IXR

interaction.**experience**..research
INTEL LABS

Moving the User Experience Beyond 2D
Society for Information Display
July 2011

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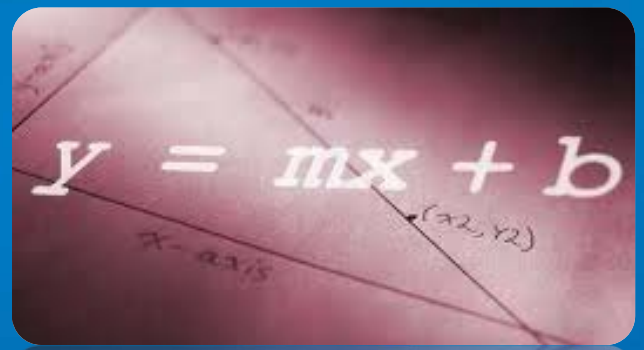
ST5 Human Factors Chair – 3D@Home

Who Am I ?



Key Messages

User Experience Is Critical

Experience Research Is Required

The Power of the User Experience!

Standardization of HDTV for North America
Determined by Consumer Quality Expectations

Historical …

3D TV set unit shipments will reach over 100 million in 2015, comprising more than 1/3 of all DTV sets shipped worldwide.

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Everything Is Going 3D!

