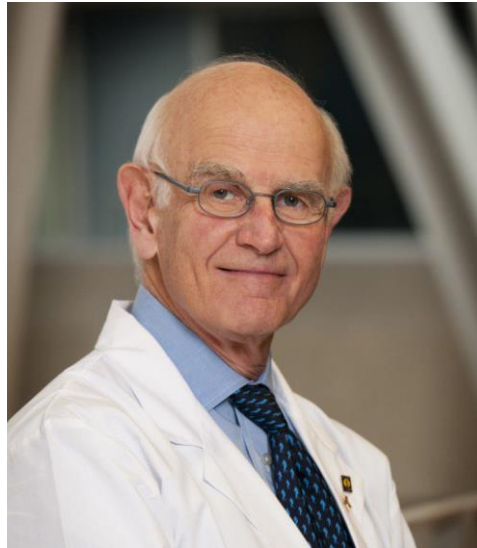


Canadian Concussion Centre

LiUNA Free Webinar Series

Tonight's Webinar



Date:

September 24, 2024

Title:

**Treatment of Post-Concussion Symptoms
Related to Screens at Work, School or Play.**

Presenter:

Dr. Charles Tator

Problems with vision after a concussion are very common and often persist for months or years. These visual symptoms include sensitivity to light, eye strain, photophobia, eye pain with headaches and nausea, cyber sickness, and computer screen intolerance. Fortunately, we and others have discovered some effective treatments that can relieve symptoms and help return to work, school or play.

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LiUNA Free Webinar Series, September 24, 2024

Title:

Treatment of Post-Concussion Symptoms Related to Screens at Work, School or Play.

Presenter:

Dr. Charles Tator

Speaker's Biography



Dr. Charles Tator trained in Neurosurgery and Neuropathology and was Chair of Neurosurgery at the University of Toronto. He headed Neurosurgery at Sunnybrook, Toronto Western Hospital, and University Health Network. He was a founder of ThinkFirst, Canada, a national brain and spinal cord injury prevention foundation, and Parachute Canada, a national injury prevention agency. He is a Scientist in the Krembil Brain Institute. He held two research chairs at the University of Toronto, and is an Officer of the Order of Canada, and an inductee of the Canadian Medical Hall of Fame and the Canadian Sports Hall of Fame. In 2009, he founded the Canadian Sports Concussion Project and then the Canadian Concussion Centre in 2015, both at the Toronto Western Hospital, University Health Network specializing in patient care and research in concussion. He is the author of 447 publications in peer review journals and books and is a member of several journal editorial boards.

Functions of the Canadian Concussion Centre: This Seminar Represents our Work in all Three!!!

1. **PATIENT CARE:** we want to help concussed people recover from concussions.
2. **RESEARCH:** we want to discover the mechanisms in the brain that are affected by concussion so that we can improve treatment and recovery.
3. **TEACHING:** we want to teach concussed people and practitioners how to improve recovery after concussion.

Almost all Concussed Patients Suffer from One or More of the Following Vision Symptoms:

