"If you're not prepared to be wrong, you'll never come up with anything original."

Sir Ken Robinson

www.interaction-design.org

3D Interaction in Mixed Reality

Design Thinking Process
Test

Prof. Carlos Hitoshi Morimoto
Computer Science Department
IME/USP

leituras recomendadas

Stage 5 in the Design Thinking Process: Test

BY RIKKE DAM AND TEO SIANG

https://www.interaction-design.org/literature/article/stage-5-in-the-design-thinking-process-test

Usability evaluation

BY GILBERT COCKTON

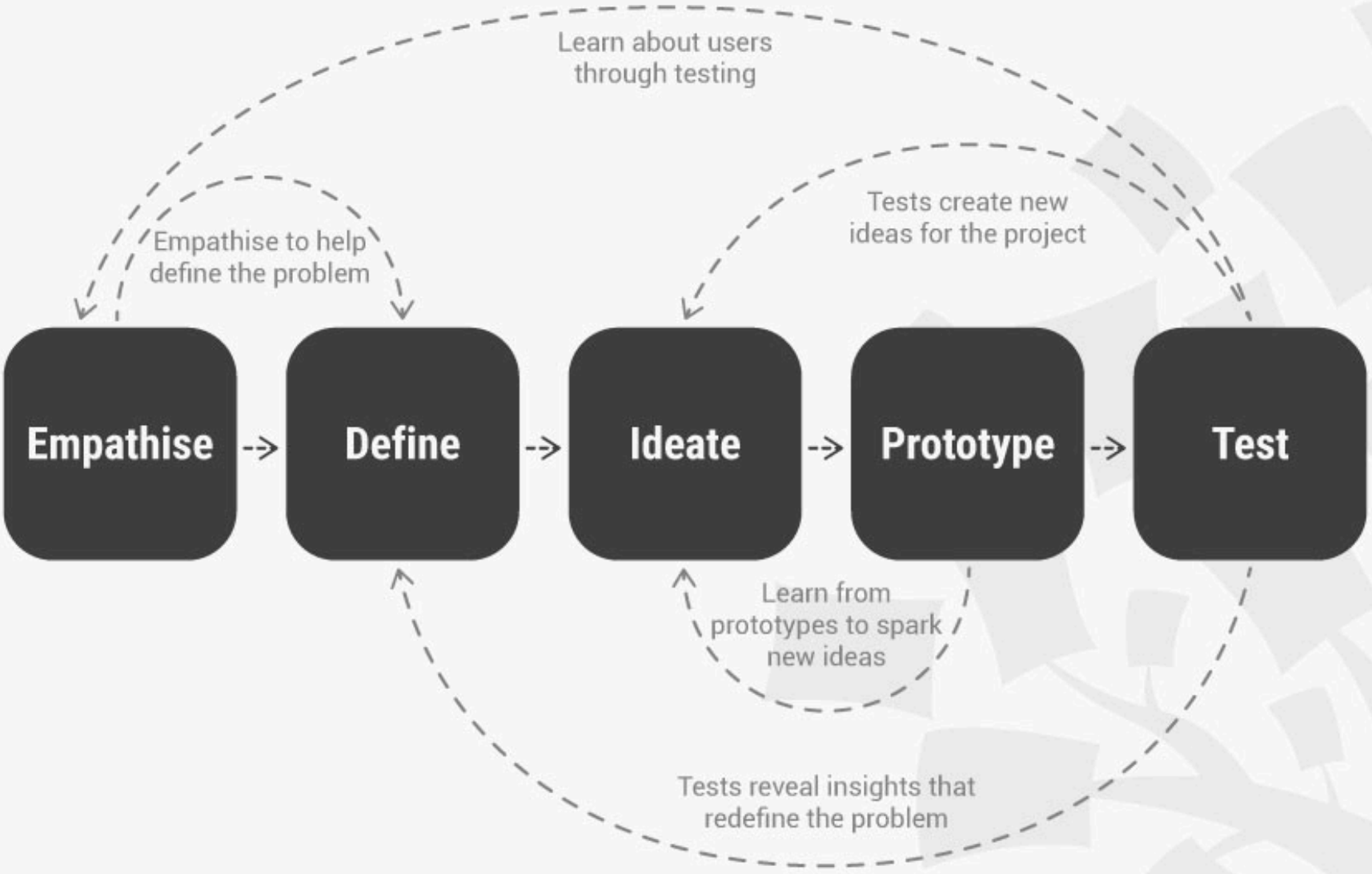
https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/usability-evaluation

Augmented Reality Design Heuristics: Designing for Dynamic Interactions

BY T. ENDSLEY et al.

https://www.researchgate.net/publication/320544042_Augmented_Reality_Design_Heuristics_Designing_for_Dynamic_Interactions

DESIGN THINKING: A NON-LINEAR PROCESS



Why and when to test?