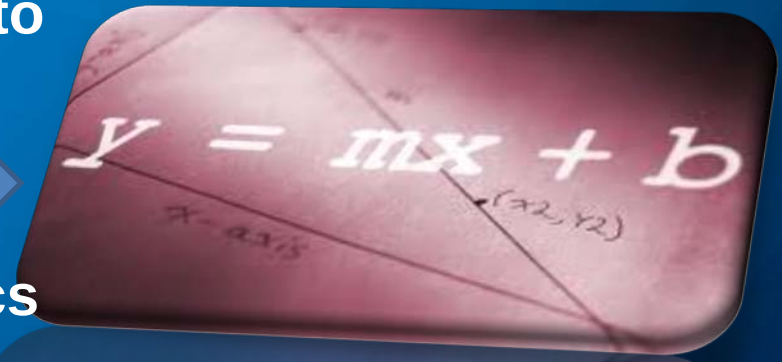
Reality……

…or more than Reality

Human Factors Research @ Intel & Industry

Translating the Subjective to the Objective

Creating Experience Metrics



Creating UX Baselines

Every Experience Is A Ride

Meeting Expectations

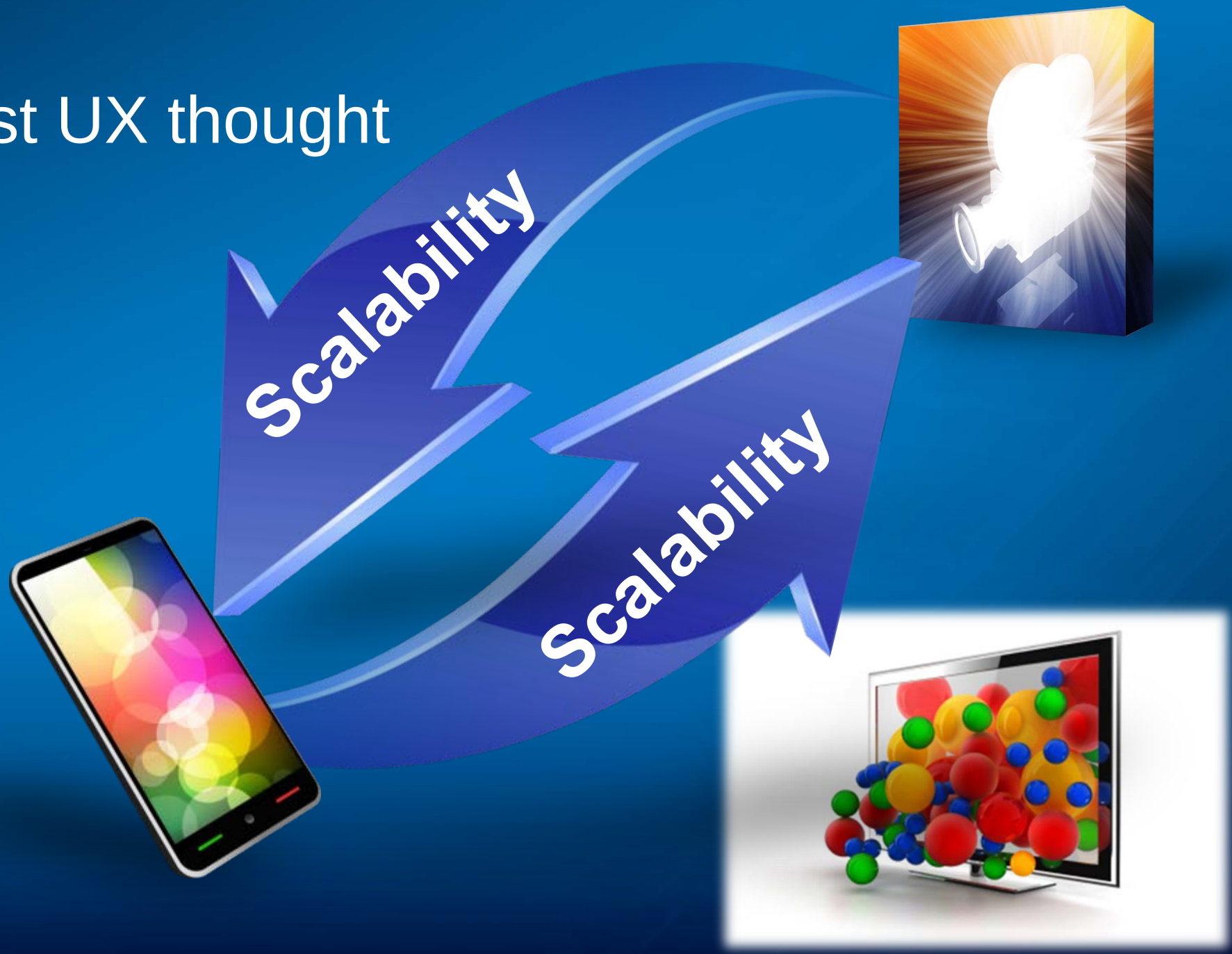
Successful Deployment

Experience Flow

Immersion

Centered - Focused - Stable

One last UX thought



Moving UX Beyond 2D – 3D

What's The Status Now

3D TV set unit shipments will reach over 100 million in 2015, comprising more than 1/3 of all DTV sets shipped worldwide.

Households with 3D TV sets will eclipse 300 million in 2015, as a la number of DTV sets sold will have 3D feature

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Current Estimations

80% Comfortably see Stereo 3D
20% Experience Issues with S3d
2-5% Can't see S3D

Does 3D Make People Sick?

- Most 3D viewers don't experience negative symptoms
  - A small percentage of people experience mild symptoms while watching 3D
  - Symptoms are worse in the home than in the movie theater
    - However, the symptoms are still mild and uncommon
  - Symptoms that do present themselves go away shortly after people stop watching the 3D content
- People also report some symptoms while watching 2D content

Symptoms from watching 3D are moderately more common than from watching 2D. The few people that do get symptoms say they're mild, and they don't last very long.

Steering Team 5 – Human Factors 3D@Home

Research and report on the human physiological experience of 3D viewing and make recommendations to enhance the 3D in-home experience.

3D@Home

Literature Search ..

80 Papers / Articles

28 Conducted User Studies

N=14 ***some*** N=1

Filling the Gap

Technology Education is Required!

Research

Research

Research

Home vs. Theater Research

Anecdotal Evidence

- There have been “reports” of people getting severely ill after watching 3D movies
- Some people - often those with vision or inner ear problems - do have issues experiencing 3D.
- According to our data set (294 people watching 2D or 3D content), there is no evidence that 3D causes major problems.

Intel/ Pacific University studies revealed no serious incidents in any of our screenings. There were zero reports of severe symptoms out of 152 people who watched movies in 3D.

Sifting for the Answers

- Our research shows that watching a movie in a dark room causes some symptoms regardless of whether it's in 2D or 3D

We want to know if 3D causes more (and/or worse), symptoms than 2D causes

3D@Home CONSORTIUM

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Measuring 3D's Physical Impact

- Intel and Pacific University conducted studies in theaters and in the home.
  - 294 participants watching either a 2D or 3D movie
- All participants self-reported physical symptoms before and after viewing
  - Eye Discomfort: physical sensations in the eyes
  - Body Discomfort: physical sensations in parts of the body outside of the eyes
  - Visual Issues: problems seeing objects or images clearly

Eye Discomfort	Body Discomfort
•Dry eyes •Wet eyes •Irritated eyes •Gritty or sandy eyes •Burning eyes •Eyes ache or sore •Pain from the inside of the eyes •Pulling sensation around the eyes	•Neck Ache •Shoulder Ache •Backache •Sleepiness •Dizziness •Nausea •Disorientation
Visual Issues	
•Blurry Vision •Double Vision	

Symptoms While Watching 3D

- Symptoms that occur more frequently in 3D*:
  - Dizziness during and after the screening
  - Disoriented during and after the screening
  - Pain from inside of the eyes
  - Blurry vision during and after the screening
  - Multiple Images during and after the screening

    (Blurry vision & multiple images may be due to ghosting)^

5 of 17 symptoms occurred more frequently in 3D screenings than in 2D screenings

What Watching 3D Doesn't Cause

- In 3D, these symptoms were the same or better than 2D
  - Dry eyes
  - Wet eyes
  - Gritty or sandy eyes
  - Irritated eyes
  - Burning on the surface of the eyes
  - Pulling sensation around the eyes
  - Neck ache
  - Shoulder ache
  - Backache
  - Sleepiness
  - Nausea

Our studies show no evidence to support the idea that any of these symptoms occur more frequently or with greater intensity in 3D screenings than in 2D screenings.

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Methodology

- 294 participants were randomly assigned to a 2D or 3D screening
  - Study # 1: 91 people watched “How to Train Your Dragon” in a movie theater
  - Study #2: 203 people watched “Cloudy with a Chance of Meatballs” in a home environment
  - 142 total watched in 2D, 152 total watched in 3D
- People completed surveys before & after watching the movie and a follow-up survey the next day to report on persistent symptoms
  - Surveys assessed symptoms in three categories
    - Eye Discomfort
    - Physical Discomfort
    - Visual Issues
  - Symptoms graded on an intensity scale of 1-5 (1= no symptoms, 5= severe symptoms)
  - Symptoms also compared by frequency, or how often a symptom manifested itself across the study

