Vision Testing for the high tech viewer

Hannu Laukkanen
Yu-Chi Tai
Andrew Reder

Vision Performance Institute
A research consortium supporting “Quality Sustainable Vision”
Who is the high tech viewer?

- Individuals whose vocational or avocational needs demand multisensory high informational density displays
  - Computer-Assisted Design (CAD)
  - Medical imaging
  - Education
  - Entertainment
- These individuals desire the best possible comfortable & fulfilling visual experience
What does the high tech viewer want from his/her display?

• These individuals desire the best possible comfortable & fulfilling visual experience

• Overarching goal:
  • Absorb maximal information with minimal effort
  • Not have to “strain” to do it
  • Able to sustain efficiency for prolonged tasks
Multi-sensory approach

- Very limited sensory data available with previous displays & devices
- Via new technology the 2D visual info expanded & augmented by other sensory info
  - Added dimension from 3D makes experience more “life-like”
  - Through Stereo-3D & auditory, the human operator can experience the projected “virtual environment” as if it were part of the world
Virtual Environment (VE)

Multisensory VE can be transformative

- **Participants can get the sense of being in the environment depicted by the VE**
  - VE can model a real-world object, such as a house; or an abstract world that doesn’t exist in a real sense but is understood by humans, i.e., a chemical molecule or a representation of a set of data; or it might be in a completely imaginary science fiction gaming world”

- **Participants may respond more to events in the VE rather than “real world”**

- Multisensory VE can become dominant

- This is called “immersion”
Immersion:

• “intense feeling of self-location within the computer-generated reality with which the user interacts”

• **After VE experience, participant remembers it as having visited a place--rather than just having seen images generated by a computer**

• subjective feeling of involvement by user in the process is enhanced by interaction

• **interaction focus offers user the possibility “to navigate, select, pick, move & manipulate object much more naturally”**
Immersion & interaction

Believed to increase interest, enjoyment, & motivation of user

Many tantalizing educational possibilities

"Better learning when individual builds own understanding of content directly interacting, rather than receiving pre-structured content from external source, ie teacher or a text"

• Can enhance & modify learning experience
• Increased knowledge transfer
• Faster acquisition of complex skills
• Heightened abstract reasoning
• Enhanced visualization ability
• Greater facility managing complex information “spaces”
Costs associated with Immersion & interaction?

Physiological cost(s) to individual?

- Anecdotal side effects reported during and after exposure to immersive VE
  - previously called “simulator sickness”
- visual, ocular, and physical discomfort
  - eyestrain, blurred vision, blurred & double vision, vergence difficulties, problems changing focus between near and far viewing, headaches, fatigue, disorientation, dizziness, motion sickness, nausea, and balance disturbances

- Cause(s)?
  - Sensory-conflict (poorly understood)
    - From incongruent sensory inputs
    - When viewer can no longer reconcile conflicts, visual discomfort thought to result
Conventional phorometric eye exam

- **Accommodation**
  - Measured with lenses
  - Stationary targets @6m & 40cm

- **Vergence**
  - Stationary targets @6m & 40cm
  - Fixed & changing prism demand by doctor creates retinal disparity
  - Subjective patient response to: target movement, target doubling, re-fusion of double images
New eye exam paradigm

Emerging S3D visual displays & interactive technology allows us to re-think traditional exam

• Huge image plasticity potential
  • flexibility of image size & movement
  • discrete images to each eye

• Patient can respond with “button-box” or hand controller—reduces need for verbal response or description of what patient sees
New VPI vision testing for the high tech viewer

- VPI goal is uncover underlying causes and to find treatments for 3D visual problems

Integration of clinical & lab science to obtain patient data:

- Visual performance
- Subjective symptoms
  - Especially during & after test
Visual Symptoms Questionnaire

We would now like to know how your eyes and your body feel right now. We are going to do so by asking you a series of questions. These questions will help us determine what you are feeling right at this moment in order to compare how your responses may change over the course of the experiment.

For each question displayed on the TV screen, you just need to use the mouse or stylus to indicate how you feel by marking on an analog scale. For example, the question might be "How sleepy are you right now?" If you are not sleepy at all, you should mark a location on the scale close to "not at all." If you are really sleepy, you should mark a location close to "extremely." Do you understand it now?

