CSC 2524, Fall 2017

Design and Prototyping for XR

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Credit: adapted from slides by Mark Billinghurst

Typical XR System

HMD

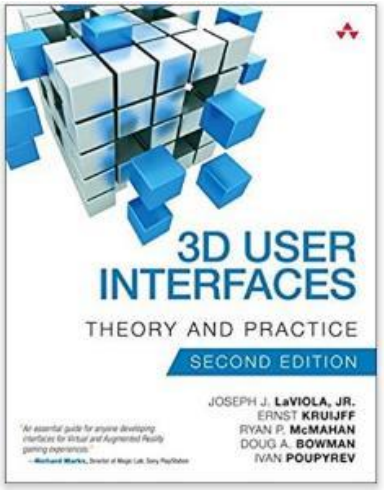
User Interface

Input

Tracking

How can we Interact in XR?

Universal 3D Interaction Tasks in XR



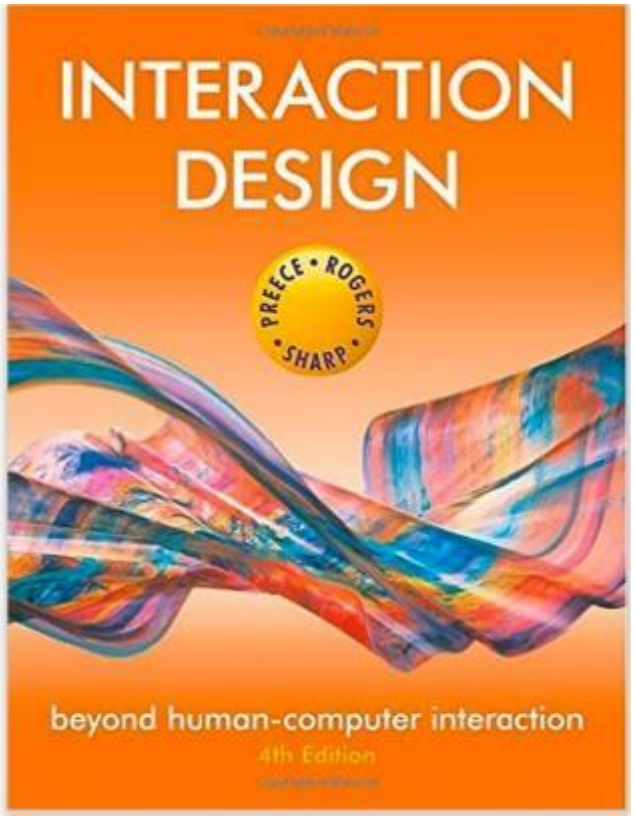
- Object Interaction
  - *Selection:* Picking object(s) from a set
  - *Manipulation:* Modifying object properties
- Navigation
  - *Travel:* motor component of viewpoint motion
  - *Wayfinding:* cognitive component; decision-making
- System control
  - Issuing a command to change system state or mode

How Can we Design for XR?

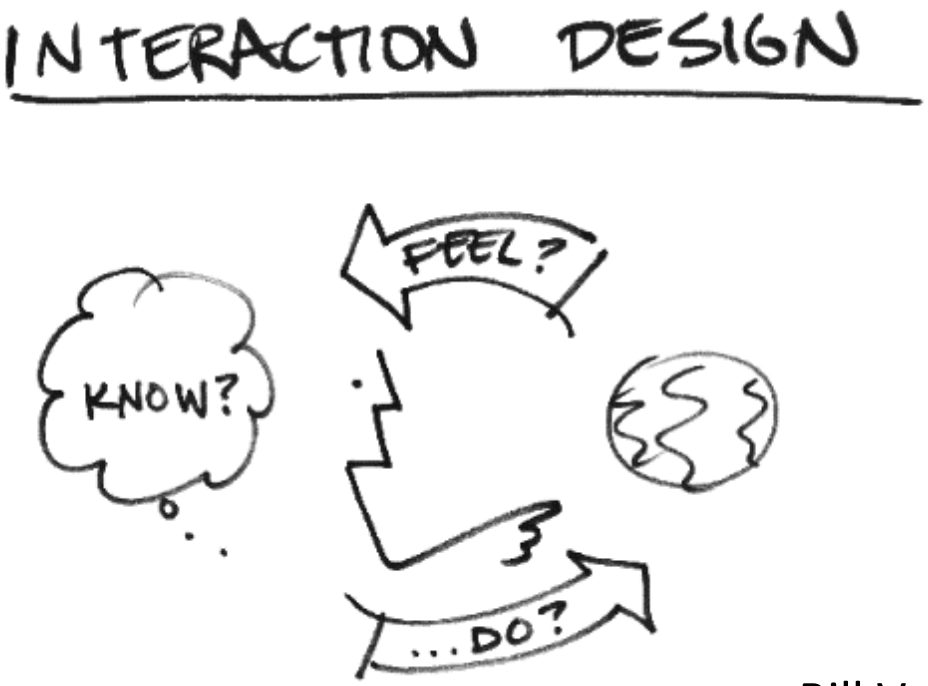
What is Interaction Design ?

"Designing interactive products to support people in their everyday and working lives"

