



3D STEREOSCOPIC GAMES

SUMMIT

3D FOR EVERYONE

GDC
Online

Game Developers Conference® Online **October 5-8, 2010** | **Austin, TX**

Bei Yang

- Walt Disney Imagineering
- Concept Designer

Keith Leonard

- Schell Games
- Graphics Ninja

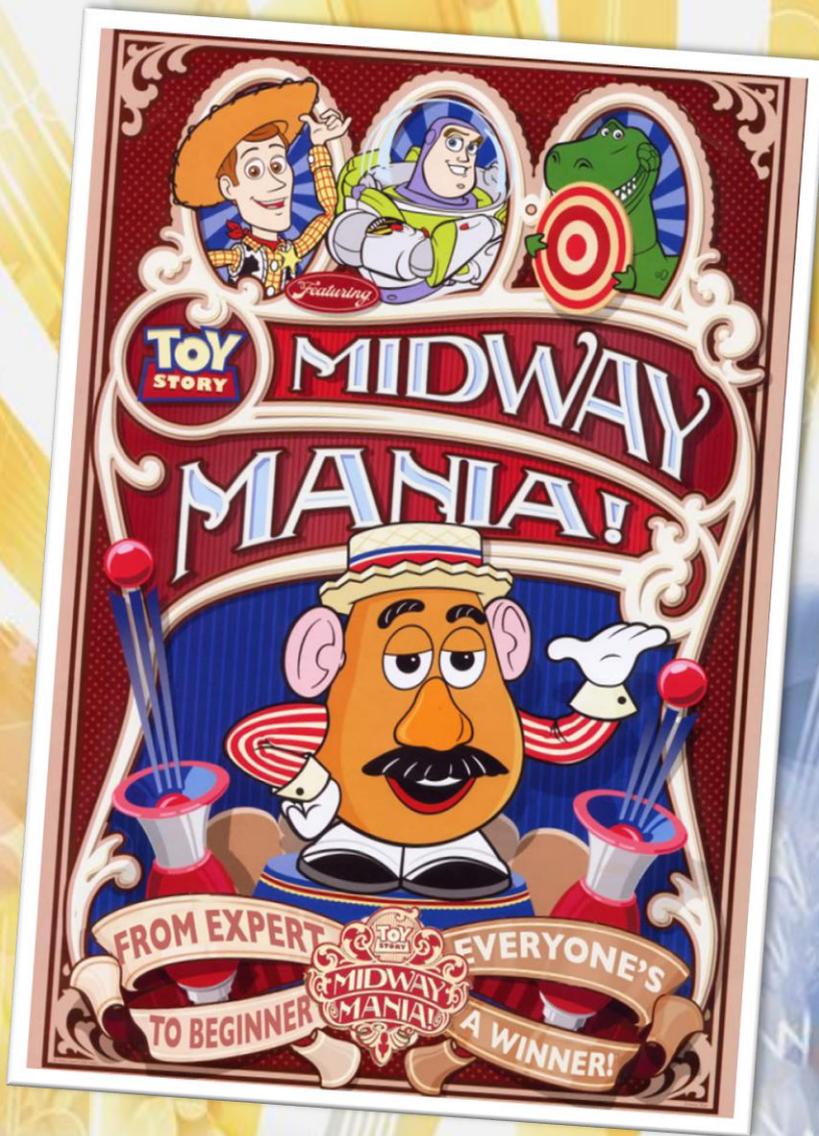






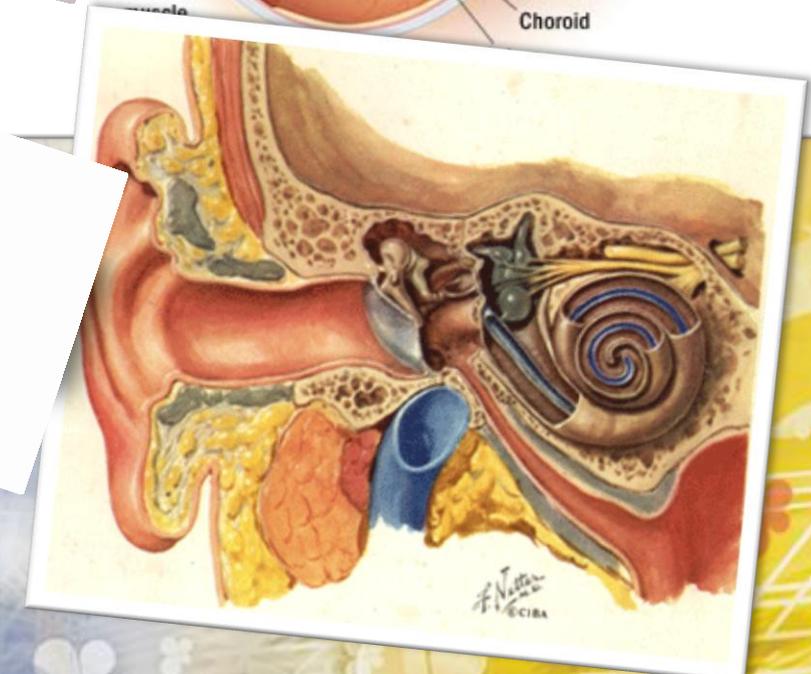
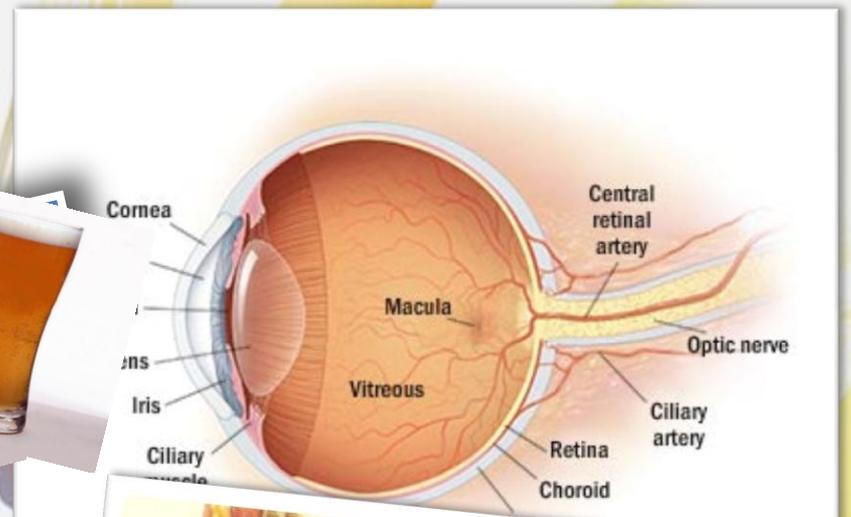


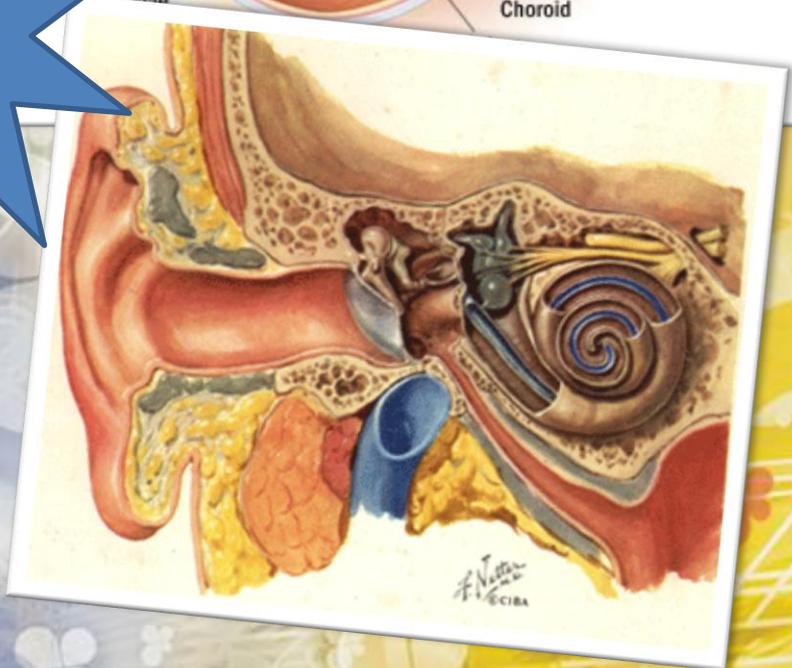
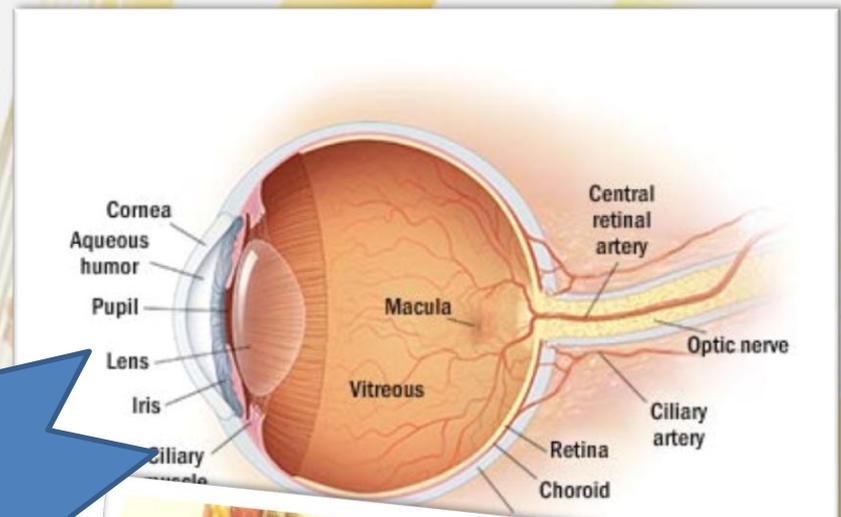
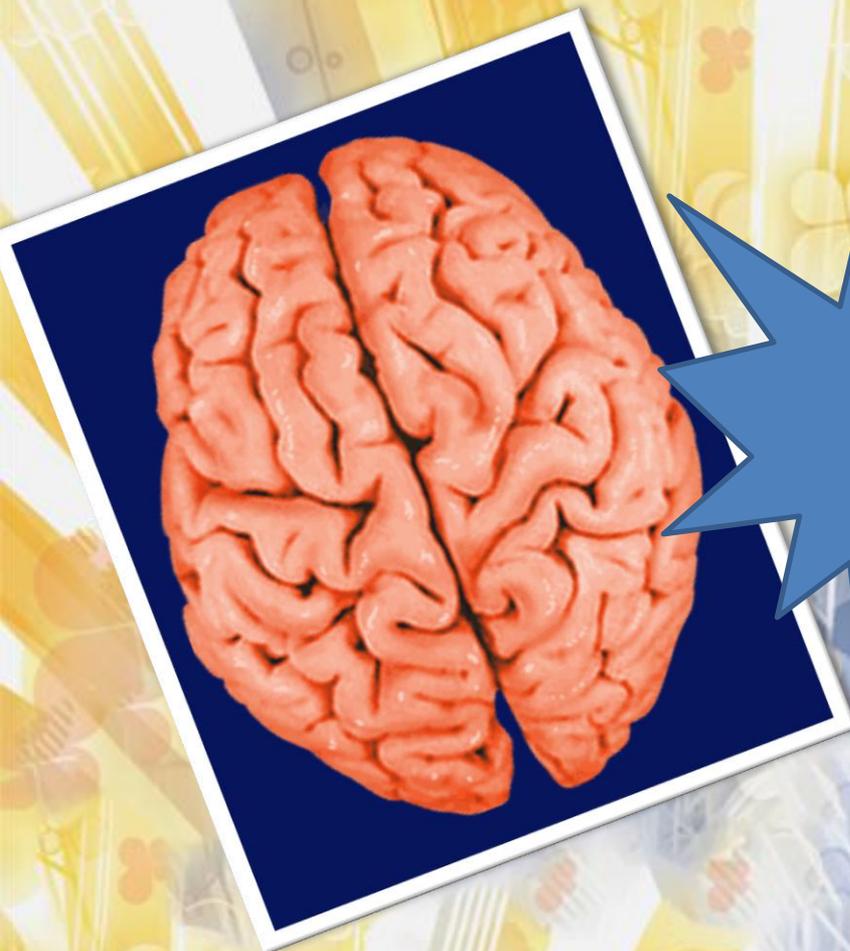














BEER GOGGLES!



THEY TURN BOW INTO WOW!



I really like Mirror's Edge, but...
HURRAUGH!

HOHHHHHLLAUGH!

HOUGH!
HOUGH!

NOOOOHHHLLAAAA!

