

Affective Social XR and Intercorporeal Regulation: A Multi-Method Approach to Supporting Mental Health and Well-being

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Spring School on Social XR @ CWI

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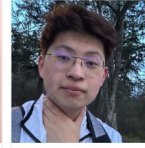
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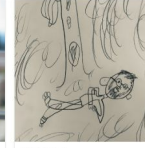
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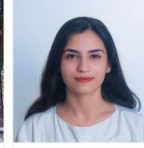
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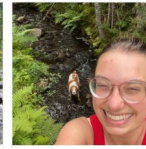
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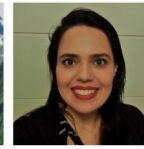
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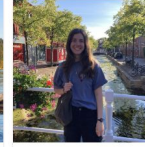
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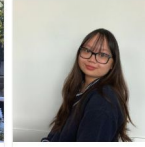
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Next Gen Social XR

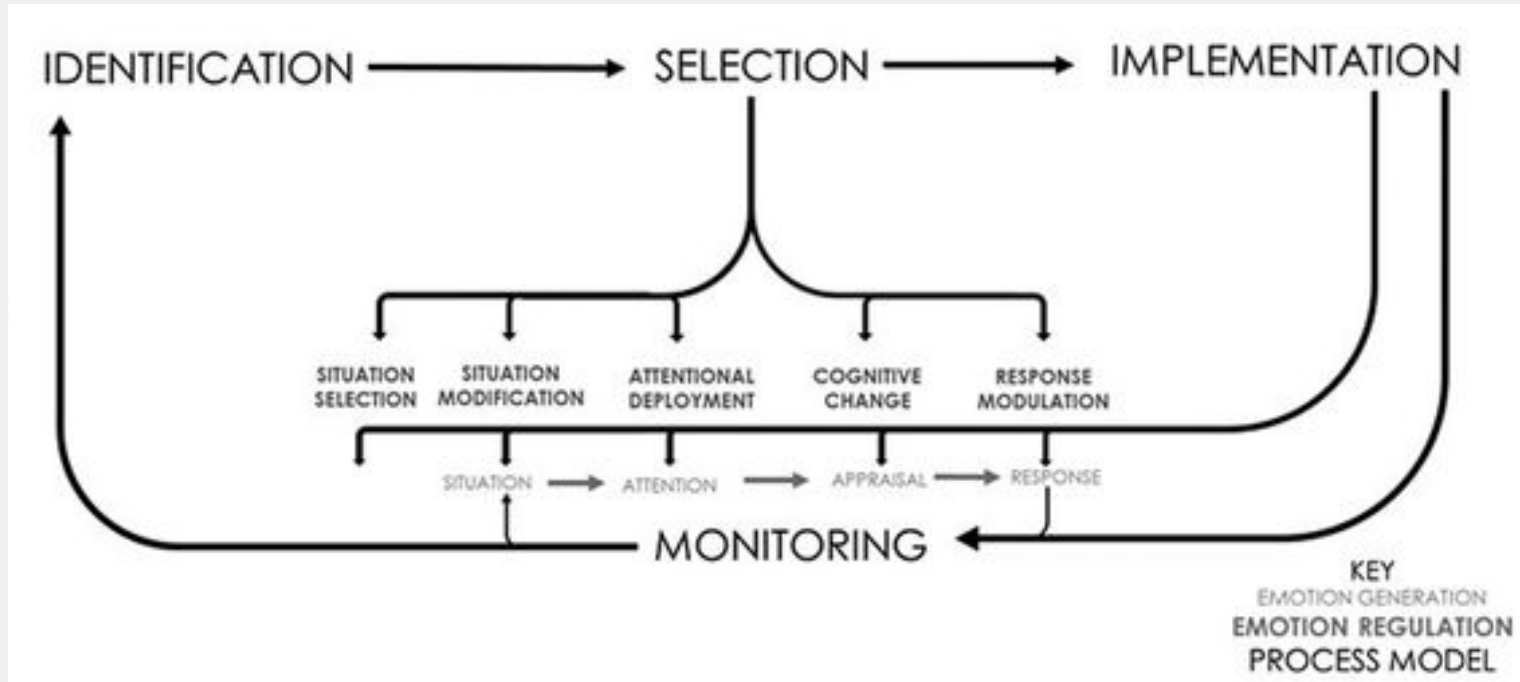
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Conclusion

"It's not necessarily the world that would make me feel happier, but the **people** I'm around in those worlds."



