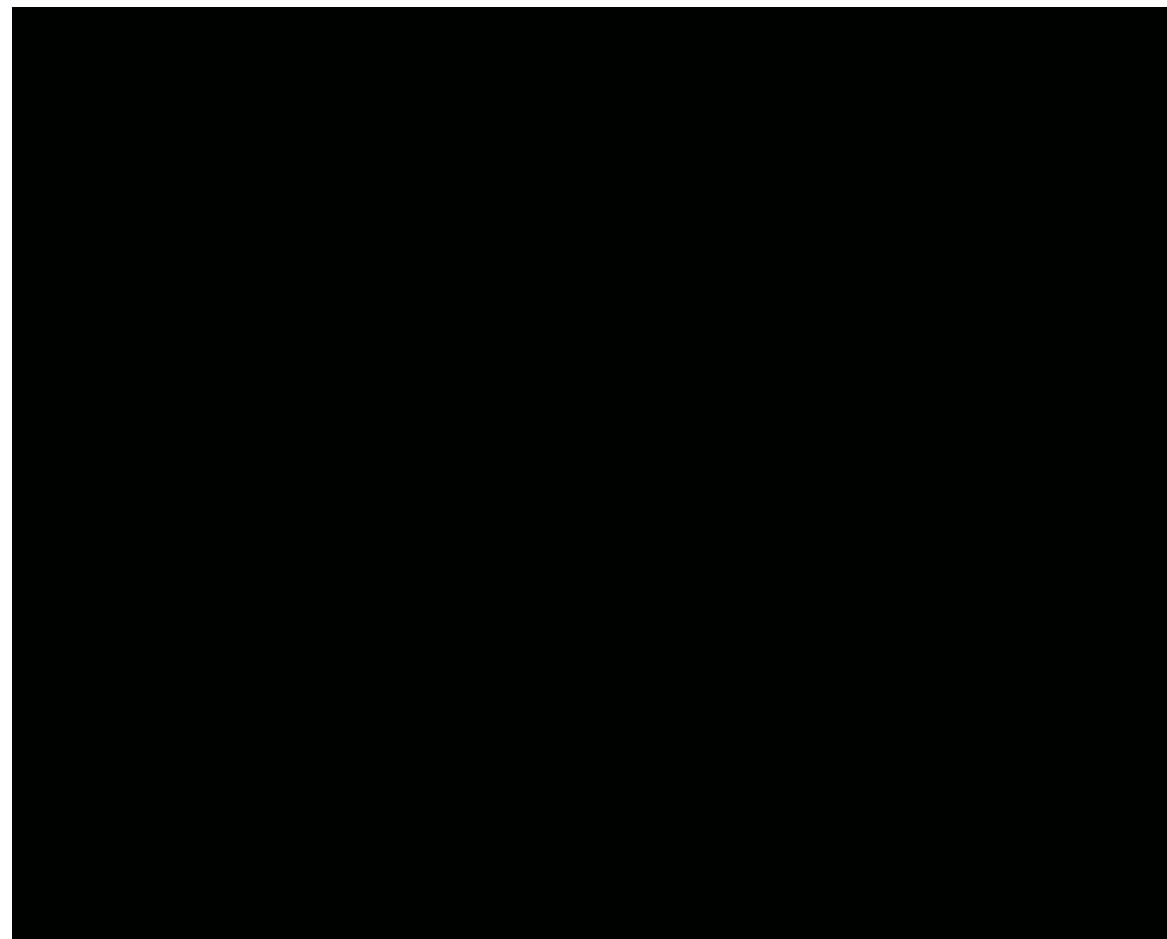


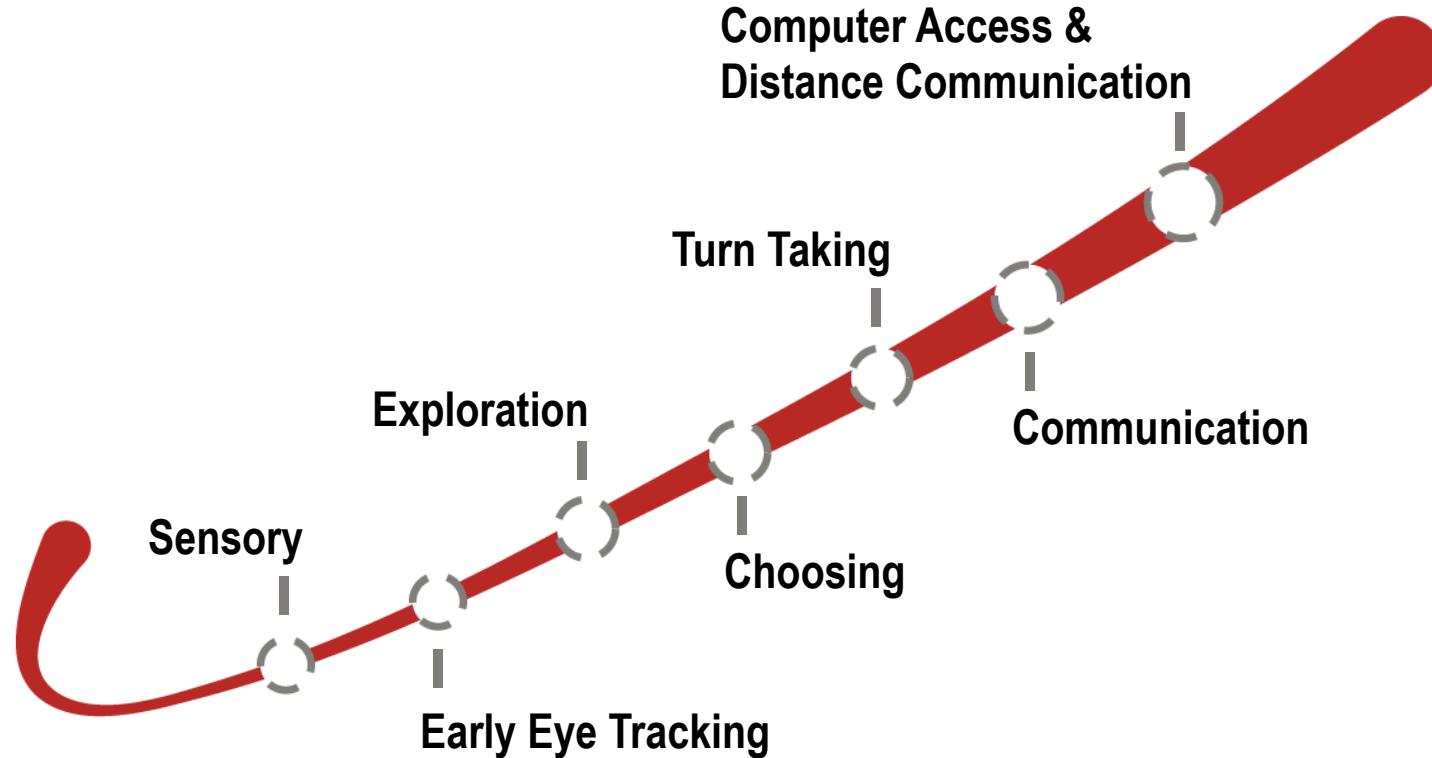
Introducing "The Tobii Assistive Technology Eye Gaze Learning Curve" and why!

Hector Minto
Tobii Technology AB





The Tobii Eye Gaze Learning Curve



History of eye control/eye tracking in SEN

- Successfully used by individuals with specific control need
- Specifically adopted by those with a communication need
- High cost and high tech
- Generally issued following extended, expensive assessment process
- Often owned by the SLT

The history of Tobii – 10 years of eye tracking and business innovation



Tobii1750



First product,
Tobii ET-17

First assistive
product,
MyTobii
D10



First eye controlled
computer, MyTobii
P10



Tobii T60, T120, X120 and
Tobii Studio



Tobii C8, C12, Ceye
Sono Key, Sono Lexis



Tobii T60XL



Tobii Glasses



Tobii S32 and
SymbolMate



Tobii-Lenovo
laptop prototype



Tobii TX300



Tobii PC Eye



Sono Primo

2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
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Tobii is founded by John Elvesjö, Mårten Skogö and Henrik Eskilsson

Tobii Inc,
USA

Tobii GmbH,
Germany

Tobii Japan

Tobii China

EyeTrackShop

Acquires Viking Software, Norway

Acquires Assistive Technology, Inc

First sold system

First profitable year

Raises 11 M€ funding

Raises 16 M€ funding

And.....what's coming?



What is eye tracking?

- We see what you're seeing!
- We know what you're thinking/processing!
- We can monitor your eye movements in real time



What is eye control?

