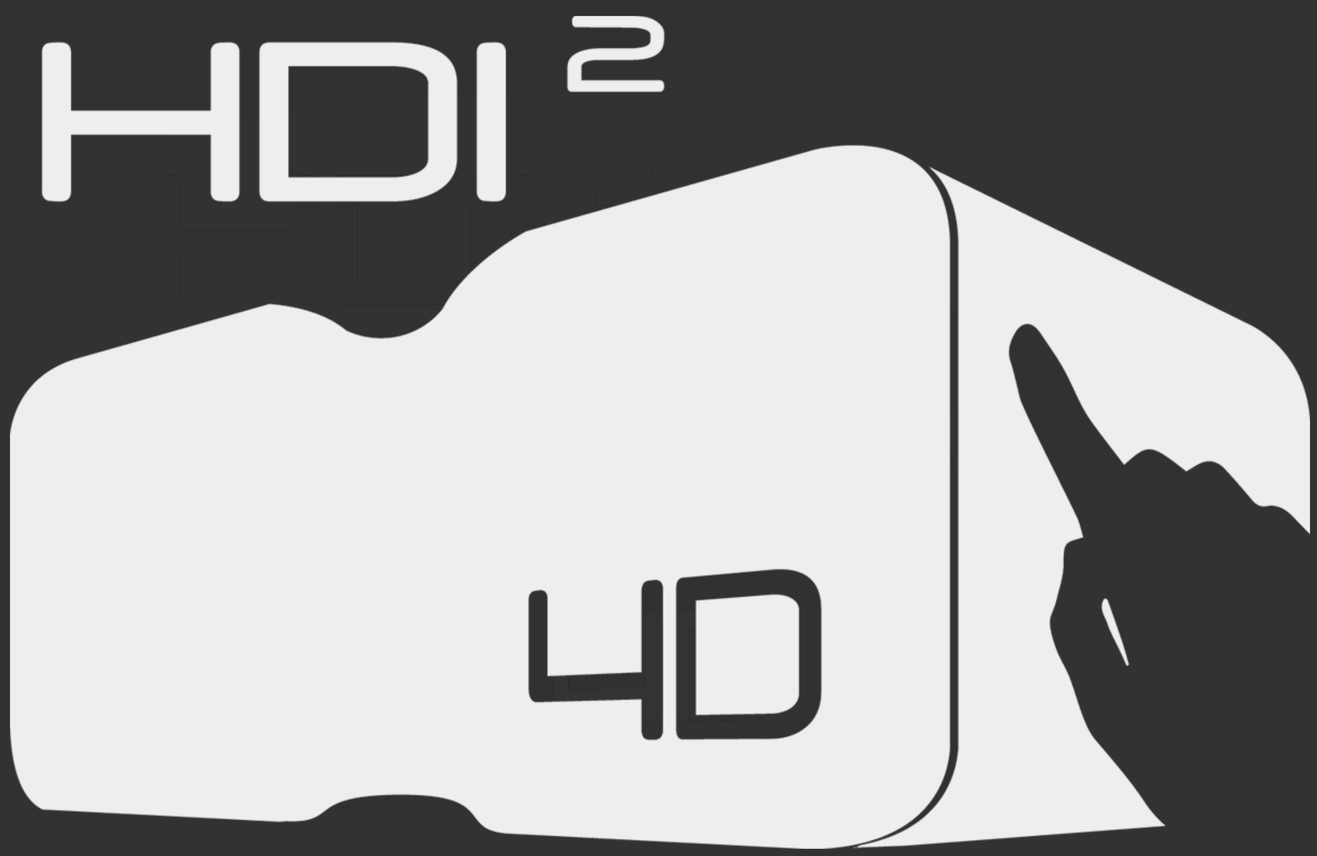


Human-Digital Content Interaction for Immersive 4D Home Entertainment
The 1st New Zealand-Korea Strategic Research Partnership Workshop

Kieran Carnegie
Victoria University of Wellington

Visual Discomfort on Head Mounted Displays

Visual Discomfort

Simulator sickness

Visual Discomfort

Simulator sickness

Visual discomfort is a subset of simulator sickness

Visual Discomfort

Simulator sickness

Visual discomfort is a subset of simulator sickness

Shown to affect ~80% of people

Causes

Immersive

- lack of outside “information”

Causes

Immersive

- lack of outside “information”
- close to face

Causes

Immersive

- lack of outside “information”
- close to face
- display covers wide portion of user FoV