What theory is used?



Adopted from McRae, K., & Gross, J. J. (2020). Emotion regulation. *Emotion*, 20(1), 1-9.

How is technology integrated?



sedentary
people +
XR app

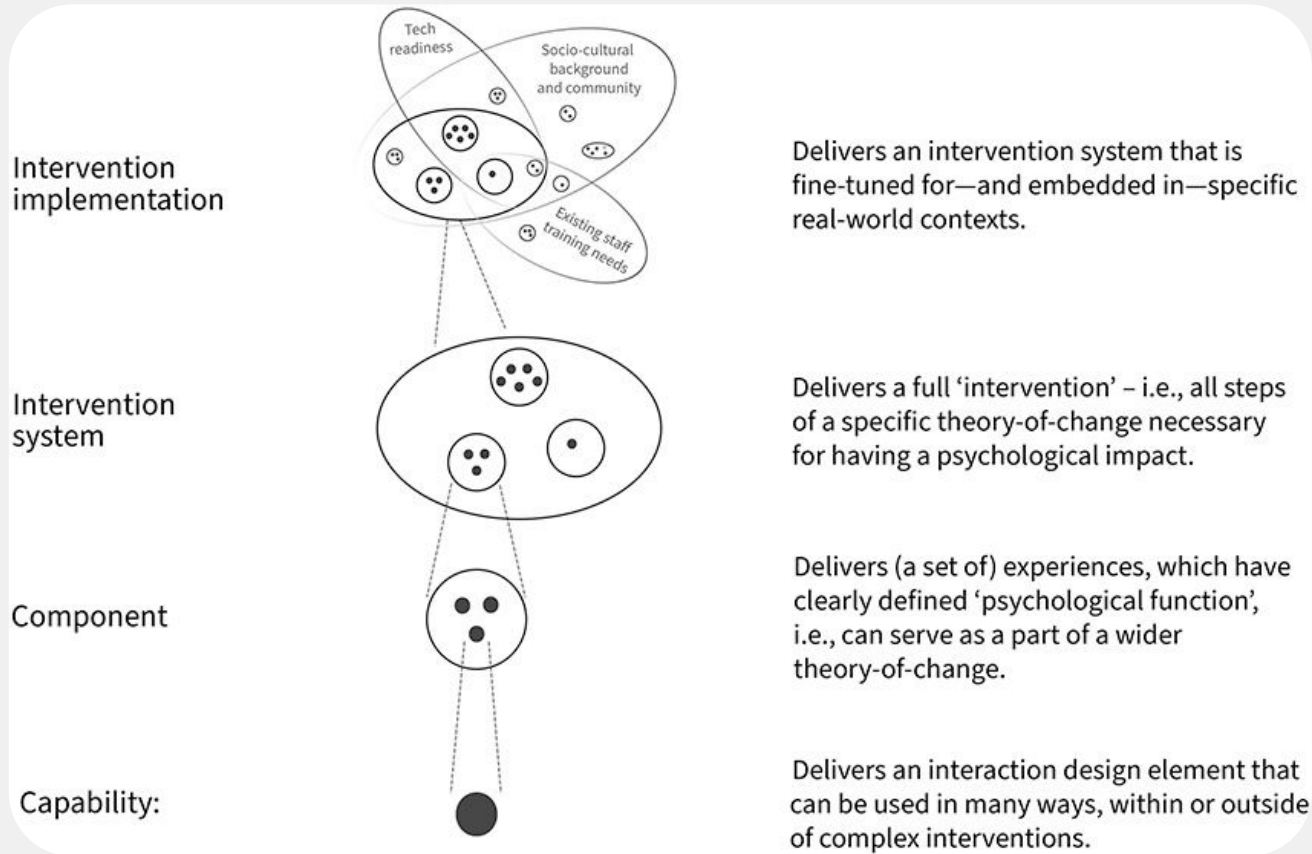
engagement with
app features
(e.g., rhythm game)

increased HR
+ metabolic
equivalents

less sedentary
person

improved
fitness

How is technology integrated?