Preece, J., (2002). Interaction Design



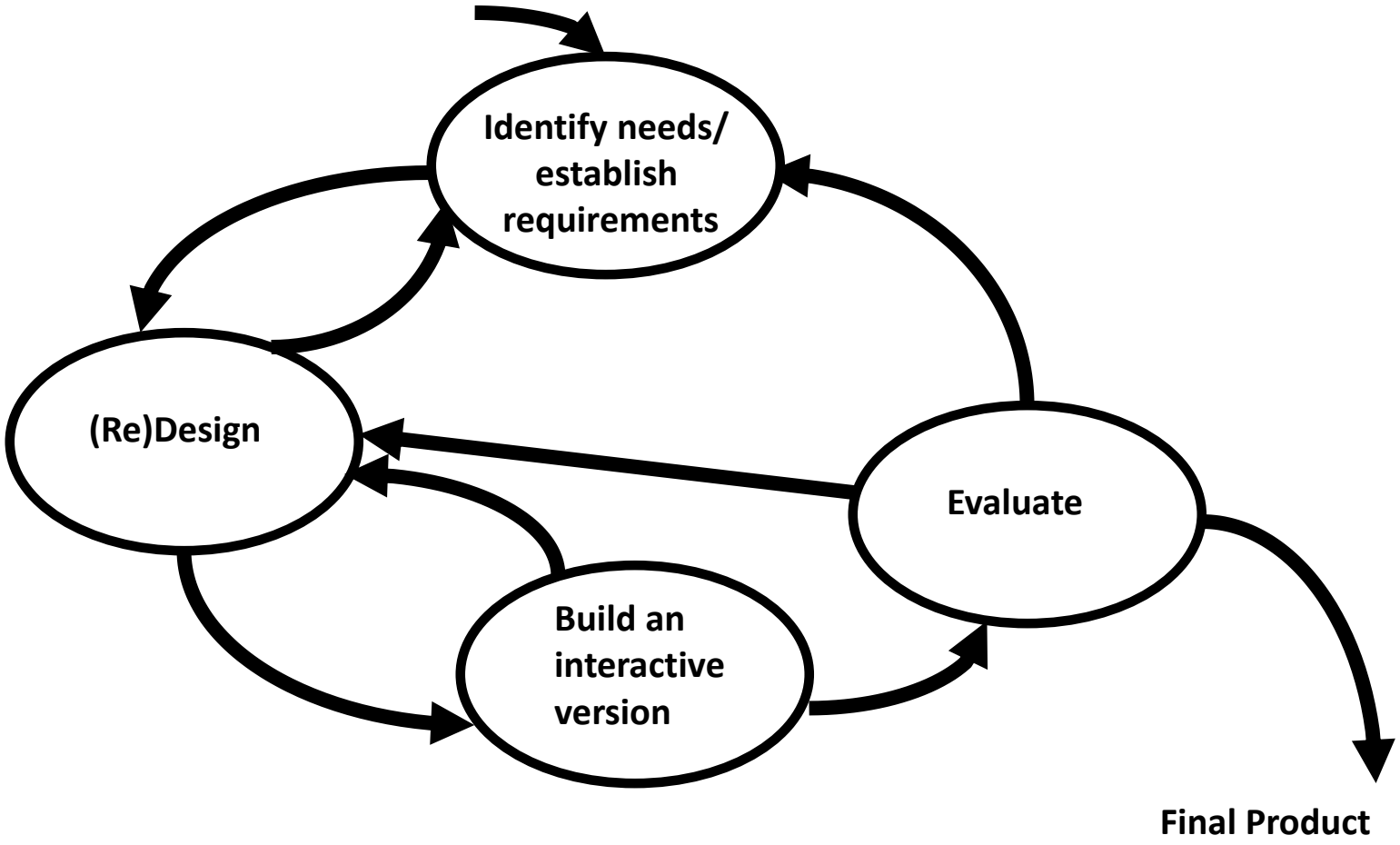
- Interaction Design is the design of user experience with technology



Bill Verplank

- What do you do? - How do you affect the world?
- What do you feel? – What do you sense of the world?
- What do you know? – What do you learn?

The Interaction Design Process



Develop alternative prototypes/concepts and compare them
And iterate, iterate, iterate....

Needs Analysis Goals

- Create a deep understanding of the user and problem space.
- Understand how XR can help address the user needs.

Key Questions

1. Who is the user?
   - Different types of users
2. What are the user needs?
   - Understand the user, look for insights
3. Can XR address those needs?
   - XR cannot solve all problems

Who are the Users?

- Different types of users, must consider them all
  - *Primary:* people regularly using the VR system
  - *Secondary:* people providing tech support/developing system
  - *Tertiary:* people providing funding/space for VR system

Methods for Identifying User Needs

Learn from people

Learn from Experts

Learn from analogous settings

Immersive yourself in context

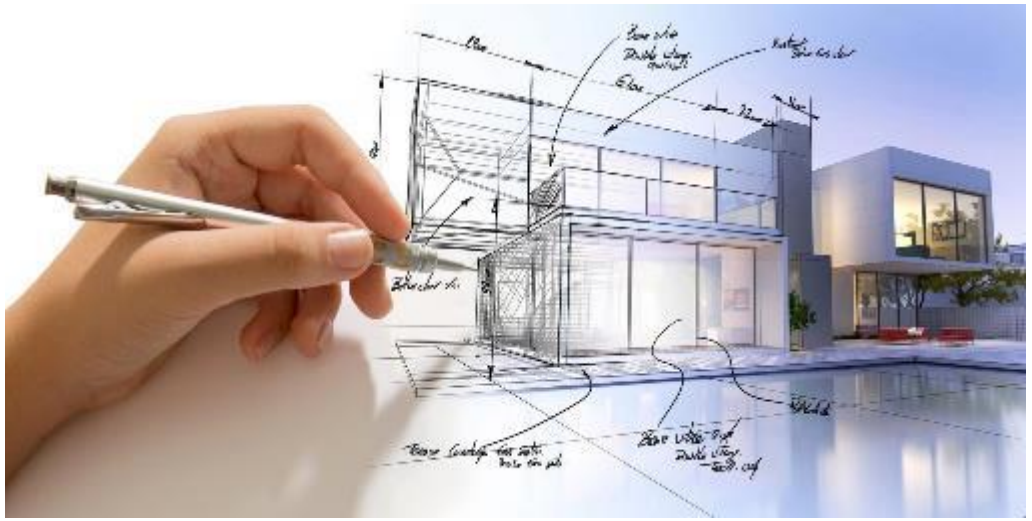
Identifying User Needs

- From understanding the user, look for needs
  - Human emotional or physical necessities.
  - Needs help define your design
- Needs are Verbs not Nouns
  - Verbs - (activities and desires)
  - Nouns (solutions)
- Identify needs from the user traits you noted, or from contradictions between information
  - disconnect between what user says and what user does…

Is XR the Best Solution?

