



October 2017 TorCHI Meeting

Designing for Virtual Reality – Beyond the Games

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I work with the Live Design group at Autodesk.

Our mission is to bring CGI and game technology (including VR and AR) to architecture, manufacturing, and infrastructure.

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What is Virtual Reality? (and why should I care?)



What is Virtual Reality?

Virtual Reality is a set of interface technologies designed to make the user feel “present” in a new environment or experience, rather than feeling like an outside observer.



What is Virtual Reality?

The experience of *presence* is its most important differentiator.

Designing for VR is all about maximizing presence, while taking care of the user's well-being and needs.



Agenda for today

- The Brain Science behind VR
- The value of VR beyond games
- Health and Safety Concerns
- Why standard interactions can fail in VR
- New ways of approaching design for VR



The Brain Science Behind VR

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*L'arrivée d'un train en gare à La Ciotat
1895*



<https://youtu.be/WETwwKbleks>

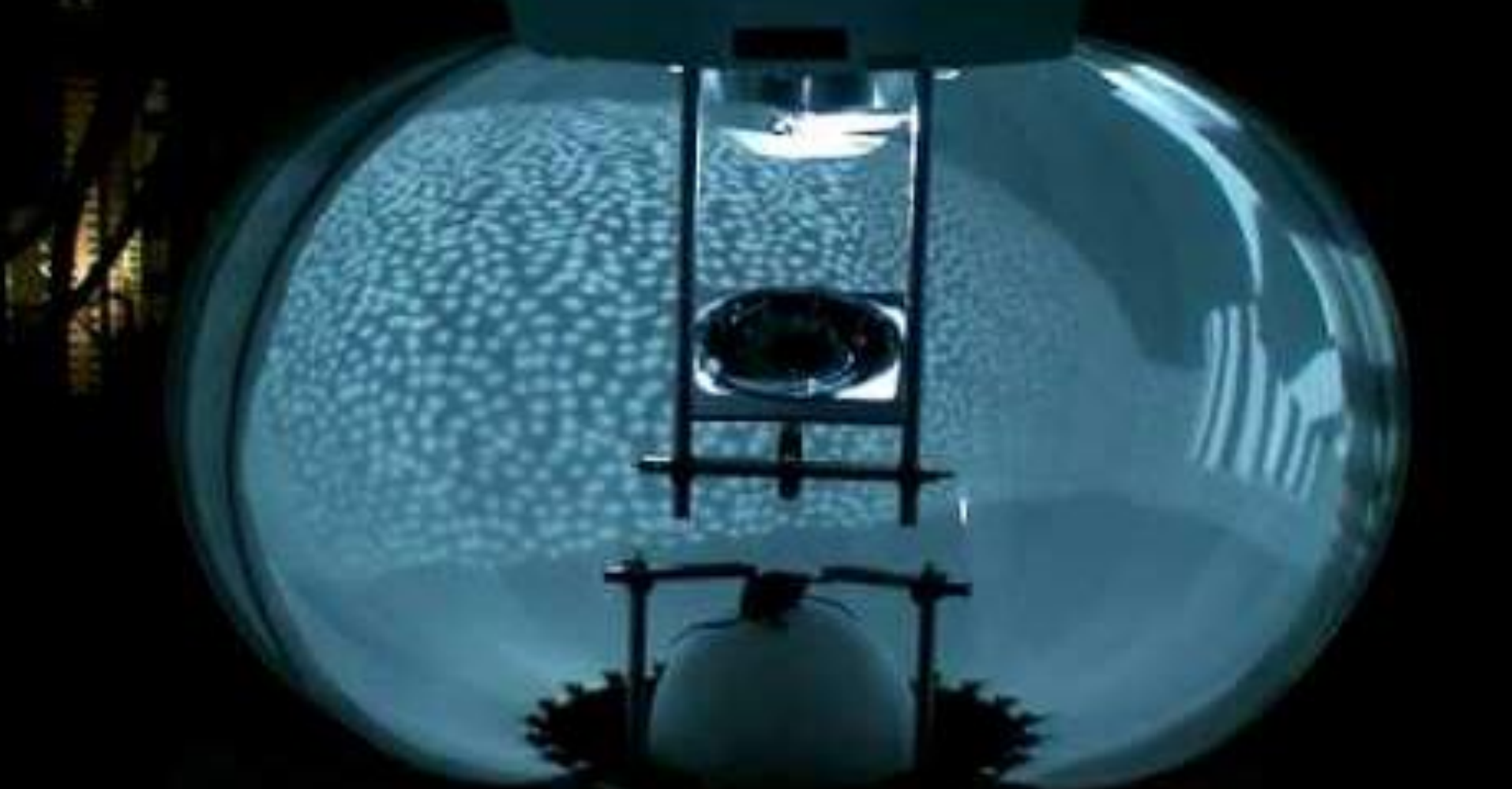
The Brain Science behind VR

- VR engages the brain in a deeper way than “regular” computer screen/mouse/gamepad interaction does.

Why is that?



The hippocampus



From "Intracellular dynamics of hippocampal place cells during virtual navigation." By Christopher D. Harvey, Forrest Collman, Daniel A. Dombeck & David W. Tank. *Nature*, Vol. 461 No. 7266, October 14, 2009.

The Brain Science behind VR

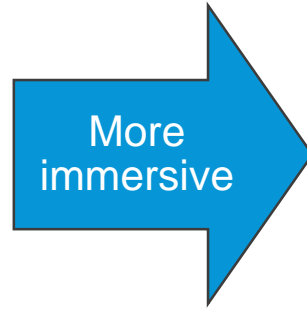
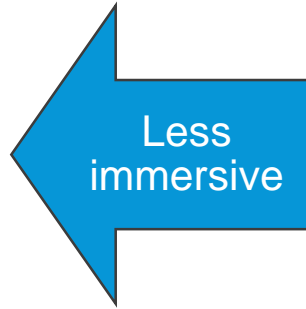
- VR engages the brain in a deeper way than computer screen interaction does.
- Your brain encodes VR experiences as “I was there”, not “I saw that”
- It’s hard to understand until you try it yourself.

