

Emotion Embodied: Unveiling the Expressive Potential of Single-Hand Gestures

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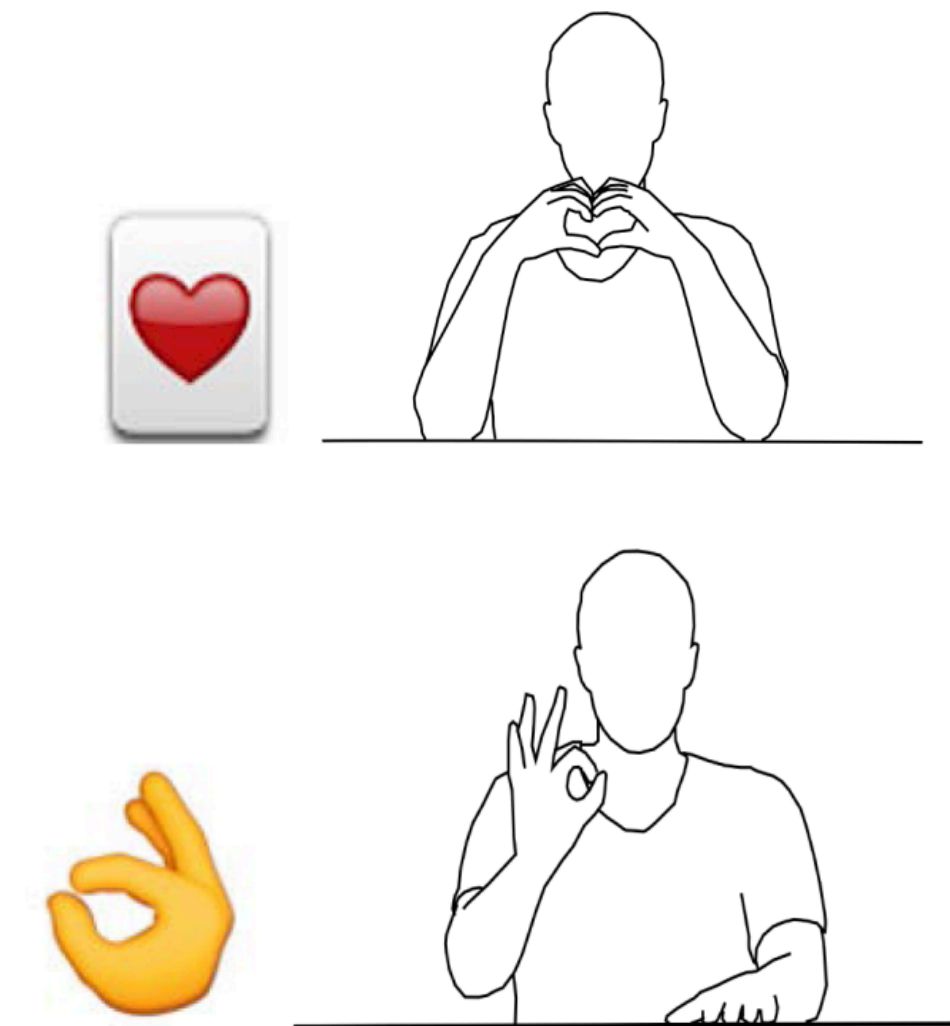
We experience and express different emotions every day



Ayboi et al. (2018). Flexible and Mindful Self-Tracking: Design Implications from Paper Bullet Journals.











Handcock et al. (2007). Expressing emotion in text-based communication



Koh et al. (2019). Developing a hand gesture recognition system for mapping symbolic hand gestures to analogous emojis in computer-mediated communication

The connections between gestures and emotion

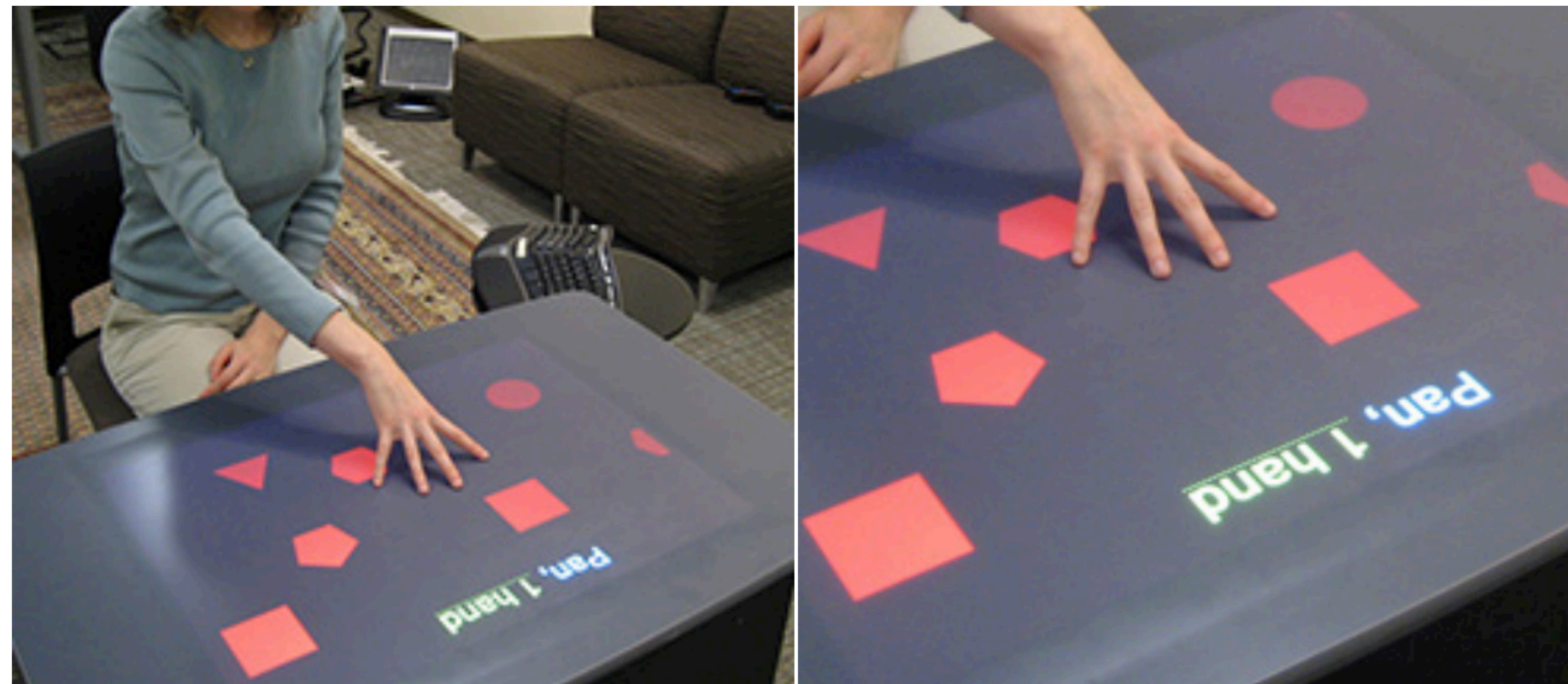
	
Recognition	Victory
	
Confirmation	Love
	
Dissatisfaction	Anger
	
Bye/ignorance	Thank

Embodied Cognition

Emotions are not solely experienced as **internal mental states** but are also manifested and expressed through

