Resolution of the naked eye

Team Romania

The problem

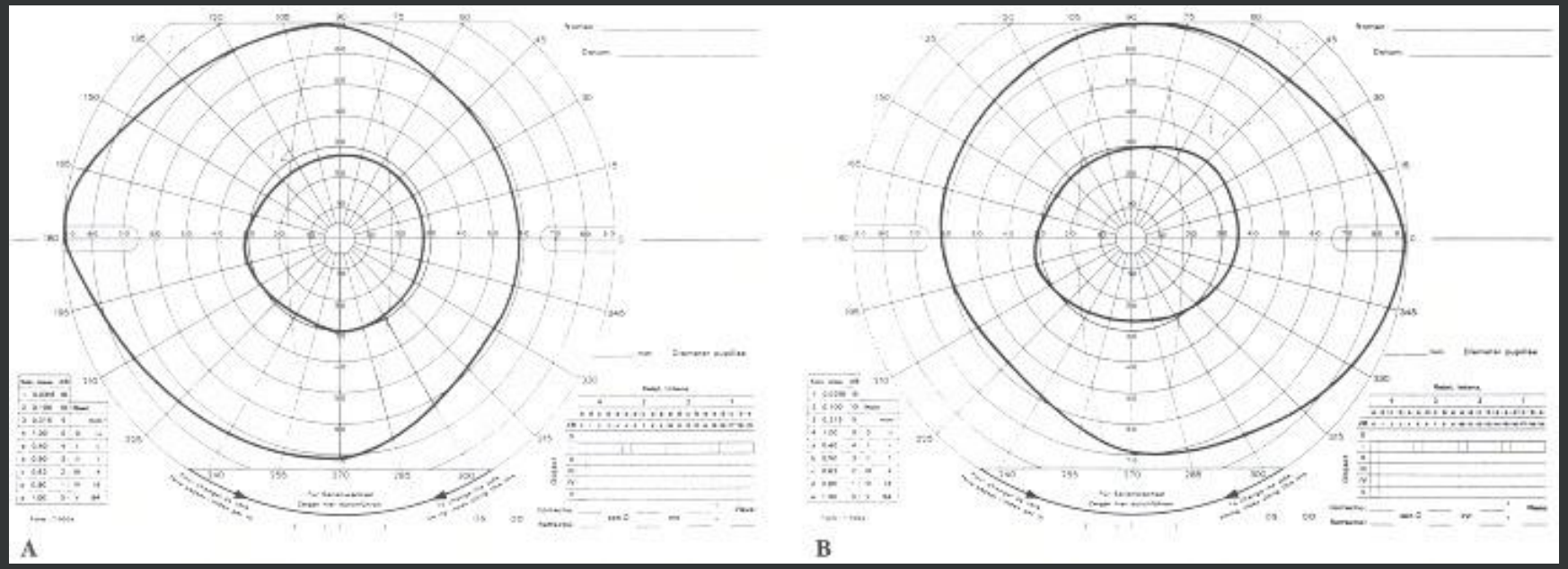
- Introduce one or several parameters to describe angular resolution of an unaided eye. Determine the values of this parameter for each member of your team.

Measuring the FOV of the naked eye

- The field of vision is that portion of space in which objects are visible at the same moment during steady fixation of gaze in one direction.
- The monocular visual field consists of central vision, which includes:

  - the inner 30 degrees of vision and central fixation

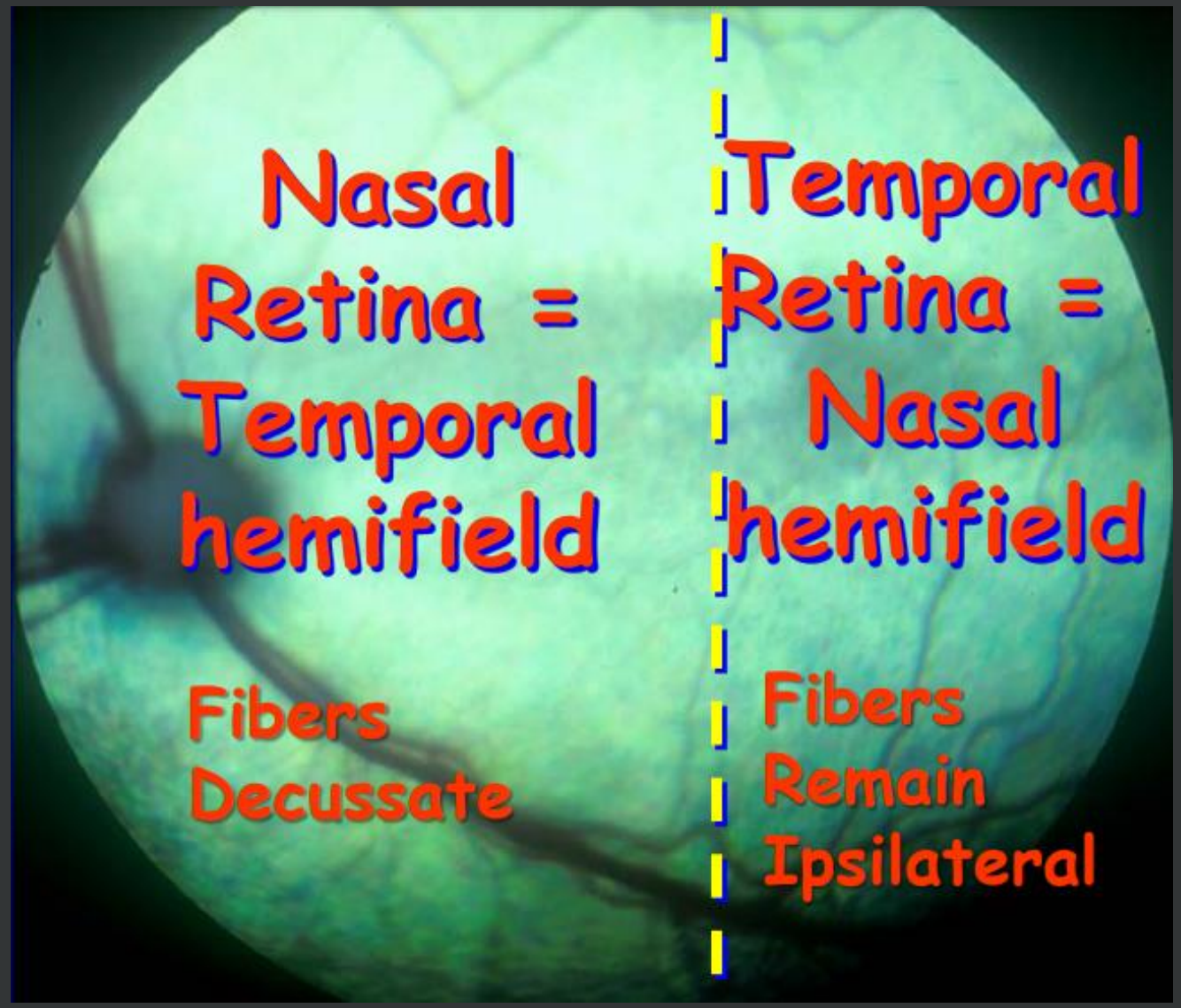
  - and the peripheral visual field, which extends 100 degrees laterally, 60 degrees medially, 60 degrees upward, and 75 degrees downward