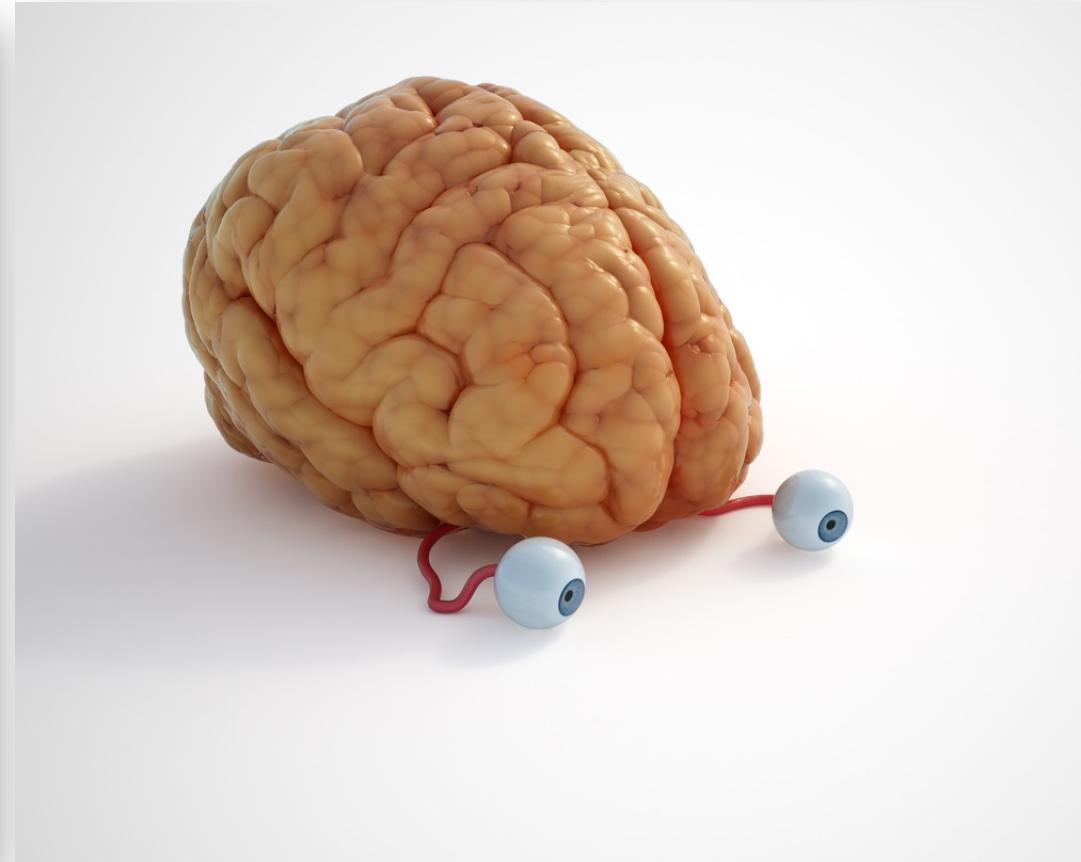
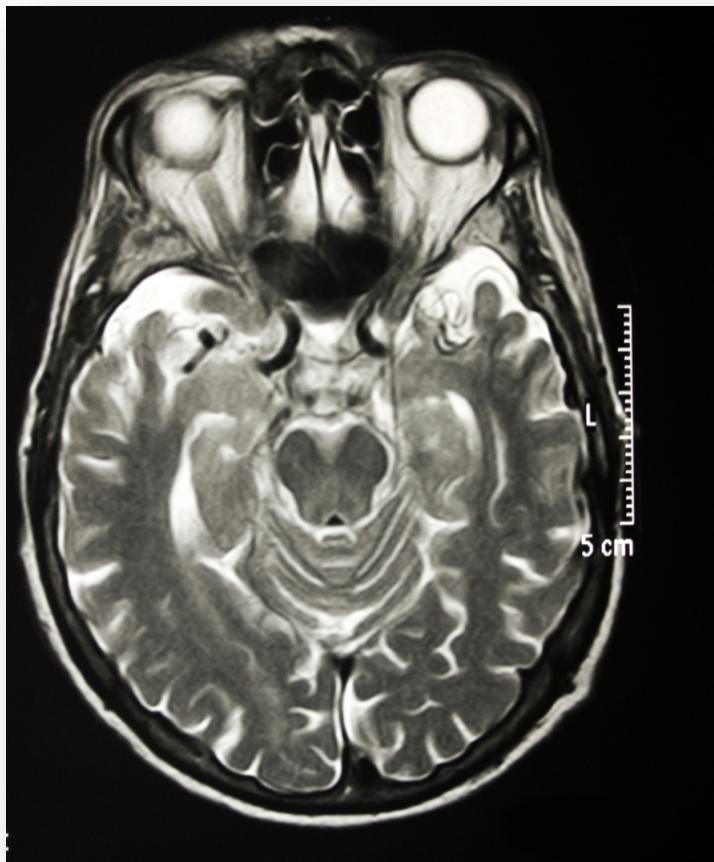
- Your eyes become your mouse!
 -regardless of head position
 -without needing to lock down precisely

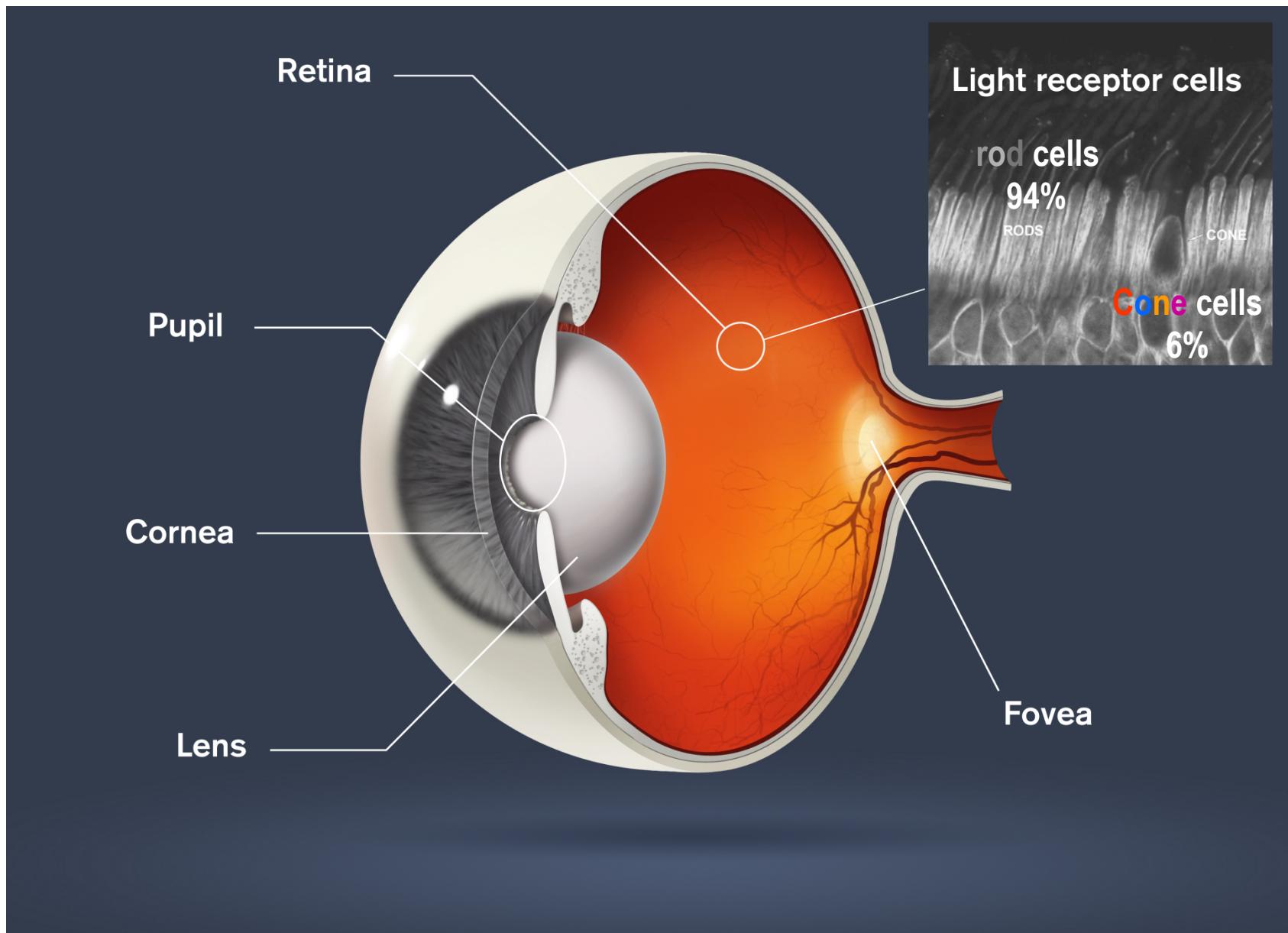
Eyegaze is a simplified method of eye control (Tobii enablement)