Testing is undertaken throughout the progress of a Design Thinking project

- most commonly during prototyping, to refine your ideas
- during needfinding, to get deeper understanding of your users and needs
- may lead to new insights that change the way you define your problem statement
- may generate new ideas in the ideation stage

How to conduct a test

Context

try to find a natural setting (normal environment in which your users would use the prototype)

if not possible, have the user play a role as in real life.

Prototype

should be designed to answer a question about your design that you put to the test.

User

make sure they know what the prototype and test are about.

do not over explain how the prototype works

User feedback

do not interrupt the user during interaction. Find a way to collect feedback without disrupting the interaction.

Planning a test

Let users compare alternatives

compare different prototypes, each with a different variable. Let them tell what they prefer.

Let users experience the prototype. Show, don't tell.

avoid over-explaining how it works.

Ask users to talk through their experience (thinking process and actions)

ask them to talk aloud what they are thinking and doing

Observe

resist the urge to help or explain how to. Mistakes are valuable learning opportunities.

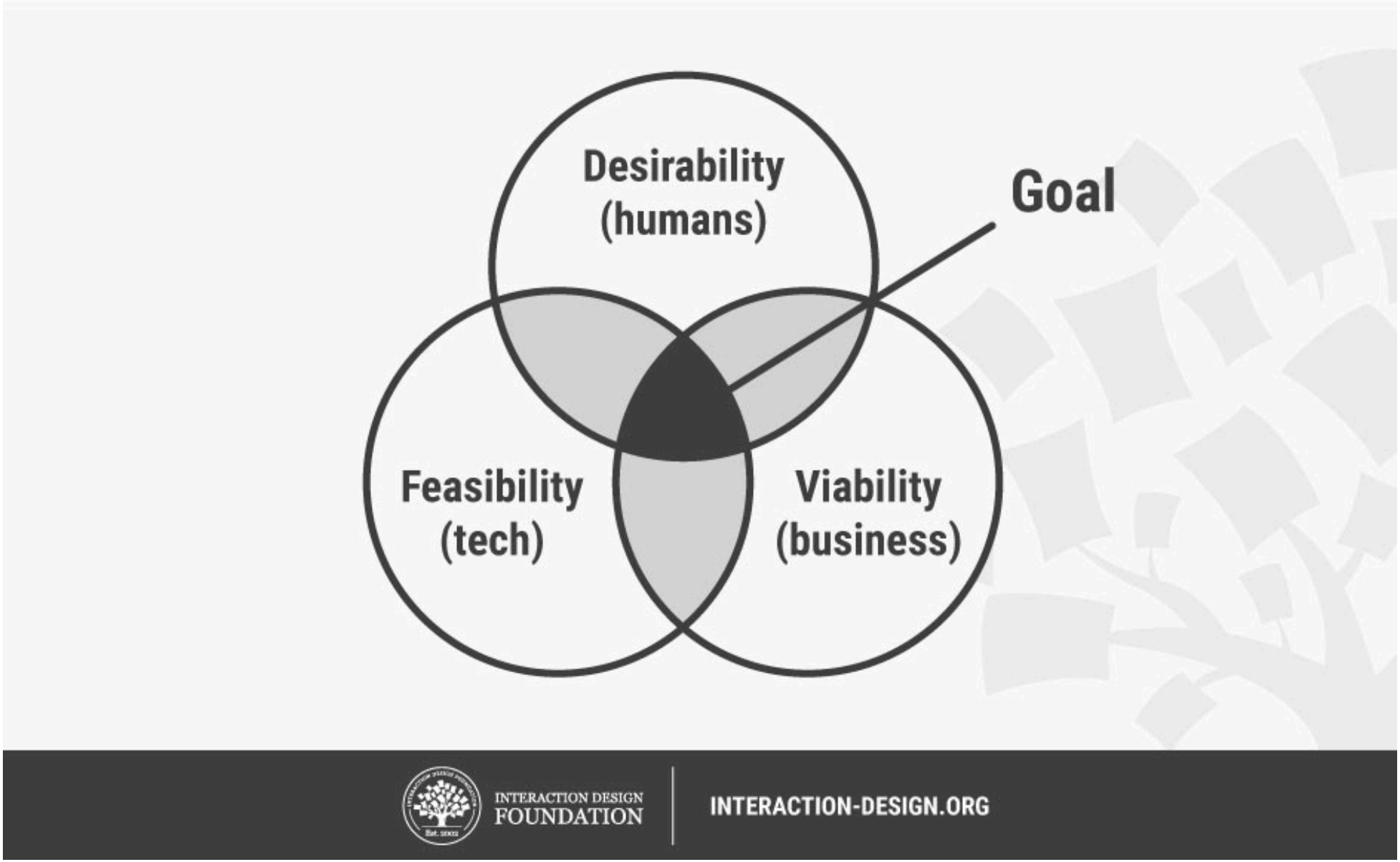
Ask follow up questions

ask why?

how did it make you feel?