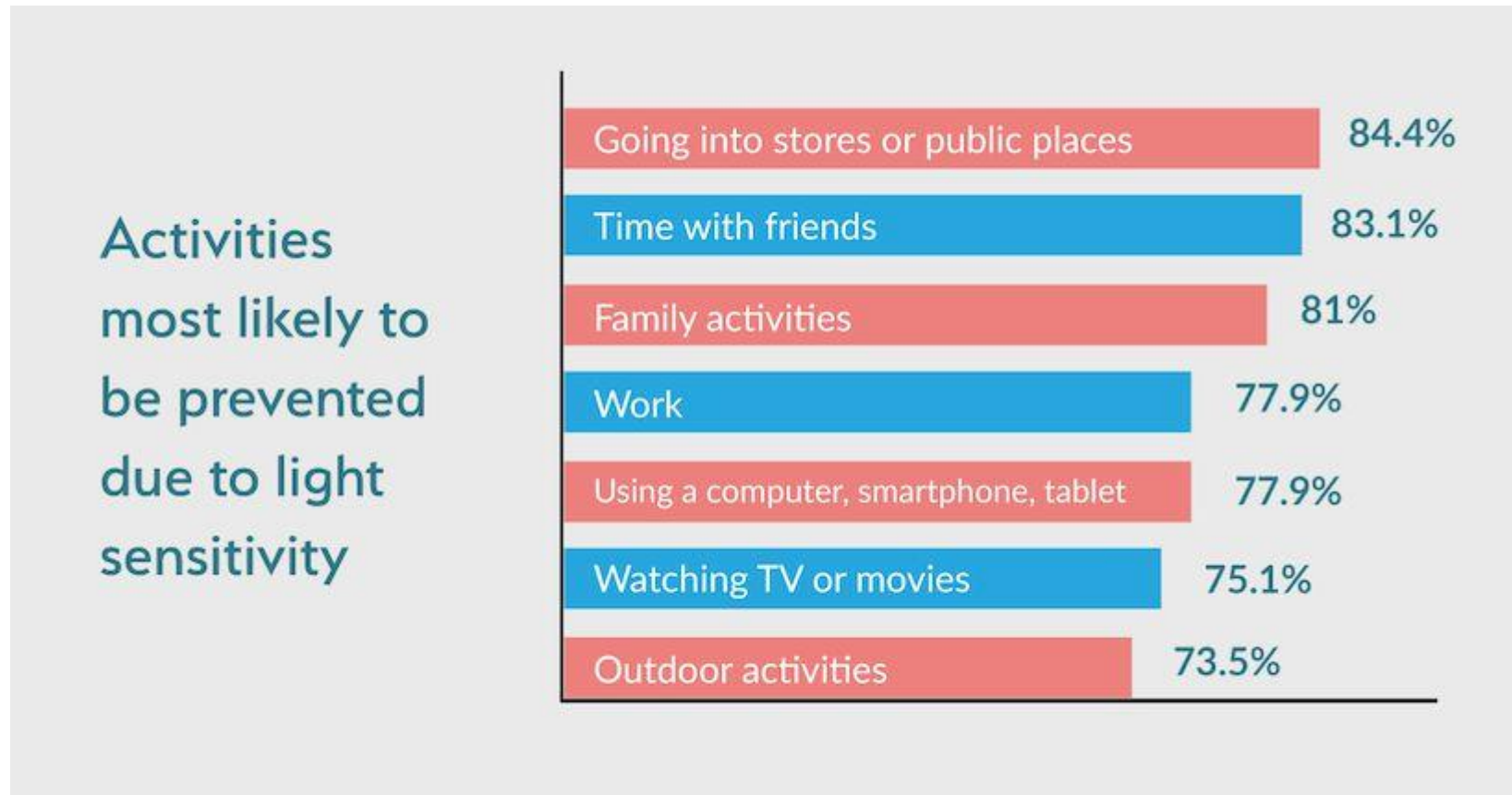
- Eye Strain
 - Double Vision
 - Blurred Vision
 - Photophobia
 - Sensitivity to Light
 - Photosensitivity
 - Computer Screen Intolerance
- “Computer Screen Intolerance (CSI)”
(also known as:
Cyber Sensitivity
Digital Eye Strain, etc.)
Can Affect Screen use involving
Computers
Cellphones
TV screens
Can Cause Symptoms of eye strain,
headaches, nausea, dizziness, etc.
Prevents Return to Learn and Return to Work

What Symptoms do Lights Trigger after Concussion?

- Headaches, even Migraine Attacks
- Dizziness
- Nausea
- Eye Discomfort and Pain
- Anxiety, even Panic Attacks
- Disruption of Sleep Cycle

General Survey of People with Sensitivity to Light. ("Theraspecs Survey").

Applies to people who have had a concussion.



Features of Light Sensitivity after Concussion: What types of lights cause symptoms?

(In order of Worst Tolerated to Best Tolerated

Light)

1. Fluorescent Light
2. Flashing Light
3. Flickering Light
4. Bright Light
5. Computer Screens
6. Phone Screens
7. TV Screens
8. E-Readers

TYPES OF LIGHT and their Effects

- **Daylight-** contains the Full Spectrum of Colours from Red (longest wavelength), Orange, Yellow , Green, to Blue (shortest wavelength). **Blue light causes the most symptoms.**
- **Flourescent Light is primarily blue light-causes more symptoms than regular incandescent bulbs**
- **Bright light of any colour causes more symptoms than dim light**
- **Glare causes symptoms**
- **Even low levels of light can cause symptoms after concussion.**

Findings from Mansur et al., 2018

- **First study to define CSI** as a term and test a non-LCD screen as a CSI therapeutic intervention.
 - Non-LCD: no backlight or flicker, lower refresh rate than LCD screen (<60 Hz).
- We measured the change in symptoms after a 30 min reading task on non-LCD vs LCD screen.
 - Sample size (n=29), 79% female.
- We found that after reading the non-LCD screen produced fewer symptoms than the LCD screen.
- But there were some limitations



Figure 3. Devices from the previous study. The screen on the left is the non-LCD screen, and the screen in the right is the standard LCD screen.

Our Research into Treating Computer Screen Intolerance or CSI Began in 2015 when we first studied this Persisting Concussion Symptom.

In 2018, we published the world's first controlled trial of this condition in 27 concussed patients with Computer Screen Intolerance (CSI) and found that an e-reader type of screen marketed by a Canadian company (Iris Technologies) was helpful for patients with CSI.

Unfortunately, patients found significant deficiencies with this computer:

- 1. No colour (B&W only)**
- 2. Would not scroll**
- 3. Screen too small**
- 4. High cost.**

(Mansour et al Journal of Neurotrauma, 2018).