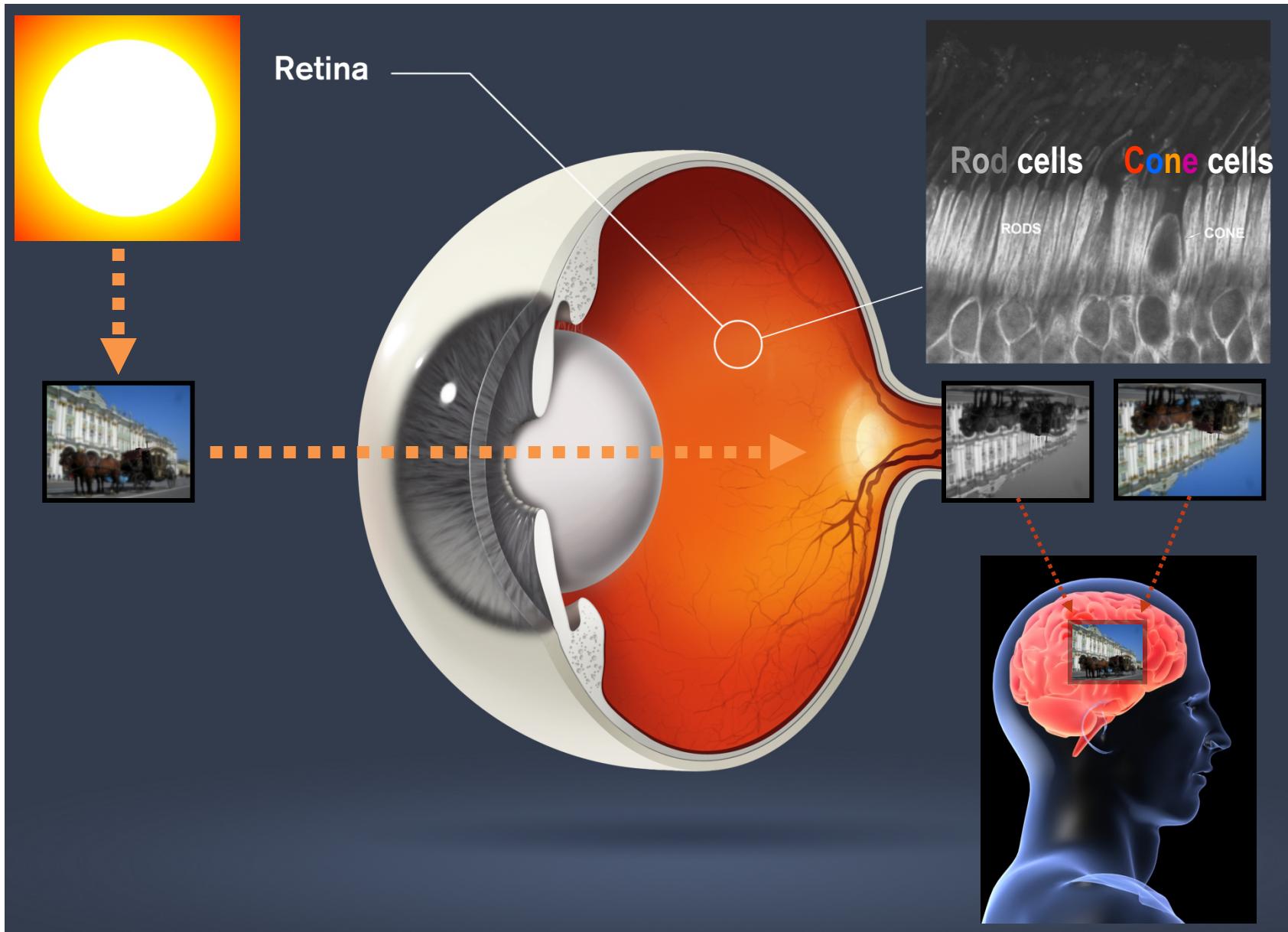
What is NOT eye control?

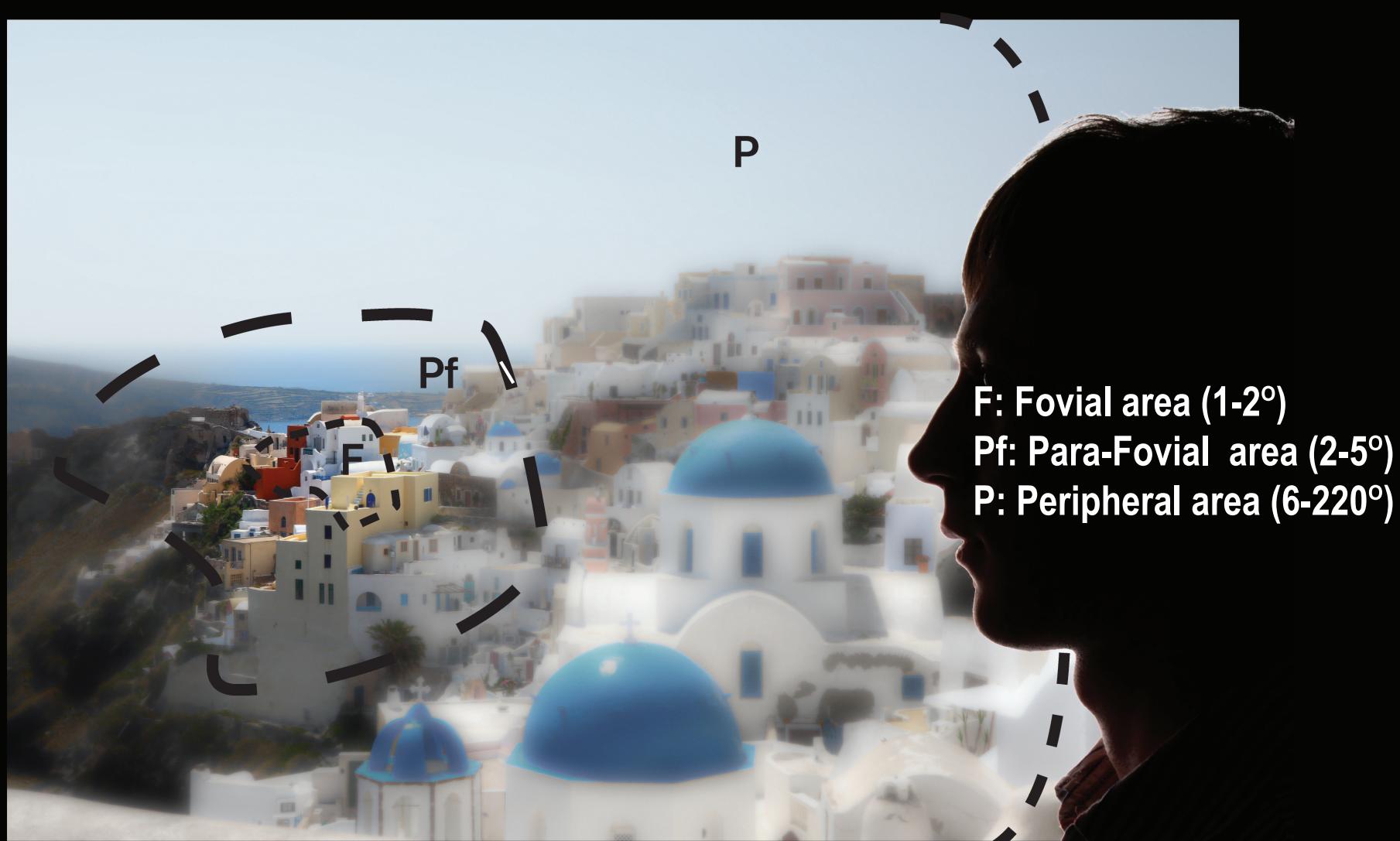
- Nose, head, eyeball, face tracking, facemouse
- Head or face trackers are relative positioning systems
- The user must understand the relative position of the cursor vs their head to adjust
- Far lower cost!

