Research Methods in **Human Computer Interaction (HCI)**

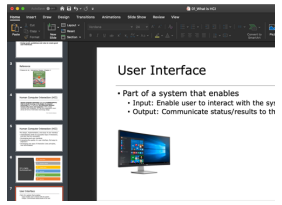
INFO5993/INFO4990 - Lecture

Anusha Withana
Twitter: @wdanusha

The School of Computer Science
The University of Sydney

User Interface

- Part of a system that enables
  - Input
    - Let user to transfer information to the system
  - Output
    - Present status/results to the user
- Essentially create the inter-communication



Why User Interface is Important?

Why should we care?

Why User Interface is Important?

Why User Interface is Important?

Three Mile Island Disaster

- Control panel light to show the status of the relief valve that prevents the reactor from overheating.
  - Light's on, valve's open;
  - light's off, valve's closed.
- It was designed to operate on user action, not to actually sense the valve condition

https://www.cracked.com/article_19776_6-disasters-caused-by-poorly-designed-user-interfaces.html

Why User Interface is Important?

One of the most critical parts of a system

Directly influence success of a product

Bad user interfaces are costly (time, money, lives, …)

User interfaces are hard to get right

Human Computer Interaction (HCI)

The design, implementation, and study of user interface

- Understanding good ways of interaction, and why they are successful
- Designing and Developing good user interfaces
- Evaluating the quality of a user interface
- Improving the user interfaces and developing new ways of interaction

Why HCI is Hard?

Sounds simple enough!

Good vs. Poor Design

Goto:
https://www.menti.com/ngr83occho

Because it involves **people**!

And people are diverse and have different preferences, opinions…

https://gifer.com/en/NWDU

HCI is Highly Multidisciplinary

Human Factors

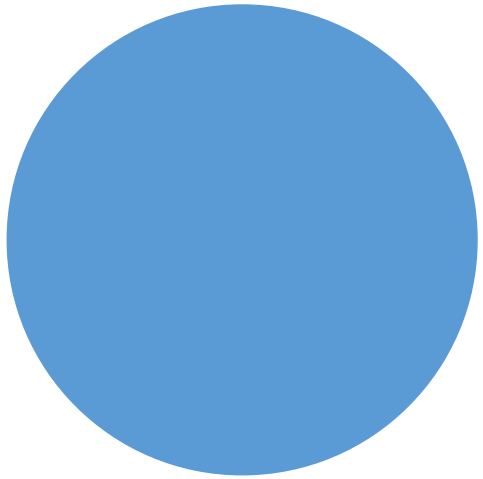
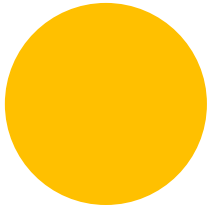
Psychology / Cognition

Computer Science

Engineering

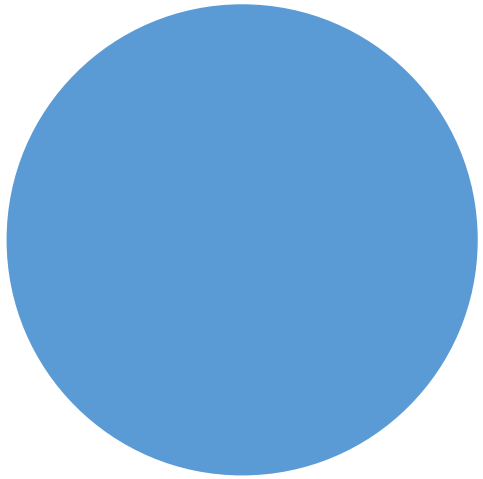
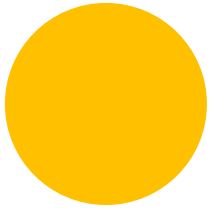
Social Science

Ergonomics

HCI is very creative

https://www.youtube.com/watch?v=JP0w9lZoLwU Merill et. al. TEI '07

Evaluating Interfaces

Research Methods

Evaluating User Interfaces

- How would you find out whether your product
  - Would appeal to intended user?
  - And they will really use it!

- Remember "Don't blame the user!"

pinterest.com.au/pin/461407924294118013

UI Evaluation Methods

- Evaluation **enables designers to check that their design is appropriate and acceptable** for the **target user** population

Evaluation

- You as the designer (and your colleagues) may think that an interface is usable and attractive
- But others may disagree

"It's the latest innovation in office safety.
When your computer crashes, an air bag is activated
so you won't bang your head in frustration."

funnybizblog.com

What should we evaluate for?

Goals?

Evaluate for **Usability**

- Effective to use (effectiveness)
- Efficient to use (efficiency)
- Safe to use (safety)
- Having good utility (utility)
- Easy to learn (learnability)
- Easy to remember how to use (memorability)

User Experience (UX)

- Going beyond usability
- Felt experienced and emotions
  - Satisfying, Helpful, Fun Vs. Boring, Unpleasant, Frustrating

How can we evaluate?

Research Methods

Types of Evaluation

- Three broad categories, depending on:
  - the setting
  - user involvement, and
  - level of control

Usability Experiments

- **Controlled settings directly involving users**
  - E.g. usability labs and research labs
- Users' activities are controlled to test hypotheses and measure or observe certain behaviors
  - The main methods are usability testing and experiments

uqul.uq.edu.au

Field Studies

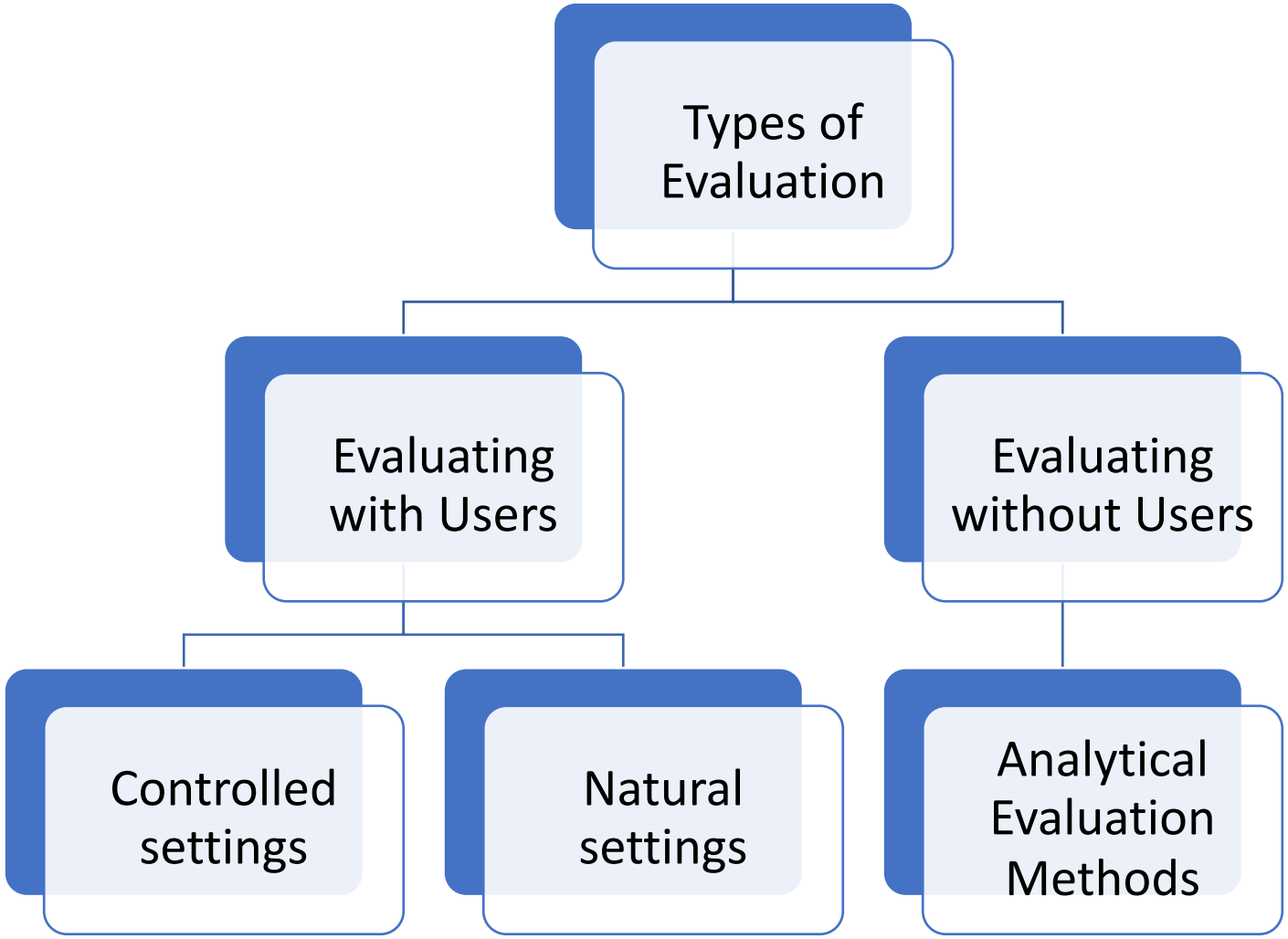
- **Natural settings involving users**
  - E.g. online communities and products that are used in public places
- There is little or no control of users' activities to determine how the product would be used in the real world
  - The main method used is field studies (also called in-the-wild studies)

