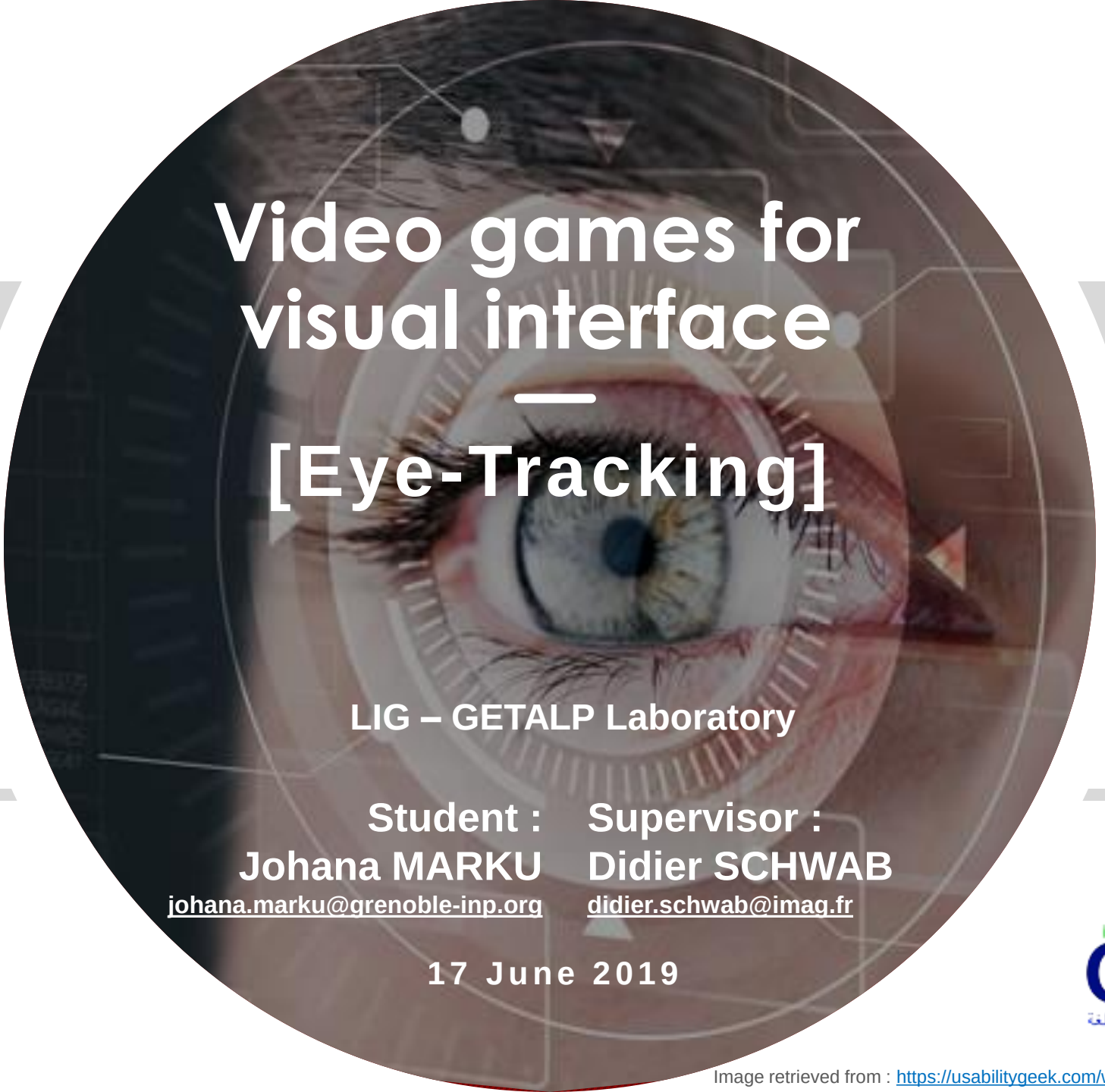
Video games for visual interface

—

[Eye-Tracking]



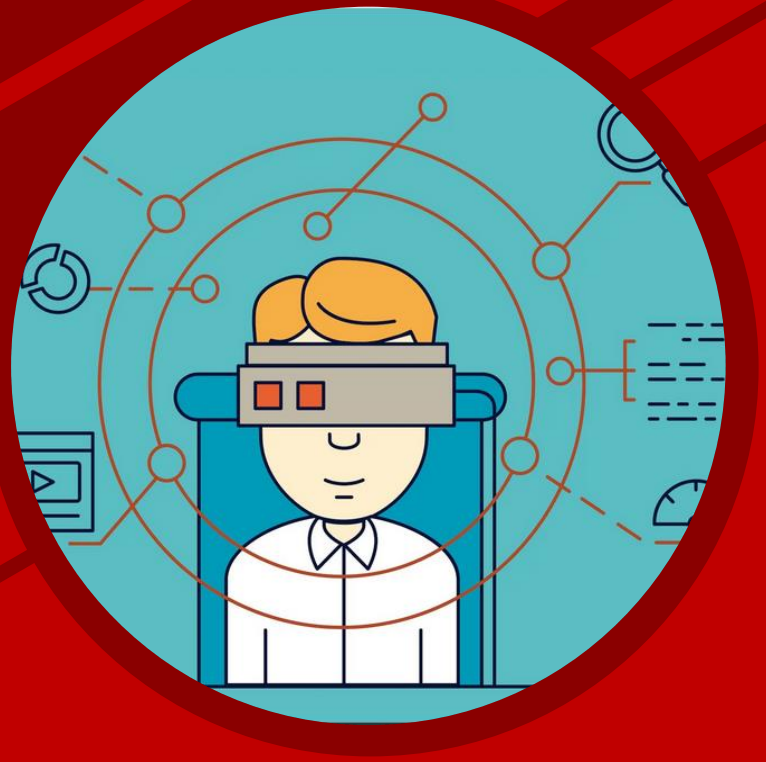
LIG – GETALP Laboratory

Student :
Johana MARKU
johana.marku@grenoble-inp.org

Supervisor :
Didier SCHWAB
didier.schwab@imag.fr

17 June 2019

Image retrieved from : https://usabilitygeek.com/what-is-eye-tracking-when-to-use-it/ (15 Jun 2019)