THUS, WE HAVE CONTINUED OUR RESEARCH INTO THE TREATMENT OF CSI

OUR MOST RECENT RESEARCH
WAS JUST COMPLETED AND
WAS THE SUBJECT OF A MASTER
OF SCIENCE STUDY at the CCC
and U of T

By Chloe Buso at the Canadian Concussion Centre

Investigating the Pathophysiology and Treatment of Computer Screen Intolerance in Patients with Persisting Concussion Symptoms

MSc Defense - July 30th, 2024

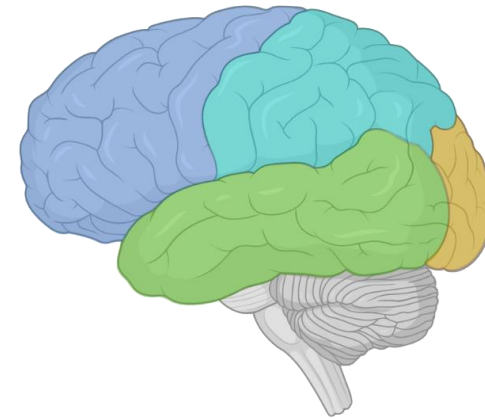
Presented By: Chloé Buso, *MSc Candidate*

Supervisor: Charles Tator

Other Research Team Members: Carmela Tartaglia, Igor Jurisica, and Michael Reber



How does working on the computer affect the brain?



Institute of Medical Science
UNIVERSITY OF TORONTO



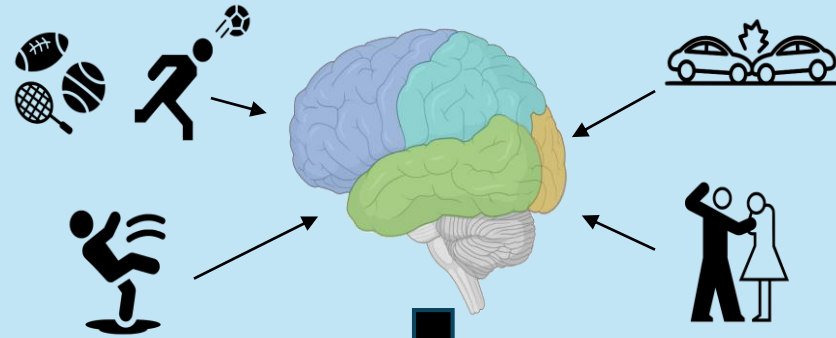
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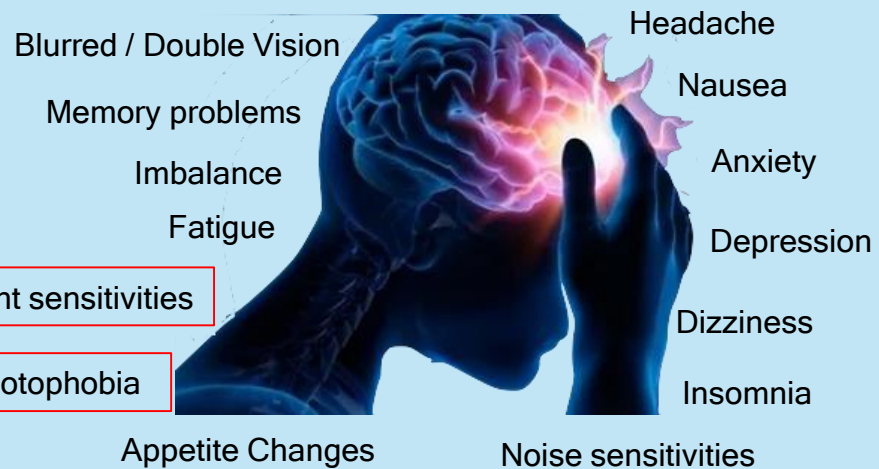
UHN Krembil
Brain Institute

Introduction to Current Study

What is a Concussion?



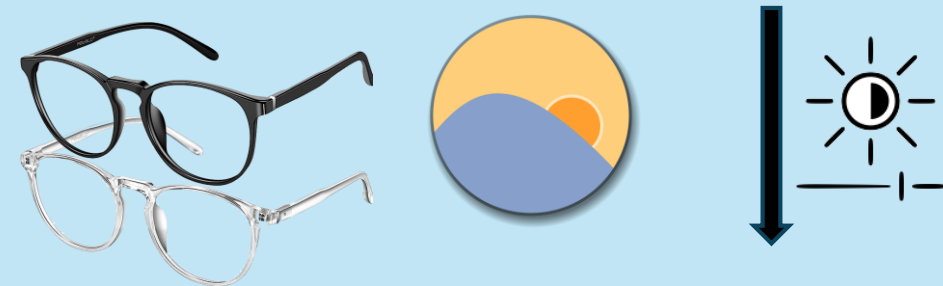
Persisting Concussion Symptoms (PCS)



Computer Screen Intolerance (CSI)



Available Treatments for CSI



Potential Mechanisms of CSI: THE EYE? THE BRAIN? THE BLOOD VESSELS? IS IT DUE TO THE Intrinsically Photosensitive Retinal Ganglion Cells (ipRGCs) in the Retina of the EYE????

