The Impact of 3-D Vision in our High Tech World

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3-D Vision
- Eye Care's unique opportunity in early detection of visual problems
- Use of 3-D technology in entertainment & education
- Public visual health awareness

Visual skills needed to see in 3-D?
- You need two well-functioning eyes, with clear vision in each
- You need to have mastered the task of focusing on objects near & far
- You need to develop the ability to coordinate eye movements
- You need to "fuse" the different images coming from each eye into one 3D perception
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**3-D as Early Detection Tool**

- Amblyopia
- Refractive error
- Binocularity dysfunction
- Accommodative dysfunction
- Eye movement deficiency
- Visual developmental delays
- Potential decline in school and sports performance

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**LAZY EYE (Amblyopia)**

- Monocular vision
- No stereopsis
- Need diagnosis and treatment as early as possible
- Amblyopia currently 6% but projected to be 14% by 2020

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**Amblyopia Correction**

- Glasses
- Contacts best for Anisometropia
- Patching-Amblyopia Treatment Trials
  - Traditional
  - Eye drop (1% homatropine PT/FT)
  - Conant Lens
- Vision therapy
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**REFRACTIVE PROBLEMS**
- Nearsightedness (myopia)
- Farsightedness (hyperopia)
- Astigmatism (image is blurred no matter where you look)

**LACK OF BINOCULAR VISION**
- Two eyes not properly aligned
- Strabismus (eye turn) is present
- Inputs from the two eyes not successfully combined in the brain and 3D stereoscopic perception will not occur

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**Correction of Refractive Error**
- Glasses
- Contact lenses
- Ortho K
- Myopia
- Hyperopia
- Astigmatism

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**Binocular Vision Tests**
- Stereo Acuity and Depth Perception
  - Randot
  - Stereofly
- Near Point of Convergence (NPC)
  - NPC with PD stick
  - NPC with R/G penlight
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**Binocular Vision Correction**

- Initial correction of amblyopia and refractive error
- Vision therapy

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**EYE COORDINATION DIFFICULTIES**

Convergence Insufficiency

- Seeing double
- Eye fatigue
- Avoidance of close-up work, such as reading
- Quality of the 3D viewing experience compromised

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**Eye Coordination Difficulties**

- Double vision
- Avoidance of close work and reading
- Fatigue
**Eye Coordination Correction**

- Glasses (Prism)
- Vision therapy

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**EYE FOCUSING (Accomm.) DIFFICULTIES**

Our eyes need to change focus when viewing objects at different distances. When viewing 3D displays, individuals having difficulty can experience:

- Blur
- Headache
- Discomfort

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**Correction of Accommodation**

- Reading or anti-fatigue lenses
- Vision therapy
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Computerized Home Vision Therapy

- HTS
- Pursuits
- Saccades
- Vergences
- Accommodative Rock
- 6 flipper sets

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Early detection

- Early detection of amblyopia, refractive error, binocularity, focusing and eye movement problems will result in...

- Earlier detection of...
  - Visual developmental delays
  - Learning related visual problems
  - Potential for decreasing school and/or sports performance

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Understanding the 3-D Viewing Experience

Is it uncomfortable working 3-D?

Dizziness
Discomfort
Lack of depth
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3-Ds of 3-D Viewing

**Dizziness/Nausea:**
- Exaggerated visual motion hypersensitivity (VMH) response, which can cause motion sickness and conflict in sense of balance
- Feeling of dizziness or nausea during or after viewing 3-D content

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Causes of 3-D Viewing Challenges

DIZZINESS AND NAUSEA – Can be caused by rapid motion effects in the 3D content

These vision-induced sensations of movement disagree with “balance system” which informs the individual that she/he is not moving. This conflicting sensory information can cause vision-induced motion sickness.

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3-Ds of 3-D Viewing

Discomfort:
- Eyes converge in front or behind the screen while viewing 3D images which can potentially create eyestrain and headaches.
- Sitting at a greater distance from the screen can help relieve strain.
3-Ds of 3-D Viewing

Lack of Depth:
A viewer simply won't see 3D.
Serves as a "vision screening" that something is abnormal with the viewer's binocular vision.