- Not every problem can be solved by XR..
- Problems Ideal for XR, have:
  - visual elements
  - 3D spatial interaction
  - physical manipulation
  - procedural learning
- Problems Not ideal for XR, have:
  - heavy reading, text editing
  - many non visual elements
  - need for tactile, haptic, olfaction feedback (!VR)

Suitable for XR or not?



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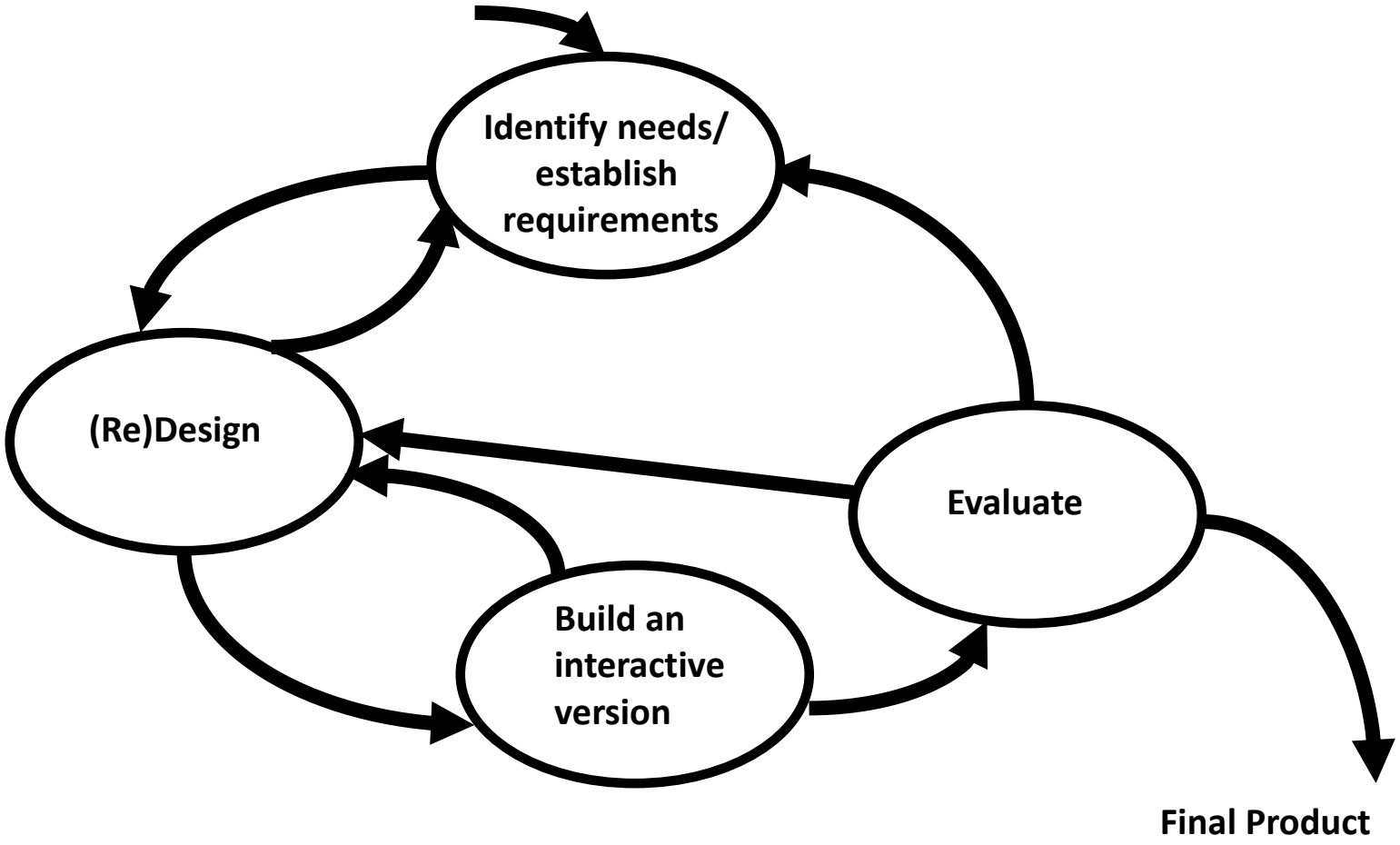