Test the prototype not the user

the end goal: desirable, feasible, and viable solutions



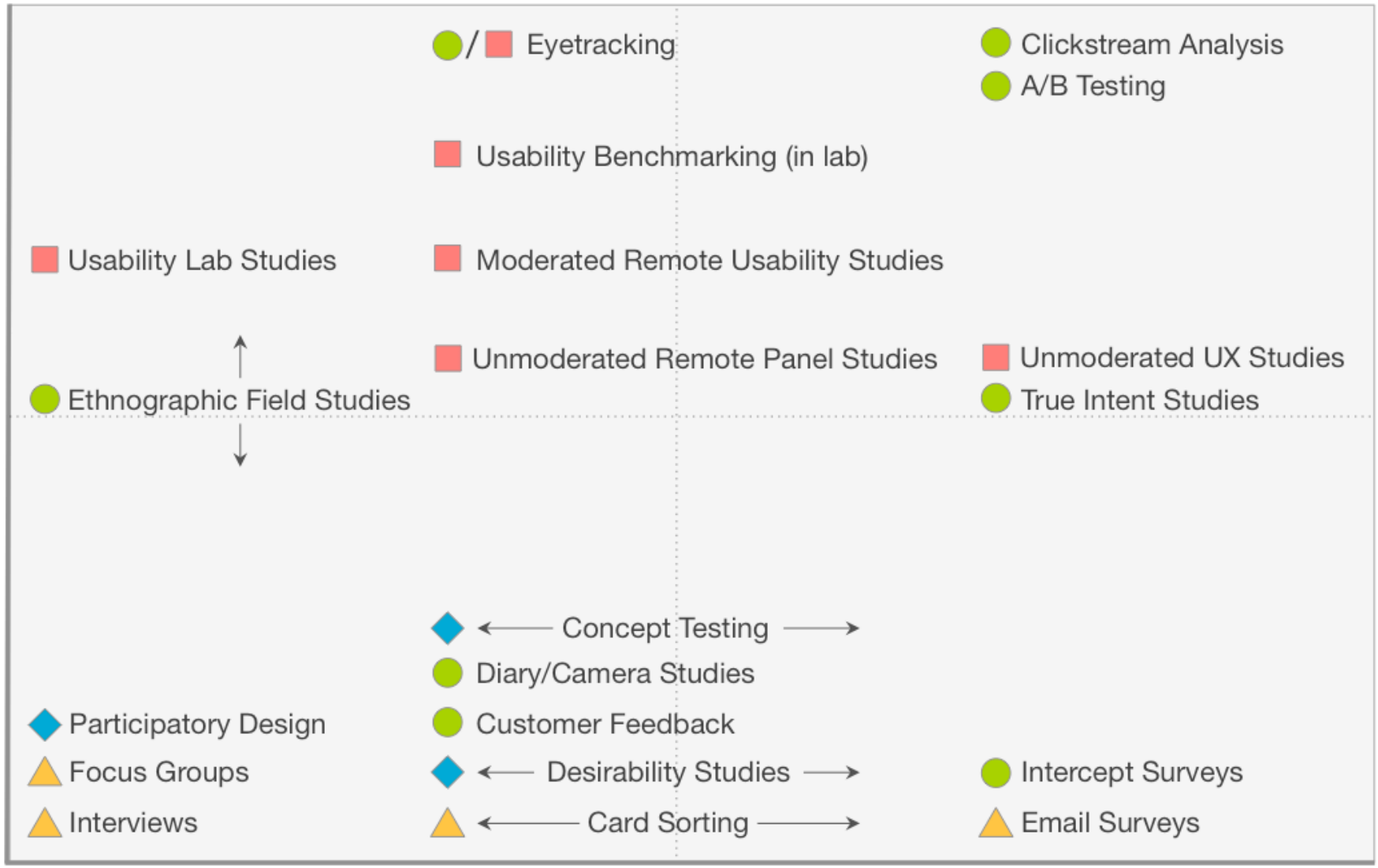
Evaluation as a 3D framework

Attitude x Behaviour

Qualitative x Quantitative

Context

A Landscape of User Research Methods



KEY FOR CONTEXT OF PRODUCT USE DURING DATA COLLECTION

- Natural use of product
- Scripted (often lab-based) use of product
- De-contextualized / not using product
- Combination / hybrid

Attitude x Behaviour

- Attitude: what people say
  - what they believe
  - Questionnaires, surveys, interviews, focus groups, card sorting
- Behaviour: what people do
  - Field studies
  - A/B testing
  - Eye tracking