What makes you feel “present” in VR?

- Immersion
- Interaction
- Consistency of action / perception
- Emotional engagement
- Belief

*

Immersion vs Cost Tradeoff





VR is not just for games

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VR Value Beyond Games

VR experiences can give you:

- Better understanding of 3d spaces and forms
- Predictive emotional responses to experiences
- Higher levels of engagement
- More effective and memorable training
- Greater emotional connection to products & services

VR Value Beyond Games

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Antonio Damasio

*Neuroscientist
& Author*

Applications: VR for Architecture

- Helps architects detect design problems early
- Helps their clients really understand what is being built
- Communicates the “feeling of being there”



Autodesk Revit Live

Example: VR for Psychotherapy

- Phobia treatment
- PTSD treatment
- Can increase empathy, with long-lasting effect
- Bad-habit breaking
- Autism support
- Depression treatment
- Body dysmorphia treatment



Image from Floreotech.com of their VR headset and software for treating autism

VR for Product Design / Manufacturing

- Reduce need for physical prototypes
- Facilitate collaboration and critique
- Onboarding for work in dangerous spaces
- Pre-build simulation of factory spaces
- Safety training



Autodesk VRED, image by Ford Motor Co.

VR for Medicine

- Protein visualization and manipulation
- Surgical visualization
- Reality simulation for neural input
- Post-surgical rehabilitation
- Help patients feel at home
- Post stroke recovery



Image by MedicalFuturist.com

but...



Health and Safety Concerns

Health and Safety Concerns

Because users feel present in VR, they become vulnerable both emotionally and physically.

Bad VR interface design can literally **make someone sick**, frighten them, or make them psychologically uncomfortable.