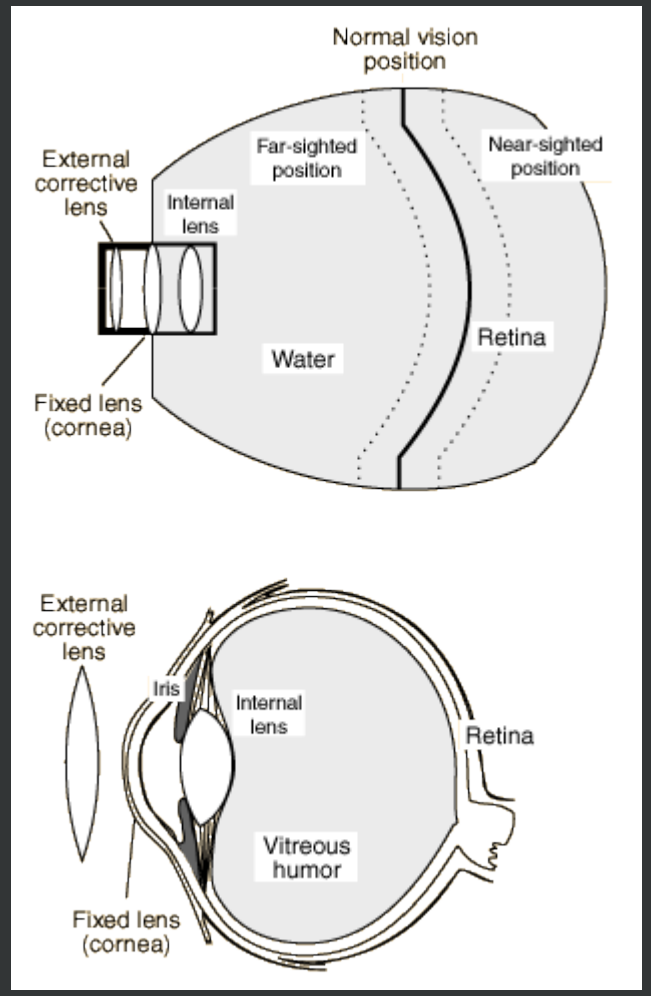
Normal visual field

A normal visual field is an island of vision measuring 90 degrees temporally to central Fixation, 50 degrees superiorly and nasally, and 60 degrees inferiorly. Visual acuity increases from movement discrimination in the extreme peripheral vision to better than 20/20 in the center of vision. Depression or absence of vision anywhere in the island of vision is abnormal

- *A vertical line bisects central fixation and divides the visual field into a nasal and temporal hemifield.*
- Situated in the temporal hemifield is the normal blind spot approximately **12 to 17 degrees from fixation** and **1.5 degrees below the horizontal meridian**.
- The **blindspot** is represented on a visual field chart by an absolute scotoma and corresponds anatomically to the scleral canal through which the retinal nerve fibers leave the eye at the optic disk.



Eye as a convergent lens



Since the eye is a convergent lens, any image that enters the eye at an angle is formed at another point of the focal plane of the cornea. Since the image does not form on the retina directly, it will be perceived as blurry.

Malformations in the eye

- Nearsightedness (**myopia**) is a common vision condition in which you can see objects near to you clearly, but objects farther away are blurry. It occurs when the shape of your eye causes light rays to bend (refract) incorrectly, focusing images in front of your retina instead of on your retina
- Hypermetropia, sometimes called hyperopia, is the term used to define being longsighted.
- If you are hypermetropic, the image of a nearby object is formed behind the retina. This means that light is focused too far back in the eye, causing things which are close up to appear blurred.

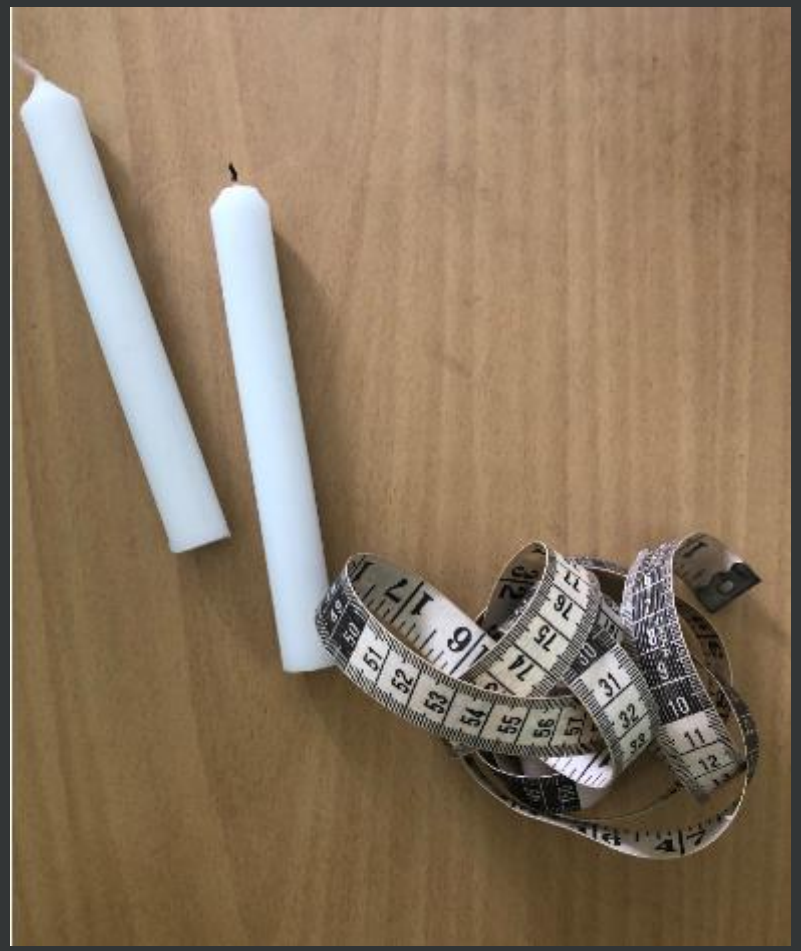
The experiment #1

- We wanted to test the limits of the human peripheral vision and the zone that is perceived as detailed.