Please click inside the box or on the lines, and answer carefully, as there is no going back.

Not at all  Mildly  Moderately  Severely  Extremely

[Blank boxes for answers]
Visual and body comfort questionnaire

Do you feel physically uncomfortable in general?

Not at all  Mildly  Moderately  Severely  Extremely

Do you feel physically uncomfortable in general?

Not at all  Mildly  Moderately  Severely  Extremely
Visual and body comfort questionnaire

Do you currently have difficulty concentrating?

Not at all  Mildly  Moderately  Severely  Extremely

Do you currently have difficulty concentrating?

Not at all  Mildly  Moderately  Severely  Extremely
Visual and body comfort questionnaire

Do your eyes feel strained?

Not at all  Mildly  Moderately  Severely  Extremely

Do your eyes feel strained?

Not at all  Mildly  Moderately  Severely  Extremely
For this task, a "C" shaped target will appear at different sizes.

Each one of the C's will be opening either up, down, left, or right.

Using the buttons on the controller, identify the direction the "C" is opening.

The diagram above shows the four possible targets, and the corresponding buttons.

If you can't see the target, press the large button on the left.

Press any button now to begin the task.

Binocular and monocular high-contrast distance visual acuity
Binocular and monocular low-contrast distance visual acuity
A diamond with four circles in it will appear.

One of the circles will be standing out from the others.

Using the buttons on the controller, which circles is standing out.

Using the buttons on the right side of the controller, press the top button if the top circle is standing out, the bottom button if the bottom circle is standing out, etc.

If you can't see the target, press the large button on the left.

Press any button now begin the task.

A diamond with four circles in it will appear.

One of the circles will be standing out from the others.

Using the buttons on the controller, which circles is standing out.

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If you can't see the target, press the large button on the left.

Press any button now begin the task.
Stereo acuity & step-vergence
You will read a few pages of text, presented in various ways.

After each page, you will be asked about how you are feeling at the moment.

A symptom will appear along with a scale that corresponds to the buttons on the response pad in front of you.

**Eye Strain**

```
None Low Medium High Severe
1  2  3  4  5
```

You will have a limited time to respond, and will be asked about "Eye Strain", "Dizziness", and "Nausea".

Press any button to begin.
Amundsen of Norway was one of the great explorers. He was noted for his thoroughness and perseverance. On his first expedition, he located the north magnetic pole and found the Northwest Passage. On his next voyage, he headed for the North Pole but, hearing that another explorer had reached it, sailed for the South Pole instead. On arriving, Amundsen established his base station on the ice cap. Using dog teams and sledges, he and his men equipped three supply stations to the south. After camping for the winter they started for the pole, a journey of two months' duration. In 1911, Amundsen flew the Norwegian flag above the pole. They spent a total of eleven months reaching the South Pole.
Visual and body comfort questionnaire

Did your eyes feel strained?

Not at all  Mildly  Moderately  Severely  Extremely

Did your eyes feel strained?

Not at all  Mildly  Moderately  Severely  Extremely
You will watch a series of dots as they move in various ways.

Periodically, you will be asked about how you are feeling at the moment.

A symptom will appear along with a scale that corresponds to the buttons on the response pad in front of you.

**Eye Strain**

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You will have a limited time to respond, and will be asked about "Eye Strain", "Dizziness", and "Nausea".

Press any button to begin.
Right-to-left random-dot motion movie
Visual and body comfort questionnaire

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circular random-dot motion
### Visual and body comfort questionnaire

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looming random-dot motion movie
Visual and body comfort questionnaire

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Summary of new VPI vision testing

- New tests should provide us with valuable information not previously available from conventional eye examination
  - Distance stereoacuity & stereoacuity dynamics
  - Step-vergence performance & dynamics
  - Reading performance during S3D conditions
  - “real-time” symptoms during vision testing
  - Visual-vestibular & visual motion-induced discomfort testing
- We believe that these new VPI tools will help us better understand the underlying causes & perhaps contribute to finding treatments for S3D visual problems
THANK YOU!

Your interest & support was appreciated

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