WIC

WEST ISLAND COLLEGE

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Problem

Students use screens for an extended period daily.

Does using digital devices affect the health of your eyes ?

Is there an impact on your eye health depending screen size and screen distance?

In our experiment, we will record how spontaneous blink rate (SBR) change under various conditions to determine the effects of digital devices.

Background Research

- Since the pandemic has started, surveys have shown increased in screen time use, especially in children. This includes TVs, tablets, computers, smart phones and gaming consoles.
- Children in U.S.A. use screen of an average of 3 hours on weekdays, and 6 hours on weekend days.
- 41 % of American teens report >8 h/day on screens.
- Research shows that when looking at a screen, adults and college students tend to blink 50% less compared to doing a daily activity.
- Reduced blinking will result in dry, red, tired and/or burning eyes. It can also cause fluctuating or blurry vision. This is known as Dry Eye Syndrome or Digital Eye Strain (Figure 1).

Background Research

- Many people report using smartphones for tasks that include homework, communication, research, and productivity, but laptops/desktops are still often the primary tools for structured academic or professional work.
- Young people hold phones much closer (~20cm) than traditional near-vision reading distances (~40 cm) when using them for typical tasks like texting or web browsing, and when lying down.
- There are limited studies on whether blink rate in children reduces with screen use, and whether viewing habits (screen size and distance) influence its effect.
- In our experiment, we are measuring spontaneous blink rate (SBR), which means how many times you naturally blink in a minute without conscious effort.

Hypothesis

Smaller screen size and closer viewing distances are expected to decrease blink rate, potentially increasing the risk of dry eye and digital eye strain.

Variables

Manipulated Variables

- Device's Size
- Screen distance

Responding Variables

- Spontaneous blink rate

Controlled Variables

- Same location and time
- Lighting of the room
- Screen brightness
- Same task
- Same duration of activity

Control

- UNO

Variables

Control

Materials

- Smartphone (Iphone 15)
- Computer (Macbook Pro 15")
- UNO Online Game (https://www.crazygames.com/game/uno-online)
- Ruler
- Stopwatch

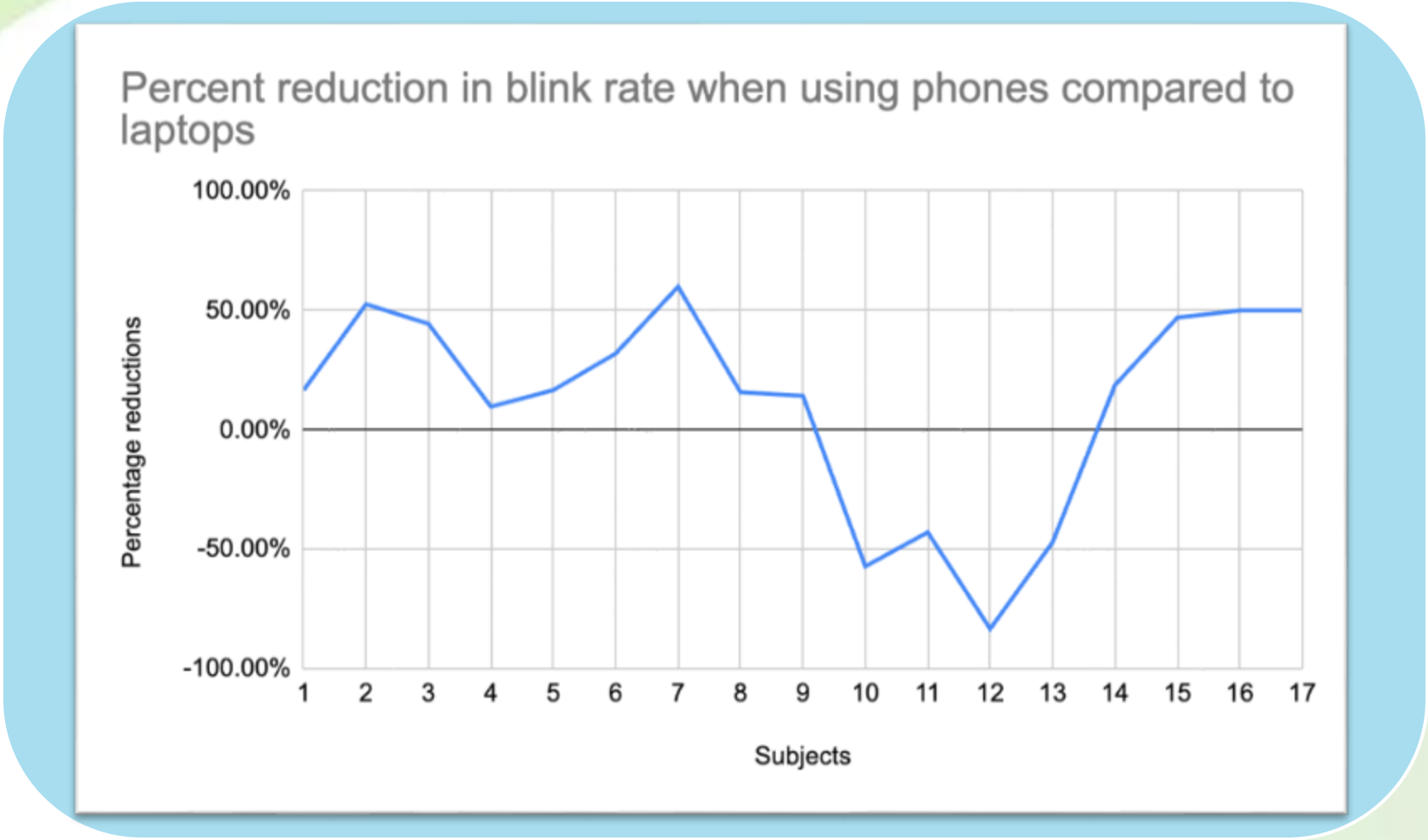
Procedure:
Changing Screen Size and Screen Distance

