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Electronic Tools for the Assessment and Rehabilitation of Post-Stroke Visual Impairments

Dr Kathleen Vancleef

Dr Alison Lane

What is visual perception?

How we see:

Signals travels from your eyes to the back of the brain.

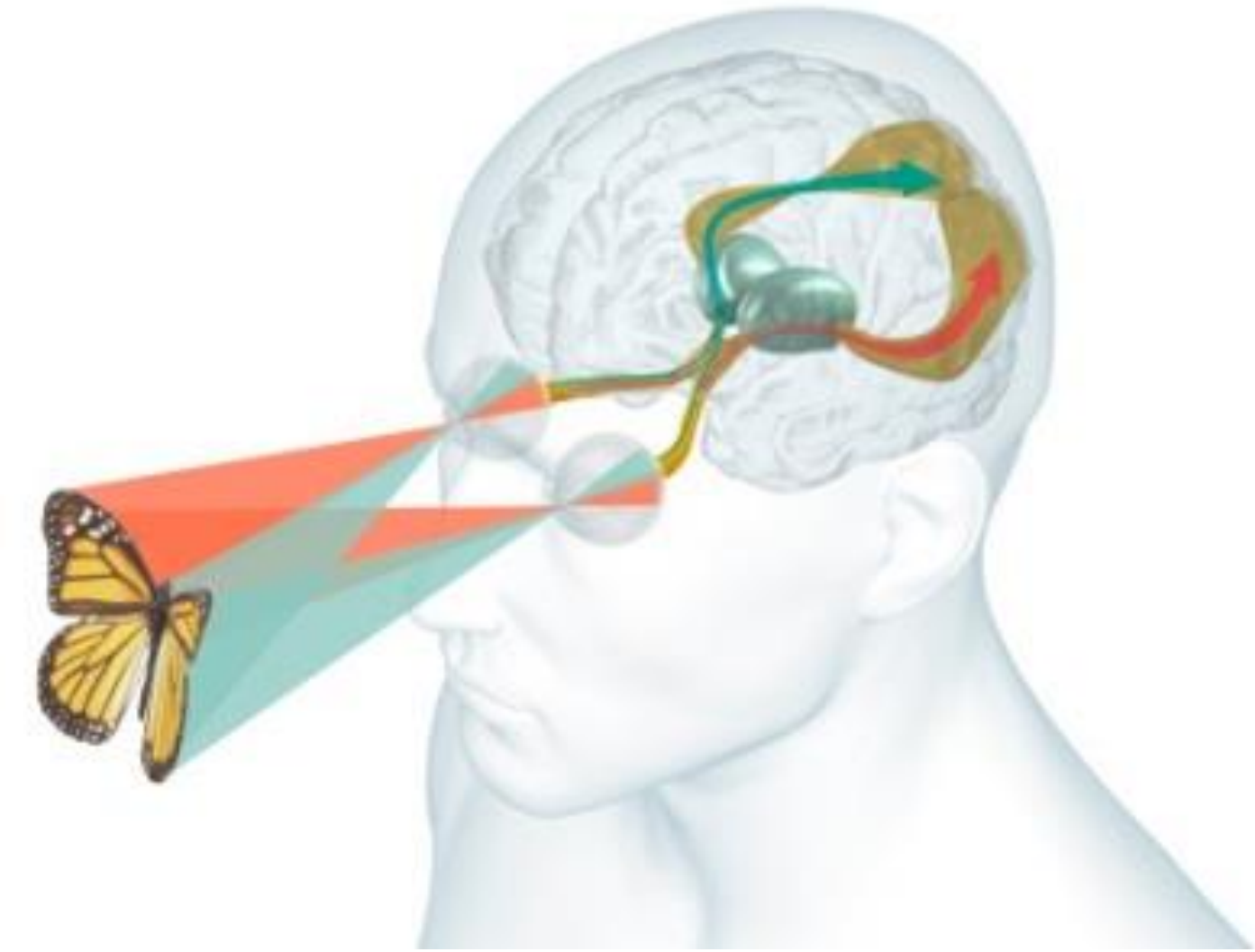

Image: http://cs336.stanford.edu/slides/RPDM_Lecture3_ImageFormation.pdf

What is visual perception?

The signals don’t mean anything to you while it travels.

Only when the message arrives, you can start trying to understand it.

Images: http://cs336.stanford.edu/slides/RPDM_Lecture3_ImageFormation.pdf
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https://www.shutterstock.com/image-photo/hands-young-woman-holding-handwritten-letter-611511482

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What is visual perception?

Visual perception are the processes in your brain that help you understand the message coming from your eyes.

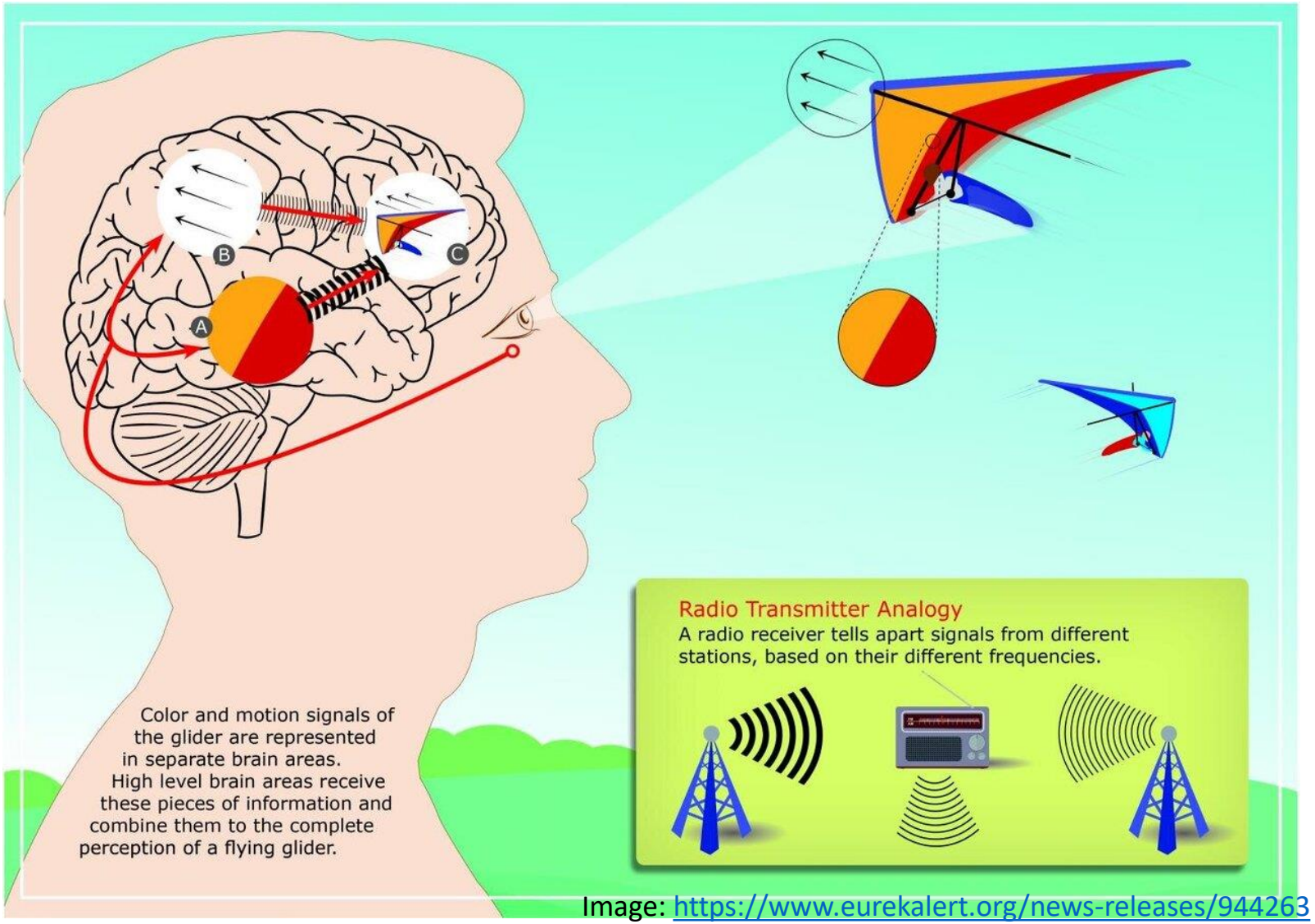

Image: https://www.eurekalert.org/news-releases/944263

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What kind of processes?

