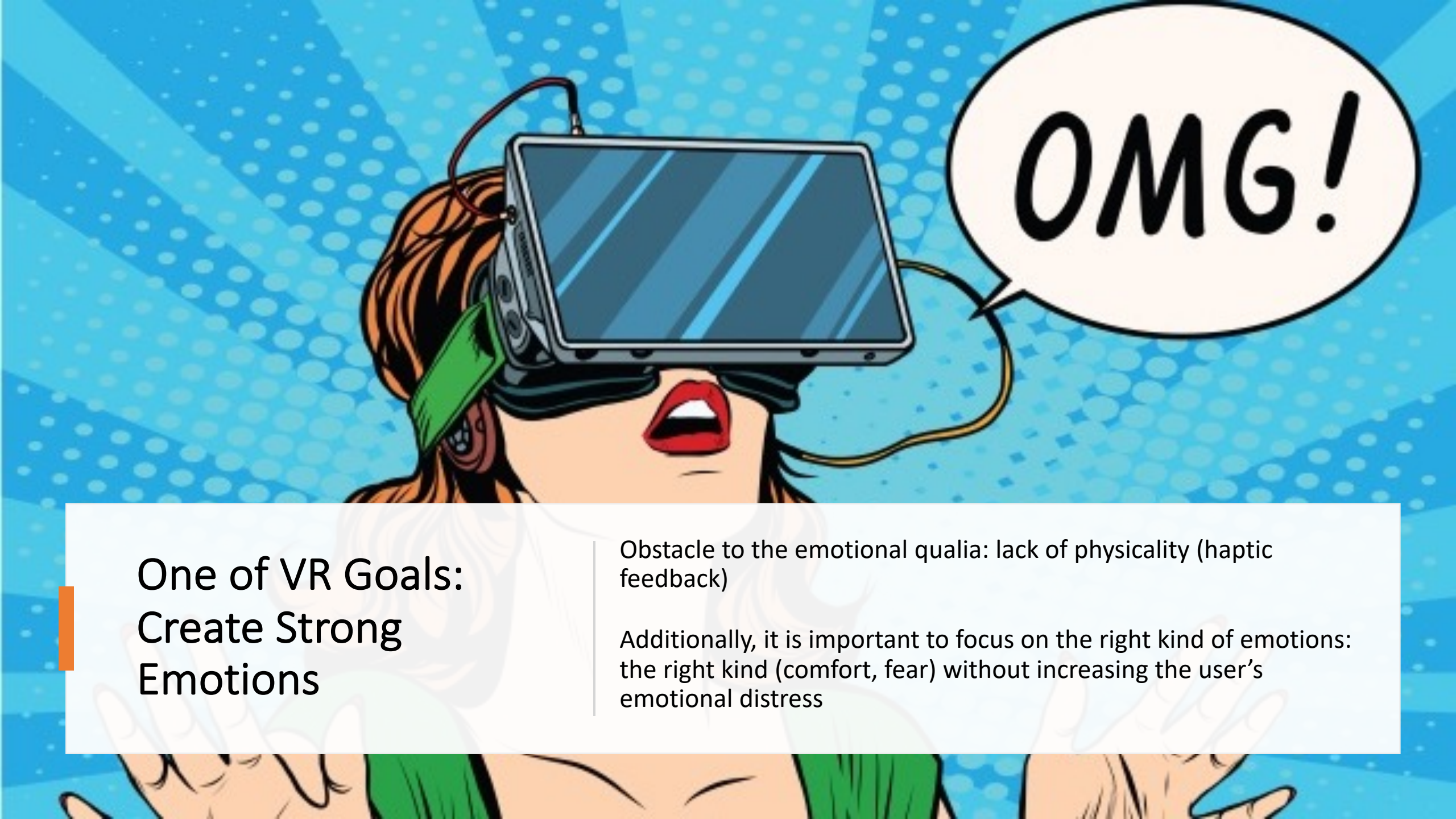
Emotions

Why they are important for Haptics in VR?

From Real to Virtual

Senses and Emotions in VR

- Technological progress related to HMDs
- All five senses are not included resulting in a lack of emotional qualia



One of VR Goals: Create Strong Emotions

Obstacle to the emotional qualia: lack of physicality (haptic feedback)

Additionally, it is important to focus on the right kind of emotions: the right kind (comfort, fear) without increasing the user's emotional distress

Monitoring Emotions is crucial

- Avoid drastic emotional changes
- Avoid emotional distress of the user

Study 1: Investigate How the Affective Response Changes based on the Visual Stimulus

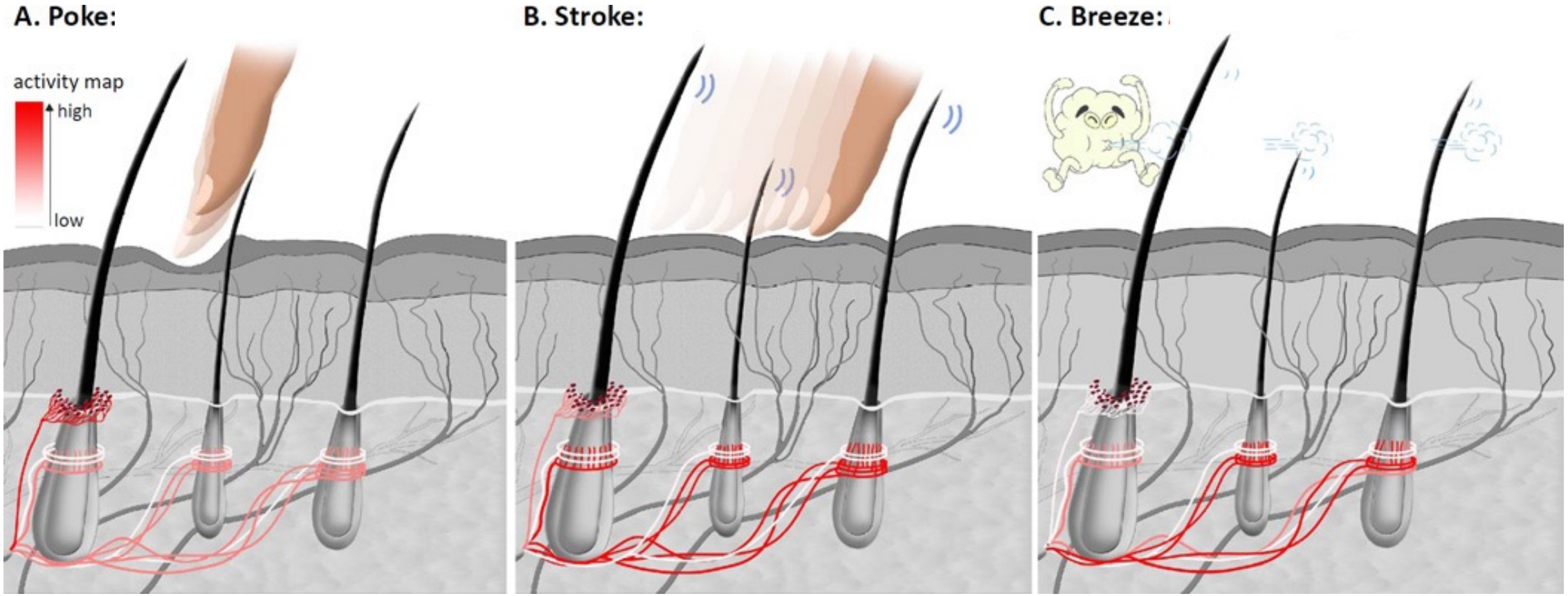
Would EEG signals be different or the same if the touch is associated with angry, sad, or happy faces?