From:

Slovak, P., & Munson, S. A. (2024, May). **HCI contributions in mental health: A modular framework to guide psychosocial intervention design.** In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (pp. 1-21).

Who is involved?

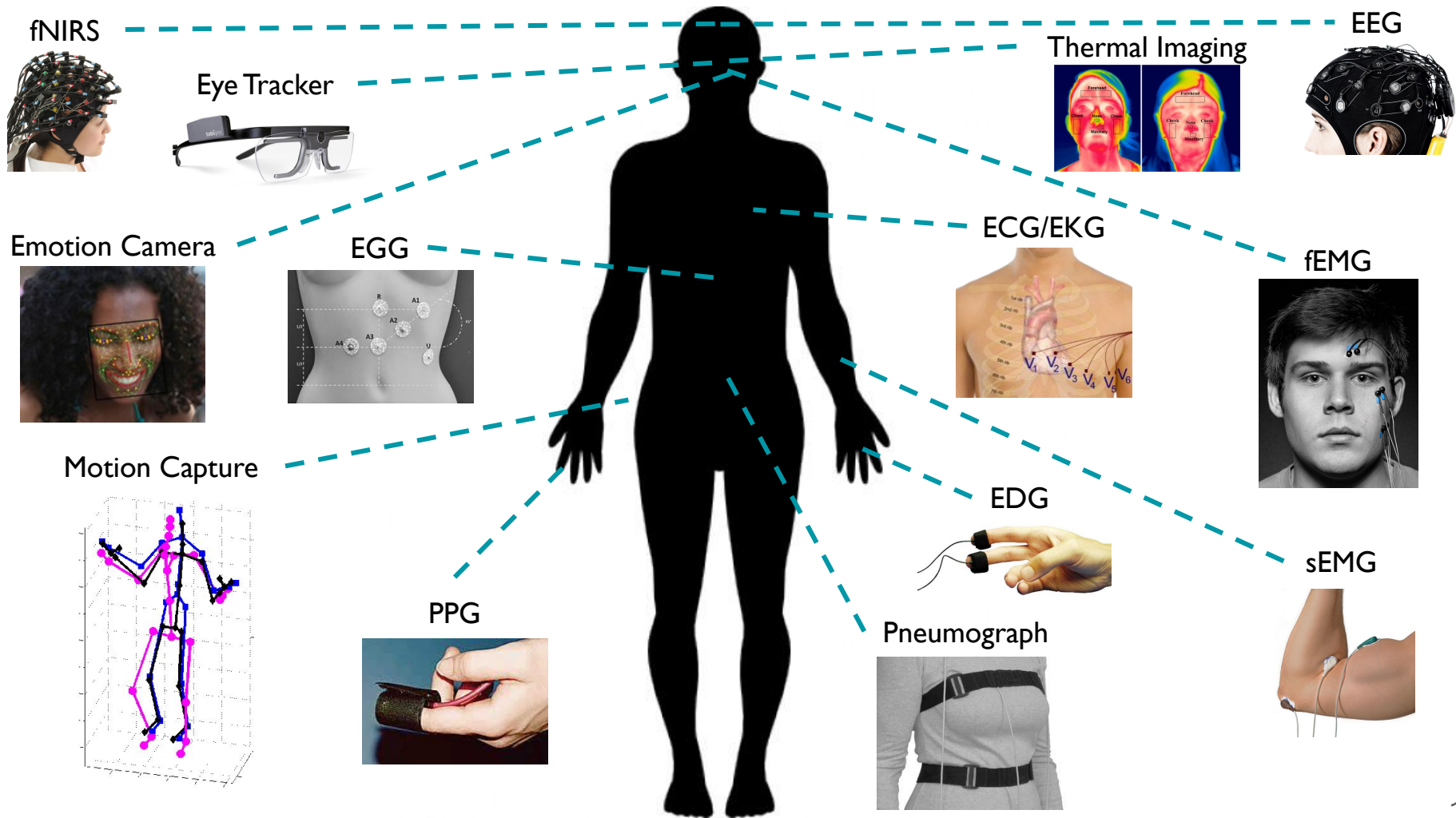


Affect and Intercorporeal Regulation



Measures





Tool	Indicates	Accuracy	Required Skill Level	Cost	Obtrusiveness	Additional Advantages and Drawbacks
EEG	Mental effort; valence; engagement; excitement	87%	High	\$\$	Moderate	Good temporal resolution; lots of noise; movement artifacts; good for measuring prefrontal cortex
fNIRS	Mental effort; engagement; excitement	60-80%	High	\$\$\$	Moderate	Poor spatial resolution; noise robust; no real-time input; no standardization; unstable accuracy between sessions
Respiration	Arousal	88%	Low	\$	Minimal	Sensitive to motion
ECG/EKG	Arousal; Cognitive processing	79%	Medium	\$	Moderate	Direct measure of HR; assesses electrocardiographic characteristics; limited to heart area for measurement
PPG	Arousal	70%	Low	\$	Minimal	Indirect measure of HR; works well on virtually any body location; assess SpO2, hemoglobin concentrations, blood constituent levels, and blood pressure
EDA/GSR	Arousal	94%	Low	\$	Minimal	Response lags stimulus; requires baseline and data processing; reliable measure for emotional arousal; sensitive to movement
Motion Capture	Emotion recognition	84%	High	\$\$	None-Minimal	Specialized hardware; lots of space required
Thermal Imaging	Arousal	82%	High	\$	None	Non-contact; occlusion and false positives likely
Surface EMG	Arousal	80%	Medium	\$	Minimal	Cross-talk phenomena; useful in biofeedback
Facial EMG	Emotional valence; intensity	88%	High	\$	Moderate	Sensitive; facial hair may interfere; requires filtration and processing
Eye Tracking	Arousal; Cognitive load	80%	High	\$\$	None	Non-contact and can build into device; requires baseline