- With a different set of subjects (8-13 years old), they played UNO online card game on a computer or cell phone at a set viewing distance of 40- 50cm.
- After, the subjects played UNO online card game on the cell phone at their preferred working distance.
- Using the video recordings, the number of blinks were counted for a period of 2 minutes for every subject for each activity.

Experimental Data

Subject #	Spontaneous Blink Rate (Blink per Minute)			Preferred Personal Distance
	Laptop 40-50cm	Phone 40-50cm	Phone Personal Distance	
1	5	6	5	35 cm
2	9	19	13	23cm
3	20	36	18	27cm
4	37	41	40	23 cm
5	20	24	16	28cm
6	17	25	19	22cm
7	6	15	13	20cm
8	16	19	15	31cm
9	24	28	36	31cm
10	11	7	4	24cm
11	10	7	12	32cm
12	11	6	9	26cm
13	25	17	15	42cm
14	13	16	10	29cm
15	9	17	13	22cm
16	4	8	7	26cm
17	2	4	1	25cm

Graph 1


Percent reduction in blink rate when using phones compared to laptops
100.00%
50.00%
0.00%
-50.00%
-100.00%
Percentage reductions
1
2
3
4
5
6
7
8
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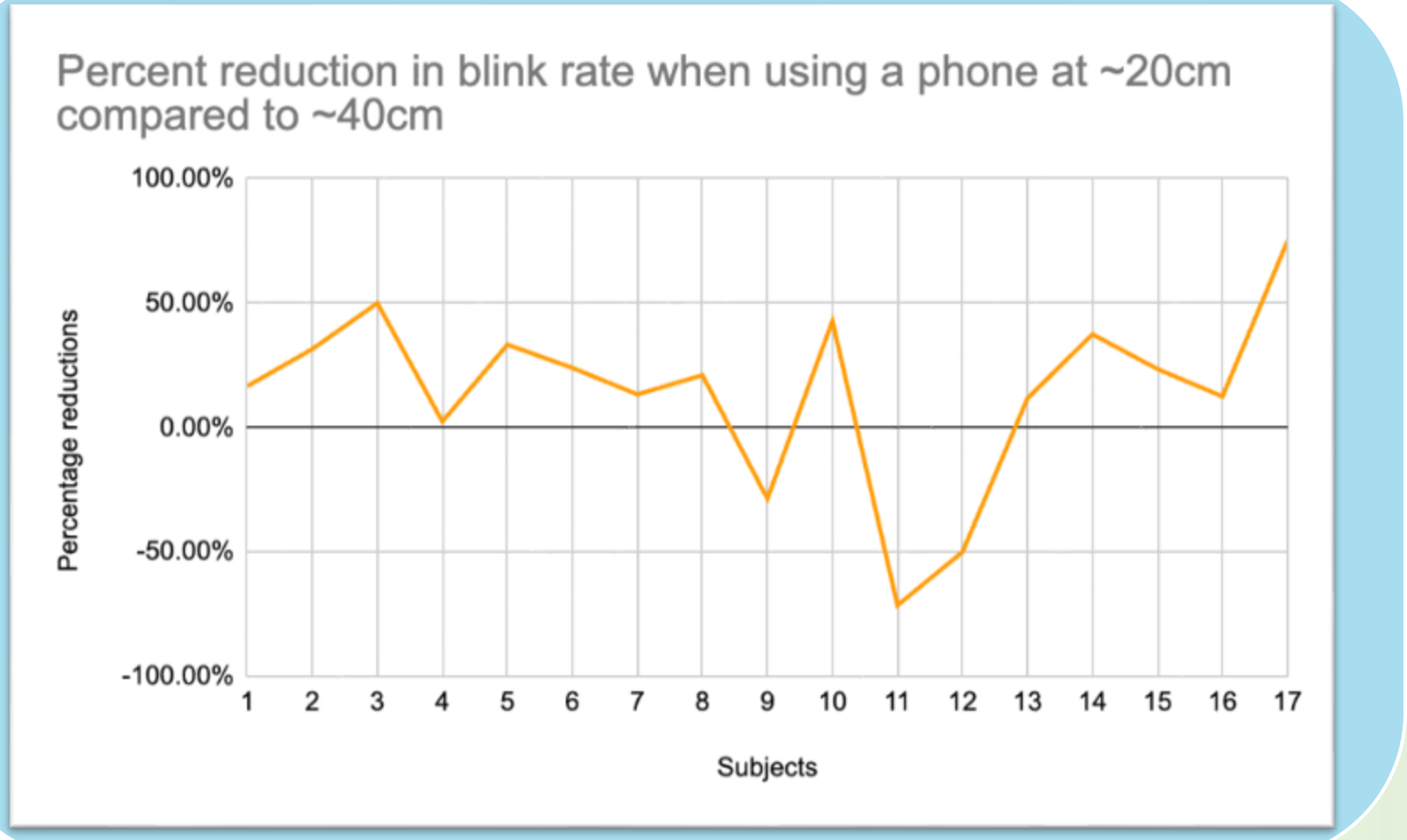
16
17
Subjects

Graphs


Percent reduction in blink rate when using a phone at ~20cm compared to ~40cm
100.00%
50.00%
0.00%
-50.00%
-100.00%
Percentage reductions
1
2
3
4
5
6
7
8
9
10
11
12
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14
15
16
17
Subjects

Results

- There's an average reduction in blink rate by 33% when using a phone at 40-50cm compared to a computer screen at the same distance
- There's an average reduction blink rate of 28% when using a phone at 20-30cm compared to a phone at 40-50cm
- We can extrapolate that blink rate decreases 60% when switching from laptop at 40-50cm to holding a phone close to the eyes

