Using Eye-Gaze Technology to Maximize Functional Vision: Assessing, Playing, Communicating

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THANK YOU

Thank you for allowing us the opportunity to present this information to you! We are honored to be here.

HELIX
High Expectations for Students With Low Incidence Disabilities
Pennsylvania's Low Incidence Conference

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Learning Objectives

- Describe how interactive eye-gaze activities can aid in a variety of subjects including functional vision evaluations, leisure skills, communication.
- Explain at least two techniques to integrate eye-gaze technology within lessons for students with visual impairments and other disabilities.
- Identify at least two different seating and positioning configurations that benefit students with visual impairments and other disabilities.

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What is Eye Tracking? What is Eye Control?

Eye tracking is measuring where one is looking or the motion of the eye

Eye control is using eye movement to control the cursor in place of a mouse

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Who Benefits from Eye Gaze

- Anyone who cannot access communication devices, leisure activities or computer programs via direct access
- Scanning may be too time consuming/frustrating
  - Spinal Cord Injury
  - ALS
  - Cerebral Palsy
  - Rett Syndrome
  - Muscular Dystrophy
  - SMA

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Low Tech vs High Tech Eye Gaze

Eye Gaze Boards- 2D/Symbols

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Low Tech vs High Tech Eye Gaze

Eye Gaze Boards- 3D/Objects

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Difficulties with Low-Tech Options

- Individual relies on communication partner to interpret eye-gaze which may lead to increased error and frustration
- There is no quick way to call for help or alert others' attention to you
- Pre-stored words/phrases do not allow for anything novel

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Benefits of High- Tech Eye Gaze

- The auditory output gives immediate feedback to students
- More engaging
- Quicker

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High Tech Eye Gaze

Brands of Available High Tech Eye Gaze

- Tobii Dynavox PC Eye
- My Gaze
- PRC NuEye
- Eye Gaze Edge, LC Technologies

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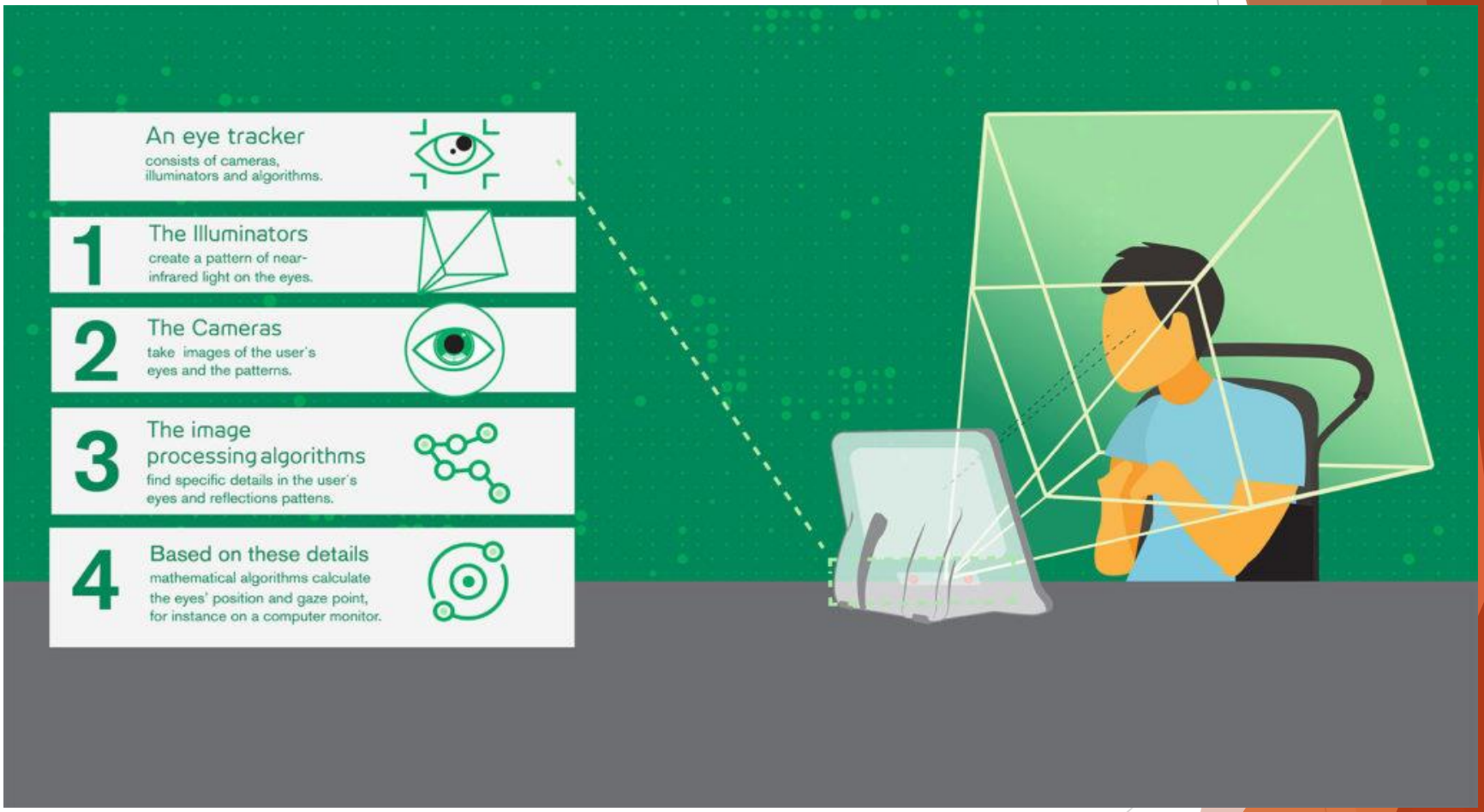
How Tobii/Dynavox Eye Gaze Works



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Vision Requirements for Using Eye Gaze

- Learning Media Assessment findings of sensory
  - learning medium- primary or secondary is visual
- 2D discrimination
  - line drawing, photos, or text
  - Cortical Visual Impairment (CVI) range at least 5
  - magnification not too high so still functional
- Scan an array
- Choosing appropriate pictures/symbols for individual
- Fixate on a choice for a few seconds
  - depending on dwell time settings
- Volitional eye movement opposed to visual pursuit

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10 Characteristics of CVI

- Color preference
- Need for movement
- Visual latency
- Visual field preferences
- Difficulty with visual complexity
- Light gazing and non-purposeful gaze
- Difficulty with distance viewing
- Atypical visual reflexes
- Difficulty with visual novelty
- Absence of visually guided reach

(Roman-Lantzy, 2007)

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CVI Range

Phase I Building Visual Behavior Level I Environmental Considerations		Phase II Integrating Vision with Function Level II Environmental Considerations		Phase III Resolution of CVI Characteristics Level III Environmental Considerations	
CVI Characteristics	**Range 1-2 (0)**	**Range 3-4 (.25)**	**Range 5-6 (.50)**	**Range 7-8 (.75)**	**Range 9-10 (1)**
Distance Viewing	Visually attends in near space only	Occasional visual attention on familiar, moving or large targets in simple or familiar settings, up to 3-4 feet	Visual attention extends beyond near space, up to 4-6 feet Complexity in the environment may reduce this distance	Visual attention extends to 10 feet with targets that produce movement. Color cues, movement and size of target may factor in.	Visual attention extends beyond 20 feet Student demonstrates memory of routes, cues or landmarks and may now be able to travel independently
Visual Reflexive Responses	No blink in response to touch and/or visual threat	Blinks in response to touch but response may be latent	Blind response to touch consistently present. Visual threat intermittently present	Visual threat response consistently present Student may now anticipate approaching obstacles	
Visual Novelty	Student only responds to familiar objects	May visually attend to objects or environmental features if they share characteristics with the familiar objects	Visually attends to landmarks or cues that are highlighted with familiar color or pattern	Selection of objects or environmental / route cues remembered after several sessions of familiarization	Selection of objects, environments not restricted or specially adapted
Visual Motor	Reach, touch, look occur as separate functions		Visually guided reach with familiar materials, simple configurations and "favorite" color	Look and reach occur in sequence but not always together	Look and reach as a single action

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Visual and Environmental Considerations

- Lighting varies results
- Contrast
- Magnification
- Distance & Positioning
- Spacing
- Font
- Time/Speed
- Endurance/Fatigue

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Using Eye Gaze for Functional Vision Evaluations

- Appearance of eye
- Presence of behaviors
- Muscle imbalance
- Visual awareness
- Visual fixation
- Shift of gaze
- Convergence
- Visual pursuit/tracking
- Visual scanning
- Visual field
- Near/Distance vision
- Visual perception

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Oculomotor Skills

- Fixation
- Convergence
- Tracking
- Shift of Gaze
- Scanning

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Fixation:

- Maintaining gaze on an object
- Length of time to calm eye into the steady gaze
- Amount of dwell time

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Convergence:

- Ability to maintain fixation on an oncoming object
- Stability of vision, depth perception and binocular vision
- Lack of convergence will have a negative influence on reading

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Tracking: The ability to follow an object as it moves across the field of vision

- Observe horizontal, vertical, diagonal, random tracking
- Smooth or jerky movement?
- Both eyes move together?
- Able to maintain fixation throughout?
- Fixation lost and regained?
- Trouble with crossing midline?
- Did slowing the rate of movements improve performance?

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Shift of Gaze

- Shift their gaze between materials presented parallel and non-parallel
- Should be able to shift their gaze in less than 3 seconds
- Note if 1 eye shifts & other not
- Lose object then searches to find again?

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Scanning

- Horizontal, diagonal, vertical and circular patterns
- Moves both his head and eyes while tracking and scanning
- Brisk, smooth, and thorough
- Any areas are neglected

Optimal Conditions for Teaching Eye Gaze

Make a dedicated space if possible

- Used for dual purpose (CVI training)

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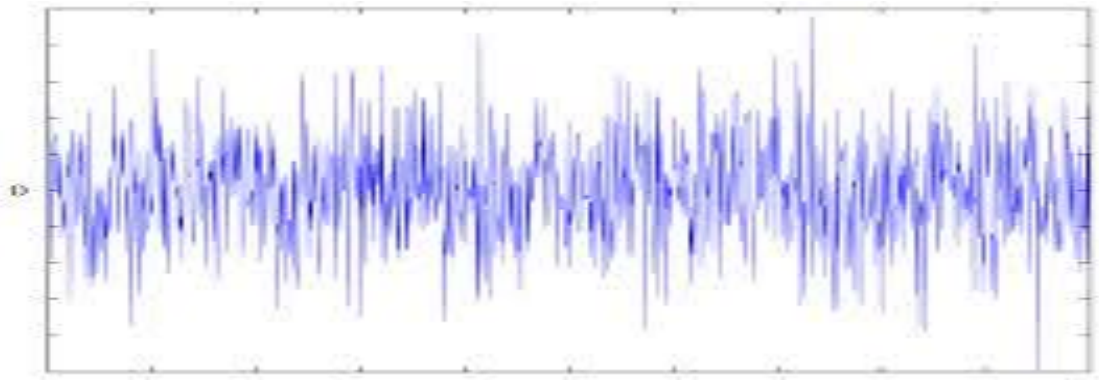
Optimal Conditions for Teaching Eye Gaze

- Background Noise
  - Limit auditory distractions also helps when a student is learning eye gaze.