Emotion Camera	Emotion recognition	80%	High	\$\$	None	Non-contact; hard to detect microexpressions
EGG	Arousal	64%	Medium	\$	Moderate	Computer analysis and baseline required; relation to emotion research in its infancy

Jesse J. Prinz



Gut Reactions

A Perceptual Theory of Emotion

*“Emotions are states that appraise
by registering bodily changes.”*

- Jesse Prinz

More Measures



Behavioural

Proxemics and movement analysis through logging avatar position, distance, orientation. Movement synchrony is a behavioral marker of social coordination. Event logging, e.g., initiating touch, proximity-seeking, withdrawal.

Qualitative

Go-along interviews, experience sampling and ecological momentary assessment, cued-recall debrief, ethnographic 'lite' observation, and discourse and interaction analysis, e.g., chat logs, voice transcripts, and social media.

Self-report

Validated questionnaires that assess affect (PANAS), co-presence/social presence (SPRES), and interpersonal/individual emotion regulation (Zaki & Williams; Gross).

Design Considerations





transcending bodies

XR enables us to transcend our bodies where a head mounted display (HMD) acts as a blindfold, replacing our “normal” selves with other representations

this diverts our attention from our own egonarratives and changes the way in which we perceive ourselves and behave towards others

Glowacki, D. R., et al. (2020, April). Isness: Using Multi-Person VR to Design Peak Mystical Type Experiences Comparable to Psychedelics. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (pp. 1-14).

Yee, N., & Bailenson, J. (2007). The Proteus effect: The effect of transformed self-representation on behavior. *Human communication research*, 33(3), 271-290.

Yee, N., Bailenson, J. N., & Ducheneaut, N. (2009). The Proteus effect: Implications of transformed digital self-representation on online and offline behavior. *Communication Research*, 36(2), 285-312.