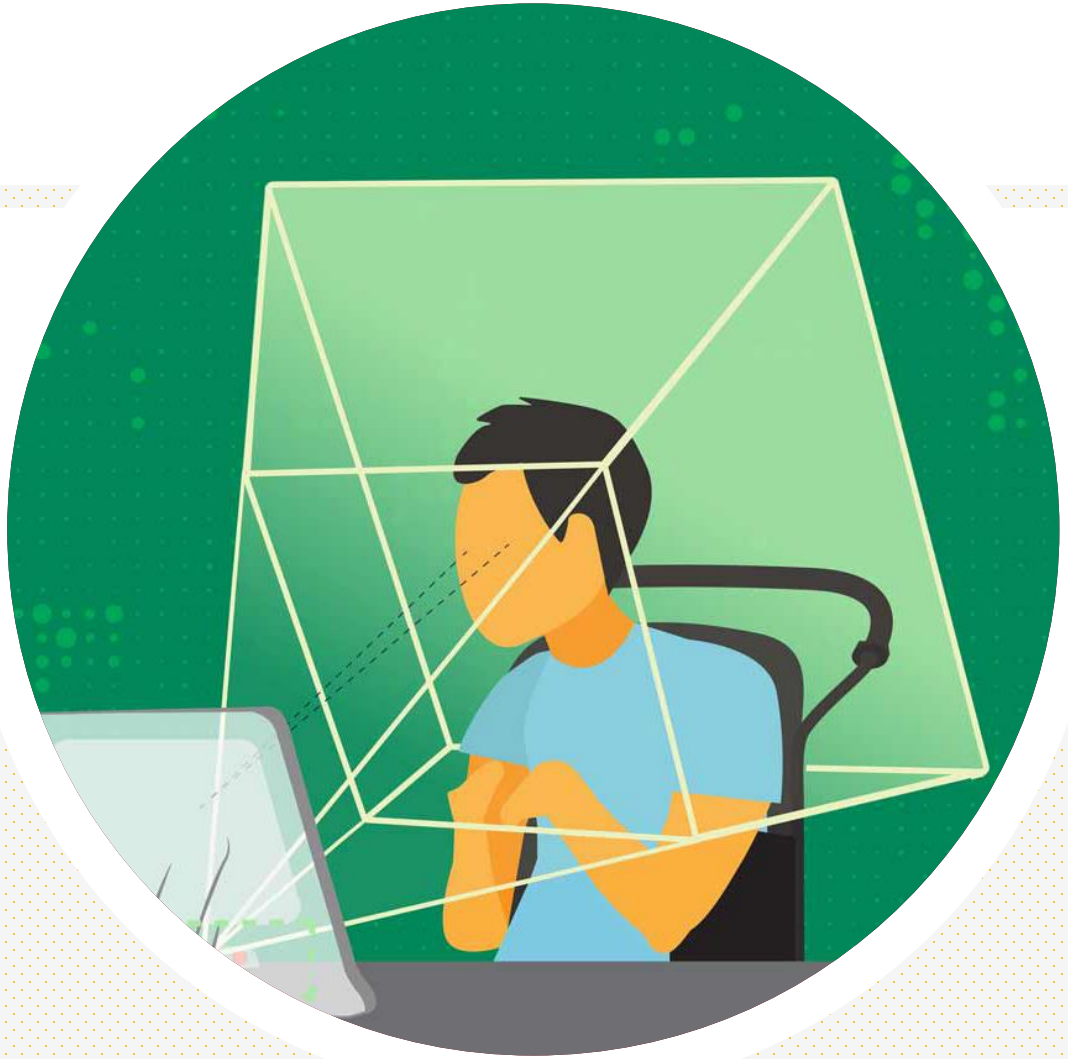


OVERVIEW

1. Introduction
2. Learning through Video-Games
3. Eye-Tracking metrics
4. Focus on Scanpaths
5. Conclusions

Image retrieved from : https://www.impactbnd.com/blog/eye-tracking-software (15 Jun 2019)

Image retrieved from : https://www.tobiidynavox.com/about/about-us/how-eye-tracking-works/ (15 Jun 2019)



Introduction

Why are we interested in eye-tracking ?

Eye-trackers = Aided Augmentative and Alternative Communication (AAC)

GOAL :
Provide a communication medium for children with multiple disabilities.

Gazing

=

one of the most natural ways for perception and interaction

Eye – trackers

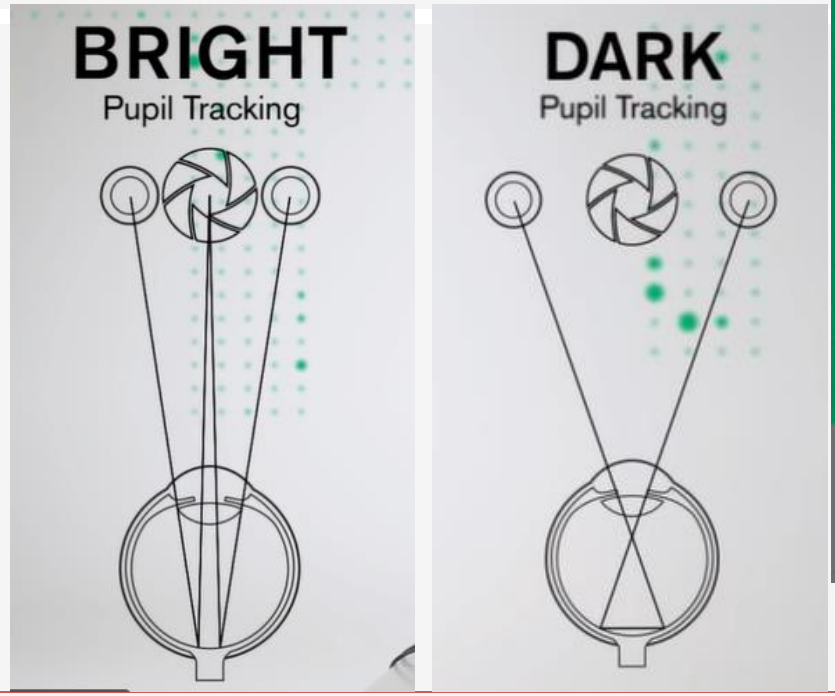
=

device for measuring eye position and movement .

Image retrieved from : https://www.trustedreviews.com/reviews/tobii-eye-tracker-4c (15 Jun 2019)

How does an eye-tracker work?

An **eye-tracker** is basically an **infrared camera** that provides raw **coordinates** from which it is possible to estimate **eye-movement**.