Vection

A “powerful illusion of self motion”

Vection

A “powerful illusion of self motion”

Caused by an illusion of presence

Vection

A “powerful illusion of self motion”

Caused by an illusion of presence

Expectation Mismatch

Brain **anticipates** and **adjusts** for expected motions or stimuli

Vection

A “powerful illusion of self motion”

Caused by an illusion of presence

Expectation Mismatch

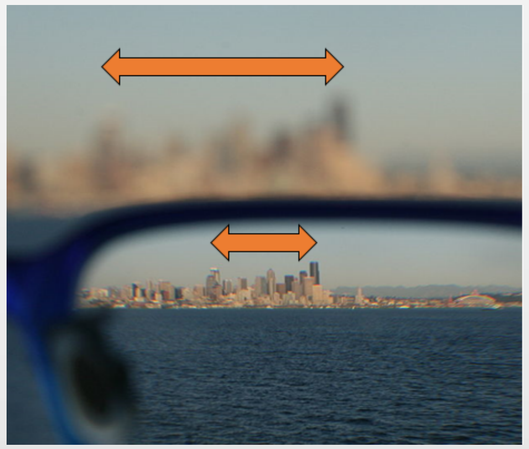
Brain anticipates and adjusts for expected motions or stimuli

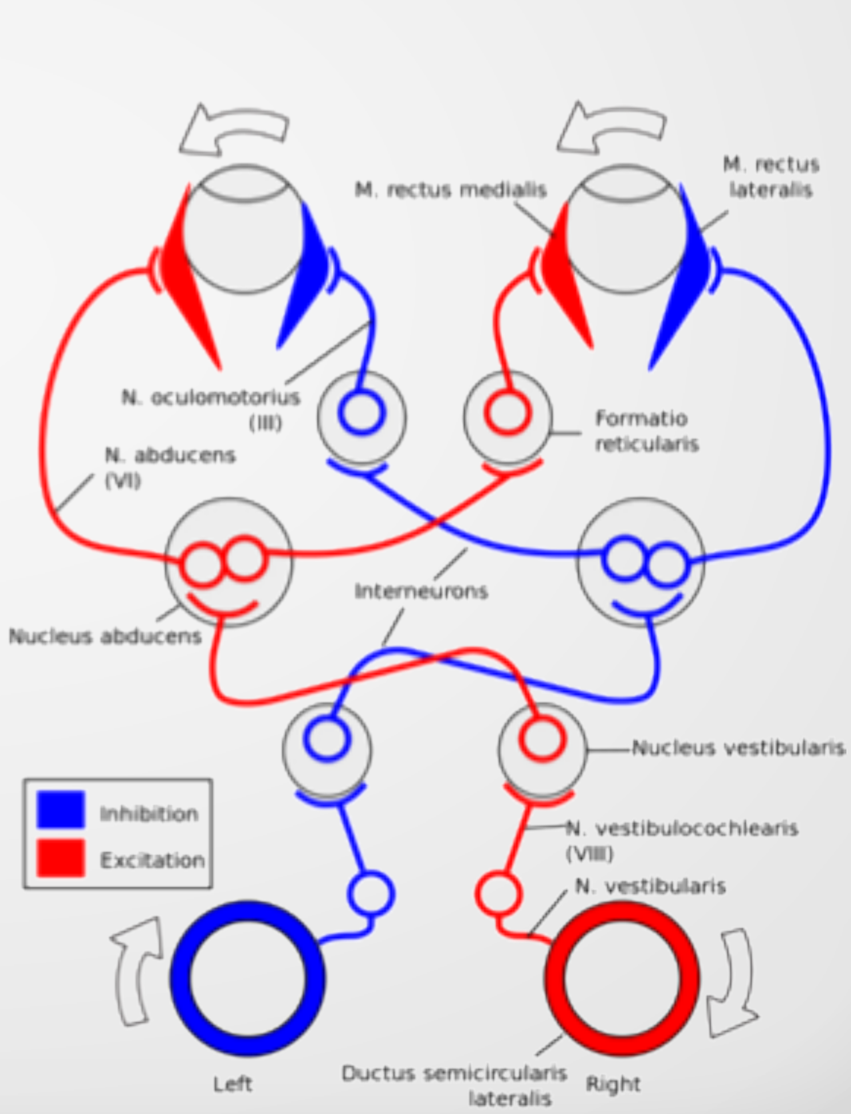
Pilots on 2-F2-H hover simulator had strong correlation between discomfort and flight hours logged

