User Interaction

COMPSCI2031

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Recap: What we did last yesterday

Lecture on Heuristic Evaluation and Human Cognition

Reading: How to Conduct a Heuristic Evaluation by Jacob Neilson

User Interaction Topics

- ✅ HCI History and Introduction
- ✅ Usability and Heuristics
- ✅ Heuristic Evaluation and Human Cognition
- Human Perception and Capabilities
- Experimental Design & Variables Research
- Personas and Scenarios
- Surveys in HCI
- Ethnography
- Statical Methods
- Theories in HCI
- Models of Interaction
- Large Scale and Mobile HCI
- User-Centered Design
- Ethics in User Testing
- Revision & Example Exams

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Human Perception and Capabilities

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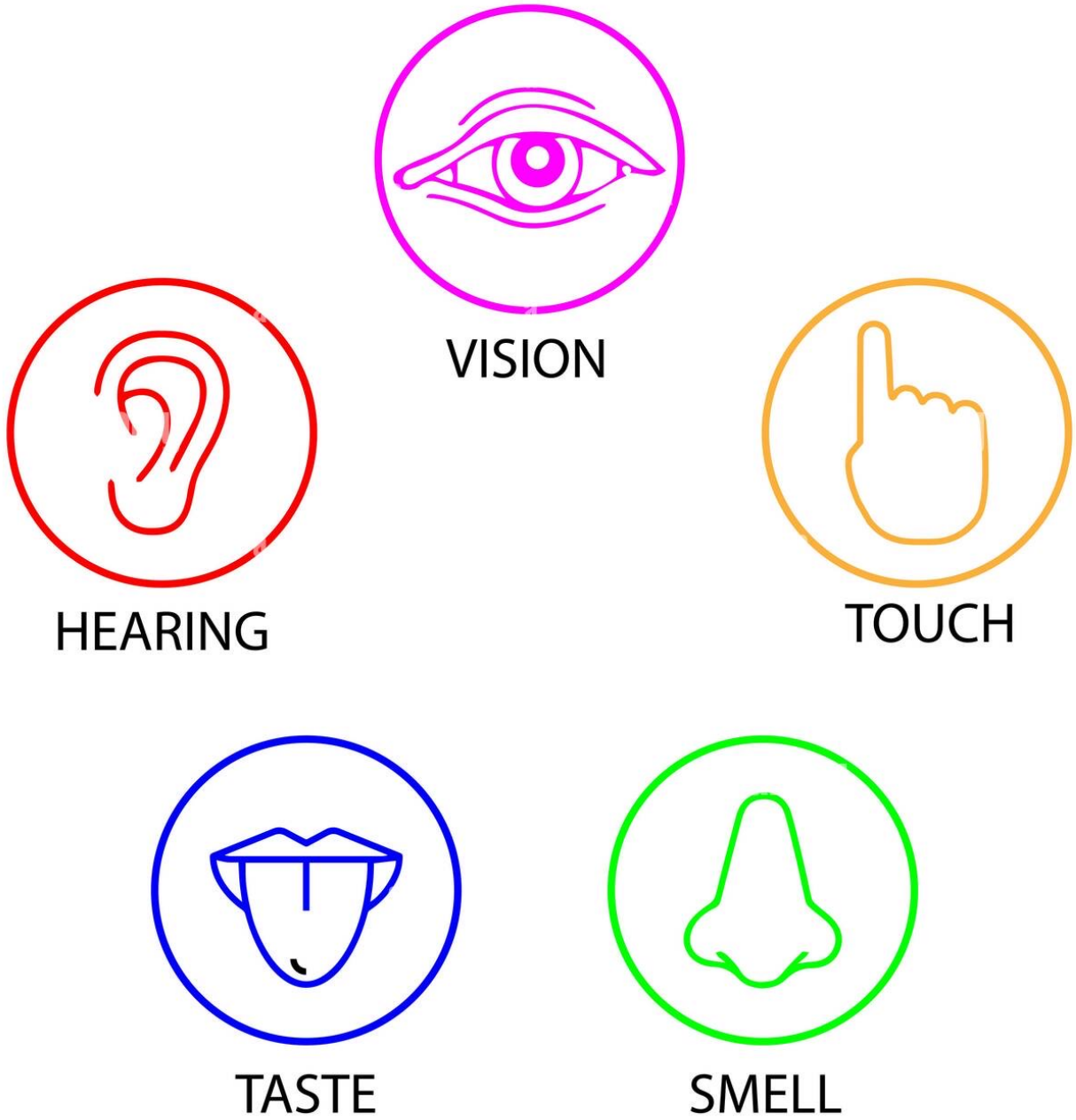
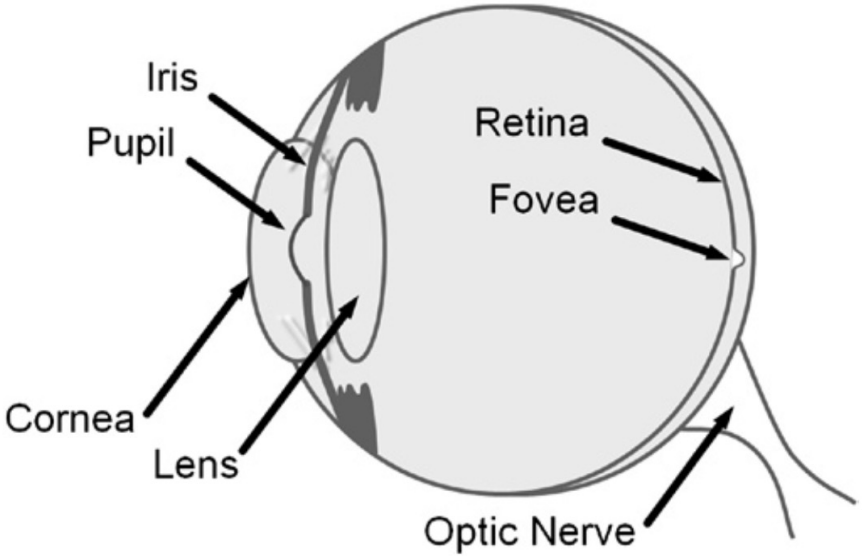
Human senses



