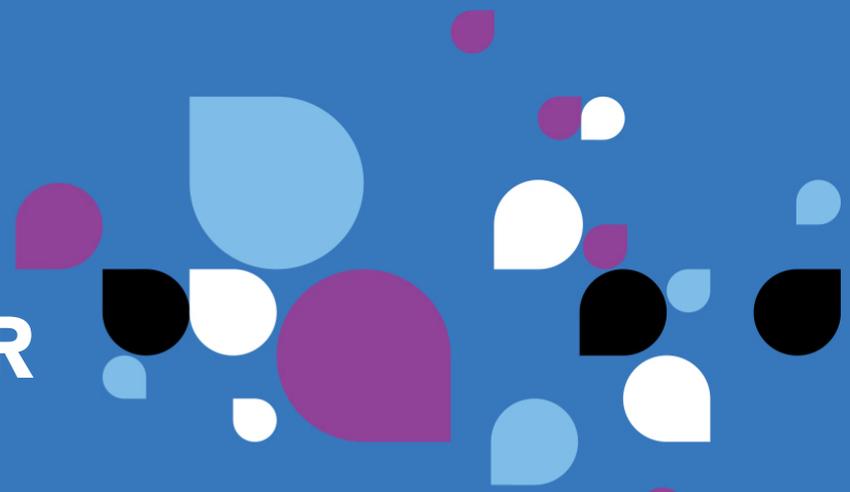


# Designing to Minimize Simulation Sickness in VR

**Ben Lewis-Evans, PhD**  
Researcher, Player Research



**GDC** 'Eu

**GAME DEVELOPERS CONFERENCE™ EUROPE**  
CONGRESS-CENTRUM OST KOELNMESSE · COLOGNE, GERMANY  
AUGUST 3-4, 2015

# ME

Games User Researcher, PhD in Psychology, former university lecturer & driving simulation inflictor.



[ben@playerresearch.com](mailto:ben@playerresearch.com)