Our eyes are the mirrors of our soul (brain)









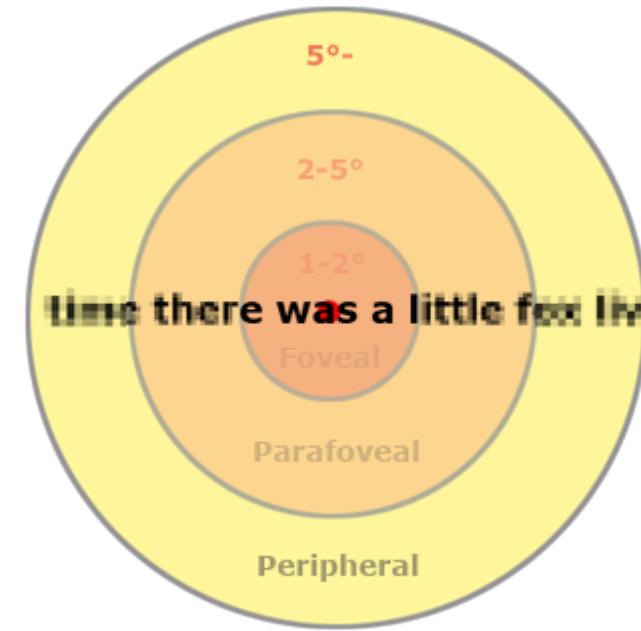
F: Fovial area ($1-2^\circ$)

Pf: Para-Fovial area ($2-5^\circ$)

P: Peripheral area ($6-220^\circ$)

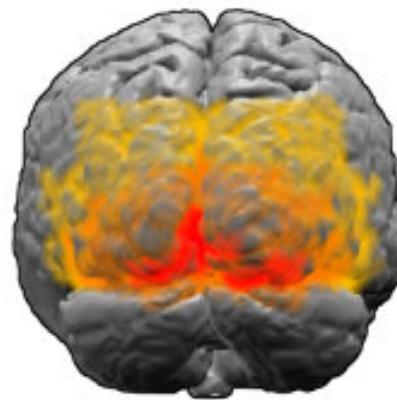
What do we see?

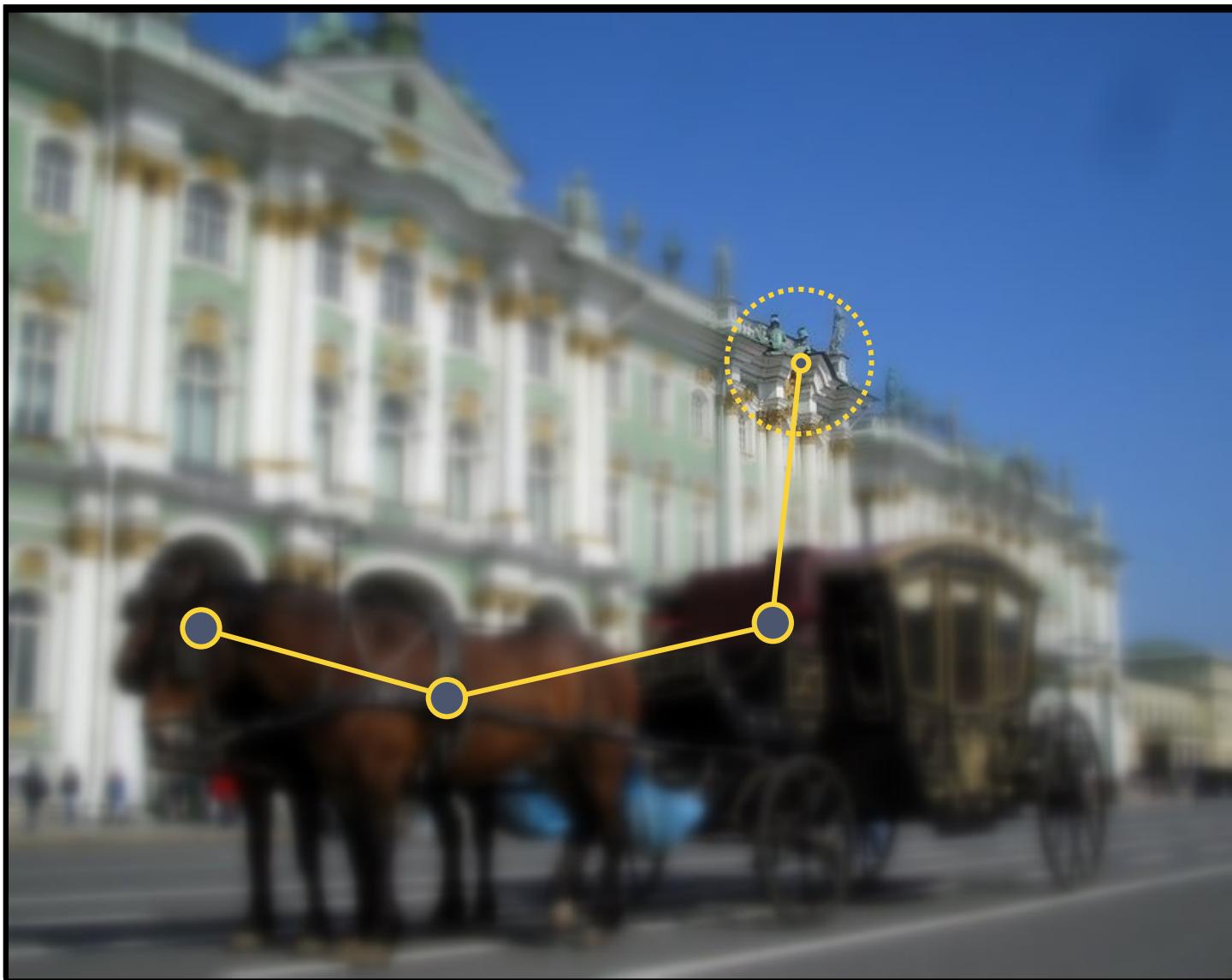
- The human visual field = 220°
- The $1-2^\circ$ area of foveal vision is about the size of a thumbnail at an arms length distance
- Only foveal vision is trackable

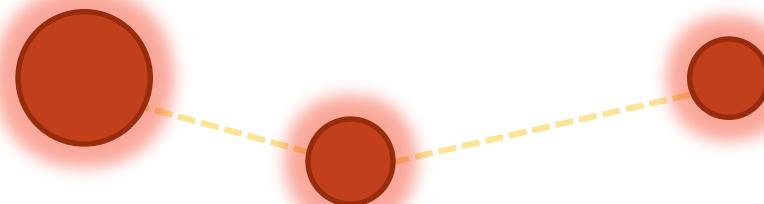


What do we see?

- The fovea is less than 1% of the retina but takes up over 99% of the visual cortex in the brain.
- Peripheral vision is mainly good at picking up movements and contrasts

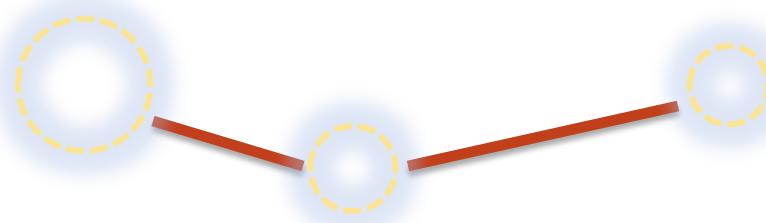






Fixations

- The fixation lengths varies from about 100 to 600 milliseconds, during this stop the brain starts to process the visual information received from the eyes.
- All the information from the scene is (mainly) acquired during fixations.
- Typical fixation frequency is < 3 Hz
- The length of a fixation is usually an indication of information processing or cognitive activities.
- Common words get shorter fixations than less common words



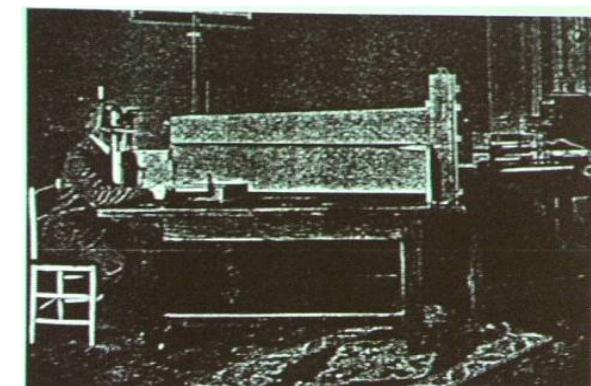
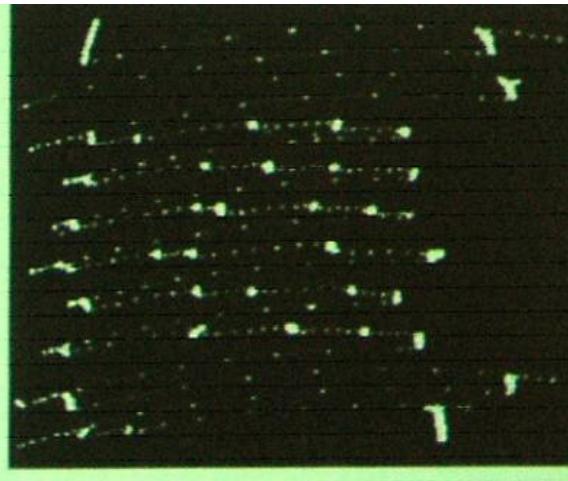
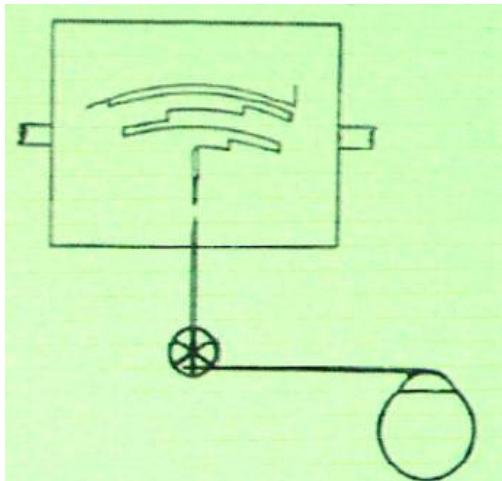
Saccades