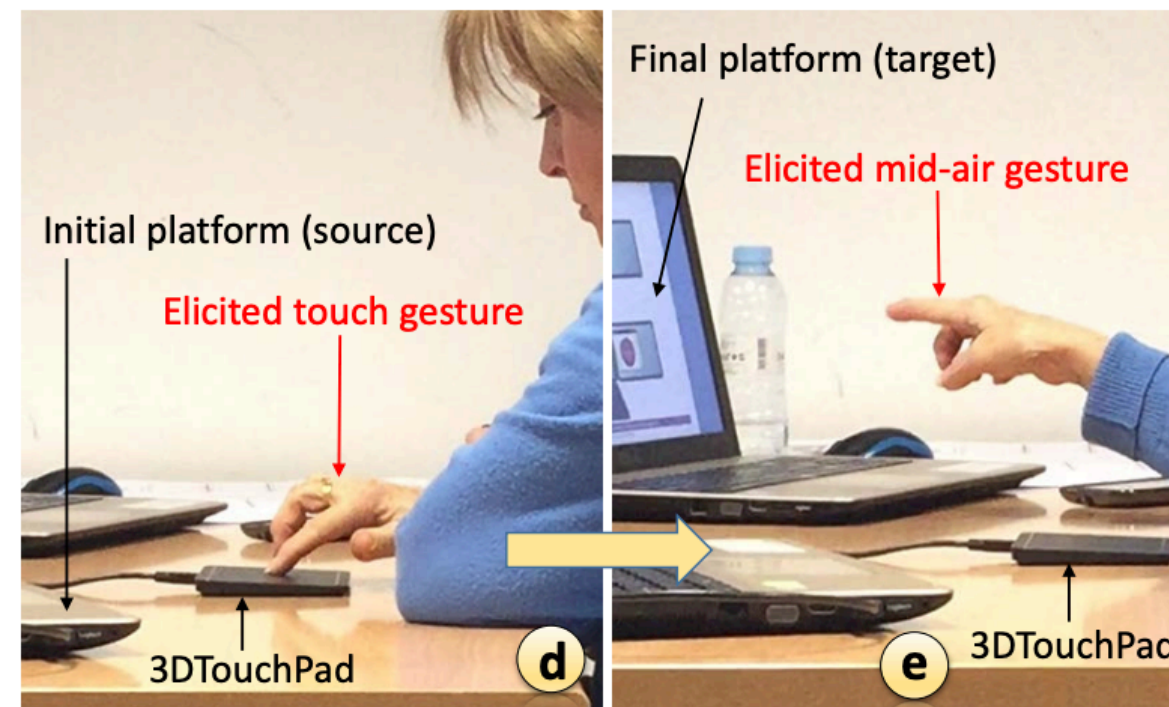
bodily sensations, movements, and postures

Gesture capture and understanding in HCI research



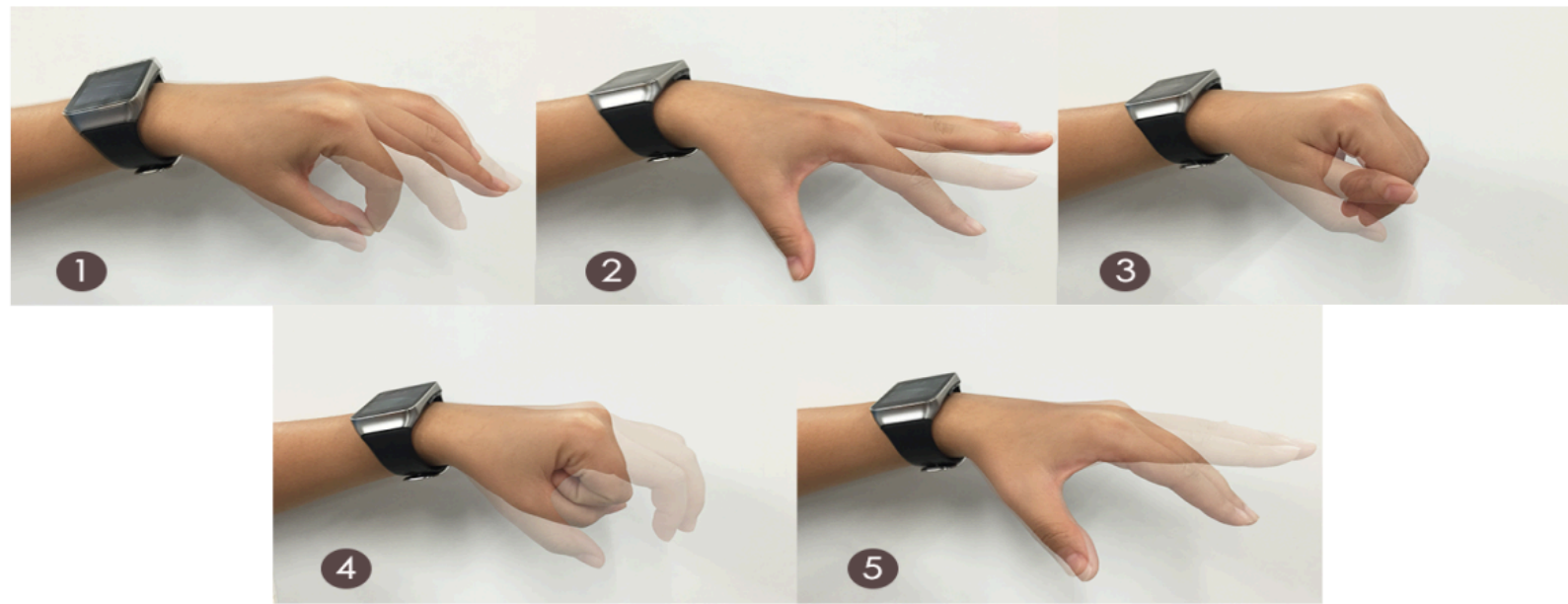
Wobbrock et al. (2009). Userdefined gestures for surface computing.

Using gesture as “**command**” to control objects, systems, and applications



How can hand gestures be used to convey emotions in human-computer interaction?

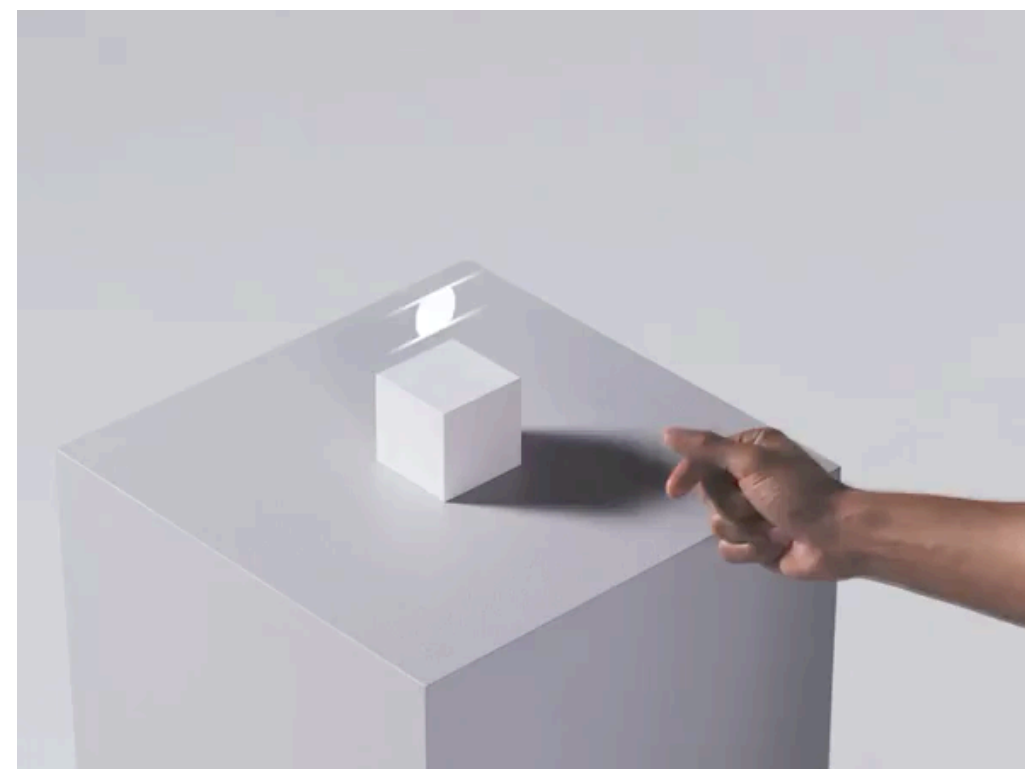
Technology advancements in gesture capture



Wearable devices

- + off-the-shelf
- + lightweight

Wen et al. (2016). Serendipity: Finger Gesture Recognition using an Off-the-Shelf Smartwatch