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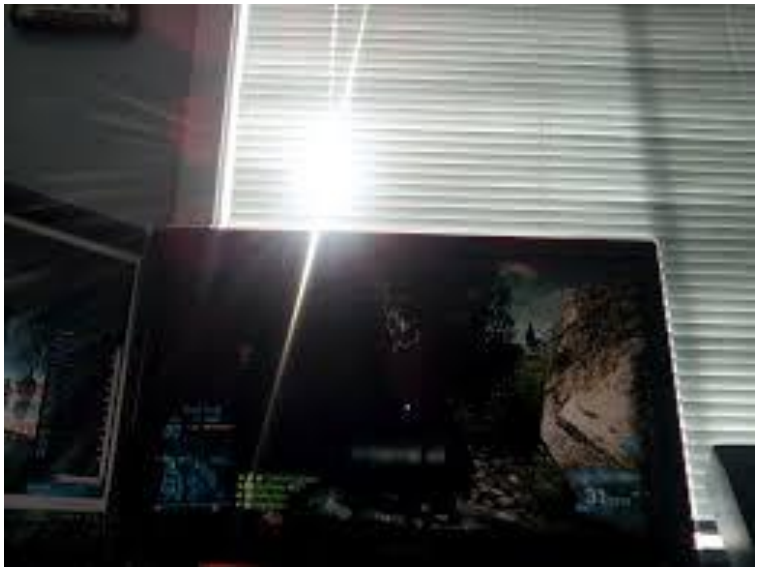
Optimal Conditions for Teaching Eye Gaze

Sun Glare:



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Optimal Conditions for Teaching Eye Gaze

Visual Clutter

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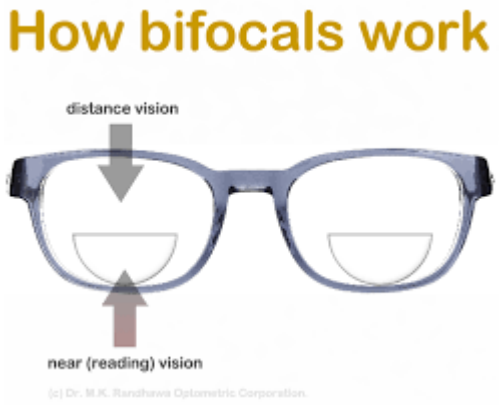
Optimal Conditions for Teaching Eye Gaze

- Bi-Focals and Thick Frame Eye Glasses
  - Can interfere with how the IR tracks the eye



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Heat Maps

Look to Learn Software
My Gaze

- Shows behavior of looking
  - Tracking
  - Field preference
  - Field restrictions

- Effort in order to fixate
- Shows distribution of looking at a stimulus

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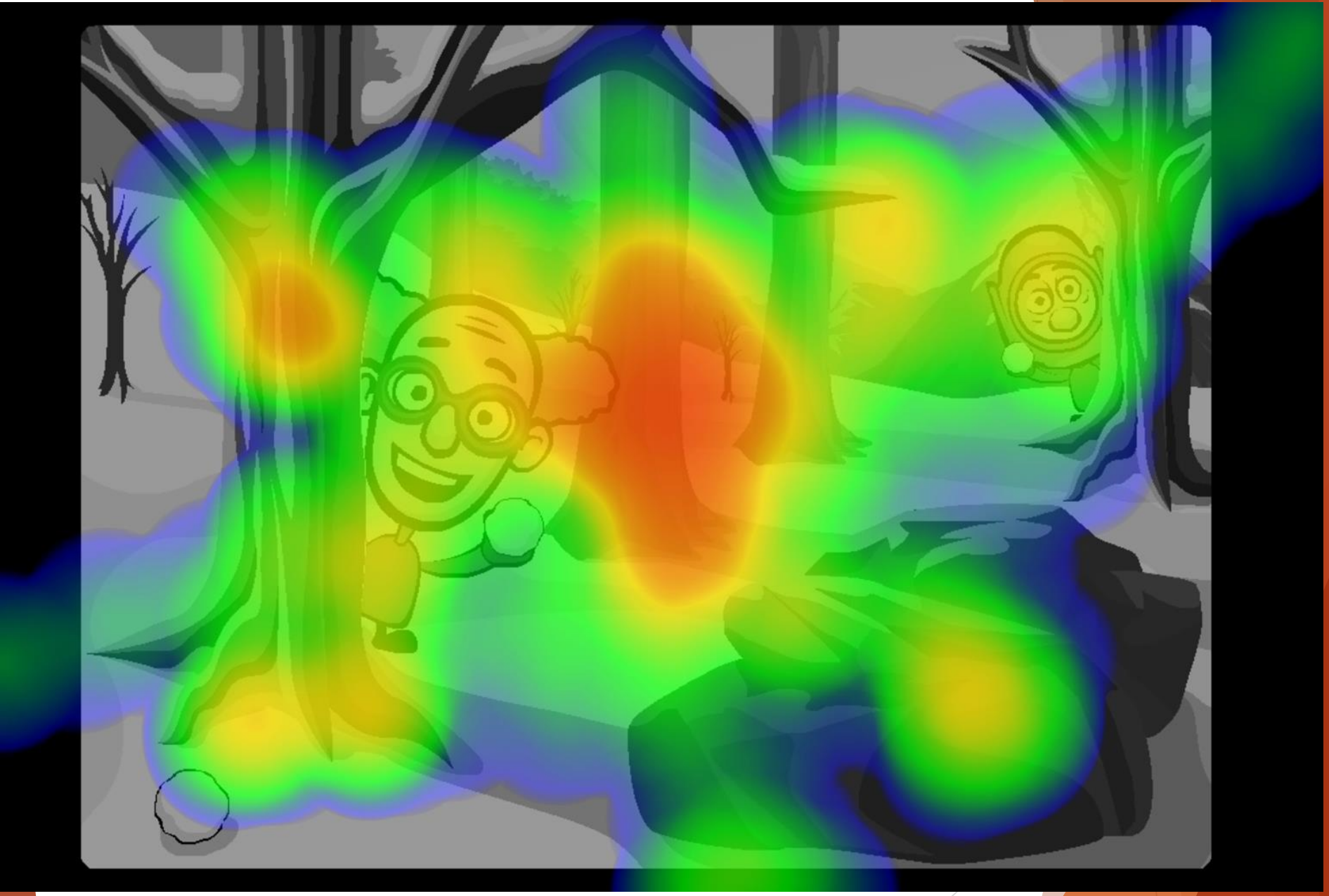

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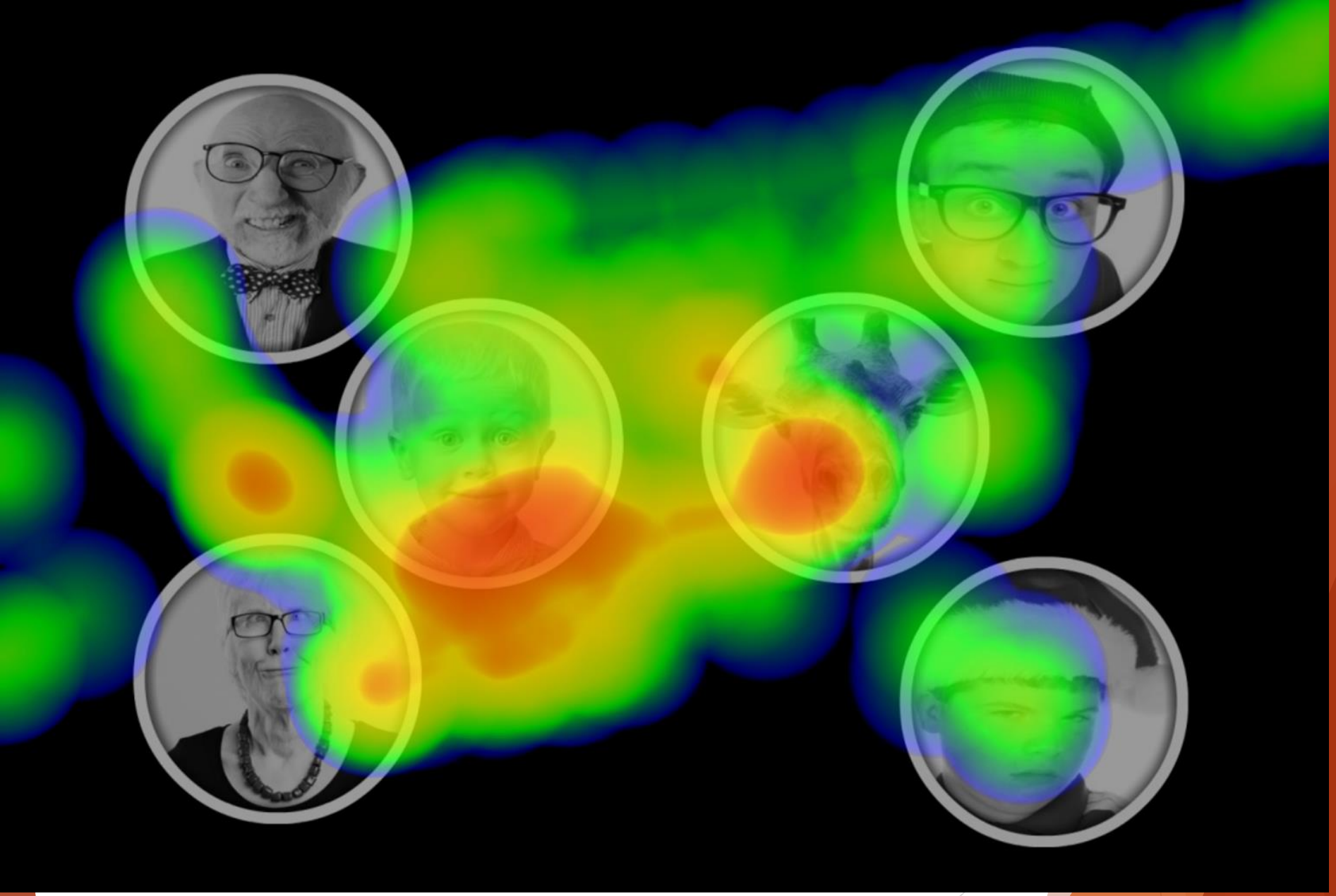