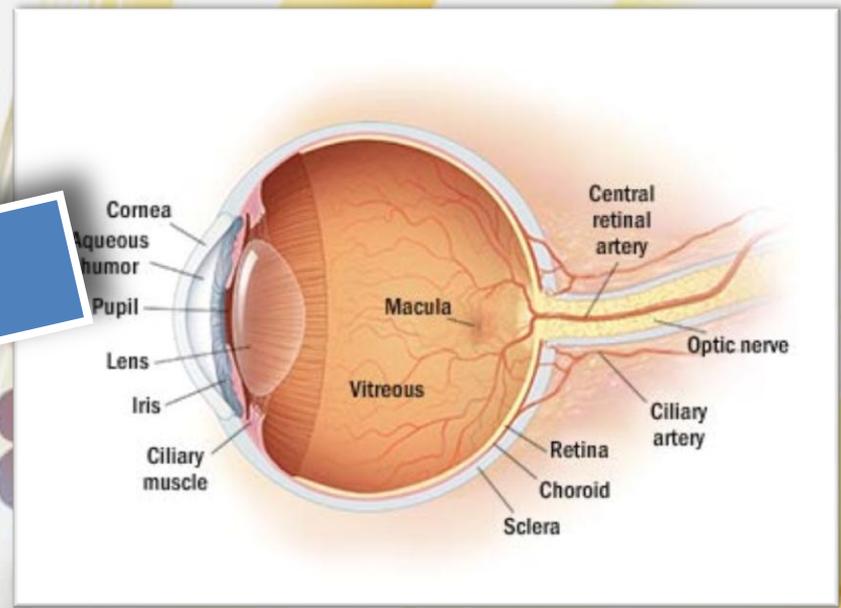
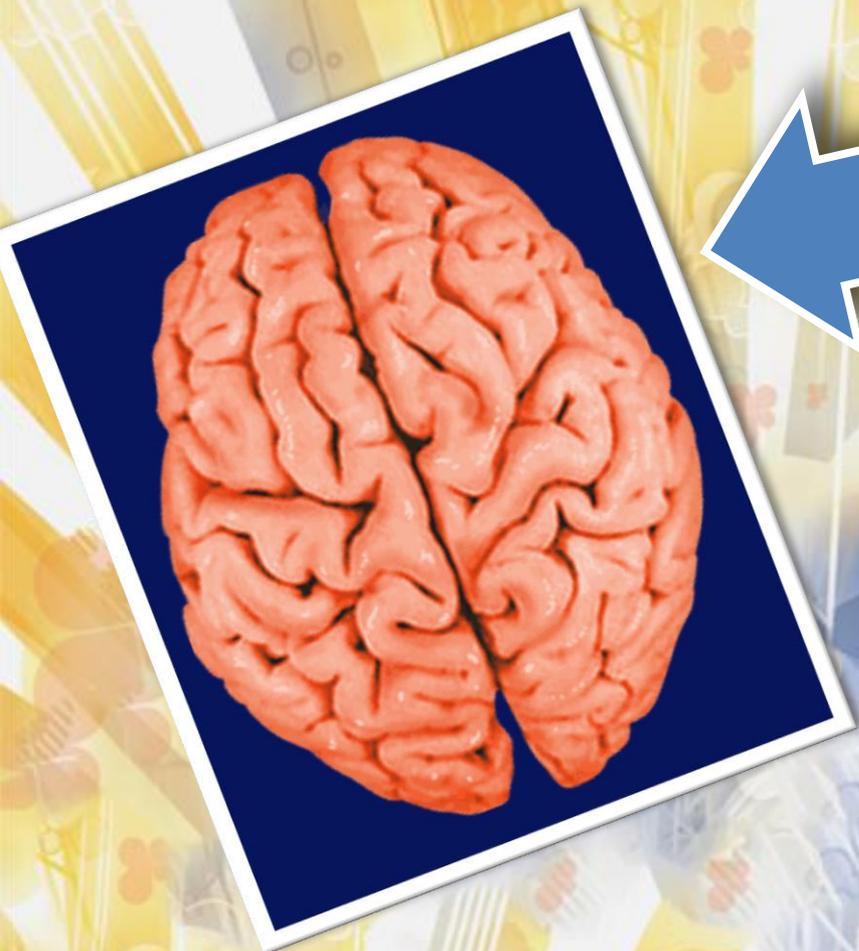
PTEH
PFEH

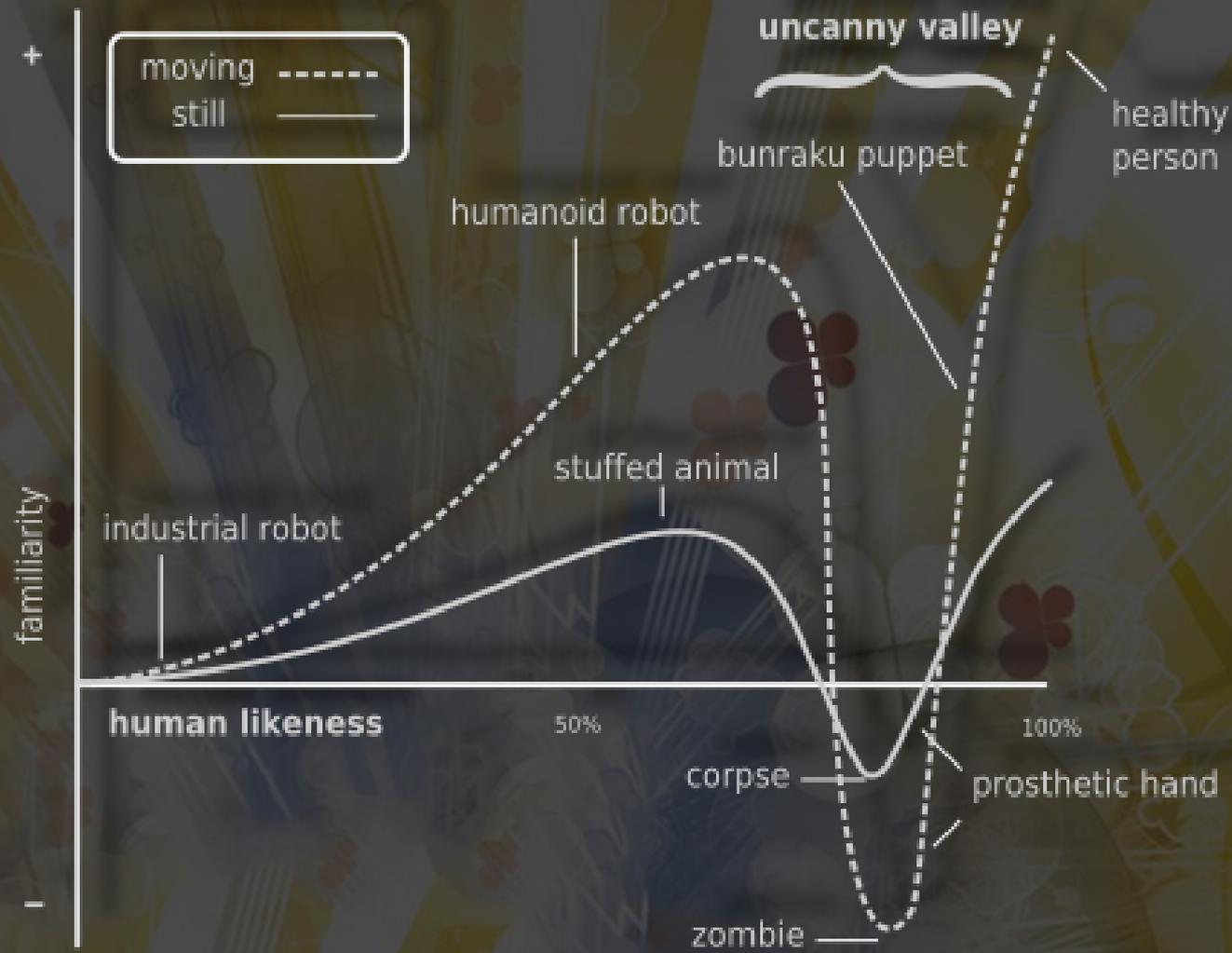
You could stop. You know? It's an option.

No, no. I'm good.

Almost done with the tutorial.

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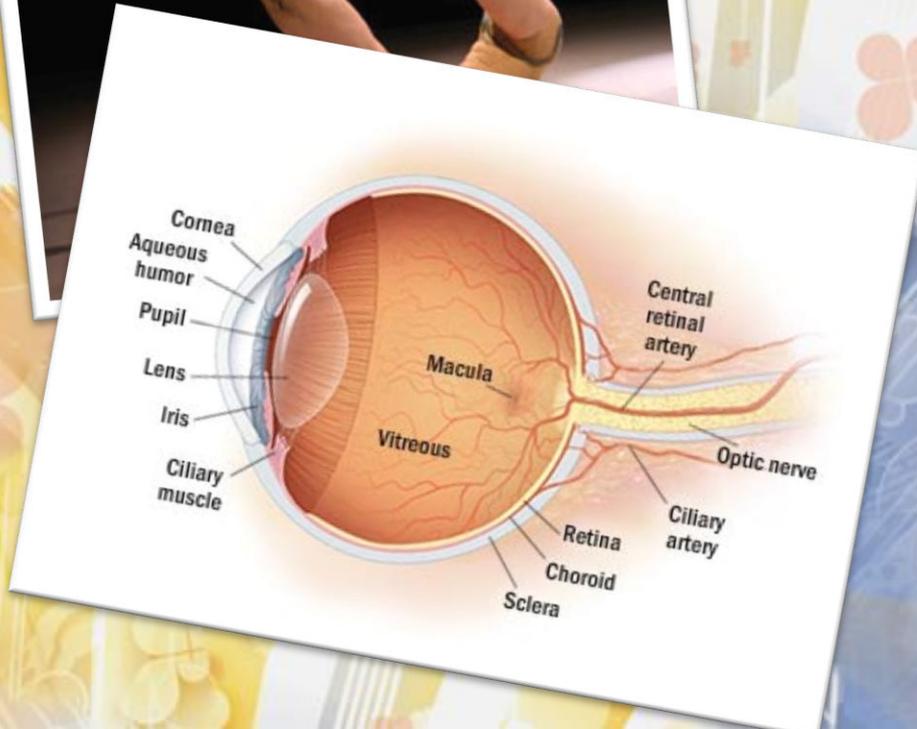
Thanks Wikipedia

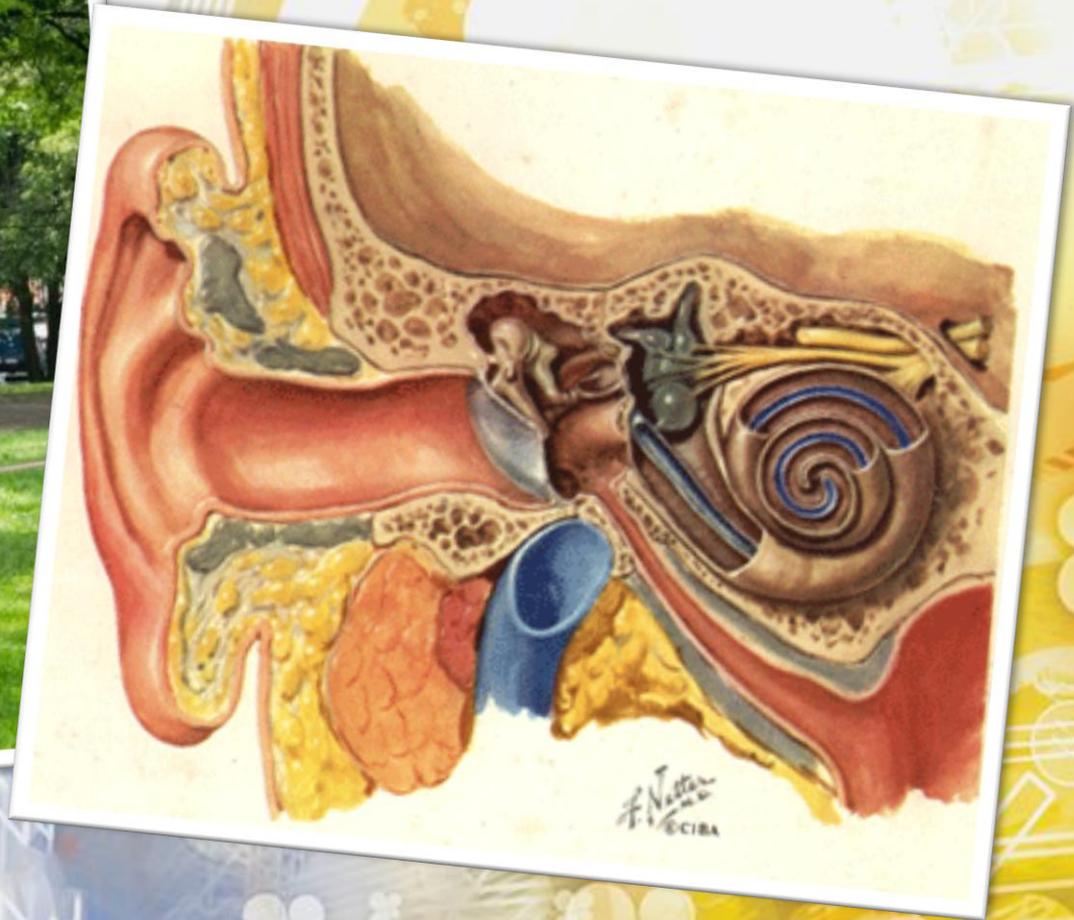


the bad news...

**THINGS YOU CAN'T REALLY
CONTROL (RIGHT NOW)**









some good news...

