EyeSwift ®PRO

EYE TRACKING
BASED VISION ASSESSMENT

NovaSight

A Clear Future Ahead

ABOUT EyeSwift ®PRO

Accurate vision assessment at the earliest age is imperative for proper eyesight development

- The EyeSwift®Pro is a quick, accurate, and affordable visual assessment system based on advanced eye-tracking technology, to be used by any trained individual.

- The system incorporates test glasses - active and passive - in order to automatically control the content seen by each eye, and to allow for automatic occlusion.

- Designed both for pediatric and adult patients, the EyeSwift®Pro requires minimal patient cooperation – patients simply watch fun short, animated videos.

- No language or verbal skills are required for most of the tests, so even very young children can be tested.

- The EyeSwift®Pro delivers quantitative assessment of multiple vision deficits.

Accurate

Objective

Easy to use

Dynamic

Children friendly

Fast

EyeSwift®PRO

AN EYE TRACKING BASED VISION ASSESSMENT

- The EyeSwift®PRO tests are grouped into automated 'protocols' by category (such as amblyopia monitoring, binocular vision, digital strain, reading, etc).

- Each protocol performs the relevant tests, and outputs a clear report which can be easily understood by the operator, as well as by the patient or parent.

COMPREHENSIVE VISION TESTS

- Stereoacuity
- Fixation stability
- Nystagmus
- Automated contrast sensitivity
- Suppression (W4D)
- Fusional vergence
- Color test
- Latent deviation (phoria)
- Reading analysis
- Manifest deviation (tropia)
- Ocular motility
- Simulated visual acuity
- Manual visual acuity

EyeSwift®PRO

EyeSwift ®PRO PROTOCOL OUTPUT

AMBLYOPIA MONITORING

- Comprehensive amblyopia monitoring
- Synergetic to CureSight™
- Amblyopia risk factors
- Eye deviation (tropia and phoria)
- Automated visual acuity with distance simulation
- Fixation stability
- Stereoacuity
- Suppression (W4D)

MYOPIA MONITORING

- Automated visual acuity with distance simulation
- Eye deviation (tropia and phoria)
- Recommendation for myopia control

BINOCULAR VISION

- Eye deviation (tropia and phoria)
- Ocular motility
- Fixation stability
- Treatment & lenses recommendation
- Monitoring over time

DIGITAL STRAIN

- Deficient vision at screen distance
- Latent deviation (phoria)
- Blinking rate and duration as indicators for dry eye
- Lenses recommendation

PEDIATRIC OPHTHALMOLOGY

- Nystagmus
- Eye deviation (tropia and phoria)
- Automated visual acuity and contrast sensitivity
- Presentation of results acc. to age norms
- Recommendations for further investigation

VISUAL HEALTH

- Contrast sensitivity
- Automated fixation stability
- Ocular motility

READING ANALYSIS

- Presentation of results acc. to language and age-related norms
- Reading ability progression over time
- Differentiation between ocular and non-ocular causes for deficient reading
- Recommendations for further investigation

EyeSwift ®PRO

EyeSwift®PRO Interpretation Guide

Main Test: Deviation

Sub-Test: CT (Cover Test) / ACT (Alternating Cover Test)

CT	ACT
Checks for the existence of manifest eye deviation (tropia) and measures the magnitude, direction, and type of the deviation (if found).	The test measures the maximal eye deviation.
Equivalent Manual Examination SPCT/ UPCT (Simultaneous/Unilateral Prism Cover Test)	The result includes both the manifest (tropia) and latent (phoria) components of the deviation when tropia is present, and the latent component alone when tropia is not detected.
	Equivalent Manual Examination APCT (Alternate Prism Cover Test)

Output (+ measurement units)

- Horizontal and vertical deviation results, reported in prism diopters.

Result

  o 1st letter- deviating eye (R= Right, L=Left, A=Alternating), only if a tropia was found
  o 2nd letter- direction (X =Exo, E=Eso, H=Hyper, Hypo=Hypo, L/R= Left above Right, R/L= Right above Left).
  o 3rd letter- T= tropia (only in CT).

- 'Ortho' result indicates that no deviation was detected.
- An indication for Intermittent deviation will be shown under the distance result, if detected.
- In ACT, an indication for DVD (Dissociated Vertical Deviation) deviation will be shown, if detected.
- Testing distance from screen (meters).

Graphic results

CT

- Color change with any reported Tropia

ACT

- Color change with any Esophoria or Exophoria larger than 6 diopters, or any vertical result.
- An indication for Intermittent (or DVD) deviation will be shown under the distance result, if relevant.