gradaustralia.com.au

Analytical Methods

- **Any settings not directly involving users**

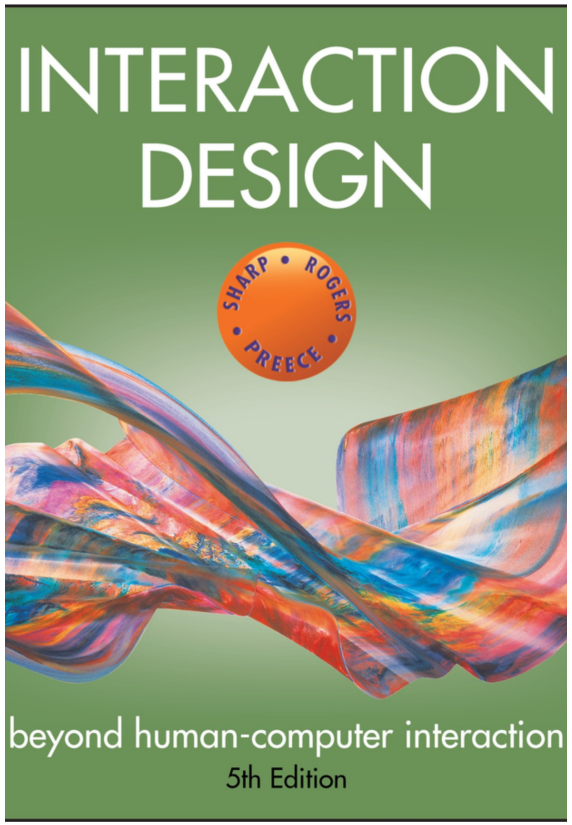
- Consultants and researchers critique, predict, and model aspects of the interface to identify the most obvious usability problems
  - The range of methods includes inspections, heuristics, walk-throughs, models, and analytics


Types of Evaluation
Evaluating with Users
Evaluating without Users
Controlled settings
Natural settings
Analytical Evaluation Methods
Usability testing
Experiments
Field studies
Inspection
Heuristic Evaluation
Walkthrough
Models and Analytics

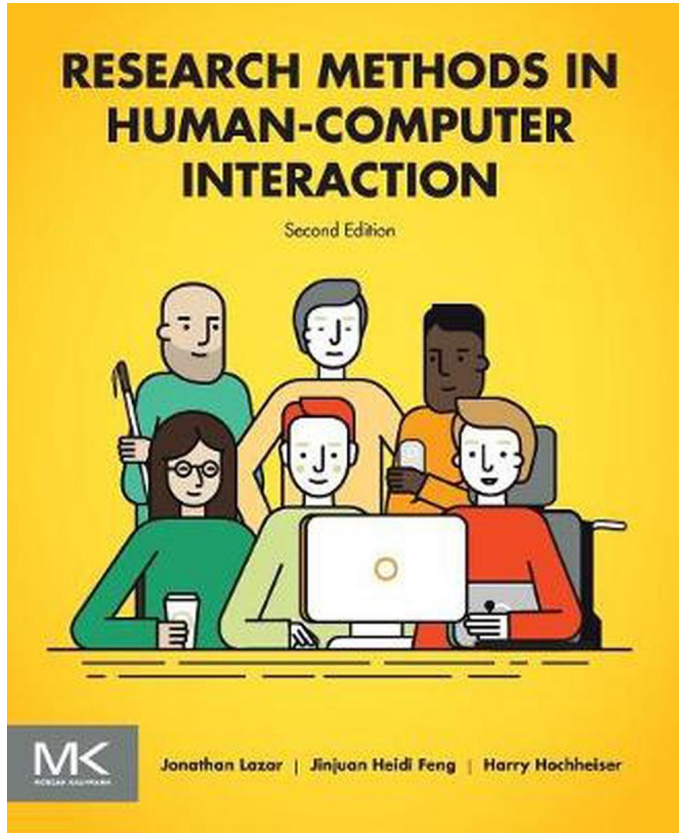
That was just touching the surface…

Reality is more complex!