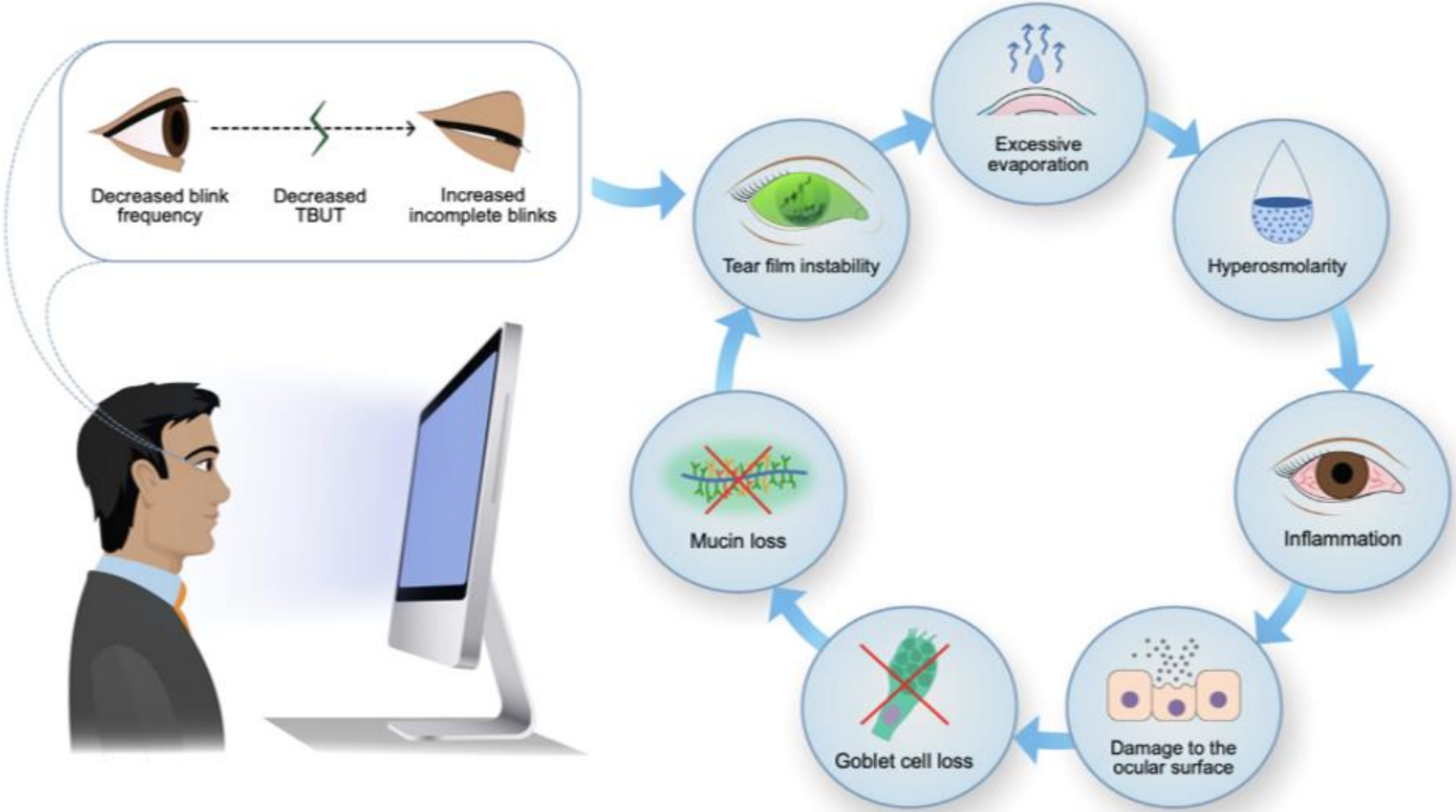


Fig. 1. Vicious cycle of dry eye disease. Video display terminal (VDT) use leads to decreased blink rates and increased incomplete blinks, promoting tear film instability, tear evaporation rates and hyperosmolarity. Hyperosmolarity can increase inflammatory mediators that damage the ocular surface and goblet cells. The loss of goblet cells decreases mucin secretion and further reduces tear film stability, leading to a self-perpetuating vicious cycle. Copyright Sara T. Nøland.

