# Canadian Concussion Centre

## LiUNA Free Webinar Series

Date:

**January 27, 2026**

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

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Presenter:

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## 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.

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# 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.

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

1. **Eye Strain**
2. **Double Vision**
3. **Blurred Vision**
4. **Photophobia**
5. **Sensitivity to Light**
6. **Photosensitivity**
7. **Computer Screen Intolerance which is a "Syndrome" defined as a collection of symptoms. Can include many of the other symptoms listed.**

- **Computer Screen Intolerance (CSI)**

(also known as:

Cyber Sensitivity

Digital Eye Strain, etc.)

Can Affect Screen use while on

Computers

Cellphones

TV screens

Can Cause Symptoms of eye strain, headaches, nausea, dizziness, etc.

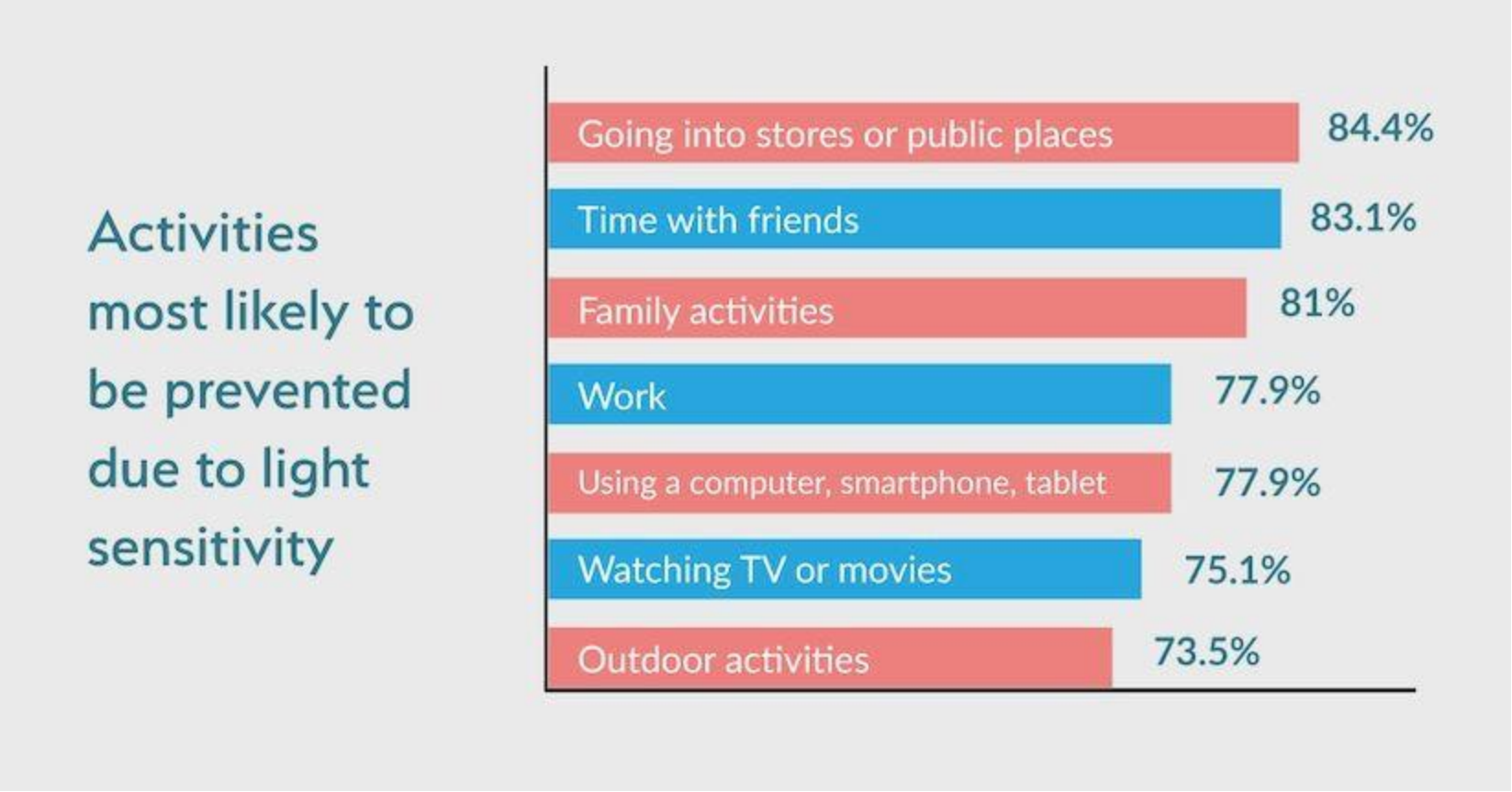
**Prevents or Prolongs Return to Learn and Return to Work**