THINGS YOU CAN CONTROL









FLOOR

2

SCORE

13000

LIVES

3



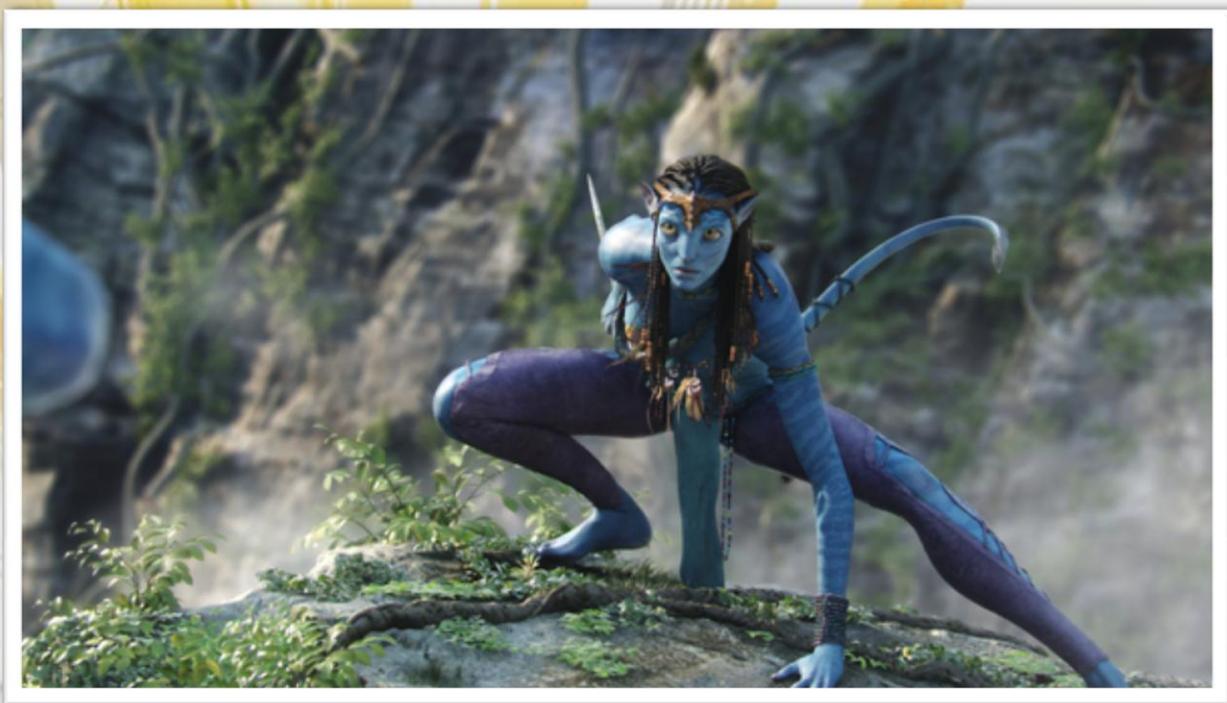
HEALTH

88%

AMMO

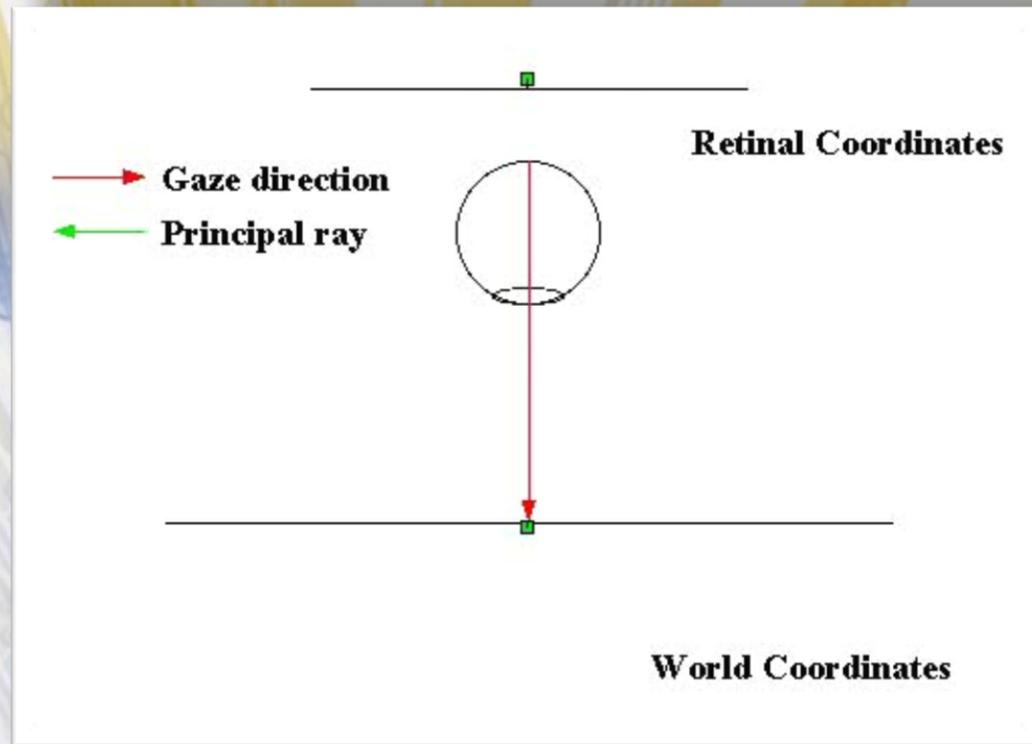
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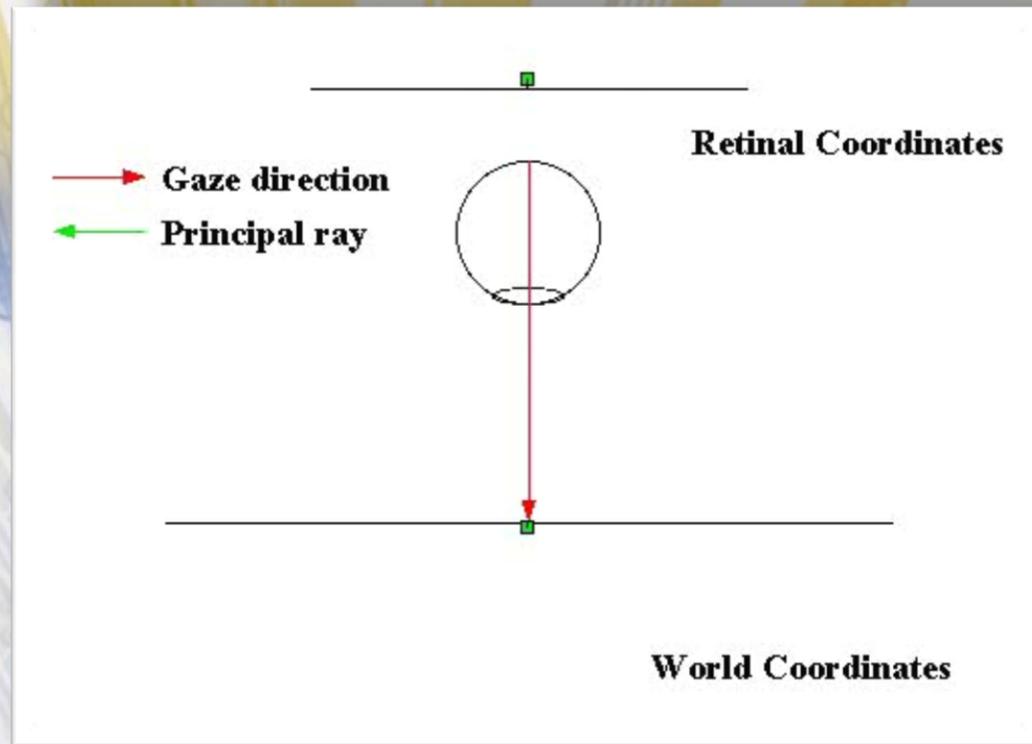




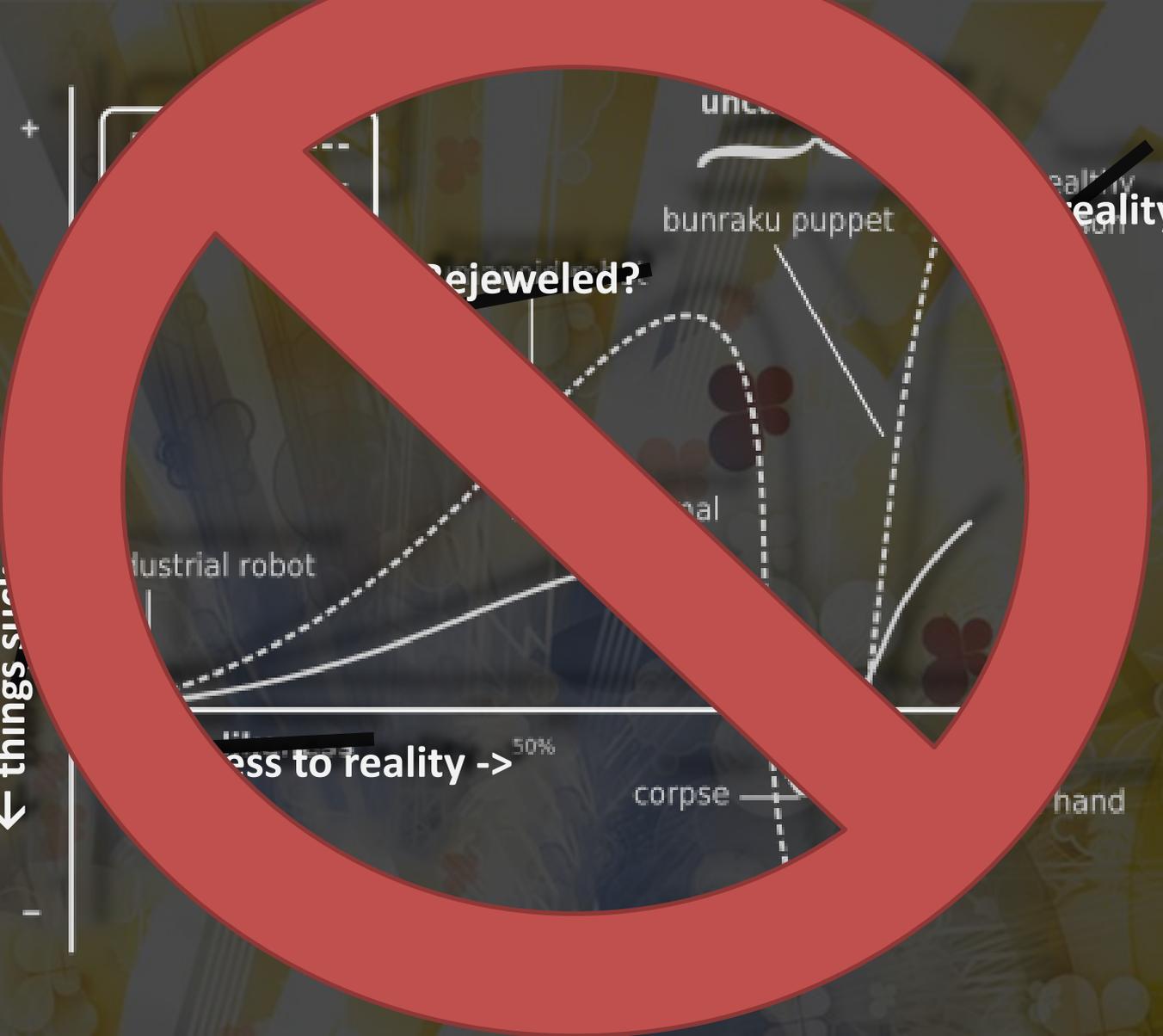




*Special thanks to Dr. Larimer for movies



*Special thanks to Dr. Larimer for movies



Rejeweled?

bunraku puppet

reality

Industrial robot

← things such as
50%
→ progress to reality →

corpse

hand

Conflicting

Matching

Stereo
Convergence

Inner Ear

Eye point
location

Focal
Proprioception

Virtual Screen
Measurements



Conflicting

Matching

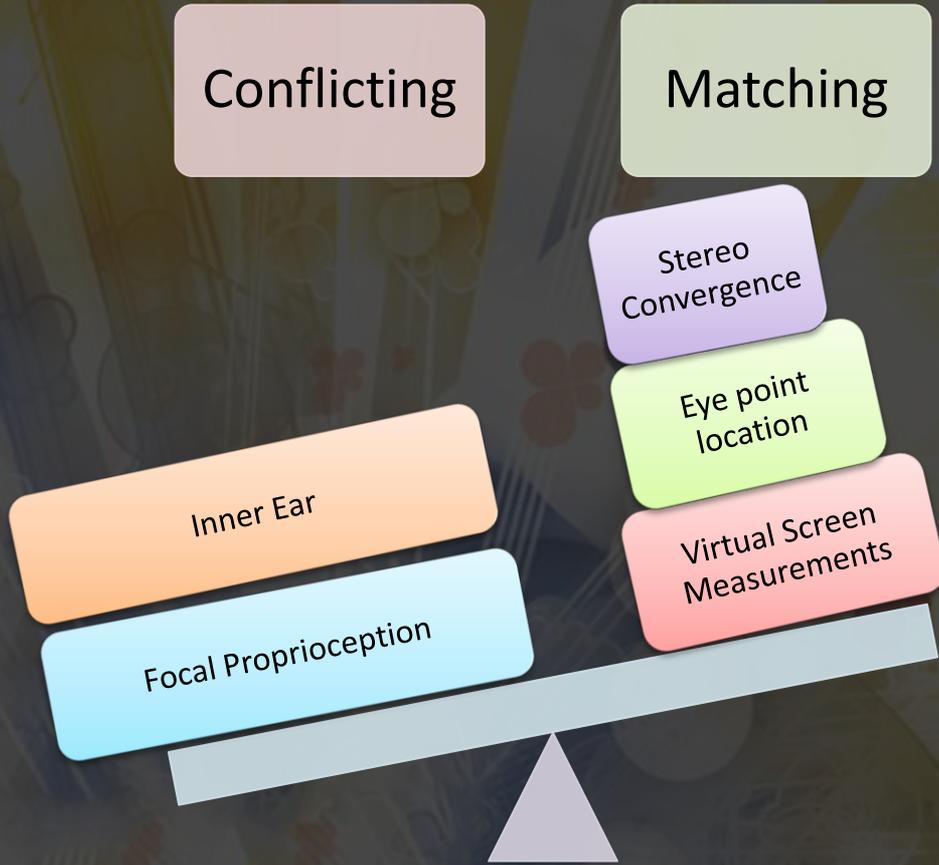
Stereo
Convergence

Eye point
location

Virtual Screen
Measurements

Inner Ear

Focal Proprioception









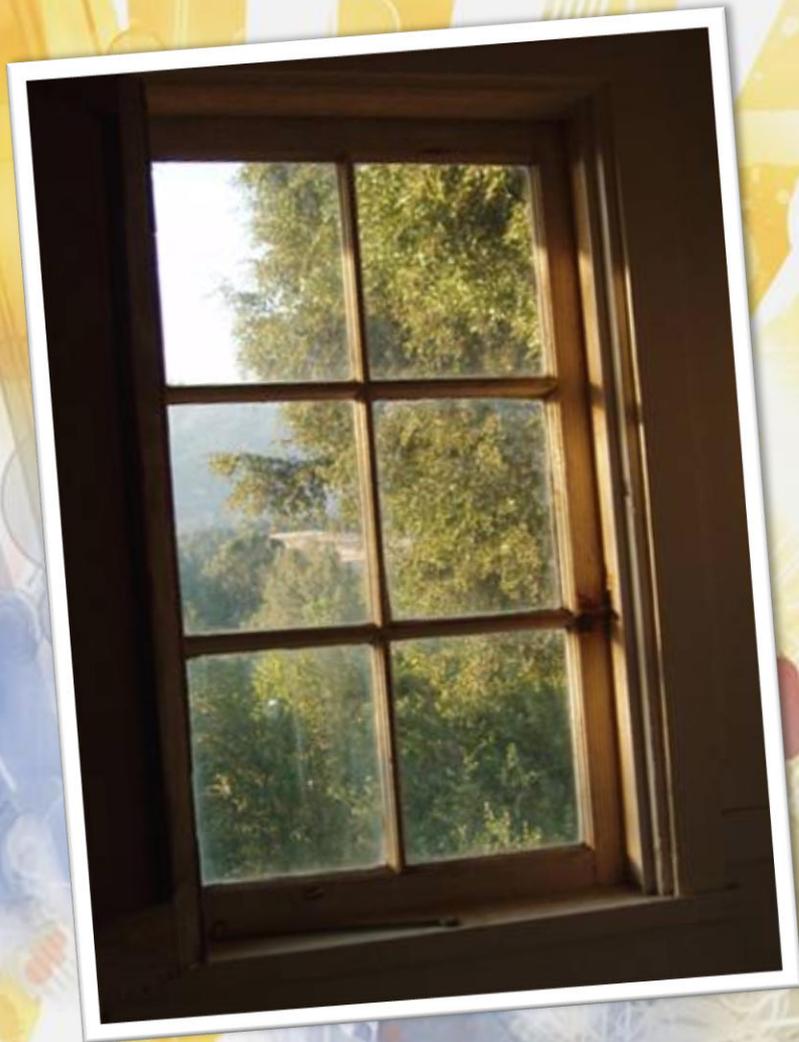
a lesson in...