Blurry Vision & Multiple Images

Blurry vision and multiple images are the most commonly reported 3D symptoms

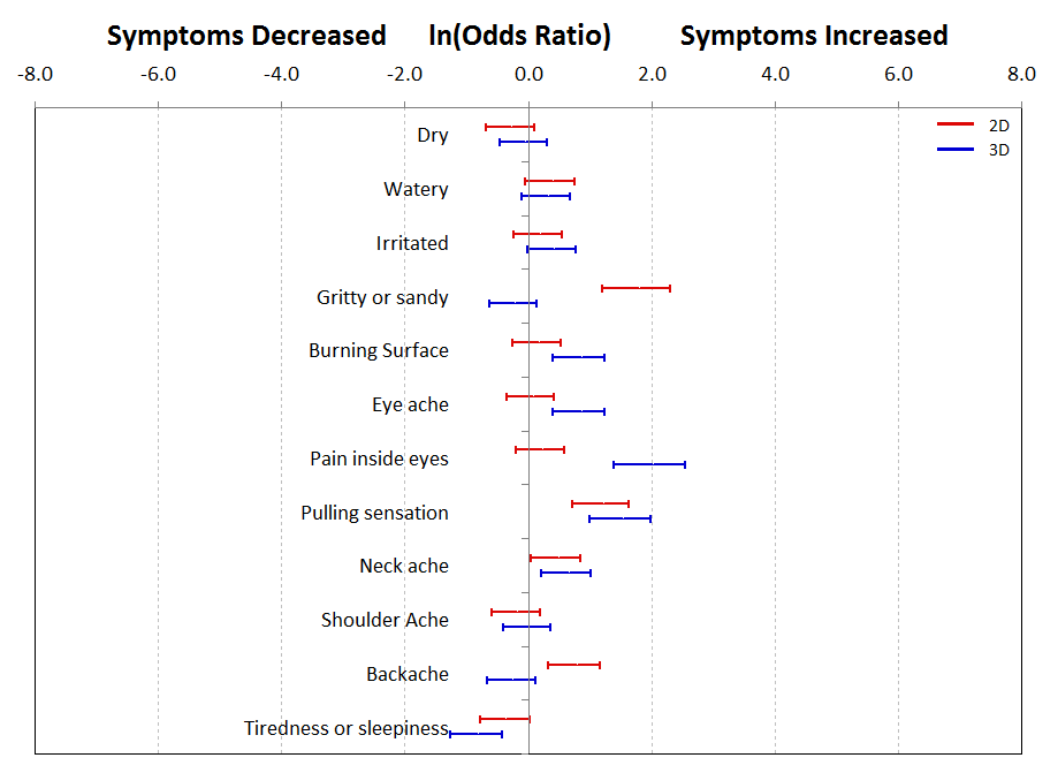
- 33% of 3D viewers experience some blurred/multiple images while watching compared with 7% of 2D viewers

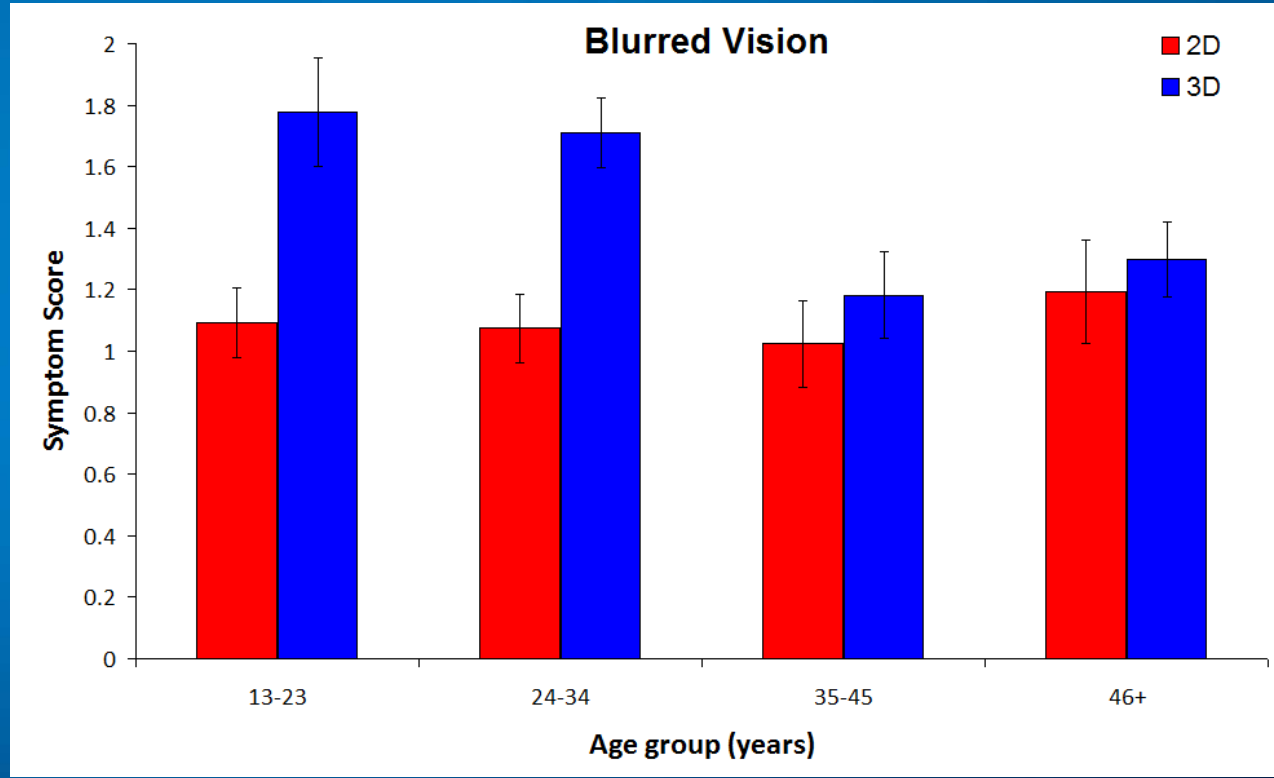
Two primary sources of blurry vision/multiple images:

- Technology Problems (“ghosting”) - Inadequate filtering of the double images by the technology – particularly in home theater setting
- Vision Problems – eyes can’t resolve the image (2D or 3D)

A small number of participants may have difficulty seeing 3D because the cognitive process fusing the offset images together doesn’t work properly

Blurred Vision





Slight increase for 3D over 2D

Effects minimal and reduce with age

Blurry Vision & Multiple Images*

Movie Theater	Blurry Vision During Movie	Blurry Vision After Movie	Multiple Images During Movie	Multiple Images After Movie
2D	7%	7%	10%	10%
3D	24%	8%	10%	0%
% Difference	**17%**	**1%**	**-**	**(-10%)**

Home Environment	Blurry Vision During Movie	Blurry Vision After Movie	Multiple Images During Movie	Multiple Images After Movie
2D	7%	6%	1%	3%
3D	37%	17%	30%	11%
% Difference	**30%**	**11%**	**29%**	**7%**

*Percentages represent the amount of people who reported an increase of respective symptoms.