@ikbenben



**Gortag**



**LagGortag**

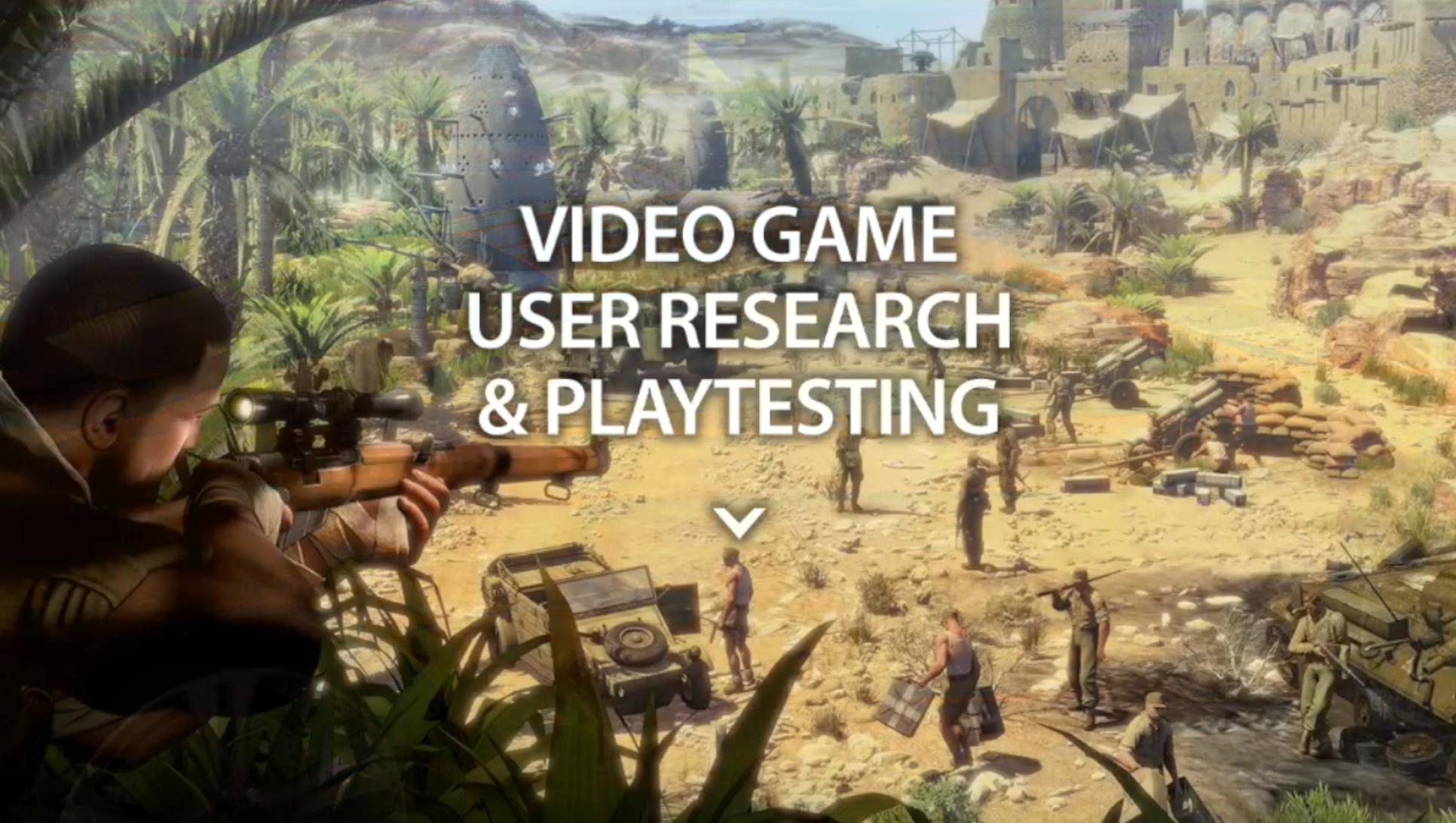


**LagGortag**



**Gortag42**





# VIDEO GAME USER RESEARCH & PLAYTESTING



# SIMULATION SICKNESS

WHAT IS IT?

WHY CARE?

WHY DOES IT OCCUR?

HOW CAN DEVELOPERS REDUCE IT?



# WHAT IS SIMULATION SICKNESS?



# WHAT IS SIMULATION SICKNESS?

A group of symptoms, **experienced by some people**, when **interacting with virtual environments**.



# WHAT ARE THE SYMPTOMS?

Balance issues (postural instability)

Sweating

Disorientation

Vertigo

Loss of colour to the skin

Nausea

(Eyestrain & Headaches)

Vomiting



**WHO**

**HAS EVERYONE BEEN VISITING AND IS BACK?**

**HANDS UP IN THE AIR**

A DJ is seen from behind, wearing headphones and a white t-shirt, with their arms raised in the air. They are standing behind a DJ booth with two turntables. In front of the DJ is a large, dense crowd of people at a night club or concert, all with their hands raised in the air. The scene is illuminated with blue light, creating a vibrant and energetic atmosphere.

# WHO IS VULNERABLE?

Experience dependent. **5-10% of population particularly vulnerable.** Sex? Genetics? Age?

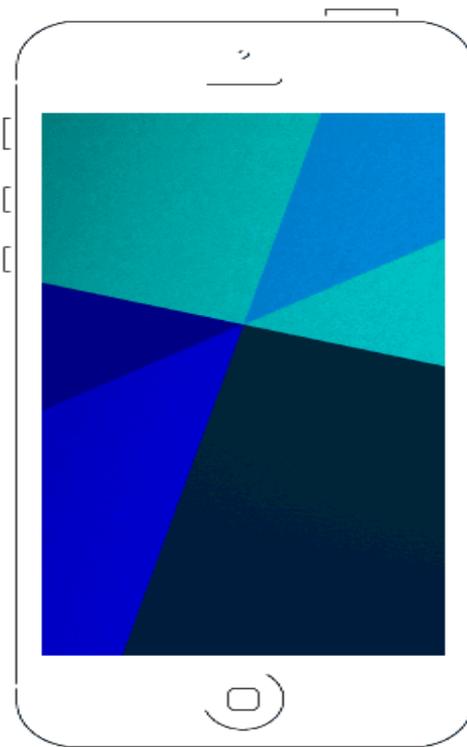
Chance **increases** if activity is **familiar**, **decreases** with **exposure**.