Dry Eye Symptoms

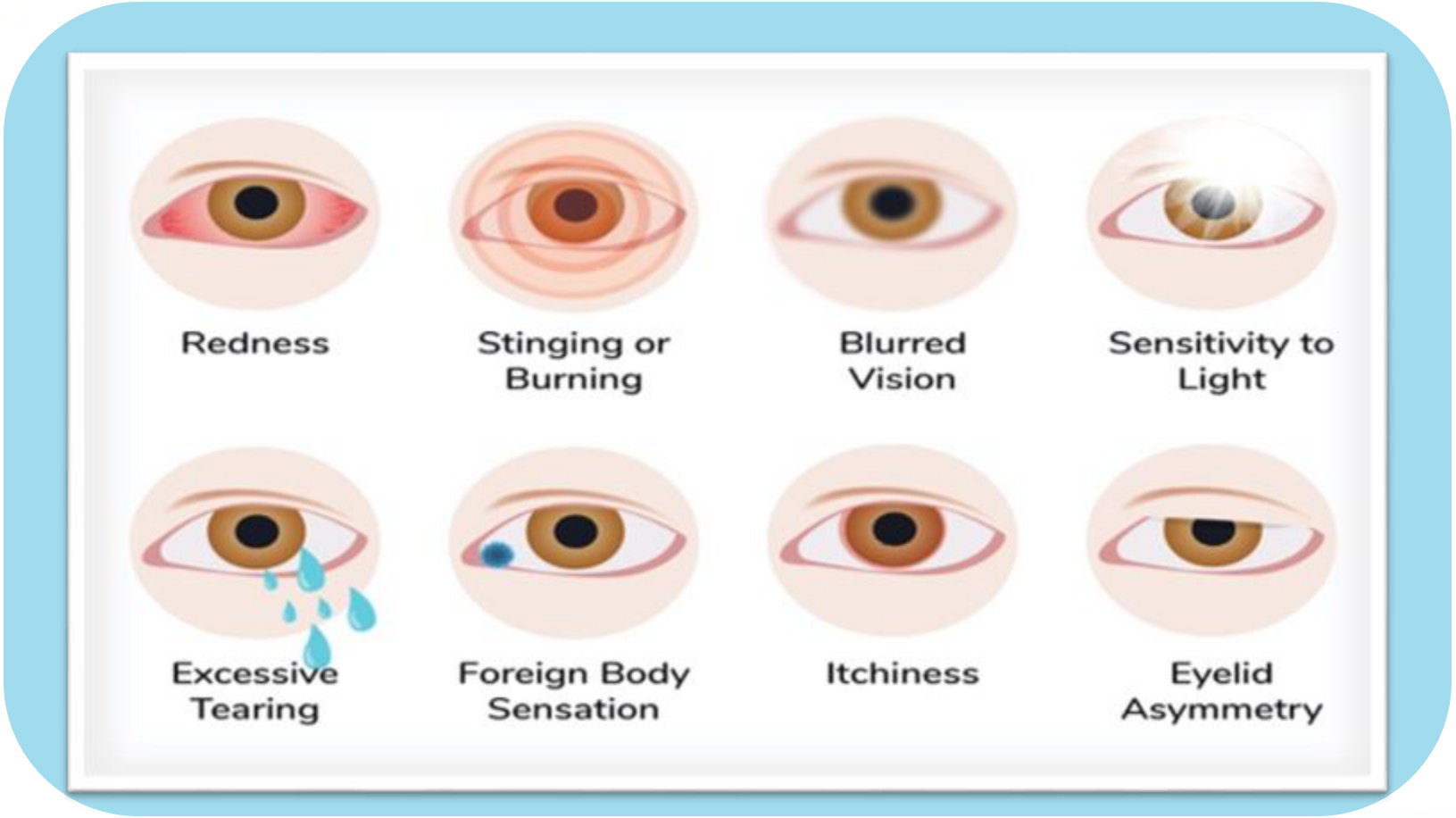


Figure 1: Dry eyes symptoms occur when your eyes do not produce enough tears. Tears are important because they keep the eyes moist, comfortable, and protected.

Discussion

- Blinking is important because it can help your eyes stay moist, clear off debris and bring nutrients to the eye.
- When you don’t blink enough, then your eyes can become dry, blurry, fatigued and strained. This can impact how much school work you can do and how well you can