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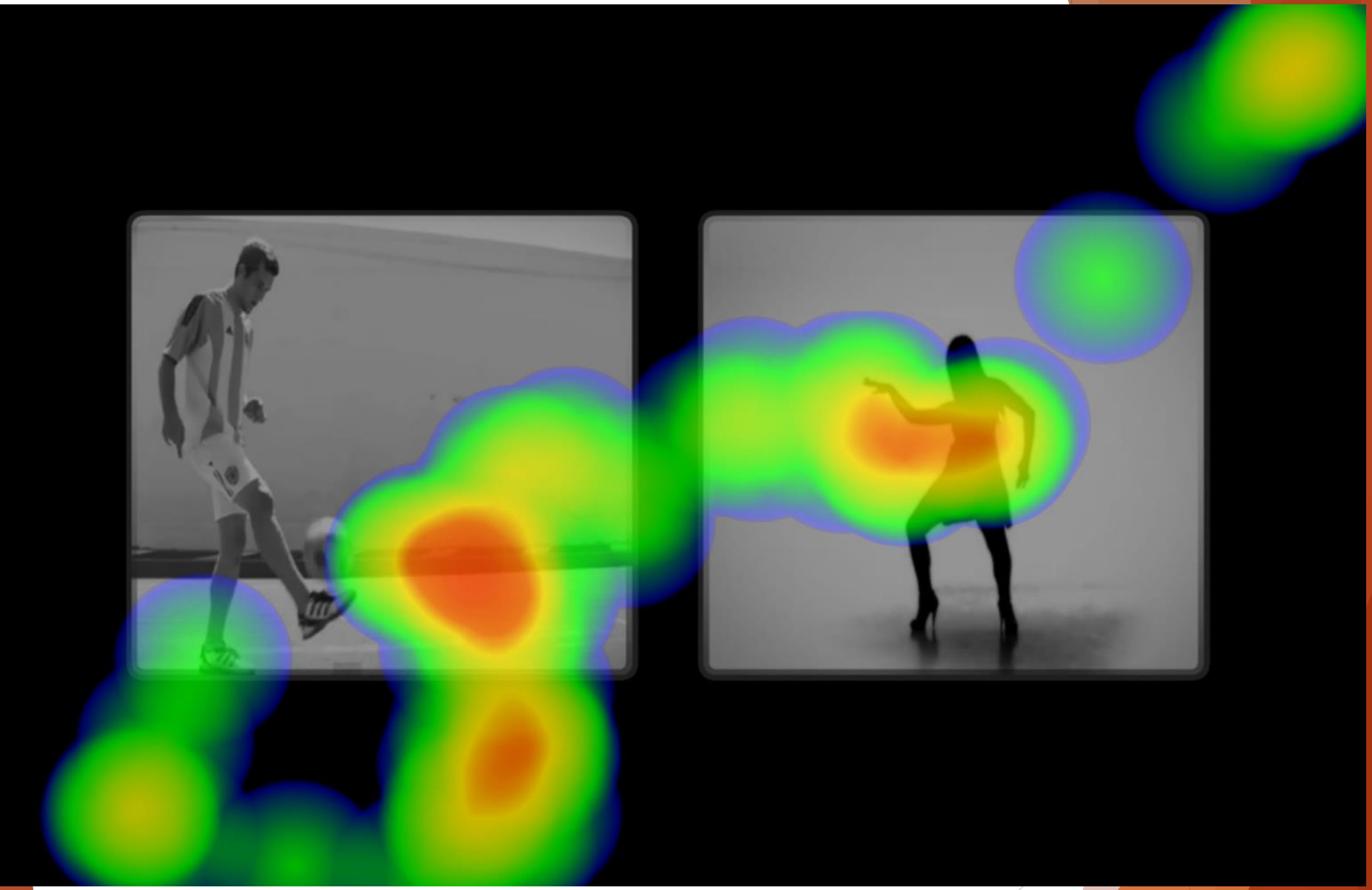

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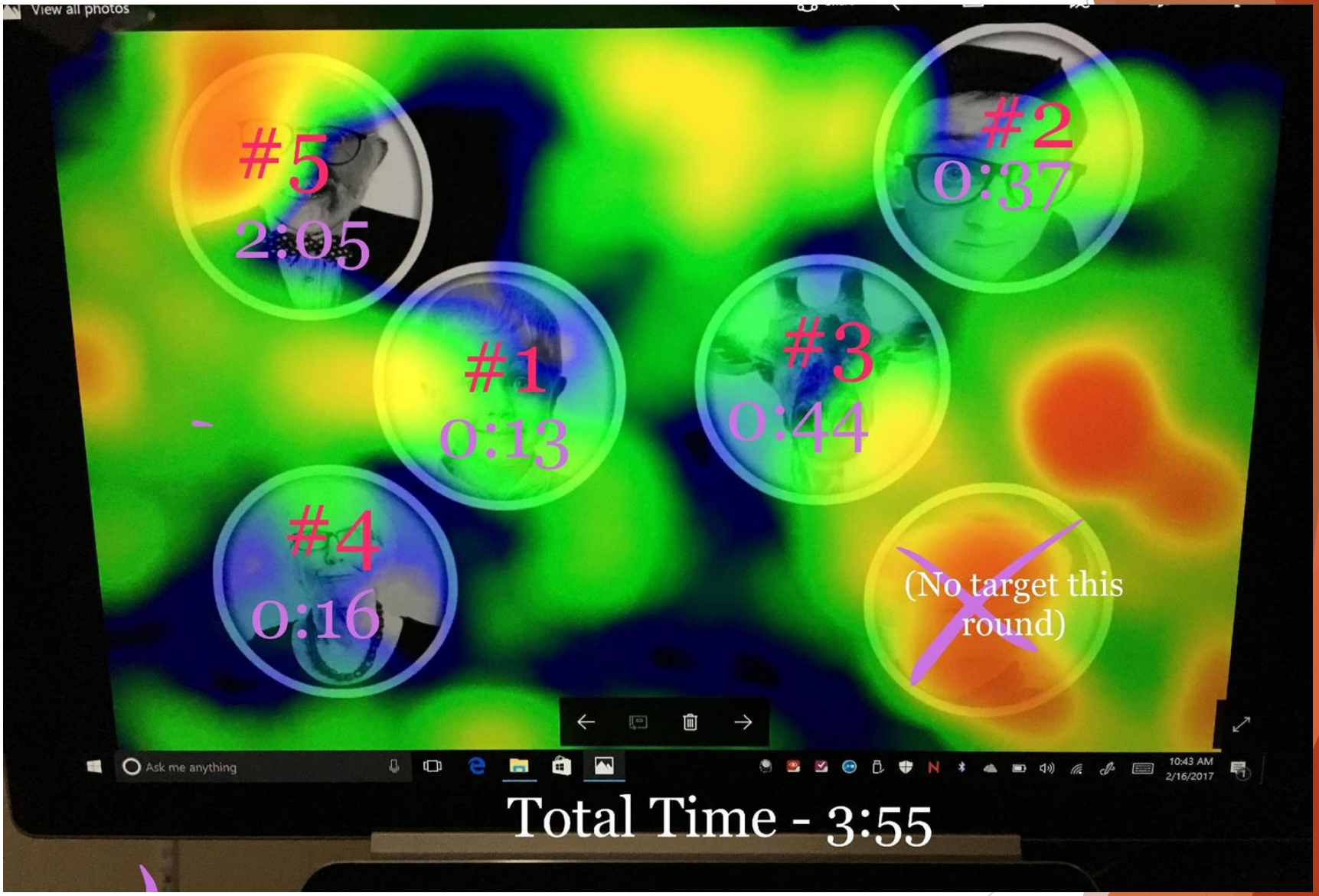

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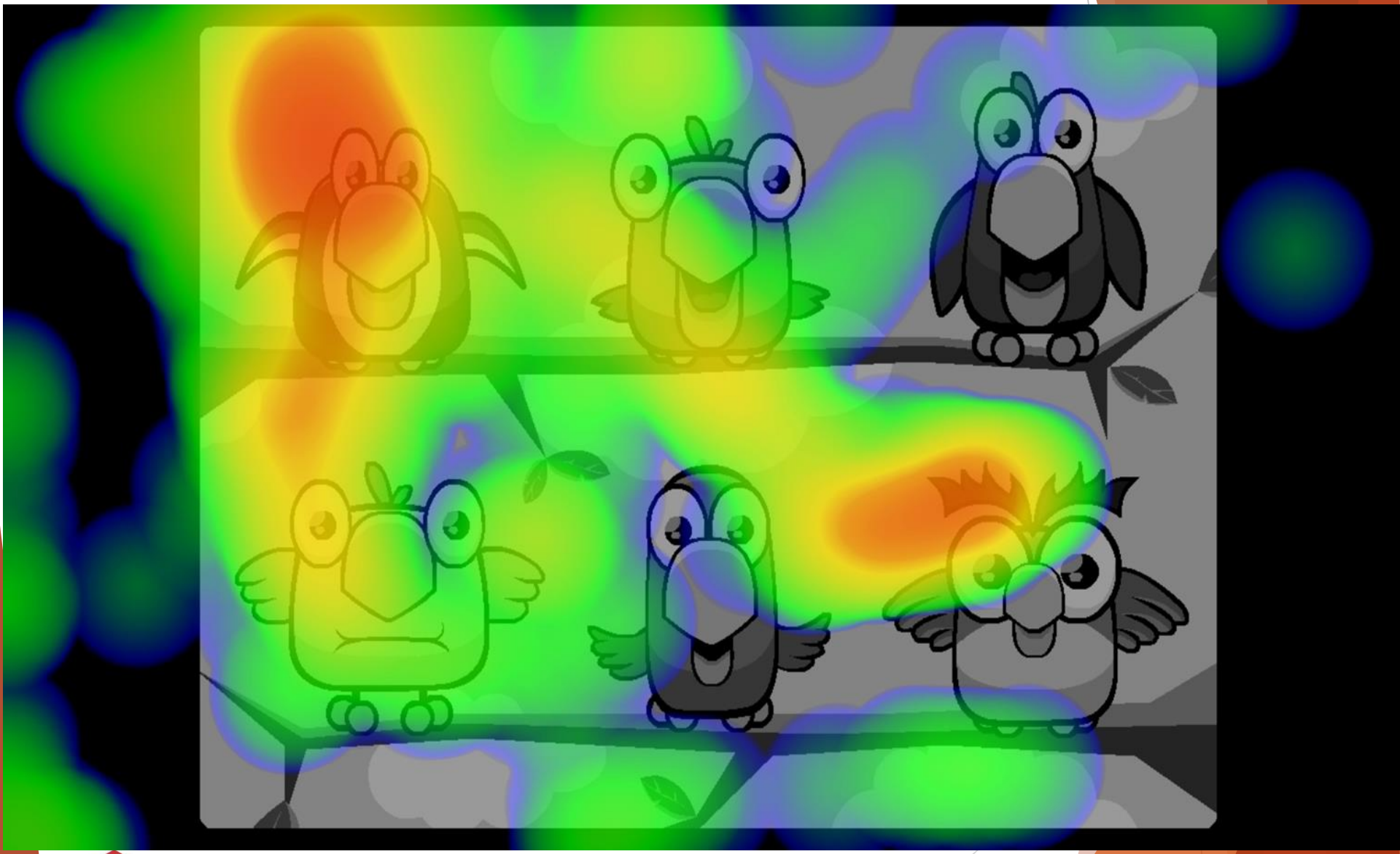