Incorrect Rendering

VOR ratio

the ration between **movement of the head** and automatic **motion of the eyes**





Incorrect Rendering

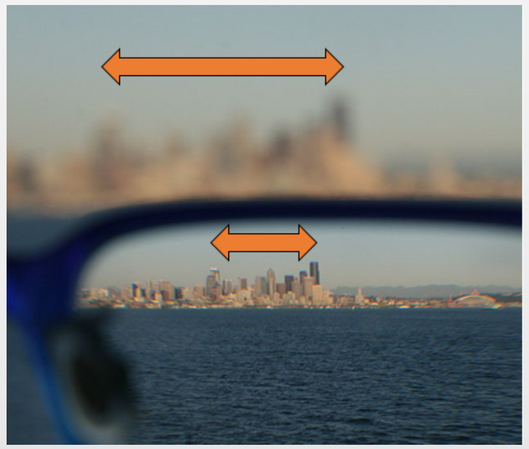
VOR ratio

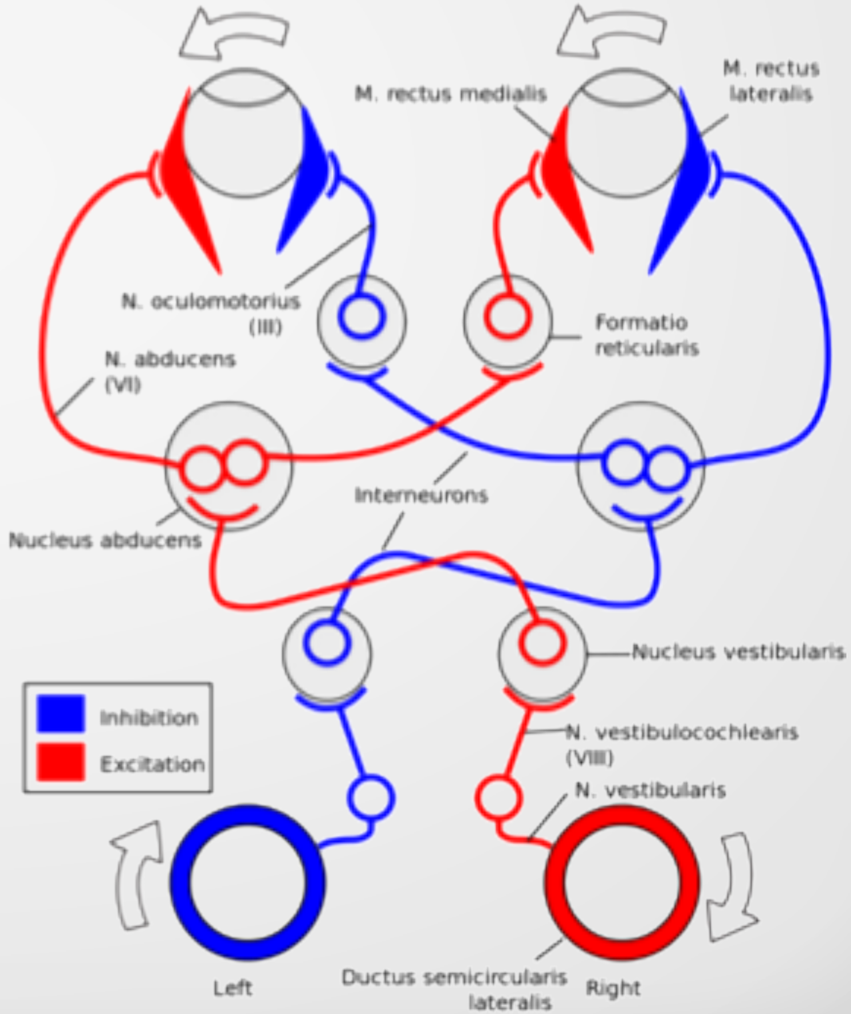
the ration between **movement of the head** and automatic **motion of the eyes**