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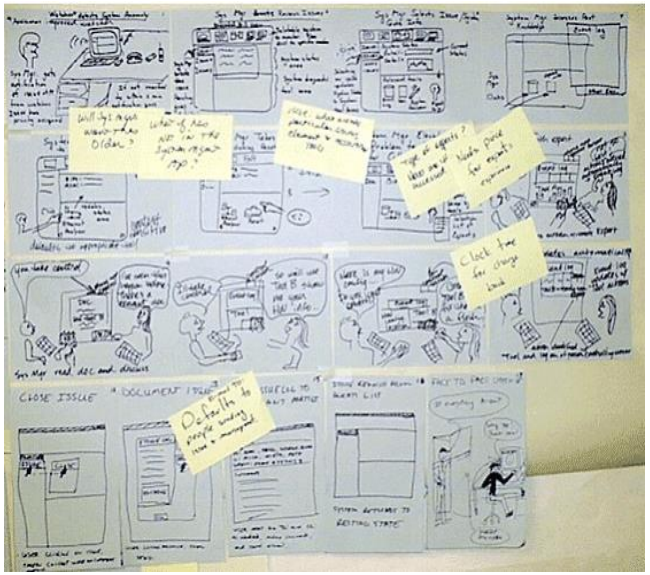
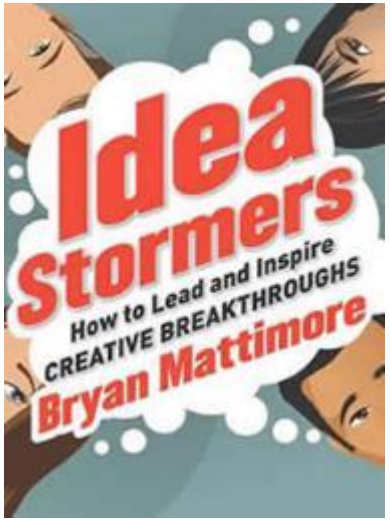
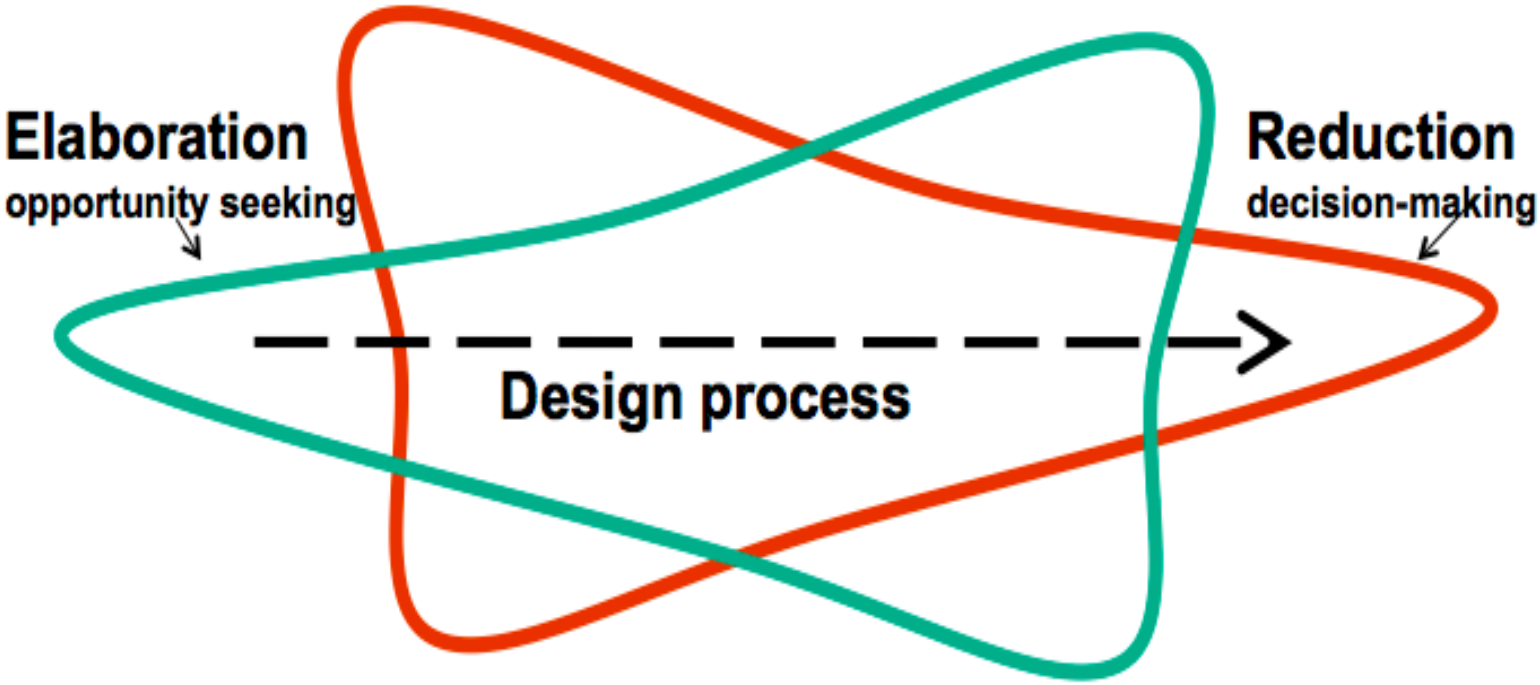
Idea Generation



- Once user need is found, solutions can be proposed
- Idea generation through:
  - Brainstorming
  - Lateral thinking
  - Ideal storming
  - Formal problem solving
  - Etc..



Elaboration and Reduction



- Elaborate on Ideas and Reduce to Final Design Direction
  - *Elaborate* - generate solutions. These are the opportunities
  - *Reduce* - decide on the ones worth pursuing
  - *Repeat* - elaborate and reduce again on those solutions