# What Symptoms are Triggered by Light after a Concussion?

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

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

Also 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, especially white fluoresecent bulbs (ask boss for yellow!)
2. Flashing Light
3. Flickering Light
4. Bright Light
5. Computer Screens are Liquid Crystal Display (**LCD**)
6. Phone Screens **also LCD**
7. TV Screens **also LCD**
8. E-Readers **not LCD**

# TYPES OF LIGHT and their Effects after a Concussion

- **Daylight**- contains the Full Spectrum of Colours from Red (longest wavelength), Orange, Yellow , Green, to Blue (shortest wavelength). **Blue light causes the most symptoms, especially Microsoft BLUE.**
- **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 our Mansur et al., 2018

- First study to define CSI and test a **non-Liquid Crystal Display** 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 READING on a non-LCD screen produced fewer symptoms than the LCD screen. <u>But there were some limitations to the screen:</u>**


**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 10 years ago in 2015 when we first studied this Persisting Concussion Symptom SYNDROME.

**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 non-LCD screen marketed by a Canadian company (Iris Technologies) was helpful for some patients with CSI.**

**However, Patients Found Significant Deficiencies with this Computer:**

1. **No colour (B&W only).**
2. **Does not scroll.**
3. **Screen is very 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 University of Toronto

**Chloe Buso MSc** led the study 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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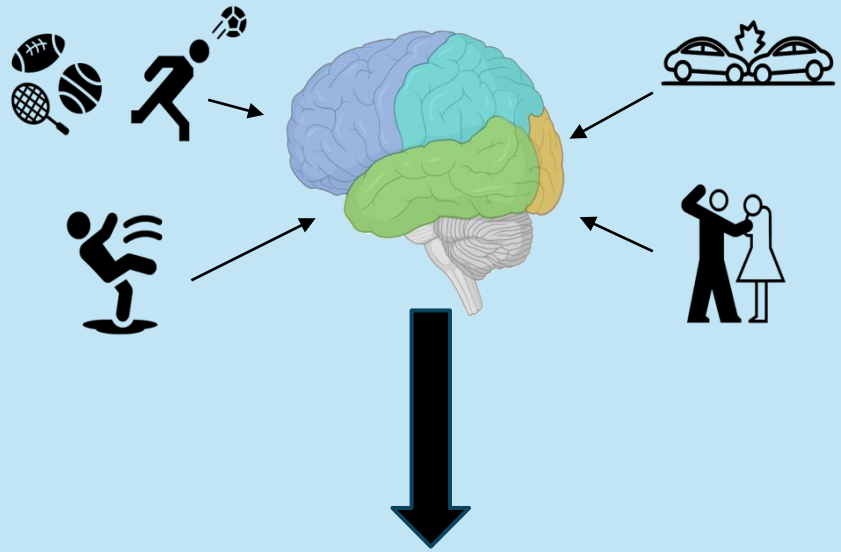
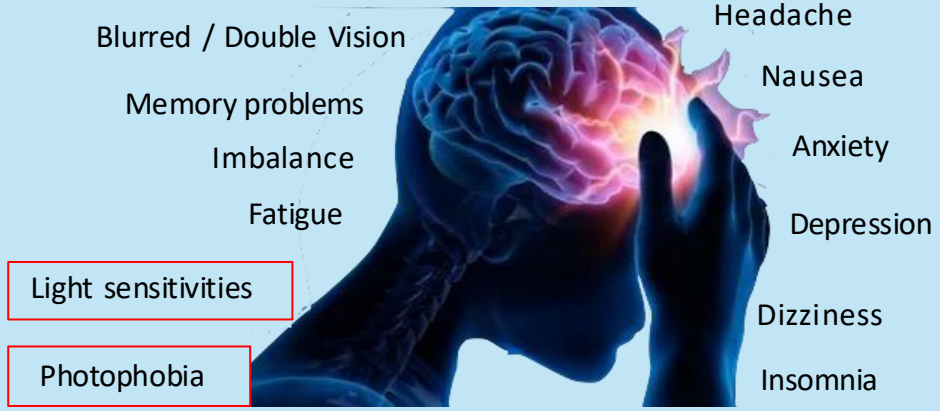
# SO WE DID MORE RESEARCH! Introduction to Our Current Study