Learnt for new situations

takes up to two weeks to learn

can switch on demand once learnt



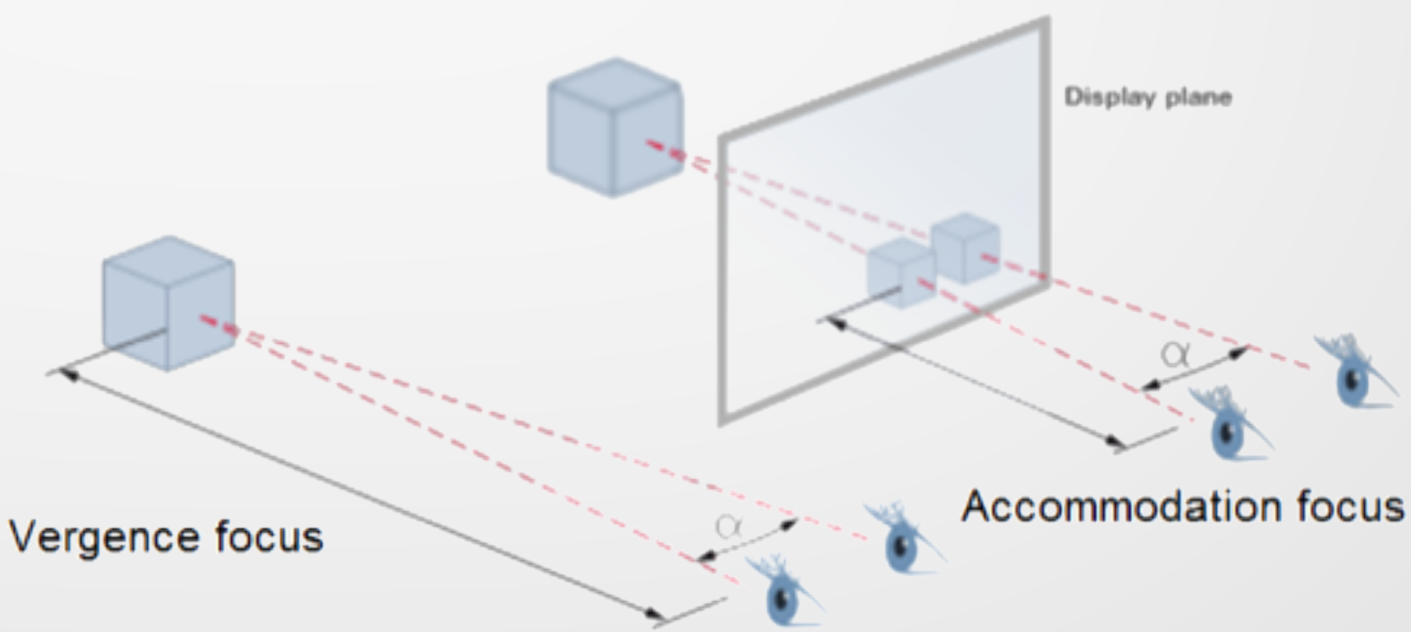


Conflicting Depth Cues

Accommodation / convergence cues do not match

Allow users to learn new VOR ratios

Learn correct cues to diminish conflict



Conflicting Depth Cues

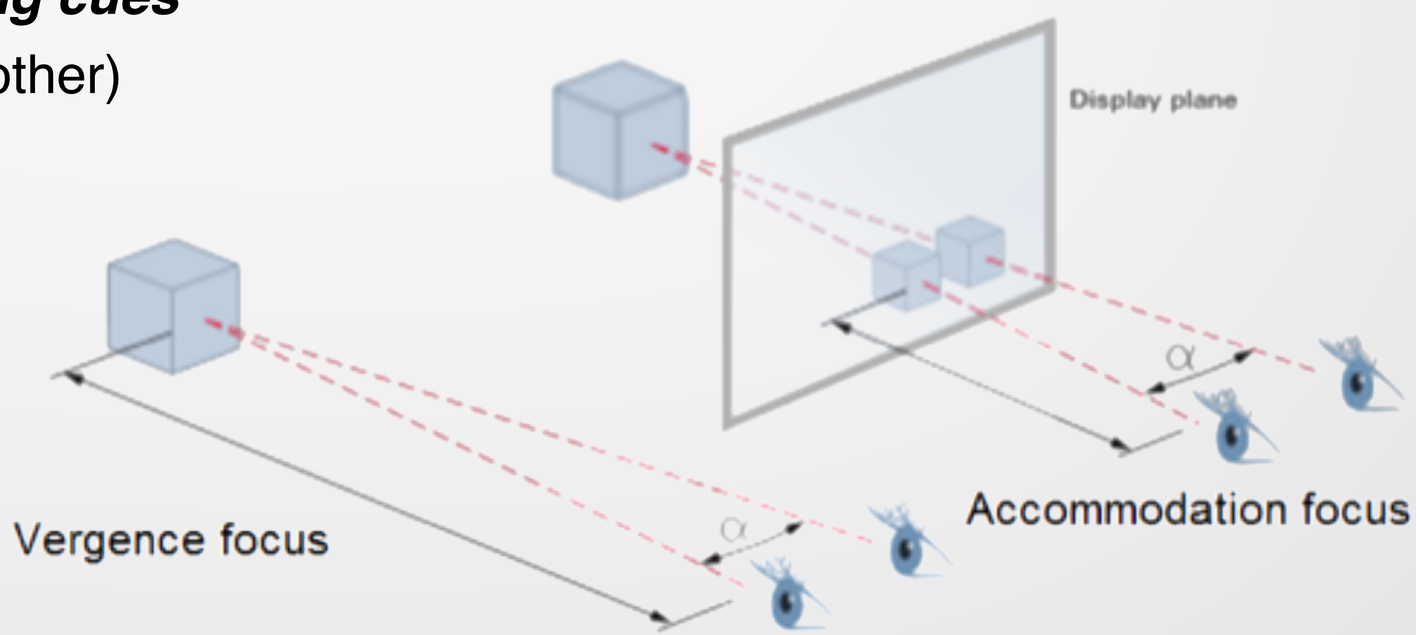
Accommodation / convergence cues do not match