Vision

- Light passes through the lens
- The lens focuses light into an image projected onto the retina
- The retina converts visible light into neurological signals
- The centre of the retina, the fovea, processes details



Properties of Vision

- Frequency of visible light
- Intensity
  - Eye light sensitivity varies by wavelength
- Fixations and Saccades
  - Fixations processes detail while the eyes are still
  - Saccades are rapids movements (30-120 ms) of the eyes to a new position
- Understanding human eye motion is important to understand how content is viewed
- Scanpath
  - In eye tracking studies, a sequence of fixations & saccades

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Eye-Tracking

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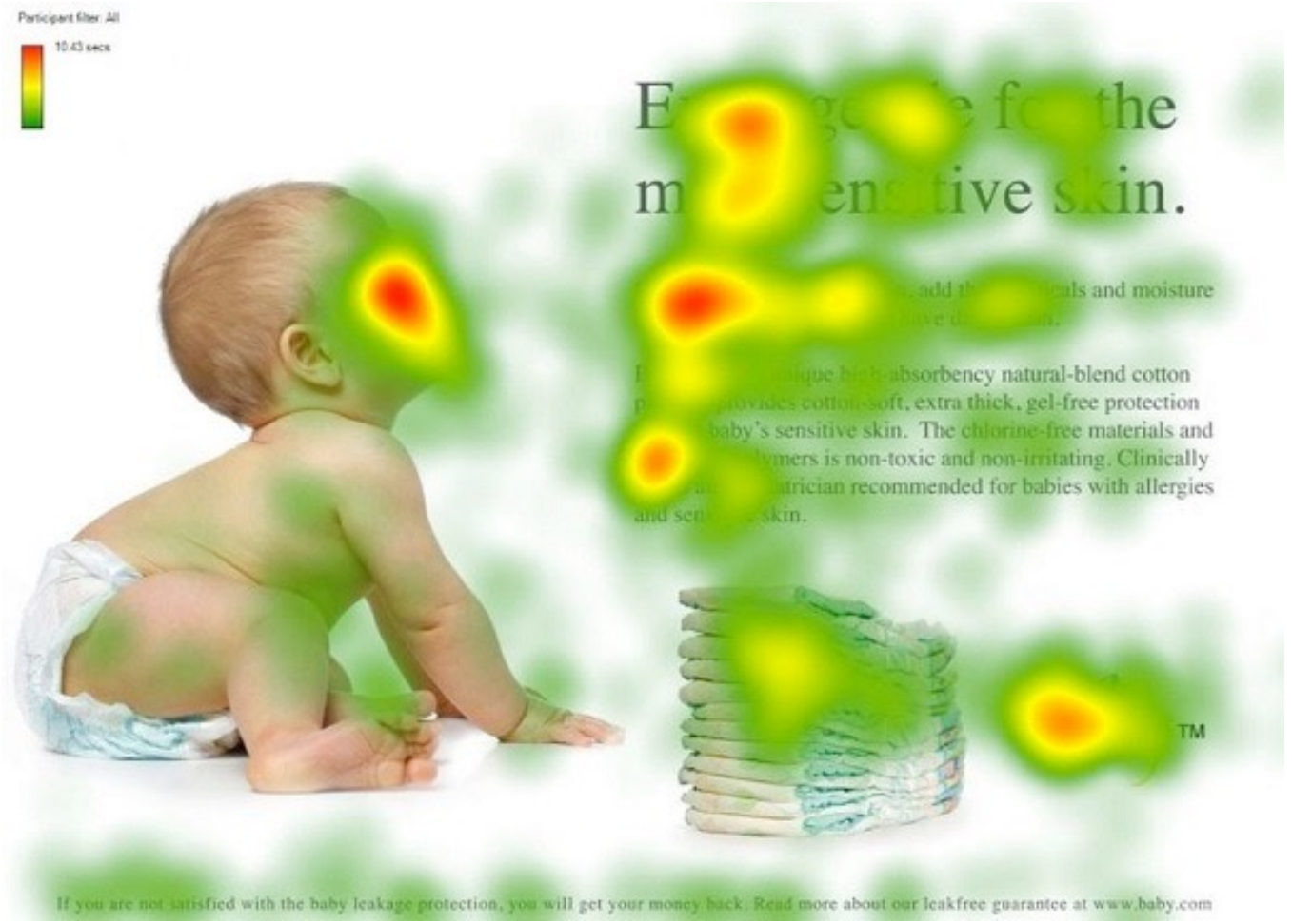
Eye-Tracking



Hearing

- Sounds are perceived from cyclic fluctuation of pressure
  - Typically, in air
- Loudness
  - Subjective perception of sound pressure level
- Pitch
  - Subjective perception of frequency
- Timbre
  - Harmonic structure to be described as richness or brightness
- Envelope
  - Changes in the subjective properties over time

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Touch

- Touch / haptic
  - Through vibration, air, and ultrasound
  - For reference: https://dl.acm.org/citation.cfm?id=2663280
- Temperature
  - For reference: https://dl.acm.org/citation.cfm?id=1979316
- Pain
  - We try to avoid this in HCI
- Proprioception
  - The ability to sense the position of your body and limbs

Smell

- Olfaction
  - The ability to perceive odors
- HCI has explored scent through scent “cubes”
  - fans that disperse scent, and pressurized delivery systems
- Olfoto: tagging photos with smells vs. text
  - For reference: https://dl.acm.org/doi/abs/10.1145/1124772.1124869

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Taste

- Yes, really!
  - Chemical reception of sweet, salty, umami, bitter, and sour
- TastyFloats
  - Levitate food onto user's tongue
  - For reference: https://dl.acm.org/citation.cfm?id=3134123

- Summary of multi-sense interactions
  - For reference: https://dl.acm.org/citation.cfm?id=3134123