Motion

Colour

Shapes

Faces

Objects

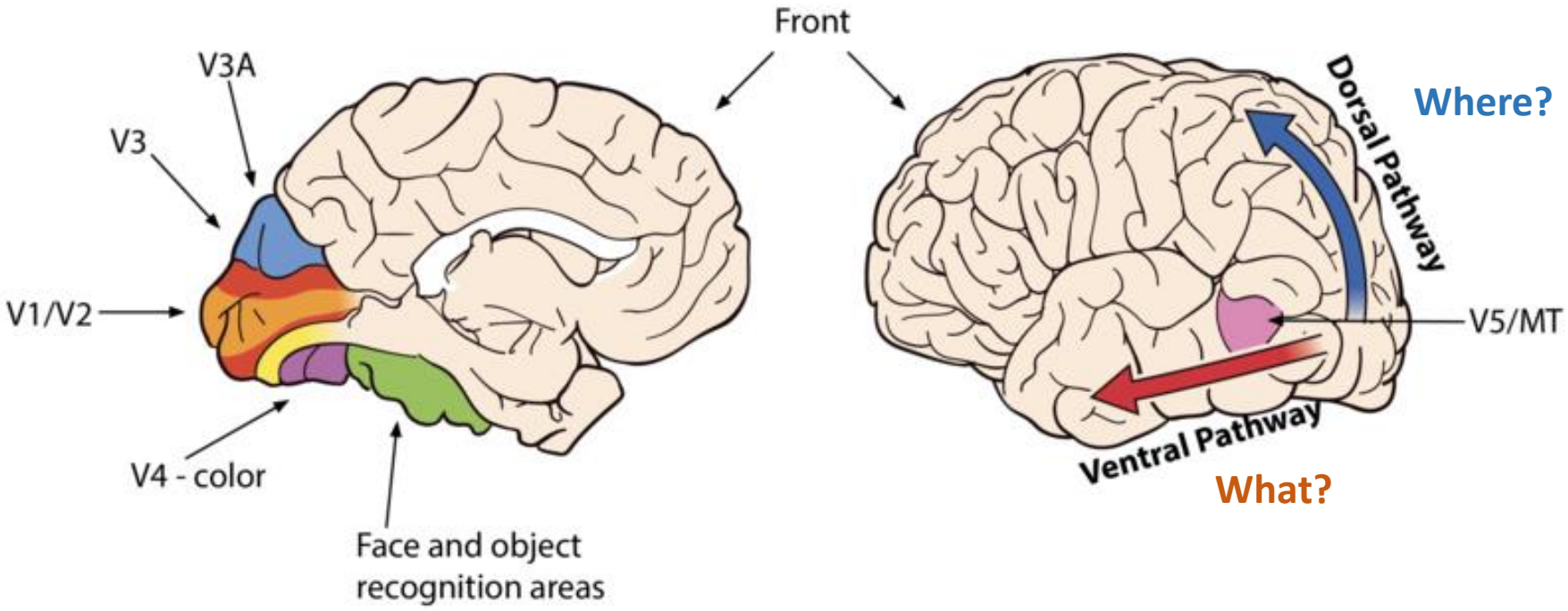

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Image: https://www.naturepagan.com/consciousness-property---space

Visual perception problems after brain injury

- Visual field

Image: https://bjo.bmj.com/content/99/5/613

Visual perception problems after brain injury

- Motion blindness

Video: https://www.youtube.com/watch?v=tYFhDzQ1rYU

Visual perception problems after brain injury

- Blindsight

Navigating Blind

Suspecting patient TN might exhibit blindsight, researchers, including Lawrence Weiskrantz (*shown with TN*), asked him to walk down a cluttered hallway, telling him it was empty. TN avoided all the obstacles, even though he remained unaware of them and of his meandering path.

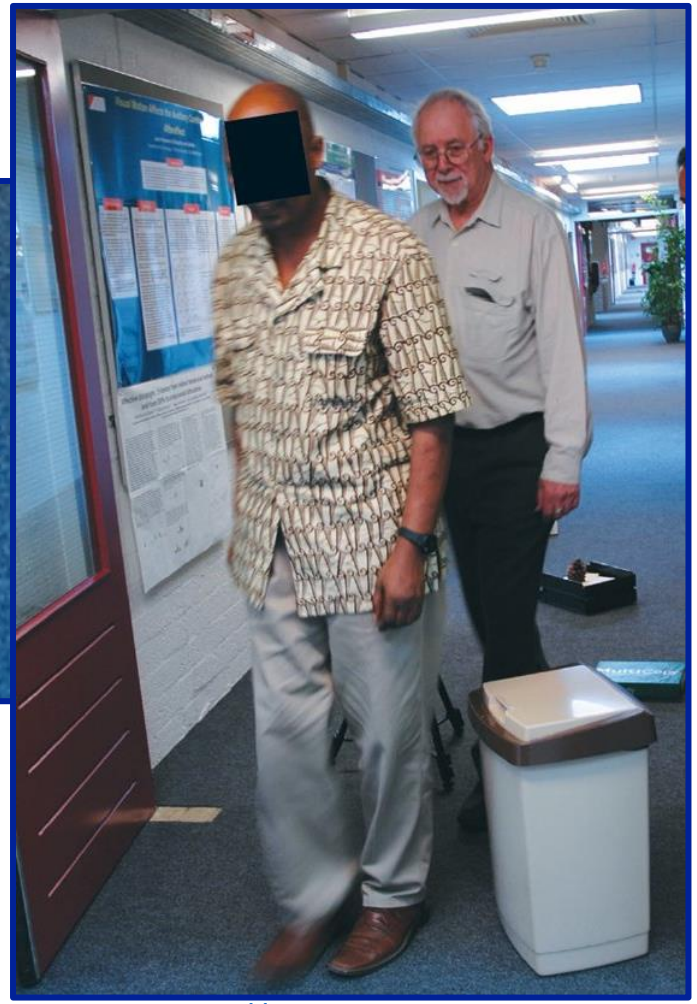


Image: https://www.scientificamerican.com/article/uncanny-sight-in-the-blind/

Visual perception problems after brain injury

- Colour blindness

Image: https://www.fightingblindness.ca/eyehealth/eye-diseases/achromatopsia/

Visual perception problems after brain injury

- Simultan-agnosia

Patients suffering from Simultanagnosia and Balint's syndrome will only report the features they are presently looking at but will not be able to understand the contents of the scene.

Image: Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983).

Visual perception problems after brain injury

- Object agnosia

Video: https://www.youtube.com/watch?v=ze8VVtBgK7A

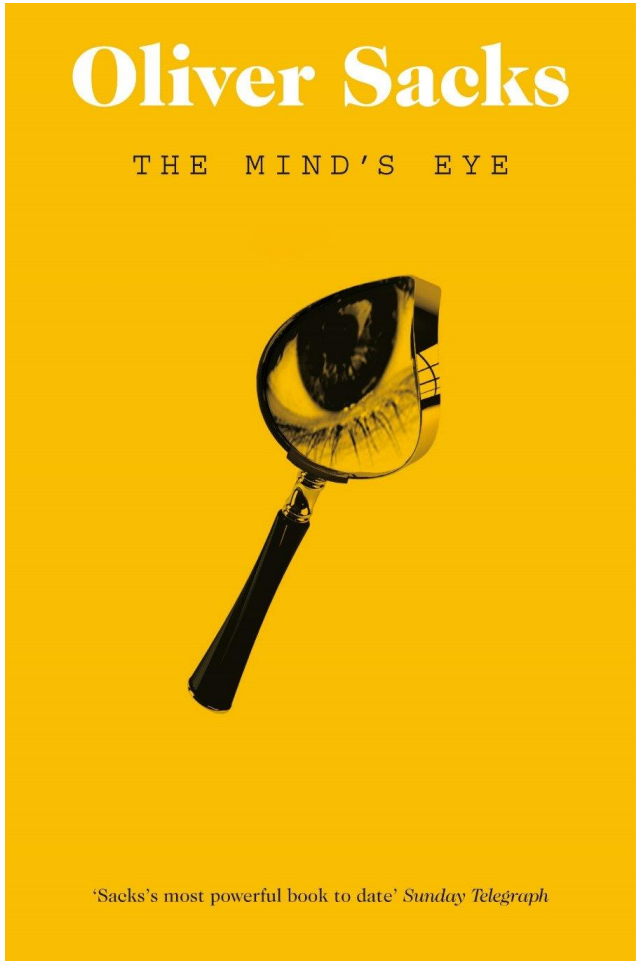
Visual perception problems after brain injury