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Dizziness & Disorientation

- 3D increases the sensation of movement, so mild disorientation and dizziness may occur
- Likely related to the greater extent to which viewers feel involved with the movie experience

While dizziness and disorientation occurred at a higher rate in 3D screenings than in 2D screenings, these occurrences were rare and of low intensity.

Dizziness & Disorientation

Movie Theater	Dizziness During Movie	Dizziness After Movie	Disorientation During Movie	Disorientation After Movie
2D	10%	7%	7%	7%
3D	14%	6%	18%	16%
% Difference	**4%**	**(-1%)**	**11%**	**9%**

Home Environment	Dizziness During Movie	Dizziness After Movie	Disorientation During Movie	Disorientation After Movie
2D	2%	5%	3%	1%
3D	9%	7%	11%	9%
% Difference	**7%**	**2%**	**8%**	**8%**

Pain From the Inside of Eyes

Every day stress to the ocular system used for seeing images in the real world can cause eye pain

Likely related to the unusual accommodative and convergence requirements of watching 3D

This is the only issue in the Eye Discomfort category that occurred more frequently in 3D screenings than in 2D screenings.

Pain From the Inside of Eyes

Movie Theater	Pain From the Inside of Eyes
2D	7%
3D	14%
% Difference	**7%**
Home Environment	Pain From the Inside of Eyes
2D	5%
3D	15%
% Difference	**10%**

Follow-Up Survey

1. Did you experience any eye or other physical symptoms when you stood up or started walking out of the screening room?
2. When you arrived home after the movie did you have eye or other physical symptoms from the movie?
3. If you had any symptoms in question #1, did you still experience them the next morning.
4. Describe any symptoms you had when you arrived home and/or continued to experience the next morning.

Participants answered this survey the day after their screening to report any symptoms that may have been persisting.

Follow-Up Survey

Home Environment	Any Symptoms	Symptoms Leaving Movie	Symptoms at Home
2D	11%	11%	4%
3D	25%	22%	14%
% Difference	**14%**	**11%**	**10%**

Home Theater Participants:

- More 3D than 2D viewers experienced symptoms immediately after, and at home that evening
- There was no difference in symptoms the next morning
- Over 90% answered the follow-up survey

Movie Theater Participants

- There was no difference in symptoms at any time after the movie
- 67% answered the follow-up survey

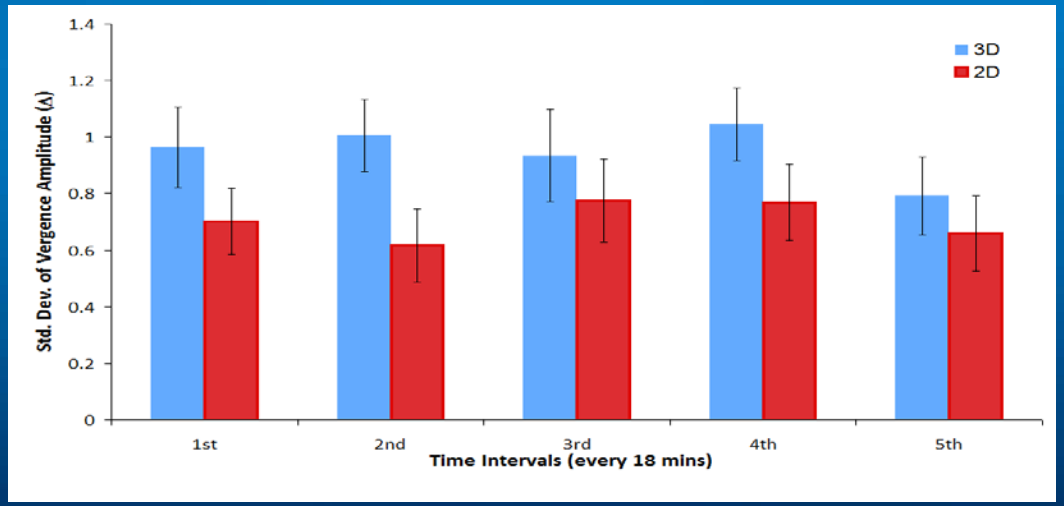
Participants who did report symptoms often reported them as mild. No participants in 2D or 3D described any symptoms as “severe”

There is a measureable increase in frequency of these symptoms when comparing 3D screenings over 2D screenings, but the data does not suggest that the symptoms are severe or long-lasting.