Allow users to learn new VOR ratios

Learn correct cues to diminish conflict

Forces brain to manage conflicting cues

(that normally complement each other)

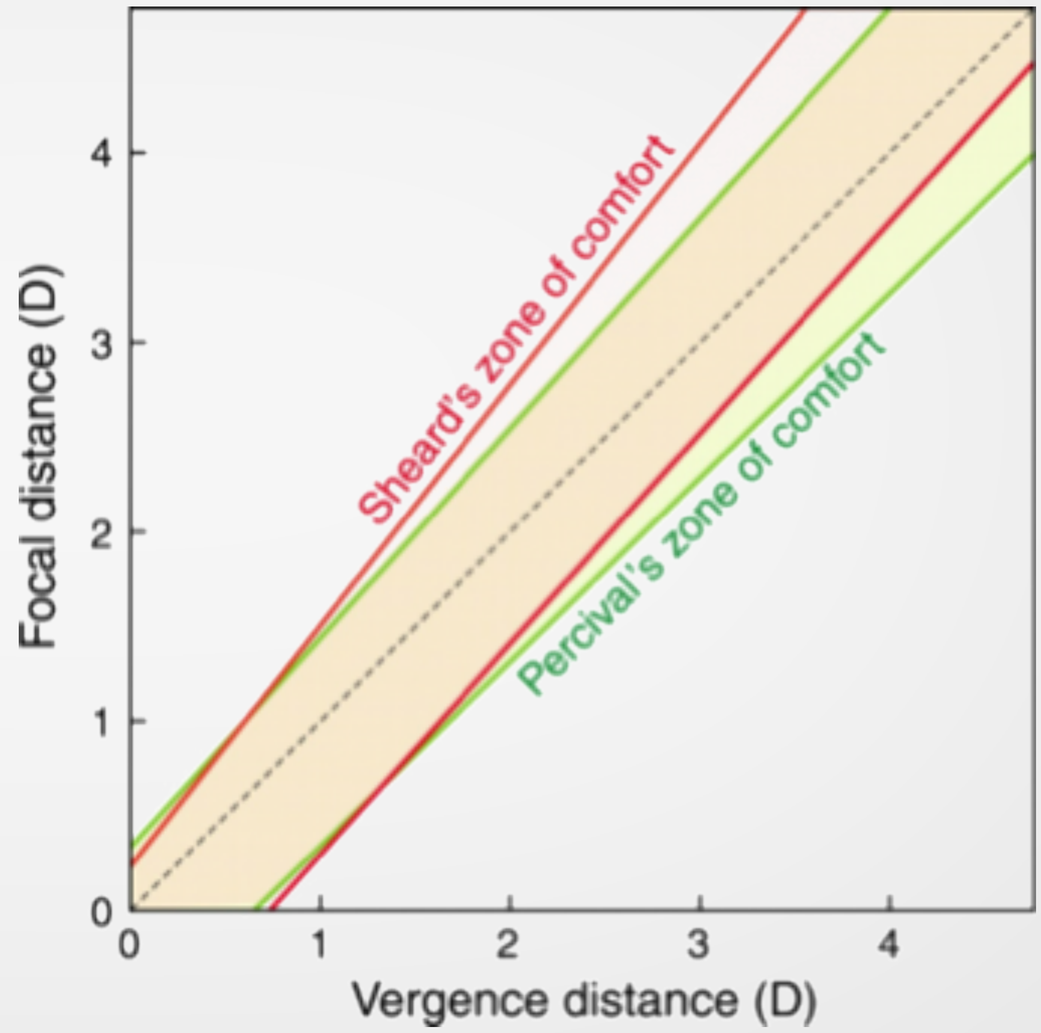


Reducing Visual Discomfort

Long term exposure