# NOT JUST A VR ISSUE

**Virtual Environments** in general, particularly if in a **first person perspective**.

Can also be caused by **User Interface**.





### THE BEAST OF WHITE ORCHARD

Find some buckthorn on the riverbed using your Witcher Senses.

Use your Witcher Senses to find the hunter.

-  4 Bread
-  2 Water

Sprint  Left Shift

Witcher Senses  [Hold]

Call Horse  X

# No more motion sickness

by CaptainCrunch

The Witcher 3 » Tweaks

Added: 07/06/2015 - 08:45PM  
Updated: 09/06/2015 - 02:18AM

DOWNLOAD (MANUAL)

TRACK

ENDORSE

VOTE



39  
ENDORSEMENTS

1.1  
LATEST  
VERSION

317  
UNIQUE  
D/LS

432  
TOTAL  
D/LS

9,911  
TOTAL  
VIEWS

ACTIONS:



LOGS



REPORT



ADD



REQUIRED



PERMS

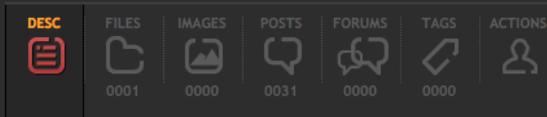


CONTACT

Uploaded by CaptainCrunch



Report ad  
Remove these ads



## Description

Last updated at 2:18, 9 Jun 2015

Uploaded at 20:45, 7 Jun 2015

Well, this isn't a mod, just a quick tweak to disable that horrible effect while using witcher senses. The FOV and the effect when using witcher senses/focus always made me very motion sick, so I took a look at the ini files and found a way to turn off this horrible effect. Just go to bin\config\base\gameplay.ini. Open the ini and look for this lines:

```
MotionSicknessFocusMode=false
```

now set it to

```
MotionSicknessFocusMode=true
```

There you go, that blurry effect on the edges of you screen is gone, no more motion sickness and now you can even use witcher senses as a tool for better exploring your surroundings since it still does zoom in.

If you liked this little tweak, download the attached Readme file and endorse.