Qualitative x Quantitative

Use context

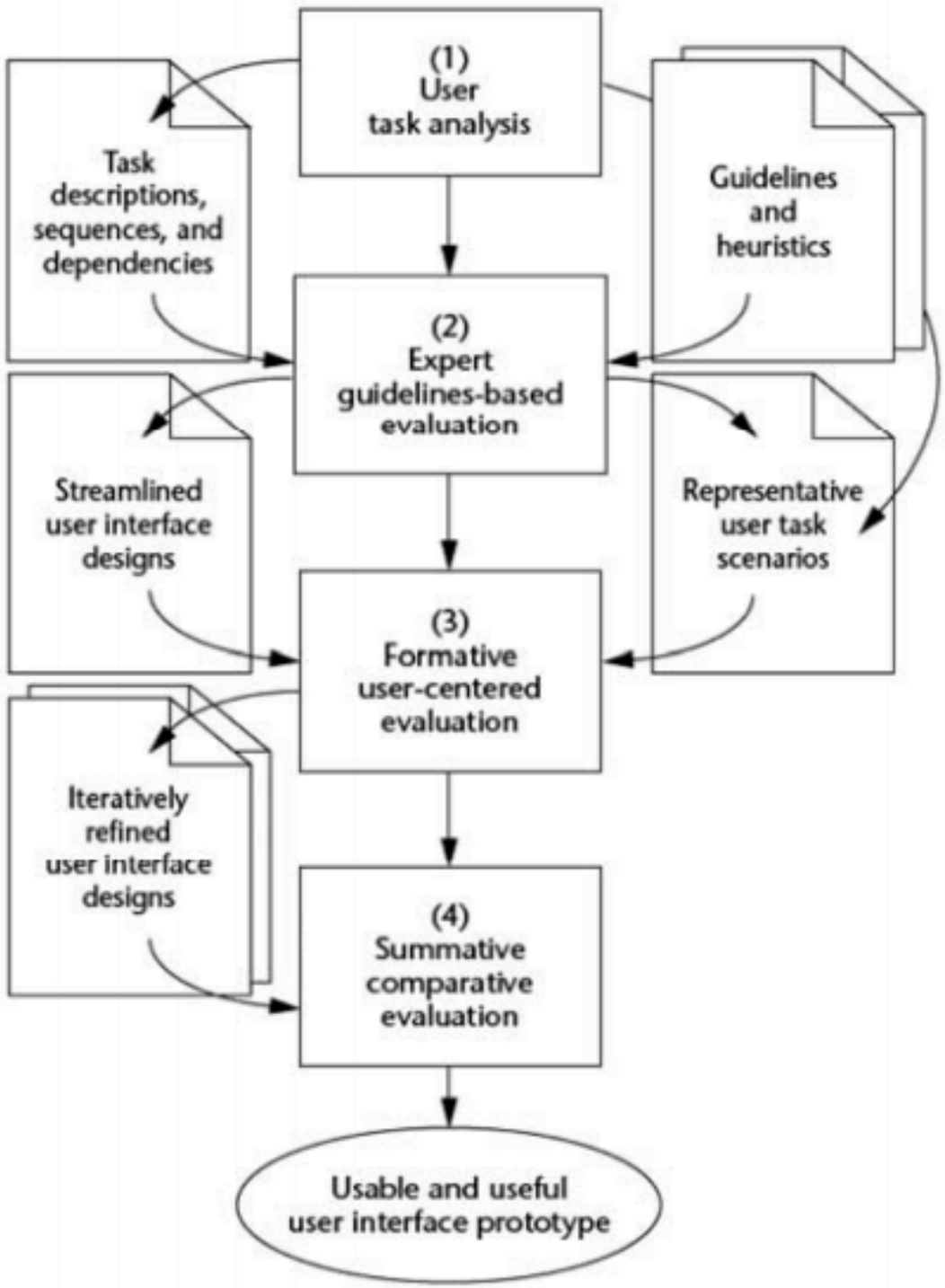
- Natural (or almost)
  - use in real environment
- Scripted:
  - follow a script
- Does not use the product
- Hibrid

	Product Development Phase		
	Strategize	**Execute**	**Assess**
Goal:	Inspire, explore and choose new directions and opportunities	Inform and optimize designs in order to reduce risk and improve usability	Measure product performance against itself or its competition
Approach:	Qualitative and Quantitative	Mainly Qualitative (formative)	Mainly Quantitative (summative)
Typical methods:	Field studies, diary studies, surveys, data mining, or analytics	Card sorting, field studies, participatory design, paper prototype, and usability studies, desirability studies, customer emails	Usability benchmarking, online assessments, surveys, A/B testing

AR Evaluation framework example

A Cost-Effective Usability Evaluation Progression for Novel Interactive System

Hix et al. [2004]



Example: BARS (battlefield AR system)

Figure 3. User wearing BARS equipment.