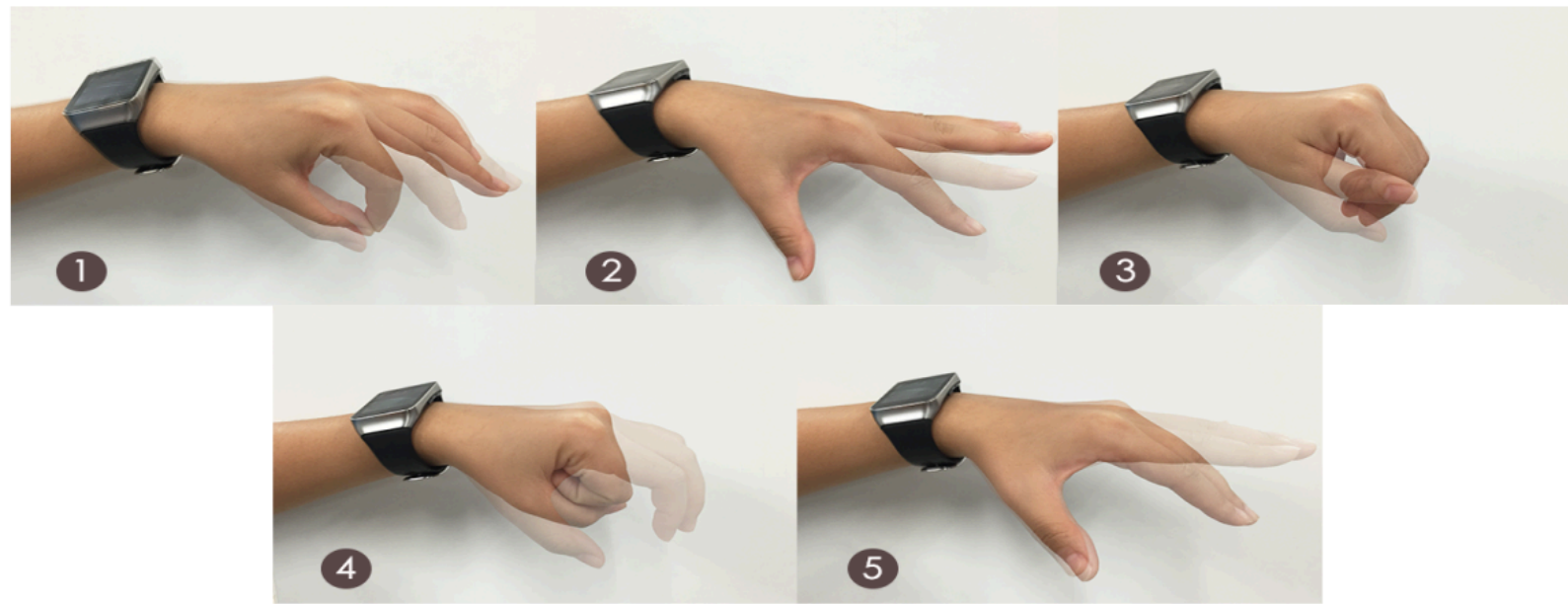


Google Project Soli

Motion sensing without Cameras

- + privacy friendly
- + easy to deploy

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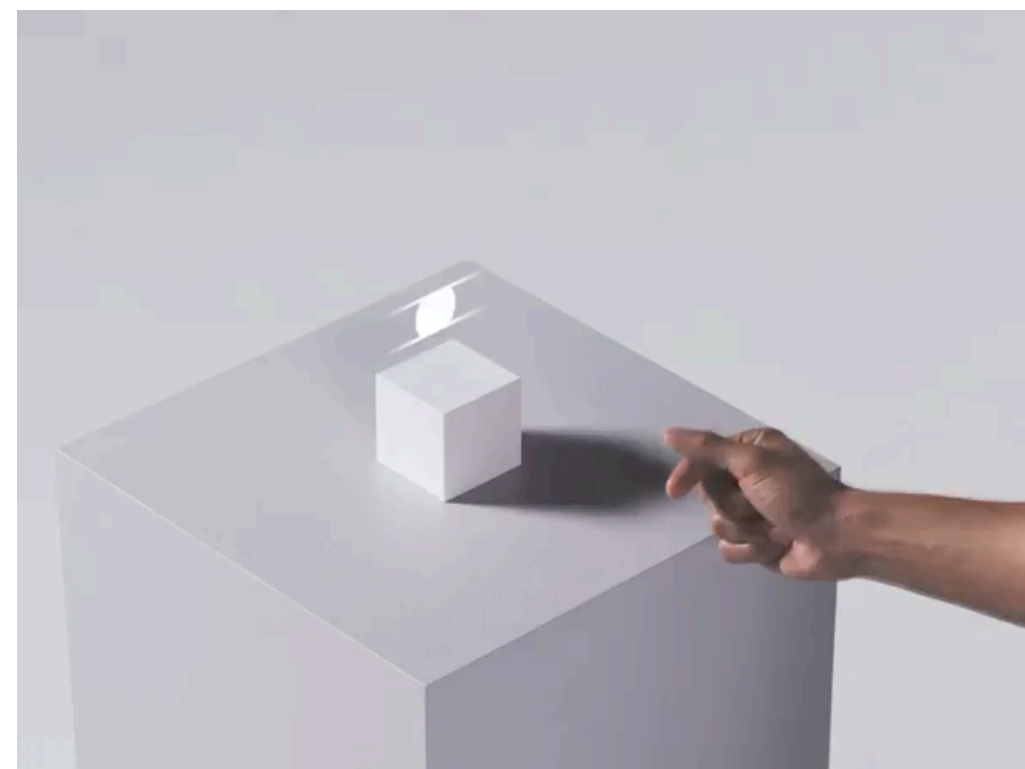
Wearable devices

+ off-the-shelf

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Single-hand gestures

- Easy to perform
- Practical to capture



Google Project Soli

Motion sensing without Cameras

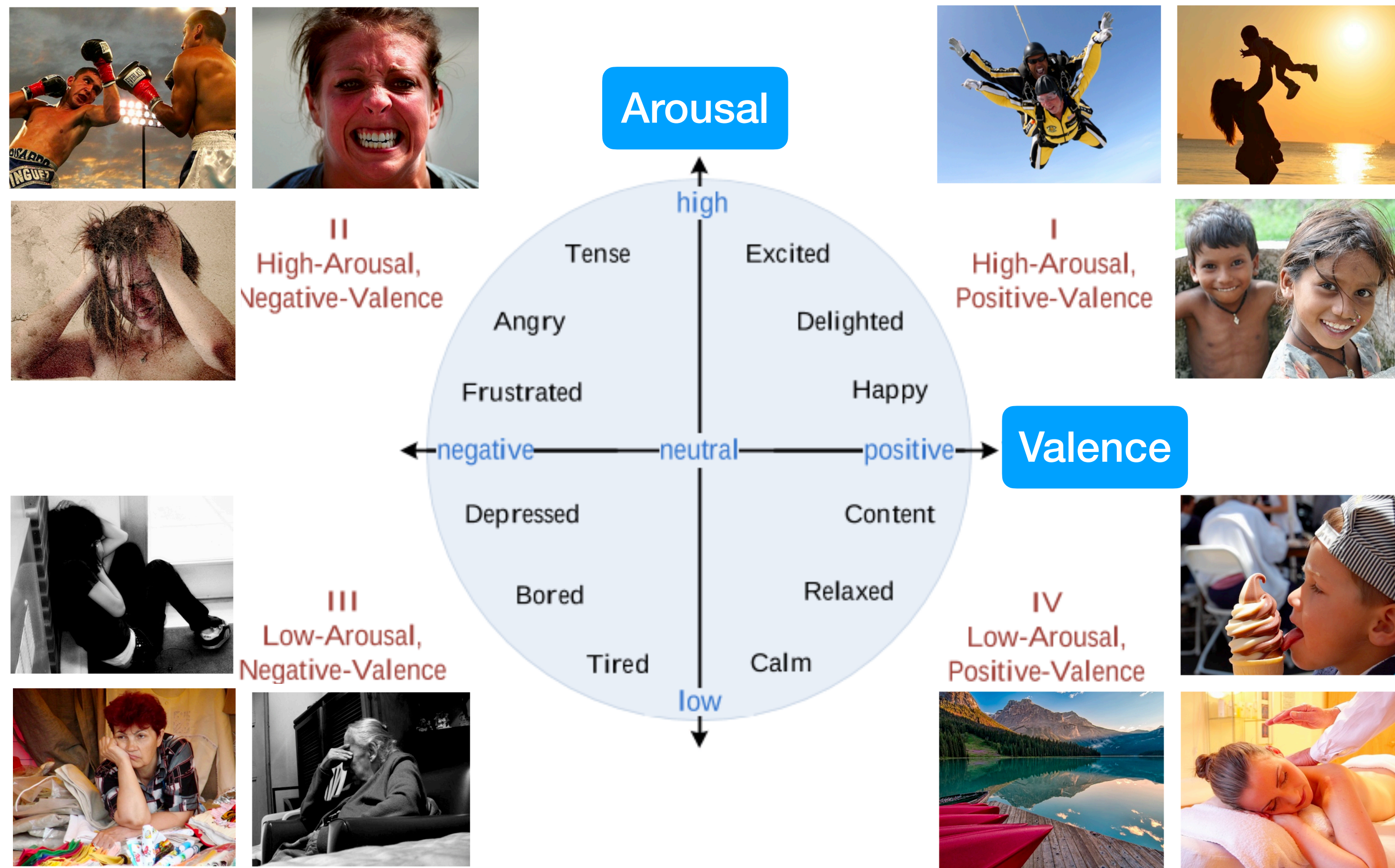
+ **privacy** friendly

+ easy to **deploy**

Research Question

How do people express different types of emotions through **single-hand gestures** (easier to perform & practical to capture)?