Resources



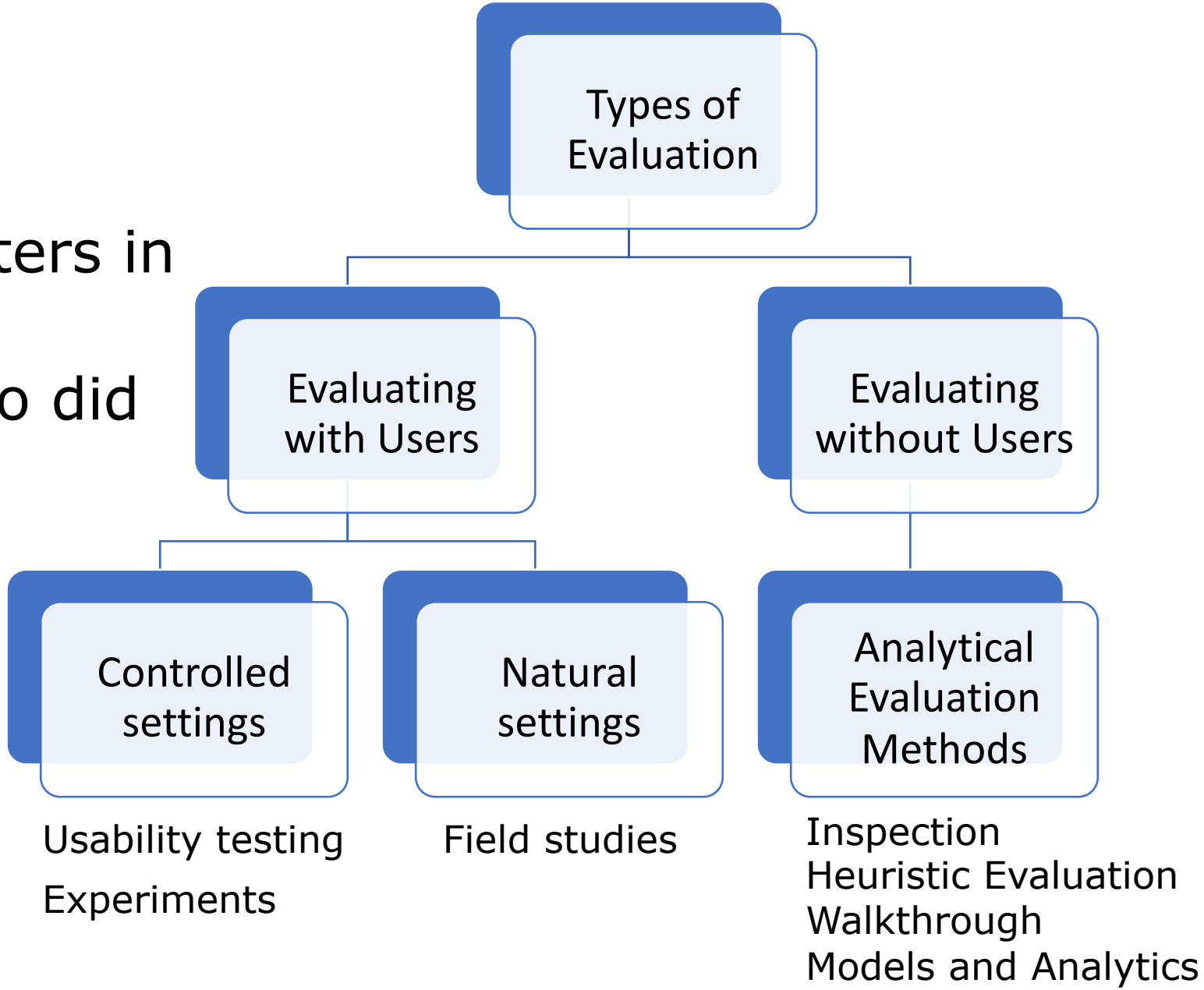
https://sydney.primo.exlibrisgroup.com/permalink/61USYD_INST/12rahnq/alma991019111179705106



https://sydney.primo.exlibrisgroup.com/permalink/61USYD_INST/2rsddf/cdi_askewsholts_vlebooks_9780128093436

Summary

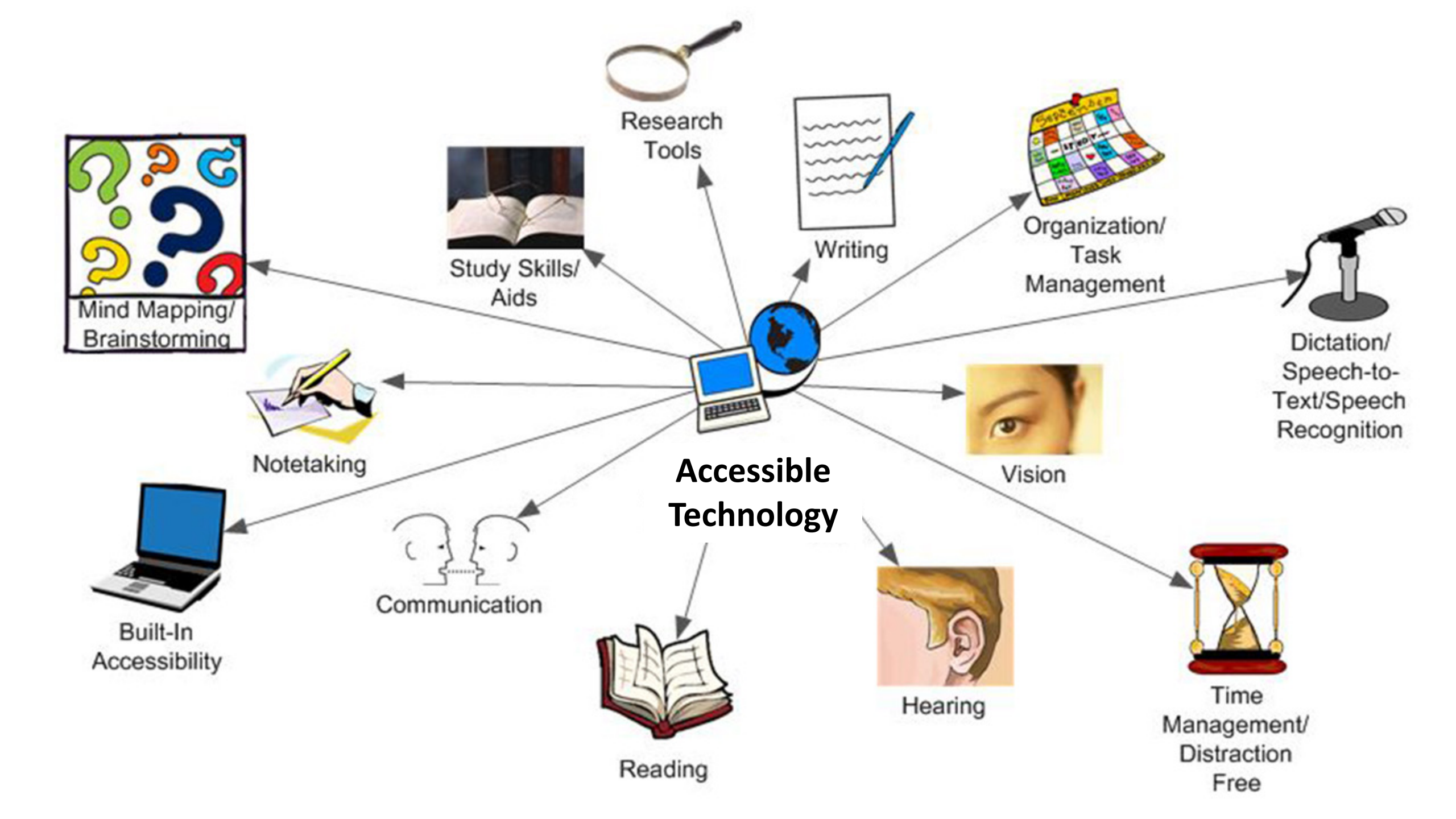
- Read relevant chapters in the book
- Consult a friend who did INFO3315 - HCI