Why don't people go to the eye doctor?
- 60% of Americans above age 40 say there is NO immediate or perceived reason to go.
- 56% of Americans between ages 18-38 have symptoms related to binocular vision problems.
- 3-D viewing may potentially drive patients to our offices if/when they experience the symptoms.

Snellen Acuity Chart
- Poor screening tool (used for the past 150 yrs)
- Low sensitivity
- Misses most:
  - Hyperopia
  - Astigmatism
  - Inbalanced refractive error
  - Binocular problems
  - Focusing problems
  - Alignment issues
  - Eye movement problems
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**3-D Viewing**

- Superior screening tool
  - Highly sensitive (Up to 94%)
  - Detects most
    - Refractive error & Imbalances
    - Binocular, Convergence & Accommodative insufficiency
    - Eye Alignment & Movement difficulties

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**Children's Vision EXAM Legislation**

What 3 states currently have comprehensive children's vision EXAM laws??

- 2000 KY
- 2007 MO (Repealed in 2011 ??)
- 2008 IL

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**Why is Seeing 3-D Important?**

- Helps develop efficient reading skills
- Increases participation in classroom
- Increasingly utilized in a growing list of professions
Commonplace experience for every sector of our community

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Entertainment Industry
- Movies
- HDTV
- Computers
- Gaming systems
- Mobile devices
- Eyewear

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How do 3-D Displays Work?

Evolution of 3-D viewing technologies
- Anaglyph
- Active Shutter
- Passive Polarized
- Glasses Free
How 3-D Displays Work

**ANAGLYPH**
- The viewer wears glasses with different-colored filters (usually red and blue) placed in front of each eye. The two stereo images—left eye and right eye—are also colored red and blue. In theory, each eye will therefore only see the image intended for it. Recently, more advanced forms of color separation (known as wavelength multiplex visualization) have been developed, with striking—and economical—results.

**PASSIVE POLARIZED**
- The viewer wears glasses with oppositely polarized filters placed in front of each eye. The two stereo images are also projected through oppositely polarized filters, so that each eye only sees the view intended for it. In movie theaters the effect is achieved by using special screens that preserve the polarization of each reflected image. In the home, image electronics and special screen materials produce the polarizing effect.

**ACTIVE SHUTTER**
- The viewers wear battery-powered glasses that receive signals from the TV equipment, or the classroom projector, which instructs them to alternately occlude each eye in synchrony with the alternating (left and right eye) images being displayed. This 'eye sequential shuttering' typically occurs 120 times a second—too fast to be perceived. Some movie theaters around the world use this technology.

**‘GLASSES-FREE’ 3D (‘autostereoscopy’)**
- Currently, this technology works best in displays that are viewed at close distances and in carefully controlled environments. It does have applications in certain specialized signage and entertainment situations, but is not yet suitable for larger audiences.

**Anaglyph**
- Anaglyph—most basic form of 3-D
- Utilizes different colored images & filters in front of each eye

**Passive Polarization**
- Utilizes screen images and lenses of opposite polarization in front of each eye
- Method currently used in most 3-D movies
  - Attached with special screen filters
  - Most economical
How 3-D Displays Work

- Active Shutter
- Alternate occlusion of R/L eye images with alternating screen images
- Sequential "shuttering" occurs at a very high rate of speed creating a Flicker Effect (120X/sec)
- Requires complex timing and expensive glasses and batteries
- Used in most HDTV and home entertainment

Rated the top 3D movie of all time

3-D Movies in 2013

- Monster's U
- Despicable Me 2
- Iron Man 3
- Jurassic Park
- Others???
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3-D Movies in 2014

- Movies in 2014

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3-D Movies in 2015

- Movies in 2015

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3 C's of 3-D Movie making

1. Comfortable
2. Consistent
3. Captivating
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**3-D Movie Ticket Sales**

- Best place to sit: center and back.
- May someday be differing ticket prices depending on where in theater the seats are... just like in musicals or theater performances.