Good VR interface design tries to minimize these effects while not “breaking presence”

“Cyber-sickness”

Happens when your eyes and your inner ear (vestibular system) give you conflicting signals.

Can be caused by slow frame rate, or visual acceleration in the scene.



“Cyber-sickness”

Various solutions:

- Don't accelerate the user – teleport!
- This is a common solution, but has problems of its own...

“Cyber-sickness”

Problems with Teleportation

- Break in presence
- Going up and down stairs, balconies, etc.
- In-sight versus out-of-sight targets
- Turning while teleporting

“Cyber-sickness”

Problems with Teleportation

- Break in presence
→ use tiny in-between transitions
- Going up and down stairs, balconies, etc.
→ curve the teleport laser
- In-sight versus out-of-sight targets
→ use fade transition for out-of-sight
- Turning while teleporting
→ use fade transition



Style



People



Home



Views



Undo



Redo



Orbit



Tap&Go



Sun



Info



Settings



VR

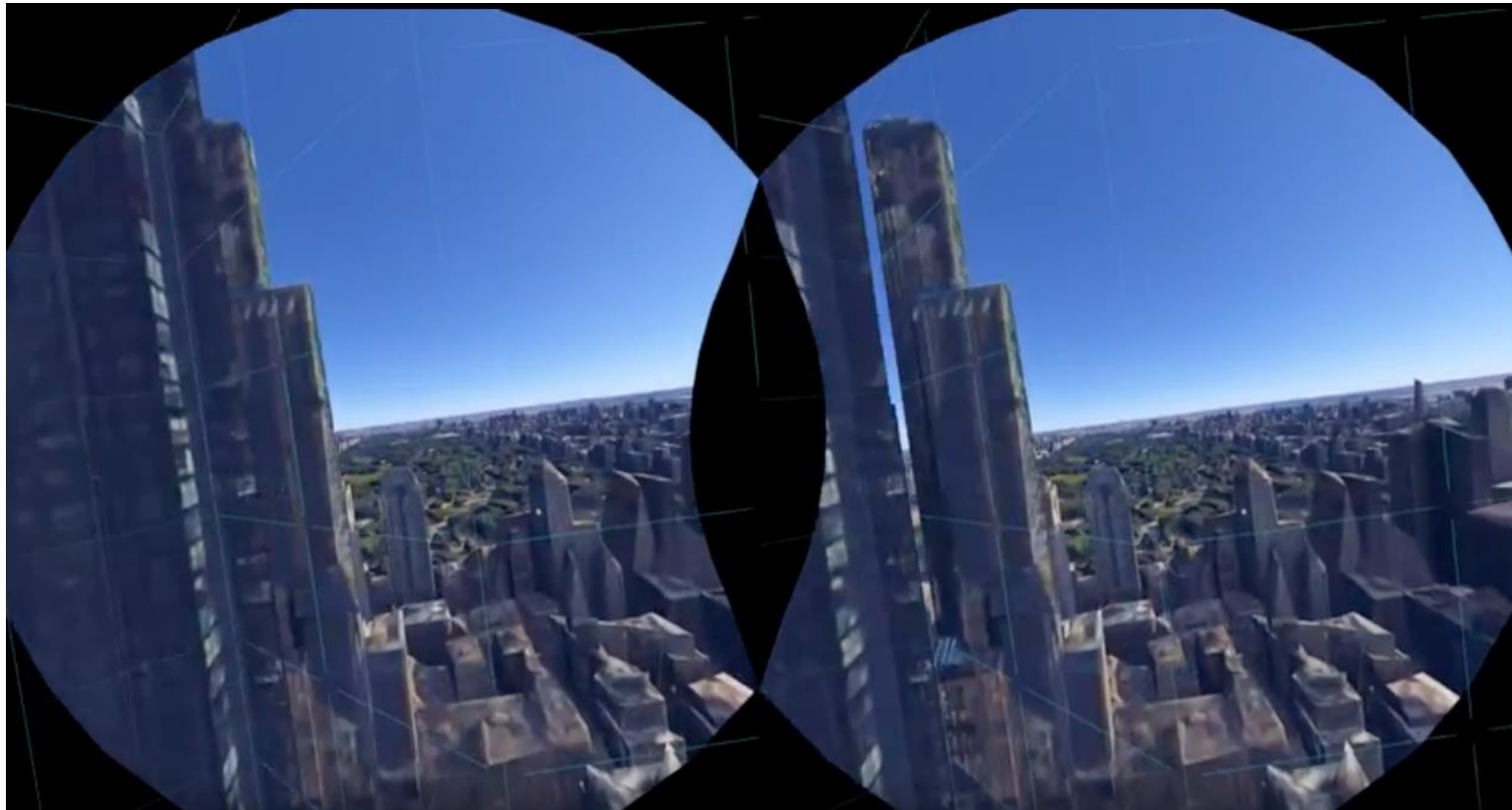


“Cyber-sickness”

Various solutions:

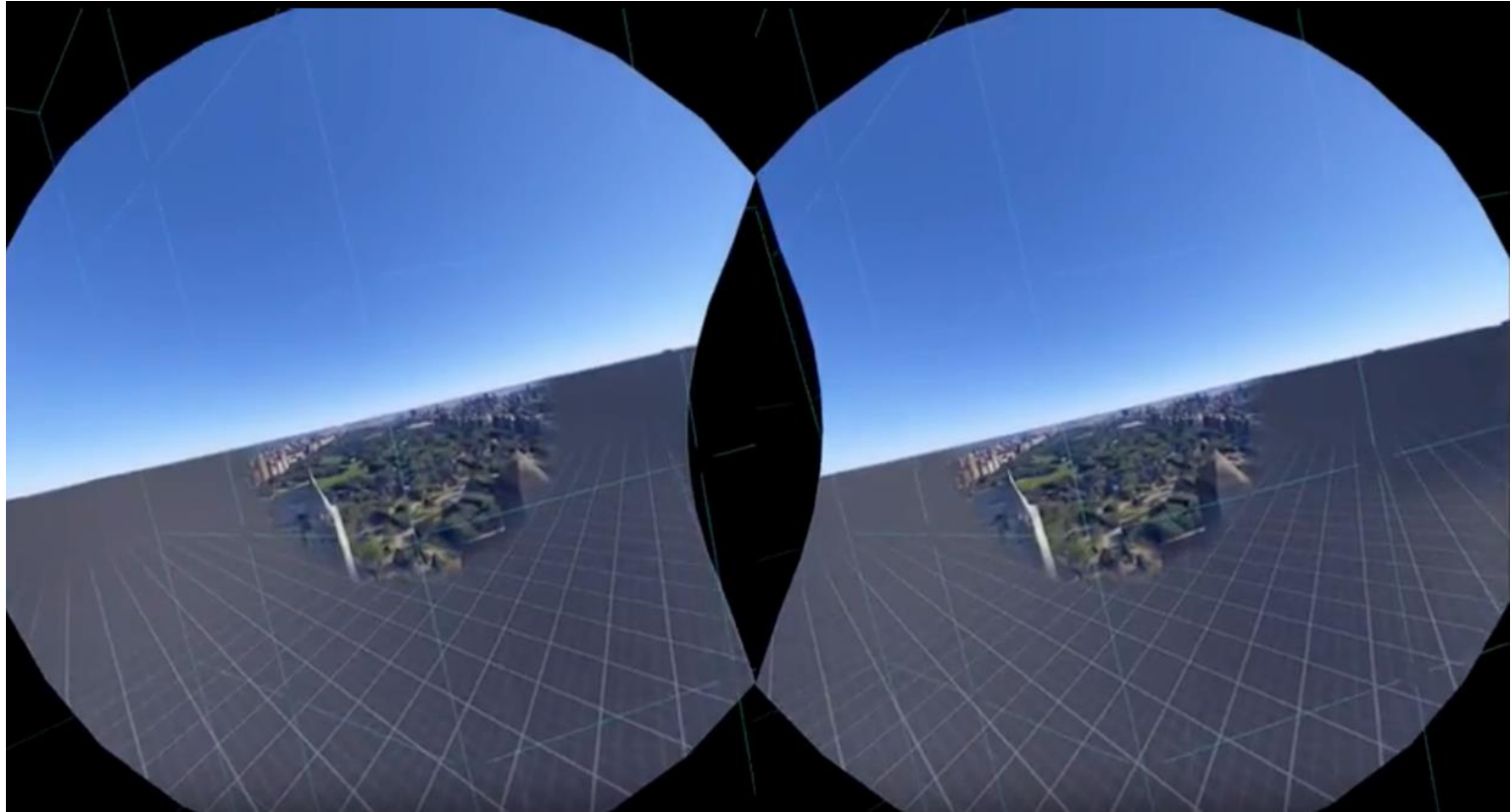
- Don't accelerate the user – teleport!
- Blur or hide peripheral vision during motion