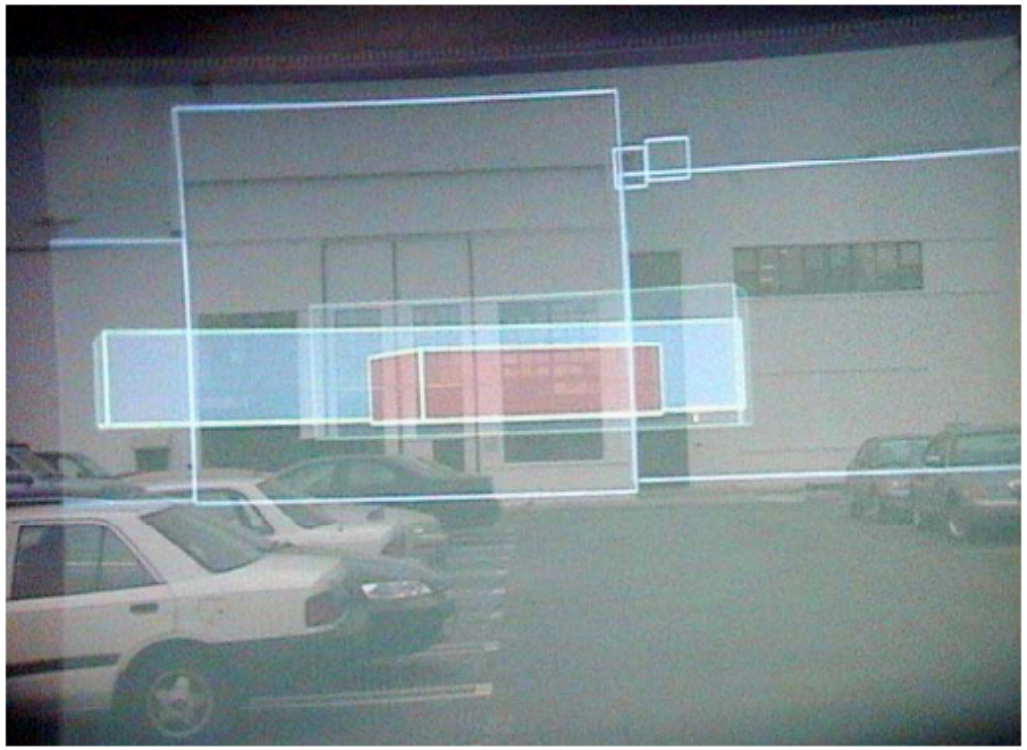


Figure 5. An example of a BARS user's view of real-world buildings augmented with overlaid graphics to indicate occluded (hidden) buildings. The overlaid information can contain text, bitmaps, or any computer-generated visual data. In this example, the lighter the shading of the object, the further away it is.

AR Heuristics

Nielsen Heuristics

Visibility of the system state

Match between system & world

User control and freedom

Consistency and standards

Error prevention

Recognition over recall

Efficient and flexible

Minimalistic design

Recognise and recover from errors

Help and documentation

https://www.interaction-design.org/literature/article/heuristic-evaluation-how-to-conduct-a-heuristic-evaluation

Process suggested by Nielsen and Molich

- Select your evaluators: usability experts with the domain expertise
- Brief your evaluators: so they know exactly what to do (list of tasks)
- First evaluation phase: The evaluators use the product freely and then identify specific elements to be evaluated
- Second phase: another run through, focusing on individual elements and looking how well they fit in the overall design.
- Record problems: either the evaluators record the problems or you should record them as they carry out the tasks.
- Debriefing session: involves collaboration between the evaluators:
  - discuss the problems that were found
  - list them
  - prioritize them

Other Heuristics

The Principles of Universal Design

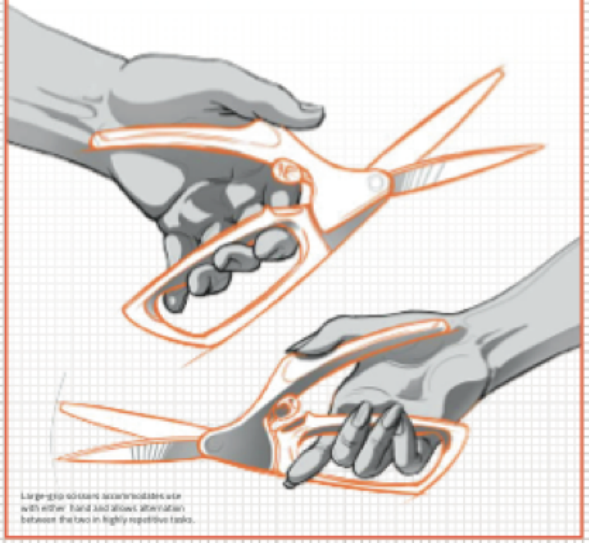
The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

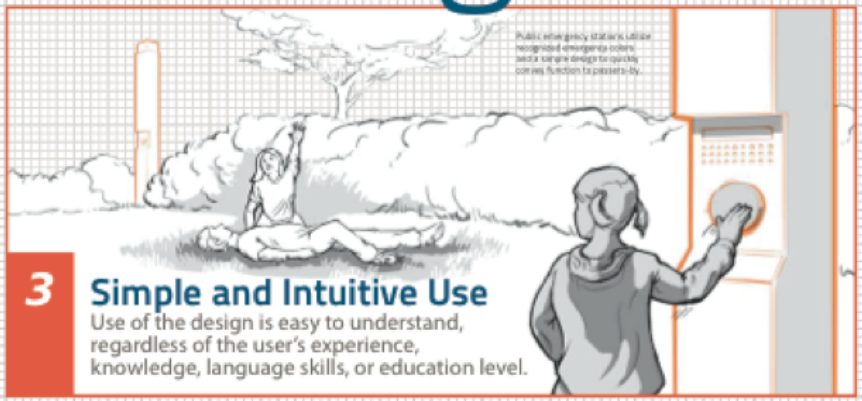
1 Equitable Use

The design is useful and marketable to people with diverse abilities.