Cheers, mates ;)  
CaptainCrunch



# WHY CARE?



**How often do you do something  
that actively makes you sick?**



**How often to you spend a lot of money  
in order to be actively sick?**



**How often do you recommend feeling sick to friends and family?**



# WHY DOES IT OCCUR?



# MANY THEORIES

**Cue Conflict:** Expect one input, receive another.

**Postural Instability:** Information needed to balance missing or incorrect.

**Poison Theory:** Feeling unbalanced/conflicting senses = poison = throwing up!



# EQUILIBRIOCEPTION (Not falling on your face)

**Dominant:** Vision

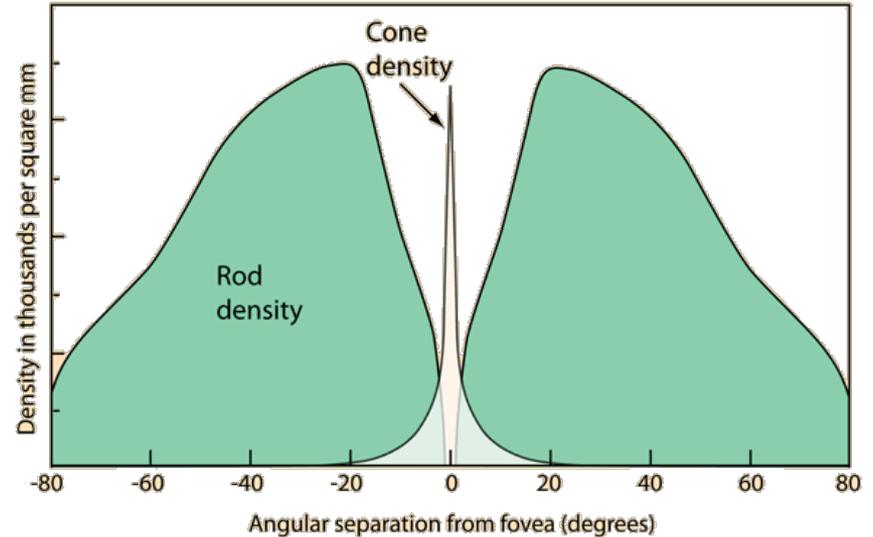
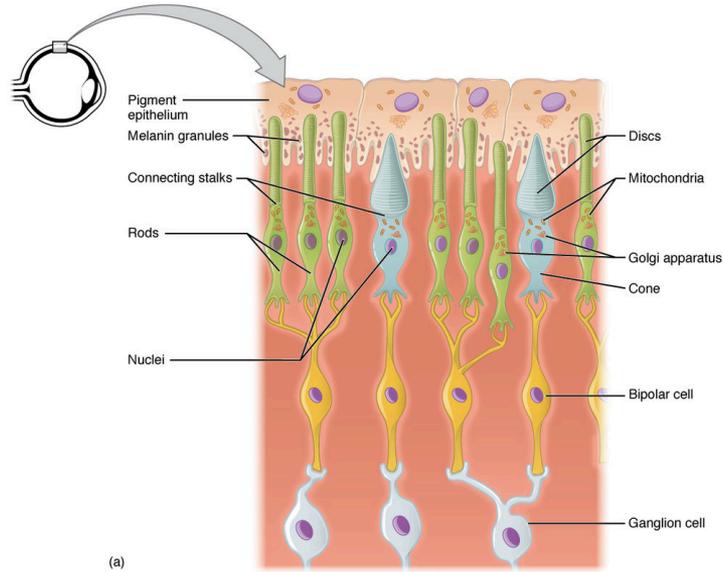
**Secondary:** Vestibular system (inner-ear)  
Proprioception (muscles)





# HOW VISION WORKS

## Cones, Rods, and peripheral vision





# HOW VISION WORKS

Vision Cones Overlap

**Optic flow & Vection**





# WHY SO BAD IN VR?

**Screens close to eyes:** Motion in Periphery  
Vection + Immersion  
Eye accommodation

**Latency:** Screen and head movement

**Weight? Heat?**





# HOW TO REDUCE IT?



# DESIGN FOR YOUR PLATFORM

Design **for the system**

For its **advantages**

For its **disadvantages**



# RESEARCH YOUR PLATFORM

**Capabilities:** Refresh rate

Latency

Tracking (real and predictive)

Distortion

Ands its **guidelines**



# FRAME RATE & LATENCY VITAL!!!

**CONSISTENT** high frame rate and low latency

**Frame rate:** At or above the display refresh rate  
(both v-synced and unbuffered)

**Latency:** Below 20ms  
Use predictive tracking



# AVOID FLICKER & BLUR

**Motion Cues:** Particularly in peripheral vision



# FIELD OF VIEW

The edge of vision = optic flow = vection

**Non VR:** Make it **configurable**

(People sit at different distances, have different sized screens, and different thresholds)



# FIELD OF VIEW

**VR: Break up** field of view, e.g. with a cockpit  
(May lead to excessive head movement)

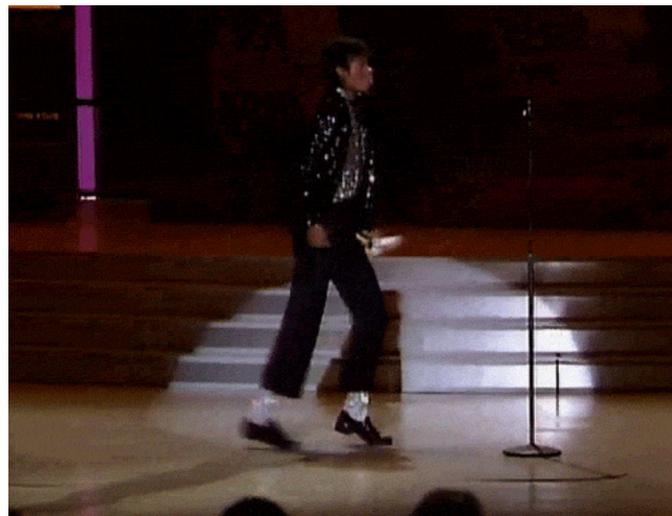
Lower than 30 degrees?