- Face blindness

Video: https://www.youtube.com/watch?v=-vQGPcYfIAo

Visual perception problems after brain injury

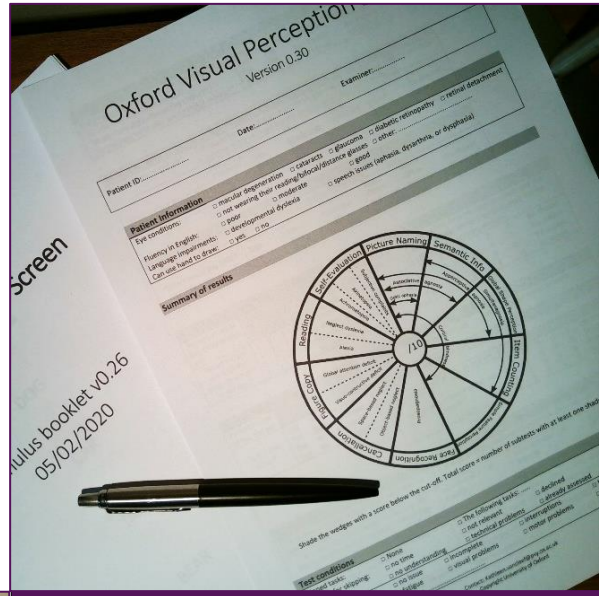
- Word blindness

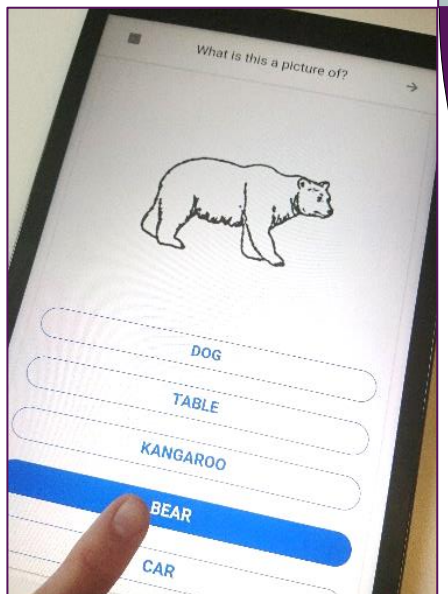


Oxford Visual Perception Screen

- 10 - 15 minutes
- Screening not diagnosis

- Developed with feedback from stroke survivors





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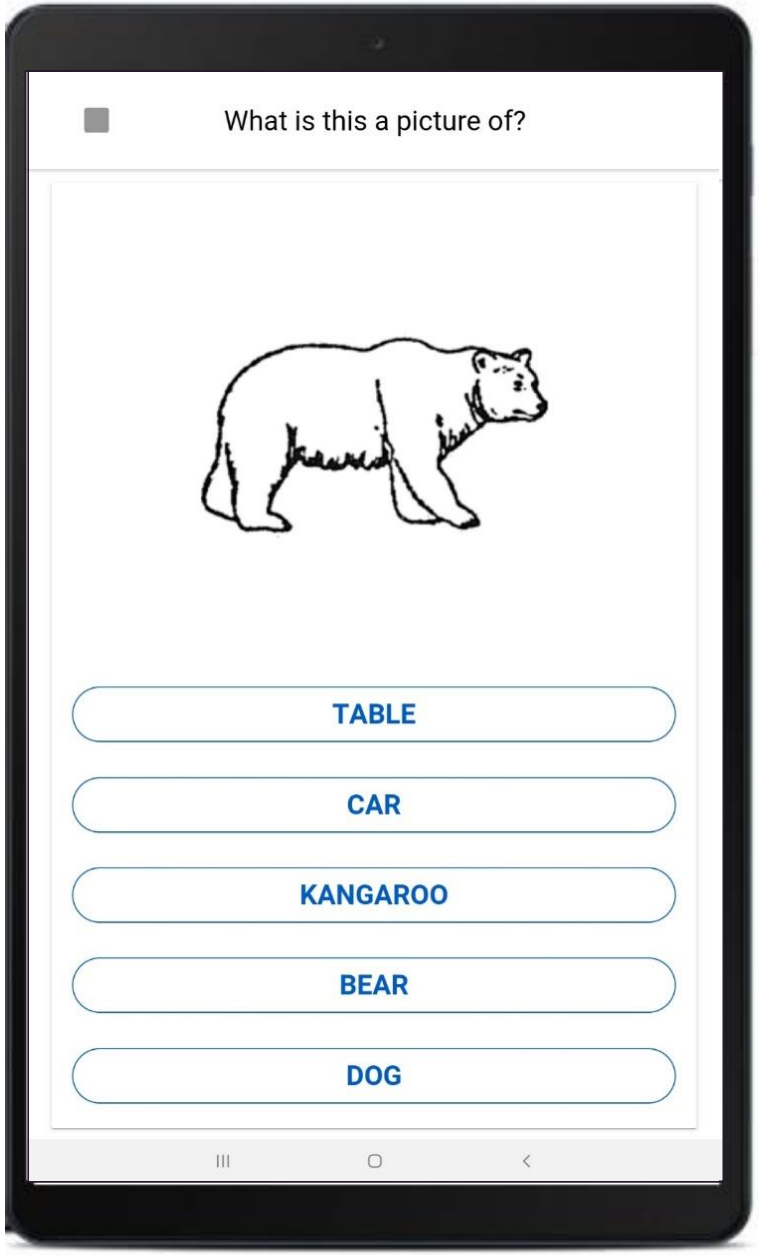
Solution: Fast and easy to use screening test



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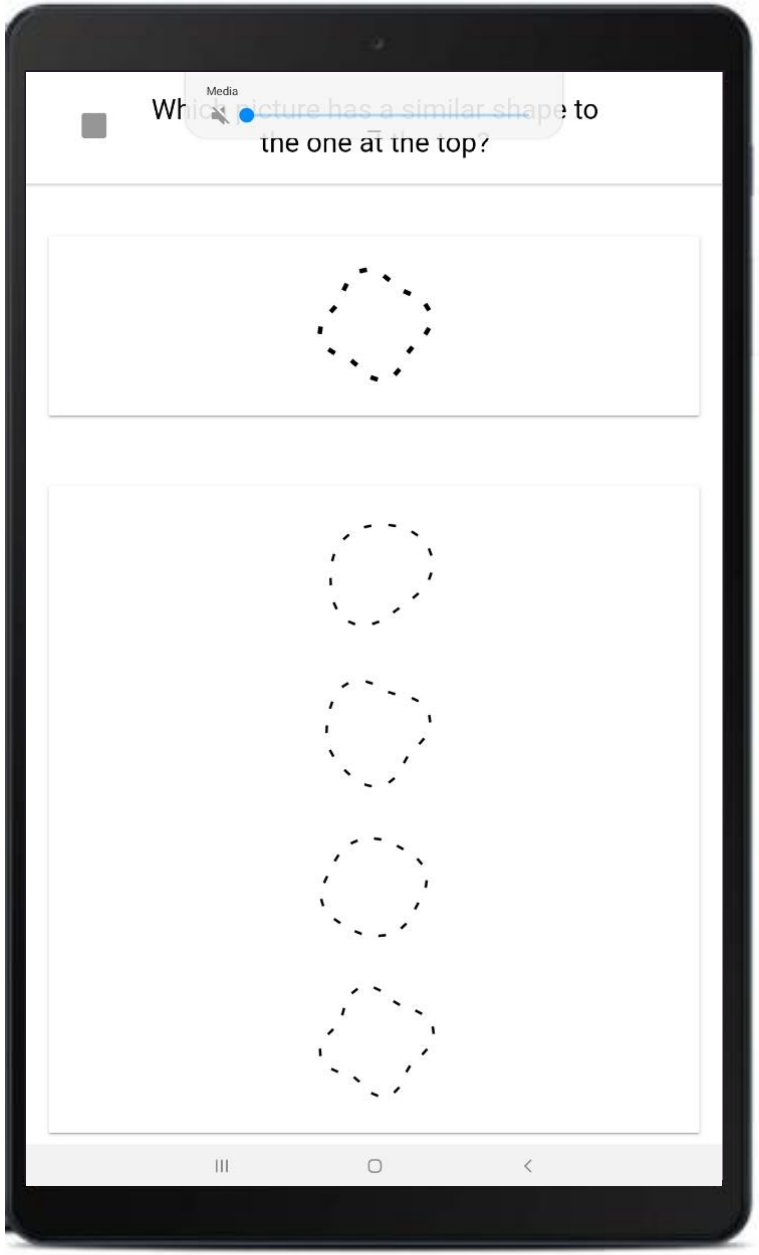

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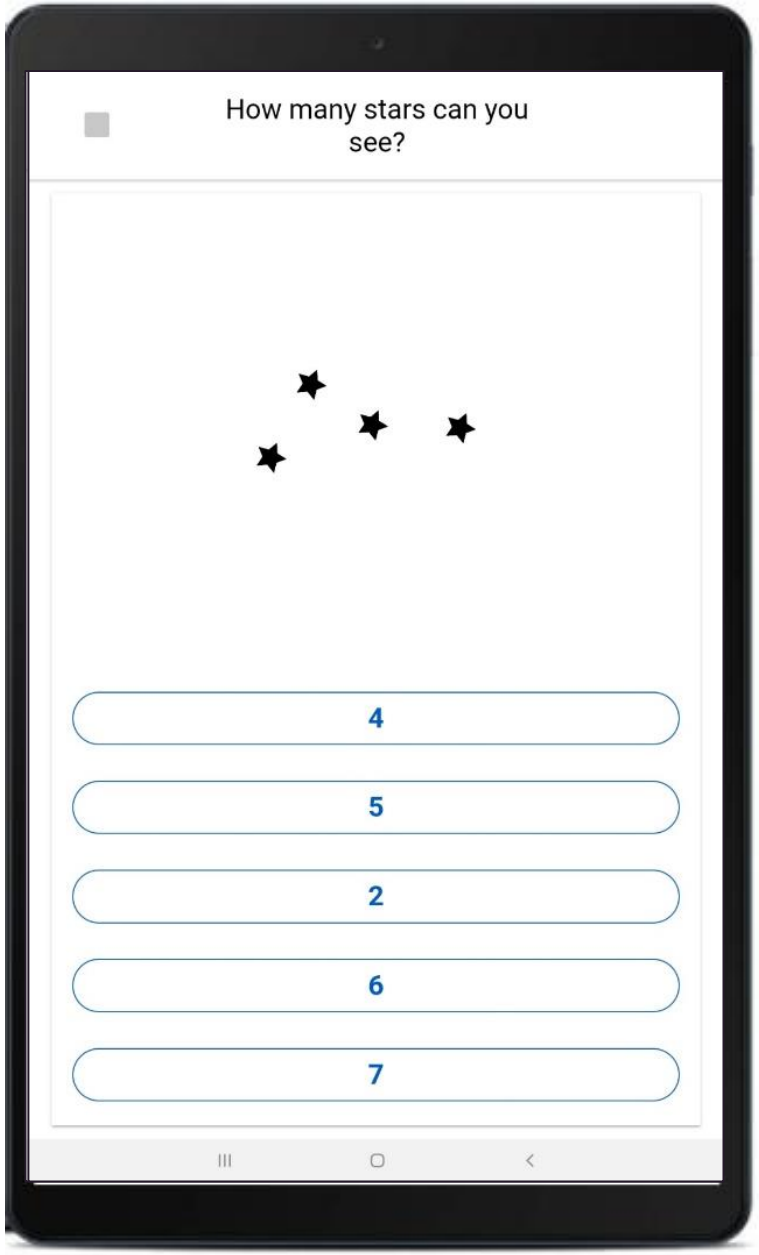