Emotional Beasts
Bernal & Maes (2017)



Awelectric
Neidlinger, et al. (2017)



connecting through physiology

added physiological
sensors can
communicate subtle
bodily signals, such as
breathing and
heart rate

virtual touch

An illustration of a woman with long red hair, wearing a red dress and a VR headset, interacting with a wireframe man in a VR environment. The man is also wearing a VR headset and is holding a glowing blue object. The background is a dark blue with white wavy lines.

criticism of social XR - does not provide emotional warmth and nonverbal intimacy

mediated or remote touch shows promise in establishing a feeling of connection with others and reducing stress

assumed effects of mediated social touch on interpersonal interaction have not been empirically established

Bailenson, J. N., Yee, N., Brave, S., Merget, D., & Koslow, D. (2007). Virtual interpersonal touch: expressing and recognizing emotions through haptic devices. *Human-Computer Interaction*, 22(3), 325-353.

Haans, A., & IJsselstein, W. (2006). Mediated social touch: a review of current research and future directions. *Virtual Reality*, 9(2-3), 149-159.

Project Overview



In-Situ Studies



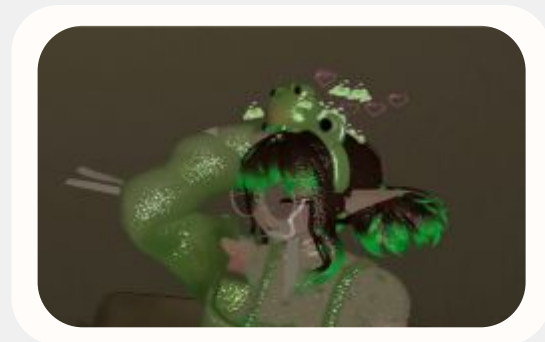
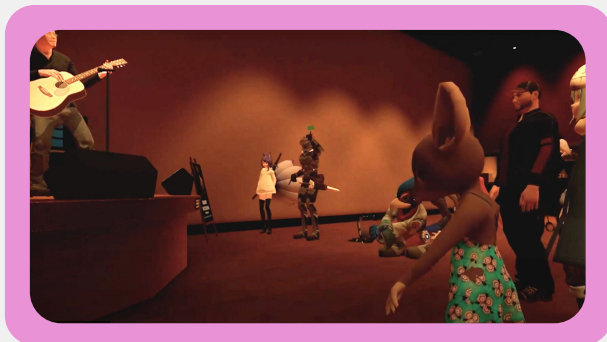
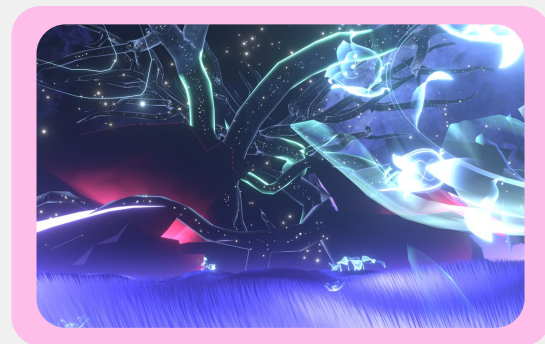
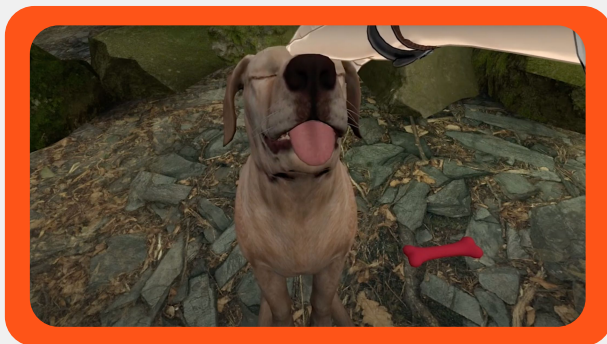
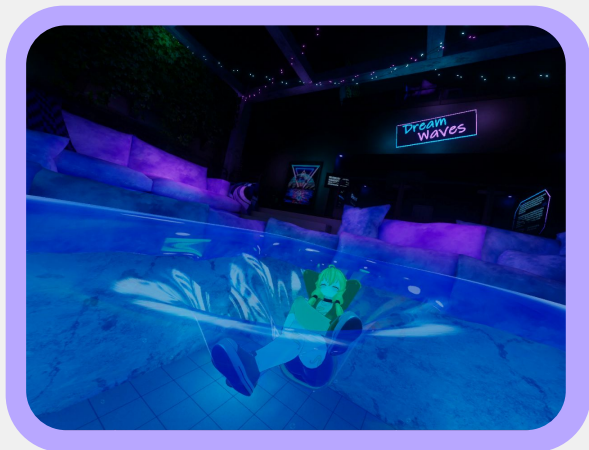
VRChat

