TIMBER - A HEALTHY FUTURE FOR SUSTAINABLE BUILDINGS

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Measurement and assessment of psychophysiological indicators of well-being in buildings

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Measurement and assessment of psychophysiological indicators of well-being in buildings

How to capture user experience

- Well-being vs UX
- Framework for capturing UX
- Methods for capturing emotions
- Limitations of methods for capturing emotions
- A look at sample experiments
- Conclusions

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ABCD Framework for UX evaluation

- A = Affective
  - Asking what user feels?
  - What's the alternative?

- B = Behavioural
  - Observational studies
  - Body posture tracking
  - Touch tracking

- C = Cognitive
  - Questionnaires
  - Interviews
  - Oral reports

- D = Deficit
  - Is this inclusive?
  - „Some User Experience"

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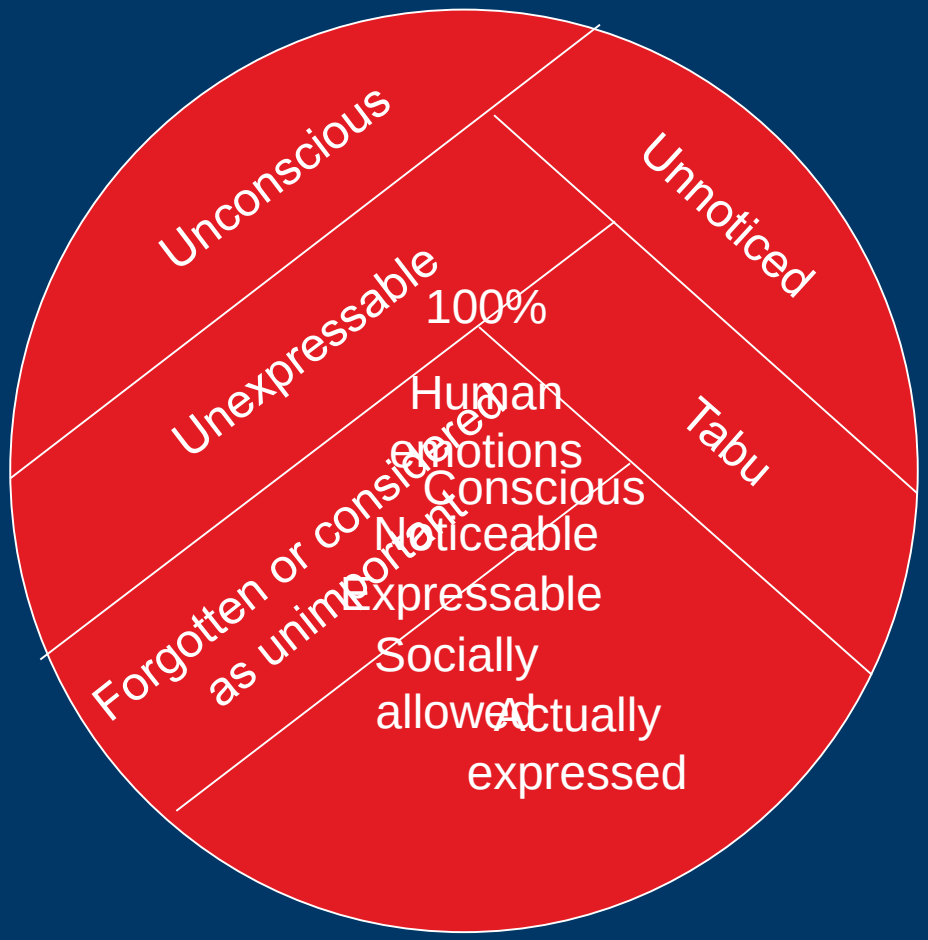
What if we ask?



- When to ask?
- How to ask?
- How to evaluate truthfullness?
- What is the true emotional state?
- What is emotional state?

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Automatic emotion recognition techniques

How to capture user experience

- Symptoms observation channels:
  - visual information processing (facial expression analysis)
  - body movements analysis
  - text input lexical analysis (sentiment analysis)
  - voice signals (prosody)
  - behaviometrics
  - physiological measurements
- Which are available and applicable in UX in buildings evaluation context?