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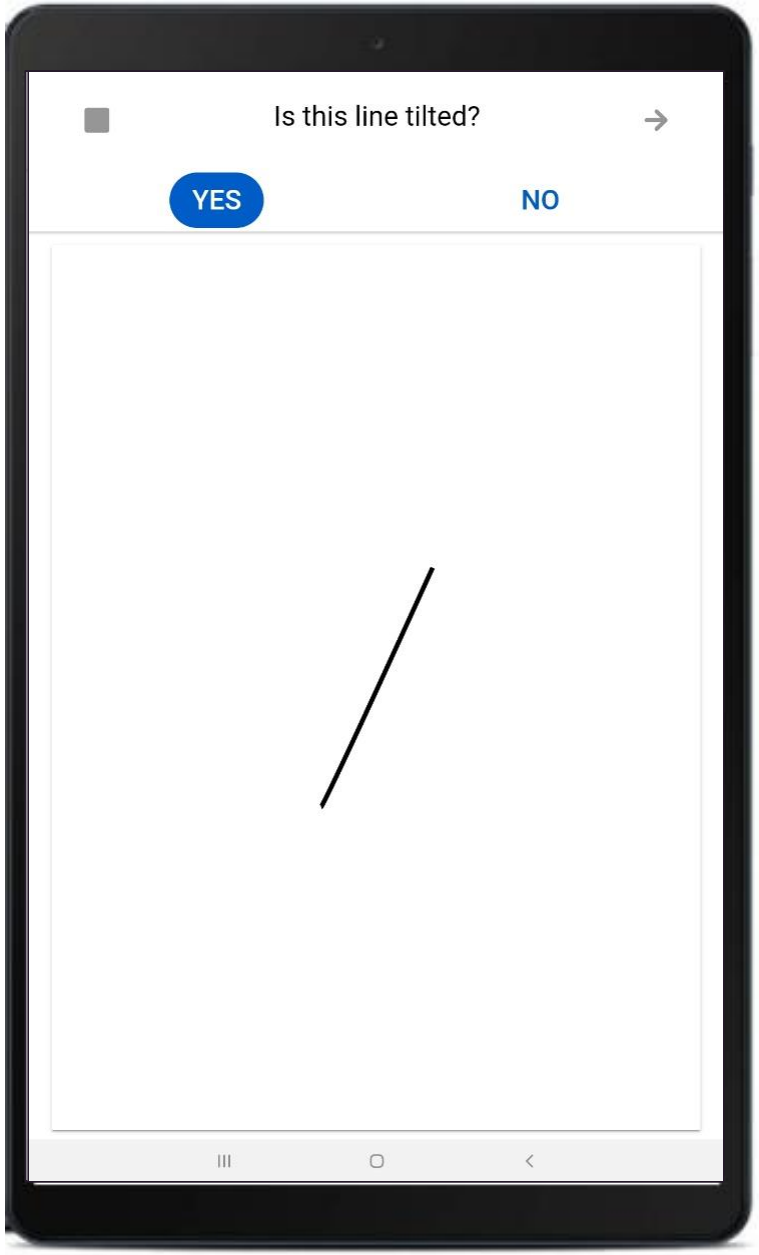

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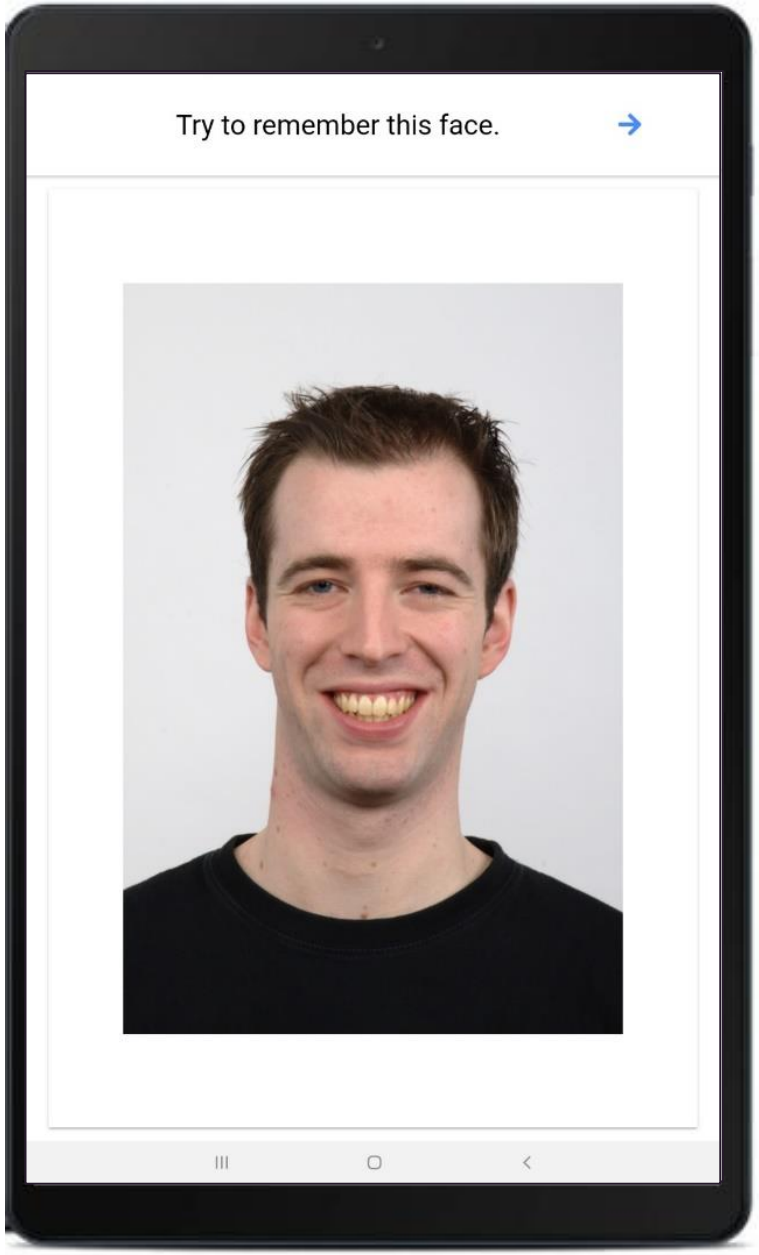

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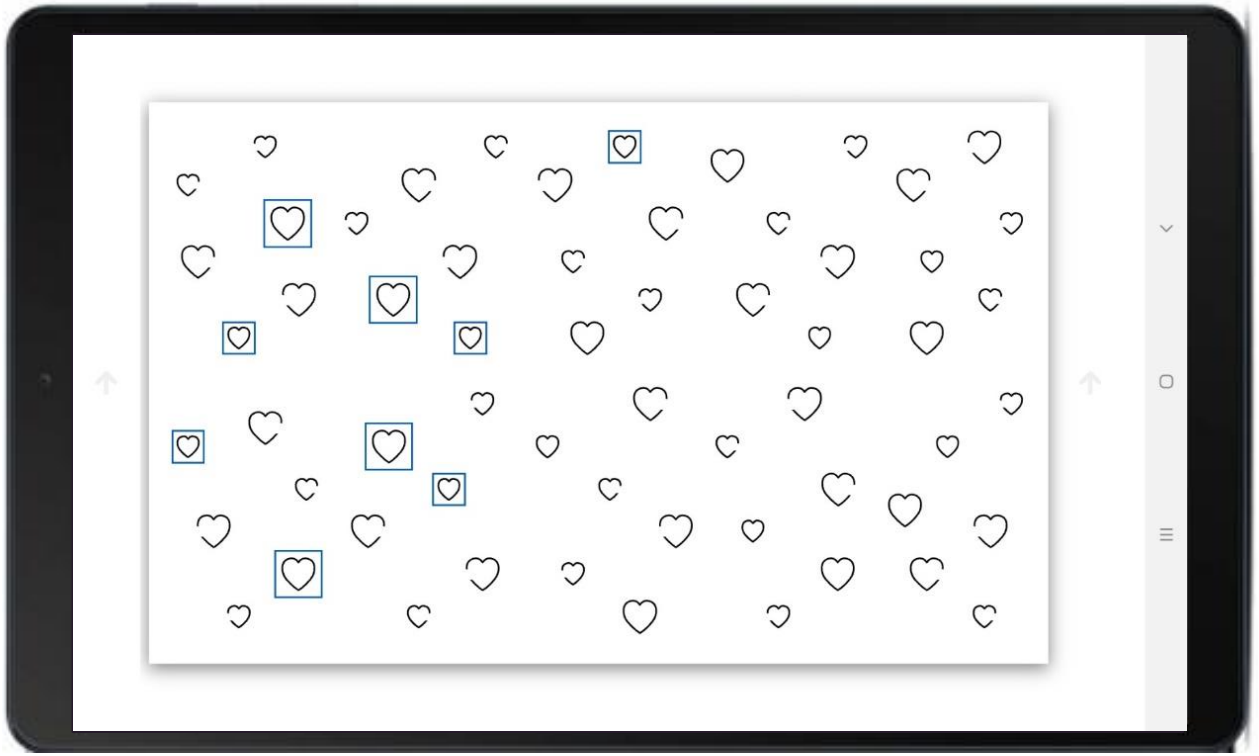