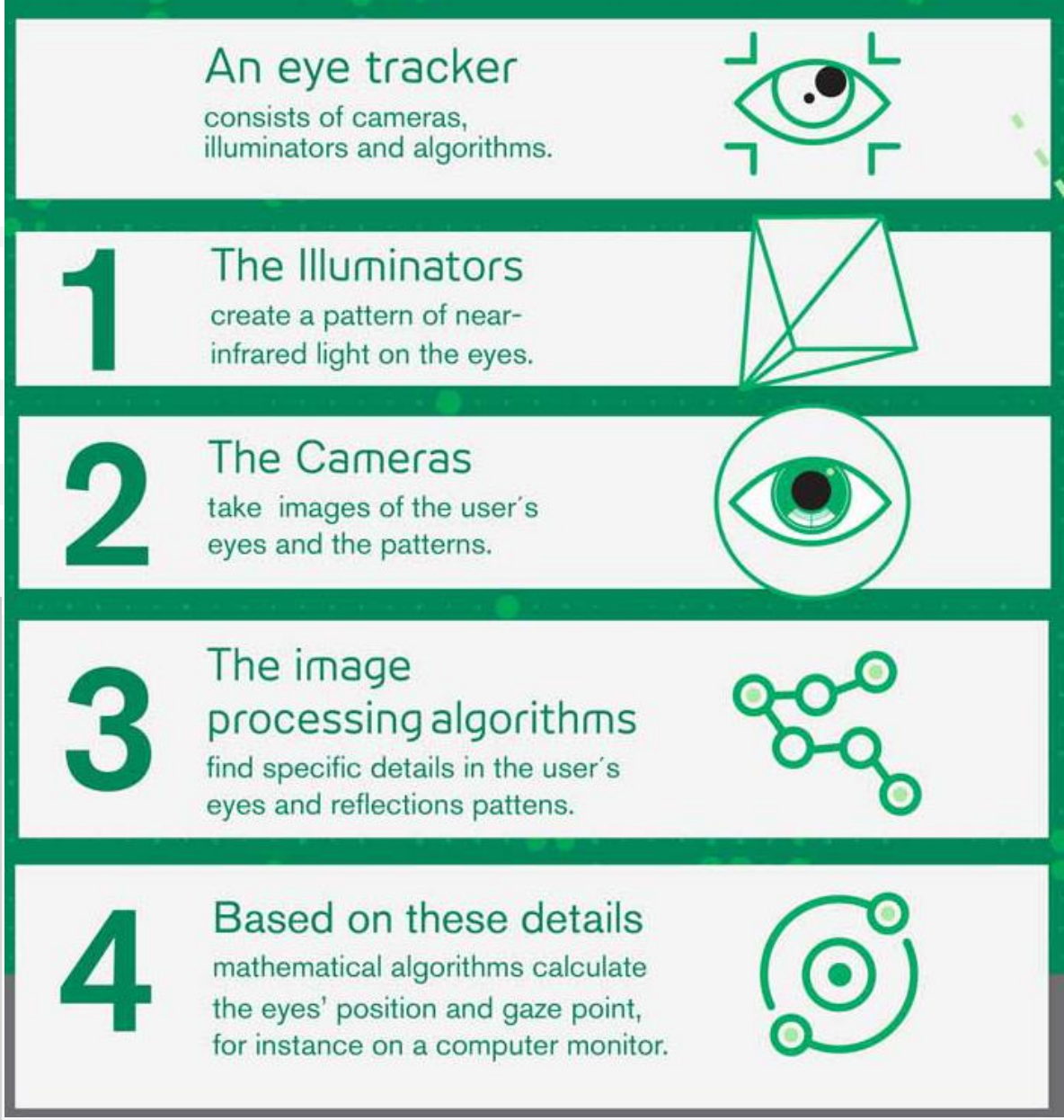


Image retrieved from : https://www.tobiidynavox.com/about/about-us/how-eye-tracking-works/ (16 Jun 2019)

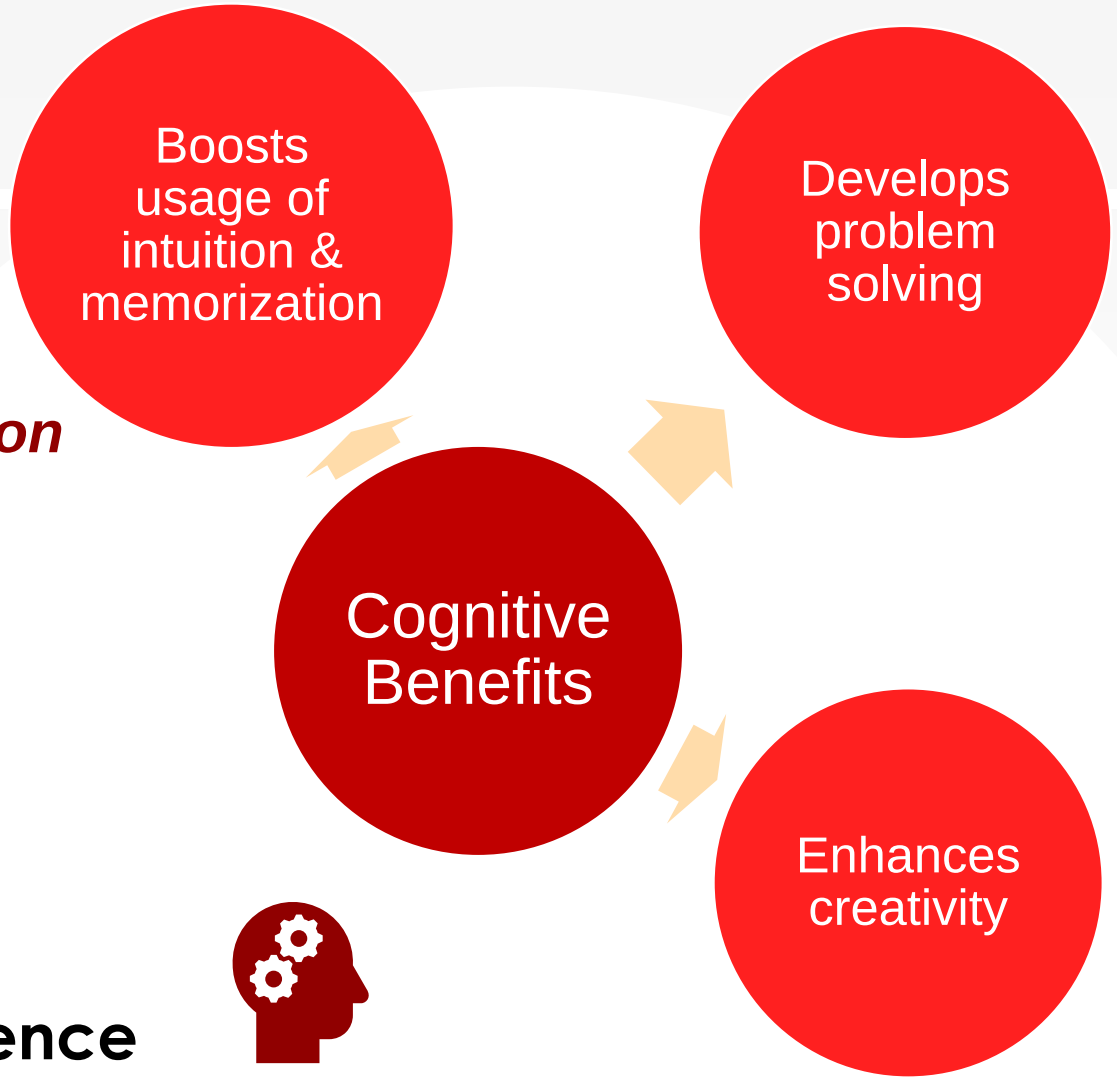
Screenshot of GazePlay home screen

Learning through video games

GazePlay

Why video- games ?

- Make learning **fun**
- Serious games = designed for training and ***education***
- Advancements in Neural Processing and Efficiency
- Keep the **motivation** & interest alive