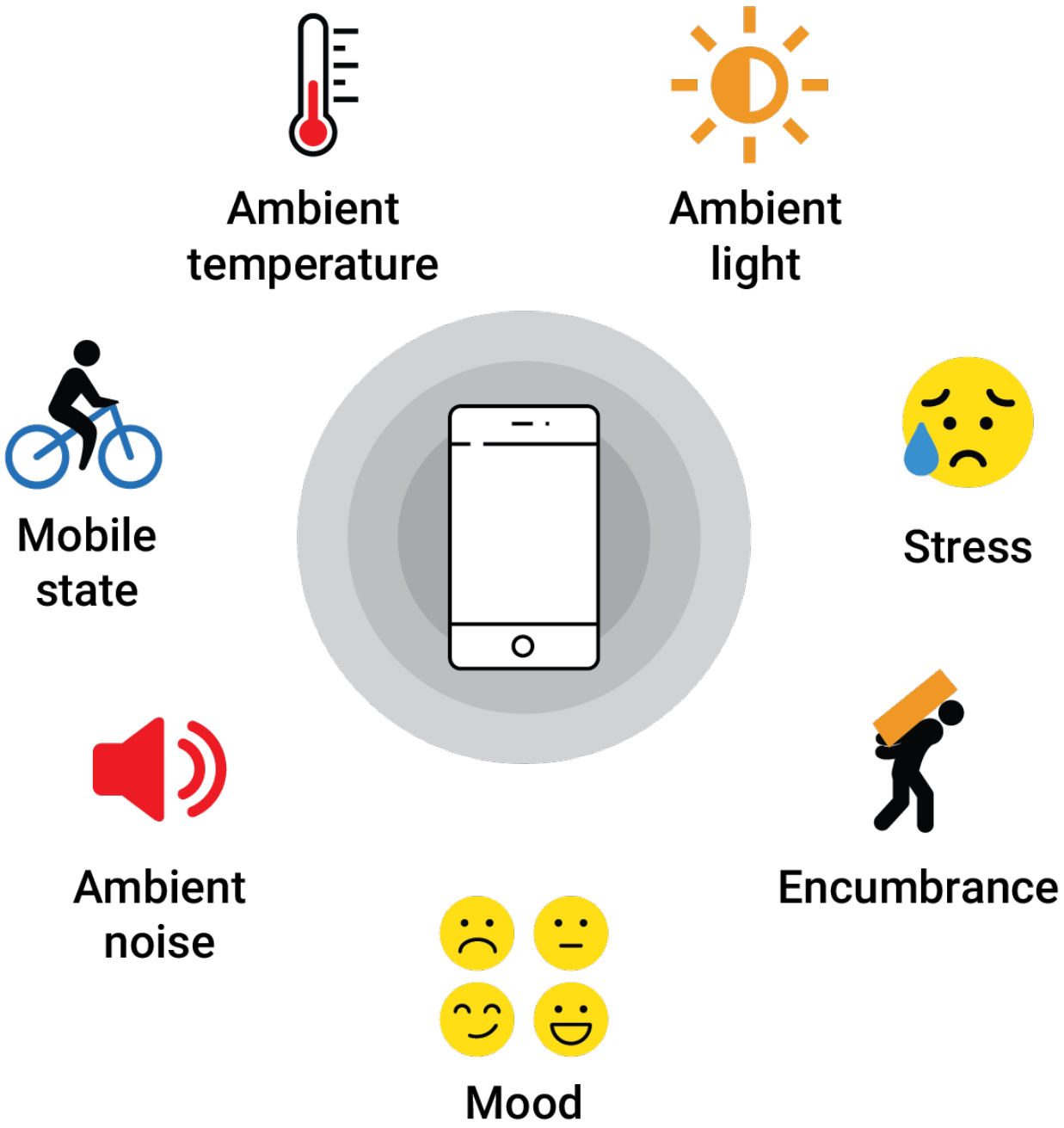
Accessibility Research in HCI

Zhanna Sarsenbayeva
Lecturer
The University of Sydney


Create accessible technologies to empower people of all abilities


Research Tools
Study Skills/ Aids
Writing
Organization/ Task Management
Mind Mapping/ Brainstorming
Dictation/ Speech-to-Text/Speech Recognition
Notetaking
Vision
Accessible Technology
Built-In Accessibility
Communication
Hearing
Reading
Time Management/ Distraction Free

Adaptive Environment or Adaptive Interface?



Situationally-Induced Impairments and Disabilities (SIIDs)

- Andrew Sears and Mark Young (2003)

Why Study SIIDs?

- Situational impairments affect users of all abilities

- Accessibility benefits everyone
  - Gregg C. Vanderheim (1997)

Why Study SIIDs?

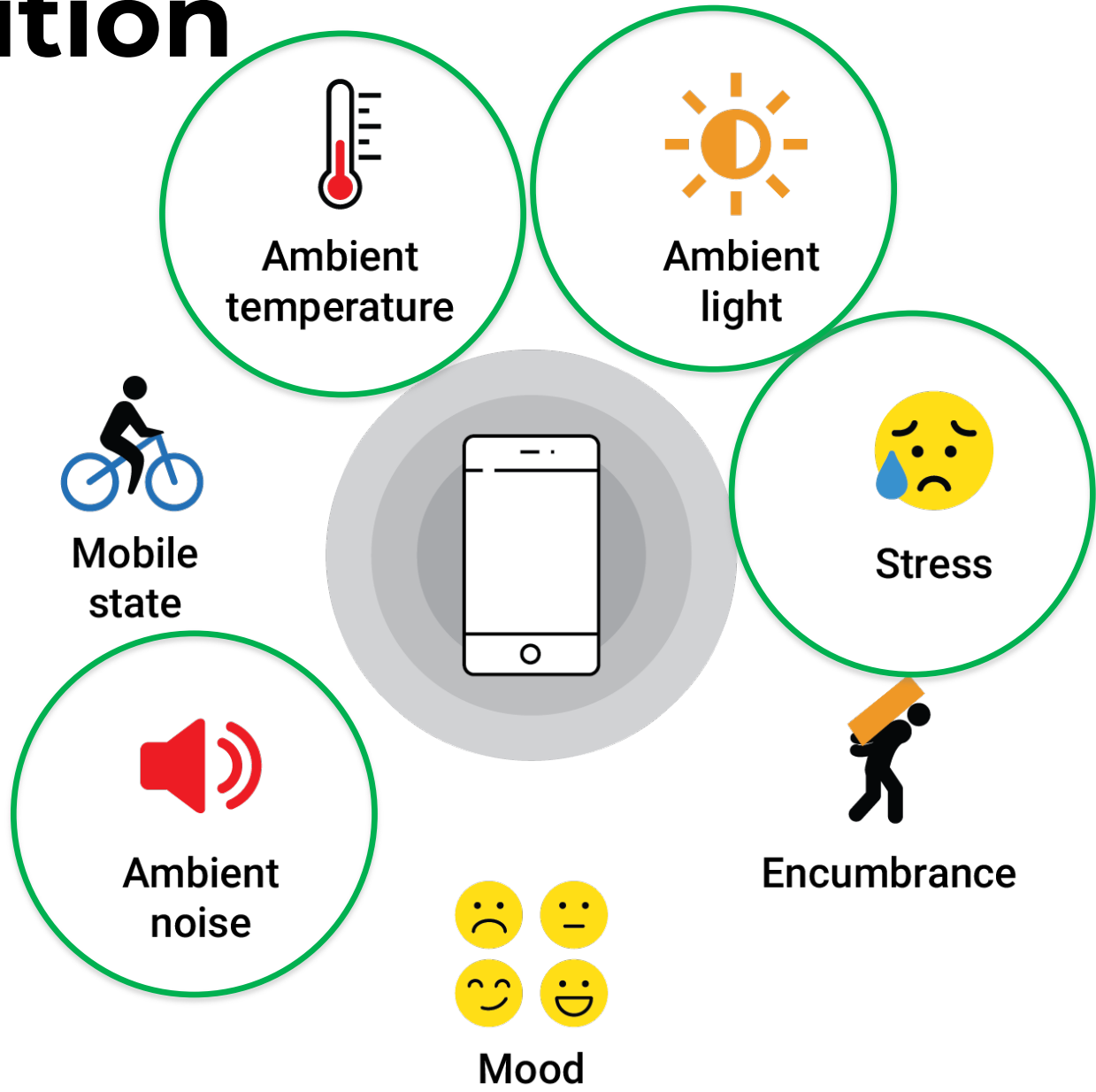
- Similarity of the effects of situational and permanent impairments
  - Yesilada *et al.*, 2010
  - Wobbrock, 2006

Why Study SIIDs?