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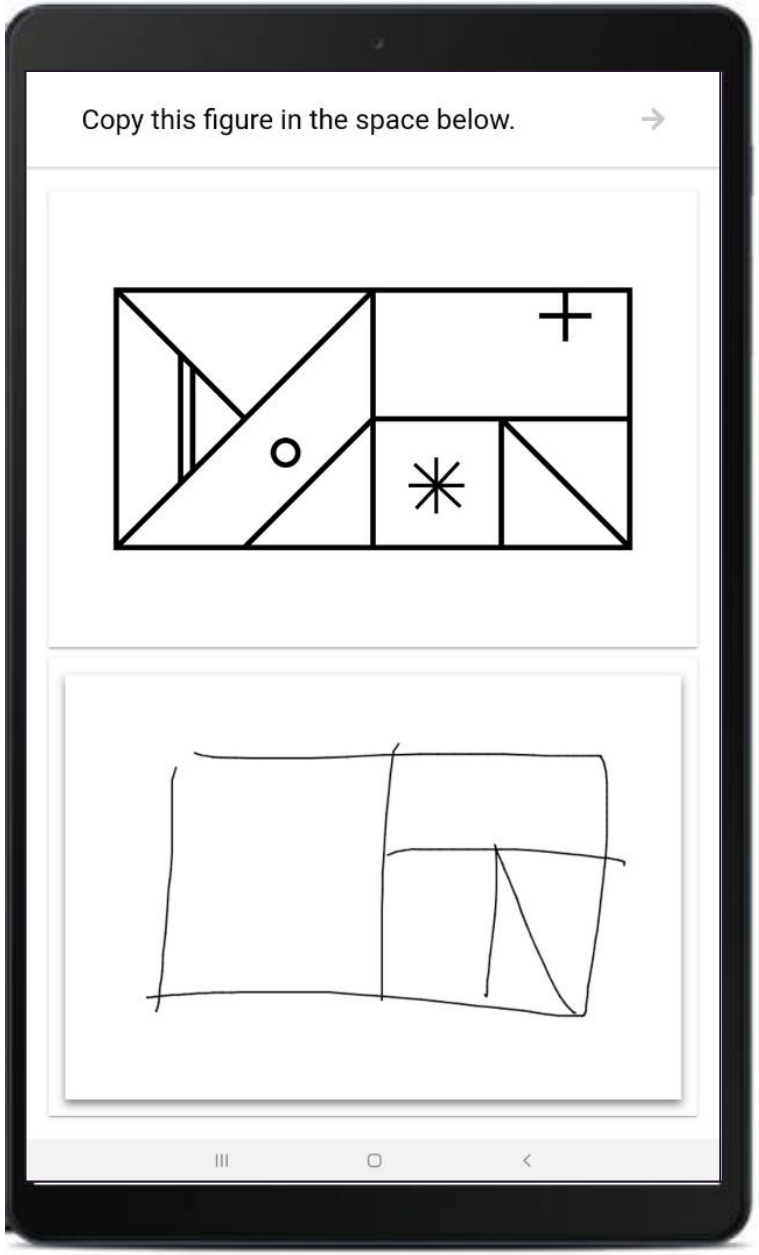

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Solution: Fast and easy to use screening test

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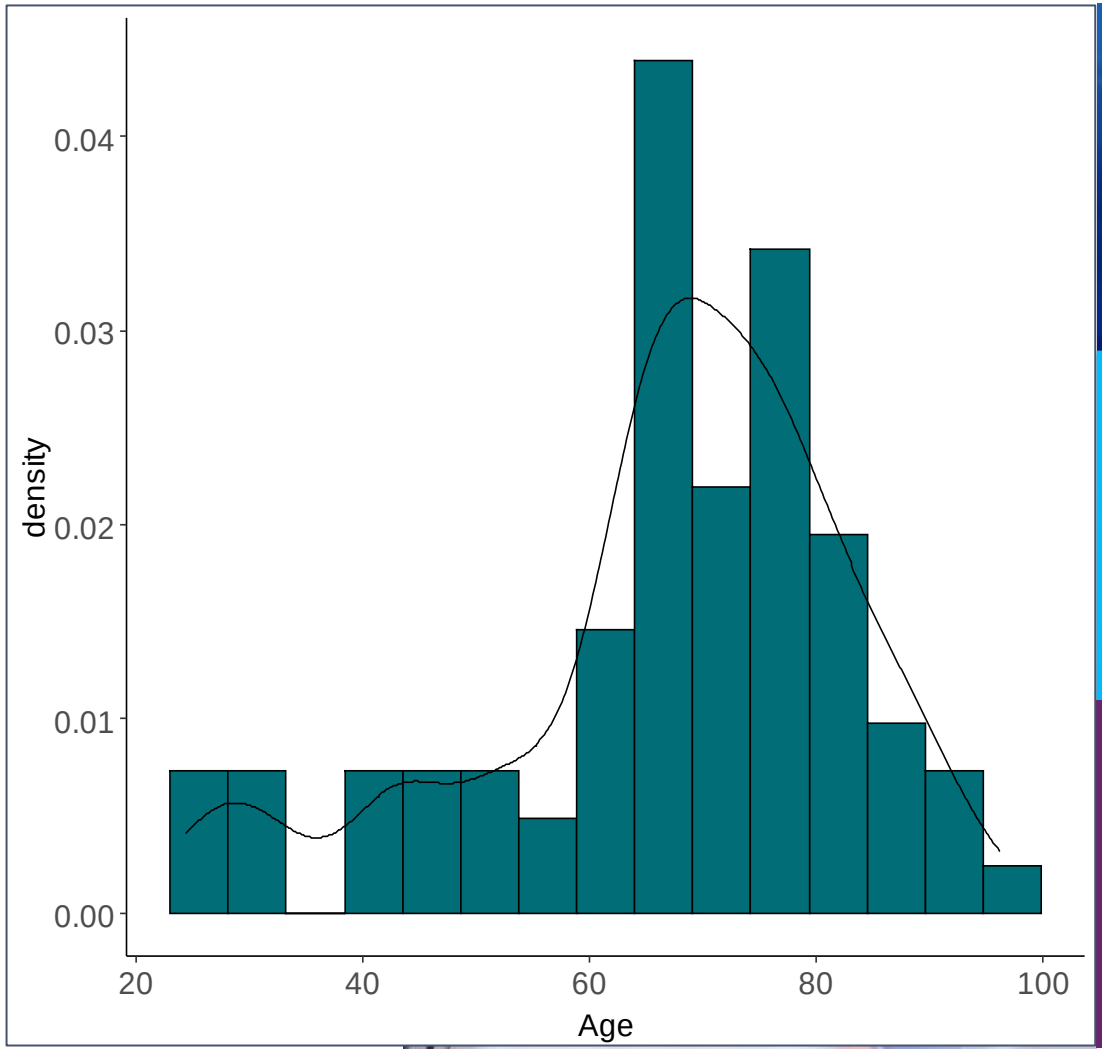
What is a normal score?

80 healthy volunteers

Mostly online data collection

53 women, 27 men

Average age = 67 yrs



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Does it really measure visual perception?

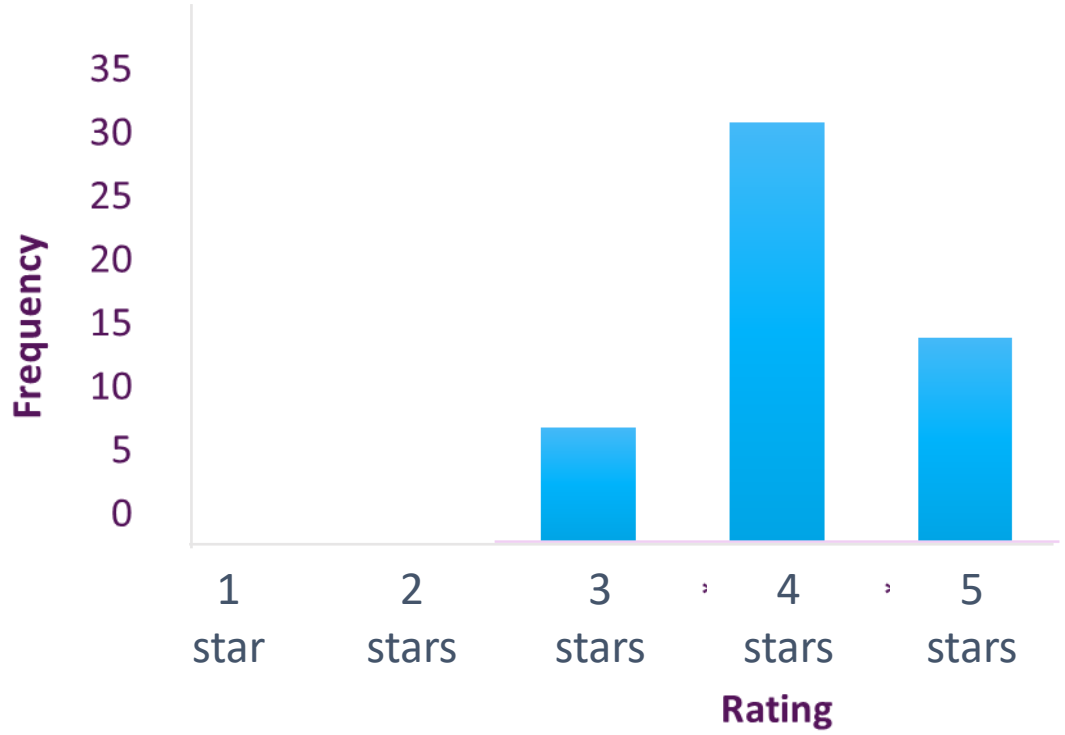
Compares to a gold standard test, OxVPS

- Picks up 85% of patients with visual perception problems
- Correctly categorises 95% of patients without such problems

Picks up subtle problems

Self-report: 20%
My test: 75%

What do clinicians think of it?



Would you use it?