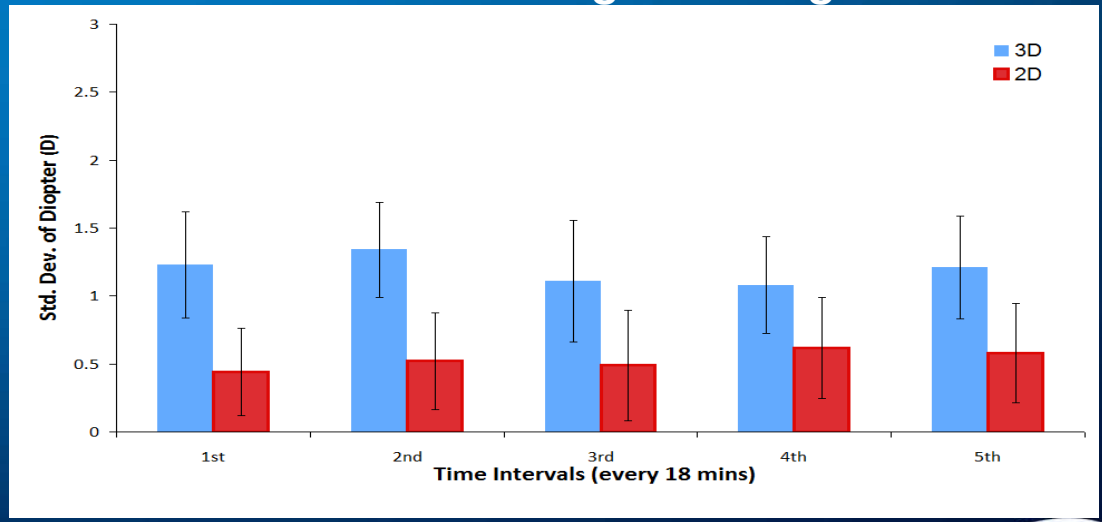
Physiological Responses during movie viewing: 2D vs. 3D for the same subjects