- Saccades are extremely fast jumps from one fixation to the other and the average length of a saccade is about 20-40 m/s, can be up to 600 °/s
- When reading English the mean saccade size is 7-9 letter spaces
- Saccadic suppression: vision is largely suppressed during the movement
- The end point of saccade cannot be changed during the movement
- Regressive saccades and the saccade pattern can reveal confusion and problems understanding

Smooth pursuit

- Smooth pursuit is the movement done when following a moving object, e.g. a car or an animal.
- The eye velocity during a smooth pursuit is most often less than $30^{\circ}/s$
- If the object moves with more than $30^{\circ}/s$ the eye has to do saccades to 'catch up'
- The eye can only pursue one object at a time – the attention of the vision is on the pursued object
- Only after about 100ms of a smooth pursuit is the eye able to compensate for changes in speed and/or direction of the followed object

Eye tracking is not a new invention!



Yet...

- Producing eye trackers that are:
 - Accurate and Precise
 - Unrestrained(...ning) and Unobtrusive
 - Capable of robust tracking
 - Easy to use and automatic
- ...has been an extremely tough challenge.
- These are the key principles and features of Tobii Eye Tracking.



Good Accuracy,
Good Precision



Large Track Box,
Accuracy during head
movement

How eye tracking works

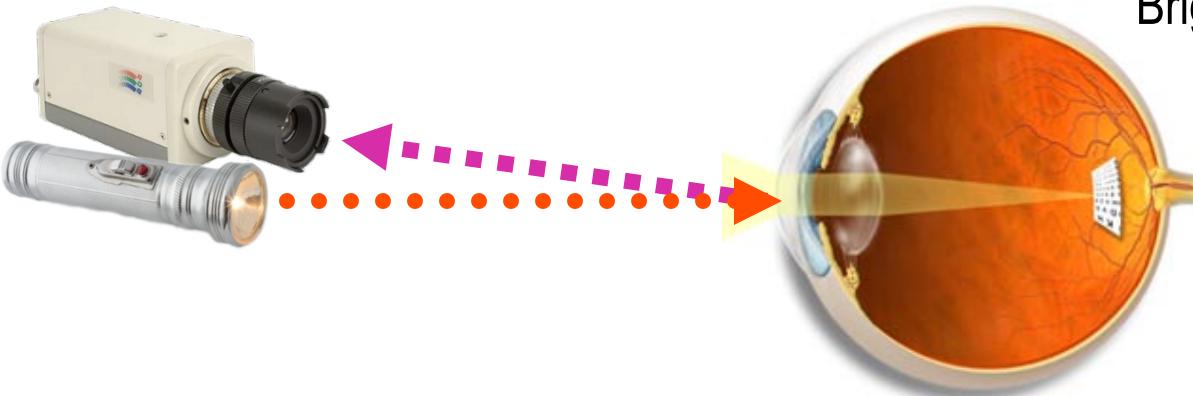


The Bright Pupil Effect

Caucasian

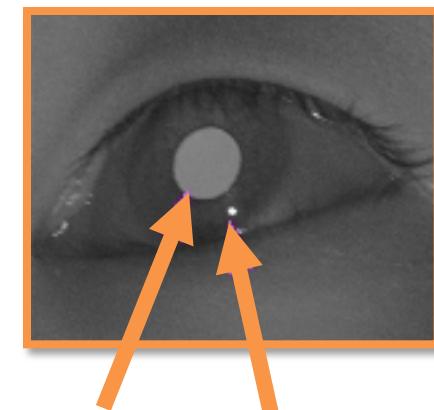


Asian



Bright Pupil

Reflection (Glint)