Tsalamlal et al. (2018). Affective communication through air jet stimulation: Evidence from event-related potentials. *International Journal of Human–Computer Interaction*, *34*(12), 1157-1168.

Physiological Evidence of CT Afferent Fibers

CT afferent fibers associated to three hair lengths

- Long Hair
- Medium Hair
- Short Hair



Servomotor
Nozzle

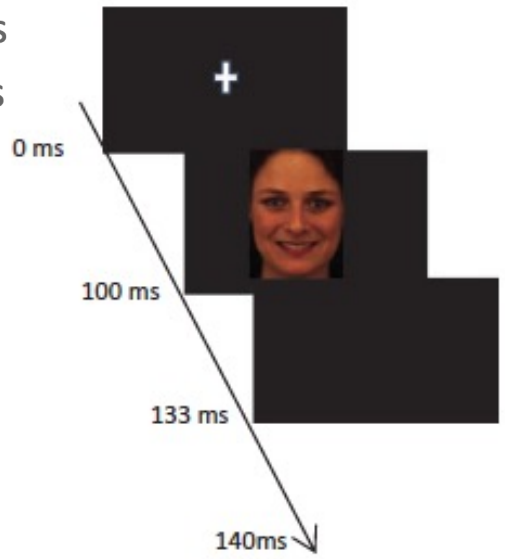
Stimuli and Task

Mix of Visual only conditions and Visual-Tactile conditions

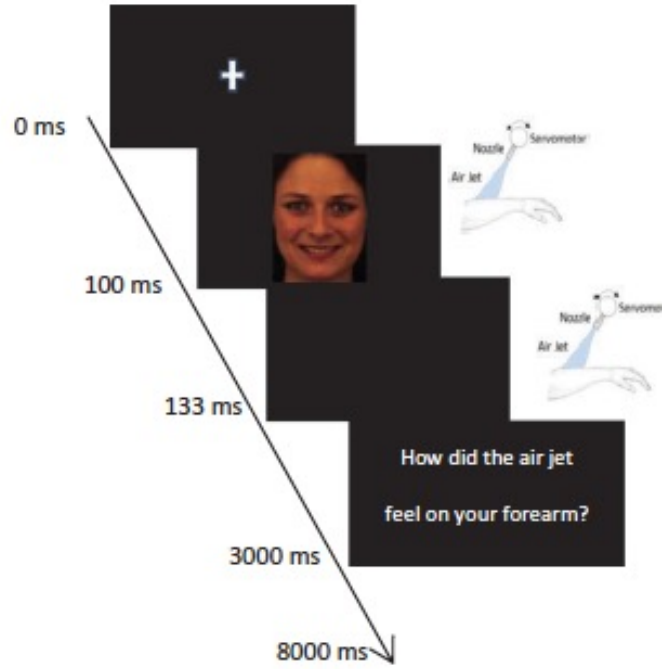
- Three air jet intensities
  - HI: flow rate (50 nl/min) with a velocity of 12 rad/s
  - ME: flow rate (25 nl/min) with a velocity of 6 rad/s
  - LO: flow rate (7.5 nl/min) with a velocity of 0.6 rad/s
- Four Visual Conditions: Neutral (houses), happy faces, angry faces, sad faces (Caucasian faces obtained from The KDEF database)

Task: Rate the pleasantness of the air-jet stimulation using a 5-pt Likert scale.