- **Stopwatch and speedometer-** both eyes are tracked constantly, including under the occlusion, so binocular parameters can be reported:
  - o **Horizontal Phoria break time** (time until phoria starts to reveal) in seconds.
  - o **Horizontal Phoria speed** (how fast the phoria develops) in Prism diopters to Second.

- Stopwatch and speedometer will not be shown in case the detected data was insufficient to compute the parameters, or for any case aside from horizontal phoria.

- For cases where ACT is run without a successful CT being run first, and for cases of 'Ortho' or 'Alternating deviation', the vertical deviations will not be presented with a direction (hypo/ hyper), but rather a description of which eye is positioned above the other eye- L/R (left higher than right) or R/L (right higher than left).

Cover Test
Dist. (m) **0.63**

Horizontal [Δ]
Ortho

Vertical [Δ]
Ortho

Cover Test : Tests for manifest eye misalignment by covering and uncovering each eye

Alternating Cover Test
Dist. (m) **0.66**
⚠ Bino strength was not calculated due to insufficient data

Horizontal [Δ]
0.0

Vertical [Δ]
6.0 L/R

Phoria Break Time

Phoria Speed

Horizontal [sec]

Horizontal [Δ/sec]

Alternating Cover Test : Tests for latent eye misalignment, and measures the maximal eye deviation by alternatingly covering the eyes

Main Test: Dichoptic Vergence

Sub-Test: Convergence / Divergence

Convergence	Divergence
Convergence is a simultaneous movement of both eyes inwards, normally for viewing a close object.	Divergence is a simultaneous movement of both eyes outwards, normally when viewing a receding or distant object following looking at near.
Equivalent Manual Examination Similar to prism fusional vergence measurement	
Output (+ measurement units) • Convergence break point (prism diopters) • Convergence recovery point (prism diopters) • Testing distance from screen (meters)	**Output (+ measurement units)** • Divergence break point (prism diopters) • Divergence recovery point (prism diopters) • Testing distance from screen (meters)

Graphic results

- For subjects who have convergence/ divergence capabilities greater than the maximum that can be tested by the device, or if break result is 0, there will be no breakpoint, and thus the positive/negative recovery step will not be performed. In these cases, "NB" (No Break) will be shown in the positive/negative recovery results section.

- For subjects where the break result reaches the maximal distance which can be shown on the screen, the result will be shown as ">", since the subject may have been able to achieve a better result if the test range were larger.

- For cases where convergence could not be properly tested, no result will be reported, a notice will be presented under the test name

- **Additional warnings which may be presented under the test name:**
  1. Quality issue - results may be affected - repeated test is recommended
  2. Warning regarding suspected phoria
  3. Warning regarding recovery result larger than break, potential for better results- repeated test is recommended
  4. Warning regarding stable break, recovery could not be measured.
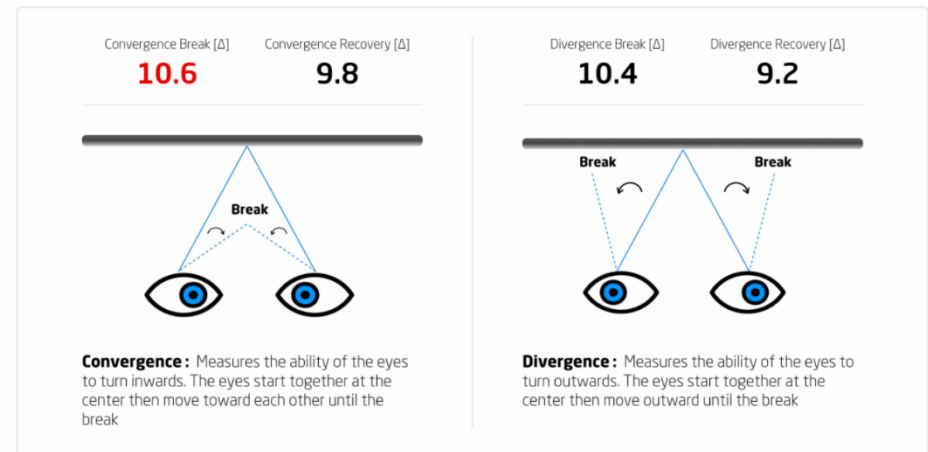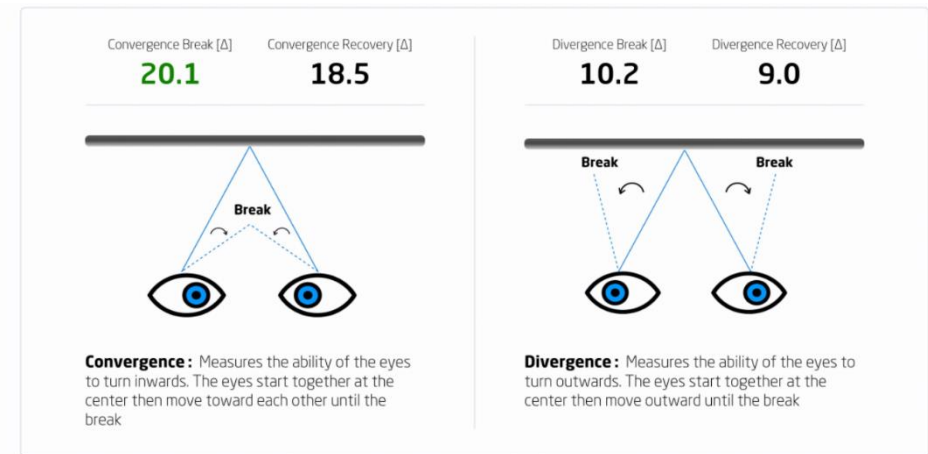
Main Test: DRA (Dynamic Resolution Acuity)