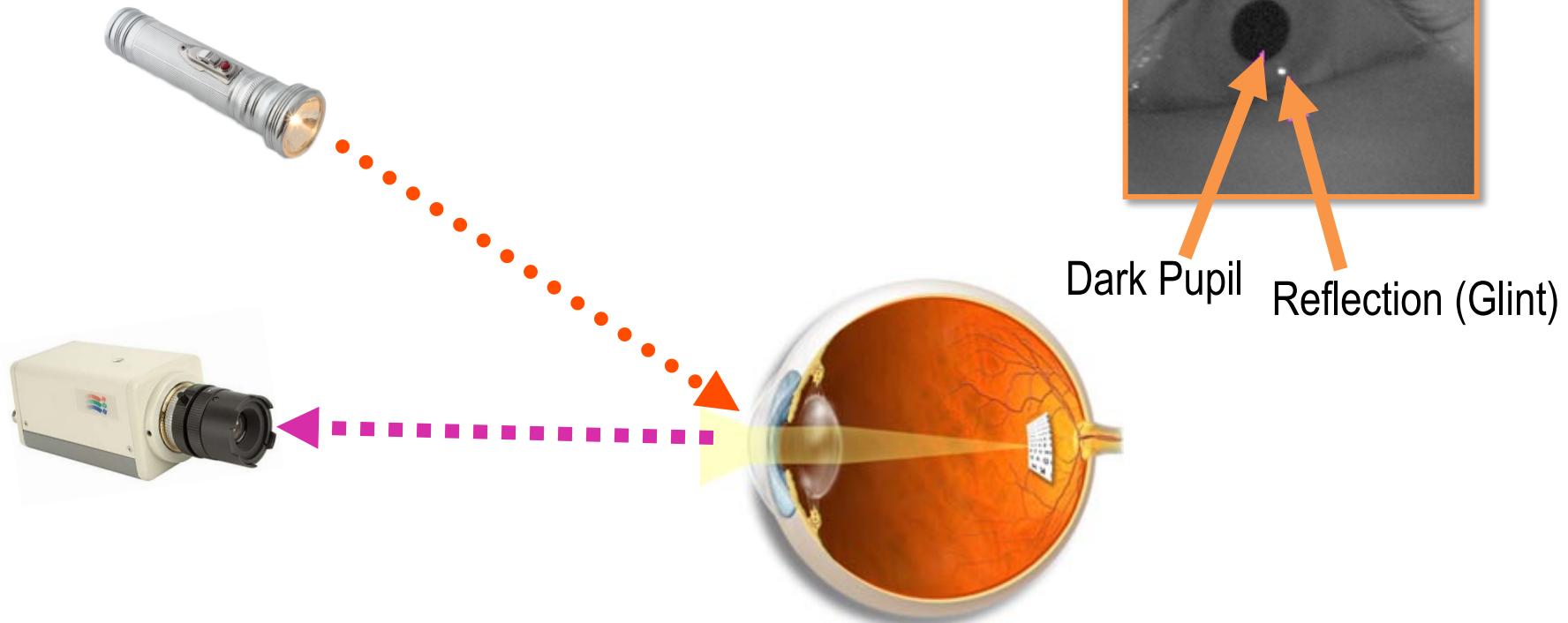


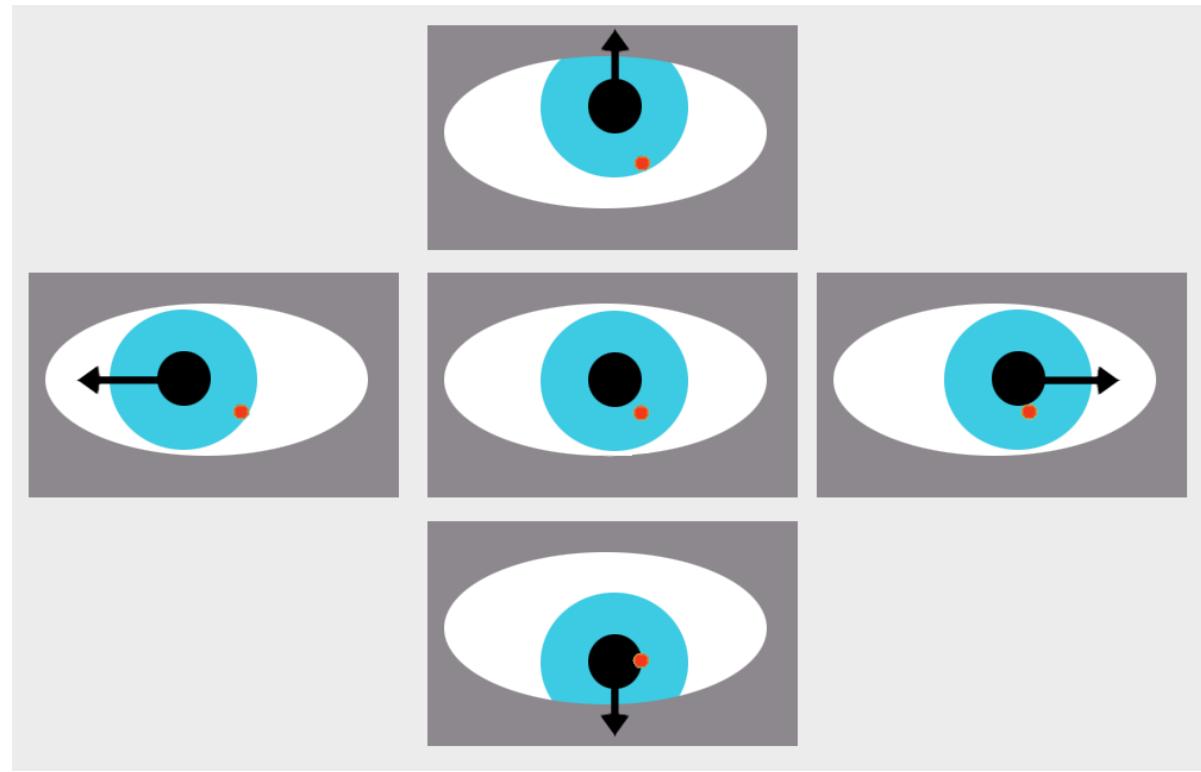
The Dark Pupil Effect

Caucasian



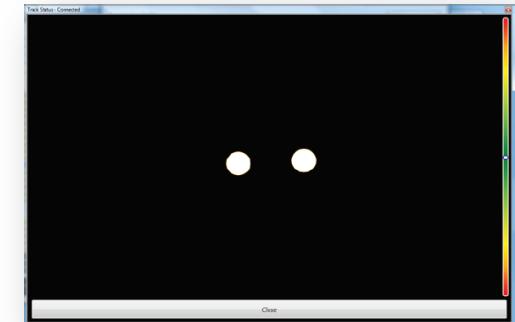
Asian





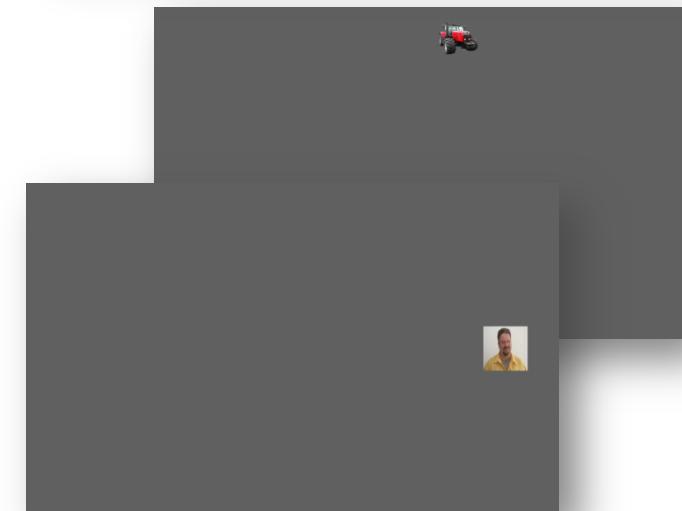
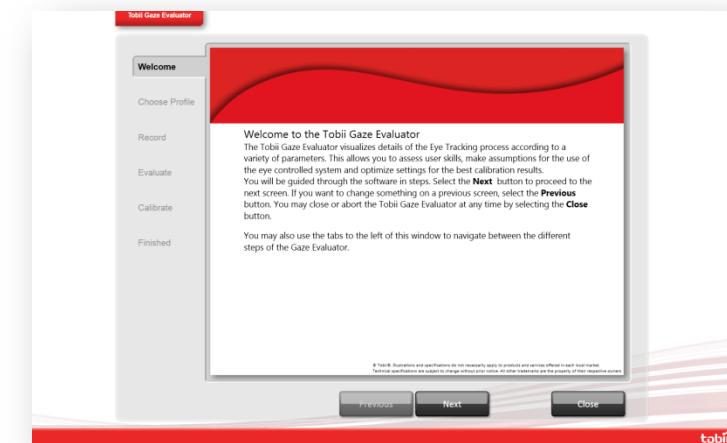
What happens during Calibration?

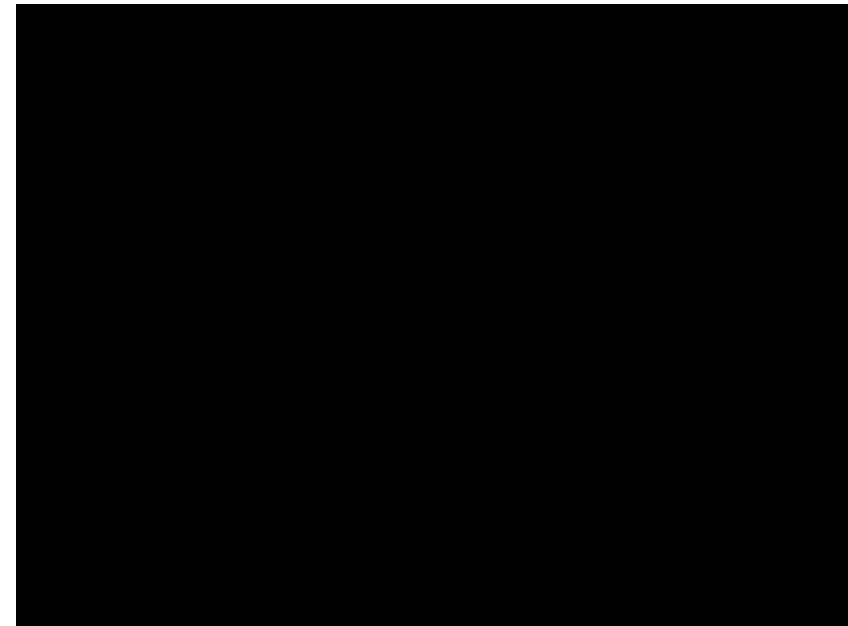
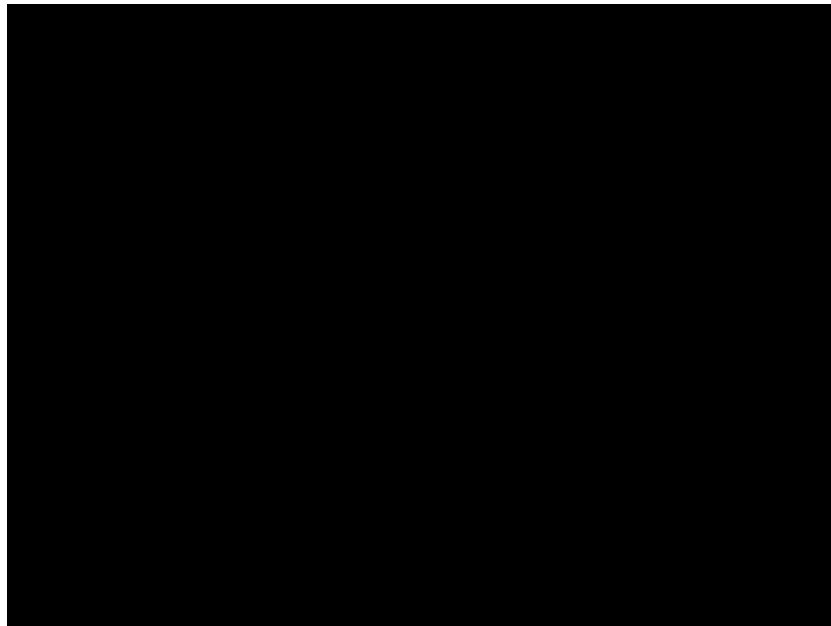
- Measures actual characteristics of users eye
 - Shapes
 - Light refraction
 - Reflection properties, etc...
- Uses this together with internal 3D eye model to calculate gaze data
- Several images of the eyes are collected and analyzed
- Image info from the “dots” is integrated into eye model
 - 2, 5 or 9 point calibration: the more “dots” the better