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State-of-the-art

- Emotion recognition algorithms differ significantly in accuracy and granularity
  - the most accurate classify two classes of emotions only
  - the more classes – the less accuracy
  - multichannel fusion provides more accuracy
- All observation channels are succeptible to context and some disturbance
  - e.g. facial expressions anaysis depend on illumination and angle
- Some symptoms of emotions (e.g. mimics) might be controlled by a human
  - intentional or unintentional modification

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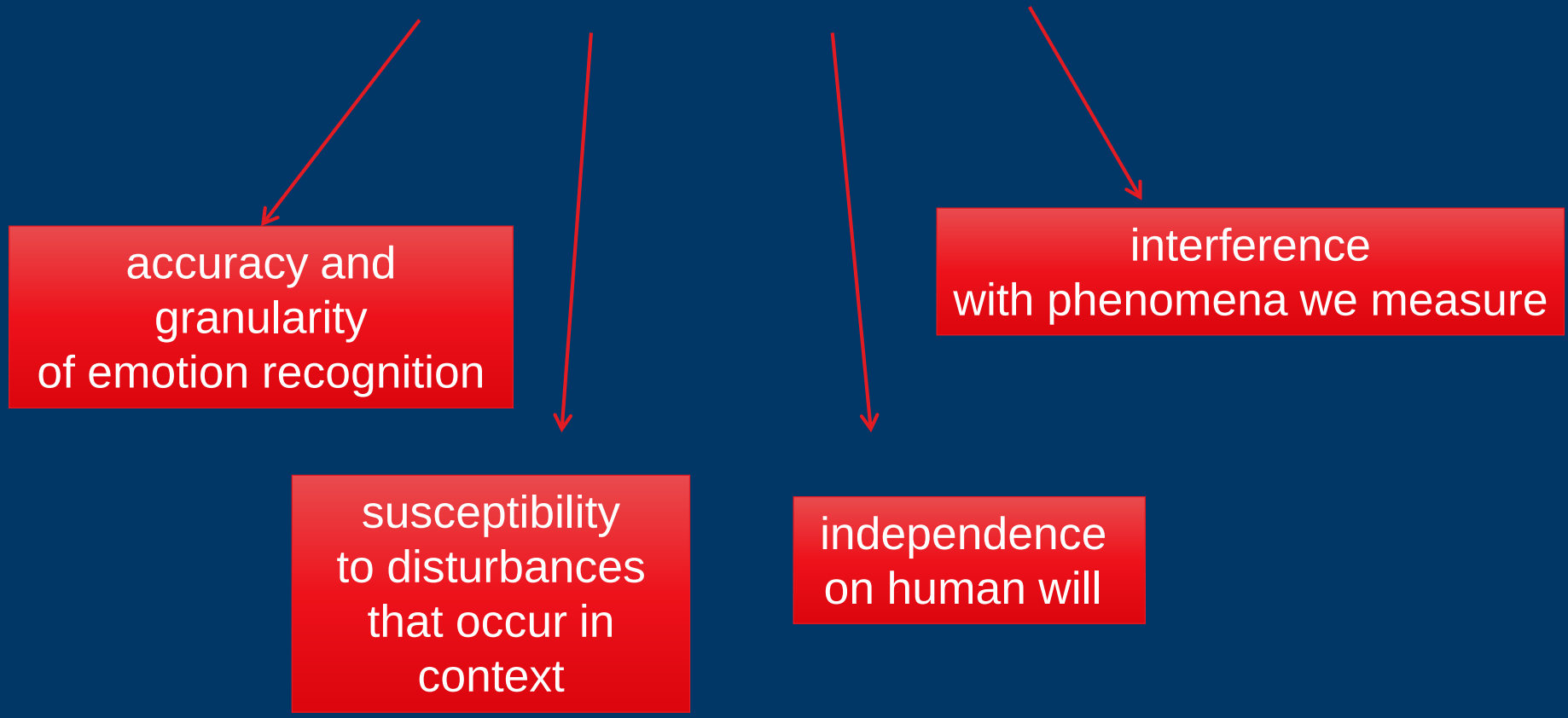
Criteria for choosing emotion recognition technique



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Experiment 1. Capturing software UX

Emotion exploration technique	Accuracy and granularity	Robustness to disturbances	Independence on human will	Interference with phenomena
Questionnaire	Low	High	Low	None
Facial expression analysis	Medium to high	Low	Low to medium	None
Body posture analysis	Low	Medium	Low to medium	Low
Behaviometrics	Low	Medium	Medium	None
Prosody of speech	High*	Low	Medium	Medium to high
Sentiment analysis	Medium to high	Medium	Low	Low
Physiological measurements	High*	Medium to high	Very high	Medium to high