Allow users to learn new VOR ratios

Learn correct cues to diminish conflict



Reducing Visual Discomfort

Long term exposure

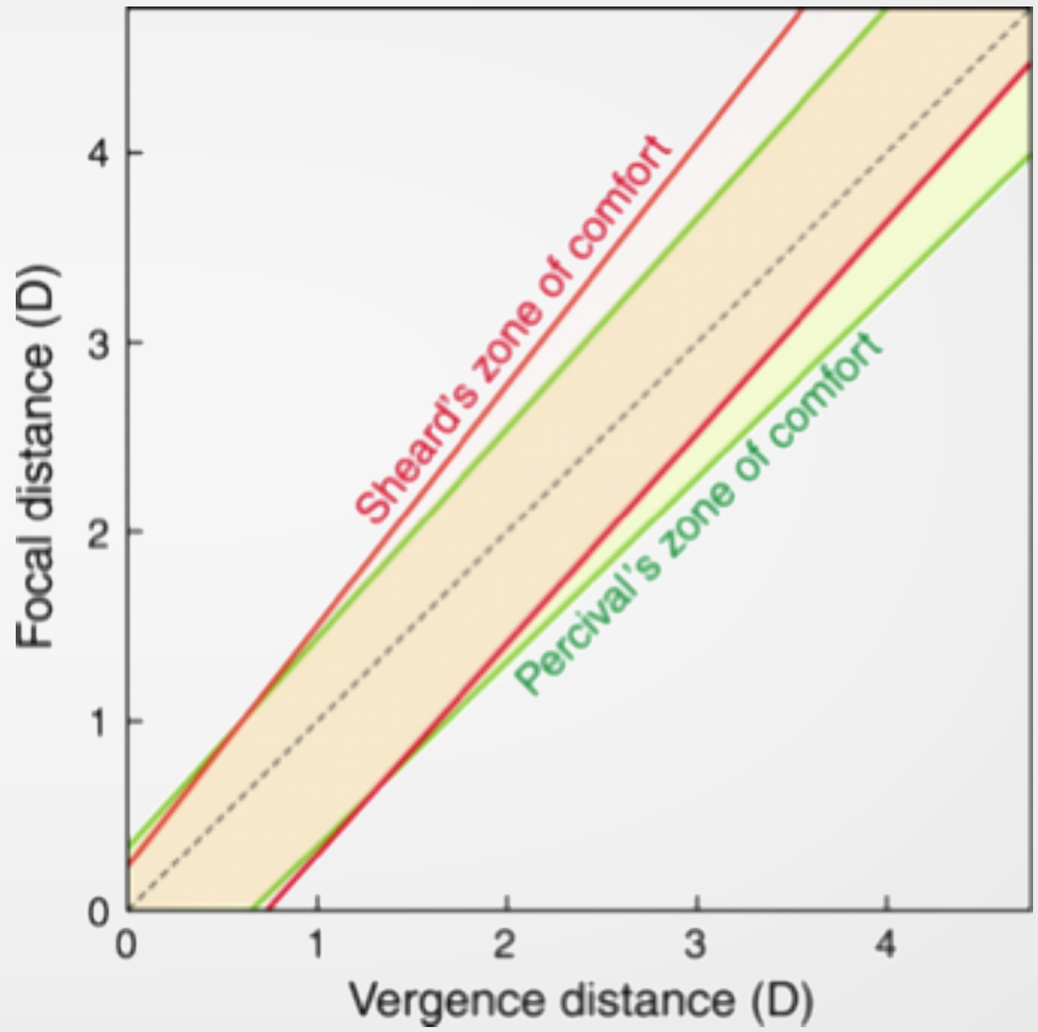
Allow users to learn new VOR ratios

Learn correct cues to diminish conflict