“

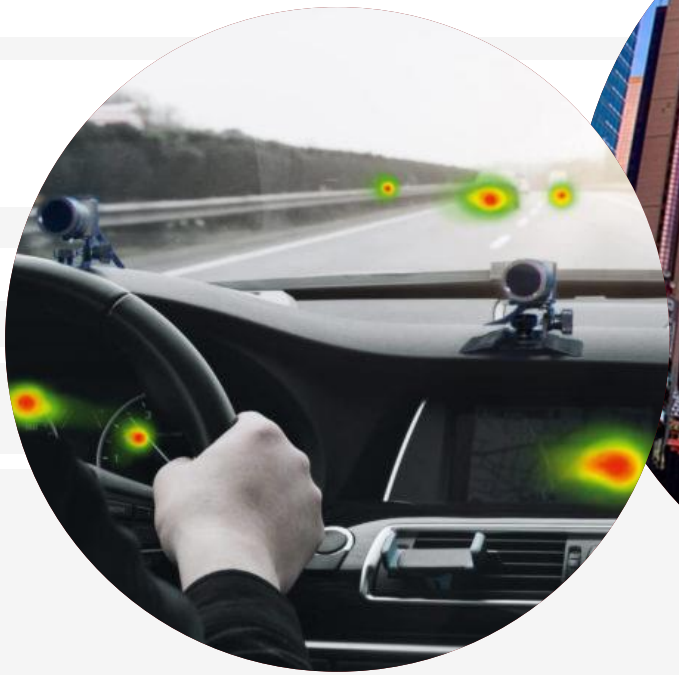
Incremental Theory of Intelligence

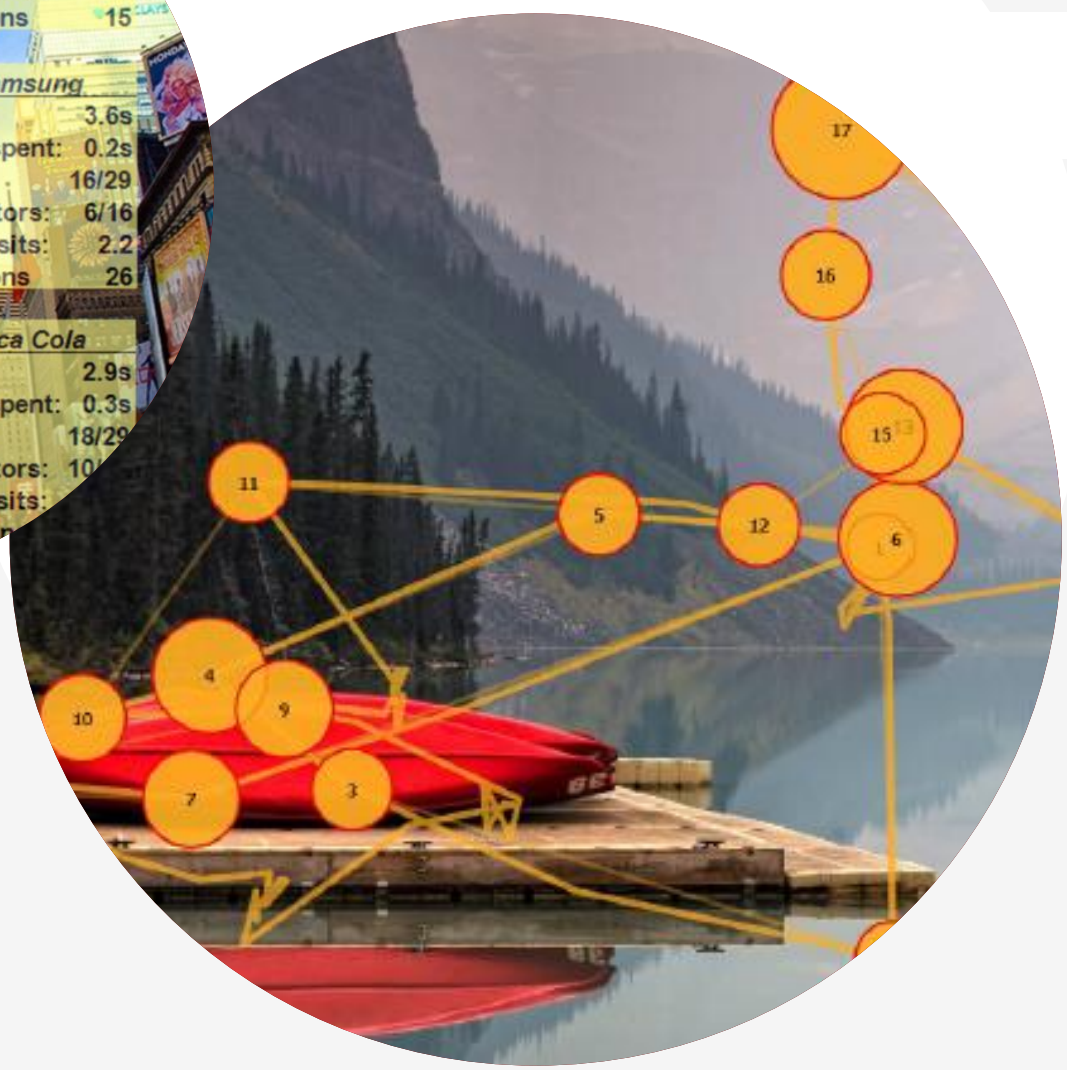
- free and open-source
- 45+ mini-games
- playable with an eye-tracker

…compatible with all eye-trackers which can control the mouse cursor…

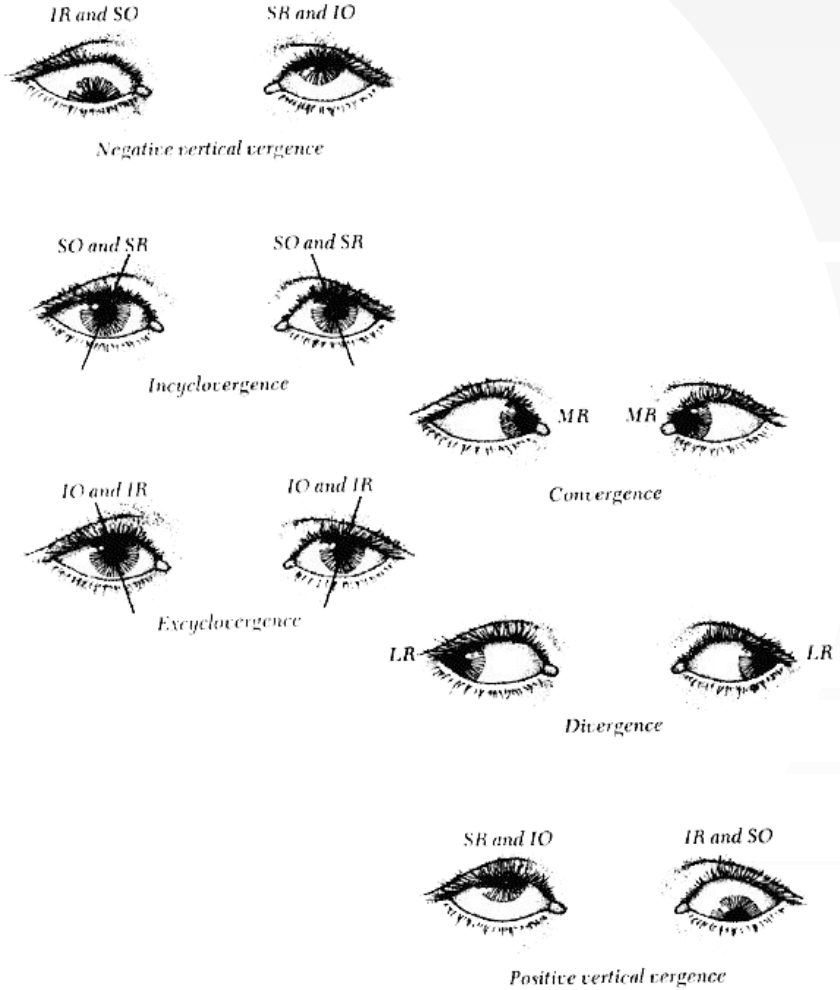
*…develop a skill from this set : **Action-Reaction**, **Memorization** and **Selection/Target**.*

Images retrieved from : https://imotions.com/blog/7-terms-metrics-eye-tracking/ (16 Jun 2019)





Eye- Tracking metrics



OCULOGRAPHY

- Eye-tracking / (oculography) is a research method
- Growth due to emergence of numerous **eye-tracking applications**

Diagnostic

Interactive

- SE researchers use eye-tracking for the study of **cognitive processes** and **efforts** of SE tasks.