Research method: emotion & gesture elicitation



Step 1: Image stimuli selection

Group voting on representative images from the OASIS database

Step 2: Online survey

For each image stimulus

- Choose a word to best describe the emotion it conveys
- Rate the *valence* and *arousal* level of that emotion
- **Form a single-hand gesture to express that emotion with a *photo + video* uploads**

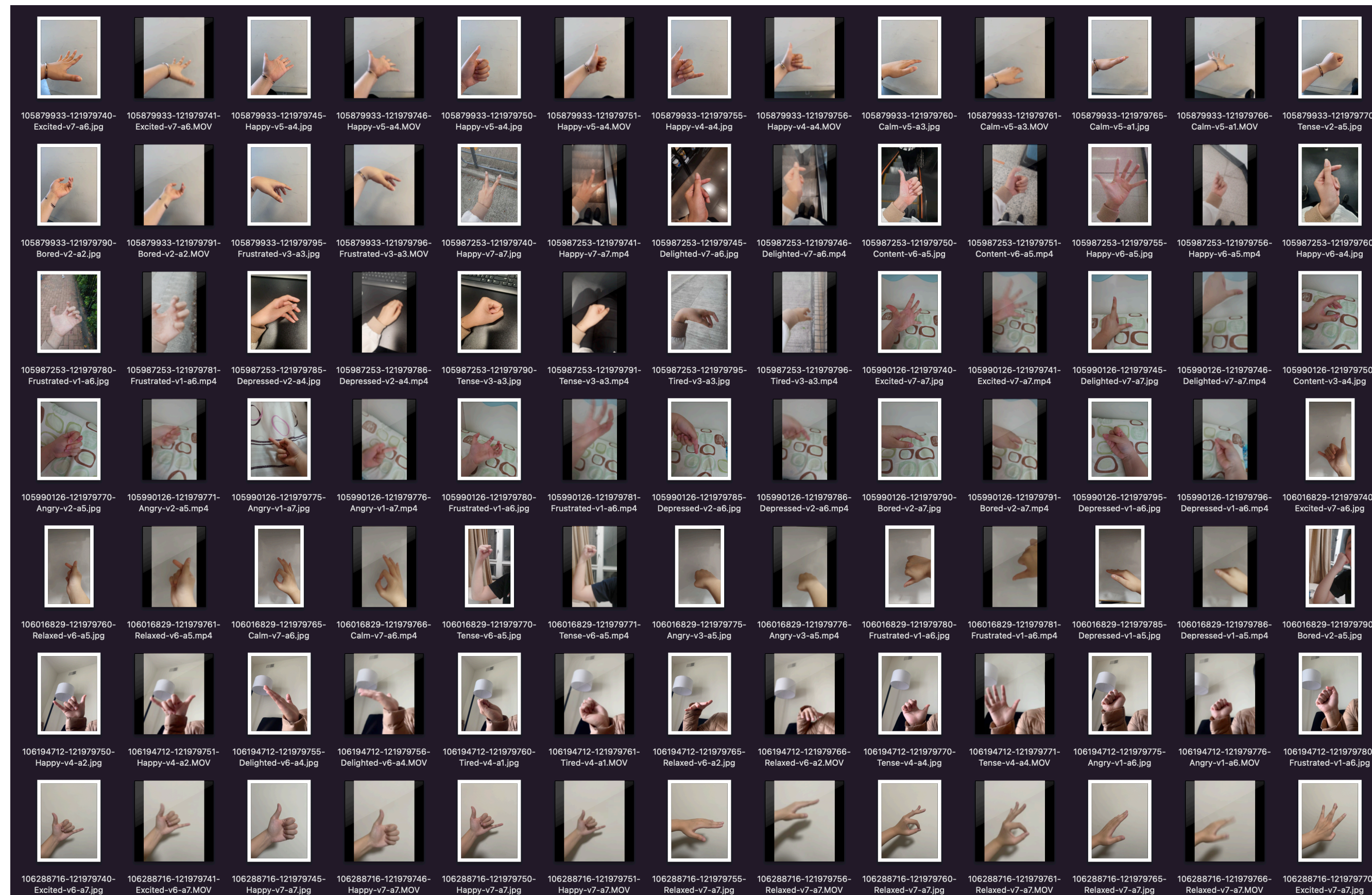
Step 3: Follow-up interview (remote)

Asking participants about their *gesture-forming rationales*

Russell, J. A. A circumplex model of affect. *Journal of personality and social psychology*. 1980

Kurdi et al., Introducing the open affective standardized image set (OASIS). *Behavior research methods*. 2017

Data collection



756 photo + video pairs from **63** participants from diverse regions including US, UK, Hong Kong SAR, Indian, etc

Interviews with **11** participants who elaborated on their gesture-forming rationale

A snippet of our collected gesture photos and videos

Data analysis: Gestures coding (qualitative)

1. Iterative gesture coding

Initial coding → codebook development → coding → inter-reliability calculation

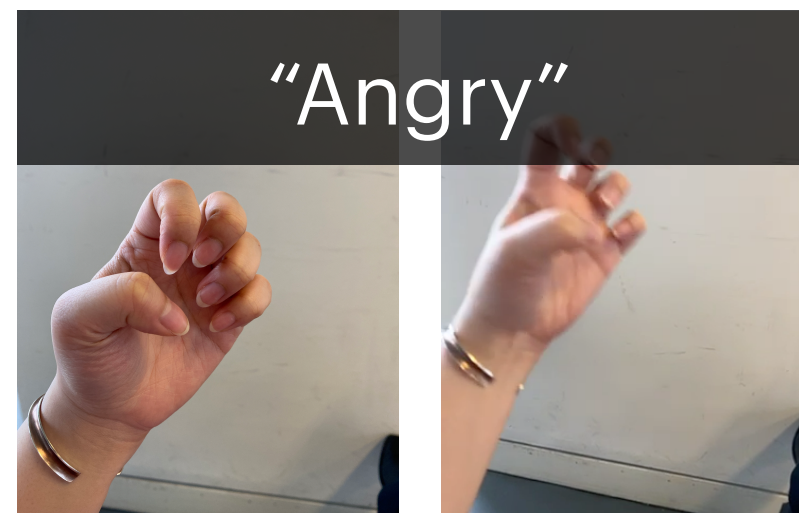
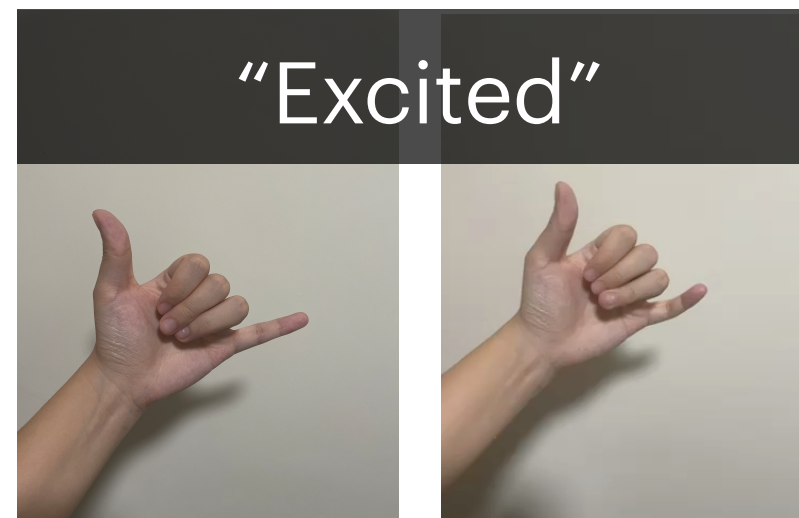
Gestural features

Static:

- Gesture name
- Finger-pointing direction
- Palm direction
- Gesture strength

Moving:

- Motion name
- Motion frequency
- Ending status



Data analysis: Gestures coding (qualitative)