2 Flexibility in Use

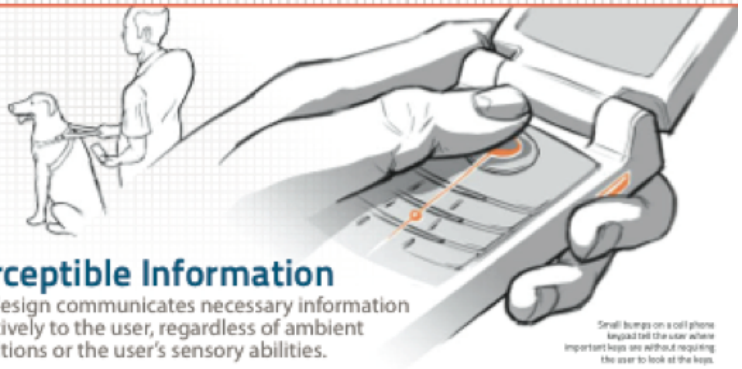
The design accommodates a wide range of individual preferences and abilities.





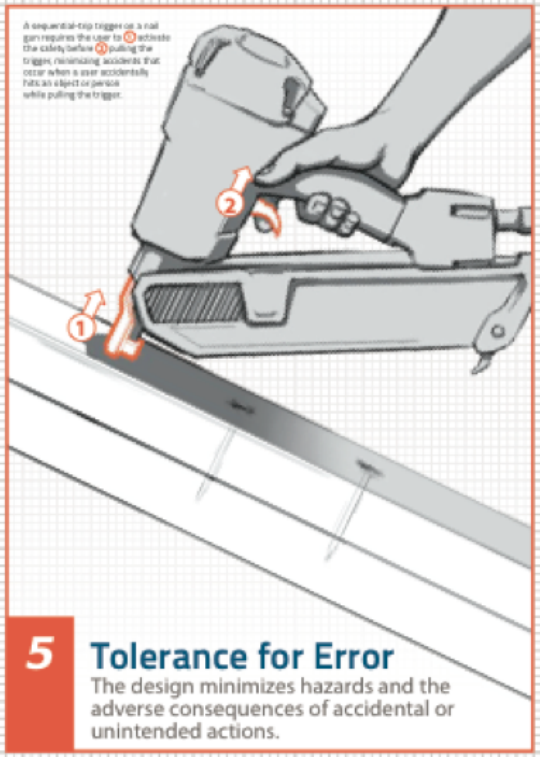
3 Simple and Intuitive Use

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or education level.



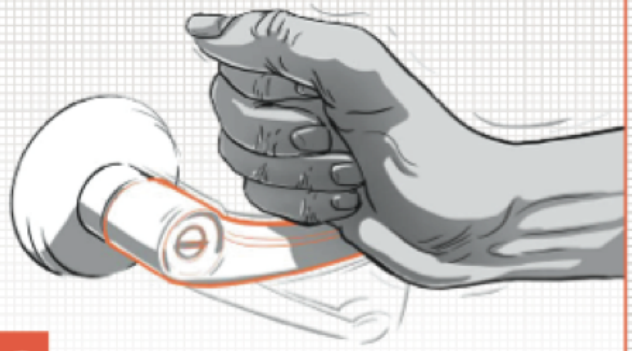
4 Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.



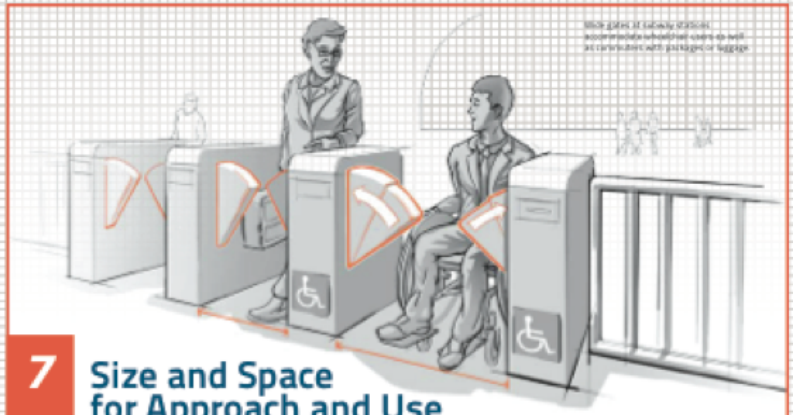
5 Tolerance for Error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.