This test measures the ability to track a dynamic target, while increasing its frequency and making it harder to detect.

Equivalent Manual Examination

The minimal detected resolution is converted to visual acuity test.

Output (+ measurement units)

- The target frequency is measured in CPD (cycles per degree), and the highest detected CPD is reported as the threshold result, for each tested eye.
- The CPD result is also converted to a simulation of standard units through an empirical formula derived from clinical trials and may be reported in any preferred visual acuity measurement units (LogMAR, Decimal, Snellen in either meters of feet i.e 6/6, 20/20, etc.).
- Testing distance (intermediate or simulated far vision) is reported under the test name.
- A warning regarding result quality may be reported under the test name.
- Testing distance from screen (meters).

Graphic results

- Results are colored red when the resolution result in CPD is below the threshold for normal vision as found empirically.

DRA (sim. VA)*
Dist. (m) **0.52**
VA Measurement Distance
Intermediate

Right Eye — **8.33 CPD** (0.3 LogMAR)
Binocular — **>10.38 CPD** (<0.0 LogMAR)
Left Eye — **>11.70 CPD** (<0.0 LogMAR)

DRA: Provides information regarding the smallest aspect/ detail of an object which can be resolved by checking the ability to track targets with increasingly higher resolution
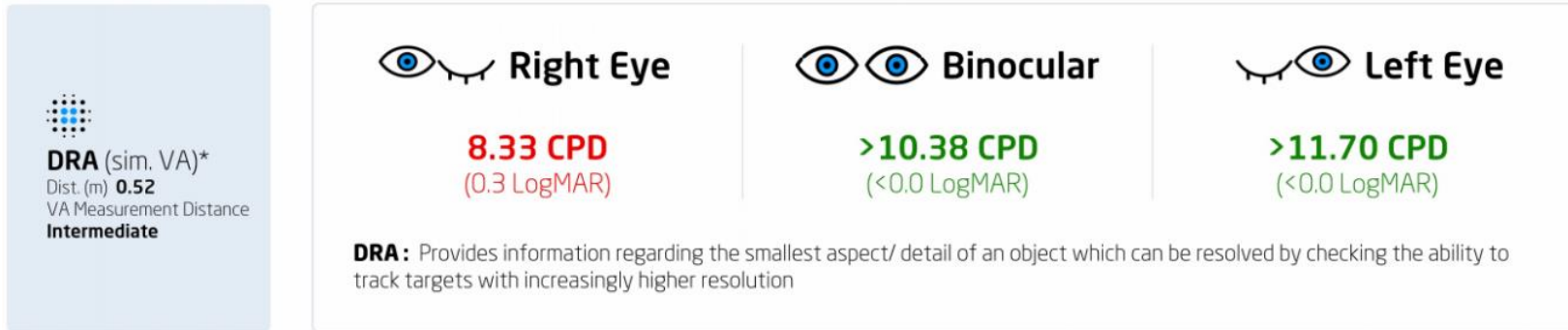
- For cases where the highest tested frequency was passed successfully, the results will be reported as ">", since the subject may have been able to receive even better results, if higher frequencies were tested.
- Examples of different units:

DRA (sim. VA)*
Dist. (m) **0.55**
VA Measurement Distance
Intermediate

Right Eye — **>13.05 CPD** (<0.0 LogMAR)
Left Eye — **8.50 CPD** (0.3 LogMAR)

DRA: Provides information regarding the smallest aspect/ detail of an object which can be resolved by checking the ability to track targets with increasingly higher resolution

DRA (sim. VA)*
Dist. (m) **0.57**
VA Measurement Distance
Intermediate

Binocular — **7.46 CPD** (.50 Decimal)

DRA: Provides information regarding the smallest aspect/ detail of an object which can be resolved by checking the ability to track targets with increasingly higher resolution

DRA (sim. VA)*
Dist. (m) **0.66**
VA Measurement Distance
Intermediate

Binocular — **>12.75 CPD** (<6/4.8)

DRA: Provides information regarding the smallest aspect/ detail of an object which can be resolved by checking the ability to track targets with increasingly higher resolution

DRA (sim. VA)*
Dist. (m) **0.53**
VA Measurement Distance
Intermediate

Binocular — **9.46 CPD** (20/25)

DRA: Provides information regarding the smallest aspect/ detail of an object which can be resolved by checking the ability to track targets with increasingly higher resolution

Main Test: Charts VA (Charts Visual Acuity)

A static recognition acuity test.

Equivalent Manual Examination

Chart based acuity test.

Output (+ measurement units)

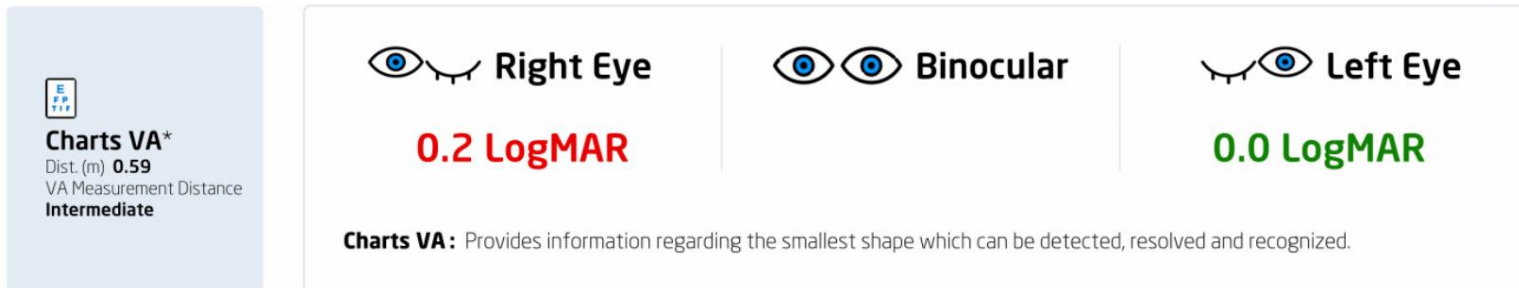- Results are reported in the selected measurement units, for each tested eye.
- Testing distance (intermediate or simulated far vision) is reported under the test name.
- Testing distance from screen (meters).

Graphic results

- Results are colored red when the acuity is worse than the threshold for normal vision.

Charts VA*
Dist. (m) **0.59**
VA Measurement Distance
Intermediate

Right Eye   **Binocular**   **Left Eye**

0.2 LogMAR   0.0 LogMAR

Charts VA : Provides information regarding the smallest shape which can be detected, resolved and recognized.
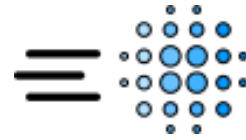
Main Test: Auto CS (Automatic Contrast Sensitivity)