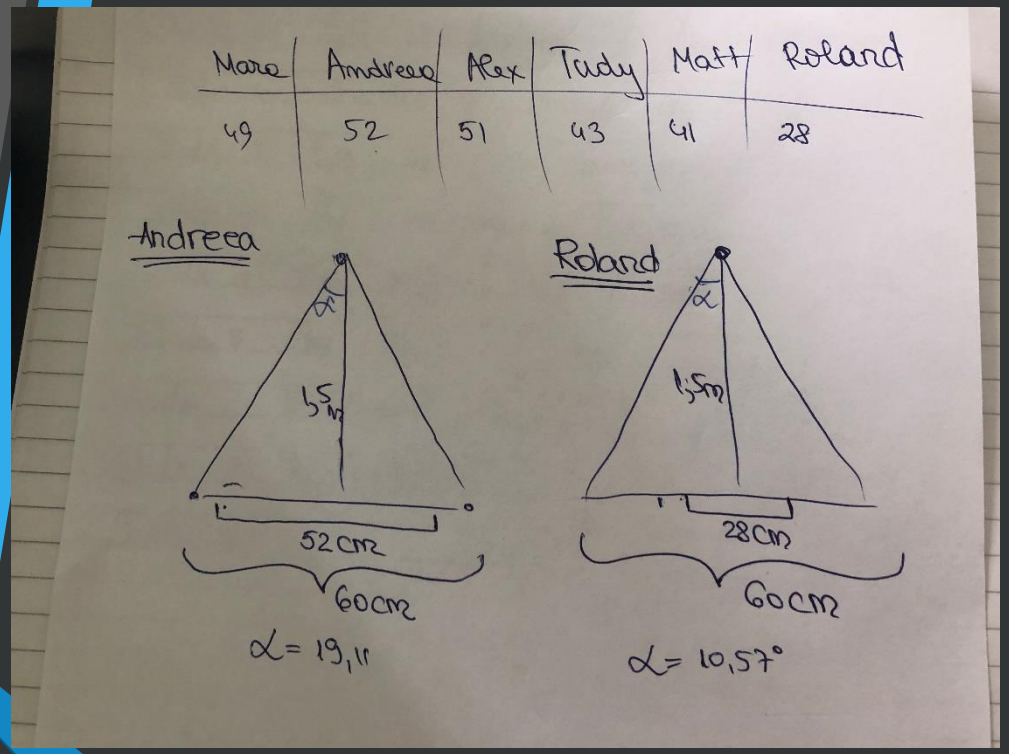
Execution of the experiment

- First we placed two of our team members at a distance of 1.5 meters away from each other.
- One of them looked at the other on the bridge of the nose while the second one was moving candles around to provide for the angle of the clear vision.
- We repeated this experiment for all team members twice.

Setup



Results



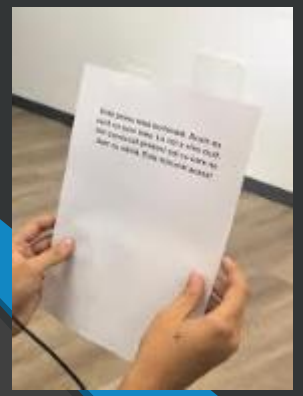
- On average the angle we got was about 120 degrees for 2 of our team members and we got 130 for the other 2 team members that were tested.
- Primary sources point to the fact that on average the FOV of a human should be 135 degrees.
- We believe that our results were lower due to 2 main factors.