Visual only Condition



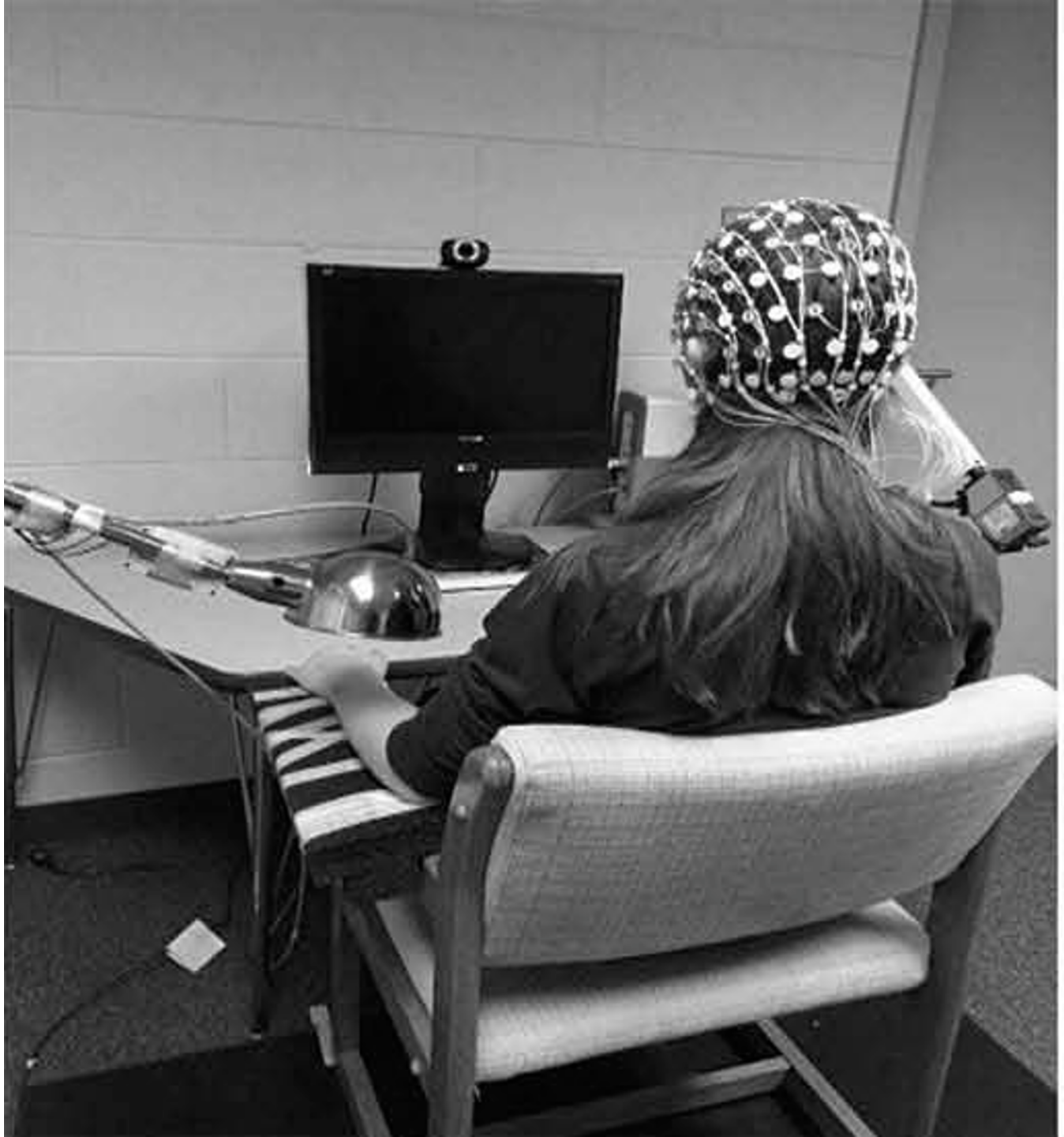
Tactile-Visual Condition



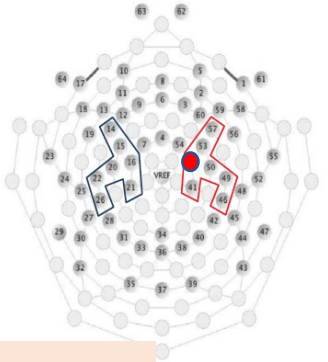
Methods

- 19 Participants (Mean age: 21.5)

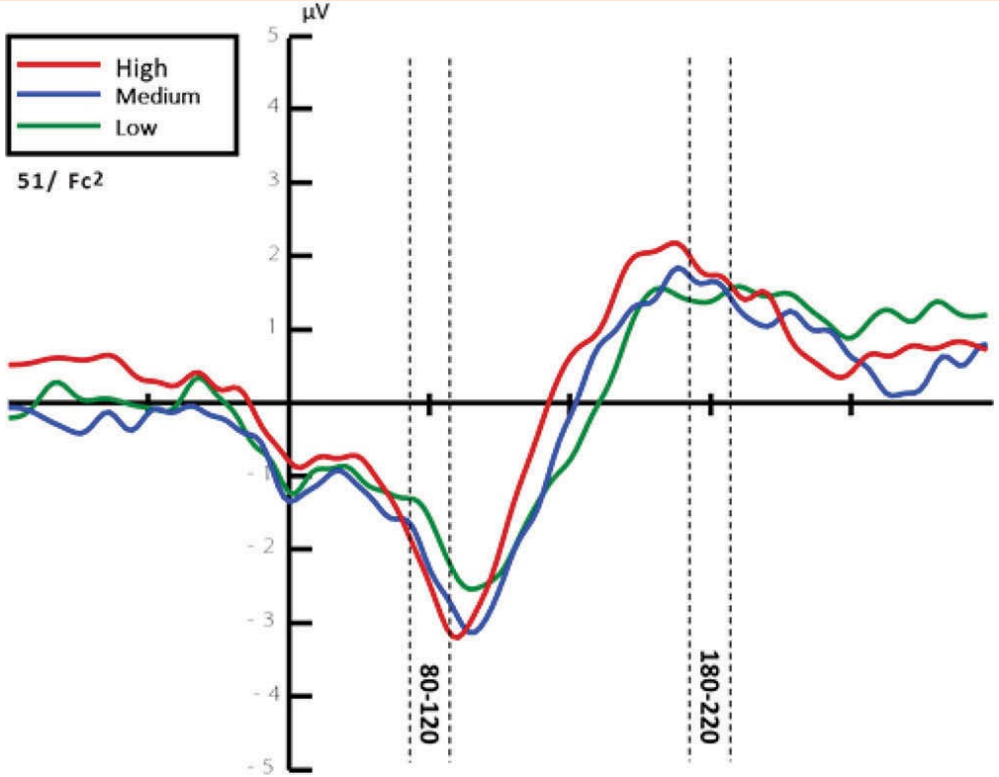
- 12 Tactile*Visual conditions repeated 20 times resulting in 320 trials presented in a random order.
- EEG net (EGI) of 64 electrodes



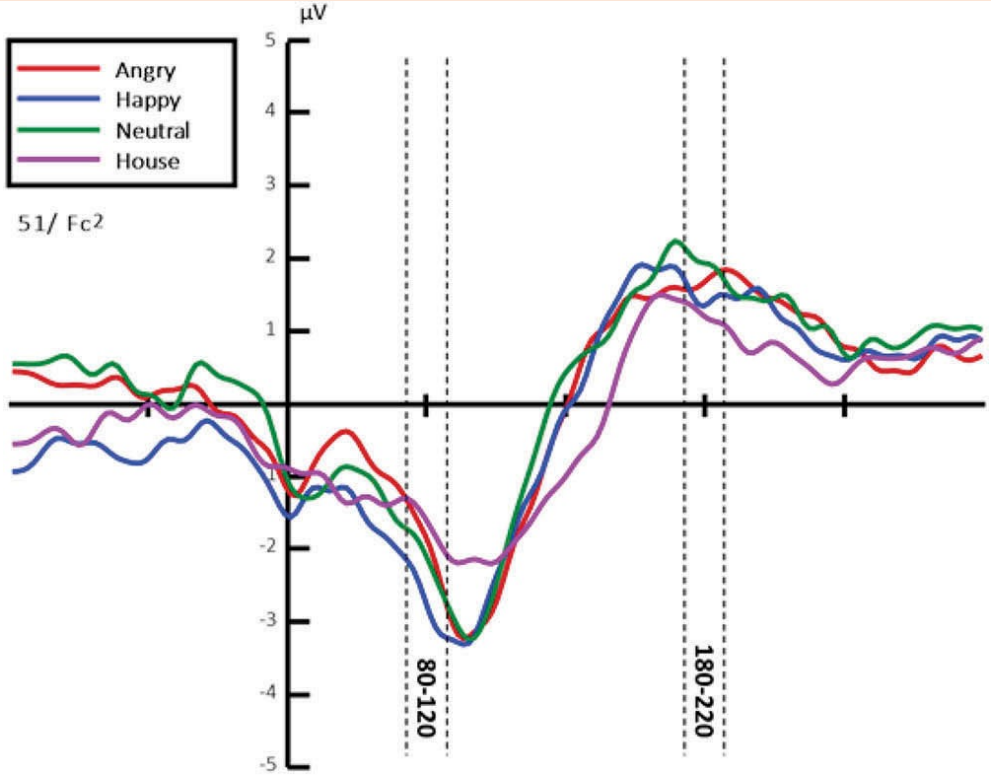
Summary of Results: Tactile and Visual Conditions (Electrode 51/FC2)



N100 and P200 components exhibit a larger value for the high intensity condition.