- Similarity of the effects of situational and permanent impairments
  - Yesilada *et al.*, 2010
  - Wobbrock, 2006
- Situational impairments worsen the experience of permanently impaired users
  - Visually impaired: Walking & encumbrance (Abdolrahmani *et al.*, 2016)
  - Visually/ motor impaired: Ambient light, on-the-go (Kane *et al.*, 2009)
  - Device accessibility issues (Naftali & Findlater, 2014)

Research Contribution

- The effects of:
  - Ambient noise
    - Effect of Distinct Ambient Noise Types on Mobile Interaction, PACM IMWUT/UbiComp'18
  - Ambient light
    - Effect of Ambient Light on Mobile Interaction, INTERACT'19
  - Stress
    - Measuring the Effects of Stress on Mobile Interaction, PACM IMWUT/UbiComp'19
- Sensing mechanism
  - Ambient temperature
    - Sensing Cold-Induced Situational Impairments in Mobile Interaction Using Battery Temperature, PACM IMWUT/UbiComp'17



Research Contribution

- Investigate and quantify the effects of SIIDs in a **systematic** way
  - Same smartphone tasks
    - Target acquisition
    - Visual search
    - Text entry

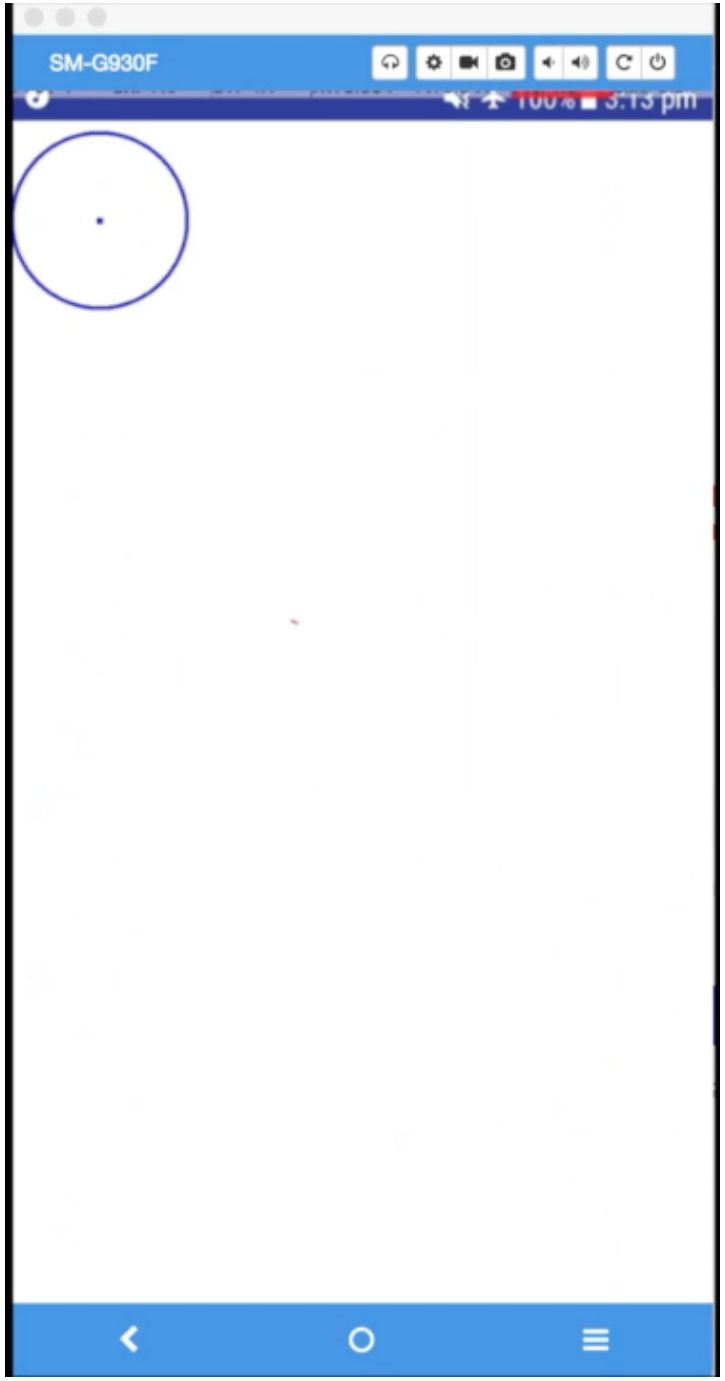
Research Contribution

- Investigate and quantify the effects of SIIDs in a **systematic** way
  - Same smartphone tasks
    - Target acquisition
    - Visual search
    - Text entry
  - Same variables
    - Reaction, accuracy, memorisation and search time, text entry rate, error rate

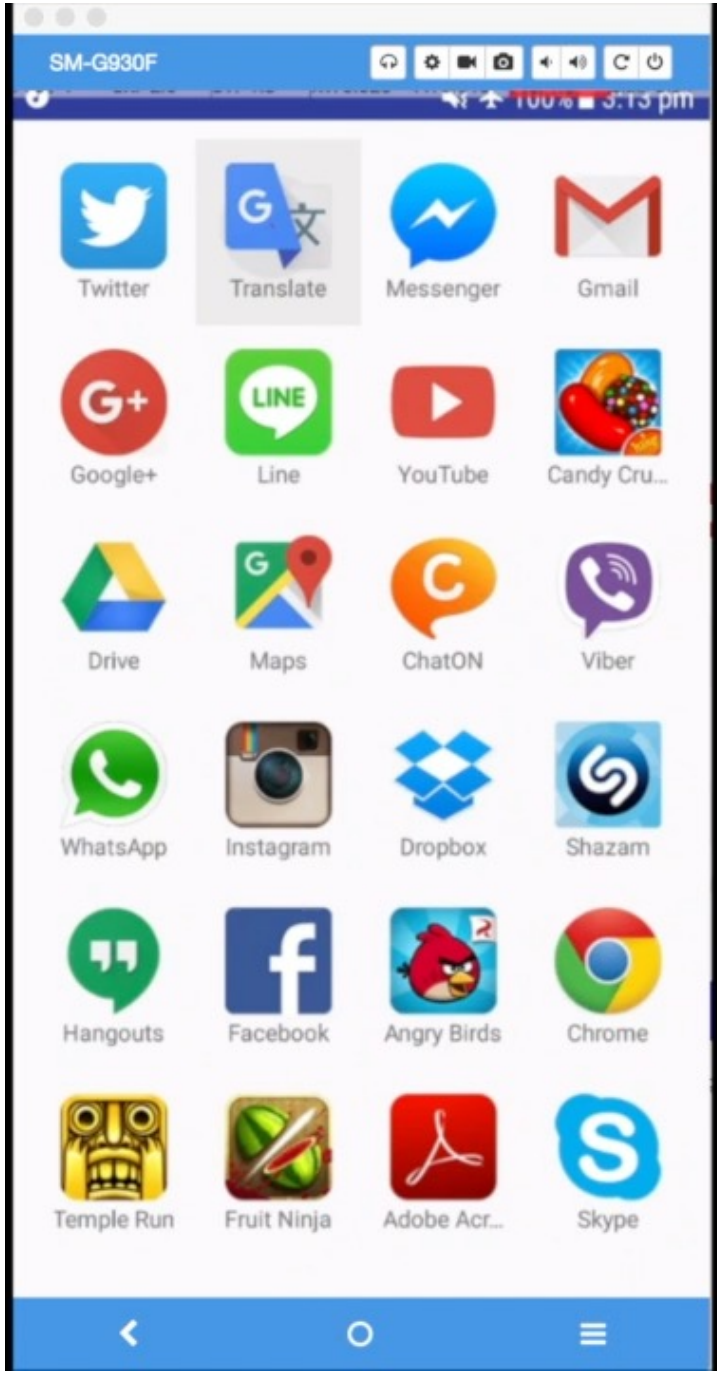
Research Contribution

- Investigate and quantify the effects of SIIDs in a **systematic** way
  - Same smartphone tasks
    - Target acquisition
    - Visual search
    - Text entry
  - Same variables
    - Reaction, accuracy, memorisation and search time, text entry rate, error rate
  - Consistent protocol
    - Baseline condition in each of the studies