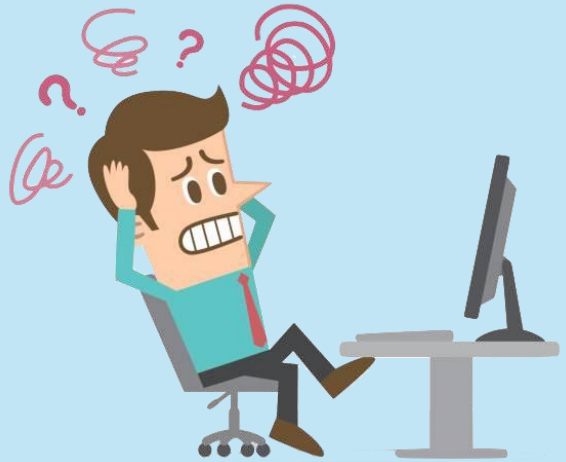
## What is a Concussion?



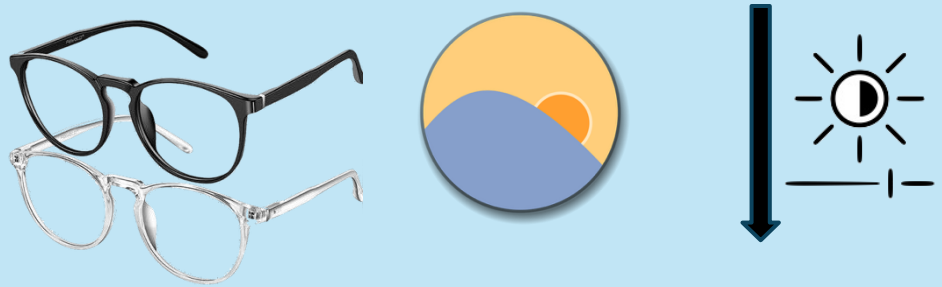
## Persisting Concussion Symptoms (PCS)




## 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 which send messages directly to the THALAMUS which is the Pain Sensitive CENTRE OF THE BRAIN????