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TastyFloats

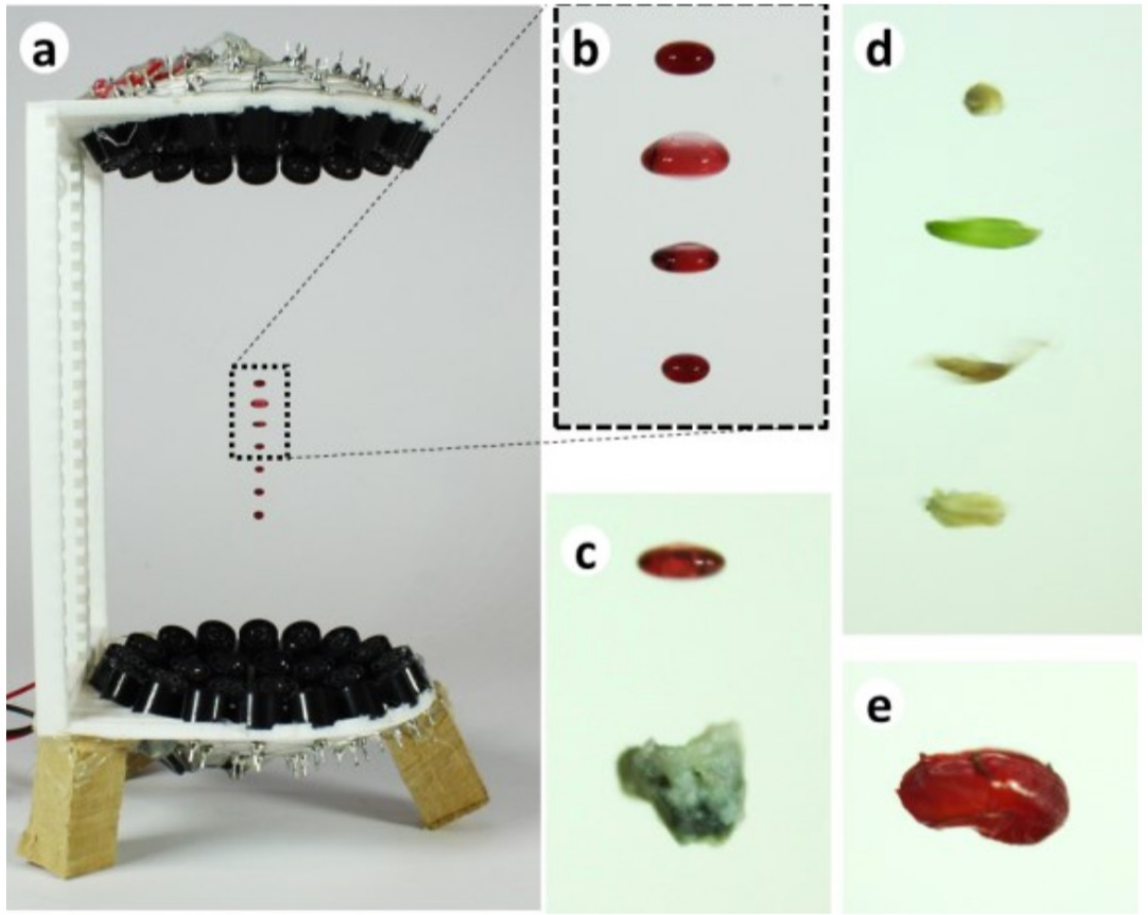

Figure 1. Examples of levitated food morsels: a, b) Acoustic levitation of droplets of wine; c) Wine and blue cheese; d) Bread, lettuce, meat and bread; e) and a raspberry grain.

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Human Responses

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Limbs

- Input for systems is primarily achieved by moving the limbs in 3D space
  - Think of typing, using a mouse, using a trackpad