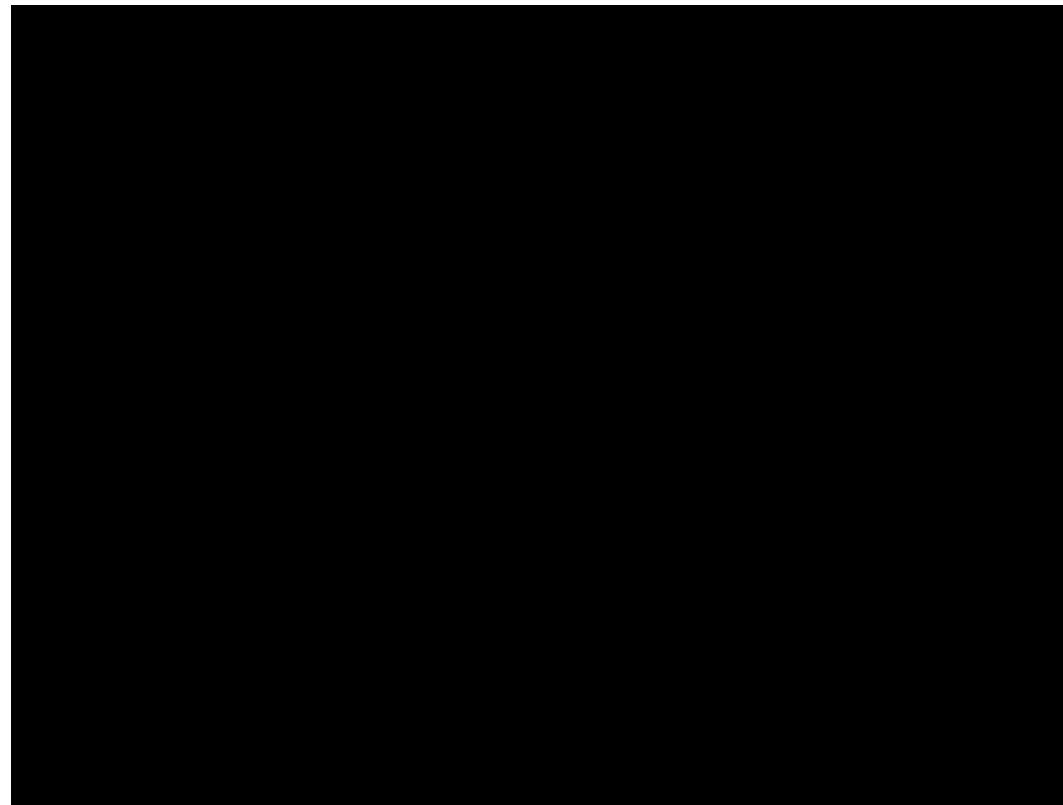


Early Eye Tracking

- Gaze Evaluator
 - Not for calibration here
 - Use “snips” of favorite images, etc, to grab attention during recordings
 - “Sneak” Calibration may take place if obvious attention is there (easy enough if step by step is used with walkthrough)





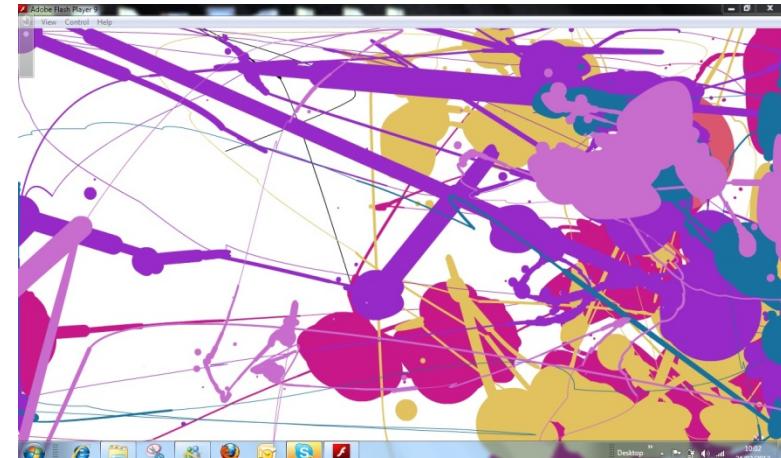


Gaze Evaluator

- Allows us to measure the offset from the calibration used
- Opens up the possibility of using 3rd party calibrations
- Allows us to
 - spot neglects
 - the spread of fixations
 - Check corners and edges
 - Look at screen sizes during assessment
 - Prove the relevance of different stimuli (video vs image vs dot)
 - Measure processing delay (smooth pursuit)
- Free on all Tobii systems

Calibration strategy/techniques

- (Monitored) Engagement is key
 - Cause and effect first (Guru/IT resources)
 - Artwork/Mouseover games/Response to video
-
- This pre-calibration data tells us areas of the screen relevant to this user.



Calibration Strategy/Techniques

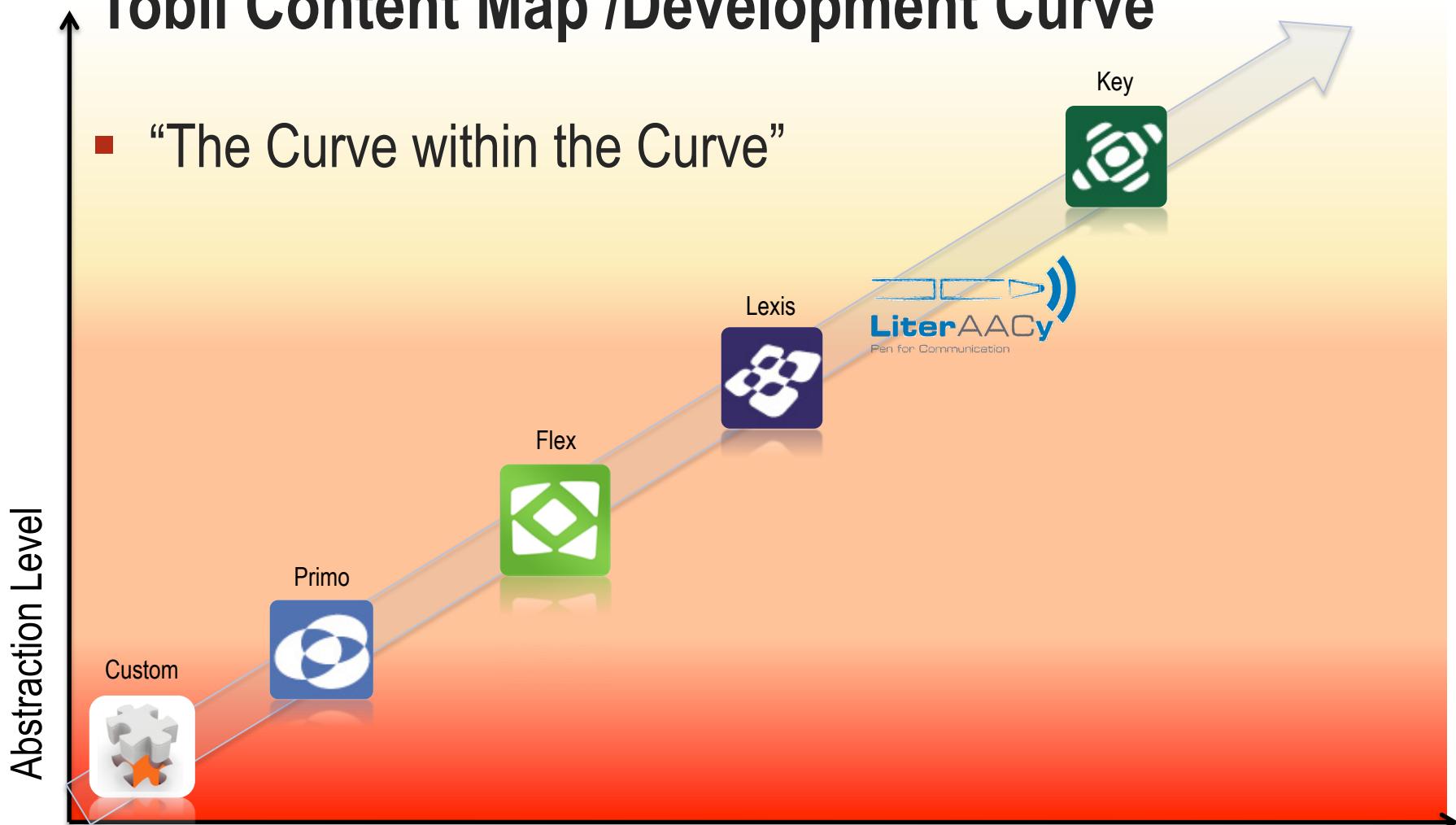
- Keyboard step through always preferable
- Dot always preferable
- Some VI patients require a video stimulus – eyetracking will tell you this
- Dark backgrounds preferred.
- Any calibration is a result. Don't fixate on the quality.
- Calibration is not a prerequisite to success – this is a learned skill for some