concentrate. If the eyes are continuously dry, it will get painful, cause eye infections, ulcers and permanent loss of vision.
- There are also mental and physical burdens to dry eyes
- There are some ways you can prevent dry eyes symptoms such as tilting and lowering the computer screen, taking frequent breaks and using blink reminder apps

Dry Eyes can cause Physical, Mental & Financial Burden

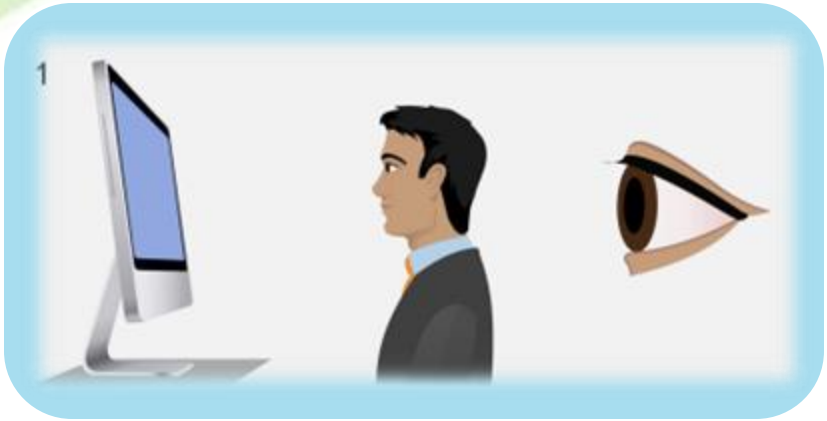
Corneal Ulcer
Contact lens intolerance
Chronic Pain Syndrome
Blurry vision
Blindness