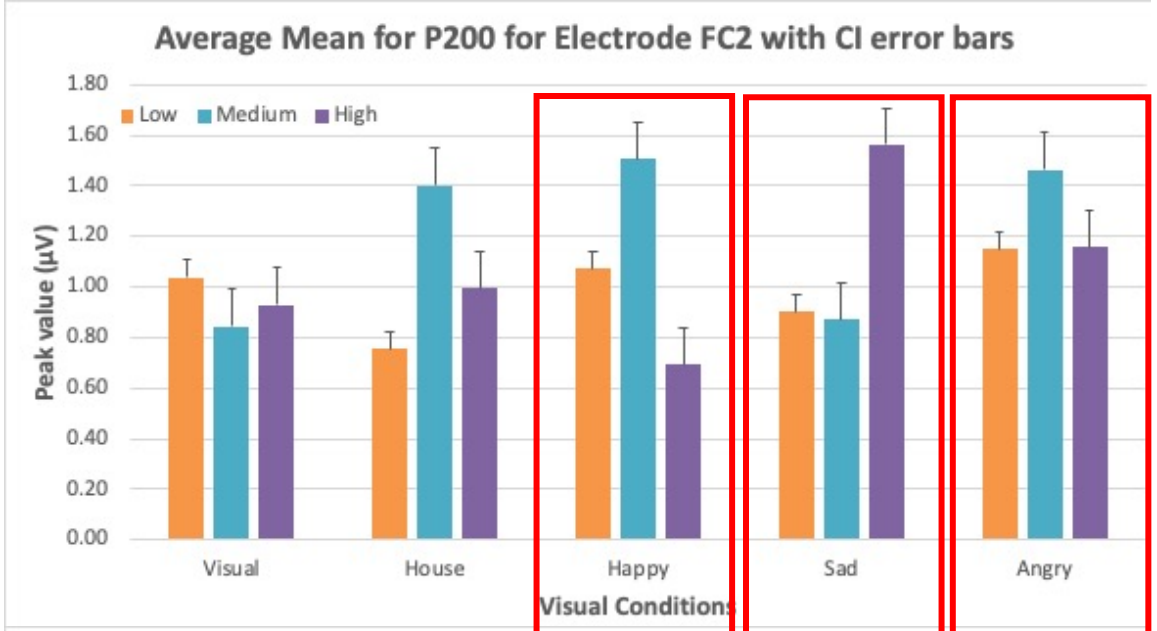


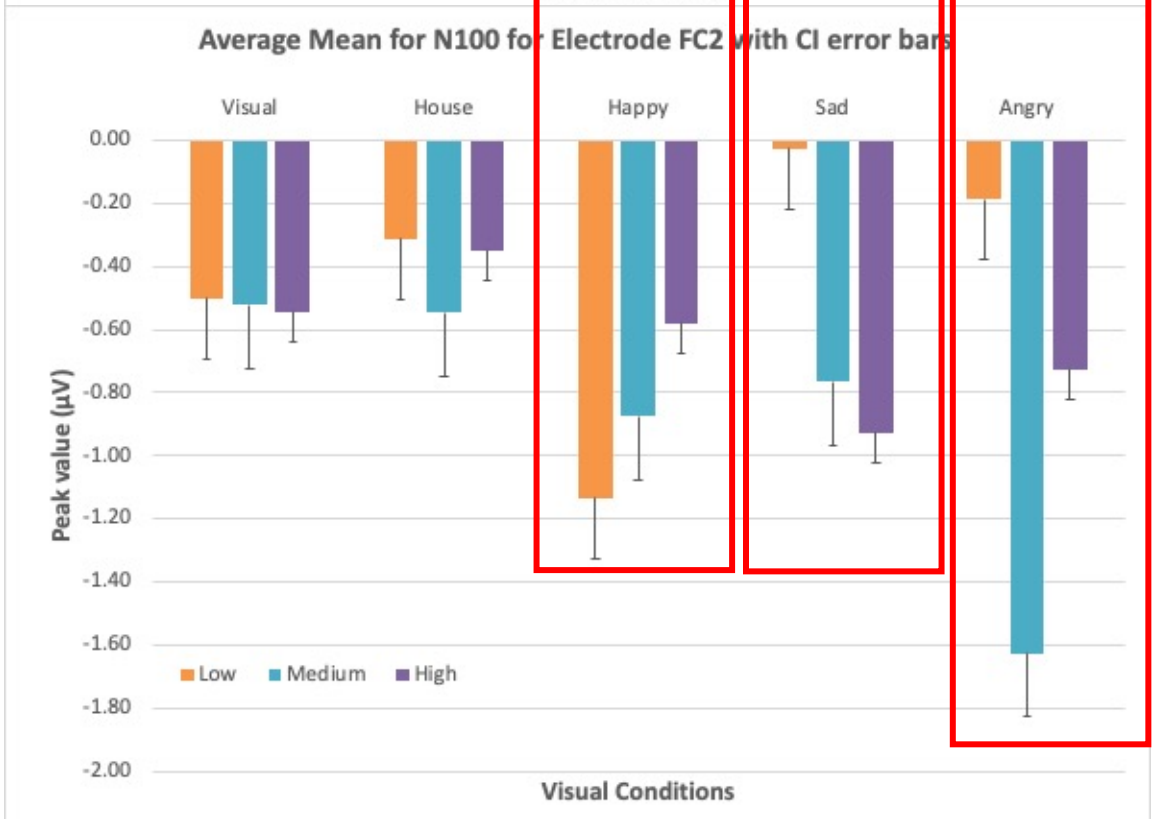
N100 and P200 components are larger for the three facial expressions compared to the house condition.



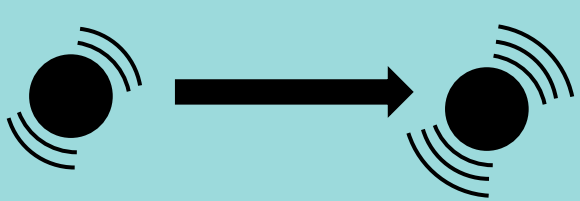
Results EEG (N100 and P200)

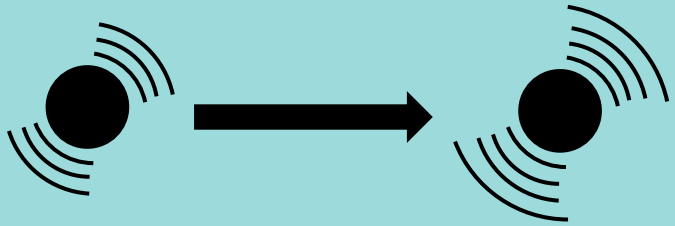
- **Visual:** No difference (no tactile conditions).
- **House (Neutral):** No difference for both N100 and P200.
- **Happy:** was significantly higher when associated with the low flow, followed by medium for N100. Trend reversed for P200 significantly higher for the medium intensity.
- **Sad:** was significantly lower when associated with low flow with higher values for both medium and high flow for N100. For P200 significantly higher for high flow.
- **Angry:** was significantly higher when associated with medium flow for N100. For P200 no difference between the flows.