“Cyber-sickness”



Google Earth VR

“Cyber-sickness”



Google Earth VR

“Cyber-sickness”

Various solutions:

- Provide a “rest frame” that respects the real world



Hover Junkies by Stress Level Zero

“Cyber-sickness”

Various solutions:

- Don't accelerate the user – teleport!
- Blur or hide peripheral vision during motion
- Provide a “rest frame” that respects the real world
- Stepwise rotation

Acrophobia or other frights

People can be frightened by heights, edges, or common phobias like snakes.



Acrophobia or other frights

Solutions:

- Don't include common phobia triggers



Acrophobia or other frights

Solutions:

- Don't include common phobia triggers
- Keep users away from long drops



Six Flags Zumanjaro

Acrophobia or other frights

Solutions:

- Don't include common phobia triggers
- Keep users away from long drops
- Instead of making the user *higher*, make the user *taller*



Google Earth VR

Acrophobia or other frights

Solutions:

- Don't include common phobia triggers
- Keep users away from long drops
- Instead of making the user *higher*, make the user *taller*

Note: making the user taller will change their *emotional reaction* to the environment.

Acrophobia or other frights

Solutions:

- Don't include common phobia triggers
- Keep users away from long drops
- Instead of making the user *higher*, make the user *taller*
- Add visual “safety” cues

Press **Esc** to exit VR



Acrophobia or other frights

Question:

What should happen if the user steps off an edge?



Scaling issues

People can be frightened or disturbed by things that might look “cute” on a regular screen



Character from “Lucky’s Tale”

Scaling Issues

Prevention:

- Don't assume that the same content will produce the same emotional effect in VR! Test it.
- Testers may feel embarrassed reporting this kind of thing, so ask specifically about it.

TMI

Sudden scene changes can be disturbing, overwhelming the user with information



Image by John Greyson– Wikimedia commons

TMI

Solutions:

- Give the user time to become accustomed to a new environment.
- Introduce new elements gradually
- Focus on a detail, then expand from there

Environmental Blindness

Users are blind to the outside world while in VR, and may collide with walls, chairs, or just feel vulnerable.



Environmental Blindness

This is being solved in hardware.

Most VR systems have visual bounds that tell you where the end of your real space is. Others may have cameras that overlay nearby objects or people into your virtual scene.

Virtual Harassment

Multiplayer anonymity can enable harassing behaviours

Being sexually harassed in virtual reality can feel all too real

Virtual reality is lifelike in a way we have never experienced. It's not a stretch to imagine that getting virtually groped or stalked can also feel real.