**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!!!!!!! A large part of the brain is involved in vision!!!!!!**

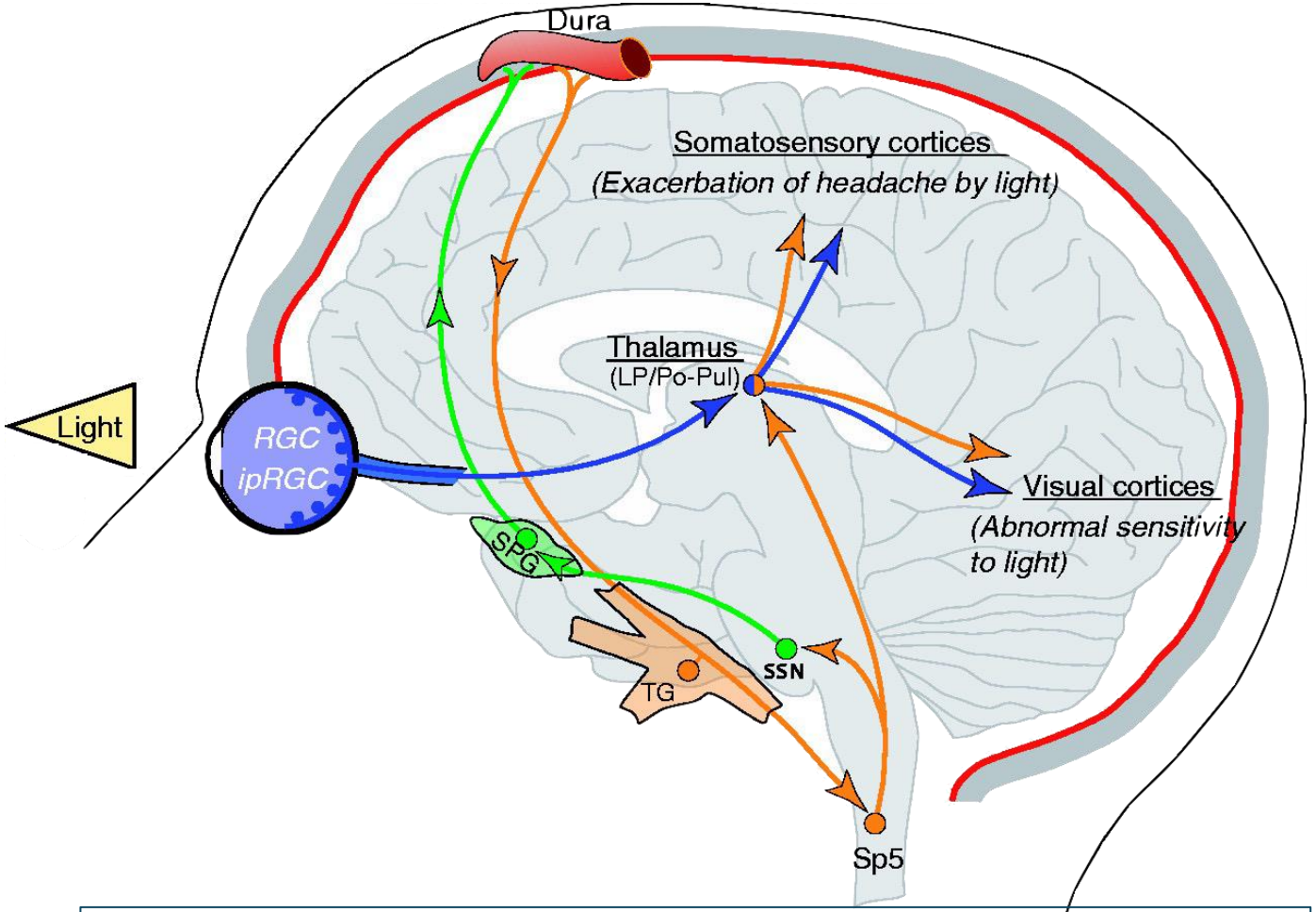



Diagram taken from Noseda et al., 2019. Current Understanding of Photophobia, Visual Networks and Headaches.