Potential Scenarios for Virtual Avatars

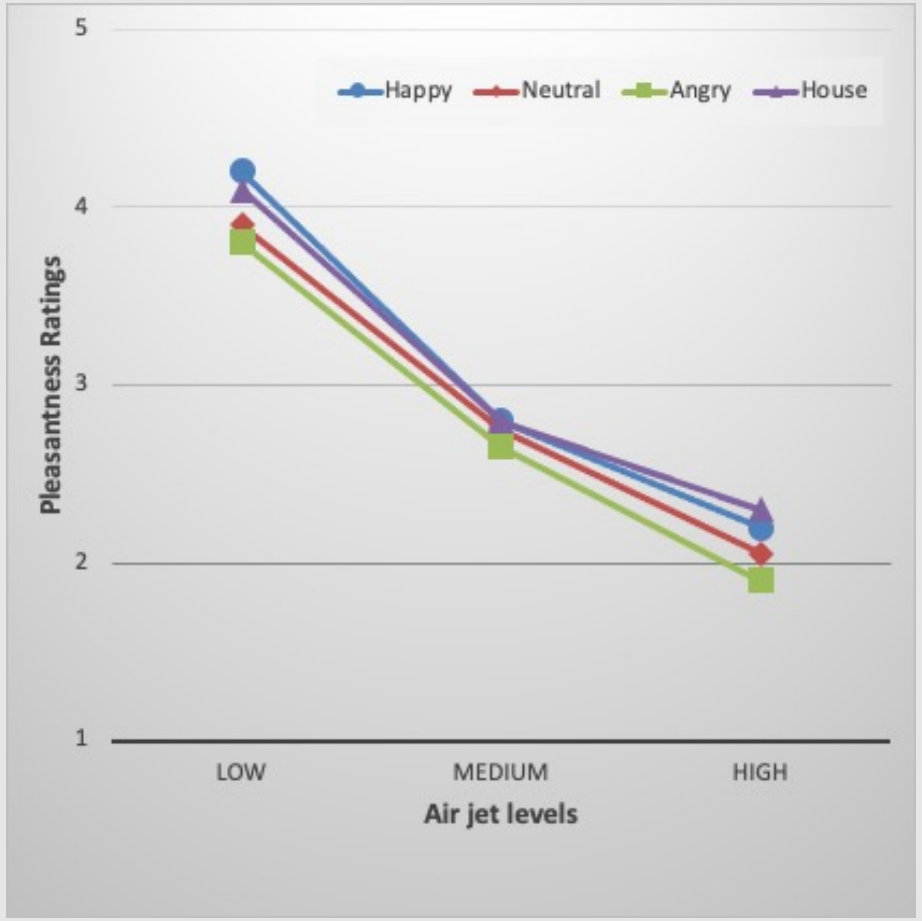




Pleasantness Ratings

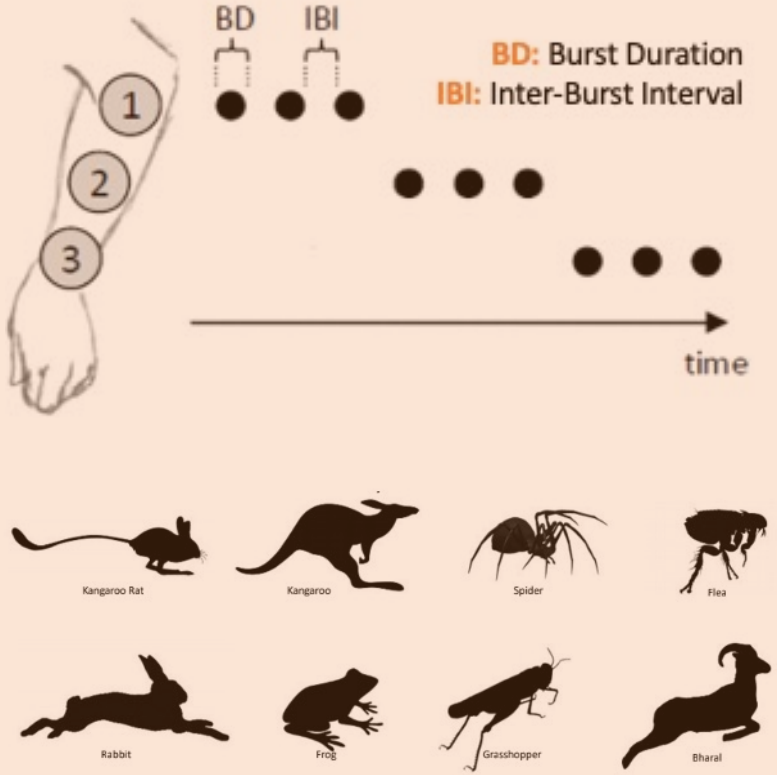
The high flow intensity was rated significantly less pleasant than medium and low levels

The low intensity level was significantly rated the most pleasant



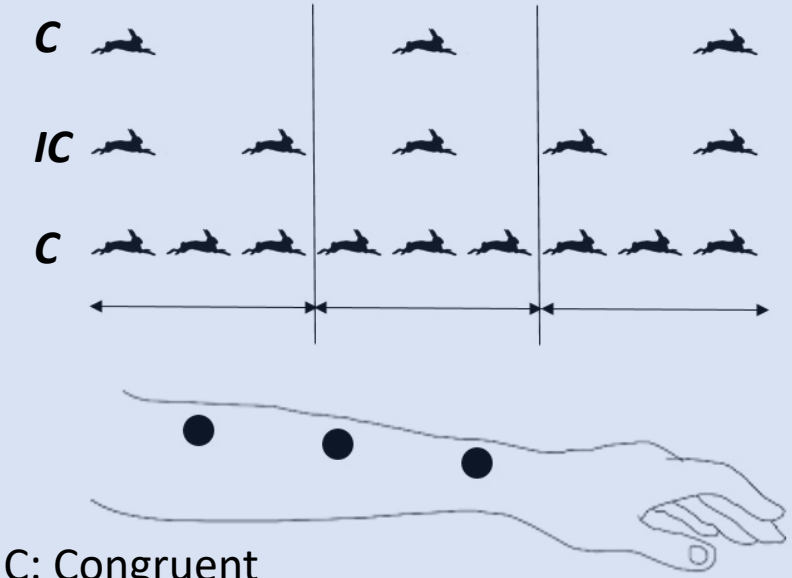
Ziat, M., & Raisamo, R. (2017, June). The cutaneous-rabbit illusion: What if it is not a Rabbit?. In *2017 IEEE World Haptics Conference (WHC)* (pp. 540-545). IEEE.