6 Low Physical Effort

The design can be used efficiently and comfortably and with a minimum of fatigue.



7 Size and Space for Approach and Use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

Center for Universal Design at NC State

Web: design.ncsu.edu/cud

E-mail: cud@ncsu.edu

AR Heuristics

Fit with user environment and task.

AR experiences should use visualizations and metaphors that have meaning within the physical and task environment in which they are presented. The choice of visualizations & metaphors should match the mental models that the user will have based on their physical environment and task.

Form communicates function.

The form of a virtual element should rely on existing metaphors that the user will know in order to communicate affordances and capabilities.

Minimize distraction and overload.

AR experiences can easily become visually overwhelming. Designs should work to minimize accidental distraction due to designs that are overly cluttered, busy, and/or movement filled.

AR Heuristics

Adaptation to user position and motion.

The system should adapt such that virtual elements are useful and usable from the variety of viewing angles, distances, and movements that will be taken by the user.

Alignment of physical and virtual worlds.

Placement of virtual elements should make sense in the physical environment. If virtual elements are aligned with physical objects, this alignment should be continuous over time and viewing perspectives.

Fit with user's physical abilities.

Interaction with AR experiences should not require the user to perform actions that are physically challenging, dangerous, or that require excess amounts of coordination. All physical motion required should be easy.

AR Heuristics

Fit with user’s perceptual abilities.

AR experiences should not present information in ways that fall outside of an intended user's perceptual thresholds. Designers should consider size, color, motion, distance, and resolution when designing for AR.

Accessibility of off screen objects.

Interfaces that require direct manipulation (for example, AR & touch screens) should make it easy for users to find or recall the items they need to manipulate when those items are outside the field of view.

Accounting for hardware capabilities.

AR experiences should be designed to accommodate for the capabilities & limitations of the hardware platform.

Design break

What are YOUR I/O requirements for an AR wearable device?

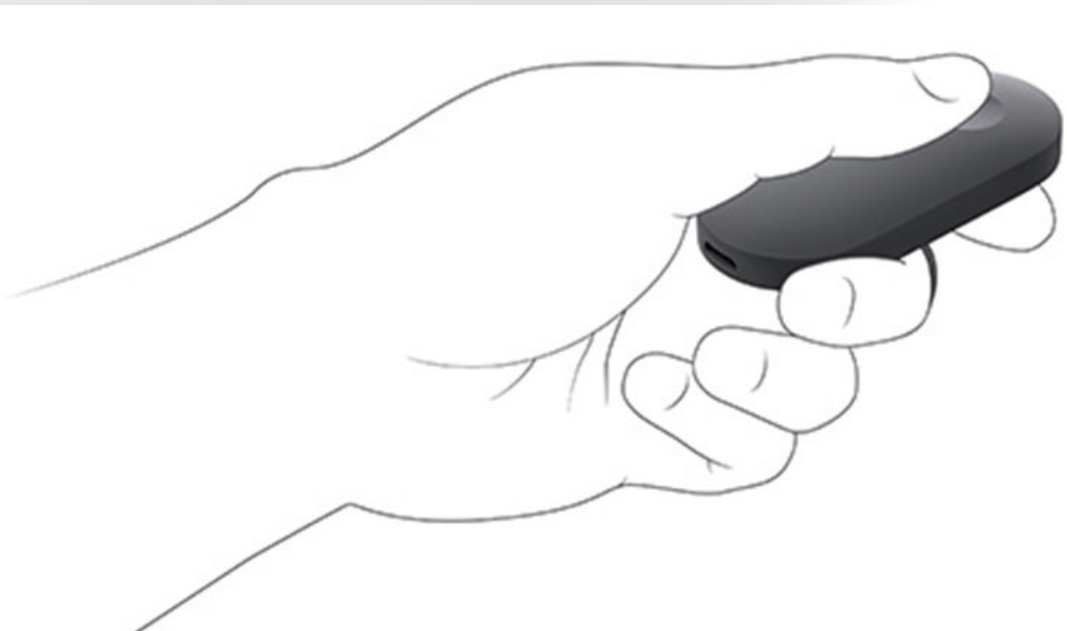
input sensors
output "perceptual displays"

Case study

3 HoloStudio UI and interaction design

https://www.youtube.com/watch?v=BRIJG0x_We8

https://developer.microsoft.com/en-us/windows/mixed-reality/case_study_-_3_holostudio_ui_and_interaction_design_learnings



HoloStudio: design tool

HoloStudio Workbench

Problem 1

People did not want to move around their creations

- why?
  - people are used to stay still when working with their computers
  - round workbench: no clear place for the user to stand.
- lesson: think about what is comfortable.