Mic.com, Toronto Metro, The Guardian.com

Sexual harassment in virtual reality feels all too real - 'it's creepy beyond creepy'

As the gaming world advances, women are facing the same physical threats online as offline. Players and developers want to do something about it



My first virtual reality groping



Virtual Harassment

Solutions:

- Do not allow anonymity
- Give everyone adjustable “personal space” that cannot be violated
- Allow blocking (mutual invisibility) or recording & reporting
- When new avatars appear in a virtual space, ensure they appear away from all the others – and that their arrival is announced.

Sharing Virtual Space

Even well-intentioned people can get into uncomfortable situations when sharing virtual space.



Sharing Virtual Space

Even well-intentioned people can get into uncomfortable situations when sharing virtual space.

- Accidental sneaking and startling
- Avatar intersection
- (if local) mismatch between real and virtual location

Sharing Virtual Space

The Principle of No Surprises

- Enforce personal and social space
- Announce all arrivals and departures
- Spatialized sound (use headphones!)
- Facilitate *following, gathering, getting attention*



Why Standard Interactions Fail in VR

Why Standard Interactions Fail

Many of the design patterns you have learned for UI on a 2d flat screen do not carry well into VR.

Why Standard Interactions Fail in VR

- Where do you put your permanent controls?
- Where does a pop-up dialog go?
- What should a button or a slider look like?
- How do you press a button? How do you adjust a slider?
- How does a context menu work?
- How do you scroll through a large set of choices?
- How do you make sure your user sees an alert?
- Where do you put a tool palette or colour wheel?

We don't know

...yet

Where do you put your permanent controls?

Choices:

- They move with the user's head – always in the same place
- They are attached to one of the controllers – always at hand
- They are summoned at need (like a pop-up dialog)
- They are at a fixed location in the virtual world

Where do you put your permanent controls?

Choices:

- They move with the user's view – always in the same place
 - causes cybersickness... or at least constant irritation
- They are attached to one of the controllers – always at hand
 - how many controls do you need?
- They are summoned at need (like a pop-up dialog)
 - where do you put them when they are summoned?
- They are at a fixed location in the virtual world
 - possibly behind the user

Where does a pop-up dialog appear?

Choices:

- Immediately in front of the user
- Where the user indicates
- Attached to the summoning hand

Where does a pop-up dialog appear?

Choices:

- Immediately in front of the user
 - is it then fixed in space, or relative? What if some other object is there?
- Where the user indicates
 - how far away should it be? What if some other object is there?
- Attached to the summoning hand
 - if they summoned it with their dominant hand, how do they operate the controls?

Where do you put your controls?

Current best practice:

- User specifies where they appear
- Once they appear, they are fixed in the virtual world (do not move with user)
- User can reposition them easily

What should a button look like?

Skeuomorphism is back!

Also lots of room for metaphor exploration. Is a VR button like...

- A balloon you can pop?
- A target you can shoot from a distance?
- A pool of water you can dip a finger in?
- A cable you can pull?

How do you press a button?

Your choices depend on the form of the button:

- Touch it
- Shoot it with a laser beam
- Pass your hand through it

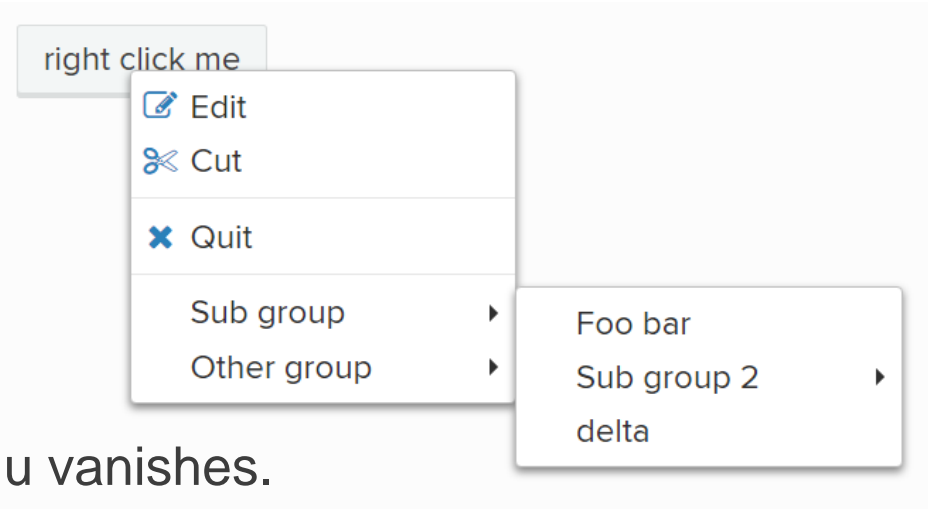
Considerations:

- Can you touch it from the back? The side?
- What if your laser sweeps across it? What if you hit more than one?

How does a context menu work in VR?

In 2d:

- User points at object of interest
- Right-click to summon
- Menu appears under cursor
- User drags to select item
- User releases to activate item, menu vanishes.



How does a context menu work in VR?

In VR:

- User indicates object of interest (which may be distant)
- Summon menu using controller button
- Menu appears... at the controller position? At the distant object?
 - Controller may not be visible if user is not looking at it.
 - Menu may be partially occluded if distant

How do you scroll through a large set of choices in VR?

So many possibilities!

How do you make sure your user sees an alert?

- Text is a big problem in VR
- Frequently ignored – needs to be REALLY BIG
- Controllers are frequently not visible
- Moving an alert to stay in front of the user is really irritating

- Same problems for help text.

Where do you put a tool palette or colour wheel?

On your non-dominant hand.

VR enables two-handed interaction -- make use of it.

Also, remember that a lot of people are left-handed!



Designing for Virtual Reality

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2D is like video

VR is like theatre

Designing for VR

Sketching/storyboarding is the natural mode of design for 2d interfaces.

For Virtual Reality, the natural mode of design is *improvisational theatre*.

Designing for VR

- Act out your interactions while holding VR controllers.



Designing for VR

- Act out your interactions while holding VR controllers.
- Use props and chairs to act as UI elements in the scene, and get colleagues to help.

Designing for VR

- Act out your interactions while holding VR controllers.
- Use props and chairs to act as UI elements in the scene, and get colleagues to help.
- Record your interactions and edit to document your design intent.

Designing for VR

To solve interaction problems in imaginary spaces, learn from thousands of years of *theatrical experience*.

Shout-out



Brendan Mcmurtry-Howlett

Founding member and former Artistic Director of *Shakespeare in the Ruff*, an outdoor theatre company in Toronto

2d is like video, VR is like theatre

Common problems in VR (and theatre!):

- Introducing users to new environments
- Changing locales quickly
- Orienting the user
- Drawing attention to particular details
- Getting the user to face another direction or turn around
- Setting the mood or ambience of a scene
- Signalling that something significant is about to happen

2d is like video, VR is like theatre

Three big themes:

- Light and Motion
- Lead with Sound
- Focus first, then Scale

Light and Motion

- Attention is drawn to light and motion
- Motion is a stronger attention cue
- Reduce illumination on unimportant regions
- Eyes follow moving objects – use that

Lead with Sound

- Change in sound draws attention to new direction
- Eyes follow, seek out source
- Commonly used in television transitions
- Use ambient sounds to establish the reality of a place

Focus First, then Scale

- When introducing an environment, limit the available information
- Give the user time to adapt
- Establish a connection to the important thing
- Then fill in the complexity



Richard the Third -2013



Wrapping up

Designing for Virtual Reality

- First – do no harm!
- Maximize presence – as much as you can without harming your user
- Take advantage of what VR is good at
- Take advantage of what your user knows about the real world.
- Never forget the third dimension
- Reduce social surprise
- Think theatrically
- Explore new metaphors for interaction



Questions?



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