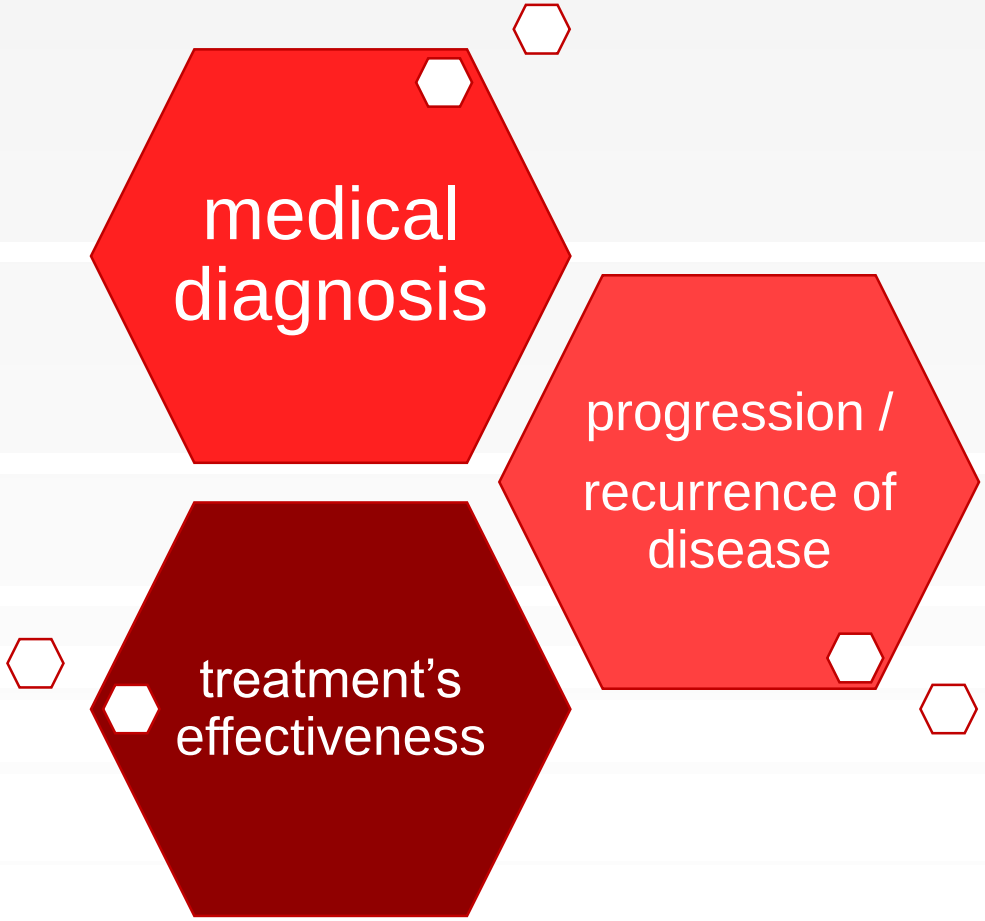
Image retrieved from : http://canacopegdl.com/keyword/eye-convergence.html (16 Jun 2019)

Terminology

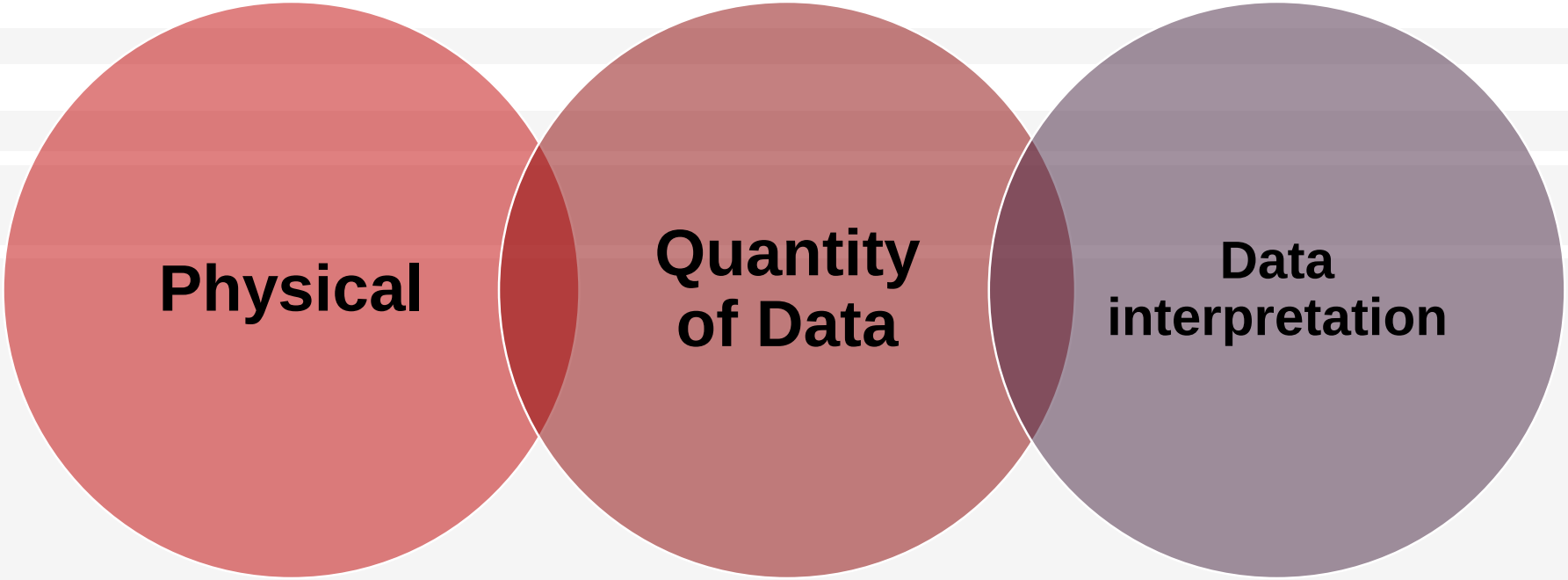
- **Fixation** - **Stabilization** of the eye on a stimuli for a period (200-300 ms).
- **Saccade** - The **quick and continuous** eye movements from one fixation to another. (within 40-50 ms)
- **Pupil Dilation** - **Widening** of the pupil, that allows more light to get into the eye.
- **Scanpath** - Series of fixations in chronological order that represents a user's **pattern of eye movements**.

Important tool in Medicine

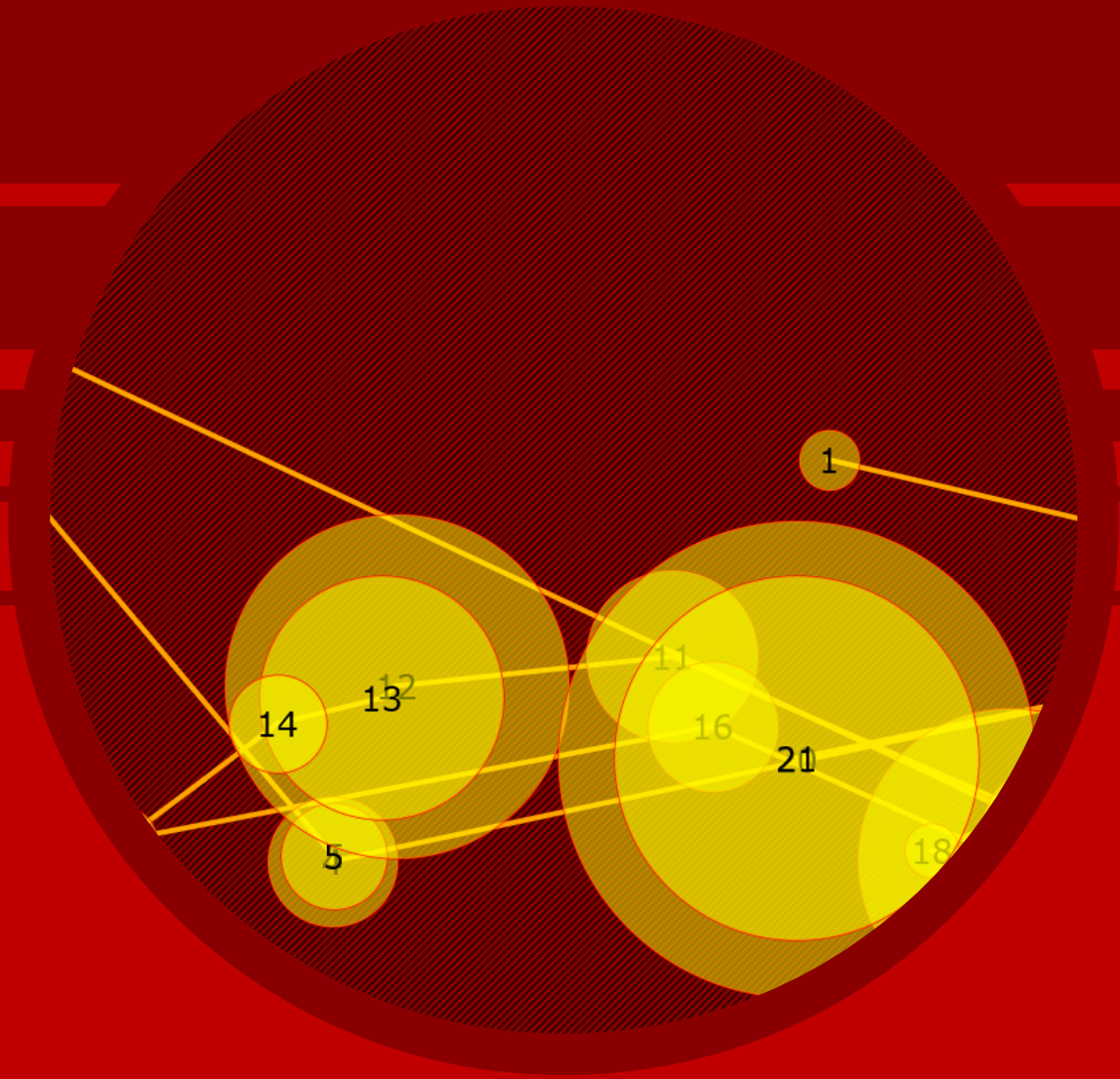
- **Long fixation duration** is correlated with *high cognitive workload* and *higher cognitive effort.*
- The **saccadic latency** metrics allows to detect *Parkinson* disease.
- Diagnose *neural disorders* - **anti-saccadic** task.
- Problems with maintaining **smooth pursuit** eye movement might indicate *schizophrenia*, *autism*, *Alzheimer* disease or *Parkinson* disease.