# 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 LOOKING FOR VOLUNTEERS!!!**

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

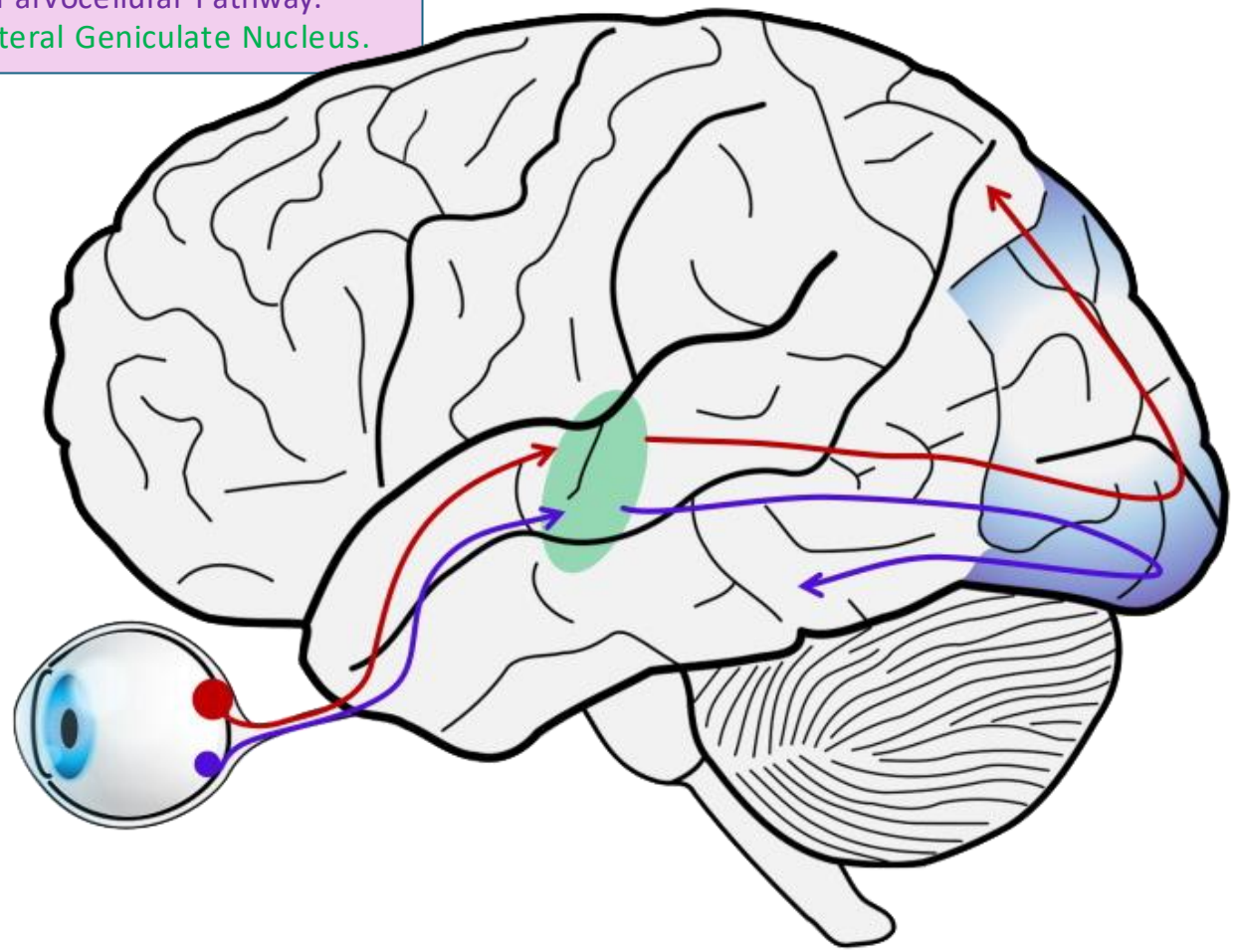
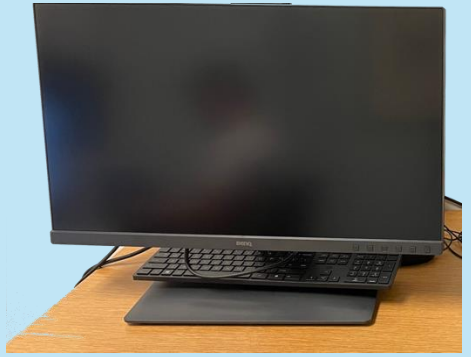