Zones of comfort

Render only **comfortable** content

Issues with dynamic content



Reducing Visual Discomfort

Long term exposure

Allow users to learn new VOR ratios

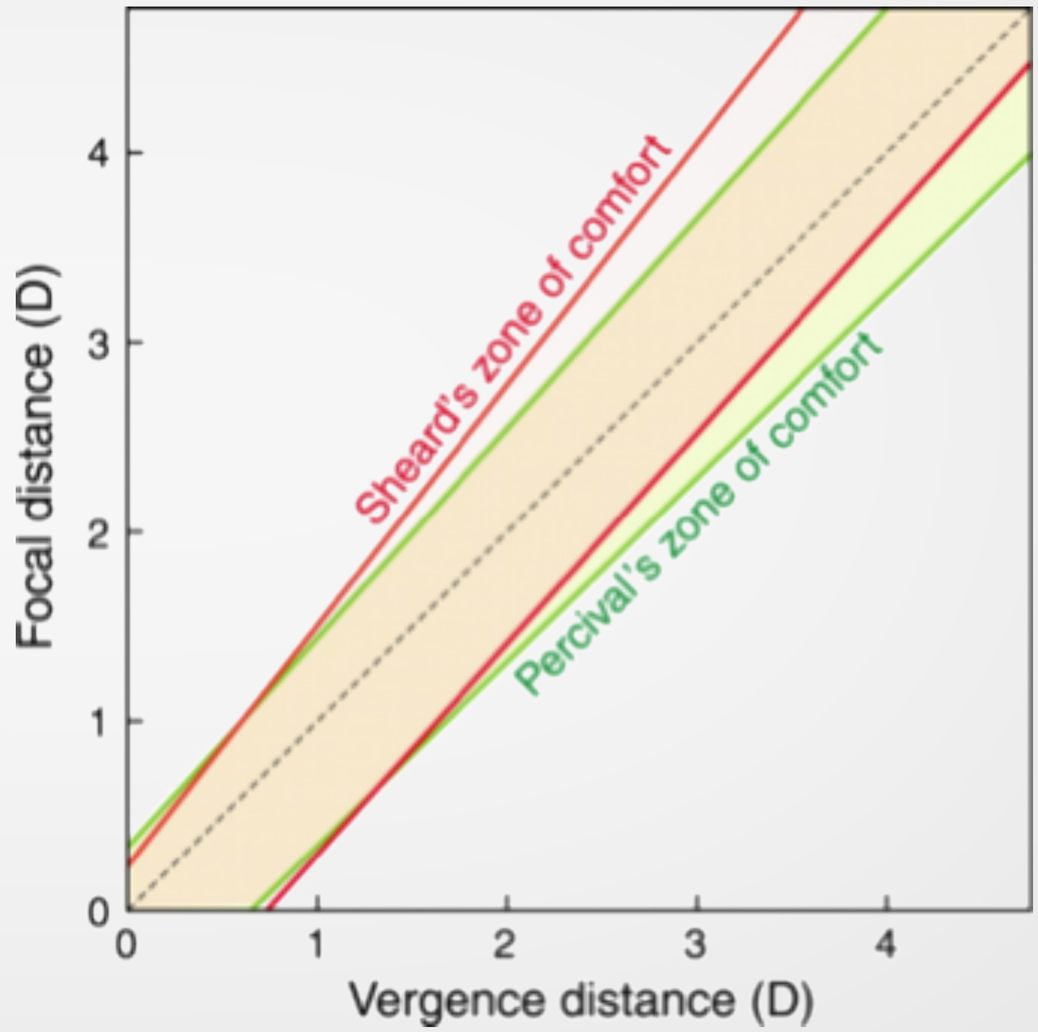
Learn correct cues to diminish conflict