Poor Concentration
Poor Grades 2-3x
Risk of Depression
Low Quality of Life
(even worse than glaucoma, macular degeneration and retinal detachment)

Cost to patients $750-2500/yr
Cost to insurance $25 billion/yr
Cost to society $55 billion/yr

Discussion

- Research has shown that smaller screen size requires more cognitive attention
- Phones have smaller screen size compared to laptop, making it harder to focus and see clearly, hence requiring more cognitive attention.
- When you hold a screen closer to your eyes it increase the amount of accommodative (eye focusing) demand.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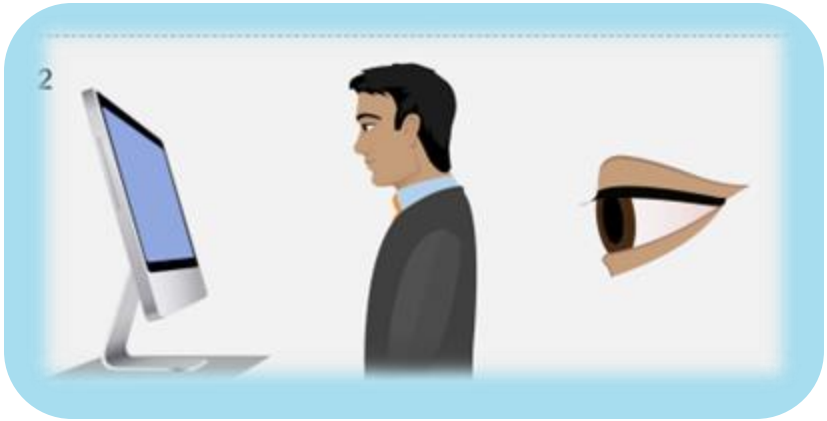
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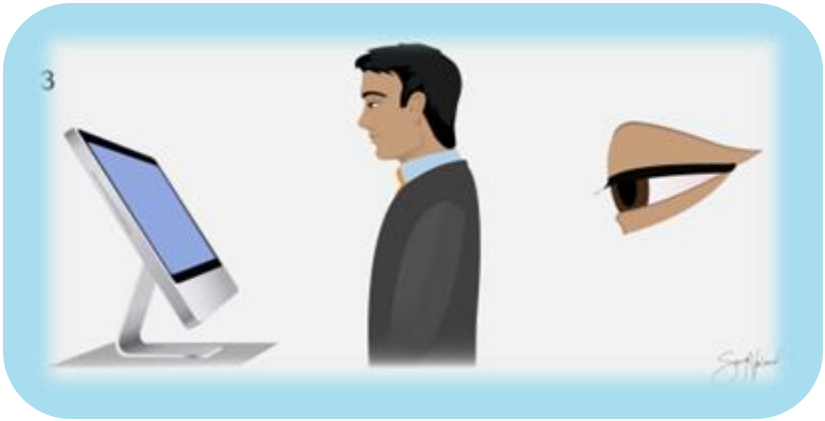
3

20-20-20 Rule

Conclusion

- When possible, students should limit amount of screen time.
- Even short duration has an immediate effect on blink rate and possible dry eyes.
- Screen distance
- Screen size
- Given the ubiquitous use of smartphones by children, future work should examine whether effects persist over a longer term causing cumulative damage to the ocular surface.

Sources of Error

- Small sample size
- Subjects got distracted while doing their tasks
- Human counting error of blinks
- Human variability
- Short testing time
- Measurement error

Future Considerations

- Add more subjects to the experiment
- Measure the effect of working distance and blink rate
- Determine if reading text on a screen vs paper will change the of spontaneous blink rate
- Determine if viewing a static versus a moving object will change the of spontaneous blink rate
- Determine the difference between blink rate for a long time of period compared to a shorter amount of time

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