solution: circular workbench

Problem 2

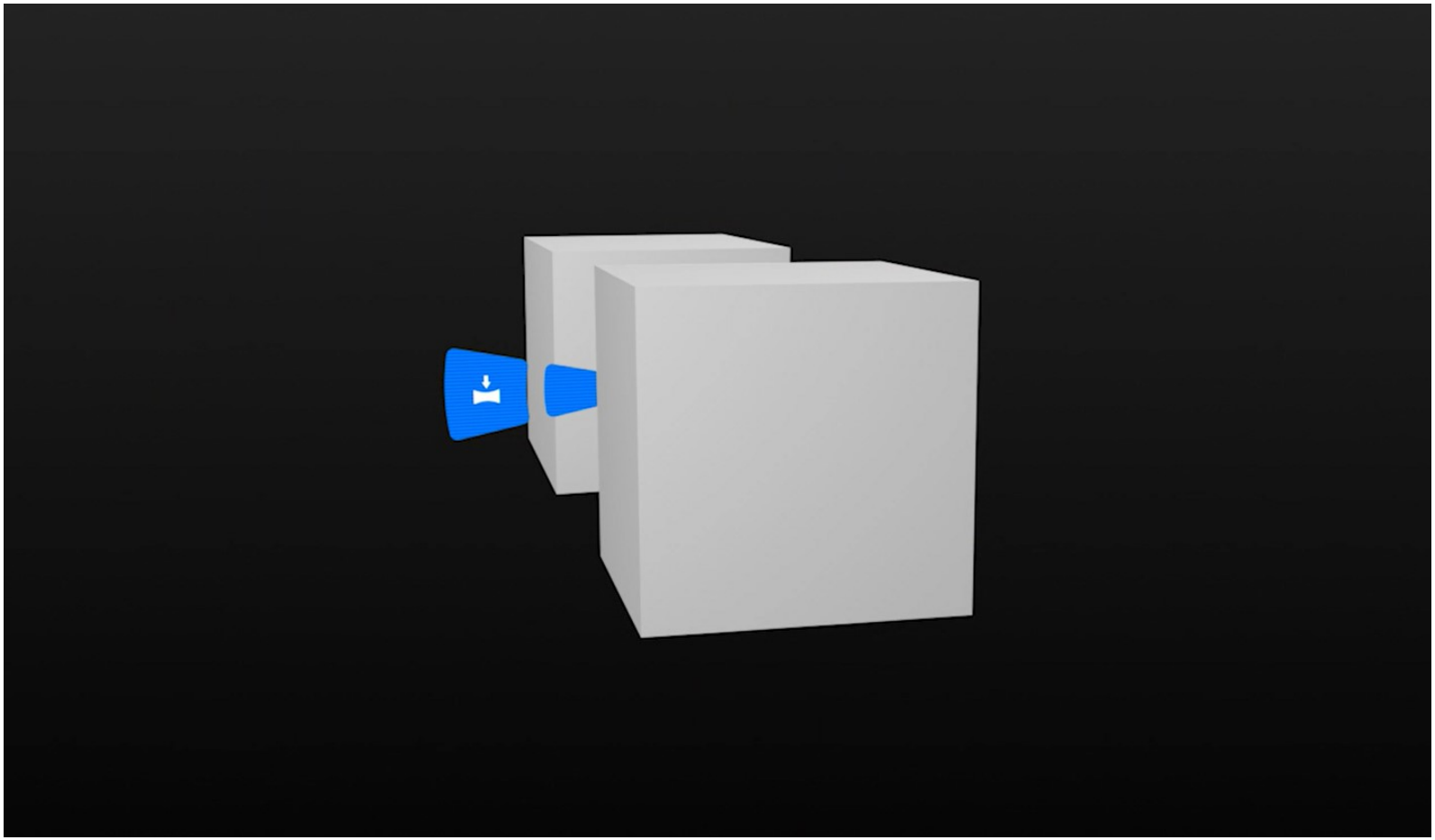
Modal dialogs are sometimes out of the holographic frame

- why? you cannot just pop up a window in 3D.
  - Maybe during a game, but not work.
  - HoloStudio uses "thought buble" for dialogs and added tendrils (pulsing) users can follow to where their attention is needed
- lesson: harder to alert users in 3D to things they need to pay attention to. Use spatial sound, light rays, or thought bubbles.

Solution: thought bubbles

Problem 3

- Sometimes UI can get blocked by other holograms



Alternative 1

- Move UI control closer to the user so it cannot get blocked

users did not feel comfortable (near control and far objects)

Alternative 2

- Move UI in front of the closest hologram to the user

users feel control detached from the hologram it should be affecting

Alternative 3

- Ghosting the UI control
  - same distance as the associated hologram (feels connected)

Lesson: users need to easily access UI controls even if they've been blocked

Summary

The end goal is to design solutions that are desirable, feasible, and viable

Testing, most common in prototyping, allow designers to refine solutions, and even the problem statement.

Consider: context, prototype, user, and feedback.

Follow the guidelines

1. let your users compare alternatives
2. let users experience the prototype
3. ask users to talk through their experience
4. OBSERVE, don’t interfere
5. ask follow up questions

Apply your discoveries to refine your designs, iteratively though the design thinking process, till you reach the end goal.