Study 1: Varying BD and IBI



Ziat, M., Snell, K., Johannessen, C., & Raisamo, R. (2018, June). How Visual Images and Tactile Durations Affect the Emotional Ratings of the Cutaneous-Rabbit Illusion. *In Eurohaptics 2018* (pp. 58-68). Springer.

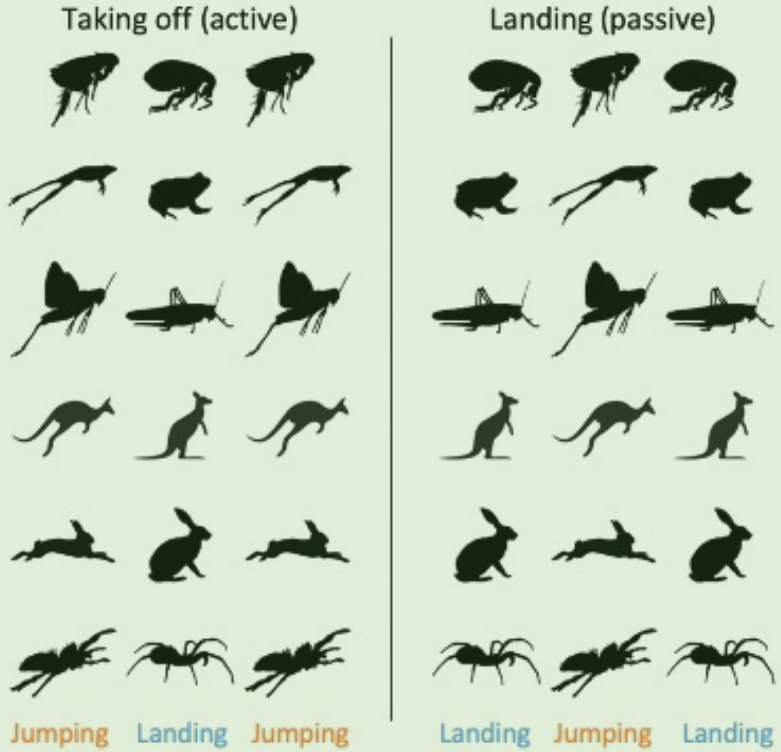
Study 2: Varying Numerosity



C: Congruent
IC: Incongruent

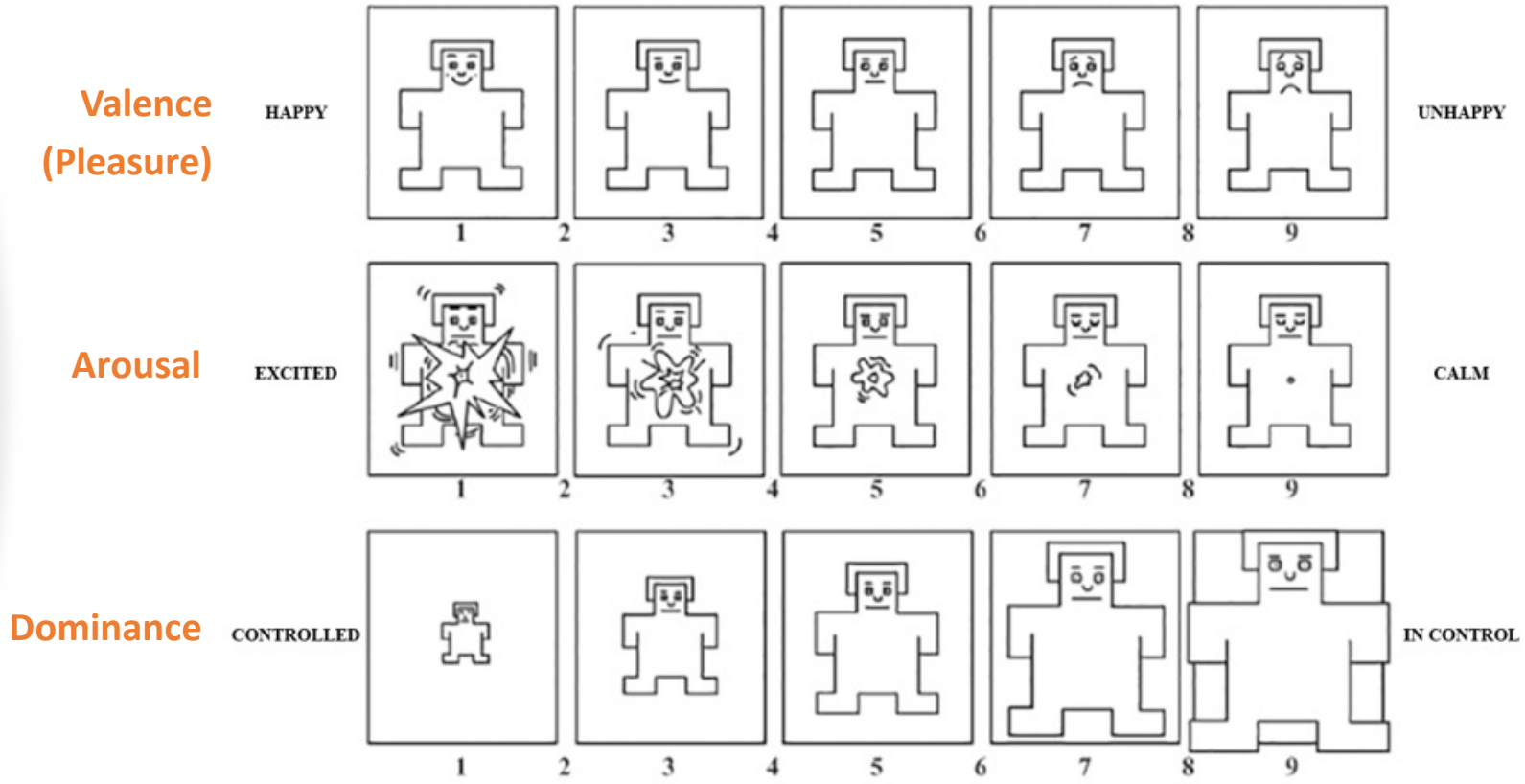
Ziat, M., Chin, K., & Raisamo, R. (2020, October). Effects of Visual Locomotion and Tactile Stimuli Duration on the Emotional Dimensions of the Cutaneous Rabbit Illusion. *In ACM ICMI 2020* (pp. 117-124).

Study 3: Dynamic Images



Self-Assessment Manikin (SAM):

Valence, Arousal, and Dominance dimensions (Bradley and Lang, 1994) based on the PAD emotion model of Mehrabian.



Disclaimer

Certain images meant to elicit an emotional response. Some of the images are categorized as unpleasant and meant to conjure disturbing or negative emotions.

If you do not like snakes, spiders, insects, or zombies please get away from your screen for the next minute.