**Figure 2. Visual Processing Pathway.** Taken from Jarod Davis, University of Minnesota.

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

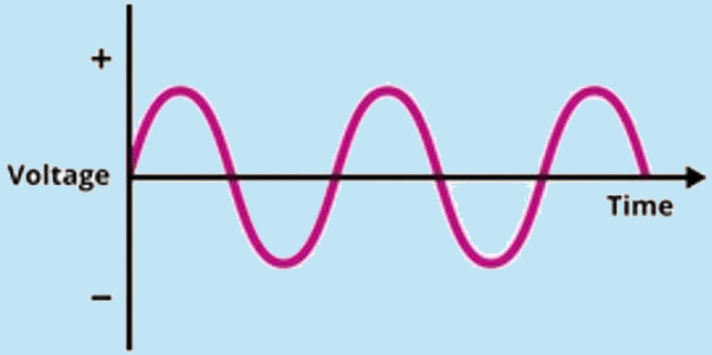
## Flicker Screen

## 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%)<br>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%)<br>Sports & Recreation (S&R): 7 (15%)<br>Motor Vehicle Collisions (MVC): 15 (32%)<br>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%)<br>No: 14 (30%) |
| **Returned to Work at a Reduced Workload (%)** | Yes: 26 (55%)<br>No: 7 (15%)<br>Not Applicable: 14 (30%) |
| **Occupation**<br><br>*Business occupations included: marketing director, consulting, CEO of company, business owner, banking / trading.<br><br>**Other occupations included: dental hygienist, delivery driver, social worker, artist / digital designer. | Administration: 10 (21%)<br>*Business: 9 (19%)<br>Student: 6 (13%)<br>Teacher or Professor: 5 (11%)<br>Lawyer, Legal Counsel, or Law Clerk: 4 (9%)<br>TV Industry: 3 (6%)<br>Retired After Concussion: 2 (4%)<br>Engineer: 2 (4%)<br>Military: 1 (2%)<br>Doctor: 1 (2%)<br>**Other: 4 (9%) |

# 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.

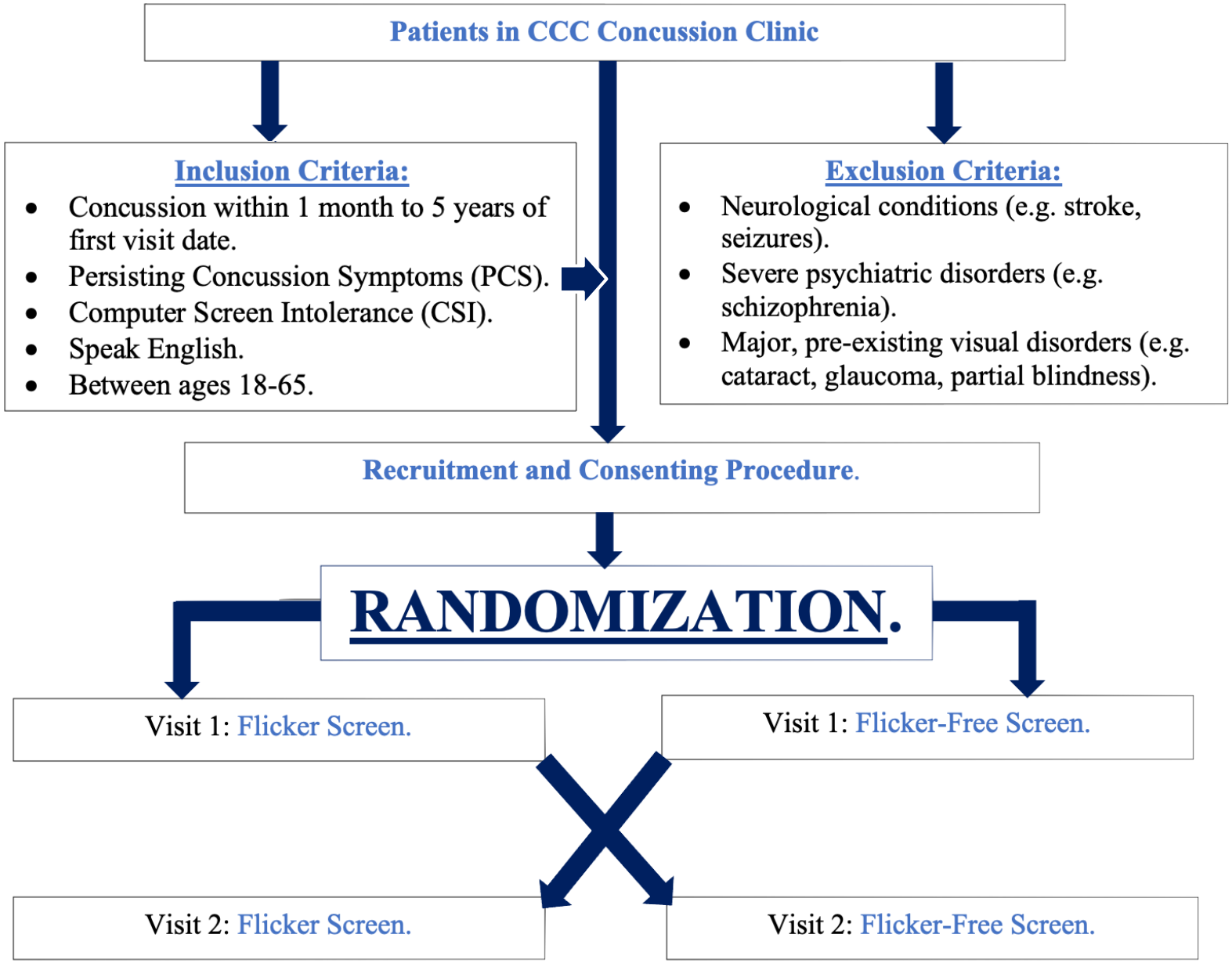
# Aggravating Light Sources that Exacerbate Concussion Symptoms in Patients (n=47).