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**3-D HDTV**

- USA currently has 9 3-D channels
  - ESPN3D sports channel
  - 3net history/action/travel/kids/lifestyle/concerts
  - Xfinity3D movies and programs on-demand
  - 3D dedicated on-demand DirecTV channel

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**3-D HDTV**

- 3D commercials used as compelling marketing tools
  - Cars
  - Food
  - Soda
  - Technology
  - Services

Consumers react more positively to the images they see in 3D.
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**3-D Computers**
- 3D gaming
- Blu-ray movies
- Future see-through

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**3-D Gaming Systems**
- PS3
- Voyageur 3D Gaming System
- Nintendo 3DS
- Nvidia 3D Vision system

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**3-D Mobile Devices**
- Glasses-free stereoscopic vision
  - Mobile phones
  - Mobile devices
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**3-D prescription glasses**

- Marchon 3D
- Gunnar Optiks

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**AOA American Eye-Q survey**

- 53% of parents with children 18 or younger believe 3D viewing is harmful to child's vision
- 29% feel very concerned that their child may damage their eyes due to prolonged use of computers or hand-held electronic devices

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**3-D in the High-Tech Classroom**

- Teachers are incorporating 3D imaging, digital devices, and the latest computer applications into their daily curriculum...
- **WHY????**
  - Learn faster
  - Concentrate better
  - Retain better
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3-D Classroom Research

- 46% increase in student engagement
- 17-25% increase in test scores
- Increase motivation, attention, participation
- Decrease behavior problems

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3-D in the Classroom

- “It helped to see a 3-D view of things. It was easier for me to picture and understand the structure.”
  5th Grade Student, CO

- “3-D videos help me learn easier, because I’m a visual learner...In 3D...it’s literally right in front of you.”
  8th grade Student, MI

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3-D Beyond the Classroom

- Sports
- Driving
- Operation of complex machinery
- Performing many fine motor tasks
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Future of 3-D imaging

- Science
- Technology
- Industry
- Military
- Medicine
- Neurosurgery
- Eye surgery
- MRI

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3-D Viewing

- Increased level of activity in certain parts of the brain
- Drop in Heart-rate

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3-D Benefits:
A Public Health Tool

AOA states there is NO evidence that viewing or attempting to view 3D images will harm a child's eyes.

For an estimated 1 in 4 children, and millions of adults - difficulties with 3D viewing can unmask undiagnosed deficiencies & lead to treatment.
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**3D as Secondary Prevention Tool**

- Screening of **ASYMPTOMATIC** populations
  - Uncover vision problems **BEFORE** people have symptoms or even realize they have a problem
  - **20%** of those who view 3D content actually have "3-D Vision Syndrome"
  - Children **AND** Adults

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**Secondary Prevention Tool**

- **Air 1 Radio**
  - "50% of people should not see 3-D movies because they either get nauseous or get a throbbing pain behind their eyes"

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**Our Role as Eye Care Providers**

- **Ask ALL patients (young AND old)** about 3-D visual complaints with movie, TV, games, etc.
  - Case history
  - VA's
  - Binocularity
  - Refractive error
Our Role as Eye Care Providers

- Binocularity testing
  - Distance and near stereo
  - Amps
  - NPC
  - CT
  - Vergences
  - Oculomotor assessment

Optometry's Role

- Diagnose and treat early!!
  - Amblyopia
  - Refractive error
  - Binocularity
  - Alignment
  - Accommodation
  - Eye Movement
  - Muscle imbalance

Vision Therapy

An individualized and progressive treatment program consisting of visual procedures to improve the deficient visual skills
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**4-Ds of 3-D viewing**

1. **Dizziness**
2. **Discomfort**
3. Lack of 3-D
4. See your **DOCTOR**
   of Optometry

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**AOA and 3D@Home Consortium**

- Group of more than 50 companies and organizations collaborating together to ensure that the quality of the 3D viewing experience is as high as possible
  - Entertainment companies
  - Consumer electronics and technology
  - 3-D display manufacturers
  - Public health
  - AOA

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**Additional 3-D information**

- AOA.org/3D
- 3DEyeHealth.org
- Vision3D.com
THANK YOU!!

Any questions??

It's been a pleasure being here...have a blessed day!!

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