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Sources of uncertainty

- unavailability of input channels (temporal, user-dependent, task-dependent)
- insufficient quality of input channels (video resolution, physiological signals frequency, etc.)
- unavailability of significant data in an input channel (observable symptoms)
- low accuracy and granularity of algorithms
- limitations of emotion representation model and imprecise mapping
- contradictions in multimodal fusion
- intentional or unintentional modification of symptoms
- influence of context

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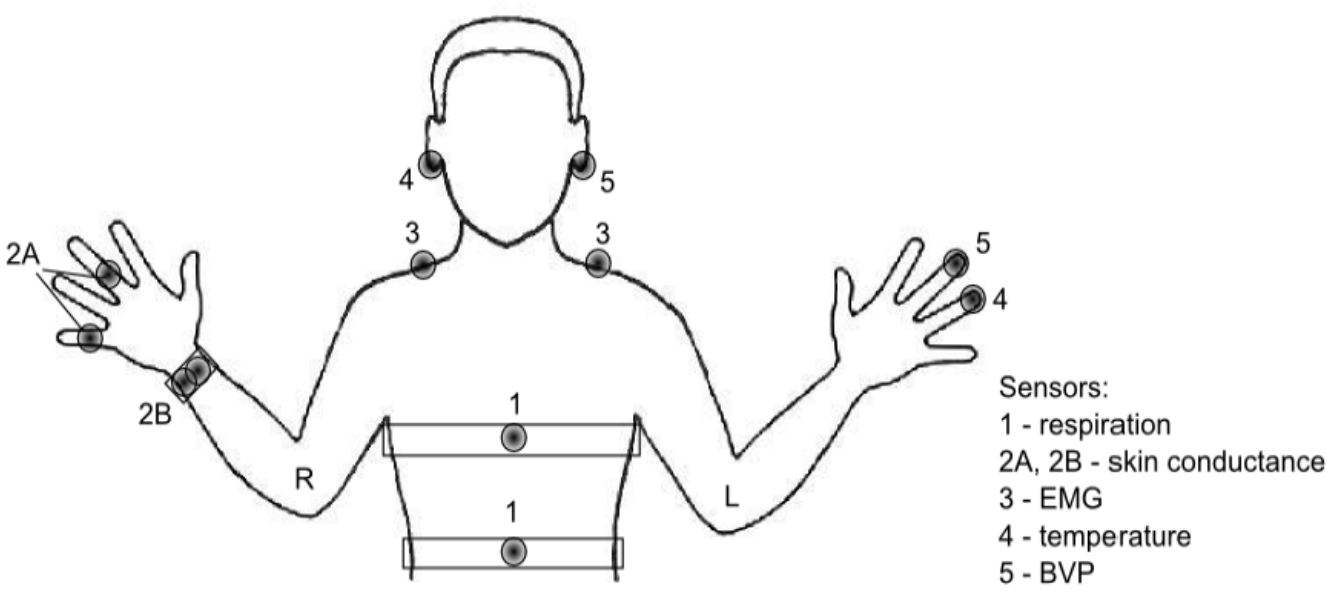
Experiment 2. biosignals acquisition while moving

- What interpheres with physiological measurements?
  electrical field
  relocation of sensors
  movements of part of the body with sensors
- What a man does during measurement?

Purpose of the experiment:

- robust and not disturbing sensor locations



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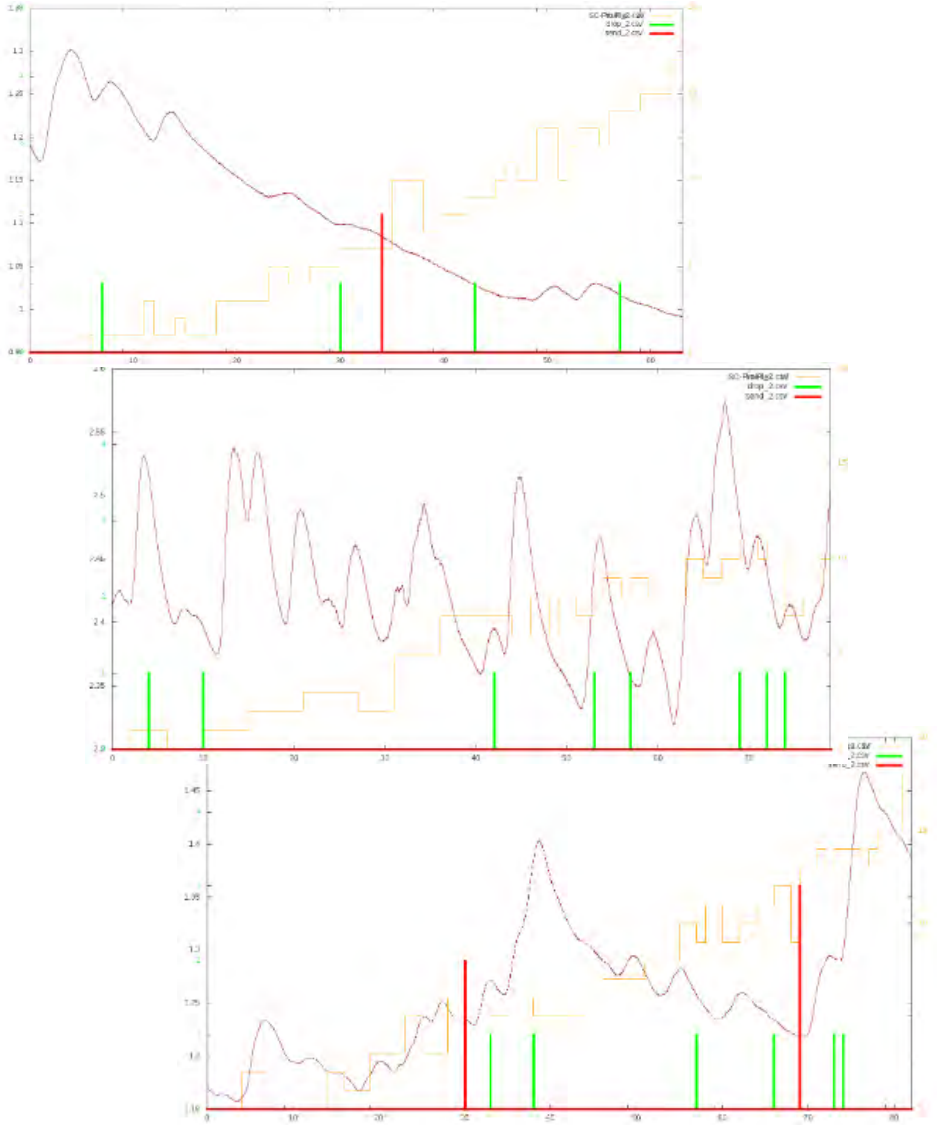
Experiment 3. Attribution to stimuli

- Participants with low-rectivity
  - simply… boring
- Participants with high reactivity
  - reacted to each and every stimuli
  - sometimes exhibited skin conductance raise before stimuli
  - reactions in neutral time
- Participants with medium reactivity
  - exhibited the expected reactions
  - less than 50%



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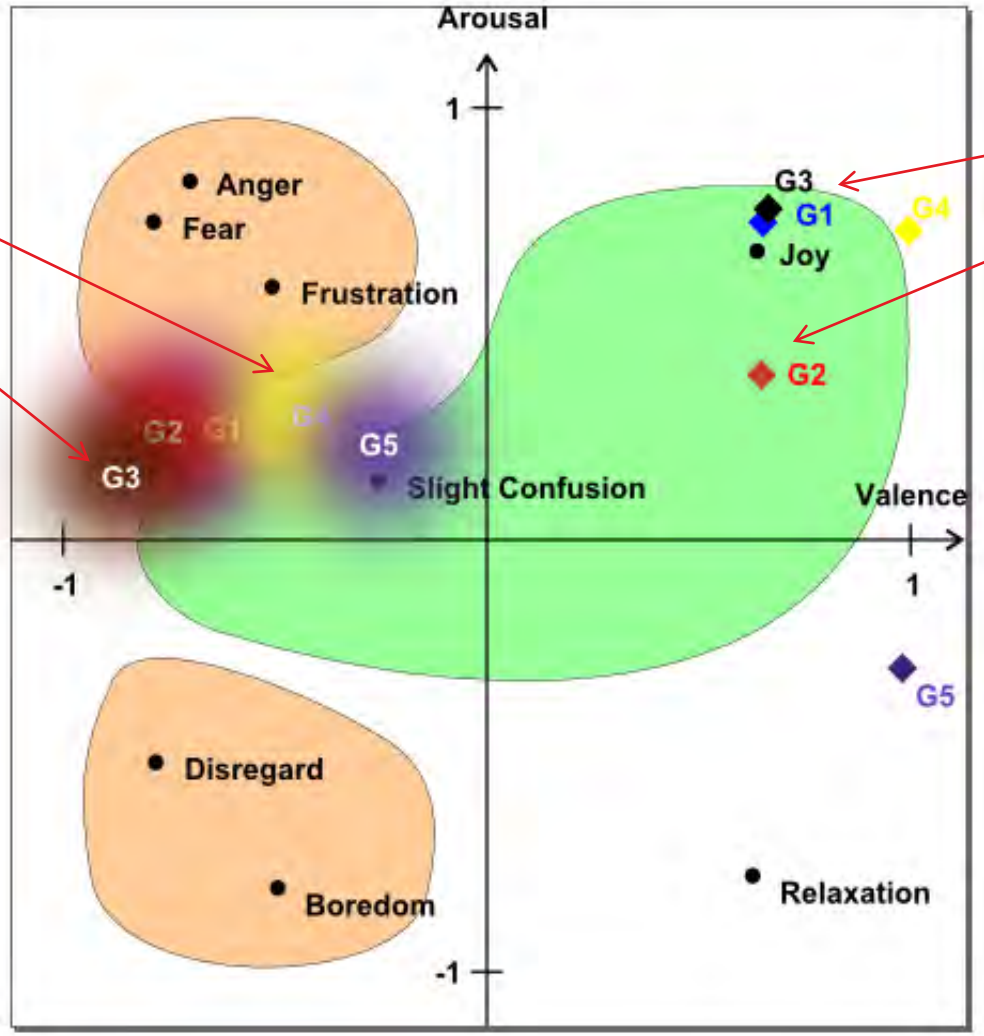
Experiment 4.
Multimodal emotion recognition