Causes of poor calibration

- Visual/Auditory distraction
- Glasses (normally frames)
- Make up
- Dry eyes
- Poor device positioning (get out of the wheelchair)
- Distance
- Pressure

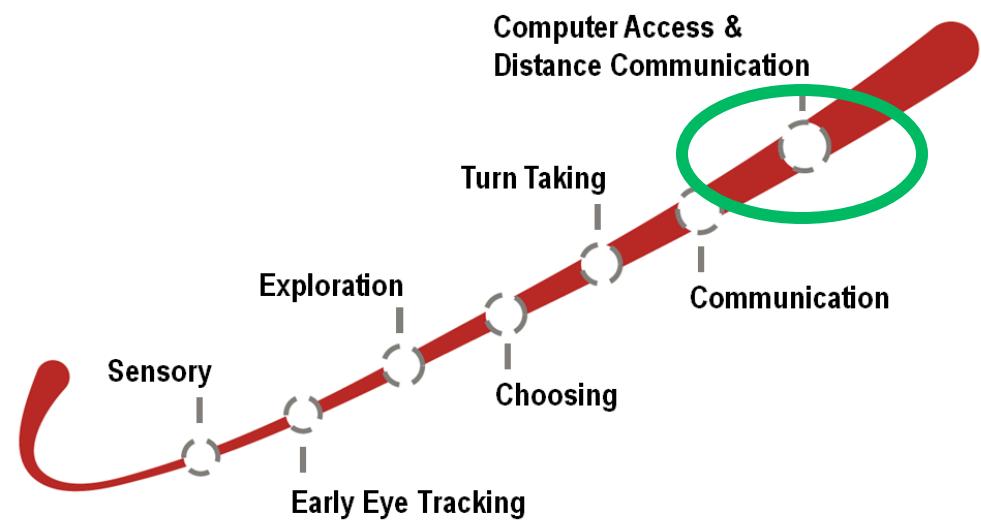
Tobii Content Map /Development Curve

- “The Curve within the Curve”



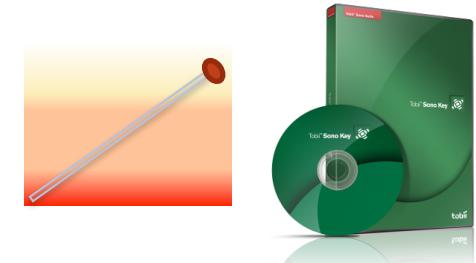
Component 7

COMPUTER ACCESS & DISTANCE COMMUNICATION



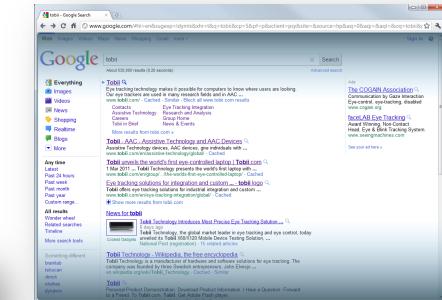
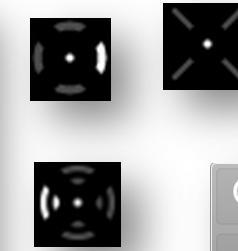
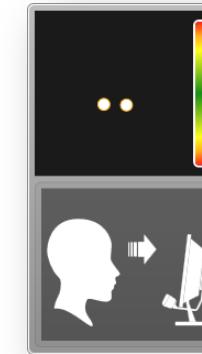
Computer Access & Distance Communication

- Sono Product for Computer Access
 - **Tobii Sono Key**
 - Interface for Tobii Communicator
 - Control speech, E-mail, volumes, alerts and other functions
 - Windows on-screen keyboard
 - Environmental control
 - Open, edit and save documents
 - Facebook, Chat, Music player, photo browser, calculator, Skype and much, much more

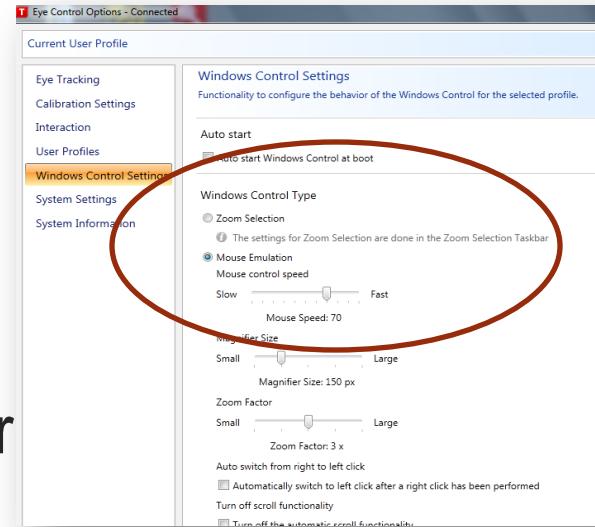


Computer Access & Distance Communication

- Windows Control
 - Learning the Windows Control menus, settings
 - Different profiles for different programs
 - Navigating the Internet



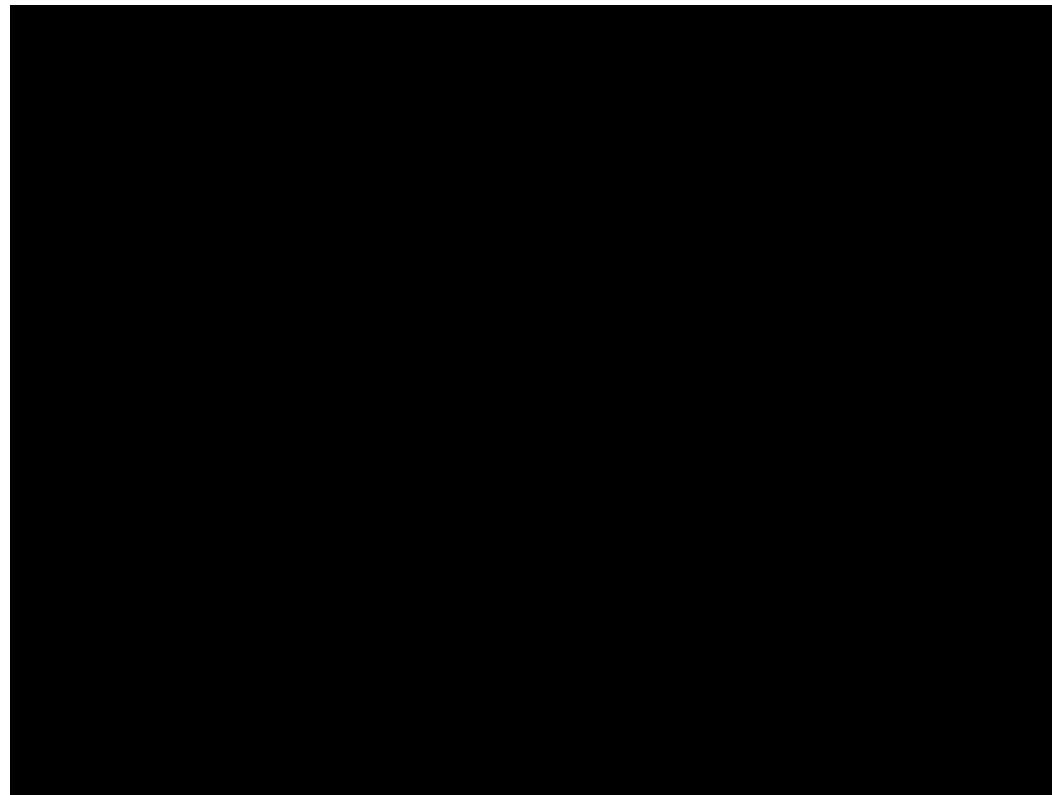
- Mouse Emulation
- Gaze Selection
(Enhanced Windows control)
- Gaming great motivator



Support is ongoing. New skills appear

- Sarah Ezekiel
 - Reluctant eyegaze user
 - Good switch user
 - Signed off
- Moved to eyegaze 1 year ago
 - Free mouse for first time
 - Internet banking
 - More communicative
 - EyeGazeArtists.com goes live next week





Step by step, Tobii is striving to fulfill the vision of eye tracking in our everyday lives



Contact

- Hminto
- Tobii UK Group (not page)
- Hector.minto@tobii.com
- 01235 841541 / 07590 992012



Tobii certification

**Tobii
Clinic
Certified**



**Tobii
Trained
Level II**

**Tobii
Trained
Level I**