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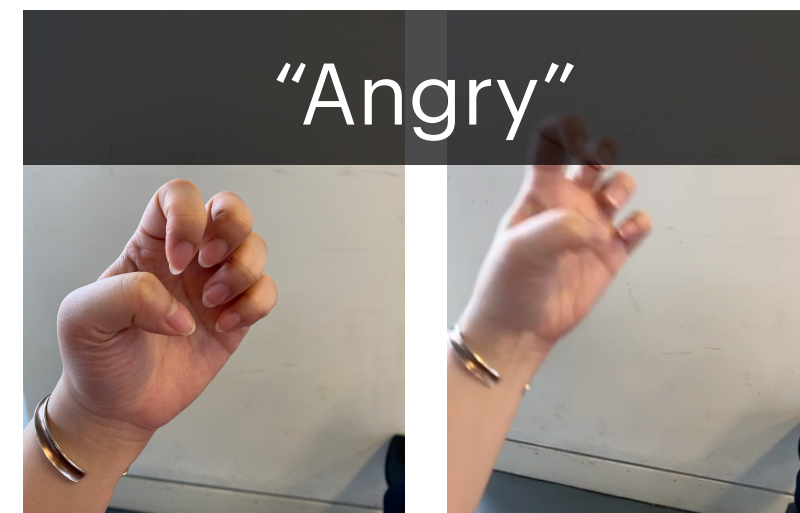
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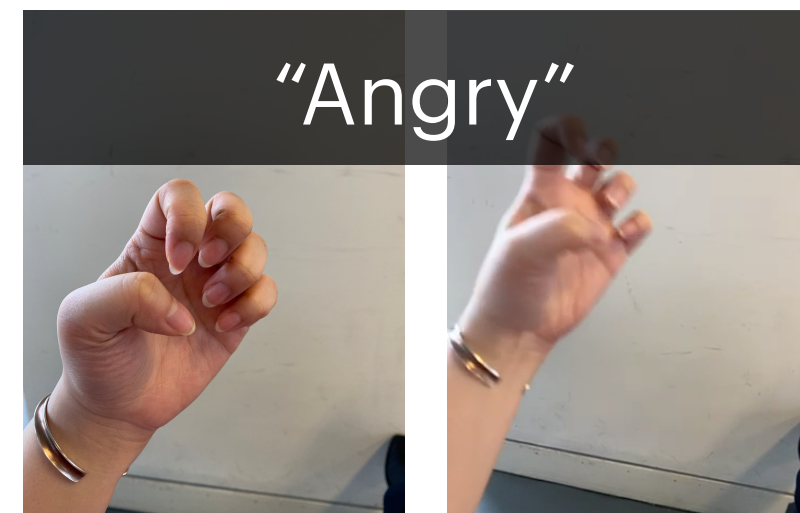
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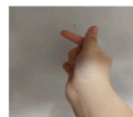





Gesture name	Finger-pointing direction	Palm direction	Gesture strength	Motion name	Ending status	Motion freq
Number six	Up	Towards the body	Unclear	finger flexion + repeated palm flipping	Moving	High
Scratch	None	Towards the body	Tight	Finger flexion	Static	Middle
Grab	Down	Down	Loose	Wrist flexion	Static	Low

Data analysis: statistical test and interview analysis

2. Statistical test

Chi-square: the **correlations** between the coded *gestural features* and *emotion valence & arousal*

Gesture photo	Emotion word chosen	Valence-Arousal	Gesture name	Palm direction	Finger pointing direction	Strength	Motion name	Ending status	Motion freq.
	Excited	Positive high	Number six	Towards the body	Up	Unclear	Others-multiple (finger flexion + repeated palm flipping)	Moving	High
	Delighted	Positive high	Horn	Towards the body	Up	Unclear	Finger extension	Static	Middle
	Happy	Positive high	Victory	Down	Outwards the body	Unclear	Pronation	Static	Middle
	Content	Positive low	Open palm with fingers pressed together	Down	Side (left)	Unclear	Repeated "water wave" (hand gently waving up and down)	Static	Middle
	Calm	Positive low	Ok	Side(left)	Up	Unclear	Repeated knocking	Moving	Middle
	Relaxed	Positive low	Finger heart	Side(left)	Up	Unclear	Repeated palm flipping	Moving	High
	Tense	Negative high	Closed fist	Outwards the body	None	Unclear	Finger flexion	Static	Middle
	Anrgy	Negative high	Scratch	Towards the body	None	Tight	Finger flexion	Static	Middle
	Frustrated	Negative high	Index finger one	Up	Outwards the body	Tight	Finger extension	Static	Middle
	Depressed	Negative low	Scoop	Towards the body	Towards the body	Loose	Finger flexion	Static	Low
	Bored	Negative low	Thumb down	Outwards the body	Down	Unclear	Repeated finger pointing downward	Moving	Middle
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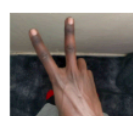
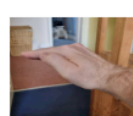



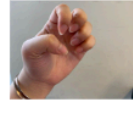




3. Interview analysis

Thematic analysis on gesture forming rationales

Data analysis: statistical test and interview analysis

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3. Interview analysis

Thematic analysis on gesture forming rationales

Findings

- Gesture distribution across emotions
- Gestural features x Emotional valence & arousal
- Emotion understanding
- Emotion externalization with gestures
- Experience of single-hand-based emotion expression and capture

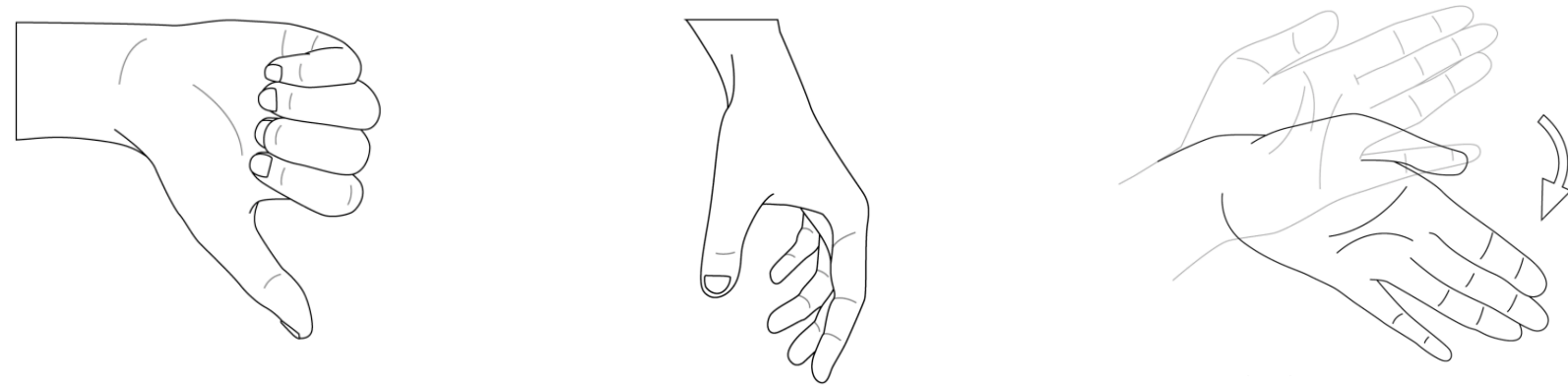
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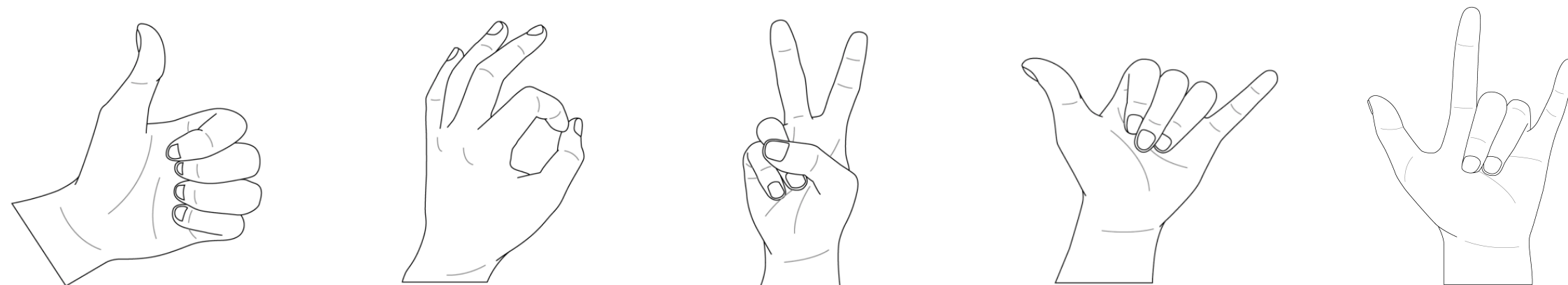
Gestural features x emotion valence & arousal

Finger pointing direction ($\chi^2 = 285.51, p < .001$)