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.

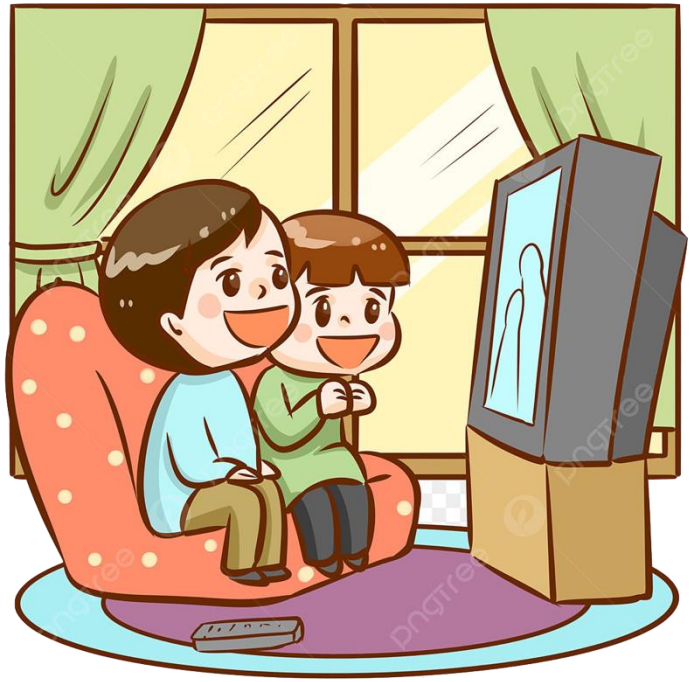
# STUDY DESIGN: RANDMIZATION & CROSS-OVER



# Conclusions

After Reading?