Are ipRGCs an Explanation for Computer Screen Intolerance (CSI)?

- Comprise 0.2-2.5% of all ganglion cells (Chakraborty et al., 2022).
- Activated by blue light (Theis, 2022).
- Migraine patients experience a light induced exacerbation of headache (Noseda et al., 2019).
 - May have similar pathophysiology to concussion.
- Thalamic neurons receive monosynaptic inputs from ipRGCs (Noseda et al., 2010; Taylor, 2010).

THE MECHANISM OF CSI - STILL UNKNOWN!!!!!!!

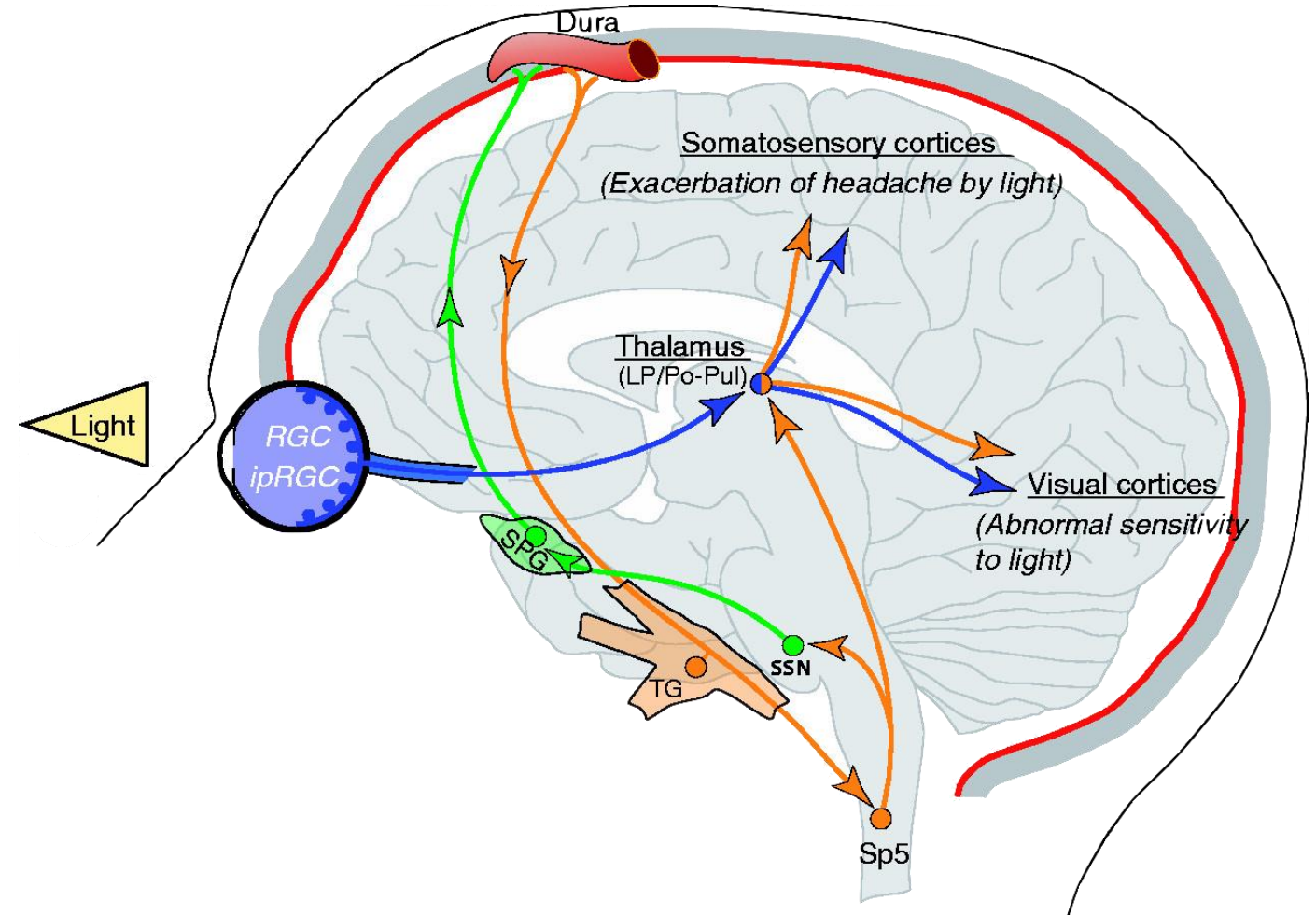


Figure 1. Diagram taken from Noseda et al., 2019. Current Understanding of Photophobia, Visual Networks and Headaches.

Another Potential Mechanism for CSI: IS IT DUE TO FAILURE OF THE BRAIN TO FUSE IMAGES AFTER A CONCUSSION?? CRITICAL FLICKER FUSION FREQUENCY (CFFF) CAN BE MEASURED.