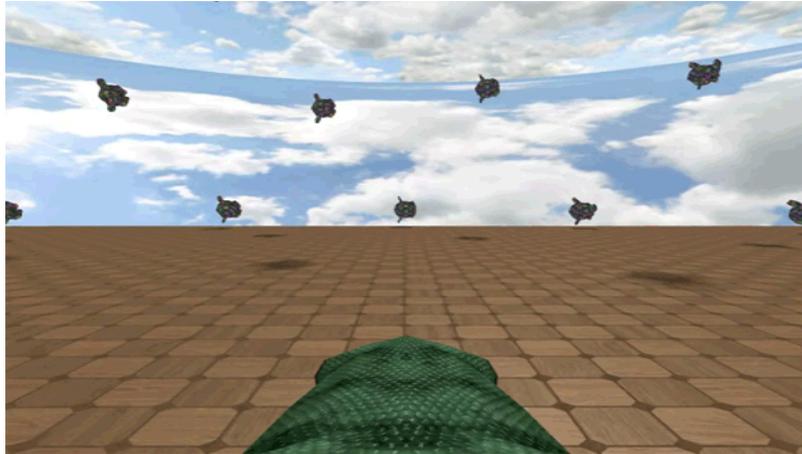


# USE APPROPRIATE MOVEMENT

**Sensory expectations:** Heads move like heads.  
People move like people



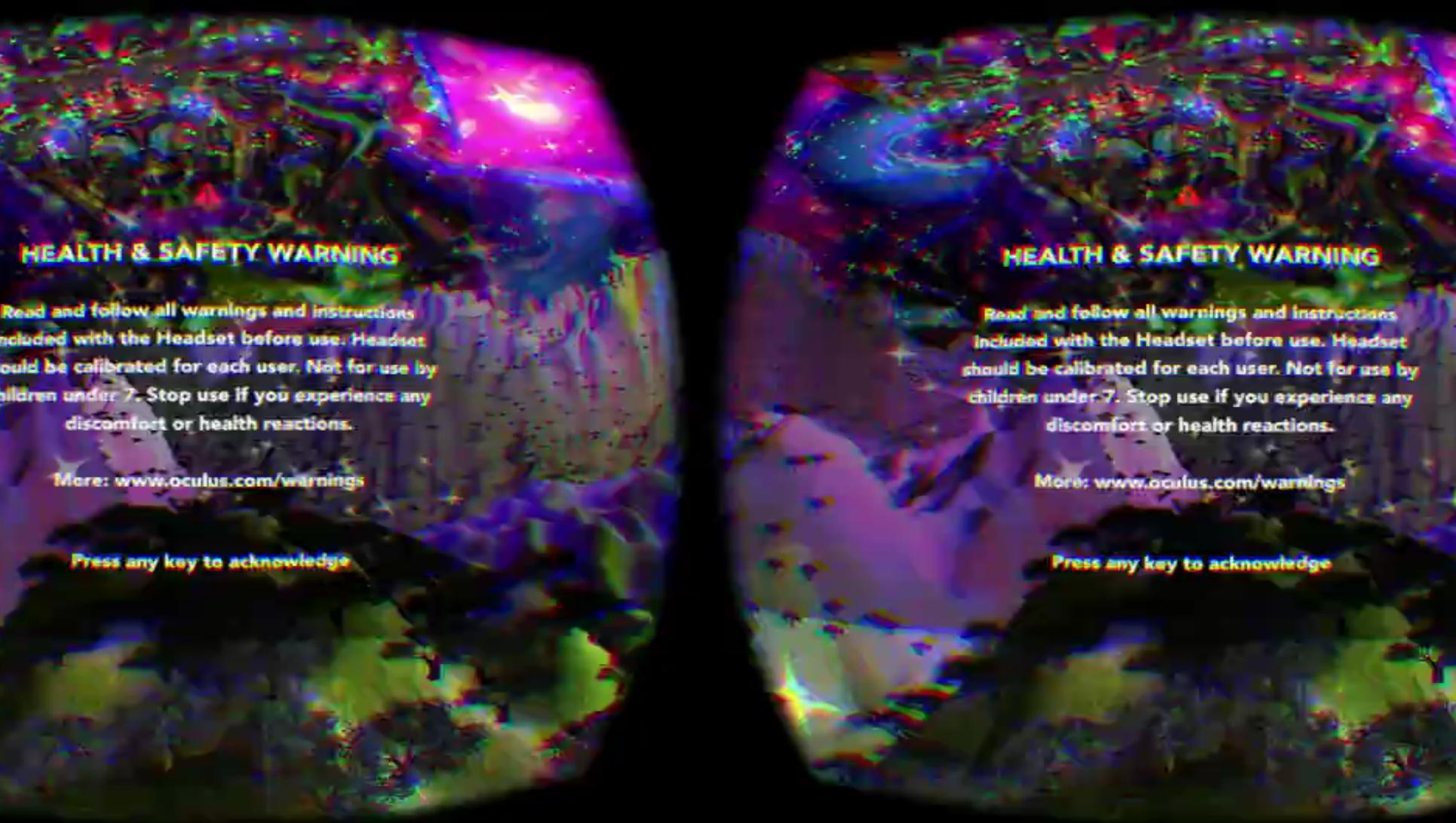
# USE APPROPRIATE MOVEMENT



**Limit/Remove:** Rapid tilting, rolling, & bouncing (Particularly wave-like between 0.05 and 0.8 Hz)

e.g. head bob, excessive gun sway, and stairs





## HEALTH & SAFETY WARNING

Read and follow all warnings and instructions included with the Headset before use. Headset should be calibrated for each user. Not for use by children under 7. Stop use if you experience any discomfort or health reactions.

More: [www.oculus.com/warnings](http://www.oculus.com/warnings)

Press any key to acknowledge

## HEALTH & SAFETY WARNING

Read and follow all warnings and instructions included with the Headset before use. Headset should be calibrated for each user. Not for use by children under 7. Stop use if you experience any discomfort or health reactions.

More: [www.oculus.com/warnings](http://www.oculus.com/warnings)

Press any key to acknowledge



# USE APPROPRIATE MOVEMENT

## **Limit or remove uncontrolled movement:**

Particularly tilting, spinning, or flipping  
(e.g. Death cams/rag dolling in first person)

Avoid rapid, unexpected, and  
uncontrolled screen transitions (e.g. Cut  
scenes with uncontrolled cameras)



# USE APPROPRIATE MOVEMENT

Limit abrupt, sudden, **changes** in acceleration/  
disconnects between acceleration and expectation.

**Avoid long, slow changes in acceleration:**

Constant speeds may be more comfortable.