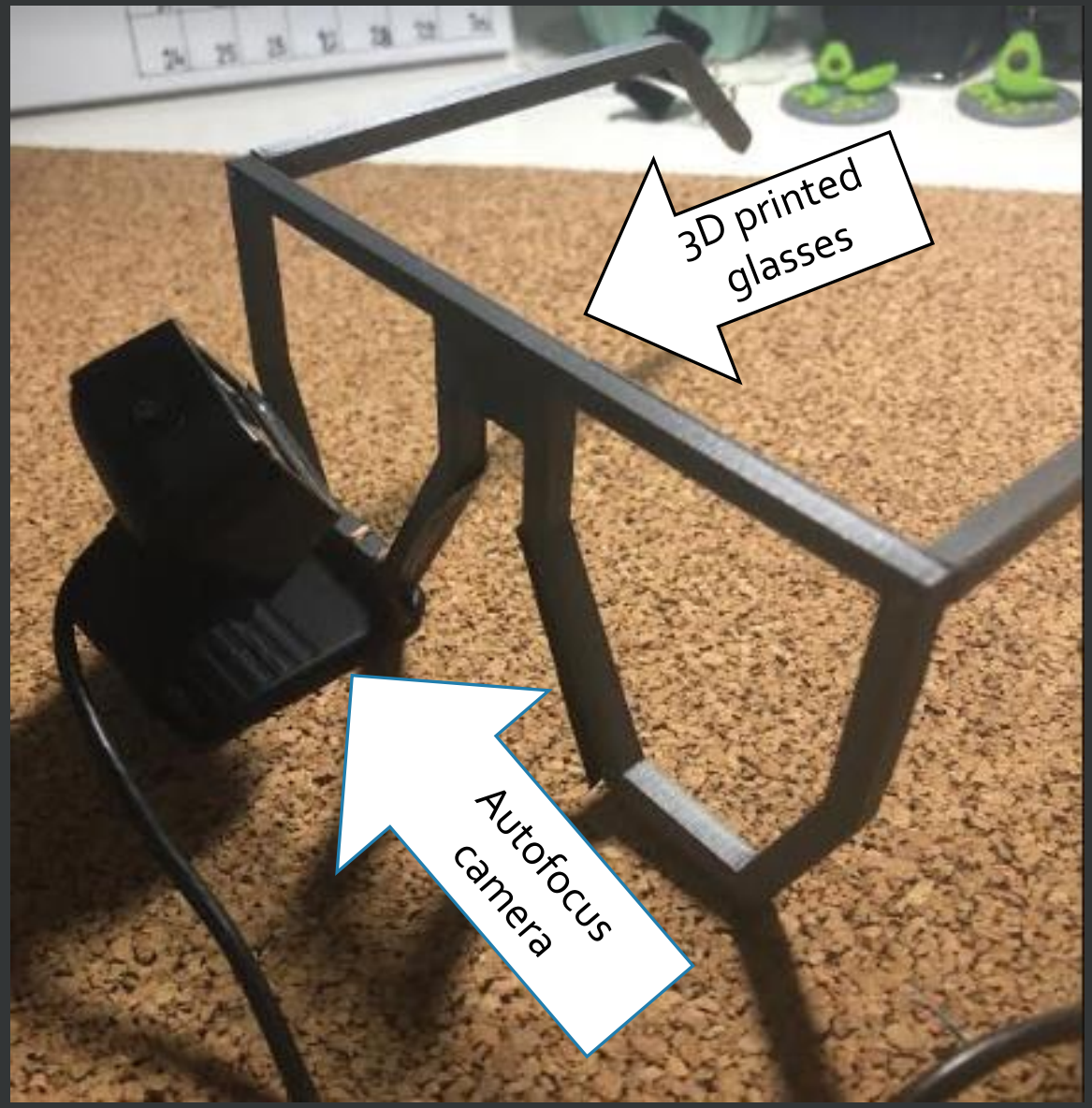
Causes of error

- The 2 main factors that skewed the results of our presentation is the fact that we are not fully developed yet. Perhaps some changes to the body in the future could impact it.
- Triangulation errors when it came to actually measuring it.
- The fact that the results are slightly subjective.
- It is also worth noting that 2 of the tested subjects has myopia.