  - We use our limbs to generate a signal that is interpreted as input

Voice

- Speech recognition has come a long way, but we still face challenges of segmentation, recovery from errors, and information throughput

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Eyes

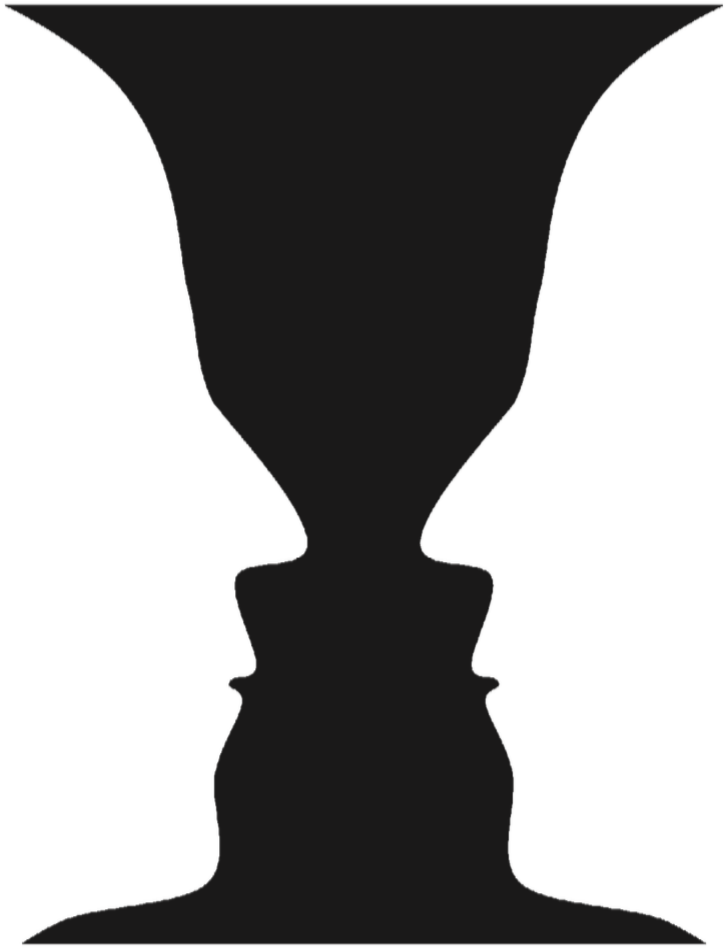
- Selection based in Gaze is a common approach in VR, and becoming more common in less instrumented environments as well
  - For example, consider common phone unlocking techniques
- Most info probably also coming in through vision, so eyes doing double tasks