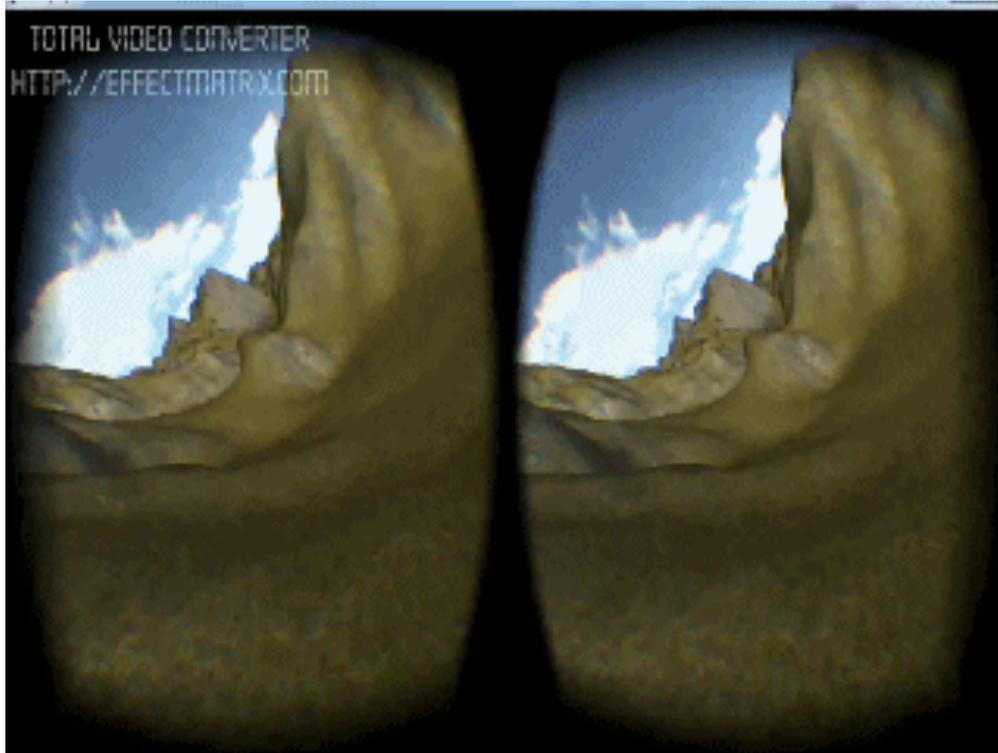


# USE APPROPRIATE MOVEMENT

Avoid **zooming the view** or anything that takes camera movement **out of close to one to one matching**.



# USE APPROPRIATE MOVEMENT



Consider Camera  
**height & object  
closeness**



# USE APPROPRIATE MOVEMENT

**Limit first person movement through a scene completely?**





# CREATE A SUPPORTIVE ENVIRONMENT

## Match expectations:

Walking hard, driving a vehicle easier

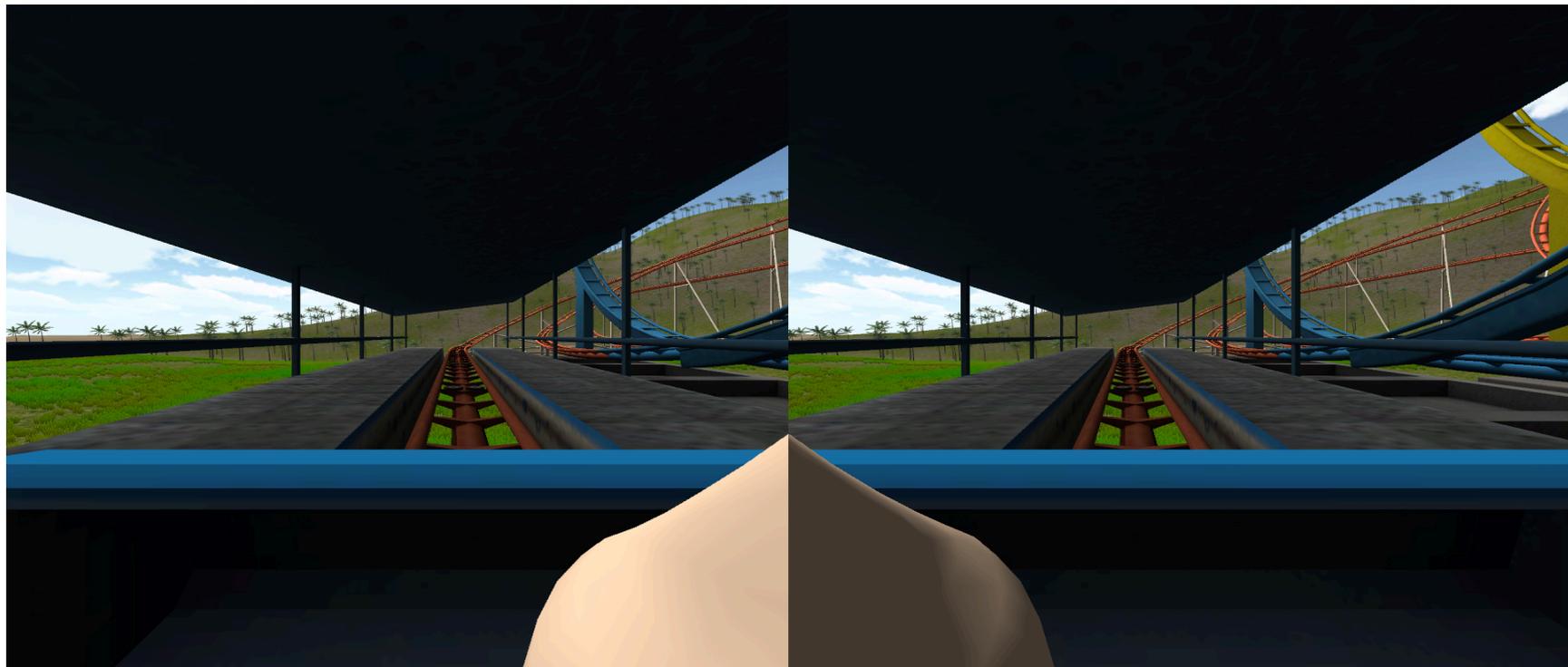
Responsive & representative avatars/  
movement(?)