Does concussion affect the brain's ability to fuse images which causes flicker to happen more often ?

CFFF (Chang, Ciuffreda & Kapoor, 2007):

- The lowest frequency light is perceived as non-flickering.
- Concussion patients with CSI may have an abnormal CFFF threshold.

Where does fusion of light occur in the brain?

- Is it in the retina or brain? Probably in the brain?

We do not know if CFFF is the reason for Computer Screen Intolerance (CSI), and plan to study it this year. WE ARE

- Red: Magnocellular Pathway.
- Purple: Parvocellular Pathway.
- LGN: Lateral Geniculate Nucleus.

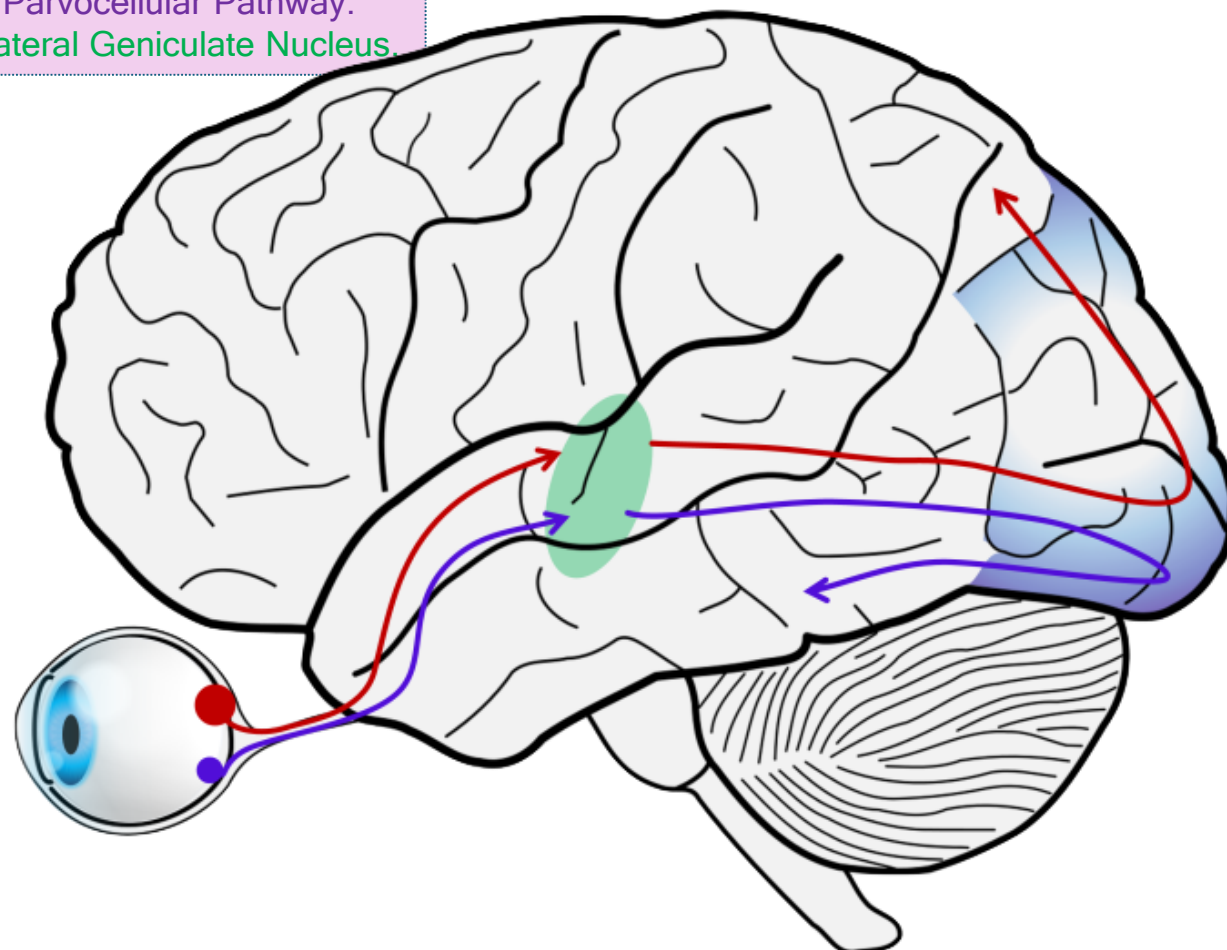


Figure 2. Visual Processing Pathway. Taken from Jarod Davis, University of Minnesota.

OUR MOST RECENT STUDY OF CSI: Evaluation of a COMMERCIALLY AVAILABLE FLICKER-FREE SCREEN.