- Participants tended to point **downward** while expressing **negative** and **low-arousal** emotions, such as “depressed” (*residual* = 6.33)



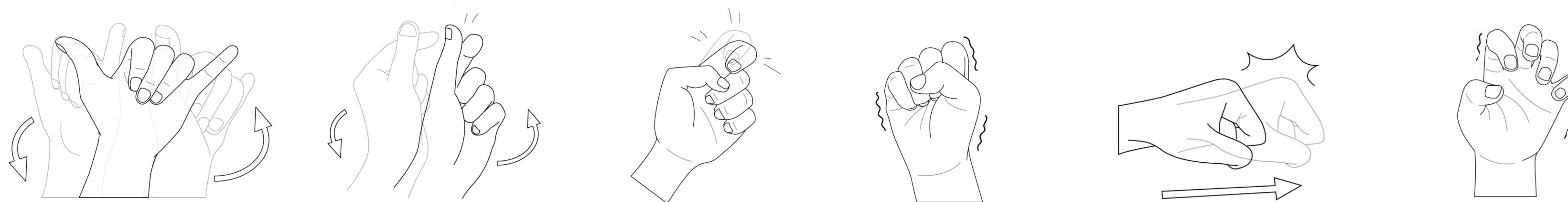
- Participants tended to point **upward** while expressing **positive** emotions (*residual* = 5.87) regardless of the level of arousal



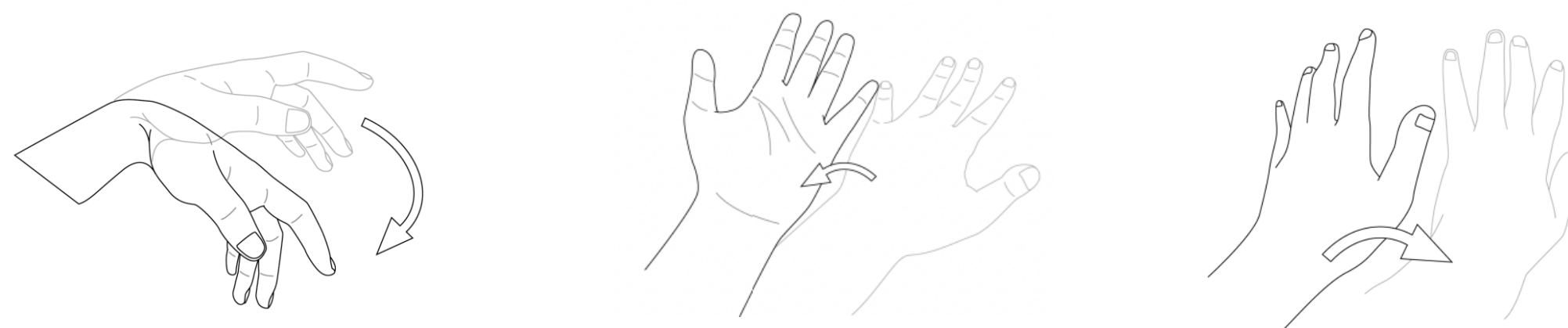
Gestural features x emotion valence & arousal

Gesture strength ($\chi^2 = 107.44, p < .001$)

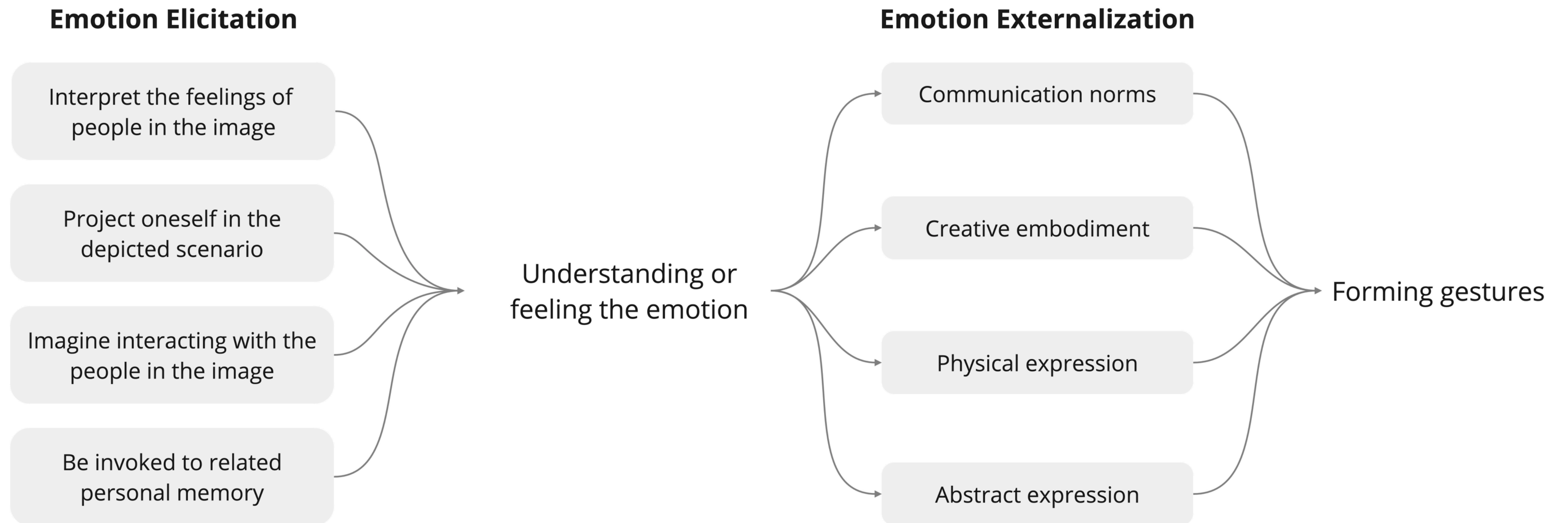
- Participants tended to form **tight** gestures while expressing **high-arousal** emotions (*residual* = 6.23) regardless of valence



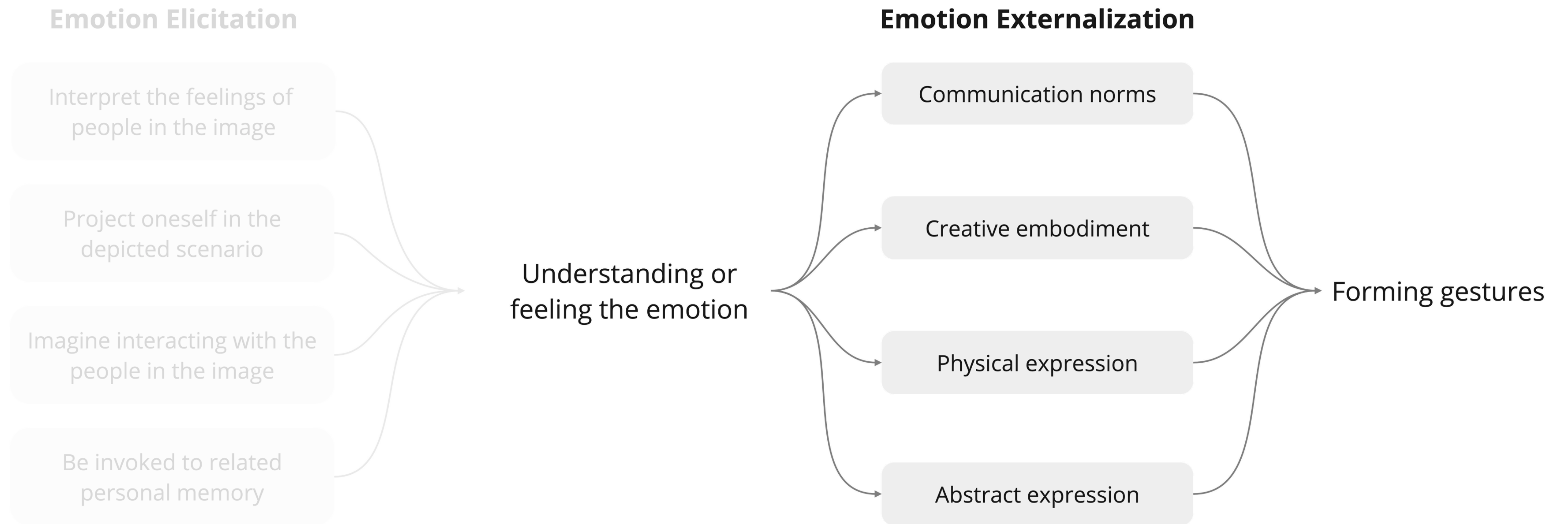
- Participants tended to form **loose gestures** while expressing **negative** and **low-arousal** emotions such as “tired” (*residual* = 4.54)