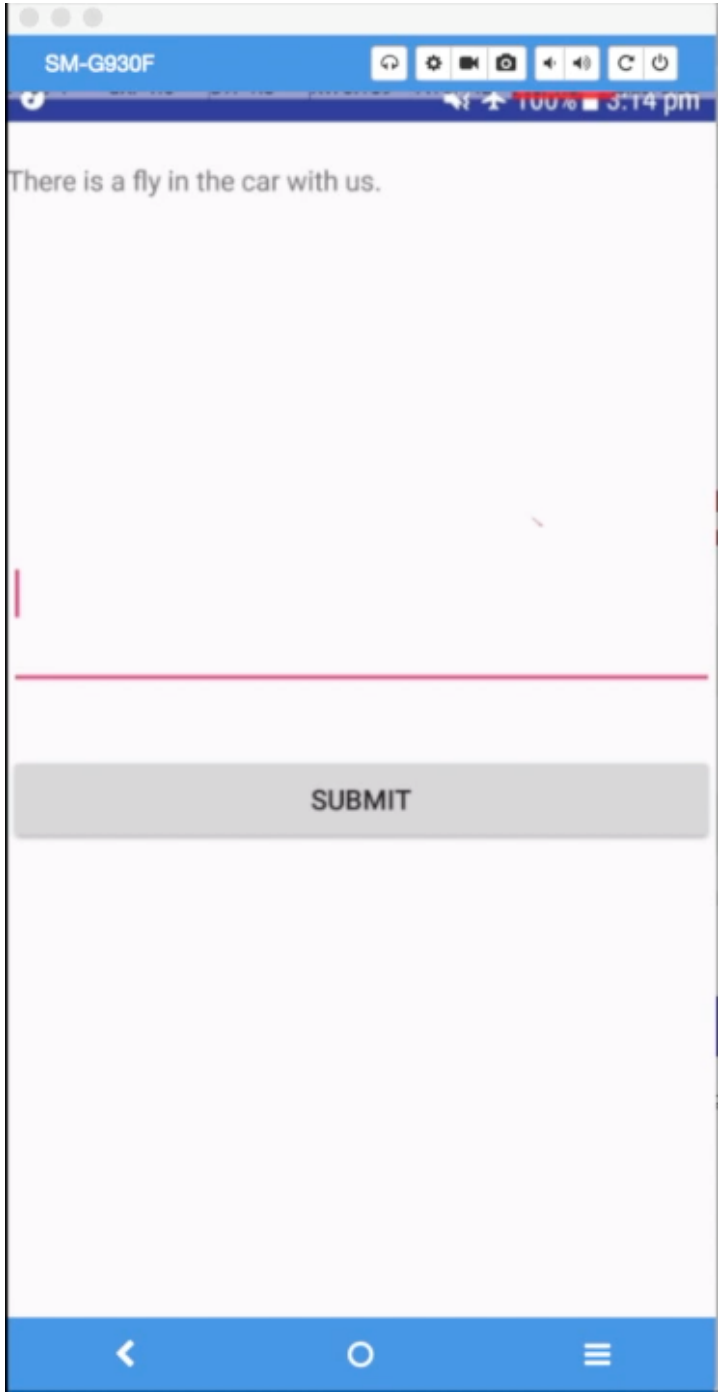
Mobile Interaction Tasks – *Target Acquisition*