Recognized emotional states

Reported emotional states



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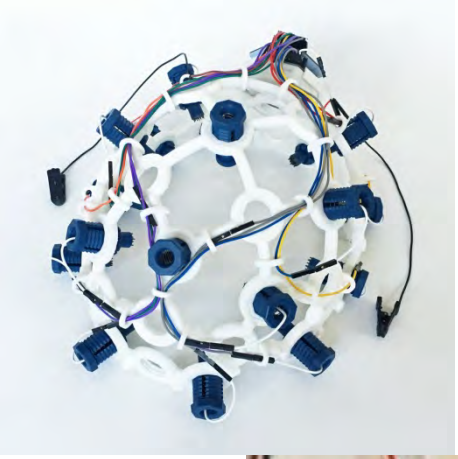
Experiment 5. Behave naturally!

Participant	Intrusiveness level of physiological sensors	Intrusiveness of EEG helmet	Intrusiveness of camera observation
P01	1	3	1
P02	2	*	1
P03	1	2	1
P04	1	5	1
P05	1	5	1
P06	1	*	1
P07	1	*	1
P08	1	*	1
P09	1	*	1
Mean (SD)	1,11 (0,33)	3,75 (1,5)	1 (0)



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Conclusions – summing up

- there are some off-the-shelf solution for recognizing human affect (produced by Affectiva or Empathica), “smart” watches,
- determining the actual emotional state of a human being is still a challenge, even for qualified psychologists,
- the only thing we could track is emotion’s external symptoms,
- there is a number of automatic emotion recognition techniques – applicability, robustness depends on context,
- each of the techniques, including questionnaire as a reference, has some drawbacks
- a significant effort should be put into finding non-intrusive ways of monitoring human experience, including non-invasive sensor locations

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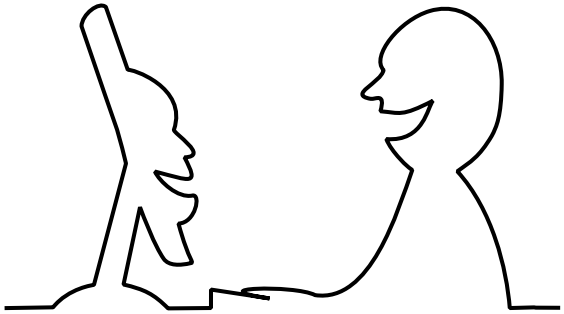
Conclusions - implications

- Trustworthiness of emotion recognition results
  - → Interpretation should always refer to symptoms, not actual feelings
  - → Mass interpretations, not individual ones
  - →Quantification of output uncertainty is essential when results are used to guide decision making

- Perhaps the internal phenomena of the emotion is what makes us really unpredictable, i.e. humans

Thank you for attention!



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