Issues with eye-tracking



Focus on Scanpaths



Scanpath output from GazePlay

What is a scanpath ?

Eye movement data collected by a gaze-tracking device, where information about the **trajectories**(paths) of the eyes is preserved.

Such data consists of ***gaze-direction***, ***fixation*** position and duration, and ***saccade*** duration.

Through scanpaths it is possible to give insight into the ***cognitive load*** required to navigate an interface for specific users.

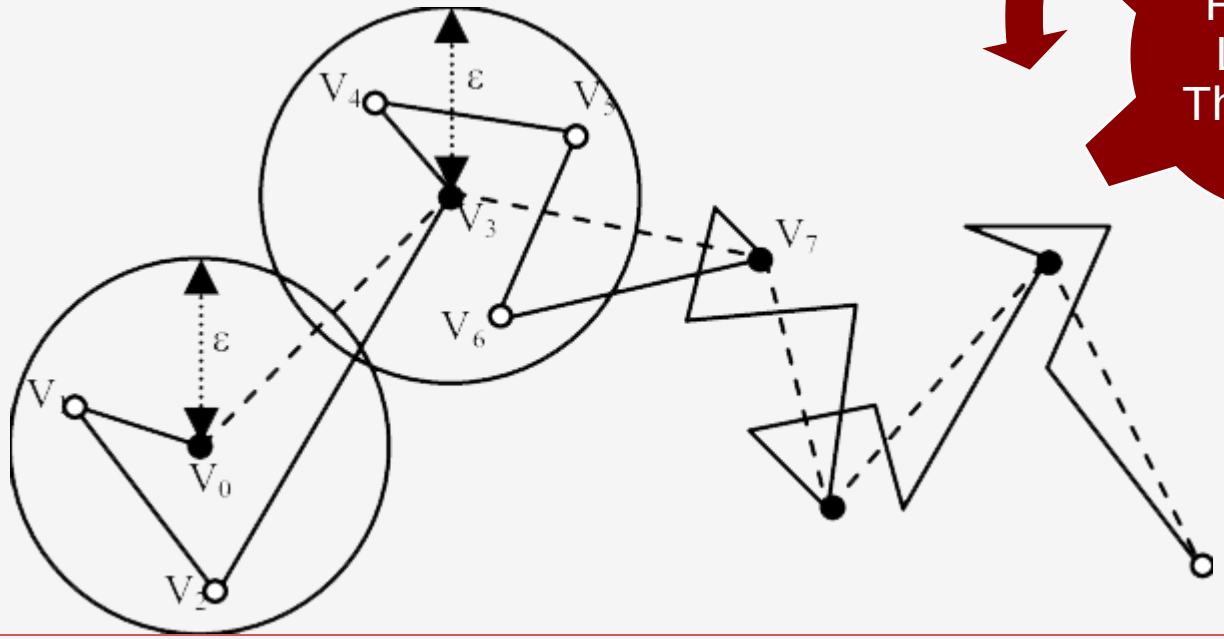
Incorrect and imprecise data retrieval due to :

- Unintentional and unconscious eye movements
- Distracting events
- Individual factors
- Environmental factors
- HW & SW