PROPER STEREO CONVERGENCE

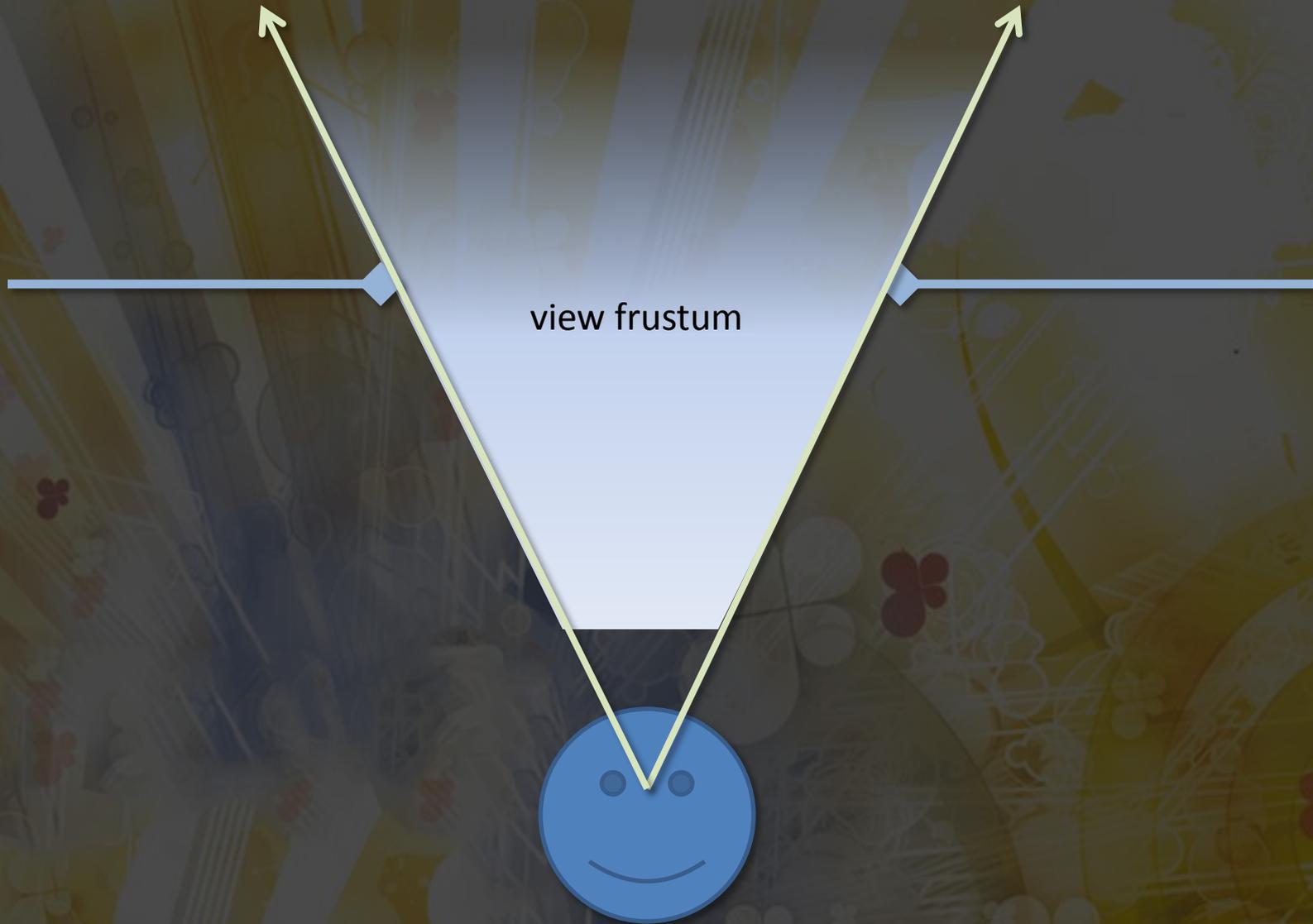




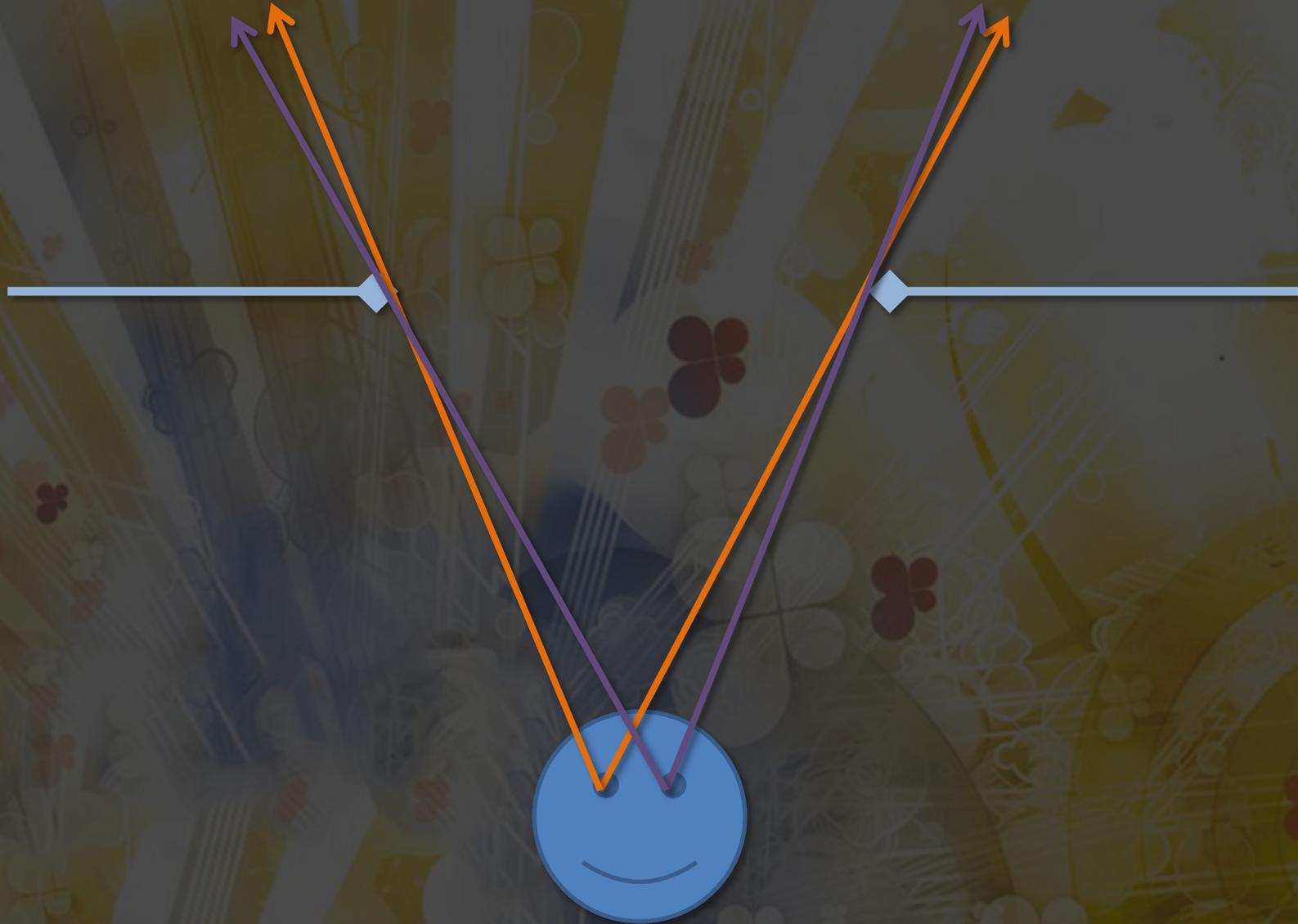


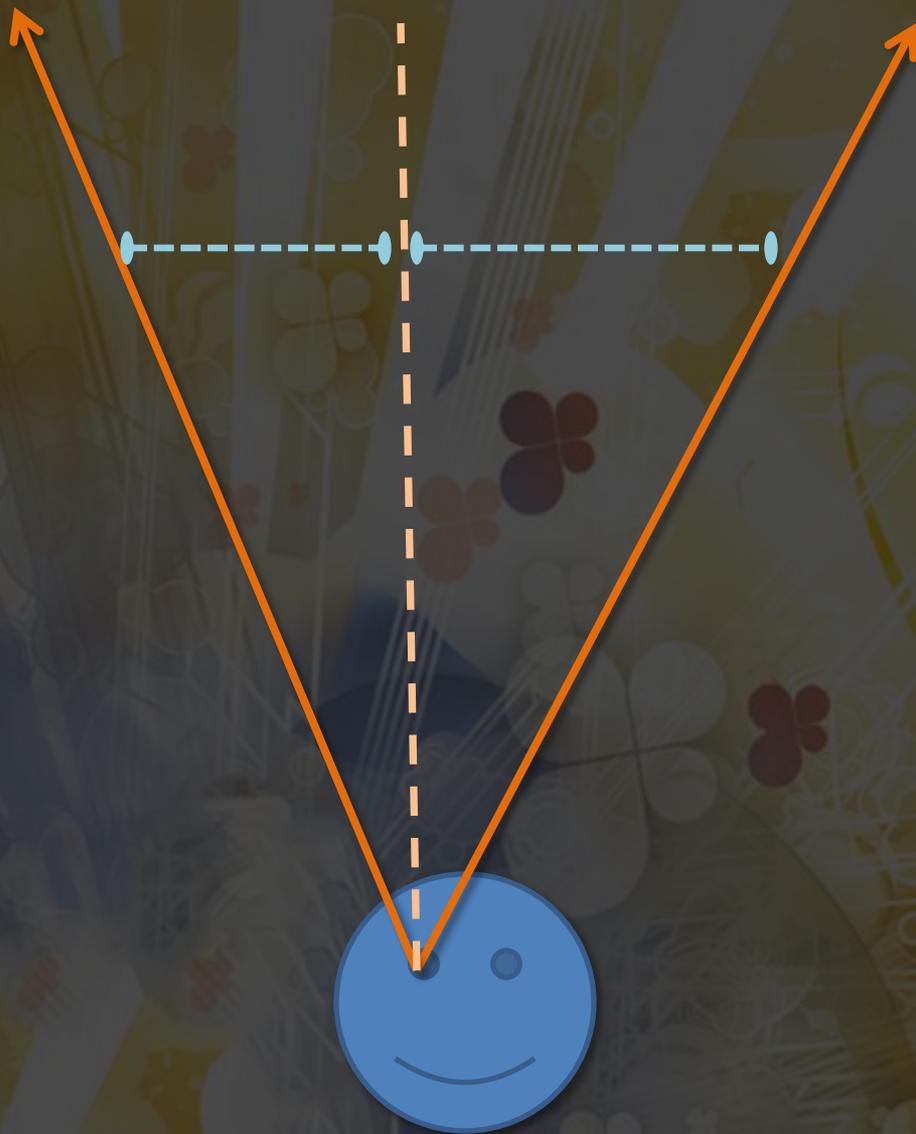