Survey N=64

Go-along interviews N=21

How do youth use social VR (VRChat) to emotionally regulate from their perspective, and what features support or hinder adaptive emotion regulation both on-the-spot and offline?

VRChat



1. Embodied perspective taking and spatial presence
2. Safe spaces and resources that leverage spatial and identity-based affordances

3. Identity tools that externalize internal states through avatar modifications
4. Skill-specific transfer that matches intervention components to strategies they can realistically support

Working with Vulnerable Groups



Teens & Emotion Regulation

What emotion regulation challenges do teens face and how can XR's capabilities support the learning and transfer of emotion regulation skills?

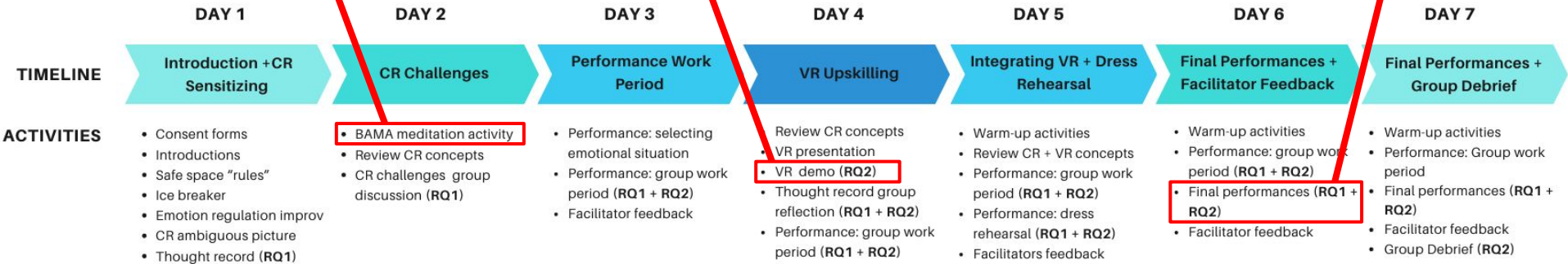
Multi-stakholder project

- Teen advisory
- Clinicians
- HCI researchers

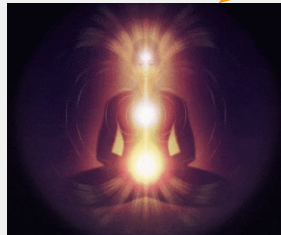
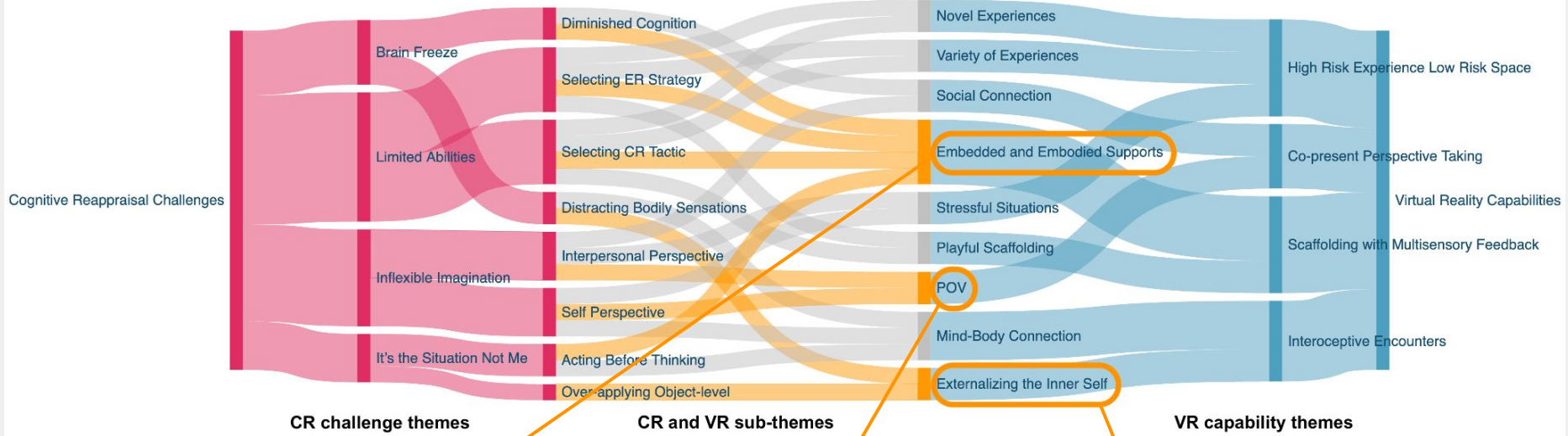
Participatory research framework