Yes: 100%
No: 0%

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Thanks to

Michael Colwell

Federica Guazzo

Xiatong Ding

Sam Webb

Philip Clatworthy

Olivia Hewitt

Mihaela Dutta

Thibaut Lestang

Fergus Cooper

Nele Demeyere










Future plans

Version 2.0

Diagnostic accuracy

Rehabilitation advice

Available in ~ 3 years time

SUPPORTED BY
NIHR | National Institute for Health Research

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Electronic Tools for the Assessment and Rehabilitation of Post-Stroke Visual Impairments

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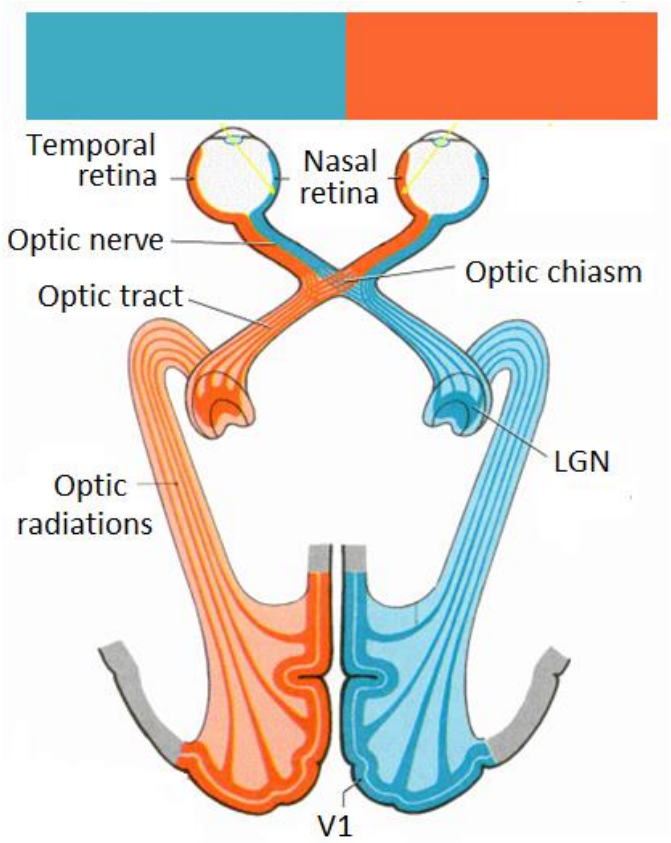
Visual Field Defects



Up to 25% of stroke survivors can develop visual field loss *(Rowe et al., 2013)*

Problems:

reading, navigation, shopping,

crossing the street, etc.

social and emotional functioning

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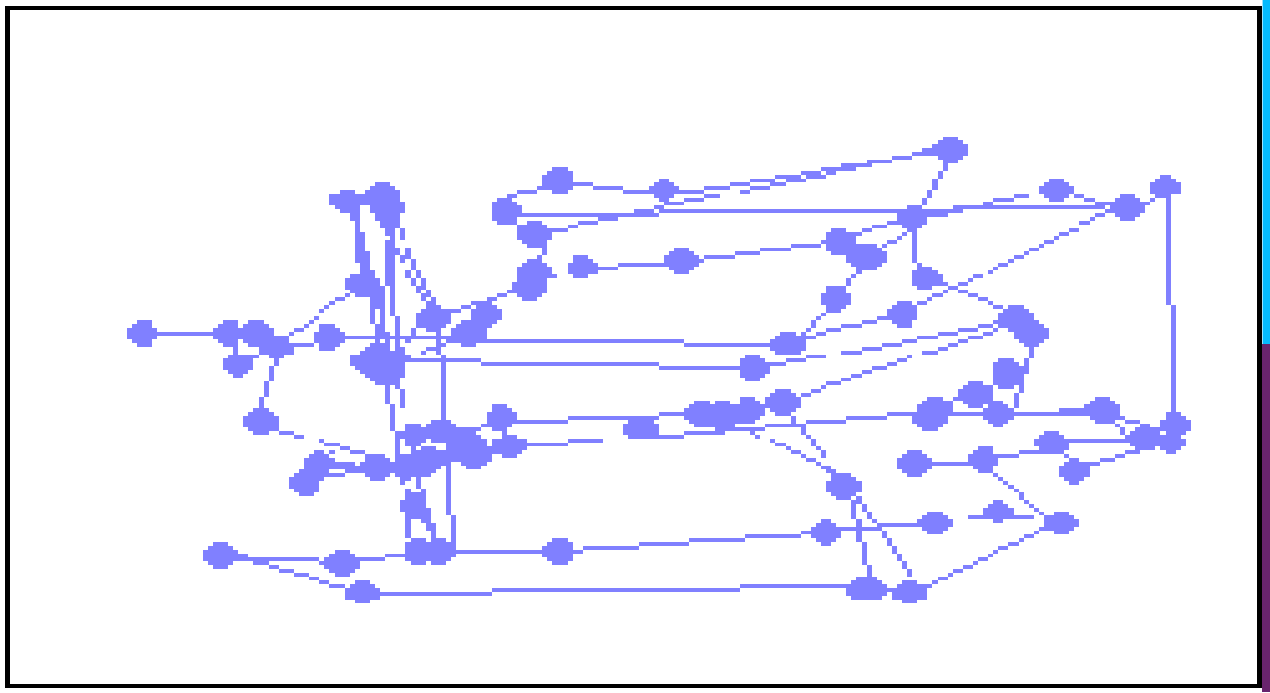
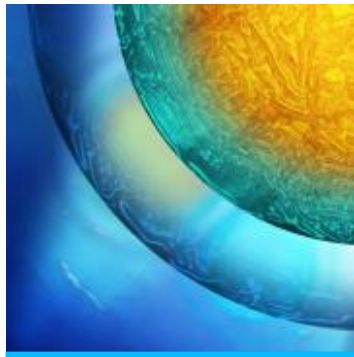
Limited spontaneous restitution *(Kasten et al., 1999)*

The maximal period of spontaneous recovery is typically three months *(Zhang et al., 2006)*

Patients may try to adapt to their visual loss.

BUT many patients' eye-movements are still disorganised 14 months after onset *(Kerkhoff, 1999)*





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Treatment

A good systematic treatment for hemianopia is not widely available within the NHS

Aim of compensatory training is to improve the efficiency of eye-movements for exploration of the visual scene

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Previous studies have demonstrated significant search improvements following saccadic training *(Kerkhoff et al., 1994; Pambakian et al., 2004)*

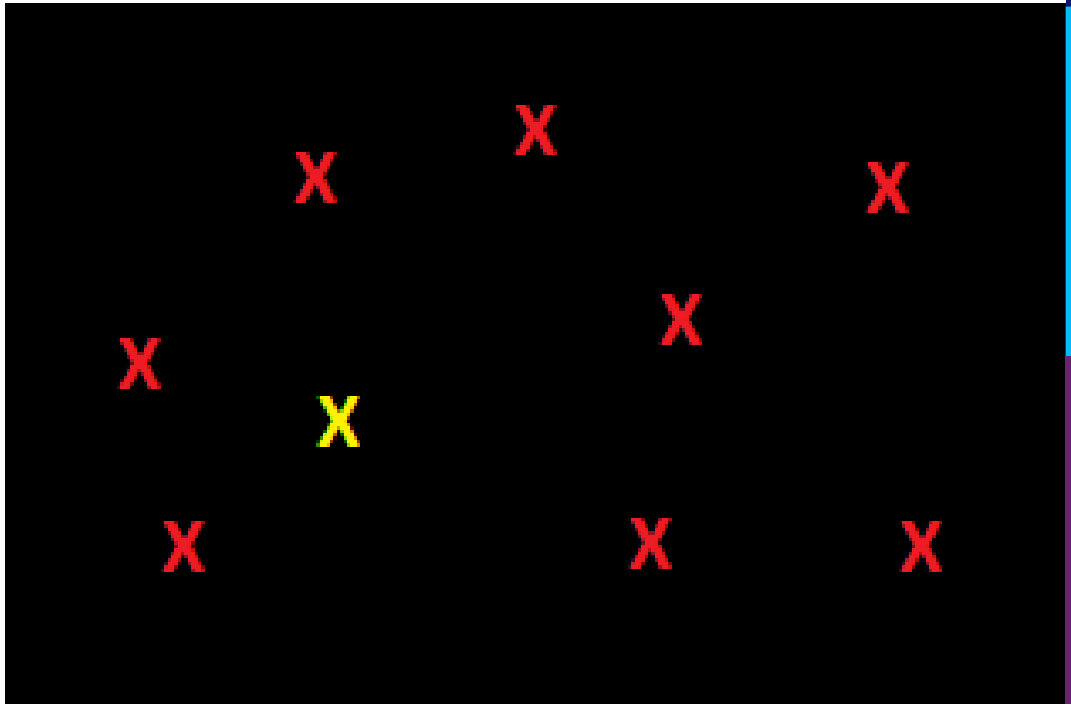
Post-training increase in mean saccadic amplitude and reduced length of the scan-path *(Zihl, 1995)*

Improvements can be maintained for at least 22 months *(Kerkhoff et al., 1992)*

The Evolution of DREX

Lane et al. (2010) *Brain, 133,* 1717-1728

- Exploration training



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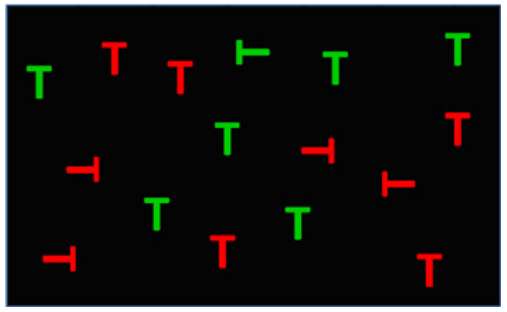
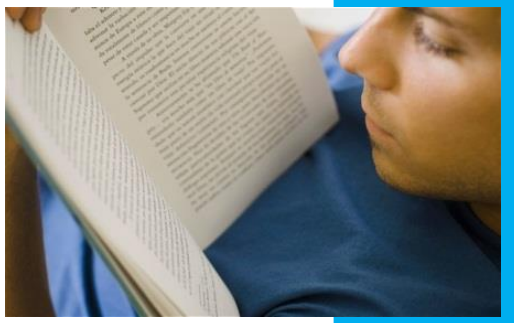
BUT:

- Specificity of training benefits



Exploration

Reading



- Costs associated with training

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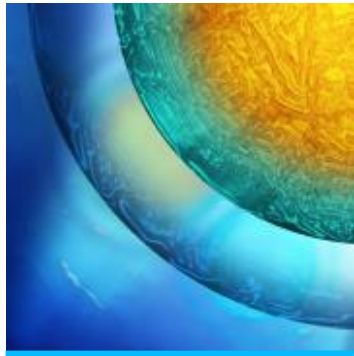
Aimola, Lane et al. (2015) *Neurorehabilitation and Neural Repair, 28,* 207-218