Human Brain

- Connects the sensors and responders
- Different processes/capabilities
  - Perception
  - Cognition
  - Memory

Perception

- First stage of processing in the brain
  - Associations and meanings take shape
- Just Noticeable Difference
  - Below what threshold can humans no longer perceive difference?



For reference: https://dlnext.acm.org/doi/abs/10.1145/2556288.2557033

Perception and Ambiguity

- Illusions work when our perception fills the gaps in ambiguous stimuli
  - Ponzo lines demonstrate how our depth perception changes how we look at the two black lines
- There are illusions that can trick our visual, aural, and haptic senses

Cognition

- Human process of conscious intellectual activity
  - Thinking, reasoning, deciding

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Memory

- Ability to store, retain, and recall information
- Short term memory capacity 7 ± 2
  - Has often been used to guide UI design, eg number menu items
    - Might be misunderstanding the original intent
    - Shorter menus probably still good though!

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Human Performance

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Human Performance

- Speed Accuracy Tradeoff – tasks completed faster are more error prone
  - People often prioritise speed or accuracy differently based on context
- Most of early HCI measured this, but still important and studied today
- E.g. performance with various input devices
  - But also augment overall human performance, e.g. find answers to questions with visualisation tool vs looking at raw numbers

Reaction Time

- Different sensory modalities have different reaction times
  - 150ms audio
  - 200ms visual
  - 300ms smell
  - 700ms pain
- Visual search is another example of reaction which includes more complex cognition that simply responding to stimuli

Skilled Behaviour

- In most tasks beyond simple responses, human performance can increase with practice
  - Like playing darts and playing chess
- Playing darts requires training of your sensor/motor skill
- Playing chess requires training of your mental skill
- Some tasks require both

Attention

- When task performance degrades with performed simultaneously with another, we can say that task requires attention
  - Consider walking and talking
  - Consider reading and talking
  - Driving and talking?

Attention

- Divided attention is concentrating/performing more than one task at a time
  - Typically, this will degrade performance, which is not an option in safety critical contexts like driving
- Focused attention is attending to one task to the exclusion of all others
  - The ability to ignore external events not always possible or feasible
  - In a noisy room, you might be able to have a conversation but are likely to be distracted at times.
- Sensory modalities are often thought of as channels, but in practice it is not so simple

Human Error

- Error is a discrete event in a task where the outcome is incorrect or deviates from the desired outcome
- In practice, this kind of coarse measure of error provides a limited understanding
  - Consider the Key Stroke dataset
  - “error” in this sense isn’t even reported in this dataset, although it’s simple to calculate
- We are often trying to measure something more complicated than % of errors

Questions?
Comments?
Concerns?

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Reaction Time Task

- In your teams:
- Test your reaction time to light: https://humanbenchmark.com/tests/reactiontime three times individually. As a group, put your individual answers together in a table to get an average time for your group.
- Test your reaction time to sound: https://playback.fm/audio-reaction-time three times individually. As a group, put your individual answers together in a table to get an average time for your group.
- Find out which one as a group you react towards fastest, post these two tables on your Teams space as well as a few sentences on what you found and how this human performance would impact how you make interactive computers for humans, e.g., auditory vs visual notifications.

Reaction Time: Class Discussion

Reading: None