A B

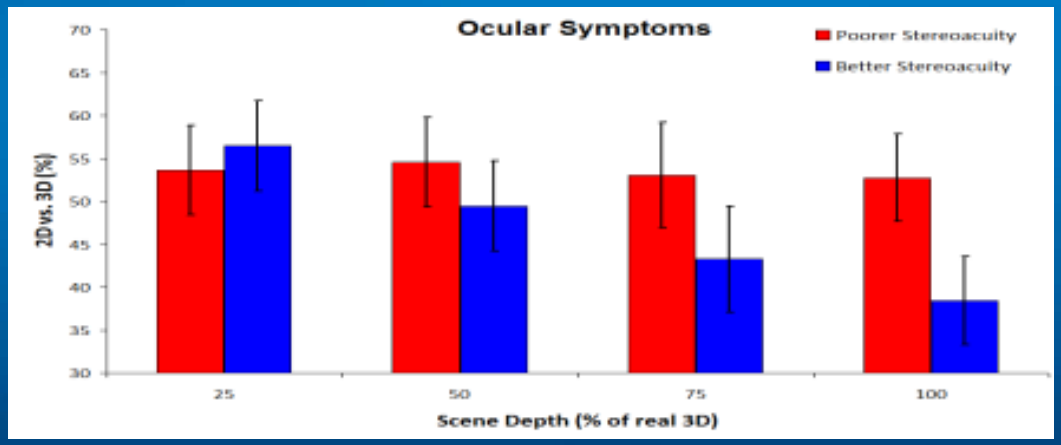
Vergence changes during movie viewing

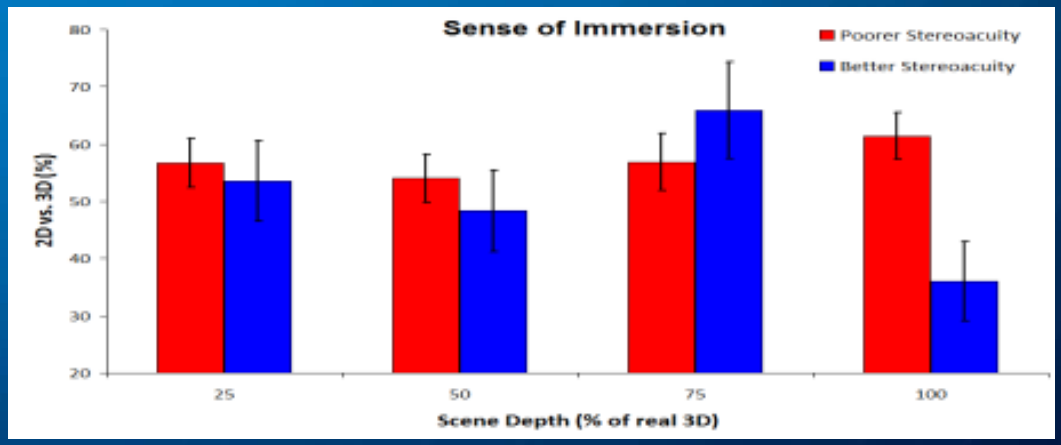


Accommodative Changes during movie



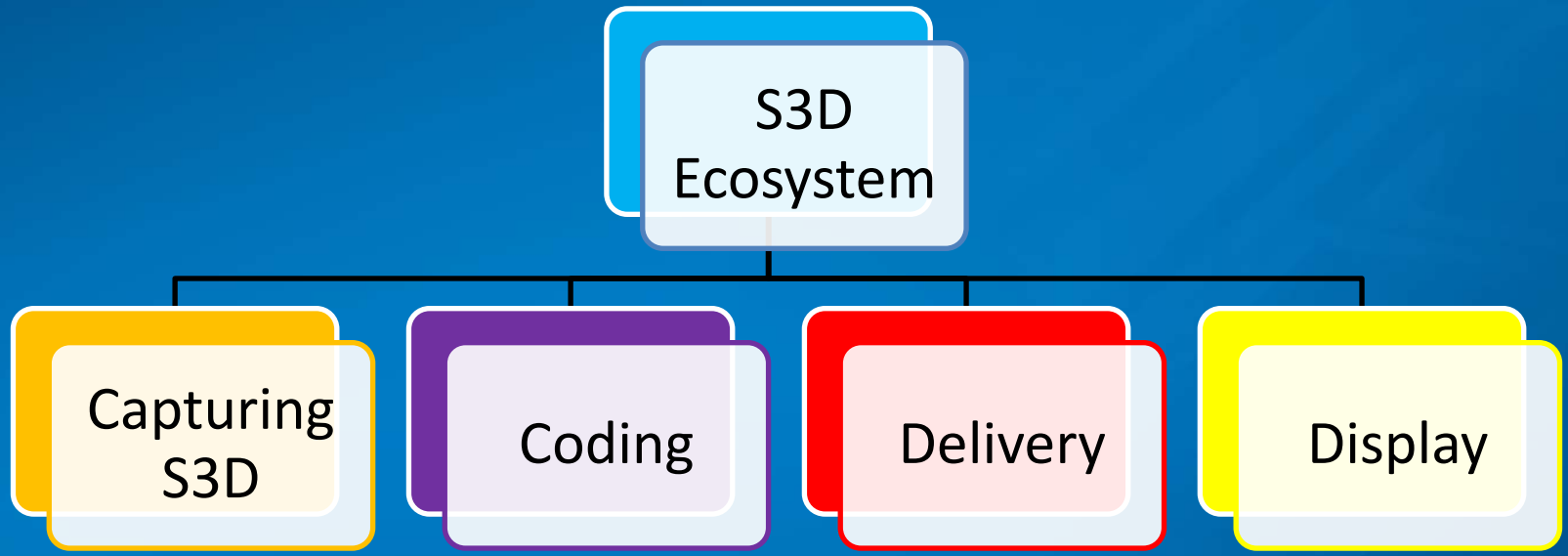
3D gaming study: effect of scene depth





There’s Much More

Ecosystem + Technology



Circling Back!

User Experience Is Critical

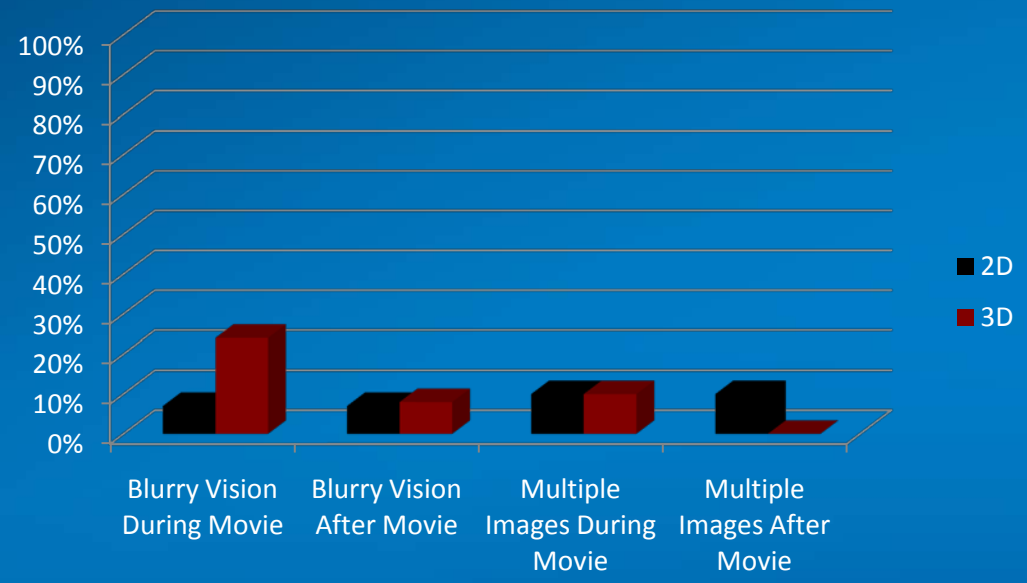
Experience Research Is Required

Thank You!