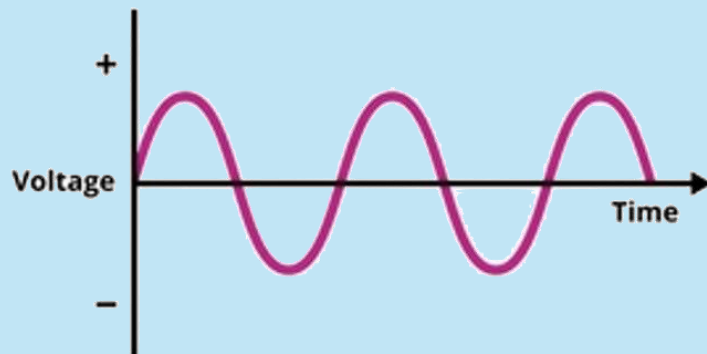
Flicker Screen



Flicker-Free Screen



What Makes a Screen Flicker?
Alternating Current (AC)



How Can a Screen be Flicker-Free?
Direct Current (DC)



Current Study: Evaluation of a Flicker-Free Screen for Patients with Computer Screen Intolerance (CSI), a Persisting Concussion Symptom (PCS).

Question:

- Do concussion patients with CSI have fewer symptoms and less severe symptoms after **READING** or **WATCHING A VIDEO** on a Flicker-Free screen compared with conventional computer screen that flickers.



Figure 4. Devices for the present study. The screen on the left is the Flicker-Free screen, and the screen on the right is the Flicker screen. THEY LOOK THE SAME, but is one better tolerated than the other?

Demographics of the 47 Concussed Patients with CSI in our Study.

Sex (%)	Males: 13 (27%) Females: 34 (73%)
Age (years)	Median = 39, IQR = 21
Number of Previous Concussion	Median = 2.5, IQR = 3.5
Cause of Concussion (%)	Falls: 7 (15%) Sports & Recreation (S&R): 7 (15%) Motor Vehicle Collisions (MVC): 15 (32%) Struck by Object / Violence (SBOV): 18 (38%)
Median Time from Index Concussion to Visit 1 (Months)	Median = 12, IQR = 24

Return to Work Status and Occupation (n=47).

	Number of Patients (%)
Returned to Work (%)	Yes: 33 (70%) No: 14 (30%)
Returned to Work at a Reduced Workload (%)	Yes: 26 (55%) No: 7 (15%) Not Applicable: 14 (30%)
<p>Occupation</p> <p>*Business occupations included: marketing director, consulting, CEO of company, business owner, banking / trading.</p> <p>**Other occupations included: dental hygienist, delivery driver, social worker, artist / digital designer.</p>	<p>Administration: 10 (21%)</p> <p>*Business: 9 (19%)</p> <p>Student: 6 (13%)</p> <p>Teacher or Professor: 5 (11%)</p> <p>Lawyer, Legal Counsel, or Law Clerk: 4 (9%)</p> <p>TV Industry: 3 (6%)</p> <p>Retired After Concussion: 2 (4%)</p> <p>Engineer: 2 (4%)</p> <p>Military: 1 (2%)</p> <p>Doctor: 1 (2%)</p> <p>**Other: 4 (9%)</p>

Reported Computer Discomfort and Average Time Per Day Spent on the Computer (n=47).

	Number of Patients (%)
Computer Discomfort	Mild: 10 (21%)
	Moderate: 29 (62%)
	Severe: 8 (17%)
Daily Computer Use (Average Time Per Day)	1 hour or less: 16 (34%)
	1-3 hours: 9 (19%)
	3-5 hours: 8 (17%)
	6-10 hours: 14 (30%)

Patients were seen between 1 month and 5 years after they sustained their concussion (median=12 months, IQR=24) when they reported these findings.