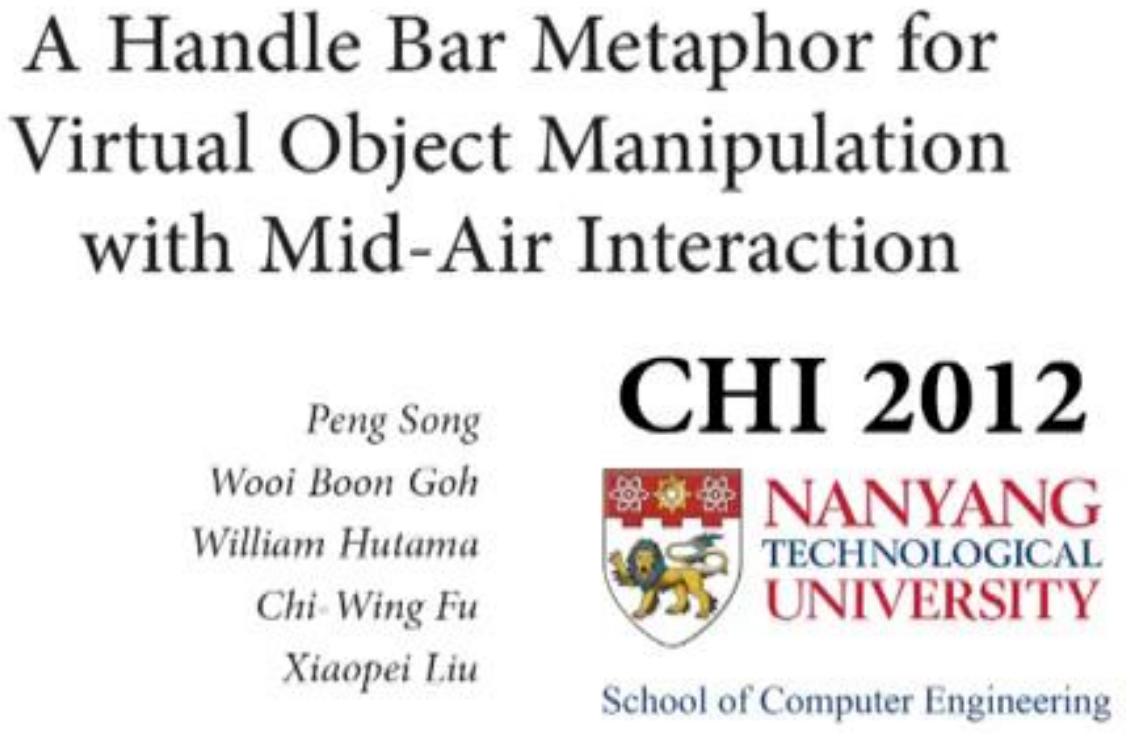
Use UI Best Practices for XR

- General UI design principles can be applied to XR
  - E.g. Shneiderman's UI guidelines from 1998
- Providing interface feedback
  - Mixture of reactive, instrumental and operational feedback
  - Maintain spatial and temporal correspondence
- Use constraints
  - Specify relations between variables that must be satisfied
    - E.g. physical constraints reduce freedom of movement
- Support Two-Handed control
  - Use Guiard's framework of bimanual manipulation
    - Dominant vs. non-dominant hands

XR Design Considerations

- Use UI Best Practices
  - Adapt known UI guidelines to XR
- Use of Interface Metaphors/Affordances
  - Decide best metaphor for XR application
- Design for Different User Groups
  - Different users may have unique needs
- Design for the Whole User
  - Social, cultural, emotional, physical cognitive

Example: Handle Bar Metaphor



- https://www.youtube.com/watch?v=VBCP63jD3OI

How are These Used?

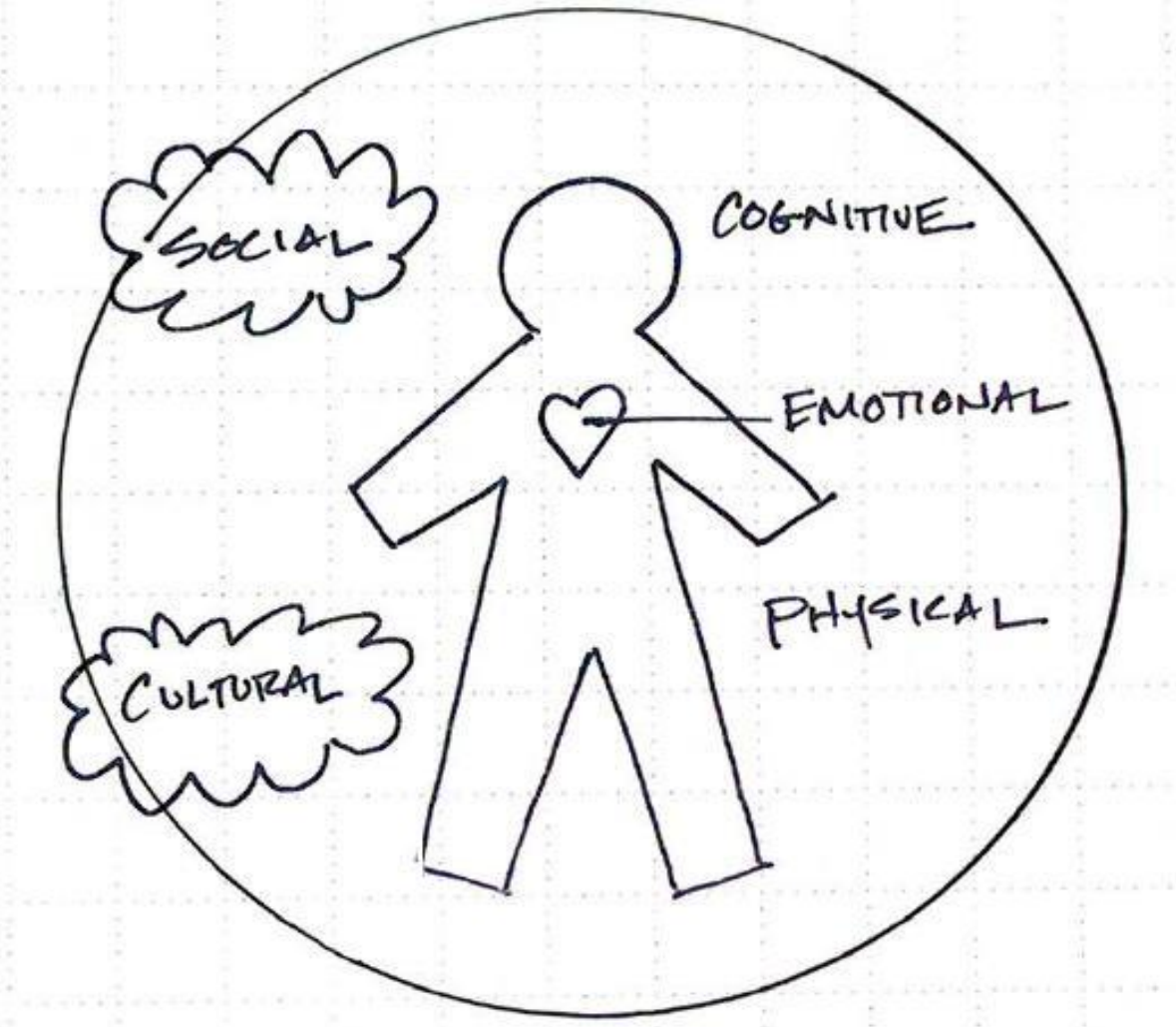
Affordances provide strong clues to the operations of things."

(Norman, The Psychology of Everyday Things 1988, p.9)

Designing for Different User Groups

- Design for Difference Ages
  - Children require different interface design than adults
  - Older uses have different needs than younger
- Prior Experience with XR systems
  - Familiar with HMDs, XR input devices
- People with Different Physical Characteristics
  - Height and arm reach, handedness
- Perceptual, Cognitive and Motor Abilities
  - Colour perception varies between people
  - Spatial ability, cognitive or motor disabilities

Consider the Whole User Needs



Whole User Needs

Would you wear this HMD?