Emotion externalization

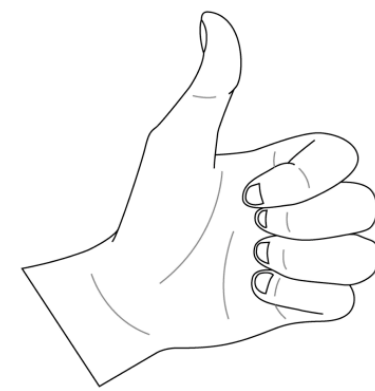


Emotion externalization



Emotion externalization: **communication norm**

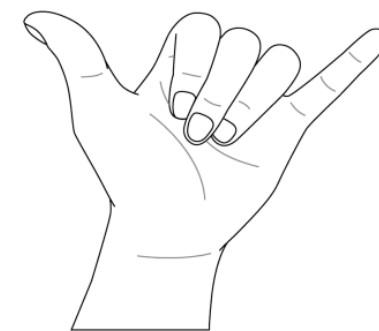
Common sense of how a hand gesture represents emotions, relying on **shared understandings of non-verbal communication norms**



"Honestly these gestures kind of like came from everyday life." (P3)



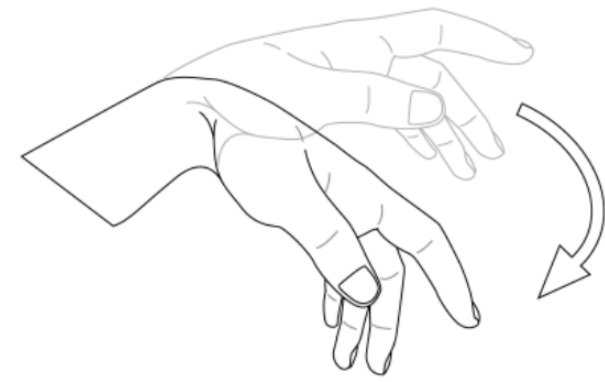
"I think most people know, it means frustrated or something." (P11)



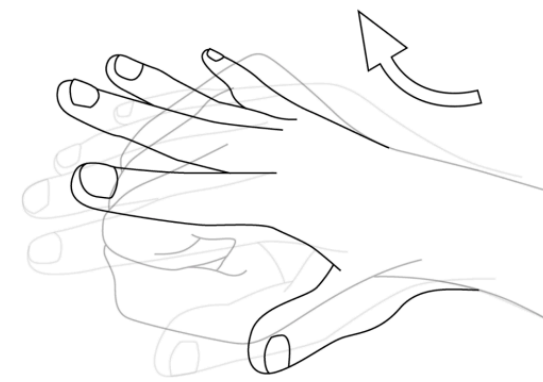
*"My inspiration is from the **street dance**, because when we see amazing poses, we respond just like this with our hands. Also, in **Chinese** we have a **slang 666** to express something really cool"* (P1)

Emotion externalization: **creative embodiment**

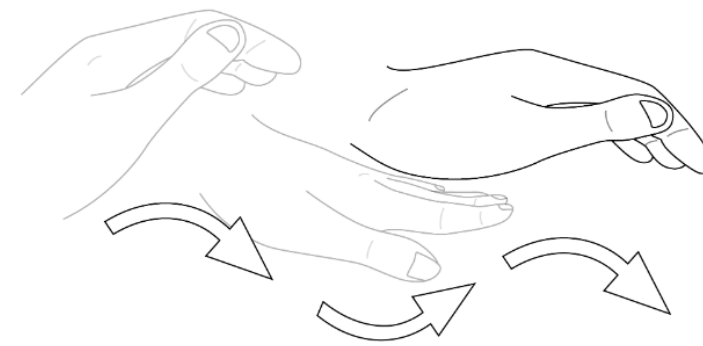
Self-created gestures with **personalized meanings** and **narratives**



"This is a downhearted person who is tired" (P7)



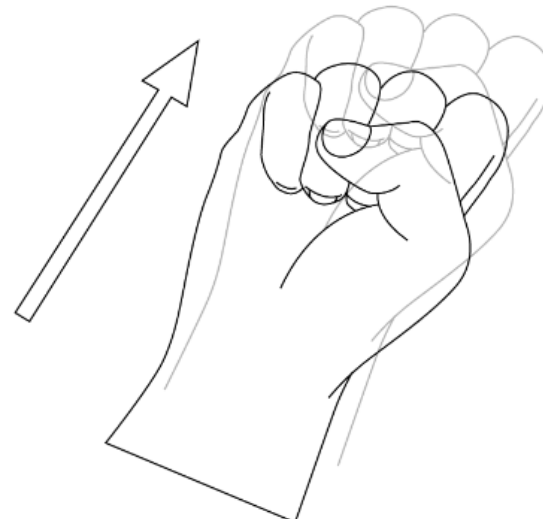
*"Just the thought of **skydiving** also seems very **adventurous** so it's like there is a **bird** or **letting go of** stuff. I remember I did it very fast because I think this is how fast it happens" (P2)*



*"It reminds of new Zealand, there are mountains and lake where the **water waving like that**" (P1)*

Emotion externalization: **physical expression**

Directly express emotions based on **physical instinct**, often as a way to **vent out** negative emotions.



*"when I'm angry, I like to just **hit some stuff like no point**" (P9)*



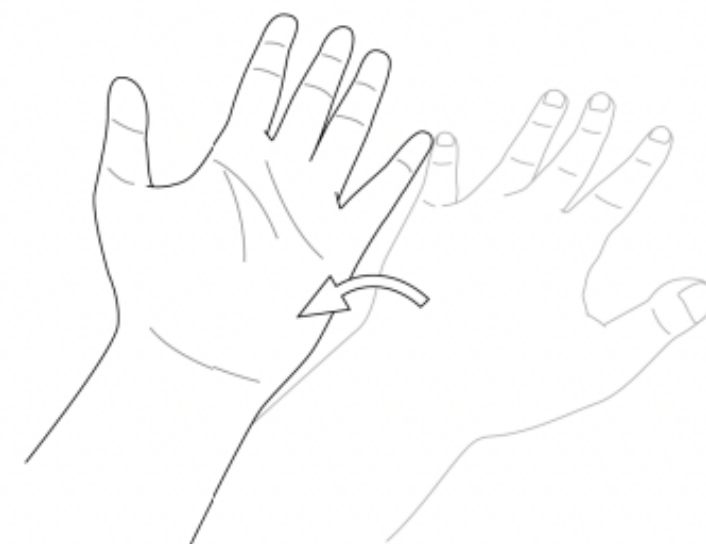
*"When you feel tense, lost, and don't know what to do, you just keep scratching your head, your leg, or somewhere else. So yeah, **this is what I would do if I'm frustrated.**" (P3)*

Emotion externalization: **abstract expression**

No direct connection to the emotion, often for expressing low-arousal emotions that are less “expressive” (e.g., bored)



*“I don't know why, I was trying to mimic something that feels bored on my own **but it's hard to explain.**” (P8)*



*“I guess it's kind like feeling bored, but **I don't recall why I did that.**” (P10)*