Equipment and props

- Autofocus camera attached to 3D printed glasses
- Computer
- Soft(Cvmob, AMCAP, Kinoveea)
- Different images or written texts





Experiment #2

Reading experiment

- For this experiment we asked people with different ages to read 3 different passages with the eye tracker glasses on
- The passages had 3 levels of difficulty:
- ✓ The first one had very common words and simple phrases
- ✓ The second one had an average level of difficulty
- ✓ The third one was composed of metaphors and less common phrases

Results:

The teenager (15 years):

- Read the fastest the easiest passage (5.5 seconds)
- Was ranked the second at the medium difficulty text
- Had trouble reading the last paragraph; skiped words that he did not understand

Results:

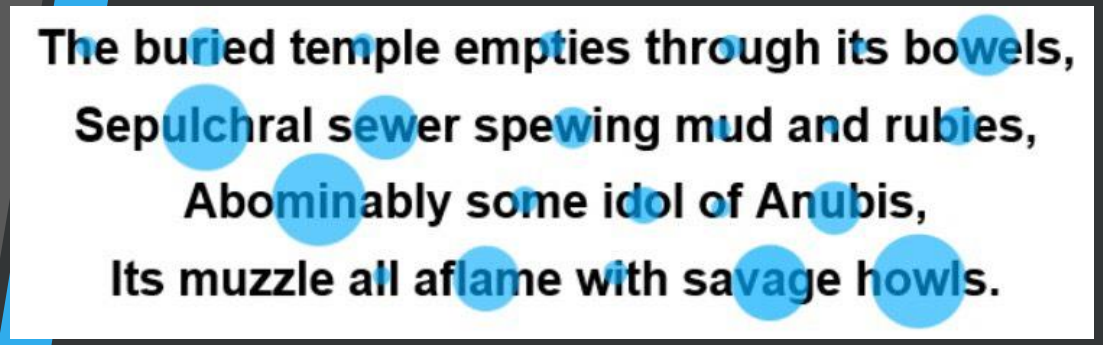
- ***The adult (45 years):***
  - Was ranked the second at the easiest text
  - Read the fastest the medium difficulty paragraph
  - Also had difficulties reading the last passage but understood and read it faster than the teenager due to a more developed vocabulary and knowledge

Results:

- ***The senior (75 years):***
  - Had the same results as the adult at the easiest text
  - Read pretty fast the second paragraph, but had some minor pauses during the reading sessions and also blinked rally often, fact that might have caused some errors
  - Was ranked first at reading the hardest passage

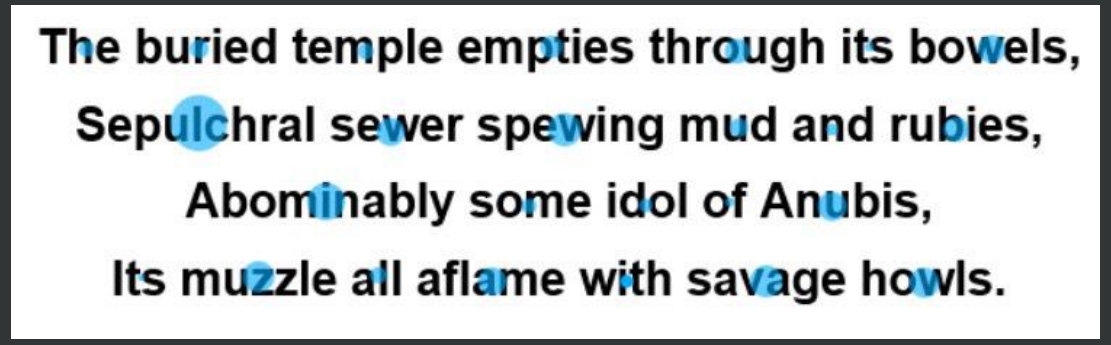
Some comparisons between the reading of the subjects

Teenager reading the hardest paragraph

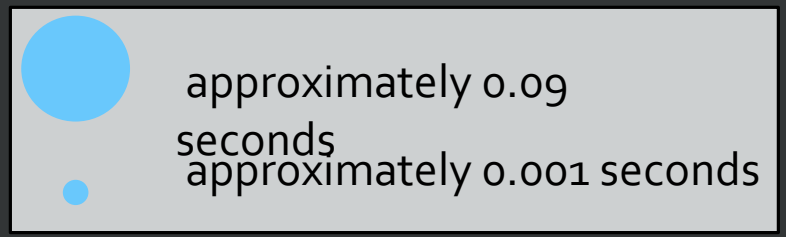


The teenager skipped some words

Senior reading the hardest paragraph



Note: The bigger the circle, the more the subject stopped to red that particular word



Conclusions

- From the first experiment we can conclude that on average the human eye can see about 120 degrees, out of which 30 degrees can be seen clearly. (Despite our prediction being 130 degrees)
- From the second experiment we can conclude the fact that on average the parts of the paragraph that are on the side, are slightly harder to read and it will take longer to read.

Thank you!