Self-adjusting computer-based visual training allowing users to train independently

Incorporates tasks to improve both visual exploration and reading



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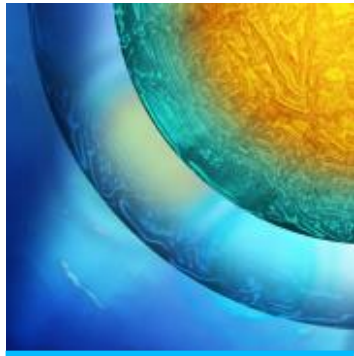
carrot

carrod

larrot



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BUT:

Issues surrounding ease of access and implementation

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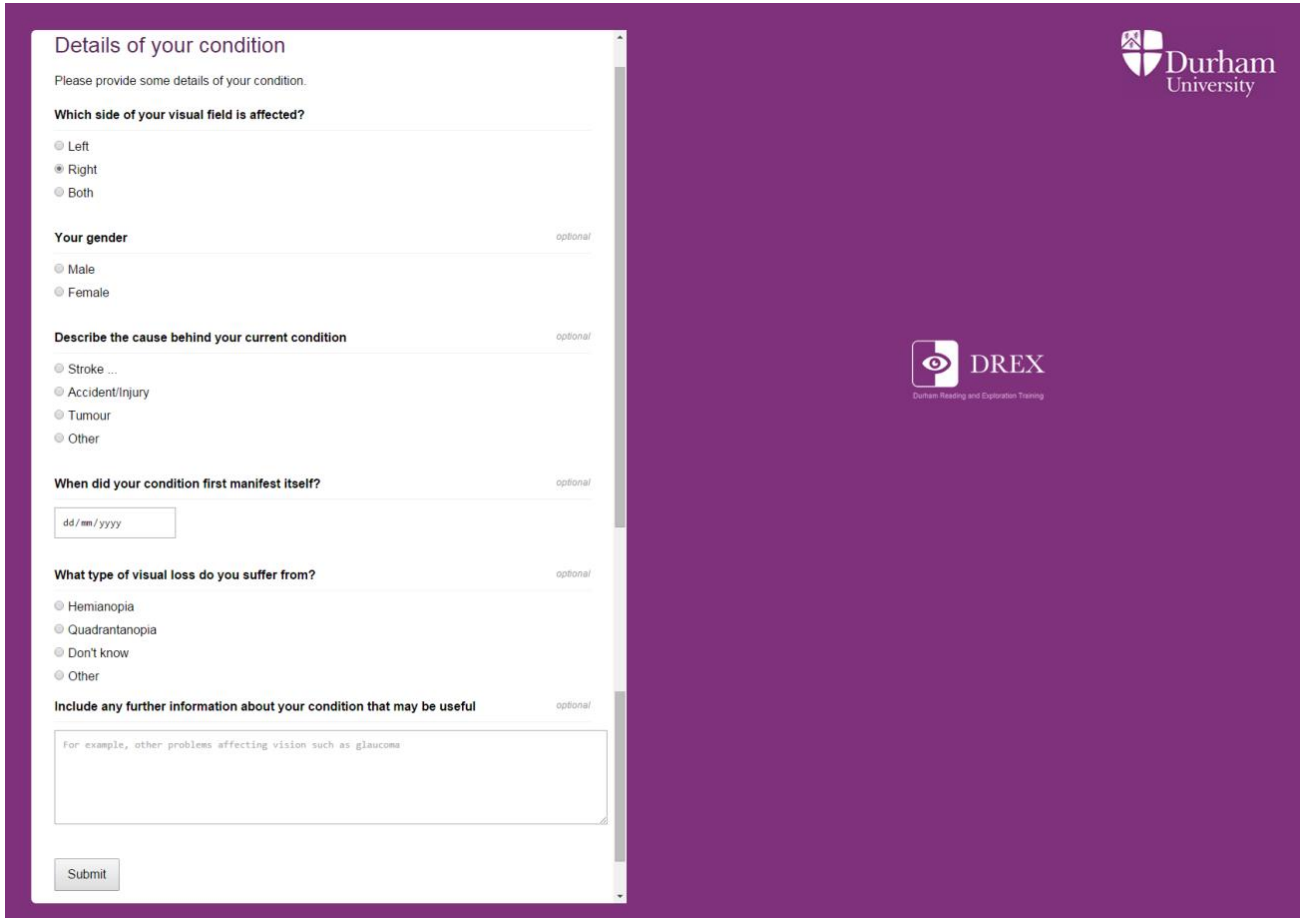
Durham Reading and Exploration (**DREX**) Training App

www.durham.ac.uk/drex



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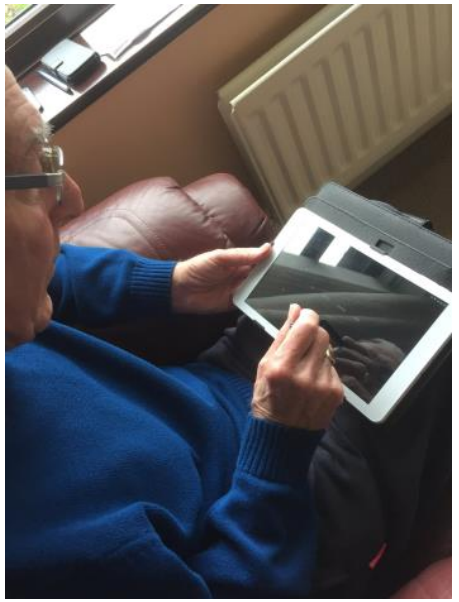
Key features:

Multiplatform

Free

No permanent internet access required

Touch screen



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Application Settings

How many training exercises do you want to complete in each sitting?

- (•) 30 (3 mins)
- ( ) 60 (6 mins)
- ( ) 90 (9 mins)