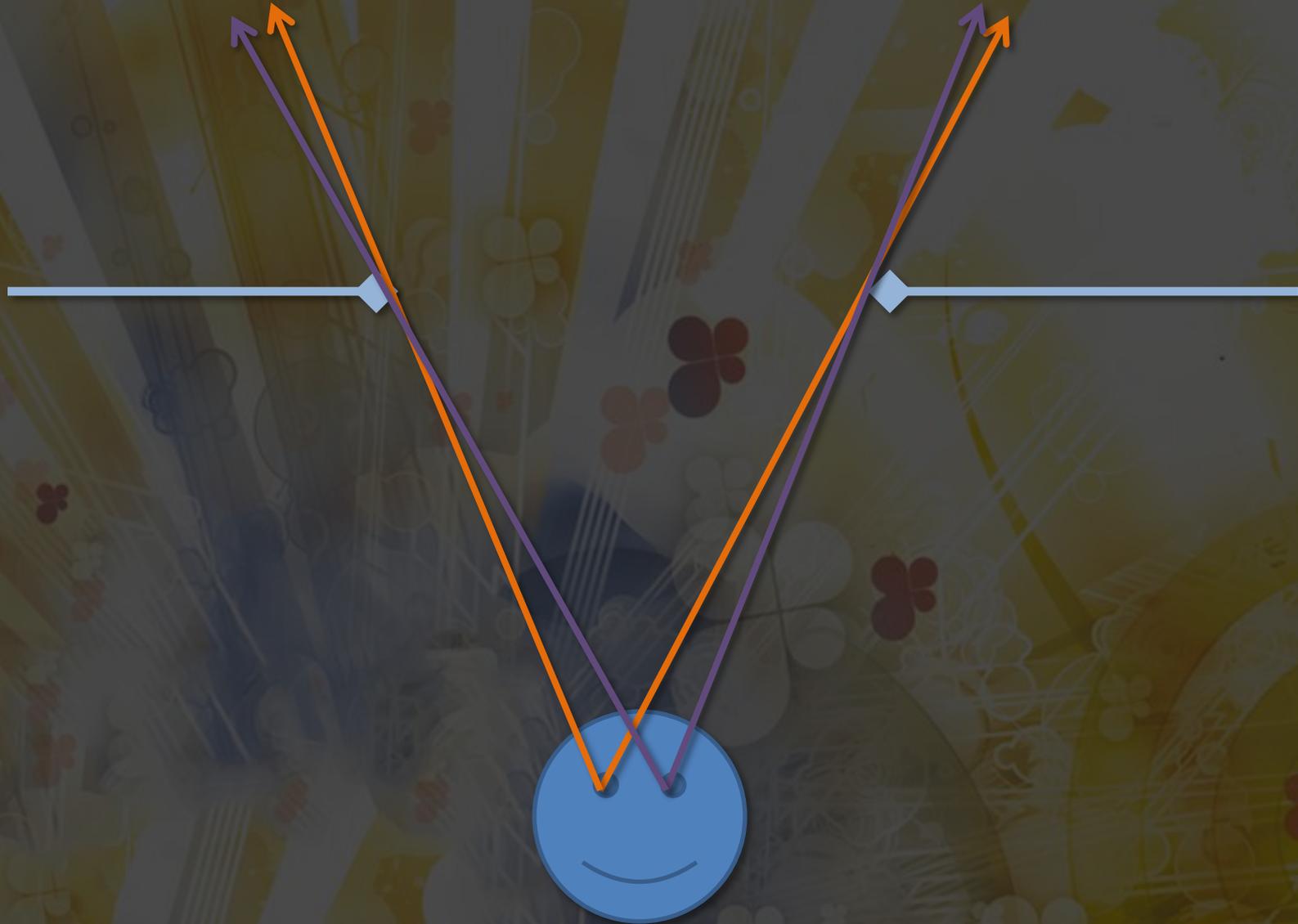
view frustum

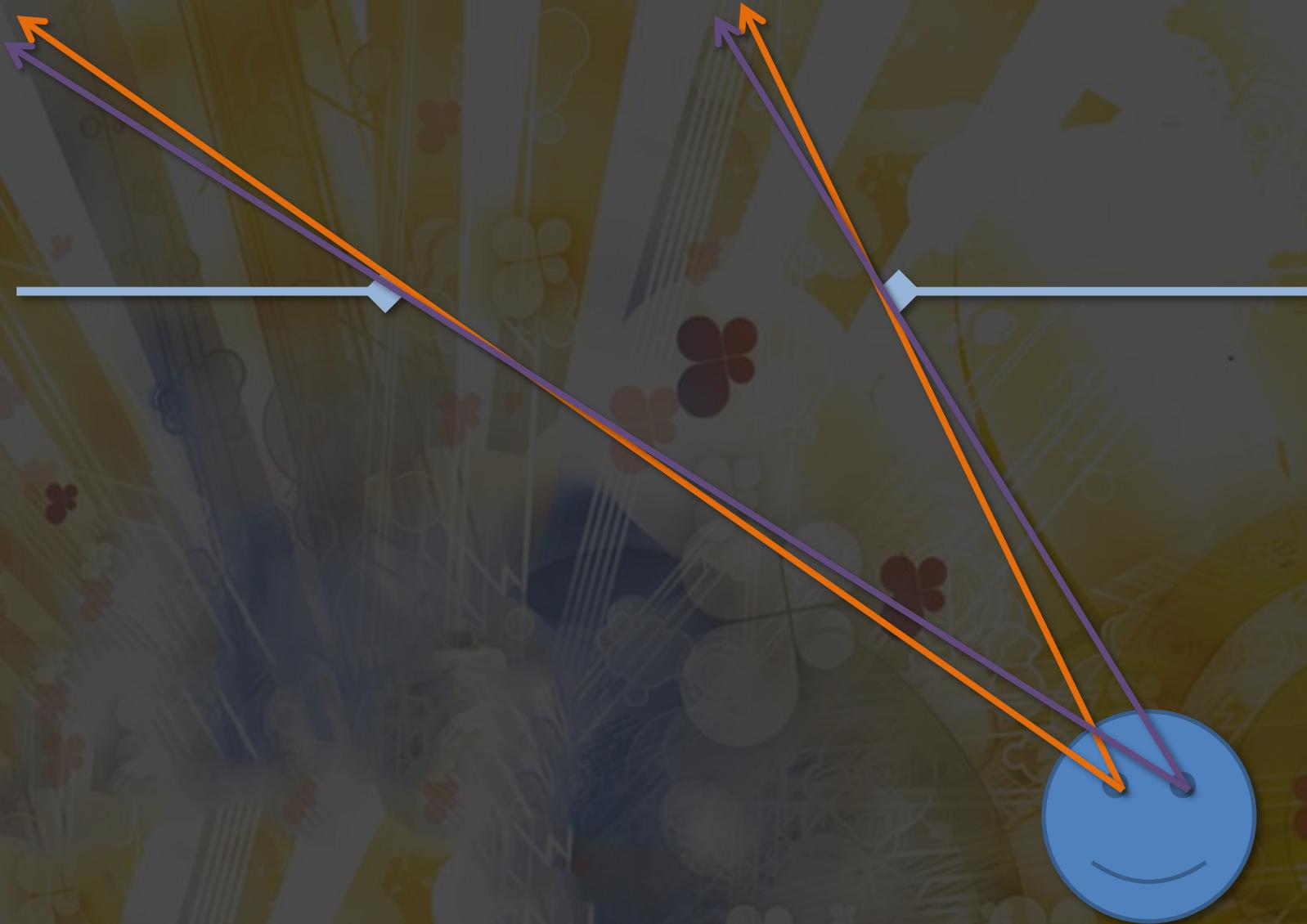


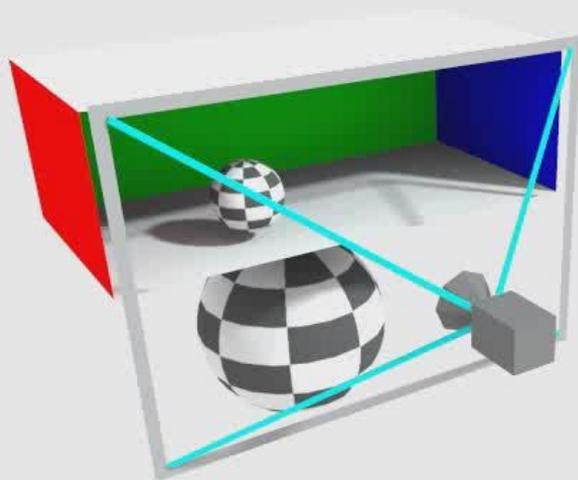
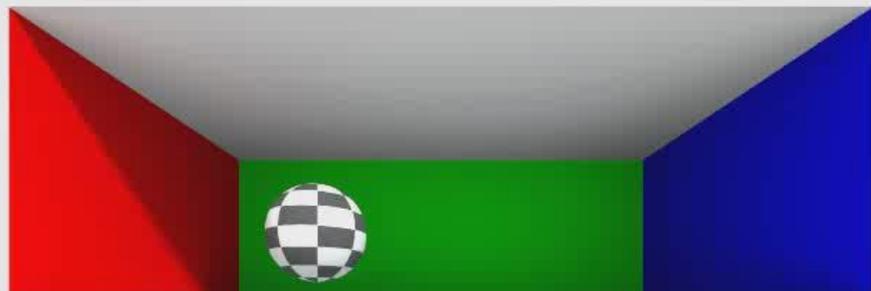