Anchor UI & place it centrally

Provide a **stable focus point/background**



# CREATE A SUPPORTIVE ENVIRONMENT



# Asteroid Racer

Ghost Challenge  
(Demo)

Single Player

Multiplayer

Quit



# CREATE A SUPPORTIVE ENVIRONMENT

**Allow and support short play via:**

Checkpoints and saves

Game design

Pause and resume



# REALITY SICKNESS

Feeling sick **upon returning to reality** after extended **exposure to a virtual environment.**



# CREATE A NOVEL EXPERIENCE?

**Novel movement experience** = no expectations to be violated.

Don't break other guidelines though...



# FOLLOW STANDARDS

Standards in visual perception & Industry standards

**Standards = Expectations**



# PROVIDE OPTIONS

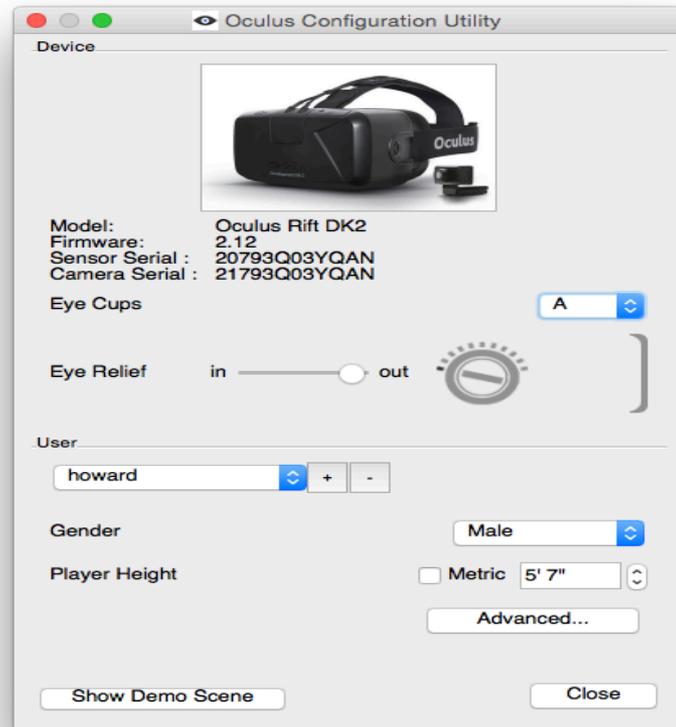
Provide access to **calibration/options** (e.g. FOV sliders, motion blur on and off, etc) **at all times**



# PROMPT CONFIGURATION

Prompt players to configure their device to their own physiology

**BUT this shouldn't be relied on.**



# PLAYTEST PLAYTEST PLAYTEST

**With others, even more than usual.**

With simulation sick prone individuals  
(Recruit specifically or use large samples)



# THE EXPECTATION PROBLEM

If you **expect to get simulation sickness**, or are even told it is possible, **you may be more likely to get sick.**

So...should people be warned or not?



# SUMMARY



# SUMMARY

- Vection can = sickness (& immersion)
- Understand vision
- Latency and frame rate are **VITAL**
- Make (camera) movement appropriate & user controlled
- Know your hardware & SDK's
- Playtest
- Support the player via calibration & playtime



# SUMMARY

Ultimately, it is your call. Your experience. Your artistic vision.

Are you happy to exclude some people?

To make some people sick?



# QUESTIONS?