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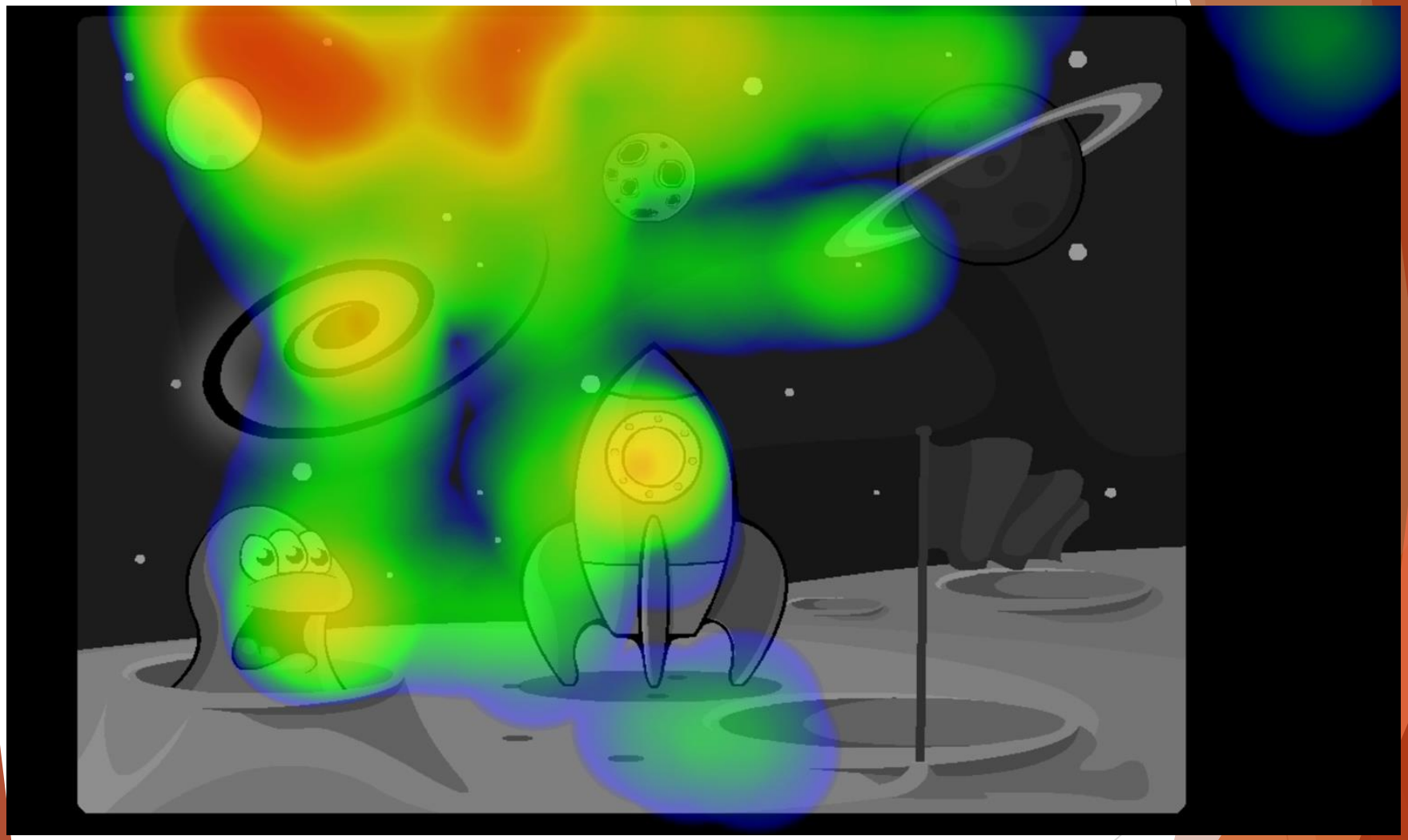

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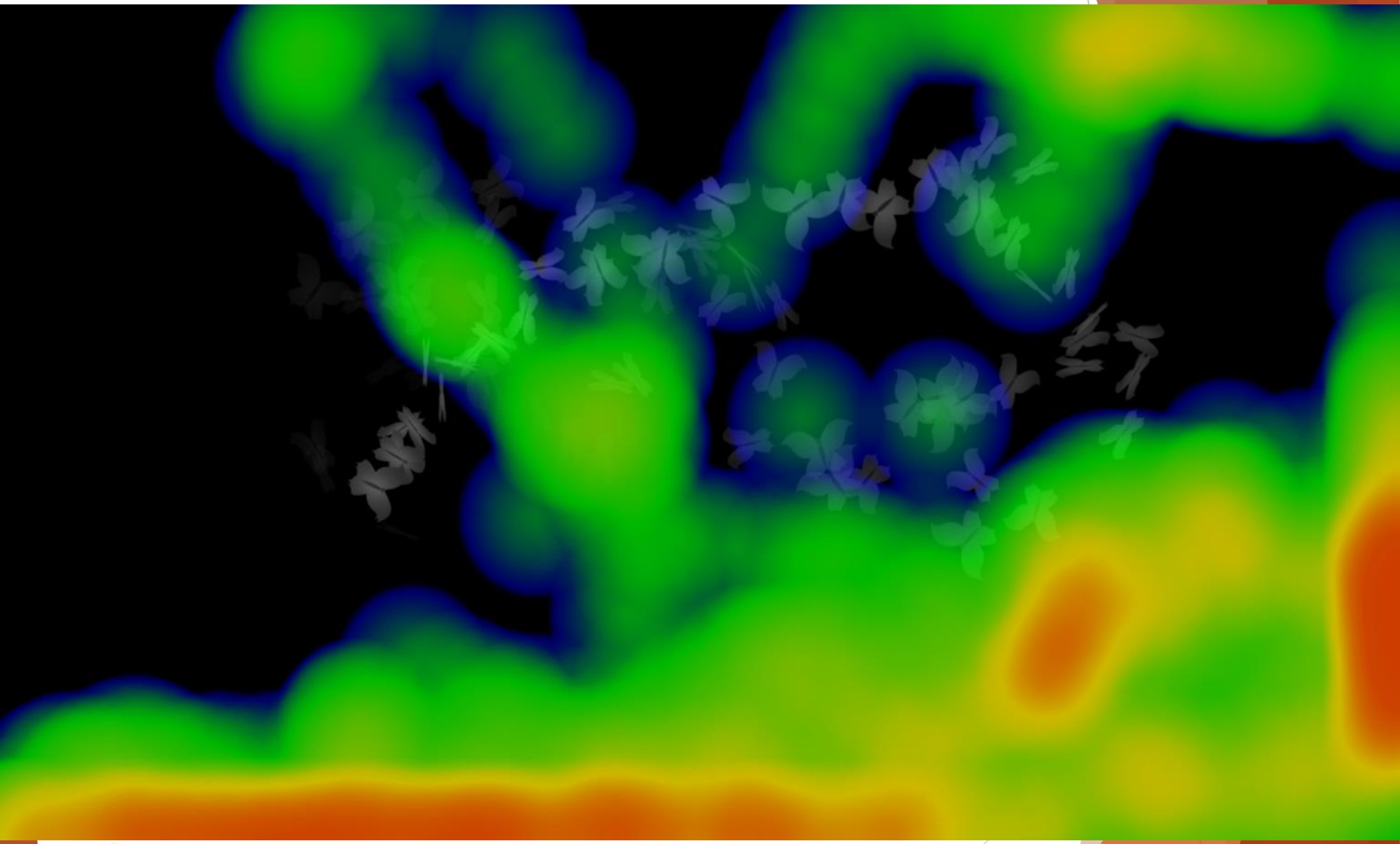

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Eye Gaze Room

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Mounting Solutions

- Stationary on a desk within the classroom or private treatment room.
- Portable with laptop, on high shelf, lower desk
- Rehadapt mount

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Table Top Clamp Mount

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Table Stand

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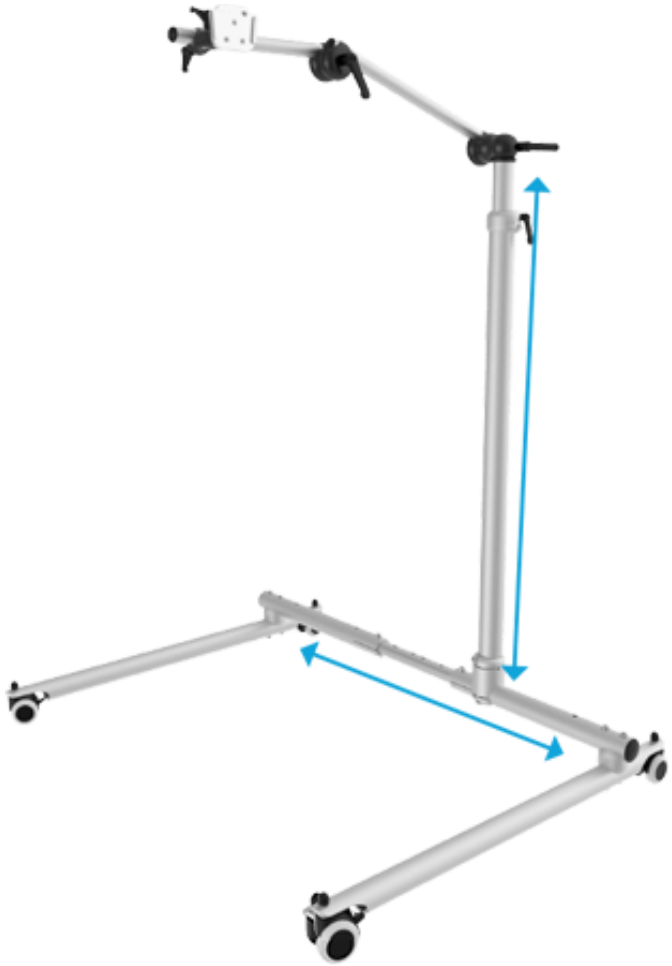
Floor Stand



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Directly on Table/Desk

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Positioning for Access

- Position the eye gaze, not the student.
- Position within the “eyebox”
  - Each Eye Gaze device has it’s own “eyebox” in which the head and eyes need to be within in order to access the system
  - Refer the manual of your device to determine your “eyebox”

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Positioning for Complex Needs