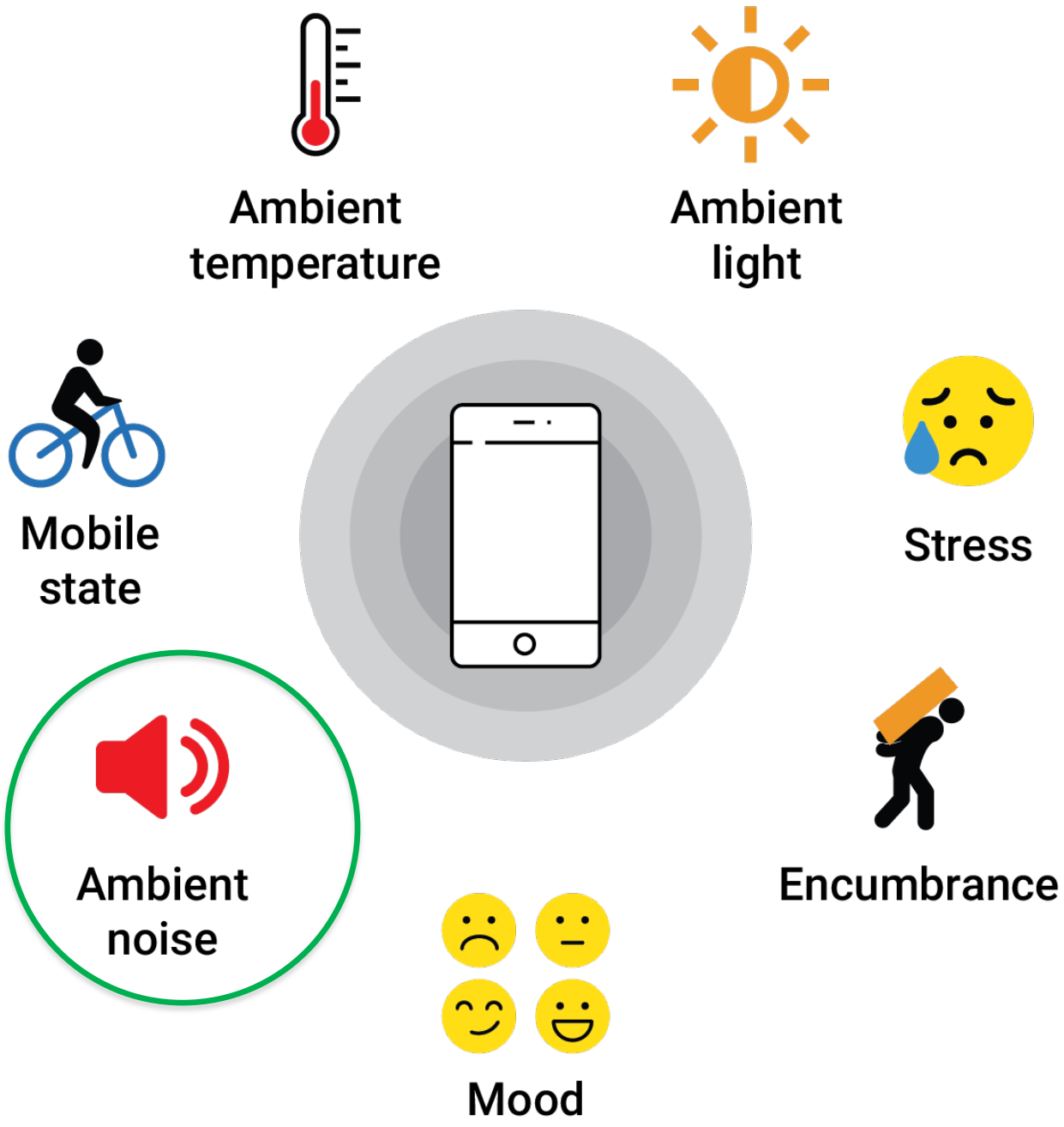


Mobile Interaction Tasks – *Visual Search*



Mobile Interaction Tasks – *Text Entry*





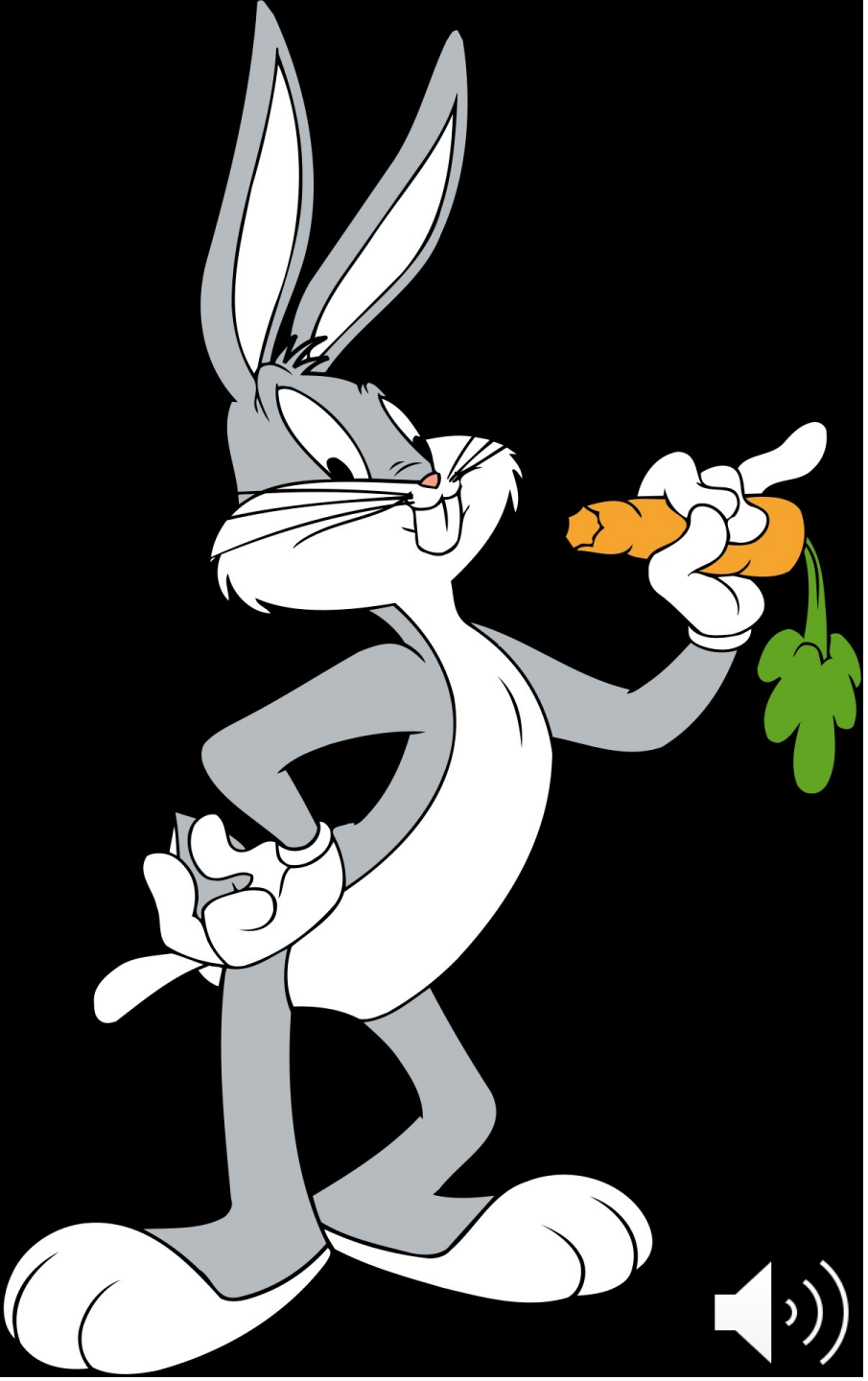
Research Contribution

- Effect of Distinct Ambient Noise Types on Mobile Interaction.
  - PACM IMWUT/Ubicomp'18
  - Sarsenbayeva et al. (2018)

Effects of Ambient Noise on Mobile Interaction

- Background music
  - Faster tempo → faster task completion (Milliman *et al*., 1986)
  - Faster music is more cognitively demanding (Holbrook *et al*., 1981)
- Urban noise
  - Outdoor urban noise negatively affects recall (Cassidy & MacDonald, 2007)
  - Indoor urban noise worsens performance in Maths tasks (Banbury & Berry, 1997)
- Speech
  - Adversely affects reading performance (Martin *et al*., 1982)
  - Distracts memory recall (Tremblay *et al*., 2000)

MUSIC



MUSIC

MUSIC

URBAN NOISE

URBAN NOISE

URBAN NOISE

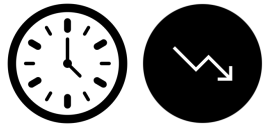
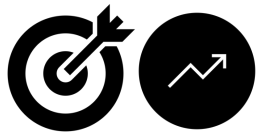
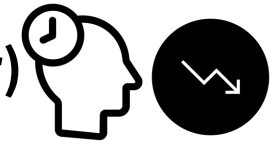
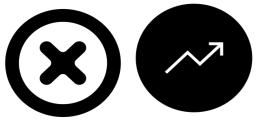
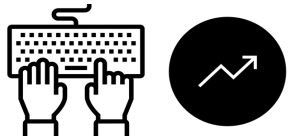
SPEECH