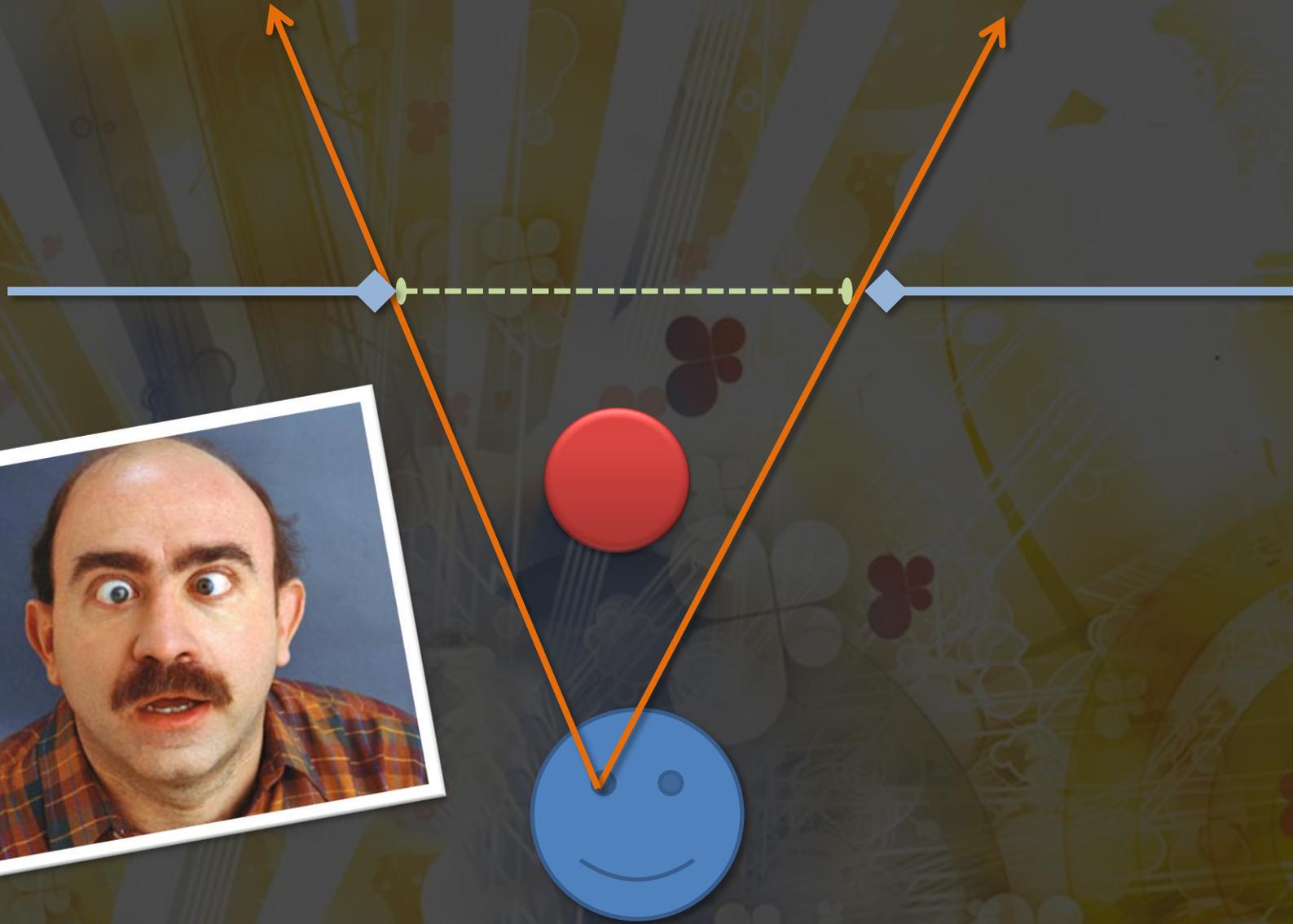


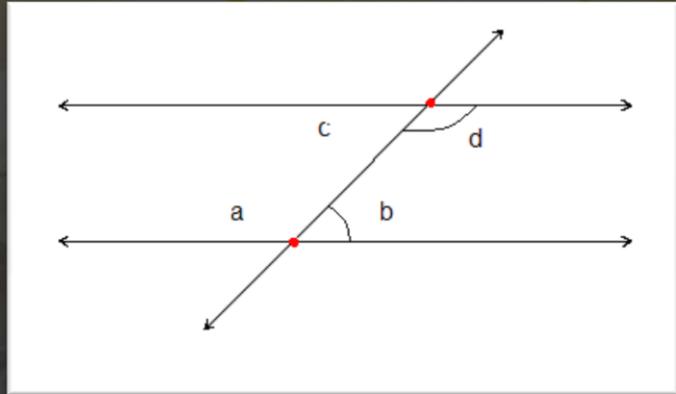
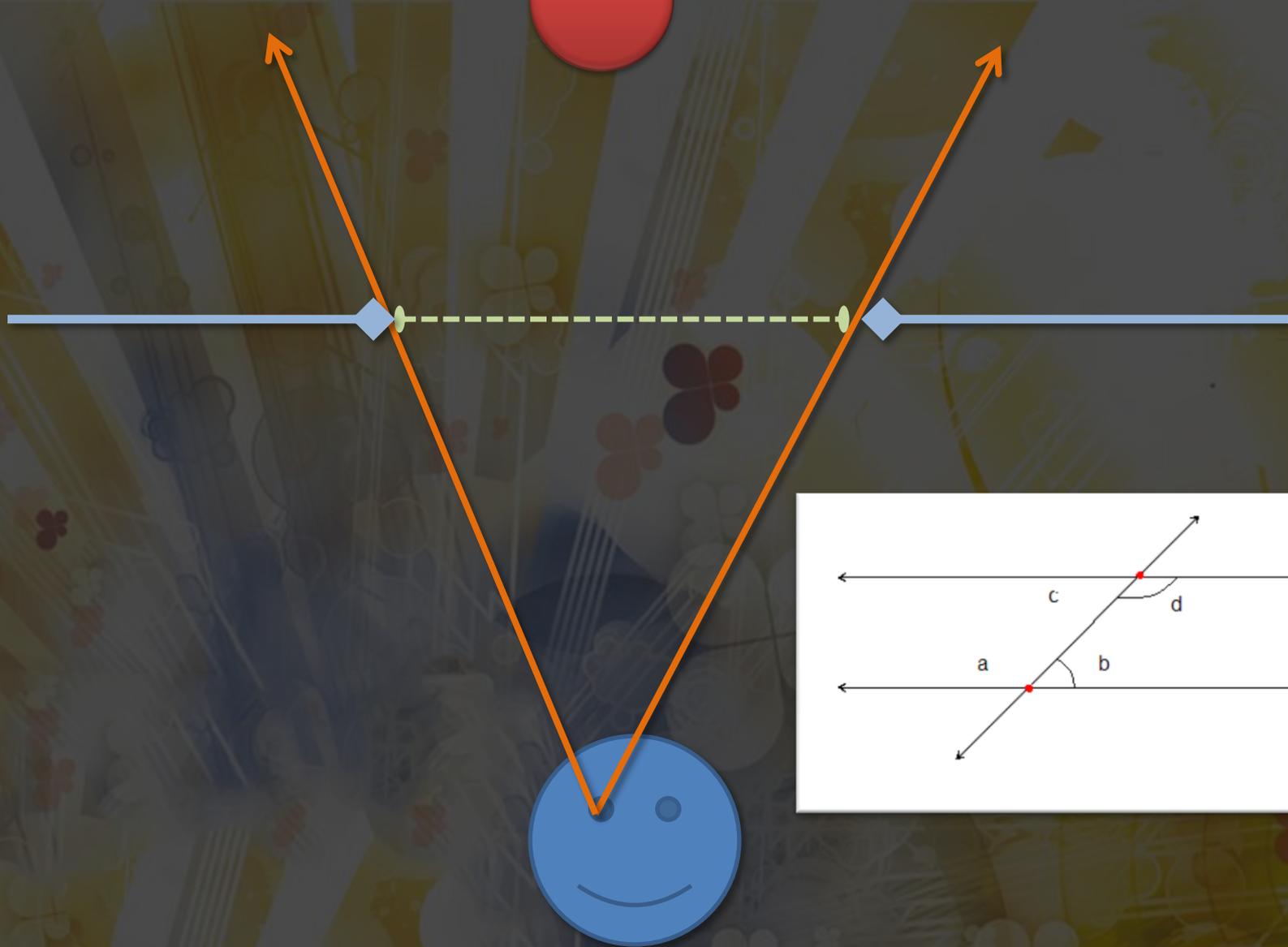




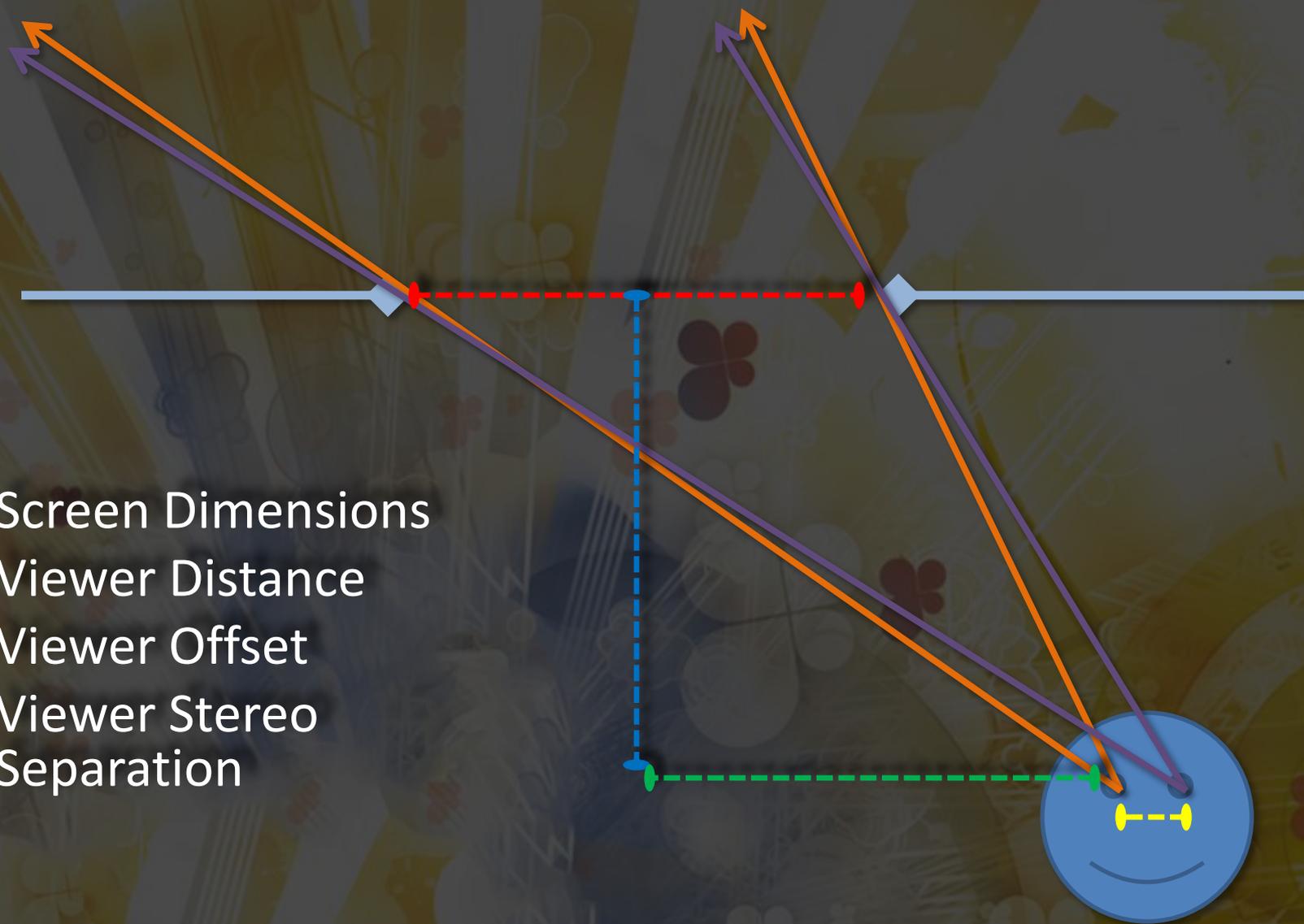


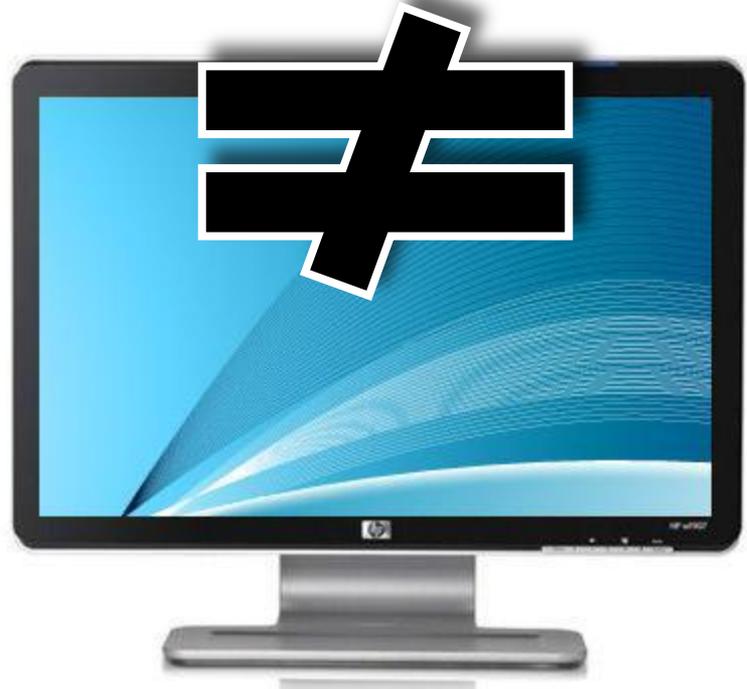


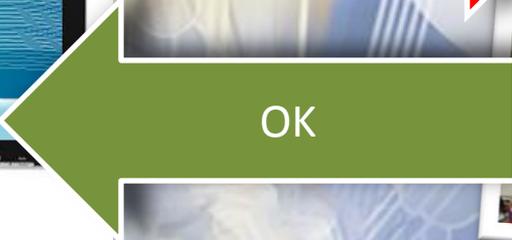
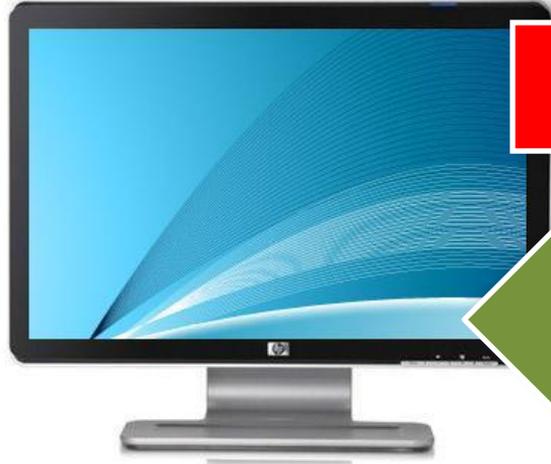




1. Screen Dimensions
2. Viewer Distance
3. Viewer Offset
4. Viewer Stereo Separation







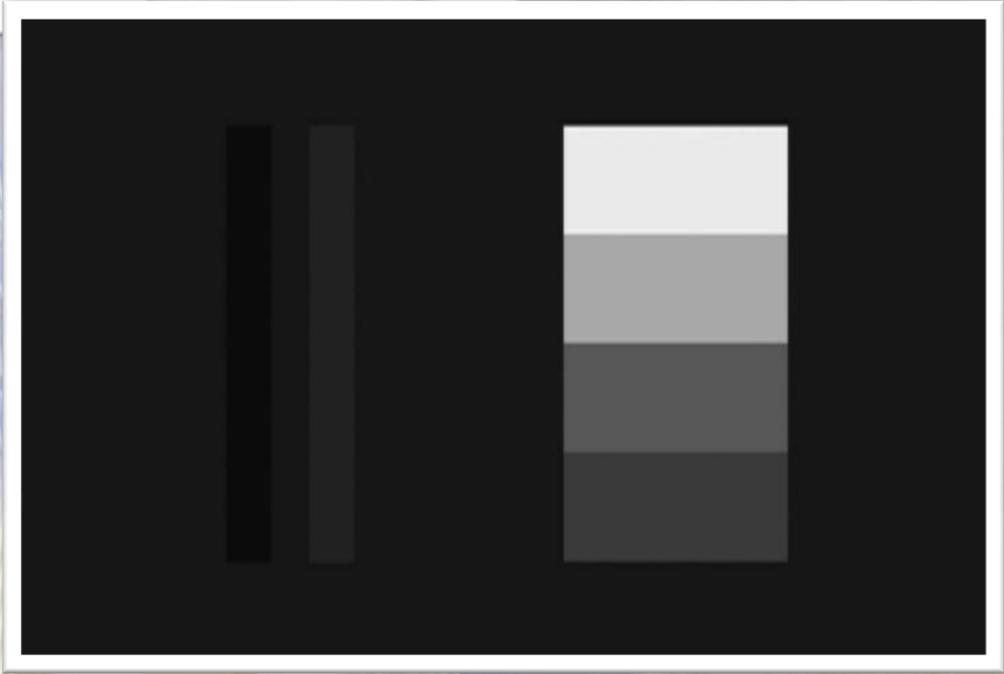
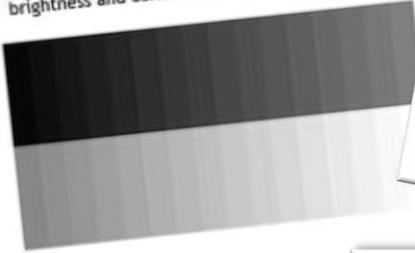