- “Just Right Positioning”
- Tilt
  - Semi Gravity Eliminated Position
  - Use of a positioning aide such as a Hensinger collar, Head Pod or Specialized Wheelchair Headrest
- Trunk Support
- Pelvic Support

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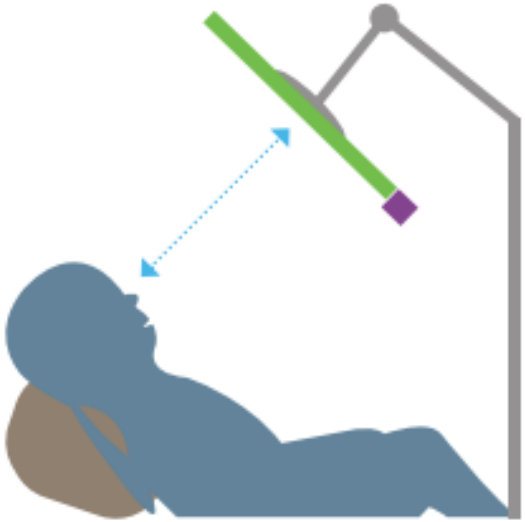
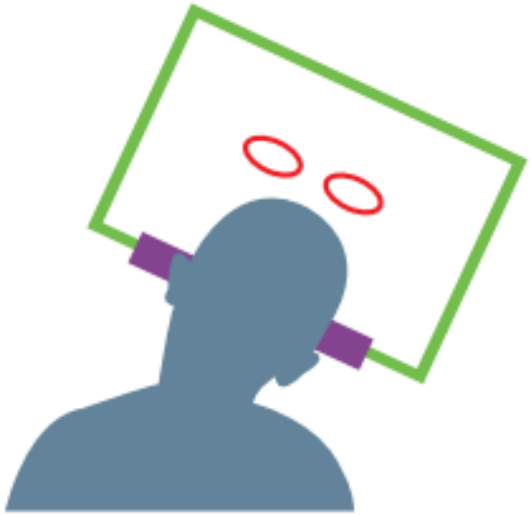
Positioning for Access

Reclined position - May need to mount the screen above using specialist mounts e.g. floor mount.



Tilted position - If student's head is normally tilted, you can tilt the screen and tracker to match.



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Positioning Aides

- Fixed Head Positioning: Headrest on Wheelchair
- Whitmyer Headrests/Sunrise Medical

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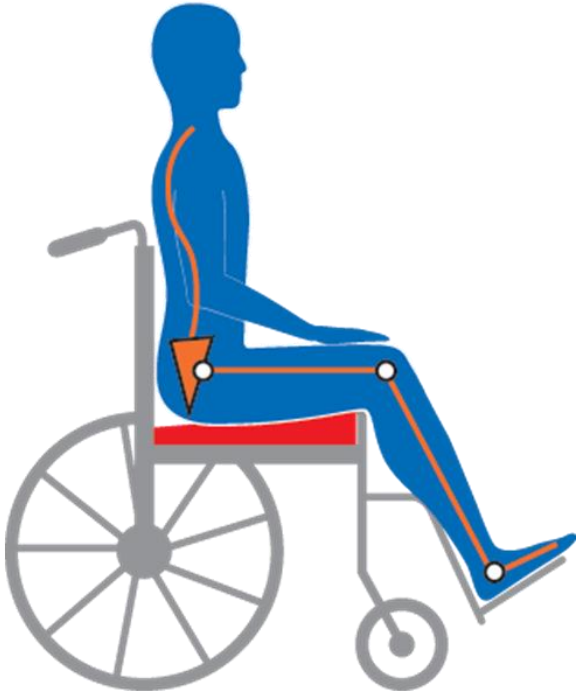
Posterior Pelvic Tilt

Before



After

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Pelvic Support

- Stabilize at the hips and pelvis
  - Ensure hips do not slide forward.

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Positioning Aides

Hensinger Collar: Soft Foam positioning aide that supports the head using the base support areas of the occiput and Jaw Line

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Trunk Supports

- Laterals (one or both sides)
- Vest or Harness
- TLSO-Thoracolumbosacral Orthosis

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Lateral Supports

Harness

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TLSO

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Breakout Vendor Hall/Tech Floor

Things to look for:

- Devices
  - What Companies are available here at HELIX
- Software
- Mounts
- Funding

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Alertness/Ready to Learn

- Time of Day
- Alerting Strategies
  - Sensory strategies such as Brushing or Joint Compressions
  - Vibration/SUBPAC
  - Combine Multi-Sensory Stimulation
  - External speaker with resonance board

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Importance of Calibration

- It is better to have a poor calibration than no calibration at all
- Never use another user's profile/calibration
- Modify calibration points for users with decreased visual attention
  - 1pt, 5pt, 9pt (the more points, the more accurate it will be)
  - Change the target size, color, or stimulus
  - Change the background color

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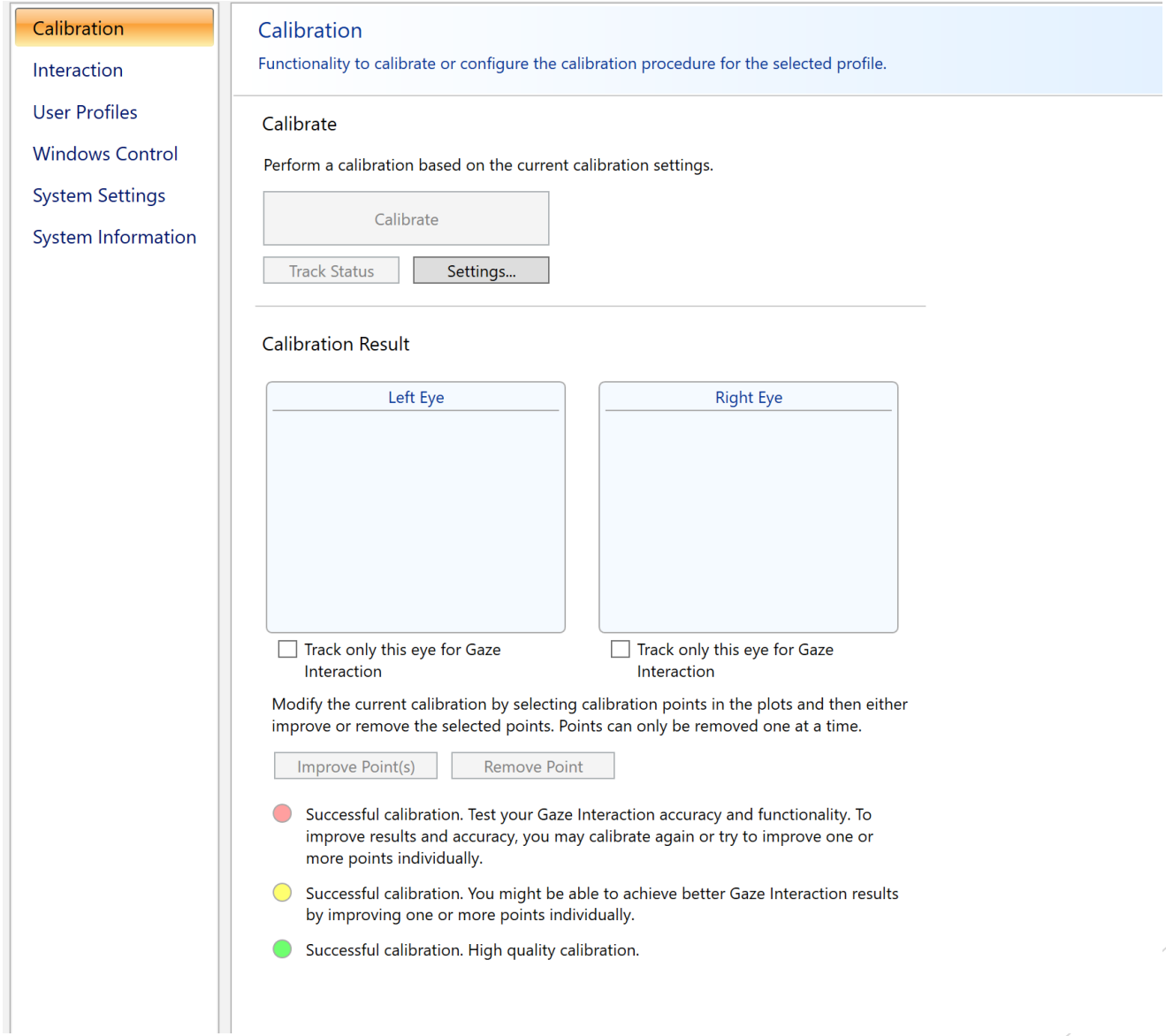

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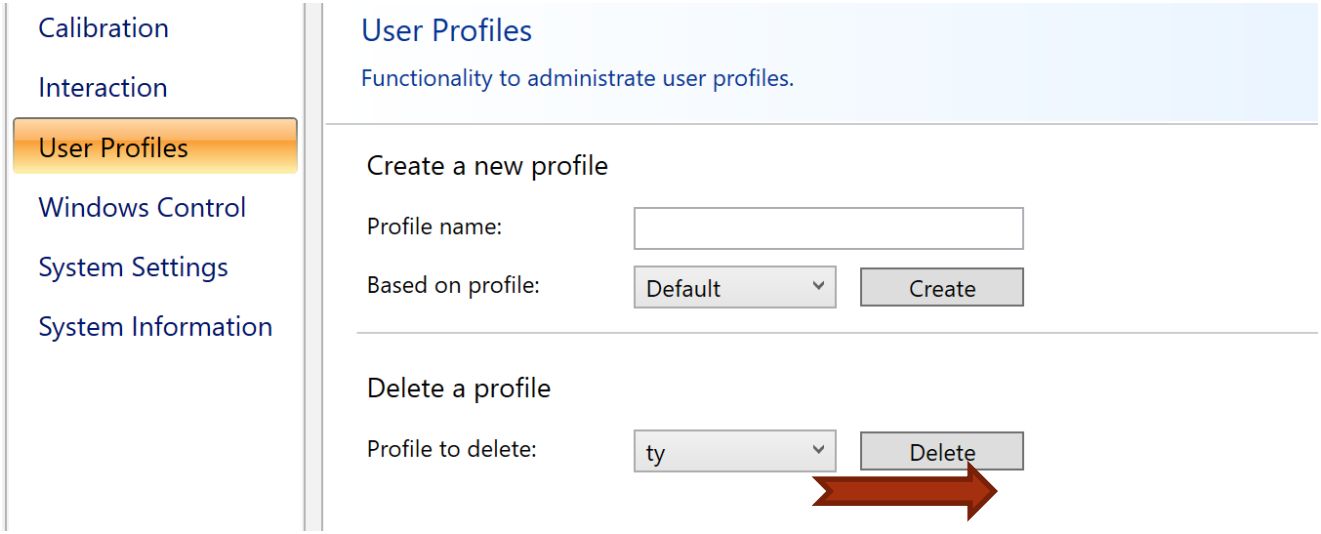
Create a profile