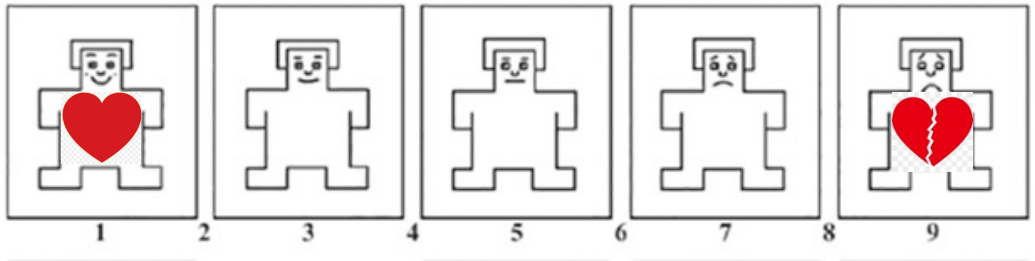
Summary of the Studies: Valence

Valence is dominated by vision for **very** unpleasant stimuli

Summary of the Studies: Valence

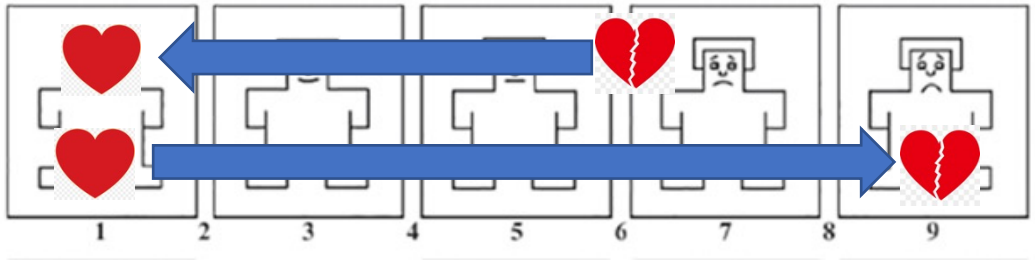
Similar to human touch: When the person engaging in touch is not welcome; no matter how light is strong is the touch, the person experience the touch would be aversive to the situation.

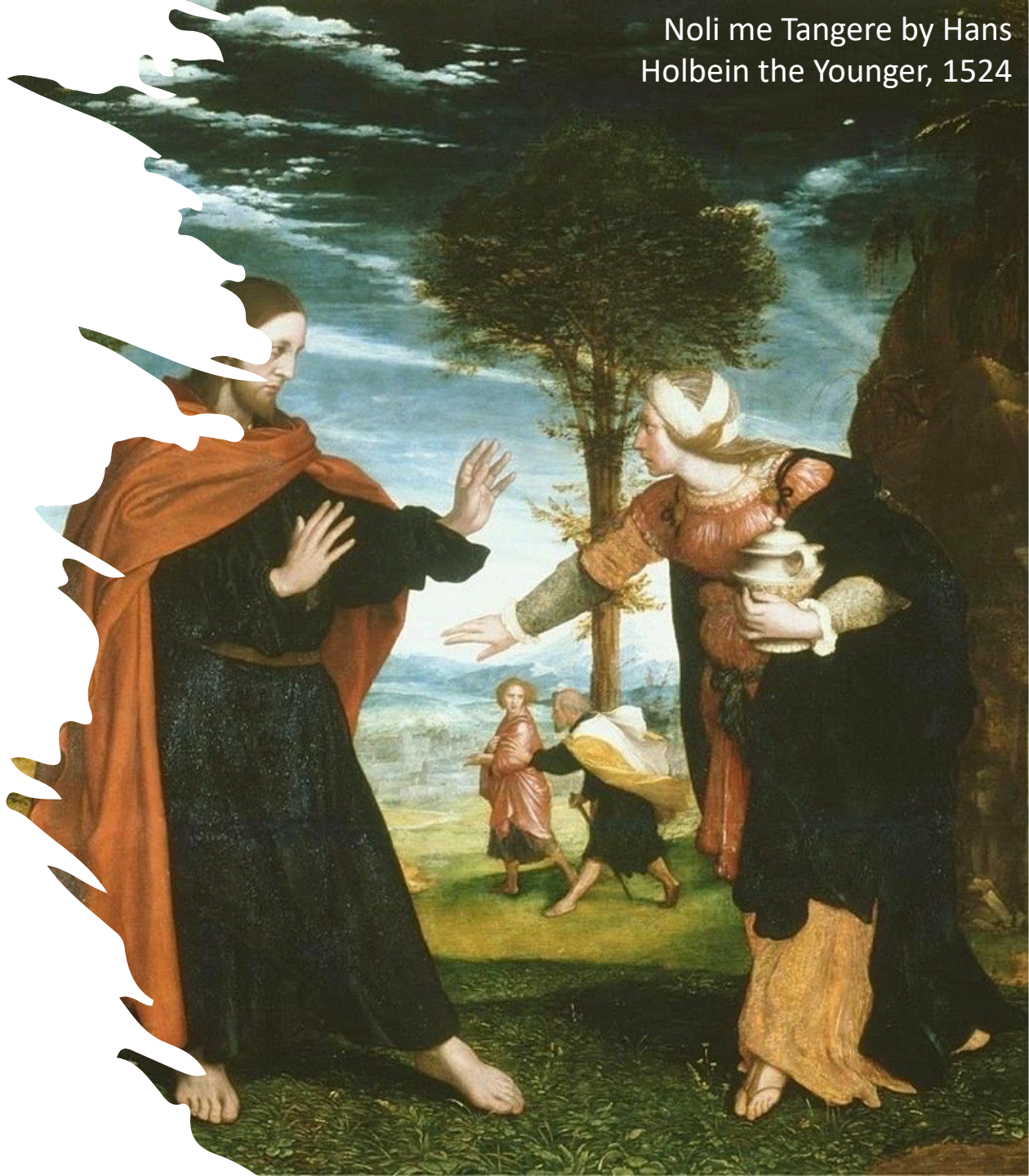
Visual Emotion



It is not very clear for moderately unpleasant stimuli and pleasant stimuli.