a suggestion

SCREEN CALIBRATION

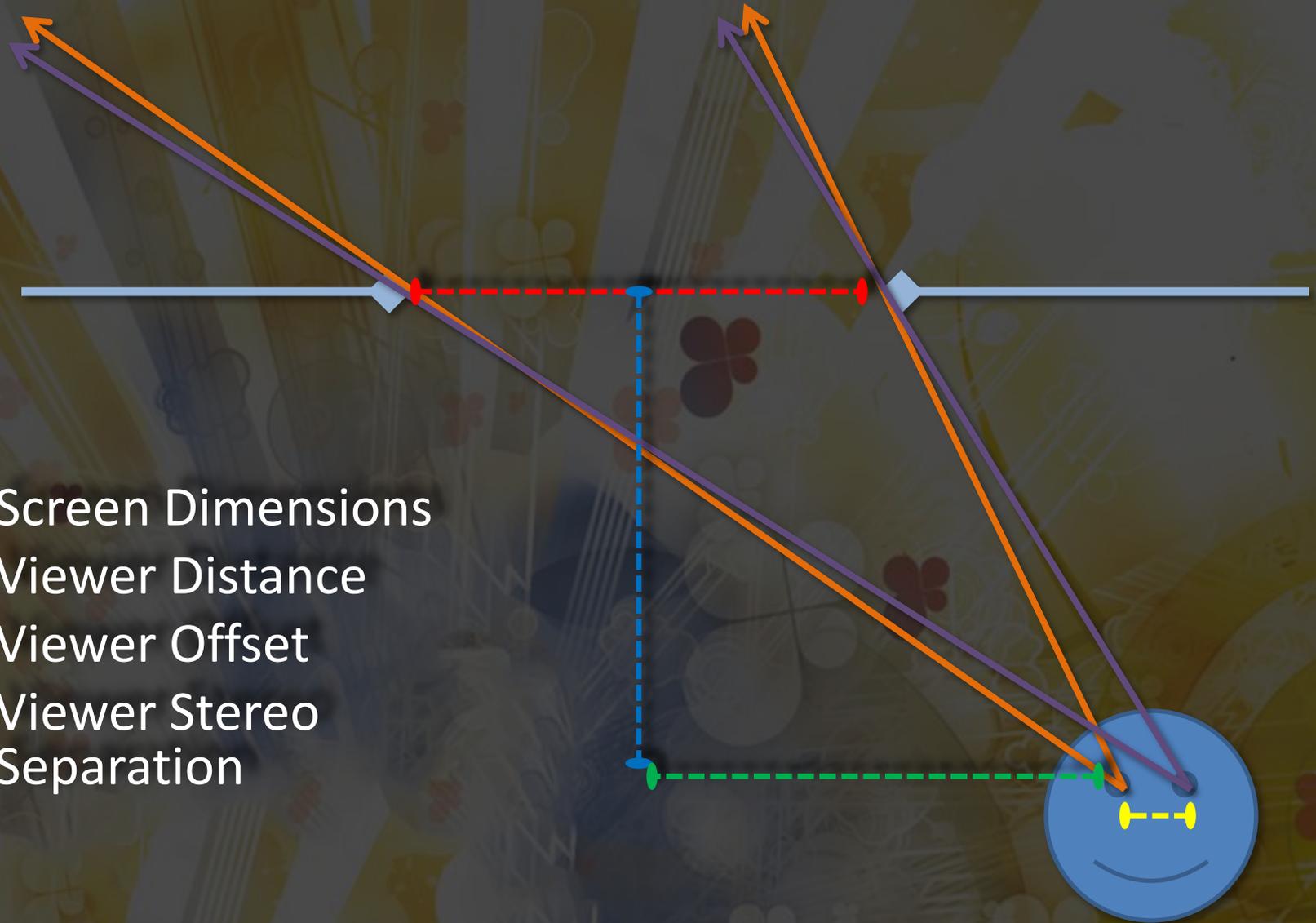


If you cannot see all 32 boxes below, then photographs on this website may appear darker or lighter than intended. Please check the brightness and contrast settings on your monitor.





1. Screen Dimensions
2. Viewer Distance
3. Viewer Offset
4. Viewer Stereo Separation





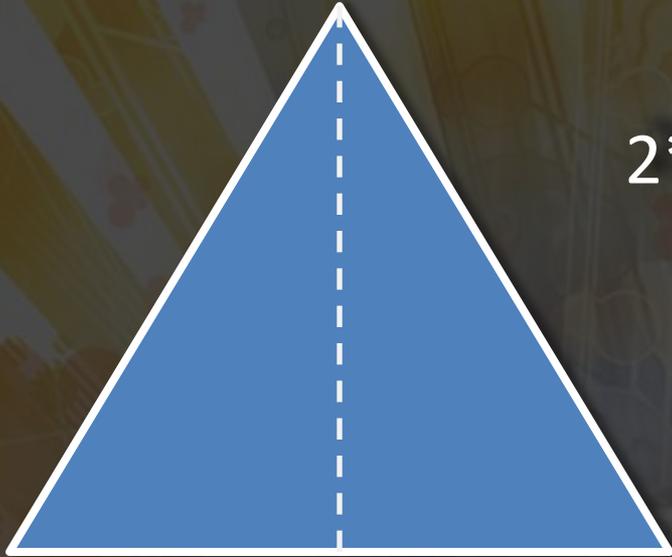
of course,

THERE IS A PROBLEM

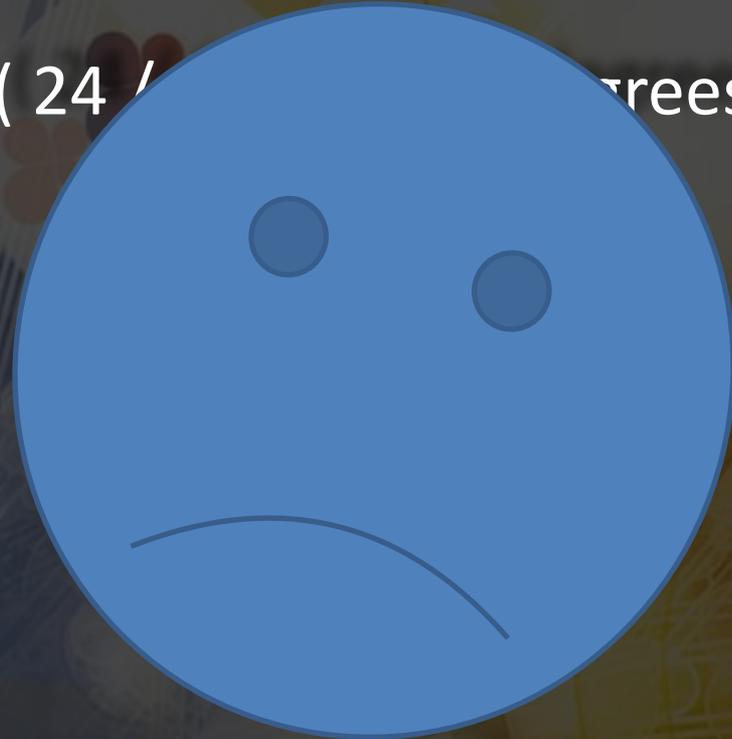


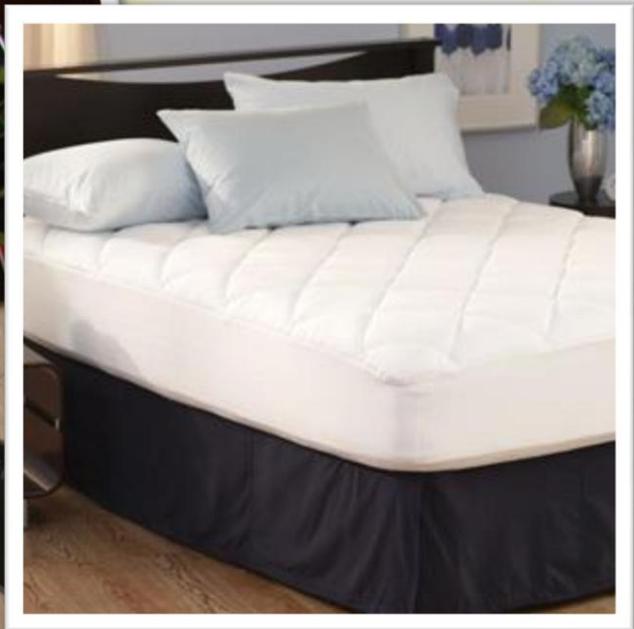
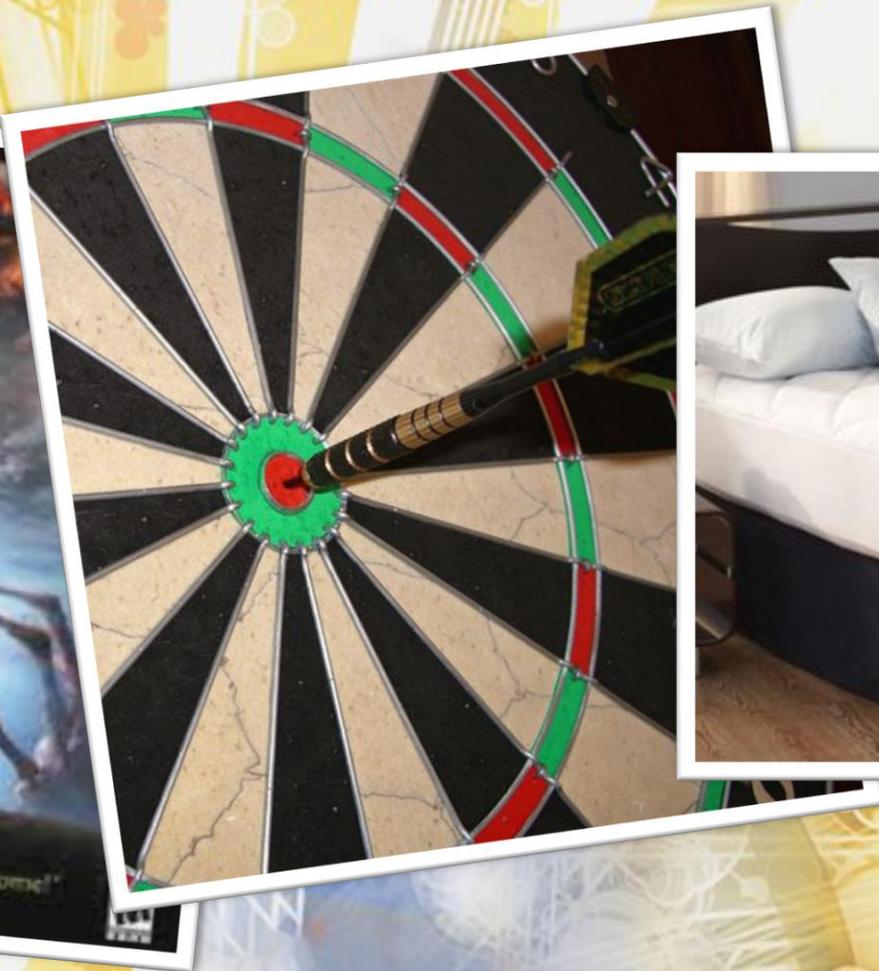
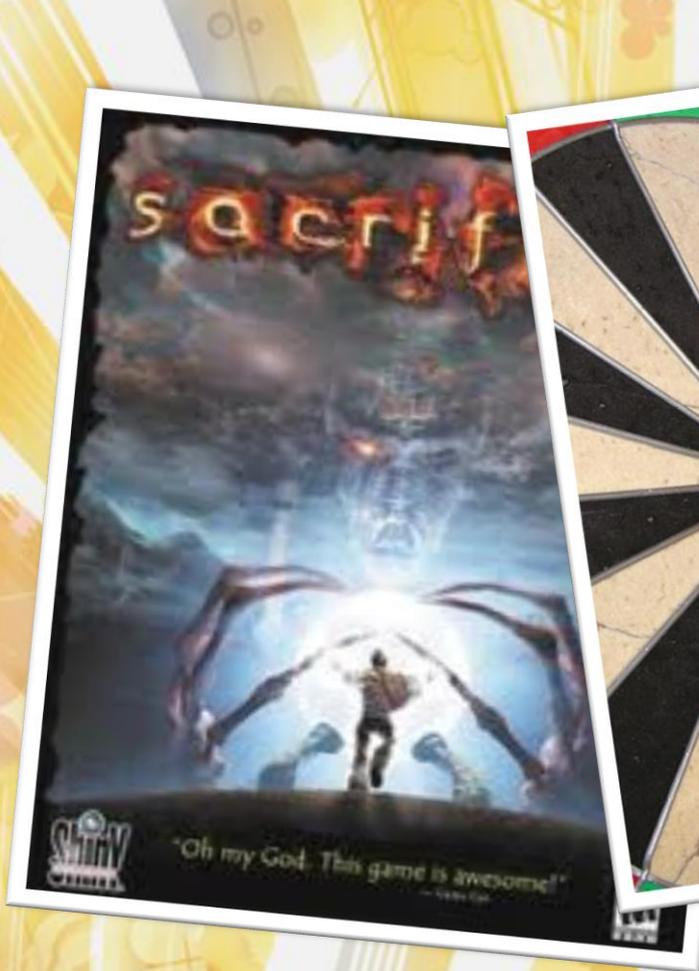


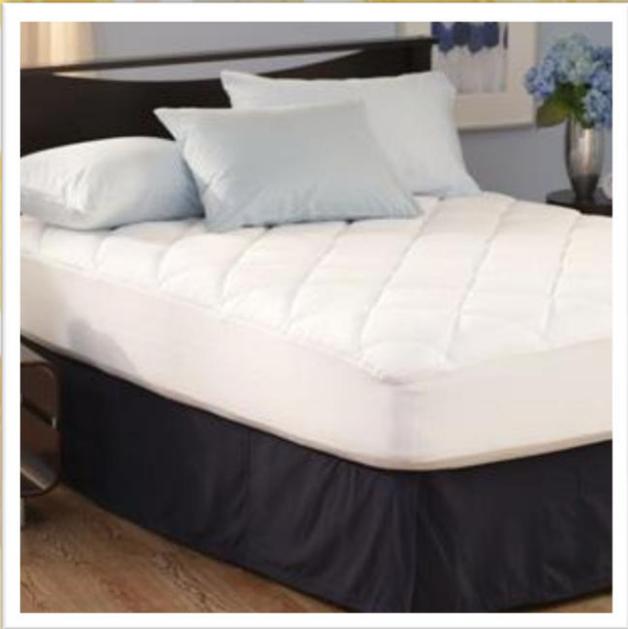
Assume 48 in HDTV and 7 ft (84 in) ...



$2 * \text{atan} (24 / \dots)$ trees ...









www.FunOnTheNet.in







variables to tweak
FIXES



Increase Screen Size



Decrease Viewer Distance



Move Objects





TEST!