- Social
  - Don’t make your user look stupid
- Cultural
  - Follow local cultural norms
- Physical
  - Can the user physically use the interface?
- Cognitive
  - Can the user understand how the interface works?
- Emotional
  - Make the user feel good and in control

UX Guidelines for XR

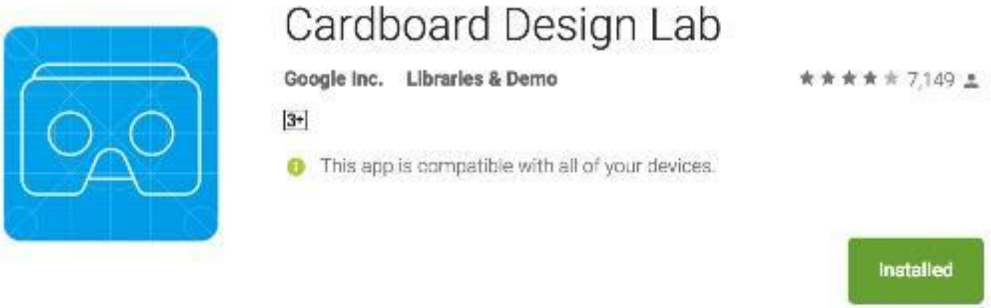
- The Four Cores of UX Design for XR
  - Make interface Interactive and Reactive
  - Design for Comfort and Ease
  - Use usable Text and Image Scale
  - Include position audio and 3D sound

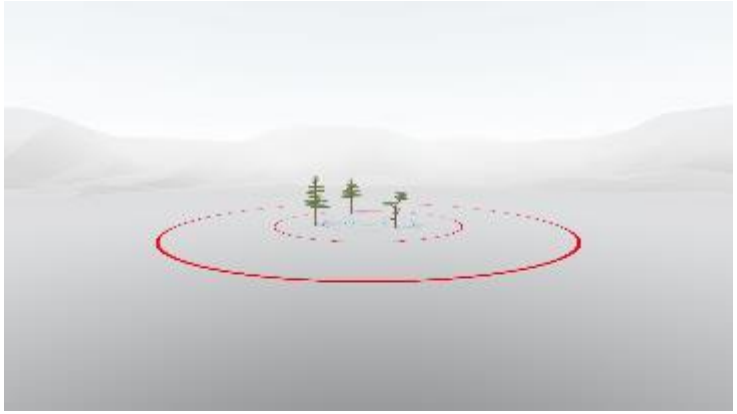
https://www.dtelepathy.com/blog/philosophy/ux-guide-designing-virtual-reality-experiences

UX Challenges

- Problems to be Addressed
  - Keep the user safe
  - Make it look and feel real
  - Make sure users don’t get simulation sickness
  - Develop easy-to-use controls and menus

Cardboard Design Lab





- Mobile VR App providing examples of best practice VR designs and user interaction (iOS, Play app stores)

Demo: Cardboard Design Lab

- https://www.youtube.com/watch?v=2Uf-ru2Ndvc

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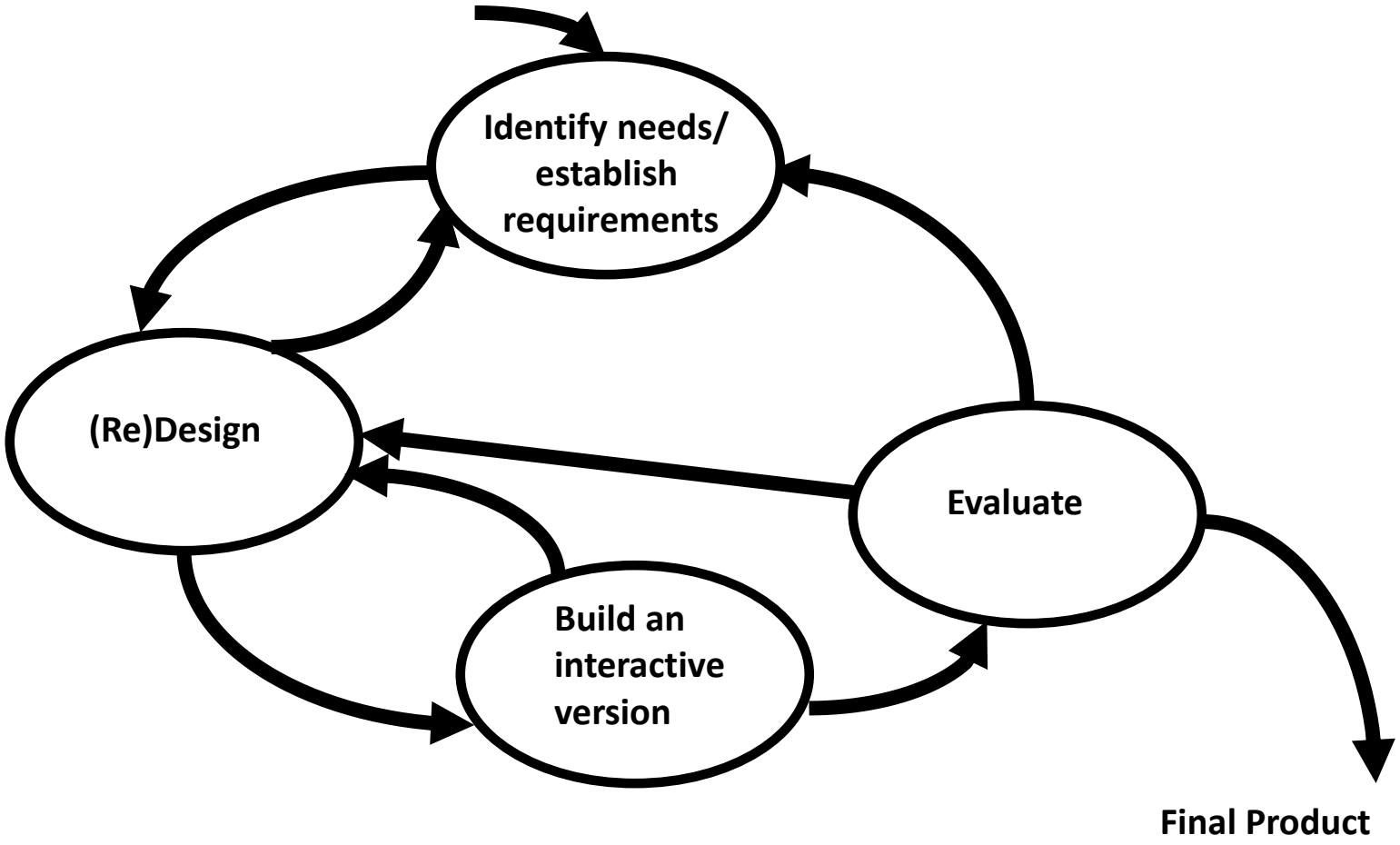