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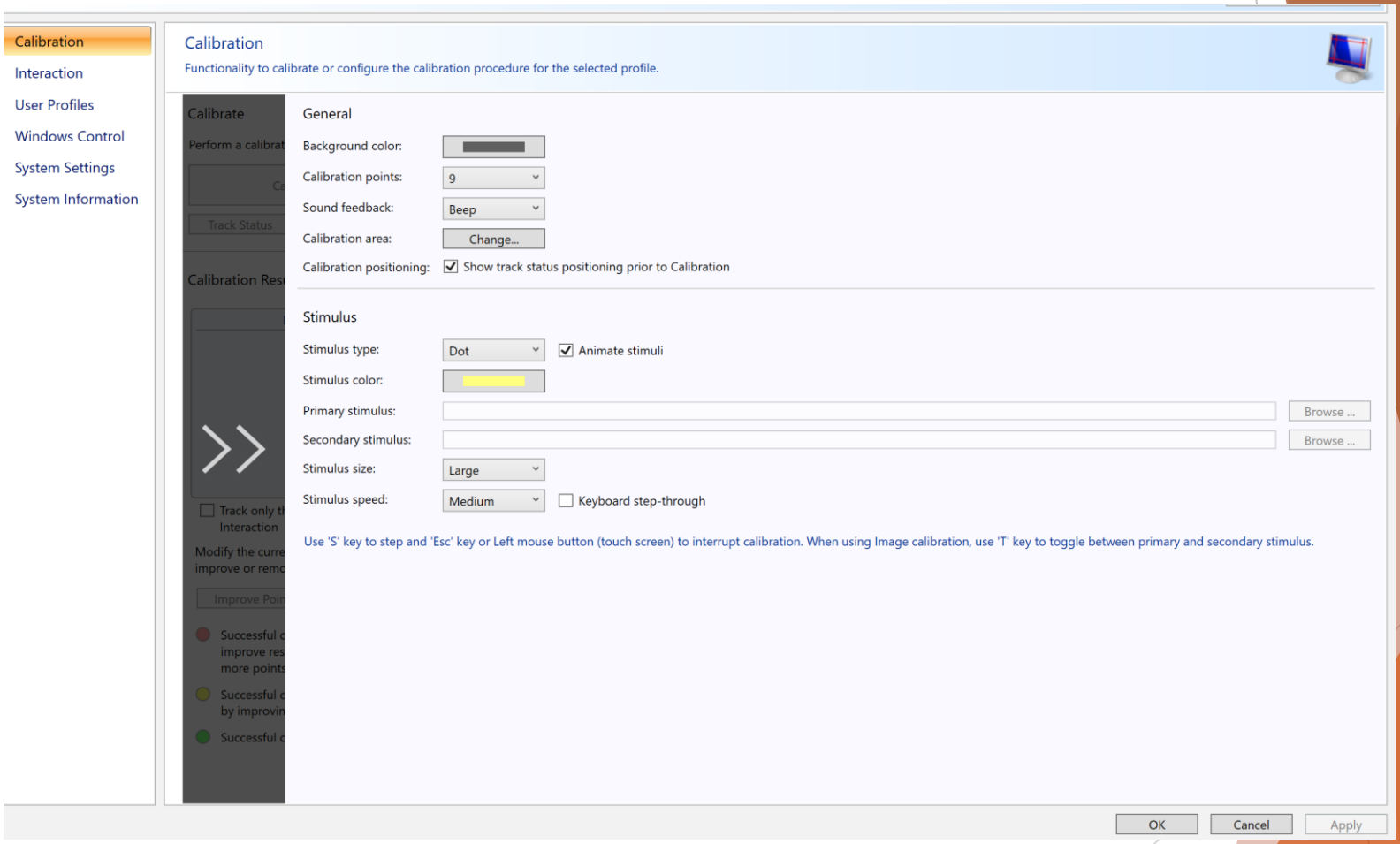
Settings



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Apply

- Do not forget to hit apply or you will lose all of the information from your calibration.

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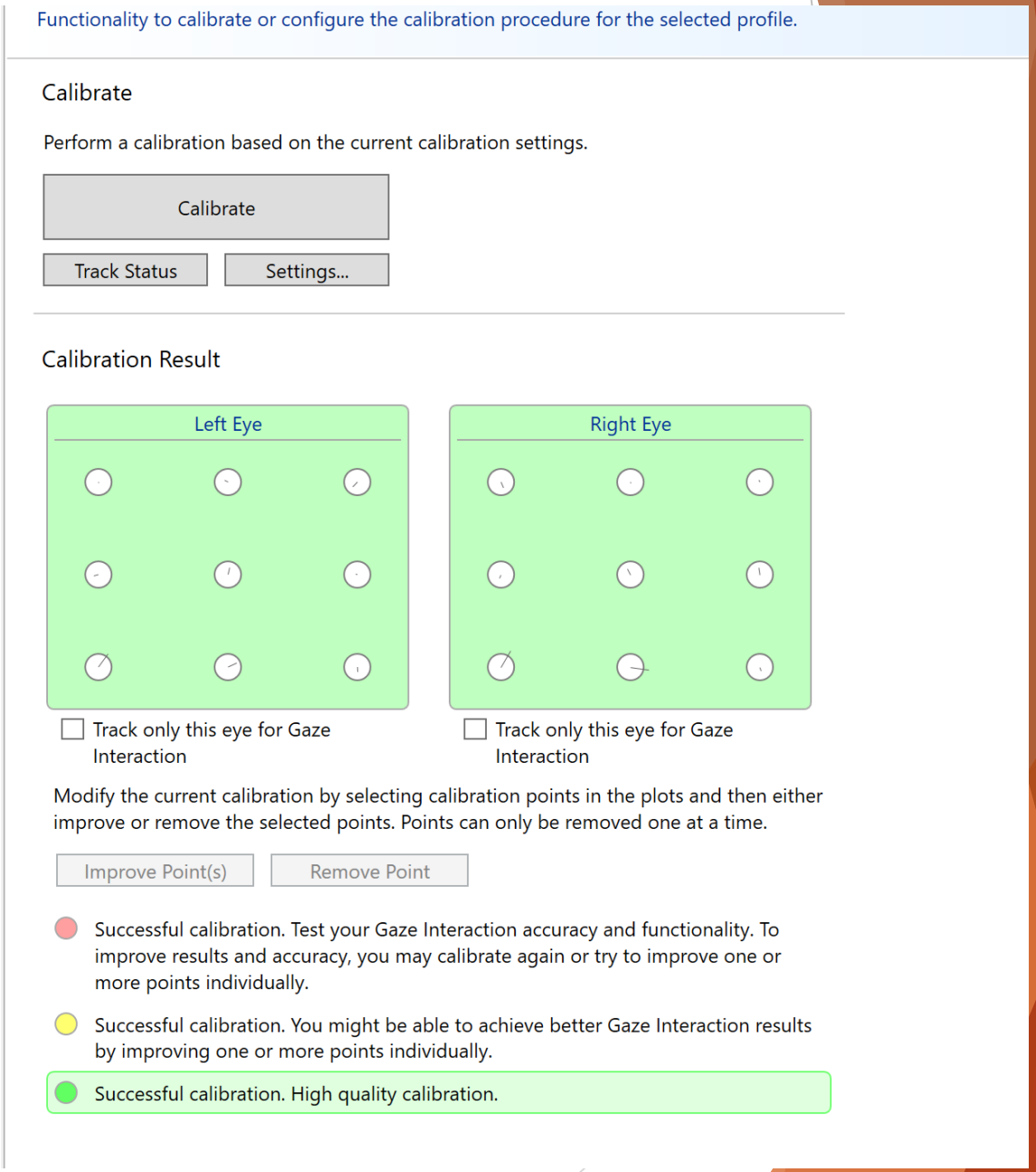
Successful Calibration



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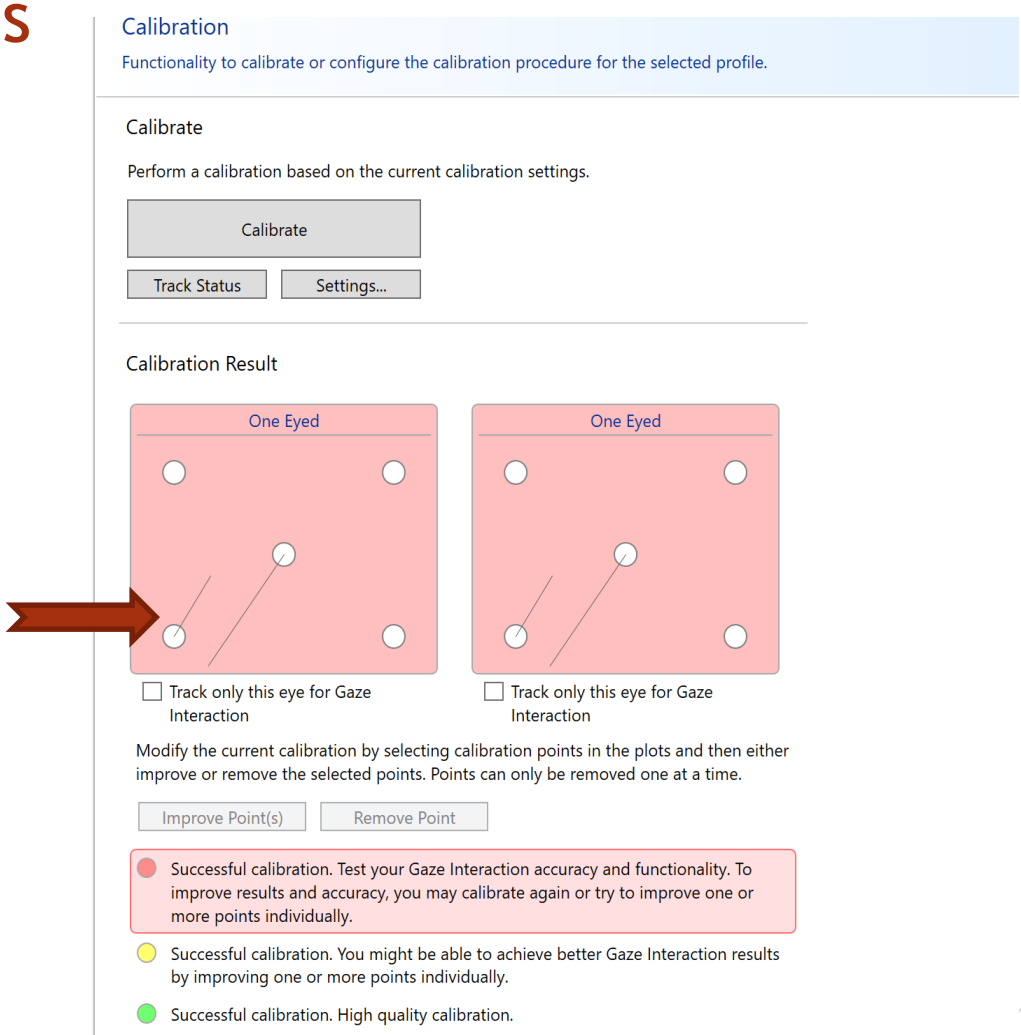
Nystagmus