Implementation into GazePlay

Data Structure

- X , Y coordinates
- First Gaze Time
- Gaze Duration



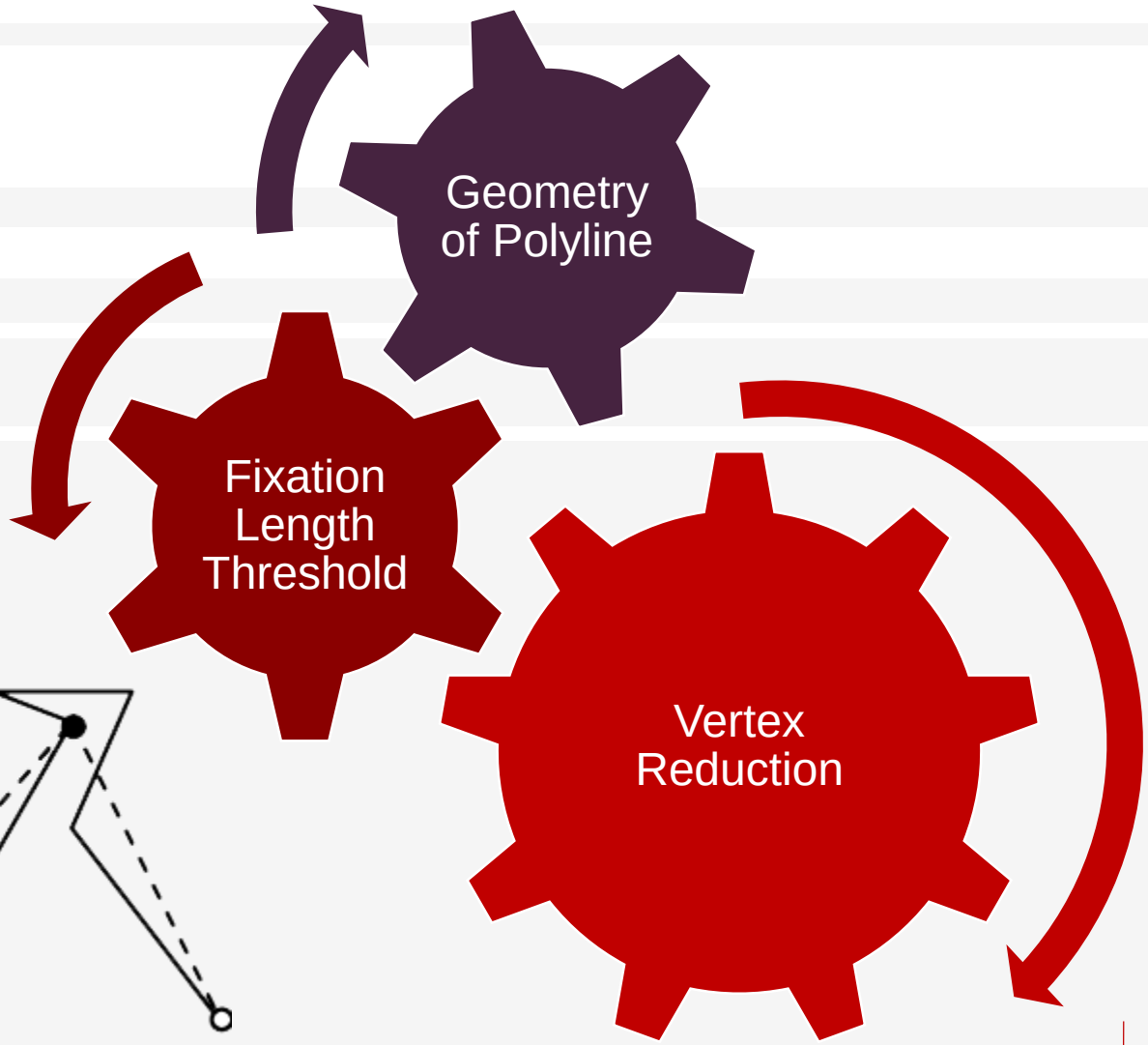
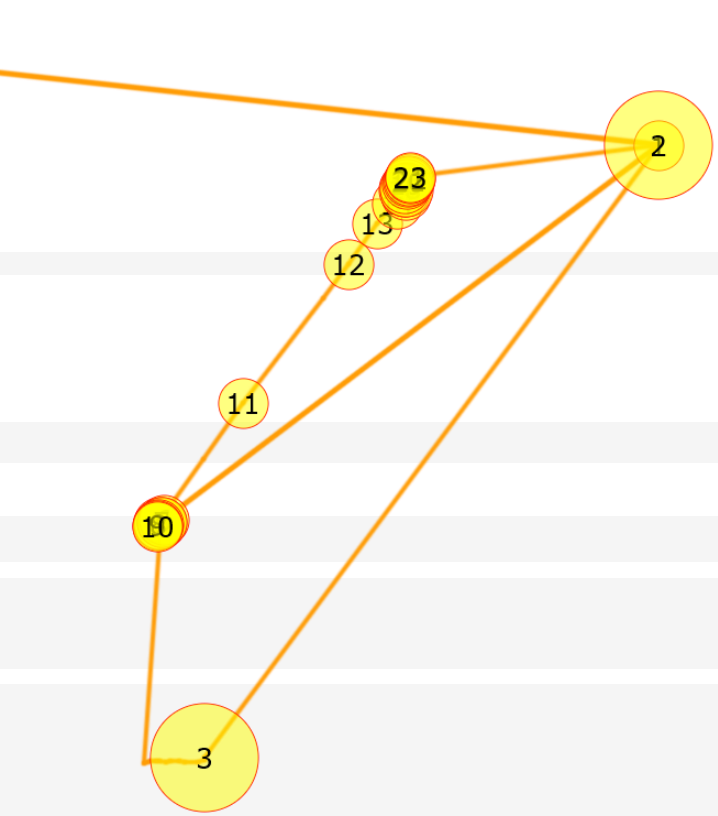
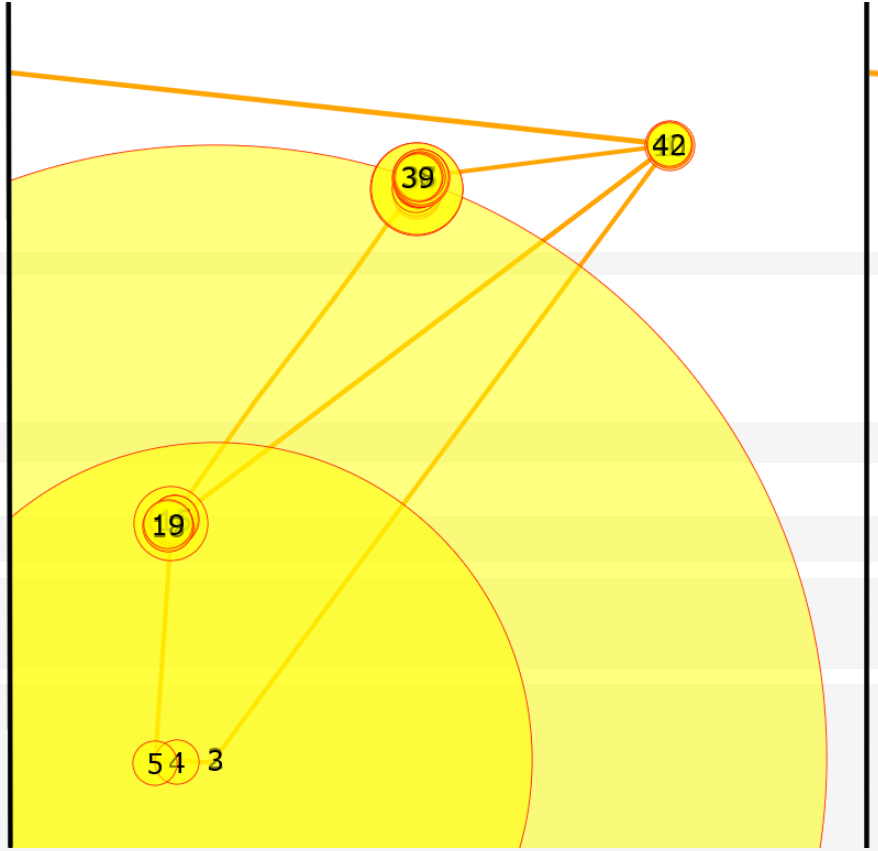


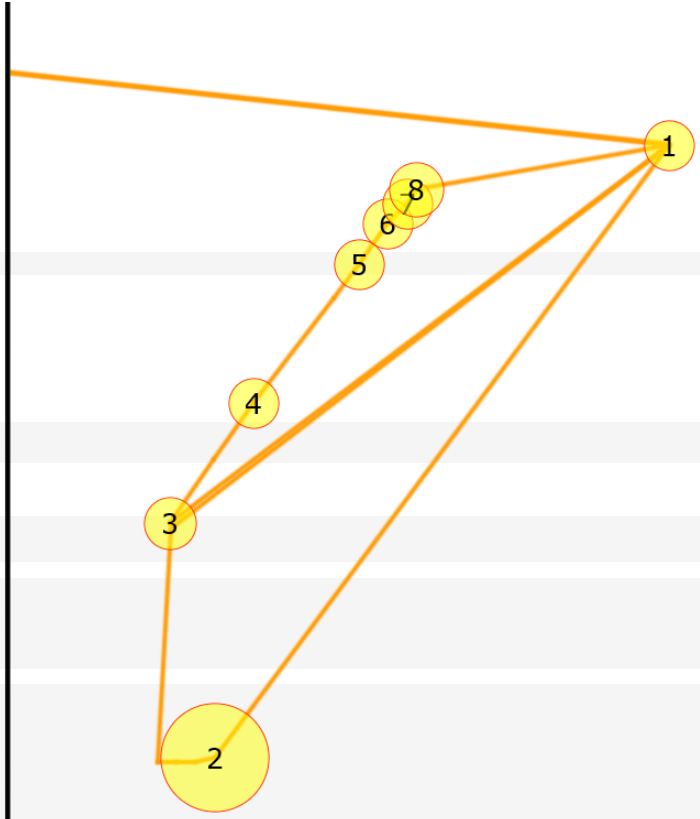
Image retrieved from : https://www.researchgate.net/figure/Vertex-Reduction-used-for-Simplification-This-is-a-fast-first-order-On-algorithm-It_fig9_215664869 (16 Jun 2019)