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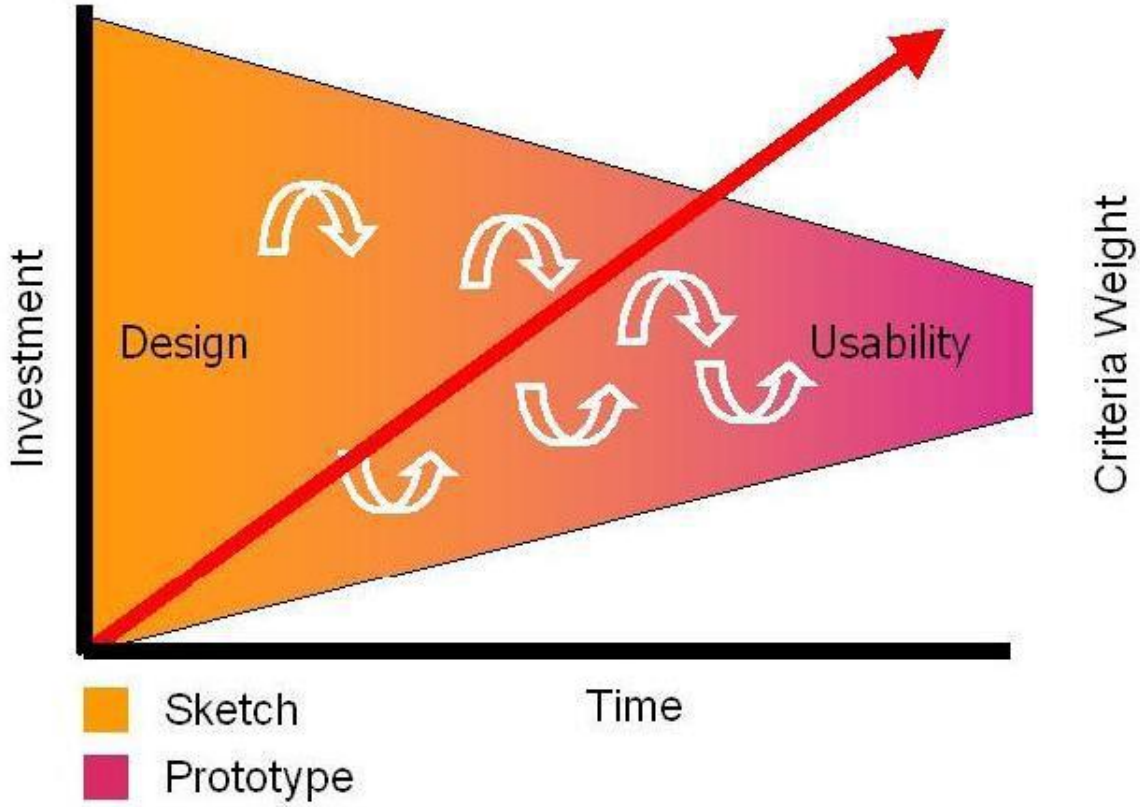
From Sketches to Prototypes

- Sketches: early ideation stages of design
- Prototypes: capturing /detailing the actual design



Sketch vs. Prototype

Sketch	Prototype
Invite	Attend
Suggest	Describe
Explore	Refine
Question	Answer
Propose	Test
Provoke	Resolve
Tentative, non committal	Specific Depiction

The primary differences are in the intent

VR Prototyping Tools

- Low Fidelity
  - Sketched Paper Interfaces – pen/paper, non-interactive
  - Onride Photoshop tool – digital, non-interactive
  - InstaVR - 360 web based tool, simple interactivity
  - SketchBox – create XR interface inside XR
- High Fidelity
  - Entiti – template based VR with visual programming
  - JanusVR / A-Frame – web based VR tool using HTML
  - EditorVR – Unity wrapper inside VR
  - Unity/Unreal Game Engine – programming needed
  - ARKit/ARCore – programming APIs