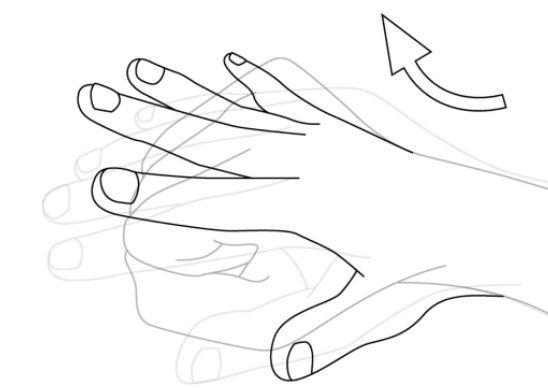
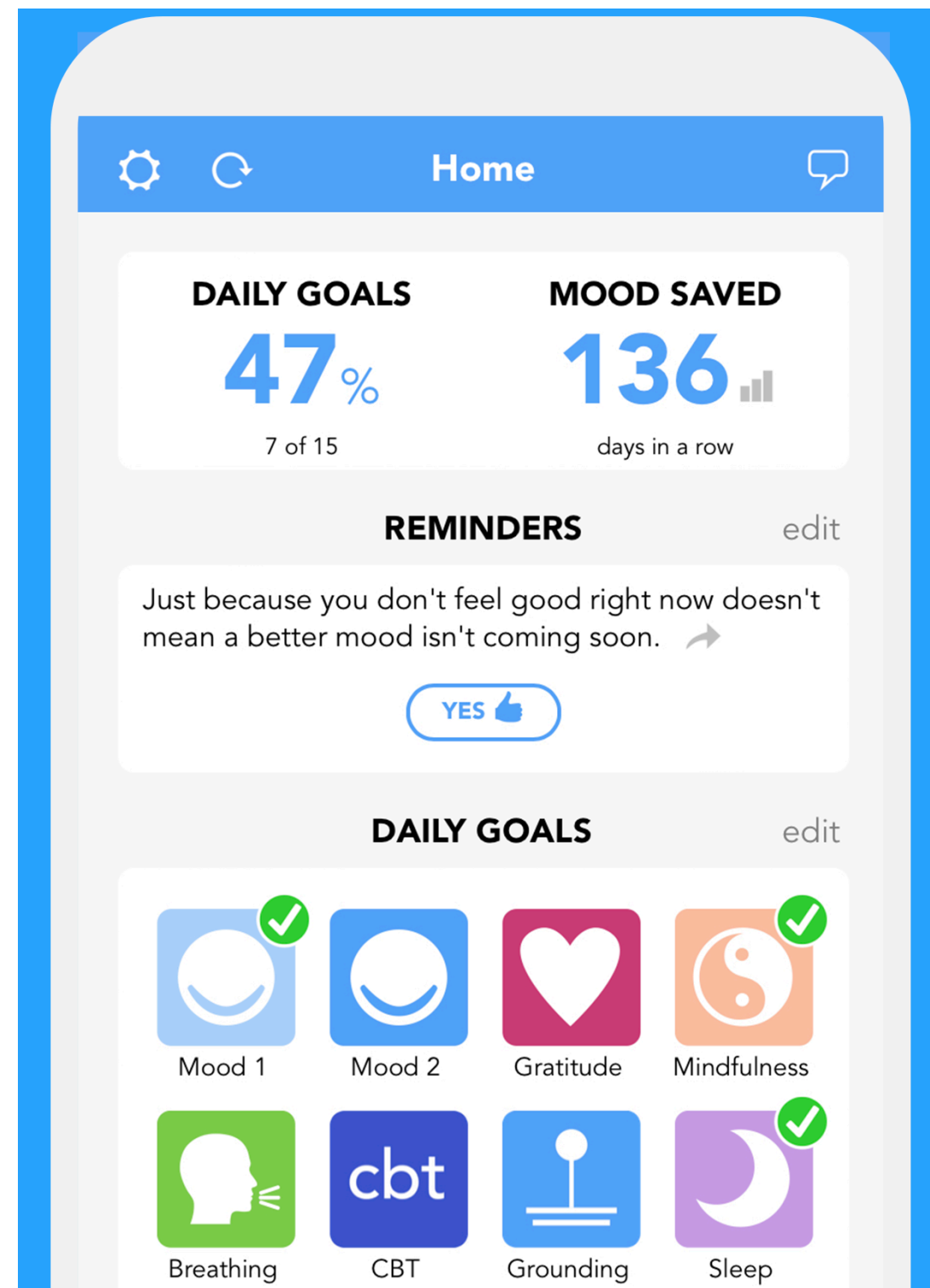
Discussion

- Emotion characterization and contextualization
- Enhancing multimodal emotion tracking

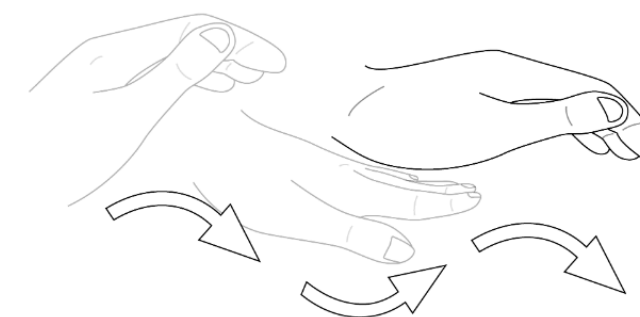
Emotion characterization and contextualization

Emotions are more than levels of valence and arousal; they are also associated with **meaning** and **experiences**

Creative embodiment: using hand gestures to express not only emotions, but also **nuanced** and **personalized cues** for emotional **contexts** leveraging the symbolic meanings of the gestures



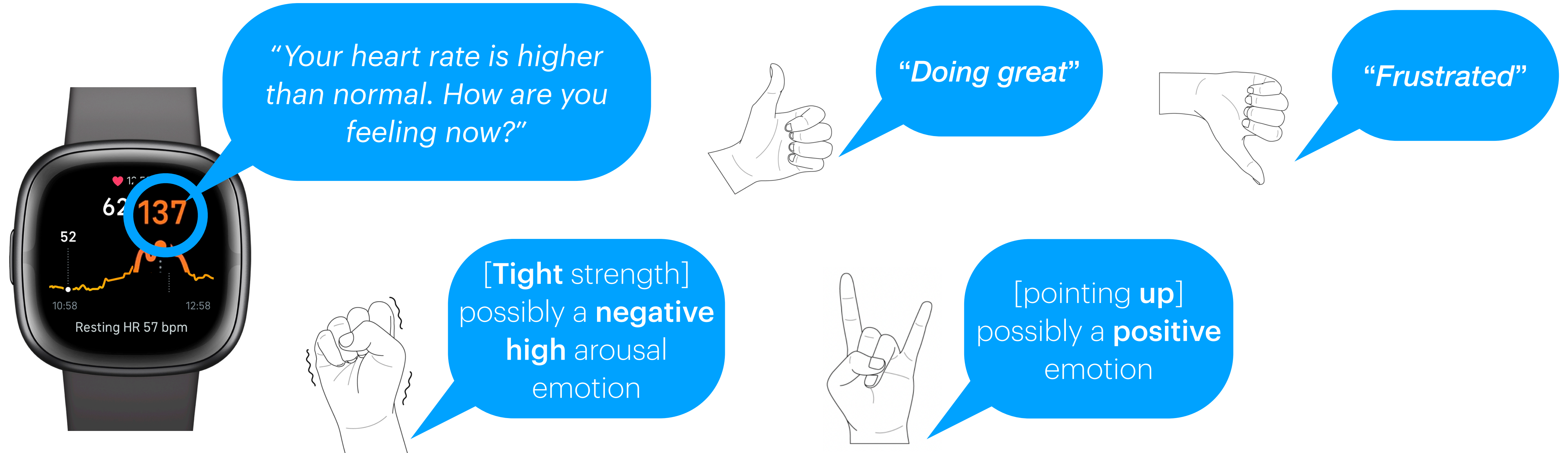
An exciting and adventurous skydiving



The slowly flowing water in a peaceful lake

Designing multimodal emotion tracking tools

Complementing bio-sensing data captured on wearables effortlessly

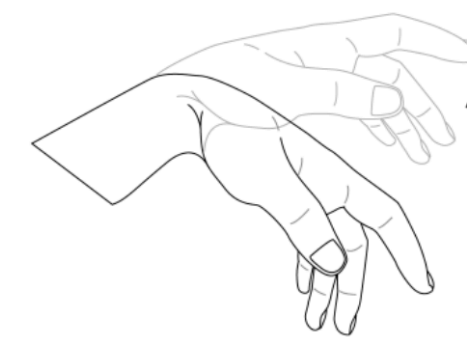
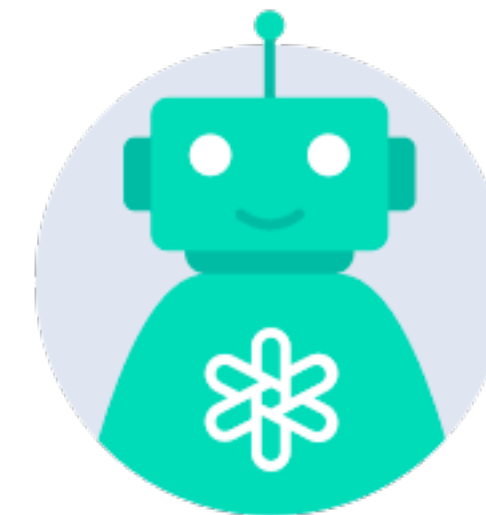


Beyond emotion tracking

Computer-mediated communication



Human-robot interaction



Acknowledgment

Participants and reviewers

Kaiyue Jia for literature search and feedback

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Looking for Ph.D. students who are interested in HCI & Health to join in our lab! (yuhanluo@cityu.edu.hk)



BiWell
Build interaction for
Wellness