SPEECH

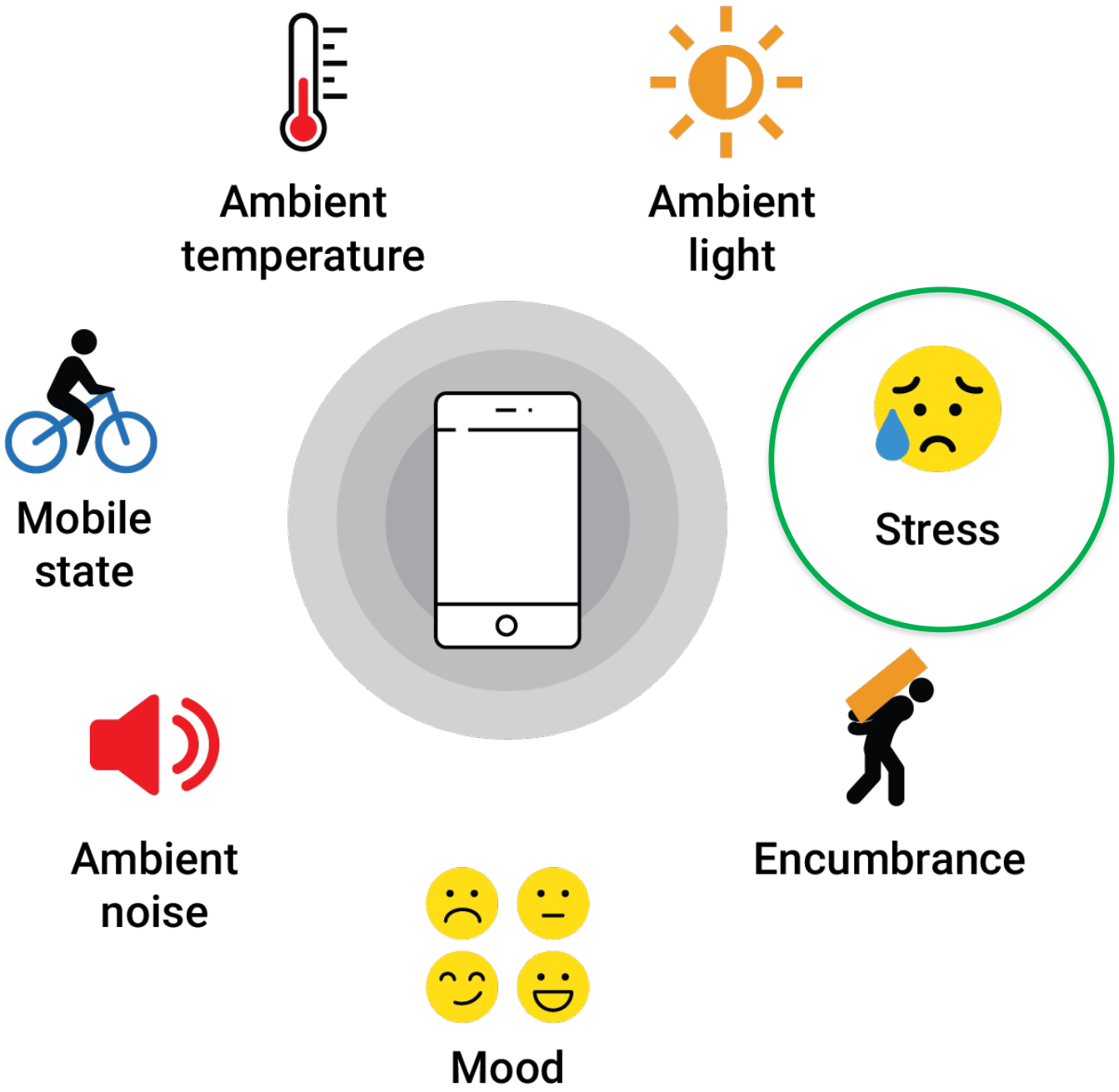
SPEECH

SILENCE

Results

- **Target Acquisition Time (Music: Fast and Slow)** 
- **Offset size (Music: Fast and Slow)** 
- **Time to Memorise Icons (Urban Indoor)** 
- **Errors in Visual Search (Urban Outdoor)** 
- **Time per Char Entry (Urban Outdoor, Meaningful Speech)** 

Moving From External To Internal Situational Impairments



Research Contribution

- Measuring the Effects of Stress on Mobile Interaction
  - PACM on IMWUT/UbiComp'19
  - Sarsenbayeva et al. (2019)

Measuring the Effects of Stress on Mobile Interaction

- Impairs working and declarative memory
  - Reduces memory retrieval (Kuhlmann *et al.*, 2005; Lupien *et al*., 1998; Newcomer *et al.*, 1999)

Measuring the Effects of Stress on Mobile Interaction

- Impairs working and declarative memory
  - Reduces memory retrieval (Kuhlmann *et al.*, 2005; Lupien *et al*., 1998; Newcomer *et al.*, 1999)
- Affects interaction with stationary technology
  - Stronger keyboard taps (Karunaratne *et al.*, 2011)
  - More mouse movements (Rodrigues *et al.*, 2013)

Study Protocol

- Trier Social Stress Test
  - Public Speaking
  - Arithmetic Subtraction

Study Protocol

SELF-EVALUATION QUESTIONNAIRE STAI Form Y-1

Please provide the following information:

Name_____Date_____S_____

Age_____ Gender (*Circle*) **M** **F** T_____

DIRECTIONS:

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right* now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

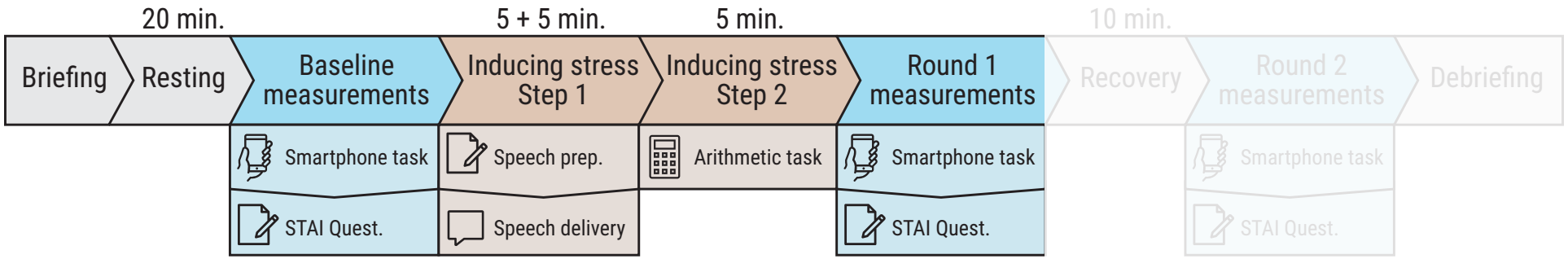
	NOT AT ALL	SOMEWHAT	MODERATELY SO	VERY MUCH SO
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4

State-Trait Anxiety Inventory (STAI)

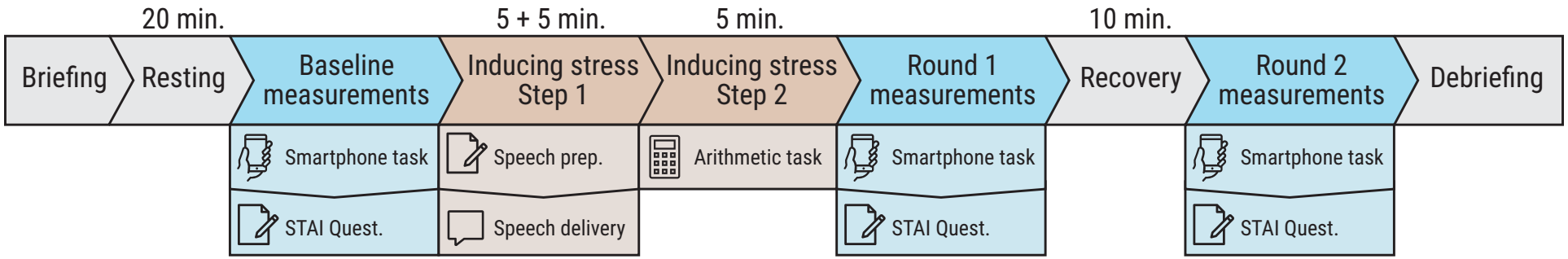
Empatica E4 sensor

Study Protocol

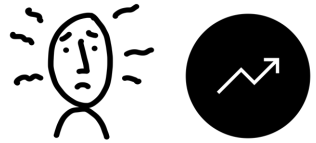
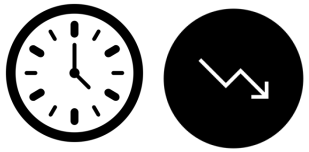
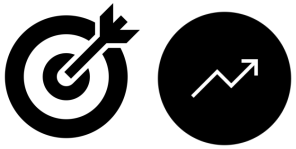
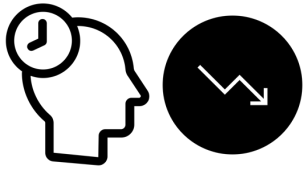
Study Protocol



Study Protocol



Results

- **HF HRV (Stress, Post-Stress)** 
- **STAI Scores (Stress)** 
- **Target Acquisition Time (Stress, Post-Stress)** 
- **Offset Size (Stress, Post-Stress)** 
- **Time to Memorise Icon (Stress, Post-Stress)** 

Thank you!

Zhanna Sarsenbayeva

zhanna.sarsenbayeva@sydney.edu.au