Measures the ability to distinguish between progressively finer increments of light versus dark (contrast). Threshold contrast is the minimal contrast required to see the target reliably. The reciprocal of threshold is called sensitivity. The Contrast sensitivity function (CSF) is usually more informative than visual acuity in describing an observer's spatial vision abilities. Retinal diseases, glaucoma and other conditions can be detected by a decrease in contrast sensitivity which appear before detecting decrease in VA.
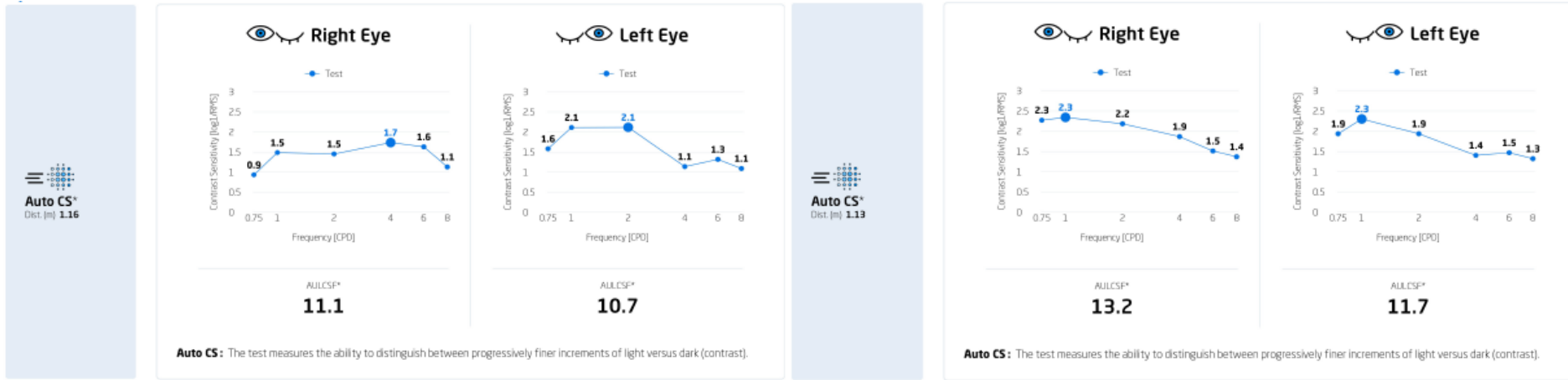
Equivalent Manual Examination

Chart based contrast sensitivity test/ computerized contrast sensitivity test
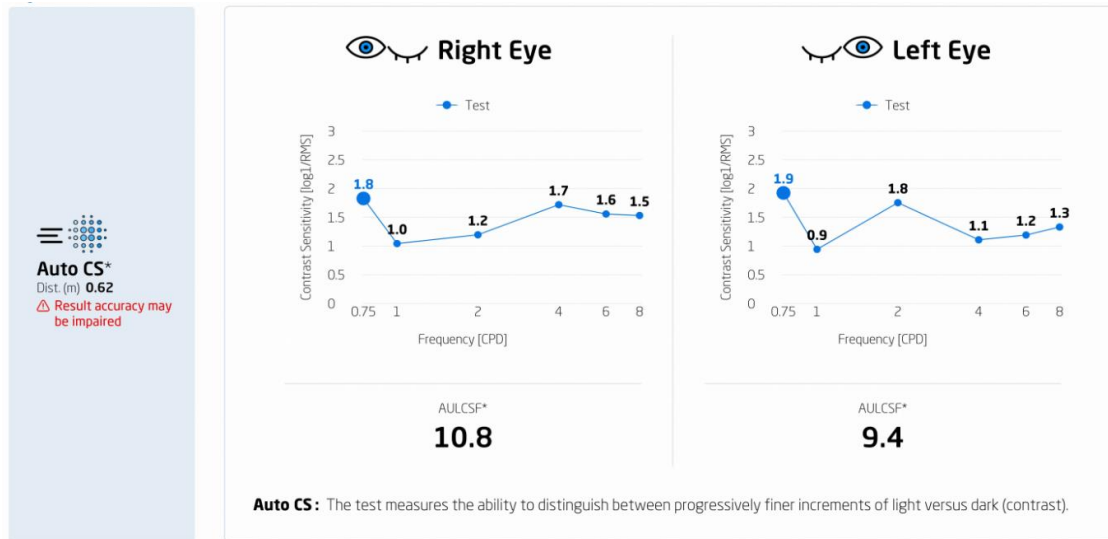
Output (+ measurement units)

- Contrast sensitivity threshold results at each of the tested frequency (per tested eye).
- AULCSF (area under log contrast sensitivity function) (per tested eye).
- Testing distance from screen (meters).

Graphic results

- A warning regarding result accuracy may be reported under the test name.

Main Test: Worth 4-dot test

Worth 4-dot is a method for detecting binocular fusion, suppression, and anomalous retinal correspondence (ARC).

Equivalent Manual Examination

Flashlight near worth 4-dot test.

Output (+ measurement units)

- Textual Result: Fusion, Suppressing OS (left), Suppressing OD (right), Alternating or Diplopia.
- Color change with any abnormal result.
- Testing distance from screen (meters).