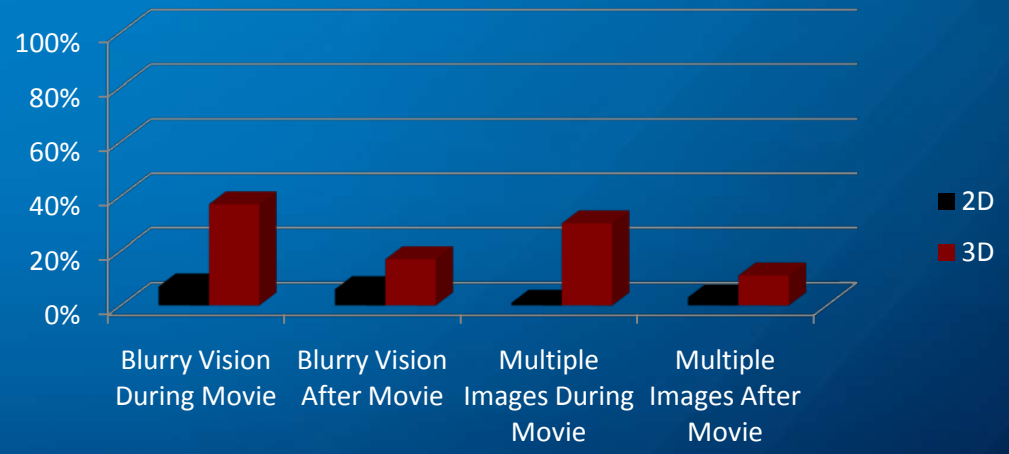
Questions

Backup Materials - Graphs

Blurry Vision & Multiple Images

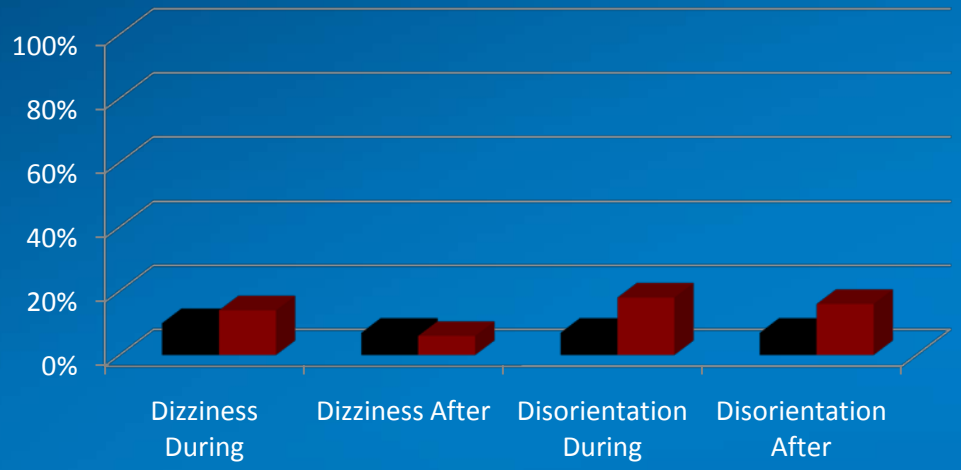


Theater

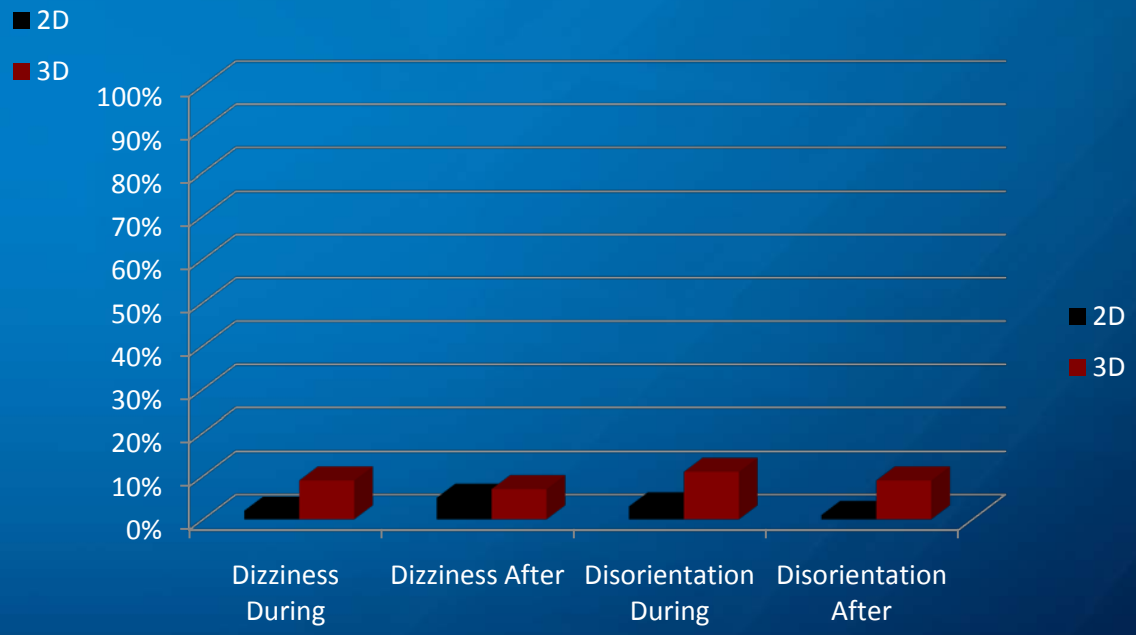