Zones of comfort

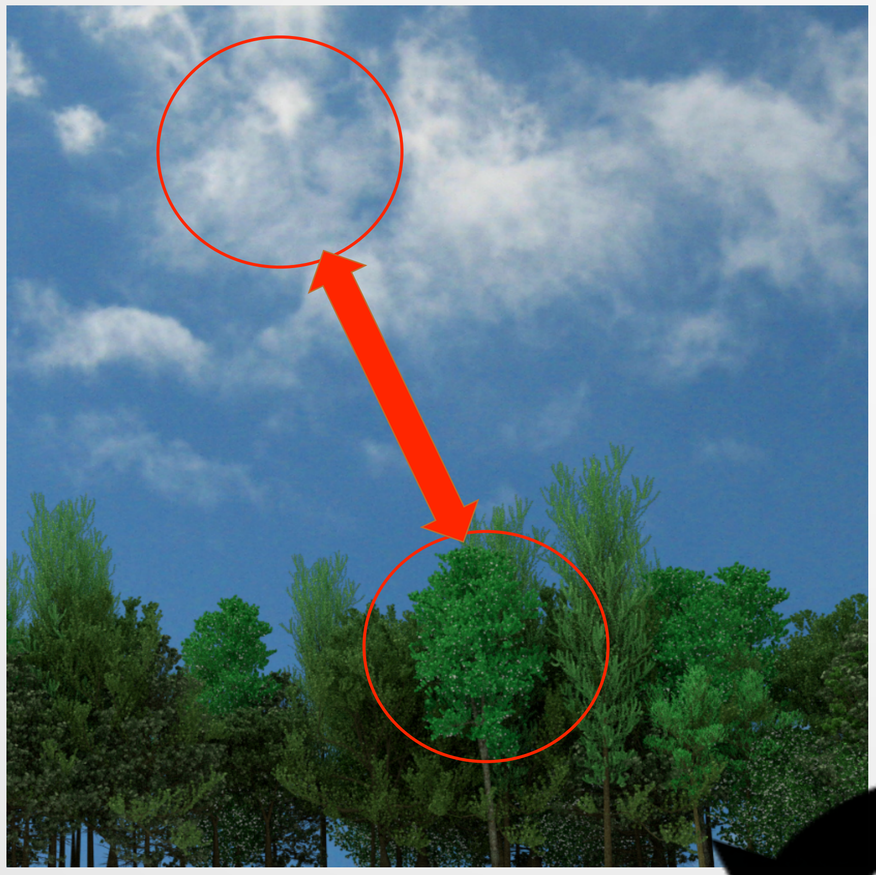
Render only **comfortable** content

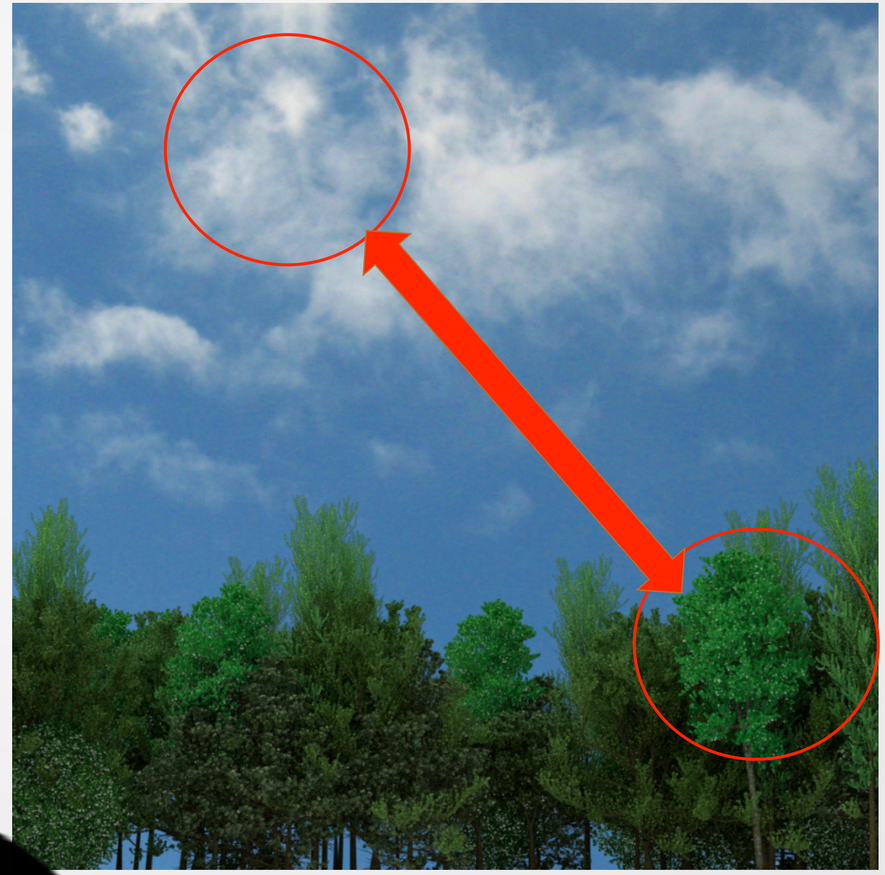
Issues with dynamic content

Outside-the-box rendering solutions



Orientation Independent Skyboxes





Questions