Adjust the touch duration to improve sensitivity when touching the screen

- (•) Normal
- ( ) Long
- ( ) Very long

If you wish to share data with your clinician, enter their reference number here

Clinician reference number | Check

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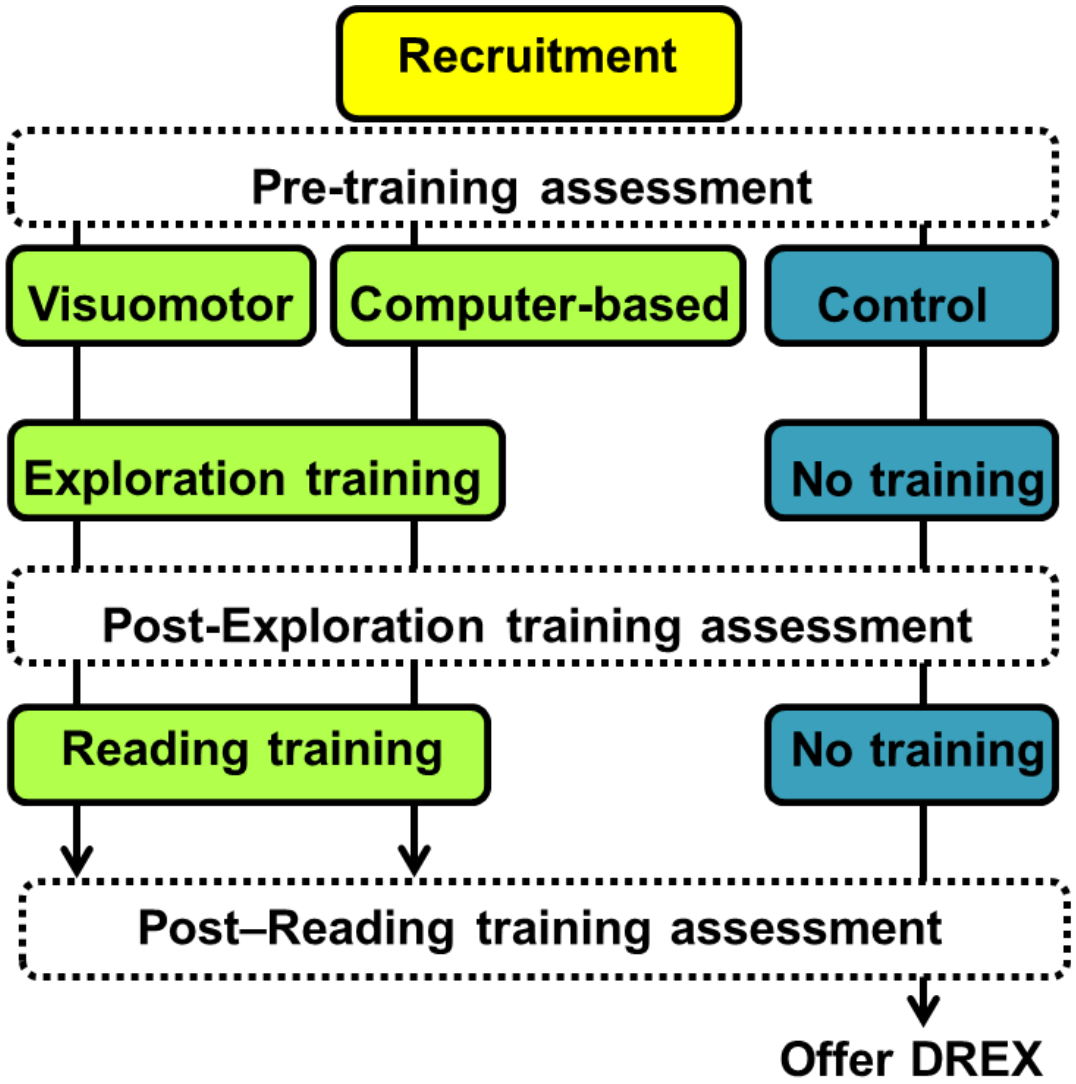
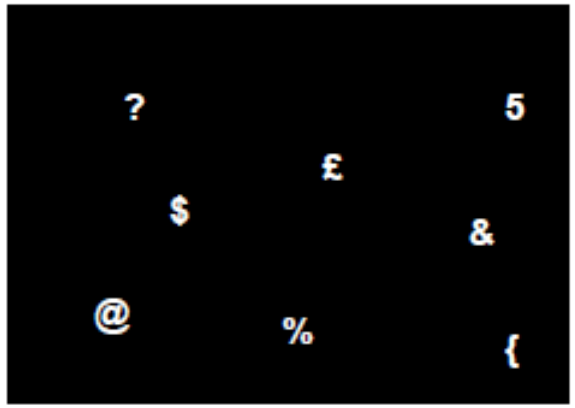
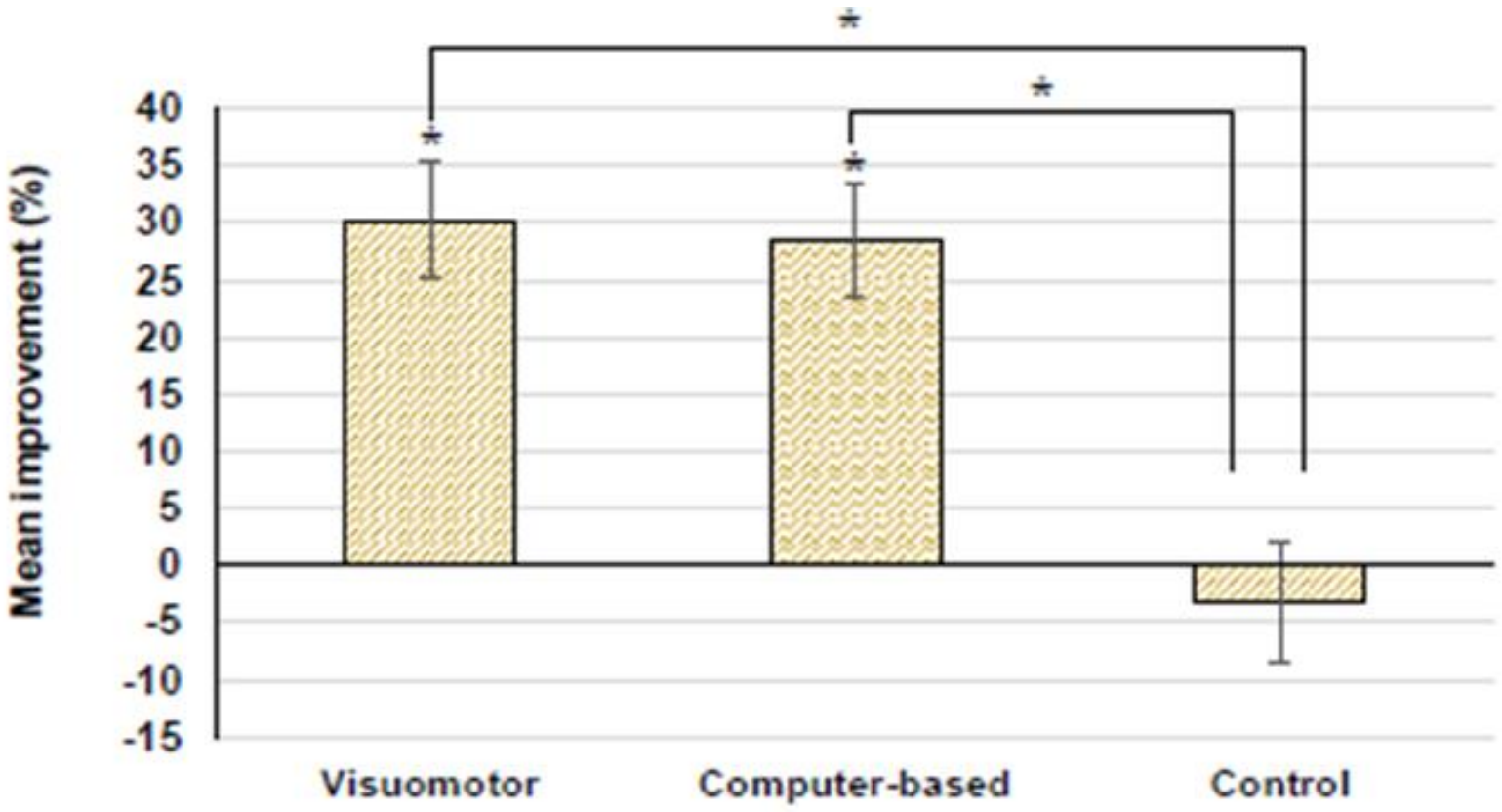

Recruitment
Pre-training assessment
Visuomotor
Computer-based
Control
Exploration training
No training
Post-Exploration training assessment
Reading training
No training
Post–Reading training assessment
Offer DREX

Primary outcome measures:

- Visual search (response time and accuracy)



- Corrected reading speed



Bar chart illustrating the mean improvement (%) in **visual search** performance for the visuomotor, computer, and control groups. Error bars represent the standard error of the mean. Significant difference (*).

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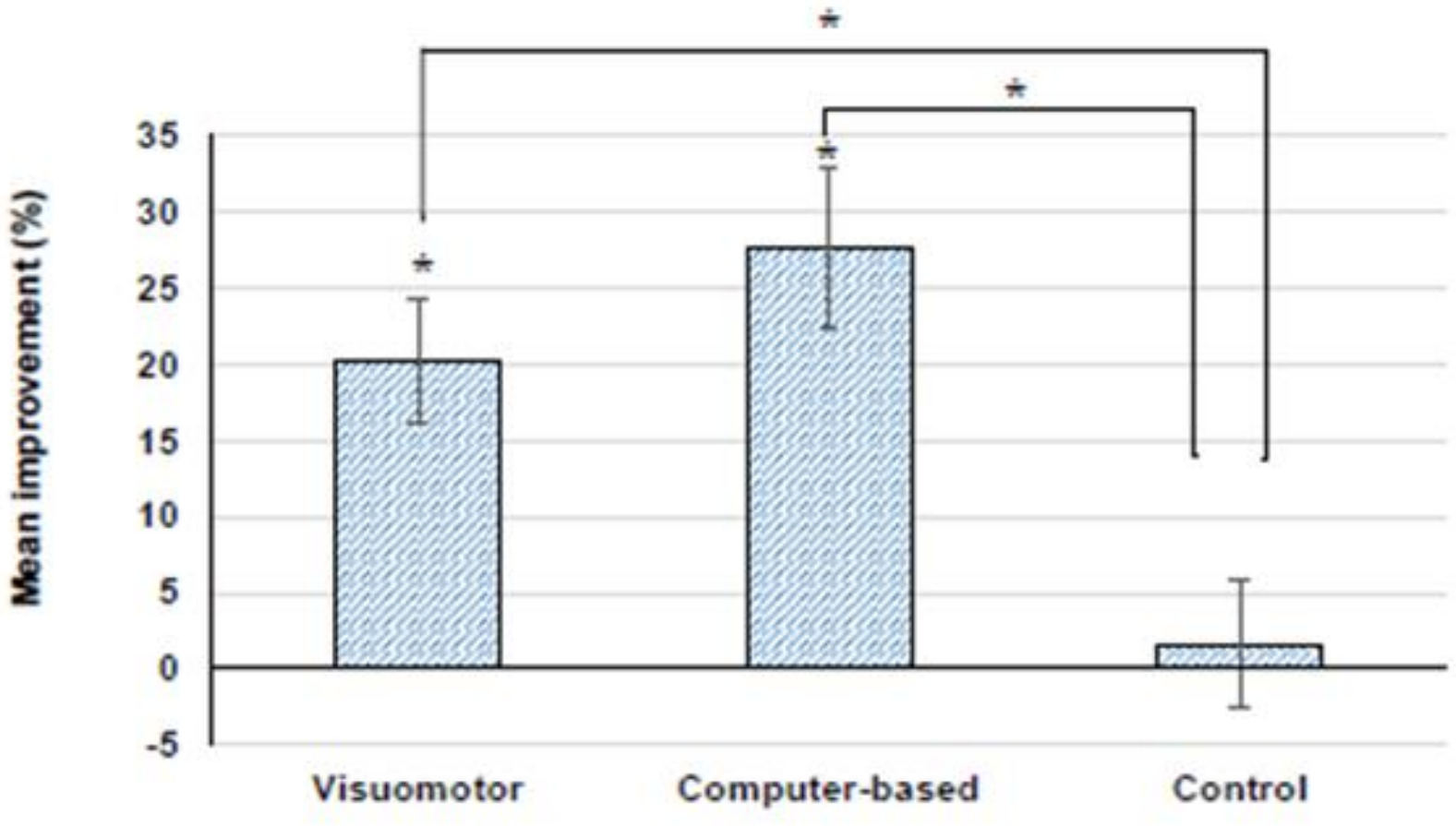

Bar chart illustrating the mean improvement (%) in **reading** performance for the visuomotor, computer, and control groups. Error bars represent the standard error of the mean. Significant difference (*).

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The Future?

Comorbidities

Conclusion

Many visual perception problems are missed in current clinical practice.

OxVPS can help the underdiagnosis. It is as good as a gold standard test, and 4 times faster. It also picks up the more subtle problems.

The DREX app is an accessible and effective rehabilitation tool for individuals with visual field defects.

“This app is so incredibly helpful”

“An amazing bit of kit”

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Thank You

Prof Thomas Schenk, Prof Amanda Ellison, Prof Dan Smith, Prof David Mendelow, Prof Georg Kerkhoff, Prof Gary Ford, Dr Lina Aimola, Dr Neil Archibald, Dr Stephen Dunne, Nicola Richards, Dr Azuwan Musa