Home

Dizziness & Disorientation in Theater

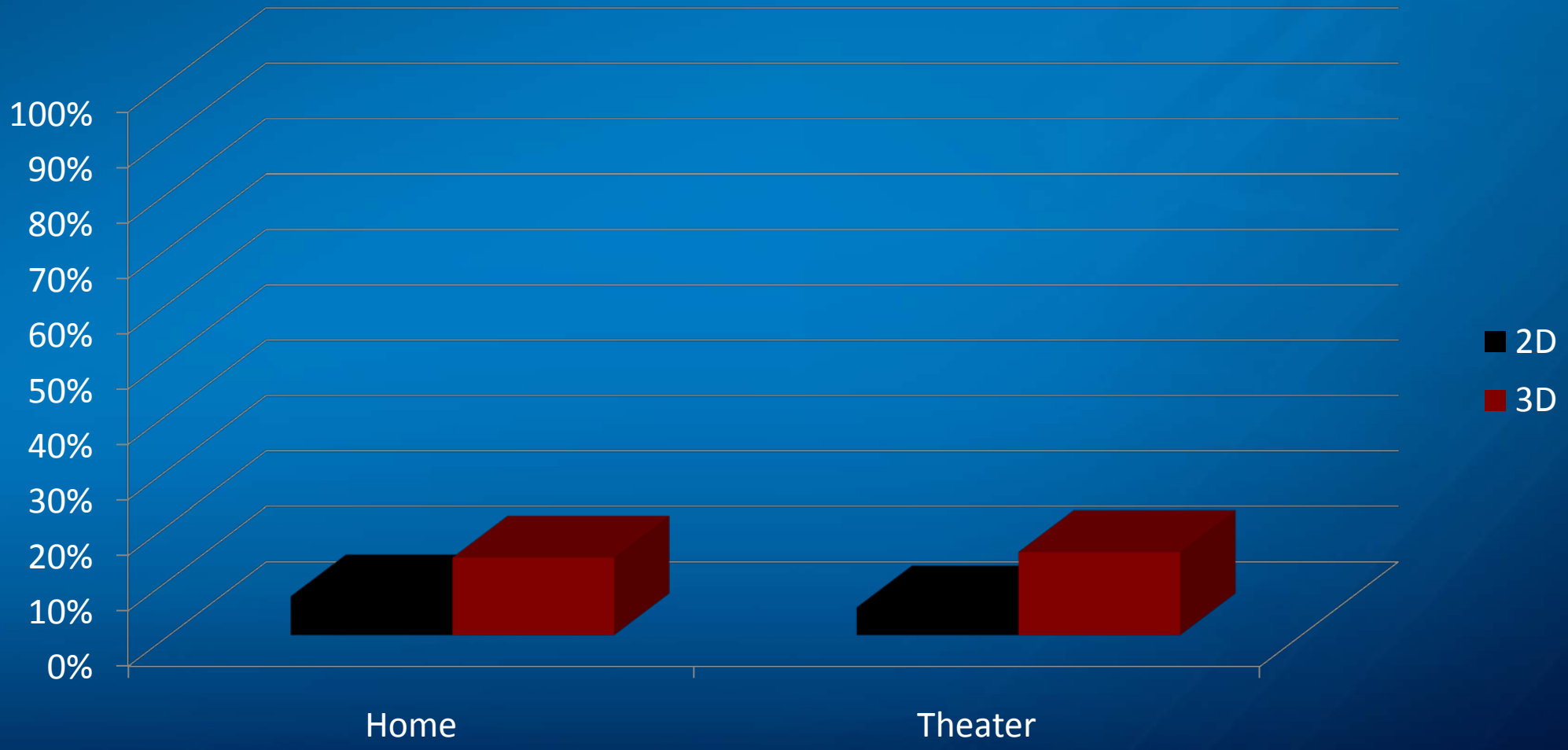
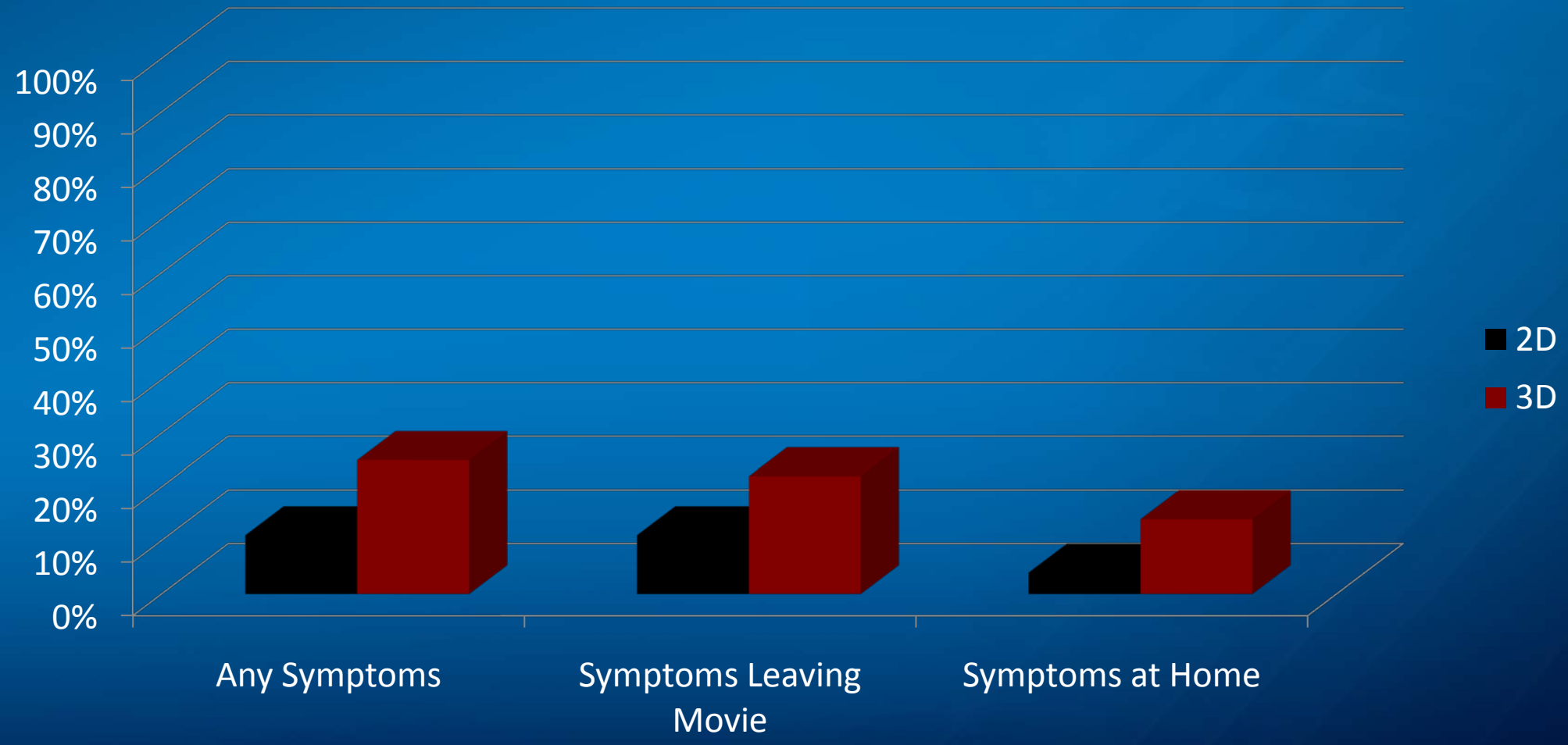


Theater



Home

Pain From Inside of Eyes



Follow-Up Survey