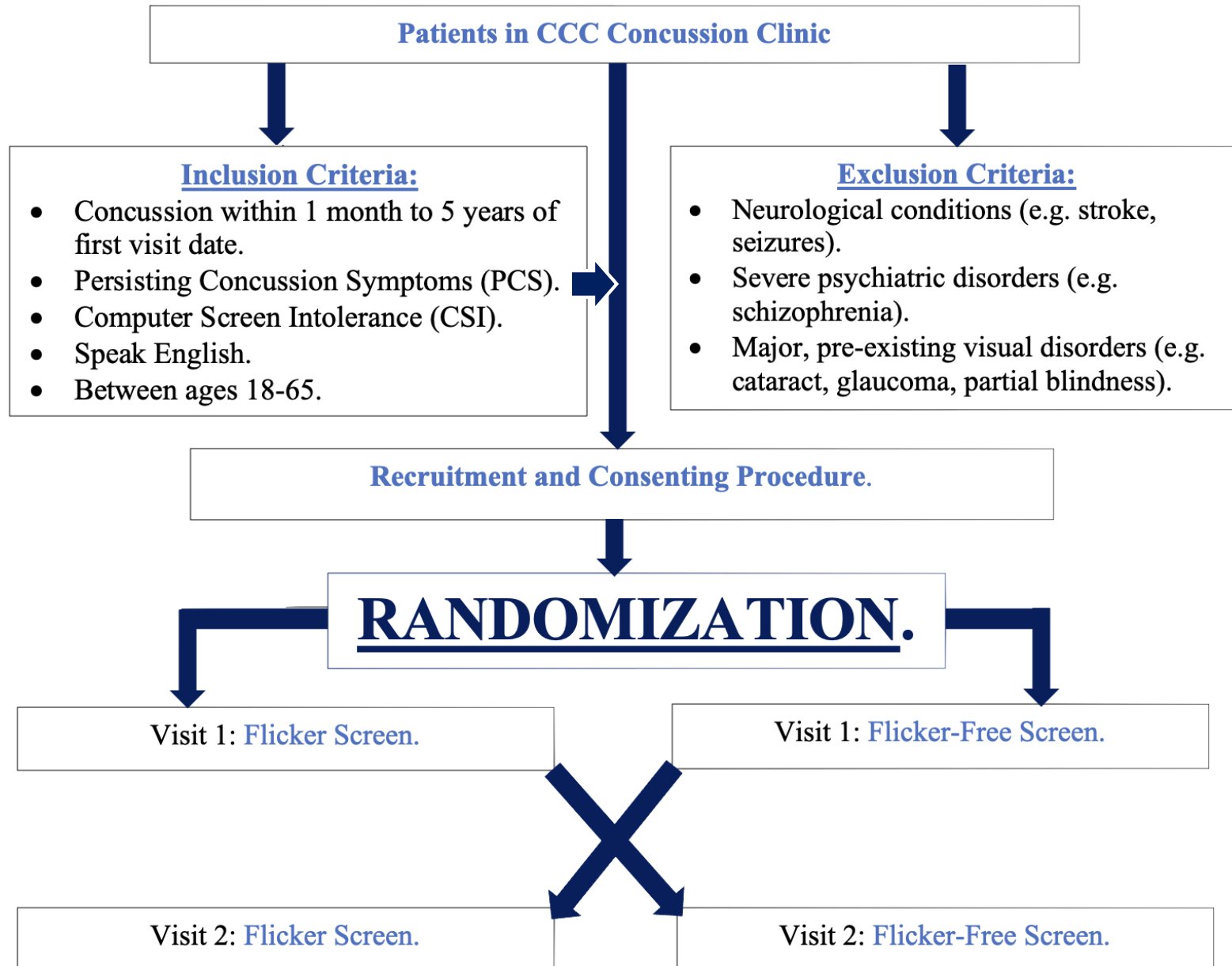
Aggravating Light Sources that Exacerbate Concussion Symptoms in Patients (n=47).

Patients were seen between 1 month and 5 years after they sustained their concussion (median=12 months, IQR=24) when they reported these findings.

Light Source	Number of Patients who Experience Discomfort from the Light Source (%)
Computer Screens	47 (100%)
Fluorescent Lighting (e.g. tube lights)	44 (94%)
Flashing or Flickering Lighting (e.g. siren lights on a firetruck / police car)	41 (87%)
Indoor Lighting (e.g. pot light bulbs)	36 (77%)
Cell Phone Screens	34 (72%)
Outdoor Lighting (e.g. bright sunny day)	30 (64%)
TV Screens	20 (43%)
Other Type of Light Source*	14 (30%)

*Other types of light sources comprised glare or bright spots of light, car headlights when night driving, blue LED Christmas lights, shadows outside, flicking lights in the subway, flashlights, streetlights in the night, and skating rink arena lights.

STUDY DESIGN: RANDOMIZATION & CROSS-OVER



Conclusions

After Reading?