OnRide Demo

- https://www.youtube.com/watch?v=1P1EfGizal0

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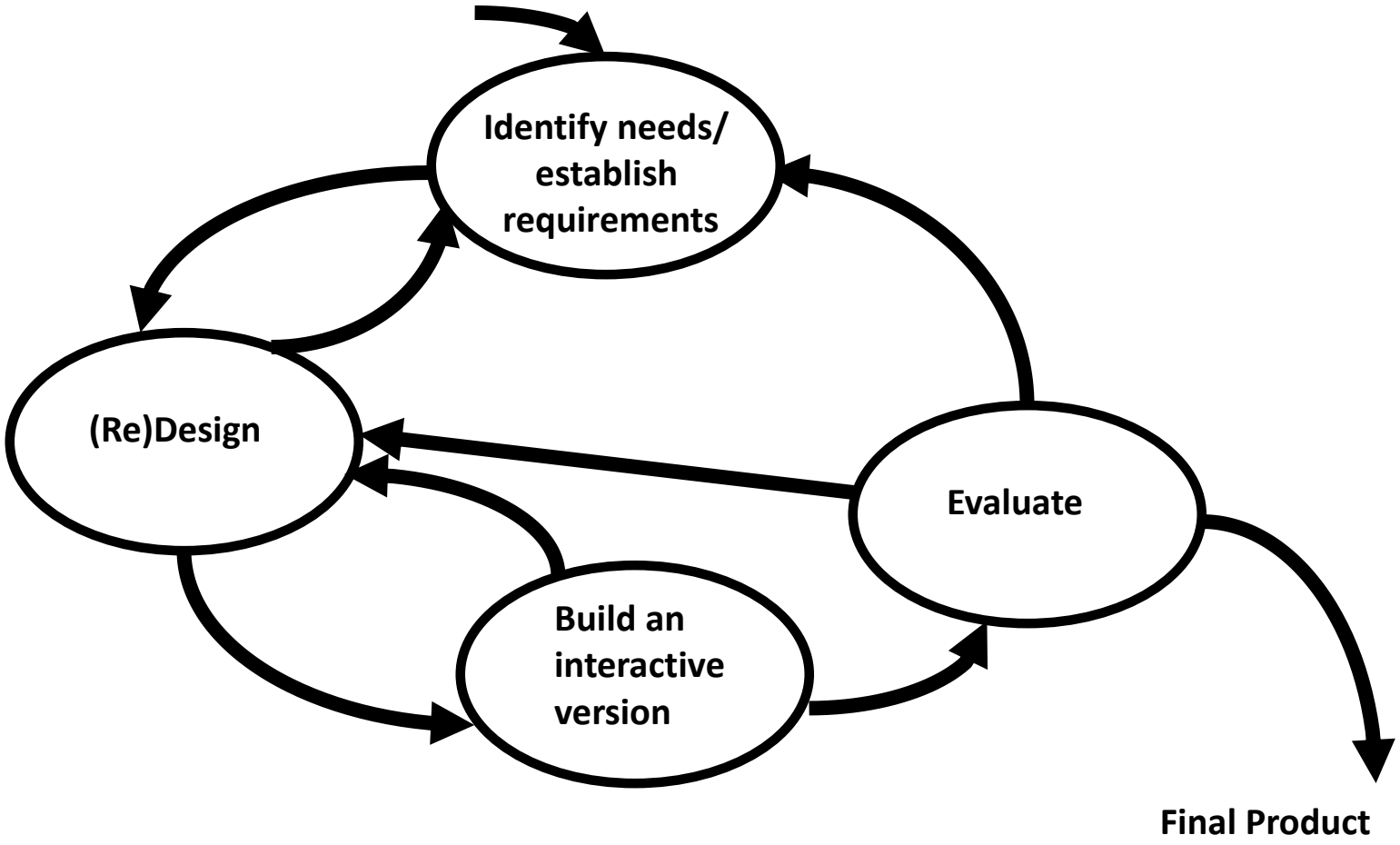

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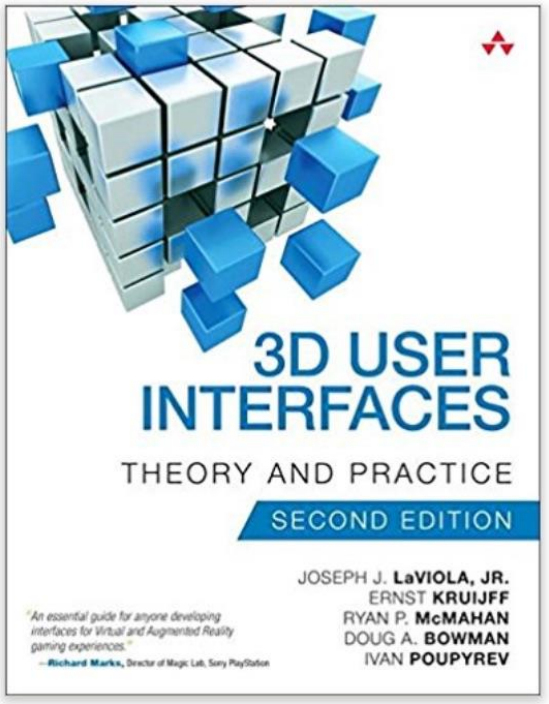
Four Evaluation Paradigms

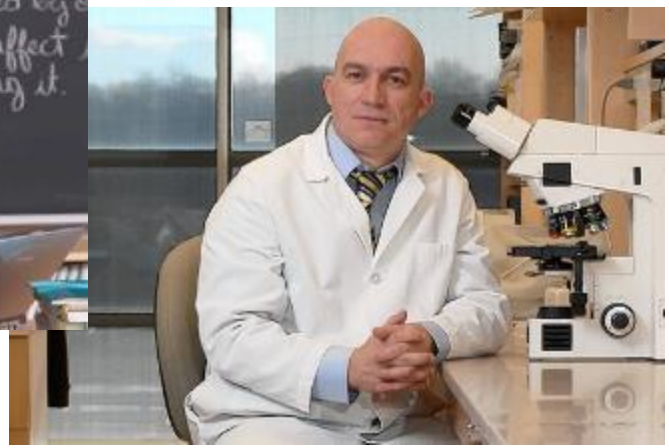
- ‘quick and dirty’
- usability testing (lab studies)
- field studies
- predictive evaluation

Resources

http://www.uxofvr.com/



2. Learn from Experts



- Experts have in-depth knowledge about topic
  - Can give large amount of information in short time
  - Look for existing process/problem documentation
- Choose participants with domain expertise
  - Expertise, radical opinion, etc.

3. Immerse yourself in Context

A day in the Life of.. **Cultural Probes..** **Role Playing..**

- Put yourself in the position of the user
  - Role playing, a day in the life of a user, cultural probes
  - Observing the problem space around you – how do you feel?
- Take notes and capture your observations

4. Seek Inspiration in Analogous Setting

What can public libraries learn from Apple stores?

- Inspiration in different context than problem space
  - E.g. redesign library by going to Apple store
- Think of Analogies that connect with challenge
  - Similar scenarios in different places