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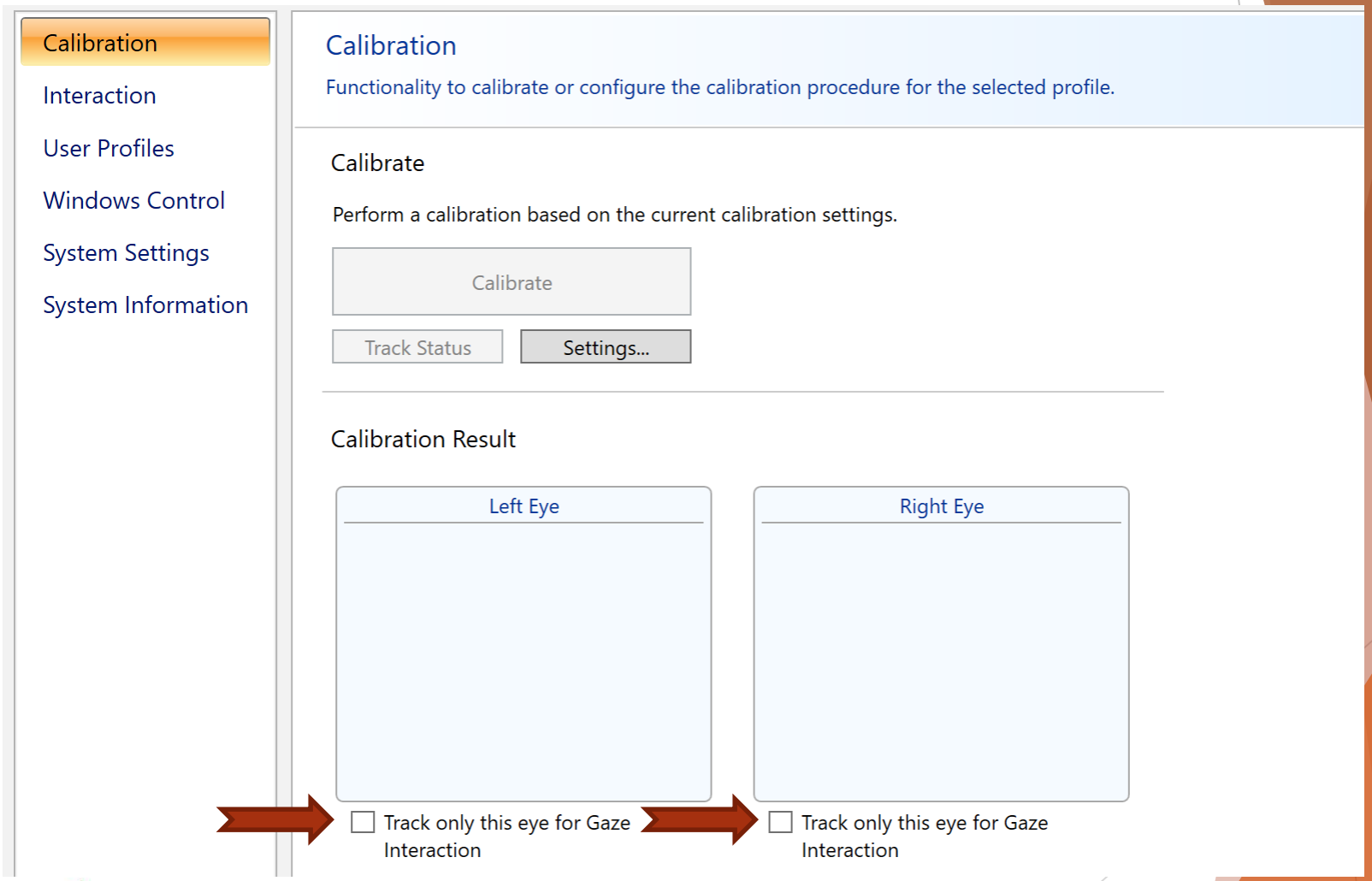
Tracking



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Set and forget it!

- You do not need to re-calibrate each time
  - Re-calibrate
    - A change in medical status
    - Received a new prescription for eye glasses
    - New seating/Positioning System
    - New positioning aide (Hensinger, TLSO, Harness, etc)

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Leisure Activities

- Cause and Effect
  - Games
    - Look to Learn Software
    - Eye FX
    - Help Kidz Learn
      - Eye Can Fly
    - Tobii Dynavox

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Tool for Vision Tracking/Evaluation

- Insight
  - Help Kidz Learn
- Look to Learn analysis
  - Look to Learn Software
- Heat Maps

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Increased Independence

Environmental Control:

- Infrared remote controls can be used to operate doors,lights, TVs, air conditioners, radio and toys
- Individuals with limited mobility and movement can use eye-gaze as a remote to operate such appliances and devices.
- Leads to independence!

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Communication

- Benefits Individuals
  - Unable to speak
  - Poor intelligibility
  - Unable to use fingers, hands or other body part(s) to access or operate a keyboard, mouse, touch screen or switch
- As language development begins at infancy, beginning to use eye-gaze for communication should start at an early age for those with which its appropriate.
- Beginning trials at OSB for use as a communication device for students with limited movement and speech difficulties.

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Communication Cont.

- Communication
  - Tobii Dynavox (Communicator 5)
  - PRC (Essence)
    - Combines spelling with word prediction
  - Smartbox Grid 3
    - Text
    - Symbols
  - VisuALS

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Teaching to Communicate

- Games
- Photos
- Animations

Eye-gaze users should be interacting with their eyes as much as possible

Eye-gaze for communication is very taxing and learning to do so is a process

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Communication Matrix (Dr. Charity Rowland): Non-speaking individuals, including, but not limited to pre-symbolic forms such as body language, facial expressions and vocalizations, augmentative and alternative forms of communication and typical forms of communication such as speech and writing.

Seven Levels of Communication

Level I. Pre-Intentional Behavior

- Not under control
- Reflects state
- Caregiver interpretation

Level II. Intentional Behavior

- Under their control
- Not used to communication with intention
- Caregiving interpretation

Level III. Unconventional Communication

- Intentional communication
- Not socially acceptable

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Matrix cont.

Level IV. Conventional Communication

- Intentional communication
- No symbol (pre-symbolic)
- Socially acceptable

Level V. Concrete Symbols : Symbolic Communication starts here!

- ***Symbols resemble what they represent***

Level VI. Abstract Symbols

- ***Not similar to what they represent***

Level VII. Language

- ***Combining icons***
- ***Understanding that different combinations mean different things***

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Core vs Fringe

We want this process to be as efficient as possible for our students/clients, as it is very tiring

CORE

- More
- Stop
- On
- That
- Want
- In
- Turn

FRINGE

- Tuesday
- Spaghetti
- Circle Time
- Uncle Joe
- Shoelaces
- Ball Pit

Spontaneous Novel Utterance Generation(SNUG) vs Pre-Stored Sentences

SNUG

- Allows person to say anything at any time
  - Most things we say in conversation were things never said before
- Keep vocabulary consistent with age
  - For typical development, children start with word and word combinations, not full sentences
    - “Today is November 14th, 2017 and the weather is cloudy and cold.”

Pre-Stored Sentences

- Faster; however…
- limit what can be said
- Rarely useful
- Doesn’t typically occur in conversations

Aided Language Stimulation

- Teaches symbol meaning
- Modeling students language
  - Verbal output
  - Selection of device
- Key rules
  - During motivating and reoccuring routines
  - RESPOND to their communication with natural consequences
  - Expand upon their utterance
  - Model their target language, plus a word or two

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Vibrotactile Stimulation

- Vibrotactile Stimulation allows a person to feel a very wide range of sensations through pressure receptors in their skin and body.
  - When vibration is applied to the skin, fast-acting mechanoreceptors are activated.
- Vibration feedback provides an “event cue”
  - an indication that something has occurred

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How we are using Vibrotactile Stimulation

- **SUBPAC:** “a wearable technology that pulses sound through your body. A patent pending, high fidelity, full-body experience.”
- **3 LAYERS OF IMMERSION**
  - HAPTICS: Receptors on skin register vibrations on surface.
  - PROPRIOCEPTION: Receptors in muscle detect subtle change in force and pressure.
  - BONE CONDUCTION: Vibrations pulse through bones to the inner ear and are sensed as hearing.

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SUBPAC cont…

- Alerting
  - Understimulated
  - Drowsy/Tired
  - Multi-Sensory Approach
- Hearing Impaired
  - Pairing the SUBPAC with EyeGaze Trials as well as music during morning meetings to provide the vibro-tactile and Proprioceptive feedback
  - Provides enhanced sensation and perception of physical sound