Tactile Modulation of Emotion

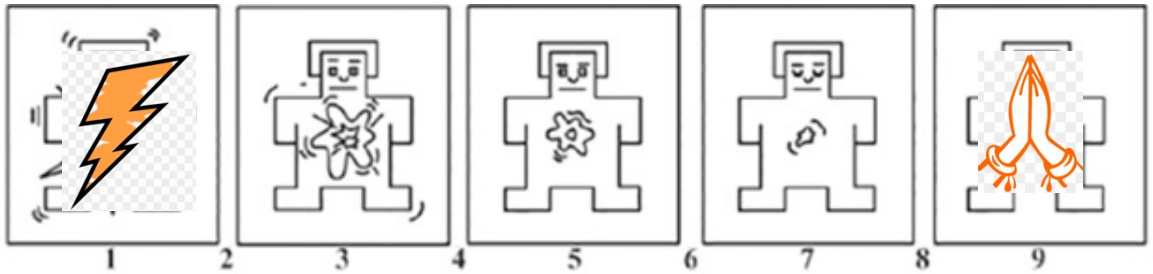




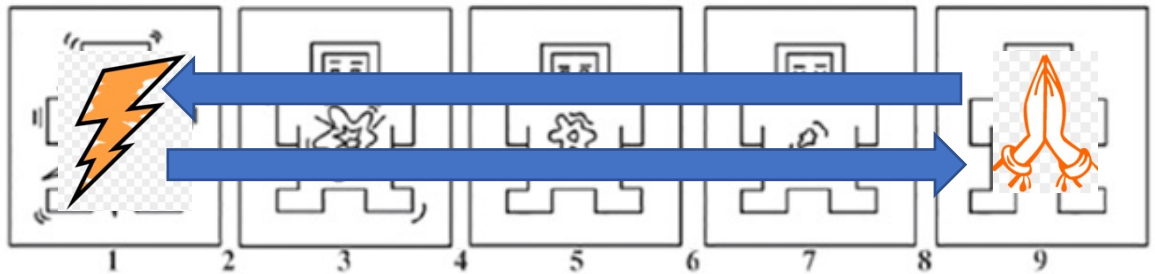
Noli me Tangere by Hans Holbein the Younger, 1524

Summary of the Studies: Arousal

Visual Emotion

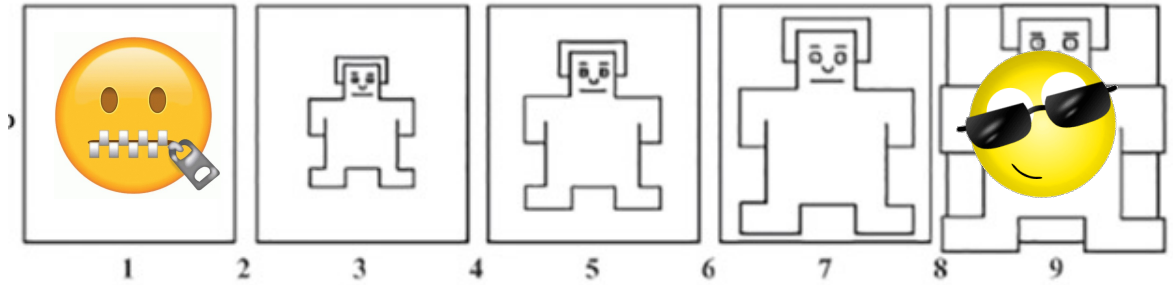


Tactile Modulation of Emotion

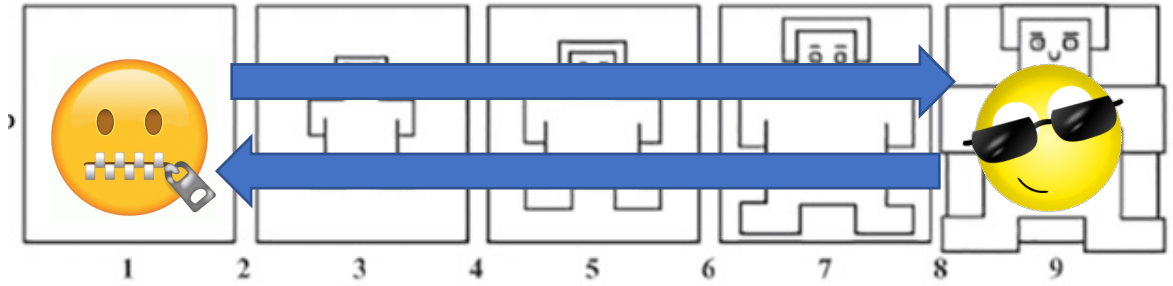


Summary of the Studies: Arousal

Visual Emotion



Tactile Modulation of Emotion



Ongoing Investigations

Before VR implementation additional aspects such as stimulus type and location (top/bottom of the screen), the participants' interaction, and PAD model need to be investigated.

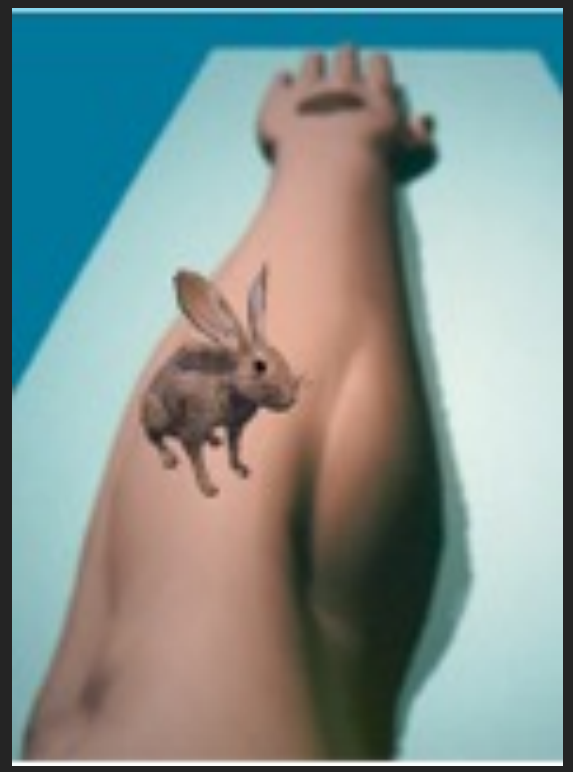
→ Further analysis of the emotional states

Table 3: Duration of the stimulation based on BD variations.

Scenario #	Valence	Arousal	Dominance	Possible Emotional State
Scenario 1	Happy	Calm	Controlled	Calm or worried state (depends on the SC)
Scenario 2	Happy	Calm	In-control	Calm state
Scenario 3	Happy	Excited	Controlled	Appetitive or nescient state (SC)
Scenario 4	Happy	Excited	In-control	Appetitive state
Scenario 5	Unhappy	Calm	Controlled	Neutral or defensive state (SC)
Scenario 6	Unhappy	Calm	In-control	Neutral state
Scenario 7	Unhappy	Excited	Controlled	Defensive and dangerous state
Scenario 8	Unhappy	Excited	In-control	Defensive state

Ongoing Investigations

- Surface Haptics Device ©Tanvas
- Combine tactile maps with images already classified as pleasant vs. unpleasant.
- Understand the dynamics of visual-tactile aesthetic experience: if a painting triggers a strong emotion in the viewer, either negative or positive, what would be the role of the tactile modality when it is available for the viewer: would the emotional experience decrease or increase by adding a sensory channel?
- Submitted to i-Perception

Thank you

I am looking for a postdoc student with experience in **haptic device design**, construction, and evaluation, including **perception experimental design**. Please reach out by email: mziat@Bentley.edu