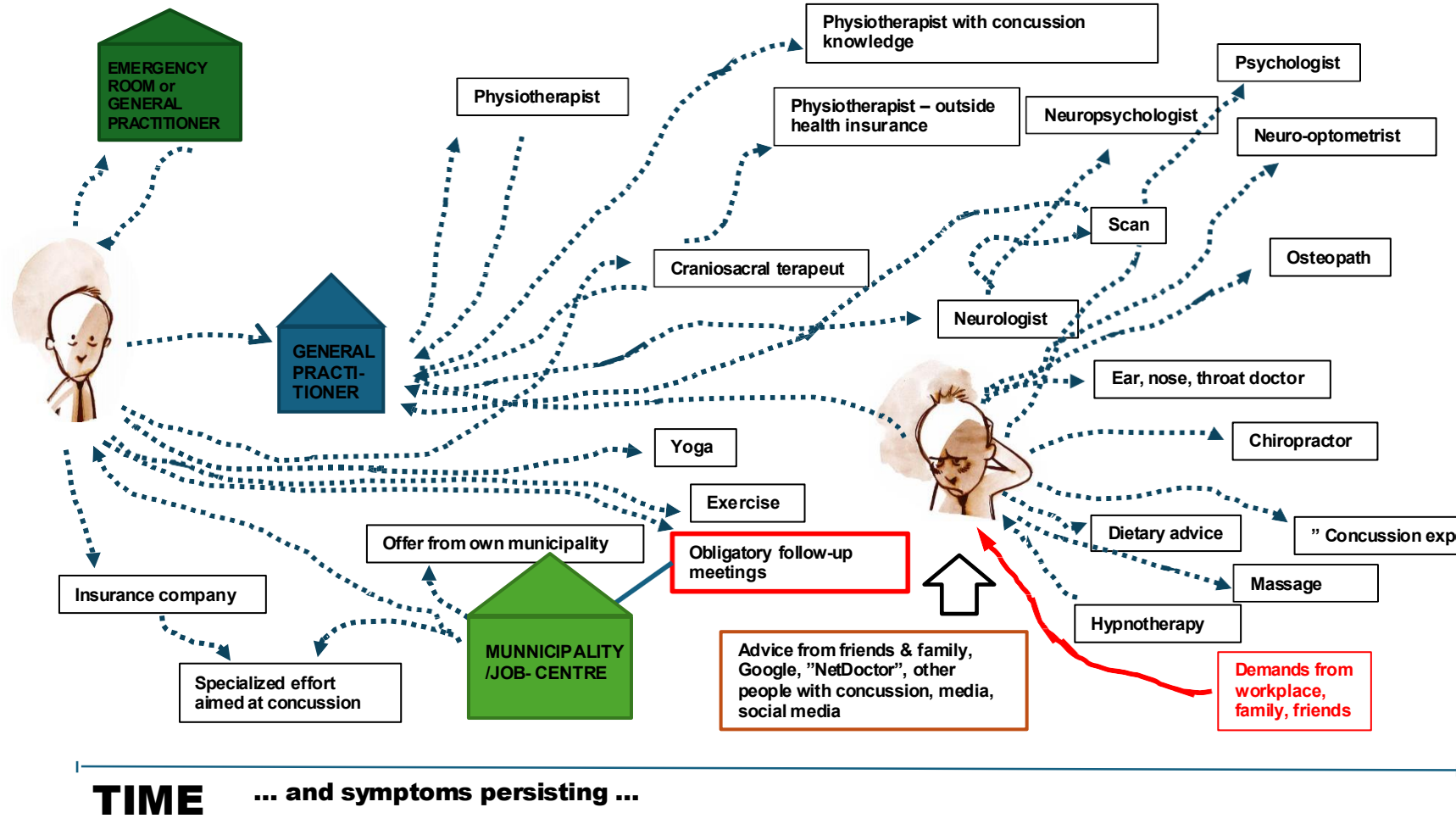

After Video?



# 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.
- The concussion itself may cause a change in your vision and you may need a new prescription.
- 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**

The Danish Concussion Center

**Feeling lost in health care system**

# If Your Vision Problem is CSI, here is the list of REMEDIES TO TRY.

- **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:**

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

- **Adjust Your Computer:**

5. **Change the Colour with the program F.lux**
6. **Reduce the brightness via Settings**
7. **LIMIT SCREEN TIME!**

# 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. A minority still using it
2. **Try A FLICKER-FREE SCREEN**: Viewsonic, BenQ, and other manufacturers are now offering **"Flicker Free Screens"** (run on DC, and do not flicker). The companies claim that "they prevent eye strain", and this is true in some people! **Go to your favorite computer/TV/ monitor store and try reading text on it for 30 minutes before you buy it!**

# BAD Treatment for CSI and other Visual Problems after Concussion –They DO NOT WORK!!!

- Toughing it out and hoping symptoms 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!

# WE ARE STILL WORKING ON IT!!!

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