Workshop



Addressing the Challenges of CR in HCI: Opportunities for Growth and Development



Example Scenarios



(see appendix of CHI'24 'I Call Upon a Friend')

Closing the Loop

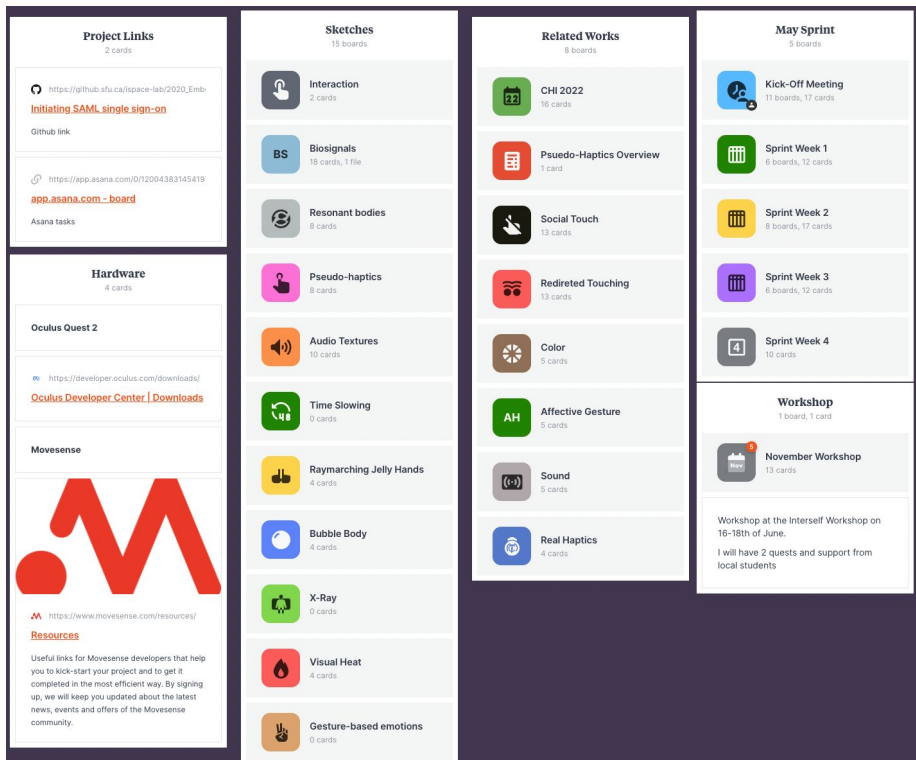


Embodied Telepresent Connection

Illusion of social touch and bodily connection, through visuals, sounds, biosignals and embodied metaphors.

Pseudohaptics support a sense of intimacy, closeness, and stimulating playfulness and collaborative exploration.