Geometry of Polyline

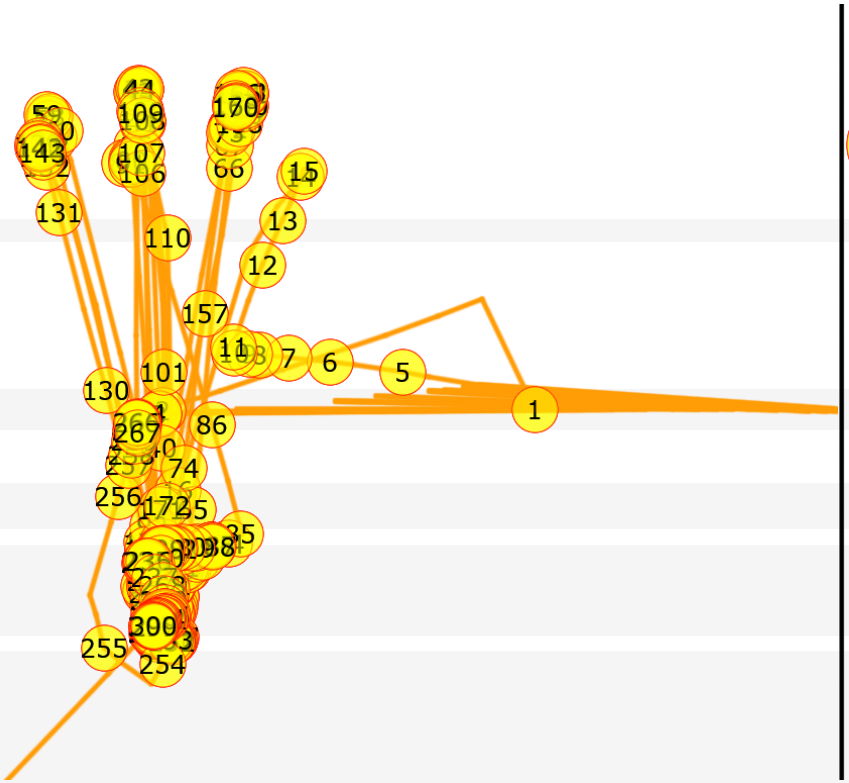


Fixation Length Threshold

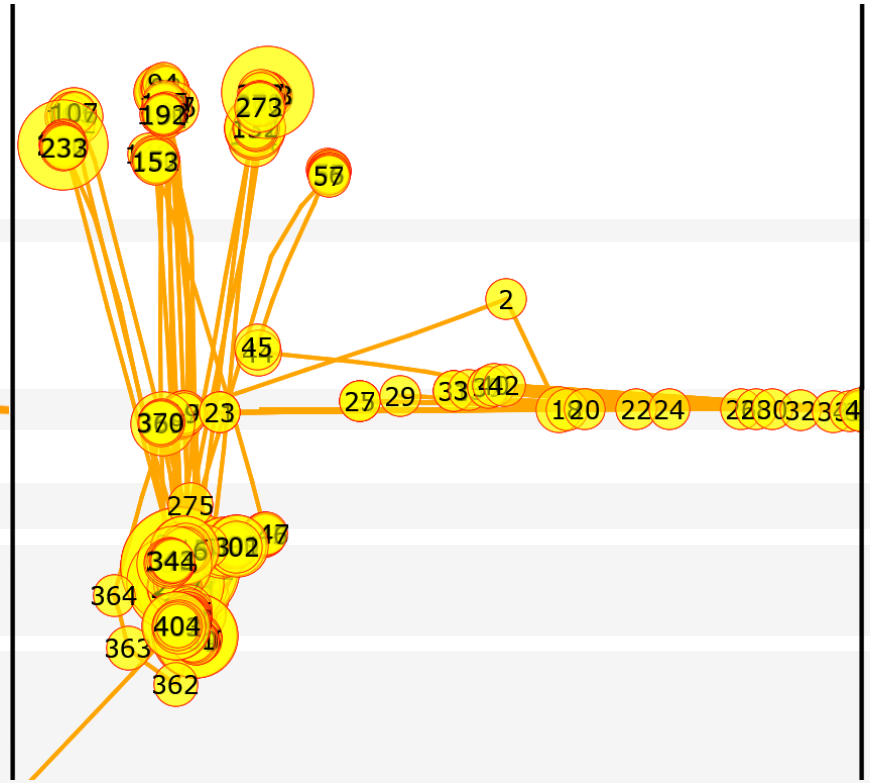


Vertex Reduction

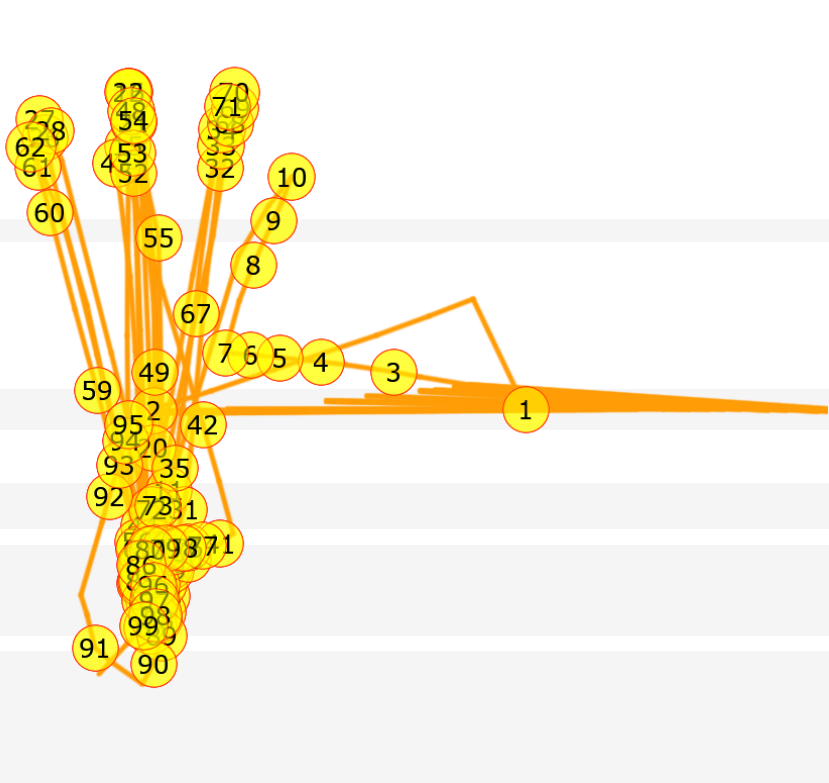
Game = Where is the animal?
Playtime =10.9s
Eye-tracker = Tobii 4C



Geometry of Polyline



Fixation Length Threshold



Vertex Reduction

Game = Piano
Playtime =11s
Eye-tracker = Tobii 4C

Conclusions

- Eye-tracking for enriching the possibilities of interaction
- Power of cognitive learning through video-games and eye-tracking
- Scanpath as an important metric
- Limitations of scanpaths
- Improvement of our implementation
- Comparative algorithms for gaze pattern recognition

Image is output of GazePlay after “Bubbles” playtime

THANK YOU!

Questions?