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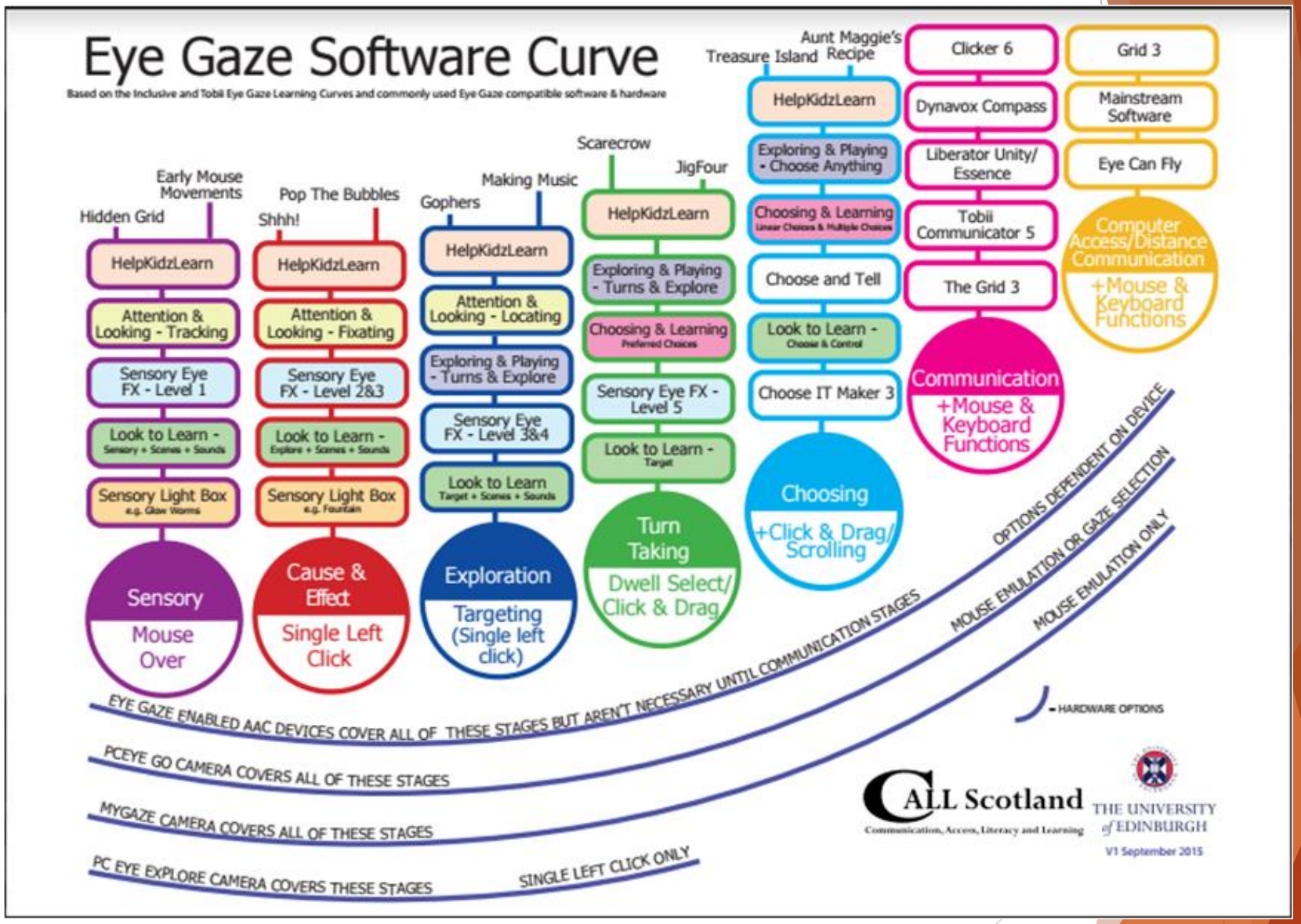

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Where to obtain a trial

PATTAN:

http://www.pattan.net/category/Resources/Short%20Term%20Loan

Pennsylvania's Initiative on Assistive Technology (PIAT):

http://disabilities.temple.edu/programs/assistive/atlend/

Tobii-Dynavox (Funded Trial Program):

trials@tobiidynavox.com

Prentke Romich Company:

Contact a PRC Consultant

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Funding (via Tobii Dynavox)

1. Consult an SLP: Your Speech-Language Pathologist will conduct an Augmentative and Alternative Communication/Speech Generating Device (AAC/SGD) assessment to determine your communication needs. The SLP will help you determine what type of device is most appropriate for you.
2. Physician Prescription After consulting with your SLP, you or your therapist will need to forward a copy of the speech evaluation to your physician. The physician will need to complete and sign a prescription and complete any state Medicaid required forms. It is also recommended to ask your physician to write a letter of medical necessity and provide documentation of your most recent Face to Face.
3. Complete & Submit Funding PacketComplete the Tobii Dynavox funding packet, which consists of the Client Information Form, The Assignment of Benefits Form, The Speech-Language Pathologist Evaluation, The Physician's Documentation of a Face to Face Visit, The Physician's Prescription and copies (front and back) of your insurance card(s). Note: Additional documentation may be required for your specific insurer.
4. Insurance Processes the Packet (approves or denies)
5. Approval and Shipping

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Case Studies

Students that are using Eye Gaze at OSB:

- Sensory, cause & effect, complex body (Sophia)
- Trial different access methods for leisure and communication, complex body (Hanna)
- Leisure (Kevin)
- Communication (Ty)
- Planning ahead (David)

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Sophia

- Complex for positioning requires tilt and assistance with her head
- Uses eye blink or facial movement for yes/no
- Slow Process
- Swedish Arm support
- Arm & knee switches

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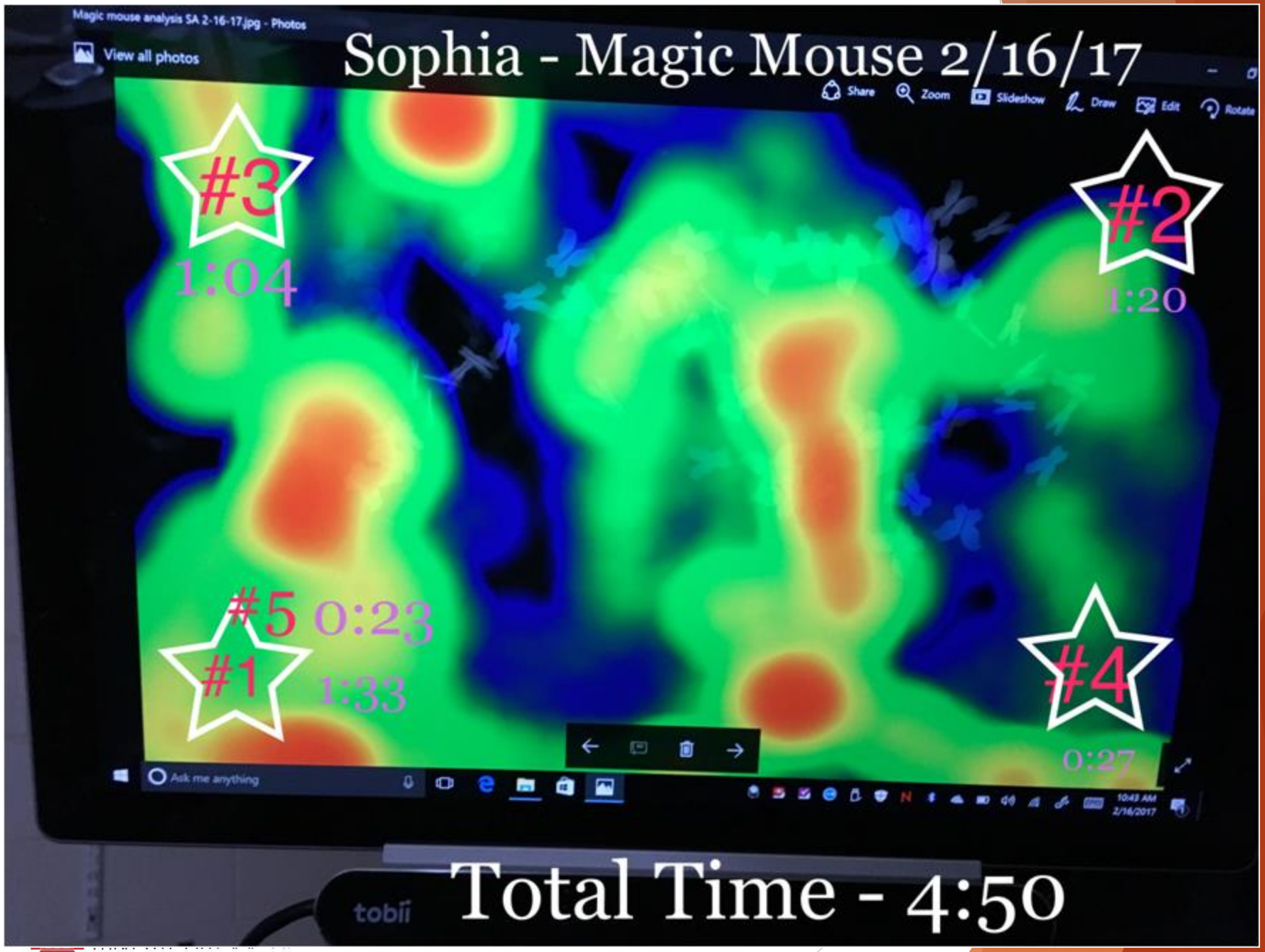
Magic mouse analysis SA 2-16-17.jpg - Photos
View all photos
Sophia - Magic Mouse 2/16/17
Share
Zoom
Slideshow
Draw
Edit
Rotate
#3
1:04
#2
1:20
#5 0:23
#1
1:33
#4
0:27
Ask me anything
tobii
Total Time - 4:50

Hanna

- Access (athetoid movements)
- More complex for positioning requires tilt and assistance with her head
- Uses traditional scan and select with Dynavox Maestro
- Slow Process for Access due to athetoid movements (Stuck in extension, arm swings out to the side, etc…)
- Relies on adult for assistance using switches(so someone always has to be there for communication to happen)

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Kevin

- More for leisure
  - Kevin is trialing an Accent for communication using Direct Access.
  - He has a difficult time accessing computer games due to decreased motor control
  - Using the eye gaze gives him faster feedback and more enjoyment than traditional computer access

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Ty

Training for communication, faster access

- Ty uses scan and select for access, communication.
- Speech is mostly unintelligible
- Slow process to communicate wants/needs and even greet peers etc.
- Beginning Eye Gaze trials to determine if appropriate means for communication in near future.
- Eye Fatigue is the biggest issue for Ty

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David

Early training due to progressive disease

- Beginning high interest leisure activities
- Speech is becoming more unintelligible
- Eventual communication purpose
- Progressing loss of motor control and muscle tone
- Slight Nystagmus but overall visual function & acuity is stable
- Pairing eye gaze with switch access or thumb controls

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References:

Augmentative and Alternative Communication Decisions. (n.d.). Retrieved October 17, 2017, from https://www.asha.org/public/speech/disorders/CommunicationDecisions/

[Brochure]. (n.d.). Retrieved from http://www.helpkidzlearn.com/downloads/EyeGaze_Guidebooks/HelpKidzLearn-EyeGaze-Leaflet-US-Web.pdf

Rowland, C. (n.d.). Communication Matrix. Retrieved October 23, 2017, from https://legacy.communicationmatrix.org/sevenlevels.aspx

Clark, C. (2013, May 8). Let's Talk AAC Blog: Stories and Strategies for Success. Retrieved October 19, 2017, from https://aaclanguagelab.com/blog/eye-gaze-and-motor-planning-for-communication-and-language

Aided Language Stimulation [ICAN Talk Clinics]. (2017, October 23). Carnegie, PA.

How eye tracking works. (n.d.). Retrieved November 10, 2017, from http://www.tobiidynavox.com/how-eye-tracking-works/

Roman-Lantzy, C. (2018). *Cortical visual impairment: an approach to assessment and intervention*. New York, NY: American Foundation for the Blind.

SUBPAC 101. (n.d.). Retrieved November 10, 2017, from http://www.subpac.com/subpac-101/

Questions?
Thank you for attending this session

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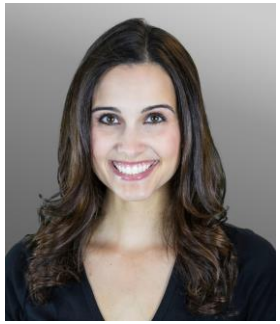

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