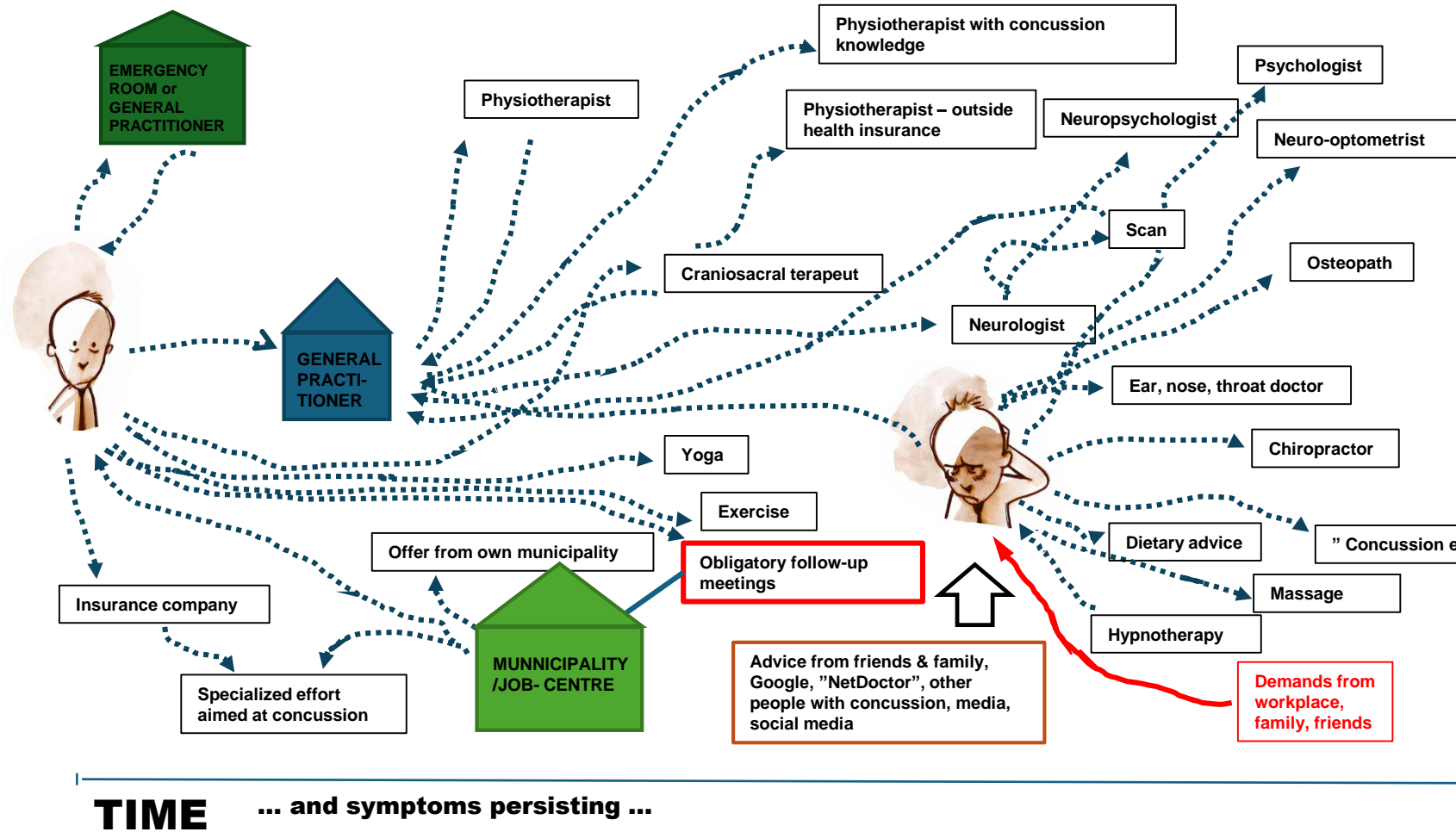
After Video?



Current Treatment for Vision Problems in General after Concussion

- Get Advice re Type of Vision Problem from your **Family Doctor**, or you may need a referral to an **Ophthalmologist** to make sure it is not something like increased pressure in your eyes unrelated to the concussion.
- If You Wear Glasses Get Advice from your **Optometrist**: your vision may have changed since your last change of glasses.
- If your visual problem after a concussion is not due to those factors then it may be due to CSI, and you need to see a **“Concussion Doctor”** which may be a difficult Pathway depending on where you live.

The Challenges of Concussed Persons with Persisting Symptoms such as Computer Screen Intolerance!!!



Return to Work, School, or Play is a challenge for those experiencing long-term symptoms



Feeling lost in health care system

If Your Vision Problem is CSI, here is the list of CURRENT TREATMENTS.

- Change Your Environment at School or Work: “ACCOMODATIONS!!”

1. **Avoid bright lights.** Tell the boss or teacher. You may need to hire an Occupational Therapist.
2. **Avoid fluoresecent lights** altogether, but if you cannot, change type of fluorescent light to yellow fluoresecent light.

- **Wear Eyeglasses:**

1. **Blue Light Filtering Glasses.** Blue is the most aggravating colour after a concussion!
2. **Sunglasses:** Best colour is orangey/brown; Best shape=“Elton John”-look like a bug glasses which also block ambient light.

- **Adjust Your Computer:**

1. Change the Colour with the rogram F.lux
2. Reduce the brightness via Settings

Current Treatments for CSI (Cont'd)

- **Reduce Computer Time.** Use more paper. Use an E-reader.
- **Take Frequent Breaks.**
- **Change the Computer and/or Monitor.**
 1. Iris Technologies.
 2. Viewsonic, BenQ, and other manufacturers are now offering “Flicker Free Screens” (such as DC, which do not flicker) and claim that “they prevent eye strain”.

Treatments for CSI and other Visual Problems after Concussion that DO NOT WORK!!!

- Toughing it out and hoping it will go away!!
- “VISION THERAPY” does not work for CSI.
- Staying at home, and not returning to school or work!

Thank You and Best Wishes!

REMINDERS:

This is Concussion Awareness Week in Canada.

Tomorrow is Rowan's Law Day in Ontario.

Both are examples that Concussion has been recognized as an important medical condition in our province and country!