Design Process



Desnoyers-Stewart, et al. (CHI'2023)

Research

Collected related works in technology-supported telepresent social connection

Sketches

Brainstormed and prioritized a series of interaction patterns that aim to evoke a sense of telepresent connection

Iterative Development

Created diverse prototypes and iterated towards 8 interaction patterns

Biosignal Integration

Heart Rate (HR) data is read by Smart Watch



HR mapped to particle energy body properties

- Tempo: fast is fast; slow is slow
- Volume: fast is loud; slow is quiet
- Rhythm: regular is rhythmic; irregular is chaotic



Proximity & Touch

between participants are mapped to HR audio properties

- Near is loud; far is quiet
- Pitch: near is high; far is low

Two participants see each other remotely as ethereal particle bodies.

Their avatars respond to proximity through sound and visuals.

Participants hear a sound and see a small firework as they make contact.

Their bodies resist one another through a physical simulation.

Telepresence

- Photon Pun2 Networking
- VRIK Inverse Kinematics
- VFX Graph Particles



Proximity

- Visual warmth
- Particle Attraction
- Tremolo Flute



Contact

- Mini Fireworks
- Playful Ping



Resistance

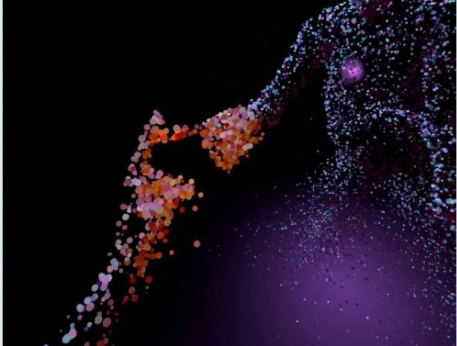
- HPTK Physics Simulation
- Audio Force-Feedback



Customization



Playfulness



Heartbeat

- Apple Watch
- Movesense



Intimacy



Interactions can be toggled individually allowing for different combinations.

Participants play together, exploring how their bodies behave in VR.

A beating heart can be seen inside each body, bringing the avatar to life.

The hand acts as a stethoscope that sonifies the other person's heartbeat.

Long term Impact

Inter-personal conflict

Different relationship intimacy between users and affective systems

Privacy concerns

Users want to understand others' emotions; don't want to reveal theirs

Ethical concerns

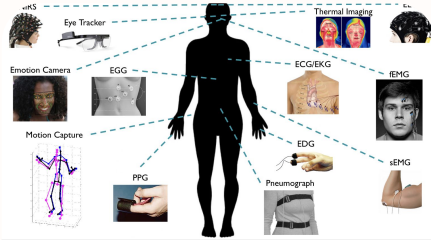
Long-term relationships with affective systems

Can (should) you gamify relationships?

Compassion fatigue

Risk of burnout and oversharing

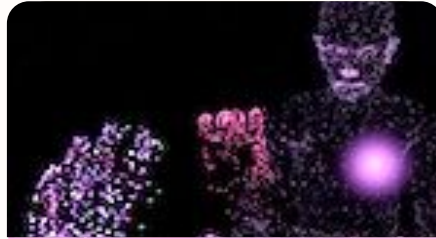
Grand Challenges



Scientific Evaluation

We need an understanding on an individual and collective level.

We suggest a focus on **mixed methods approaches** for the scientific evaluation of emotions and see benefits in supporting AI models that take into account the user(s)'s traits, background, etc.



Ethical Concerns

Affective (and empathic) computing can support understanding our own and others' emotions. This also means that we hand over our data to a system to tell us, in return, about how we or another person feels.

This requires great trust in an empathic system, further requiring transparency and a certain level of user control.



Context Adaptation & Reaction

Emotions are context- and person-dependent.

Challenges arise on different levels, leading to a system's sensitivity regarding when to disclose a user's emotions



Evolving XR

It might lead to a greater digital divide between users of social XR and non-users, followed by a diverging understanding of (social) reality.

AI systems and proxies will become regular members of our social system, communication, and collaboration.

"It's not necessarily the world that would make me feel happier, but the **people** I'm around in those worlds."



Thank you!

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