Summary

- Accuracy = Comfort
- Proper Stereo & Moving Eye point
- Stereo grade for different screens
- Screen calibration
- Accuracy Vs. Game play

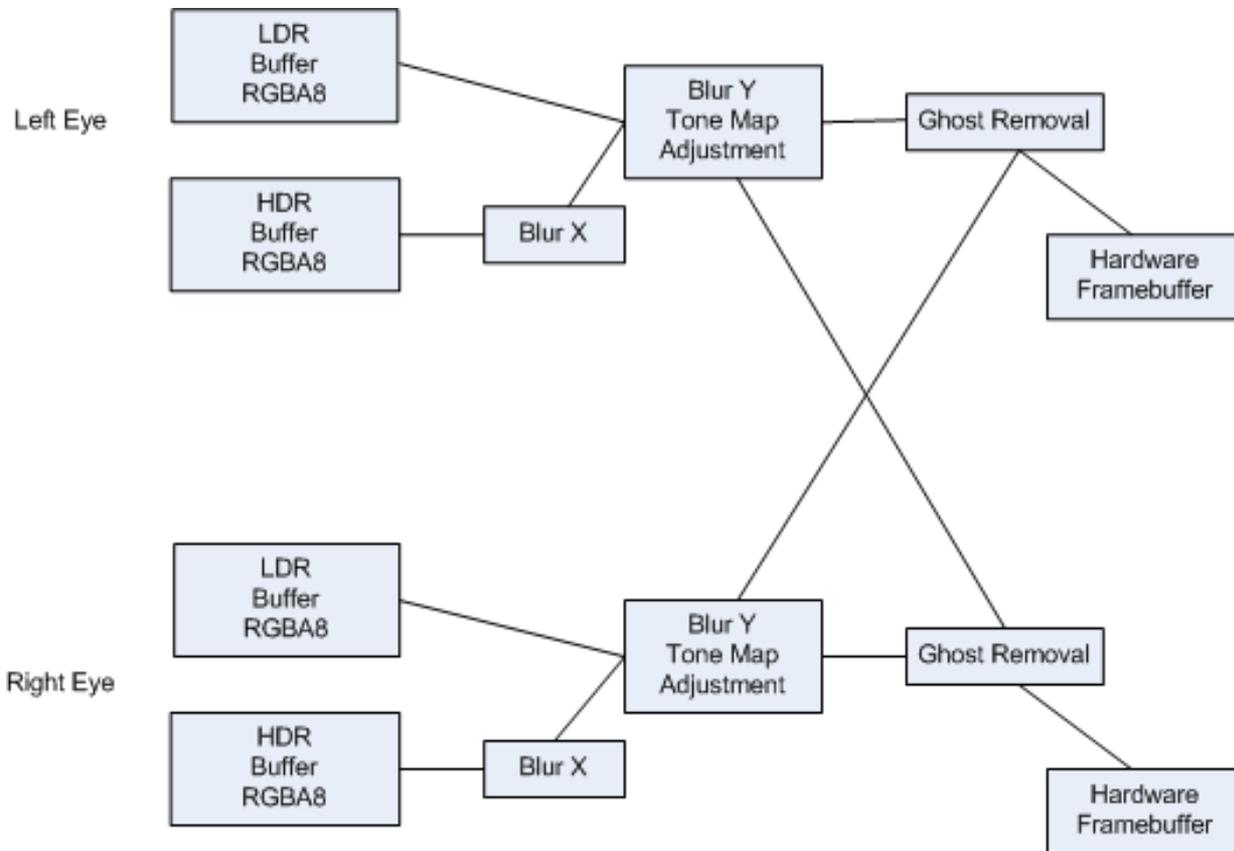
Keith Leonard

The technical might behind the magic.

The Basics

- Panda 3D game engine was used for Toy Story Midway Mania. (TSMM)
- OpenGL 2.0 API was used for stereo rendering and framebuffer_object extension for render to texture.
- Forward rendering was used to keep the draw call count to a minimum for stereo.
- Dual RGBA8 targets to simulate High Dynamic Range rendering.
- A shadow map buffer was used, but not shown.
- This is a simplified chart, not taking antialiasing into account.

Toy Story Midway Mania rendering pipeline



Adjustments for Stereo Projection

The first set of completed screens showed unexpected problems. These steps taken.



Example Filter

- Luminance was measured from the silver projection screens.
- Textures were created to drive adjustments per pixel.
- Filters use color channels to control aspects of adjustment for projection.
- Color correction was also applied.
- Future work is planned to have these adjustments change over bulb life.
- The filtration is adjusted during eye movement.

Ghost Busting



- Ghosting occurs when eye filtration is inefficient.
- Off screen rendering allowed for easy ghost reduction.
- Several techniques were tried to get the best effect for content.
- Fairly simple solution used in the end.

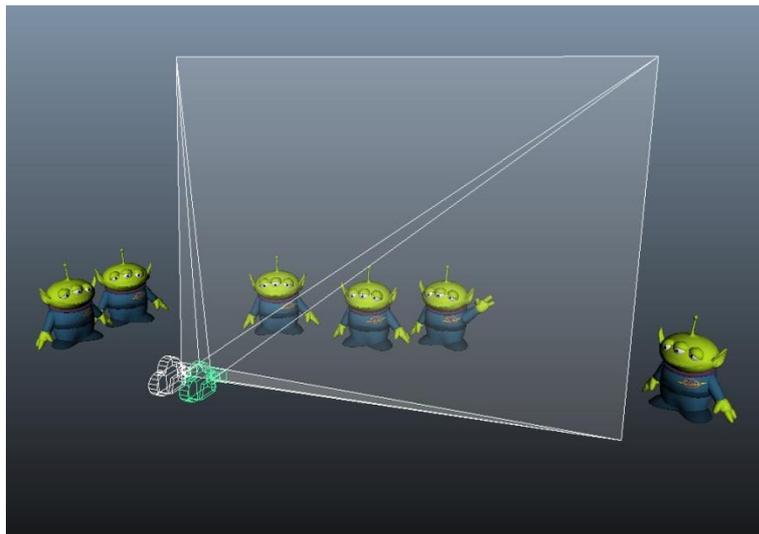


Stereo Rendering and Performance

- Frustum culling in stereo.
- Load balancing CPU vs GPU tasks
- Draw call reduction
- Integration of pre-rendered elements



Frustum Culling in Stereo



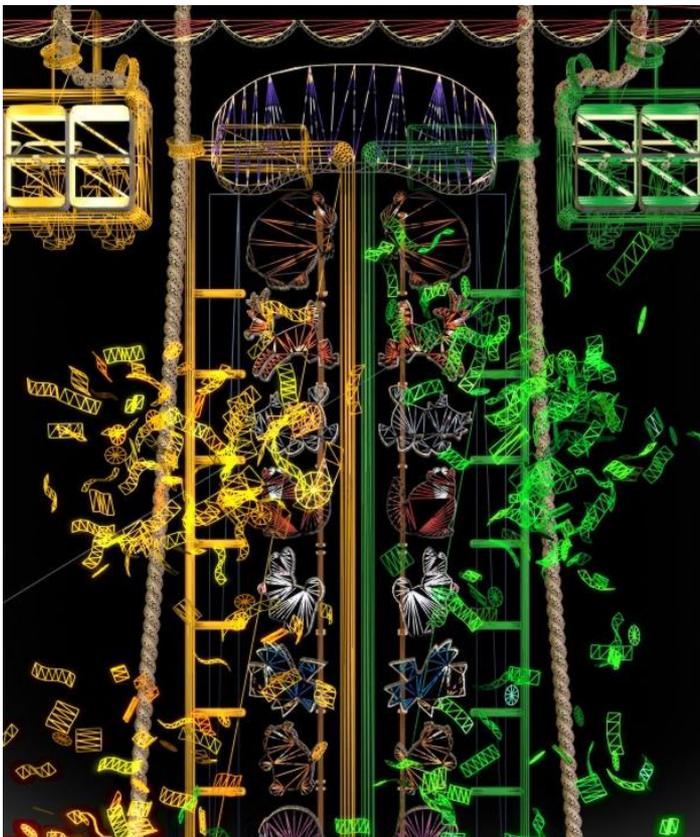
- Frustum cull removes objects out of line of sight.
- In stereo, cull for each eye.
- Better idea, build a combined frustum, and cull against that.

Load Balancing CPU and GPU Animation



- Skinning and blend shapes were used in Midway Mania.
- CPU skinning/transform feedback means no redundant skinning.
- Rig complexity and number of blend shapes breaks GPU implementation.
- Quad core Xeon 3ghz, dedicated PhysX card, and Quadro GPU means time left for CPU work.

Load Balancing CPU and GPU GPU Particle simulation



- Skinning and CPU overhead from draw calls comprised the bulk of our frame time.
- Particle simulation was also a significant CPU hit in some situations during gameplay.
- Solution: Move simulation into the shaders.



Draw Call Reduction Atlases and Material Attributes



- Stereo rendering = twice the draw calls.
- Combine objects with the same render state.
- We built texture atlases to increase combine efficiency and reduce state change.
- We also embedded material information in vertex streams.

Draw Call Reduction Plate breaking

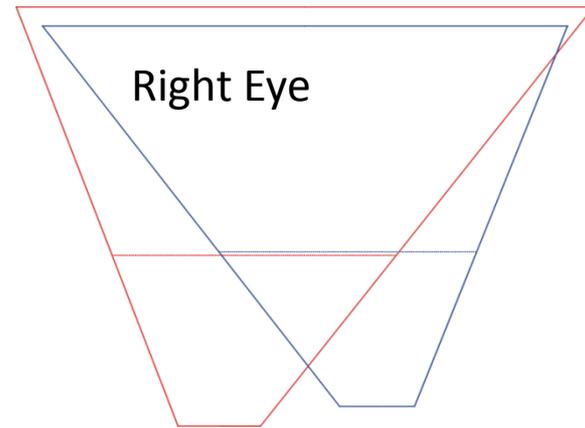
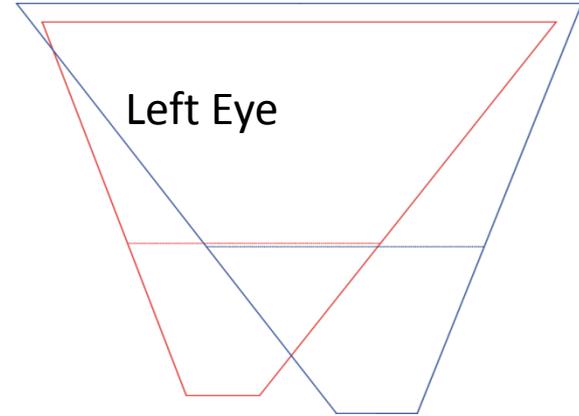
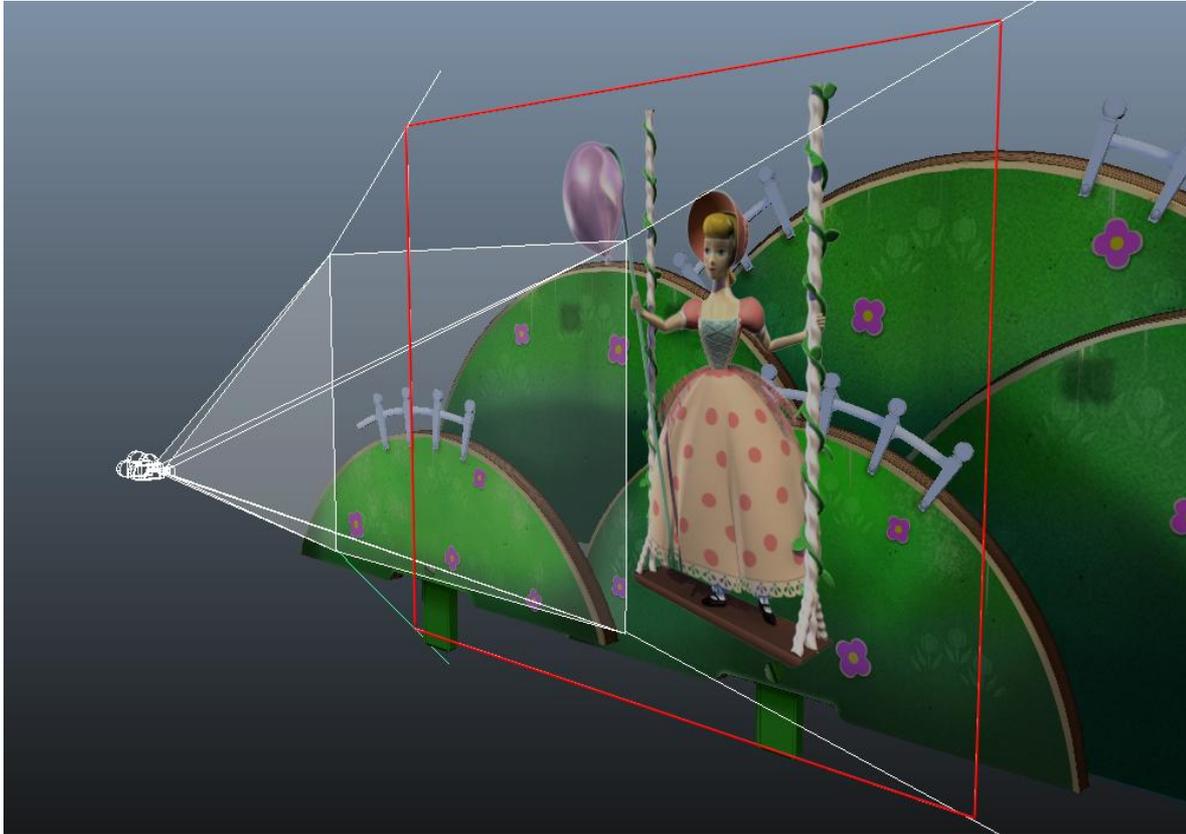


- Design hates constraints, need to make fun stuff work.
- Smashing dishware is fun.
- Broken plates = 5x draw call.
- Solution: 5 shards still 1 model/1 draw call.

Integration of Pre-rendered Content



- Pixar host intro animations are at the start of each game.
- Originally real time rendered, sanity prevailed.
- Tight integration with the set work was important.
- Stereo image planes with depth solved the issue.
- Lots of compressed textures.



Toy Story Midway Mania
Success!

Happy players, long queue



photo courtesy Walt Disney Imagineering

Thea award
outstanding
achievement



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Special Thanks!



The Midway Mania Production Team

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Art Director / Schell Games

Jason Pratt
Programmer / Schell Games

Adam Serdar
Programmer / Schell Games

Chris Rodriguez
Programmer / Bethesda

Susan Bryan
Show Producer / Disney

Jesse Schell
CEO / Schell Games

Kyle Kenworthy
Artist / Schell Games