Graphic results

Worth 4-dot
Dist. (m) **0.56**

Fusion

Worth 4-dot : Checks fusion, suppression, and anomalous retinal correspondence

Main Test: Color Test

The test is based on pseudoisochromatic panels, which change after each subject response. The panels contain either a number, or a non-descript shape. The panels change randomly, avoiding the possibility of memorizing the test.

Equivalent Manual Examination

Ishihara color vision test.

Output (+ measurement units)

The result is output as "Normal Color Vision" (in green) or "Abnormal Color Vision" (in red).

Graphic results

Main Test: Stereo Test

Stereoscopic acuity (i.e. stereo acuity), is the smallest detectable depth difference that can be seen binocularly.

Equivalent Manual Examination

Randot stereoacuity test.

Output (+ measurement units)

- The result will be the minimal observed disparity and will be reported in seconds of arc (arcsec).
- If the last observed disparity is the minimal disparity the device is able to present, the result is shown as <60.
- Type of images used (in/out) for result (refers to the optical feeling that the image is going into the screen or coming out of the screen).
- "No stereo" or >800 will be presented if the maximal disparity presented cannot be detected.
- Testing distance from screen (meters).

Graphic results
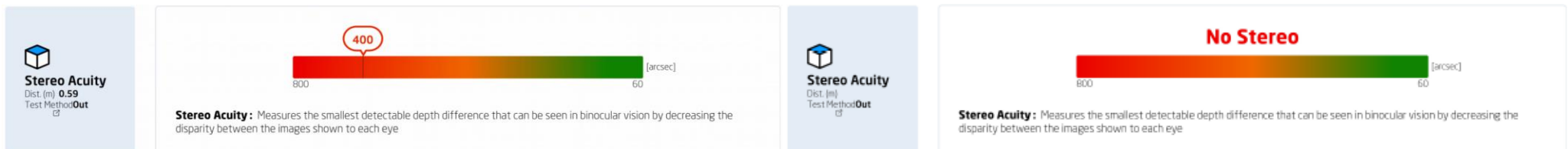
Main Test: Reading

Abnormalities in reading capabilities can arise due to a variety of underlying causes including reduced visual acuity, amblyopia, strabismus, learning disabilities, attention deficit disorders, retinal vision disorders, etc.

Equivalent Manual Examination

Reading capabilities are usually assessed manually by a teacher or psychologist, by having the subject read a text.

Output (+ measurement units)

- Numeric results (number of fixations/100 words, number of regressions/100 words, percent of regressions, average fixation duration in seconds).
- Indication for age group.
- Reading rate is shown on a range according to age appropriate norms.

Graphic results

	Normal Reading Pattern	Abnormal Reading Pattern
Visual Result	I went camping last week with three friends and their parents. We camped in the woods by a little house. The hike to get to the house made us huff and puff. At night we slept inside the house. The floor was covered with straw mats. They made the floor soft and warm. I heard the wind blowing during the night. I heard a tree branch knock on the door. It was spooky. But I wasn't scared. I might warn others that the hike is hard. But I want to go camping again!	I went camping last week with three friends and their parents. We camped in the woods by a little house. The hike to get to the house made us huff and puff. At night we slept inside the house. The floor was covered with straw mats. They made the floor soft and warm. I heard the wind blowing during the night. I heard a tree branch knock on the door. It was spooky. But I wasn't scared. I might warn others that the hike is hard. But I want to go camping again!
# Fixations	80	88 *(more fixations)*
Regressions	1 (1%)	19 (22%) *(more regressions/ higher percentage of regressions)*
Fixation Duration	0.218 sec	0.285 sec *(longer fixation duration)*
Reading Rate (Words/min)	230	78 *(lower reading rate)*
Reading Rate Percentile	>90th percentile	40th percentile

Main Test: Fixation Stability

Fixation stability is the precision of eye fixation and the eye movements observed within fixating on a small target. Fixation stability may be impaired in situations such as retinal disorders, amblyopia, attention deficits, etc.

Equivalent Manual Examination

Microperimeter

Output (+ measurement units)

- Diagnosis (Normal Fixation Instability, Abnormal fixation Stability etc.) for each eye (Left, Right).
- The diagnosis color changes with any abnormal result.
- Number of saccades per second.
- Testing distance from screen (meters).

Graphic results

- 3 heat-maps for Monocular Left eye, Monocular Right eye, Binocular viewing (Left, Right). On the graphs- numerical results reflecting the percentage of the fixation time within a circle of a certain radius (3 different radii)
- A warning regarding result quality may be reported under the test name.
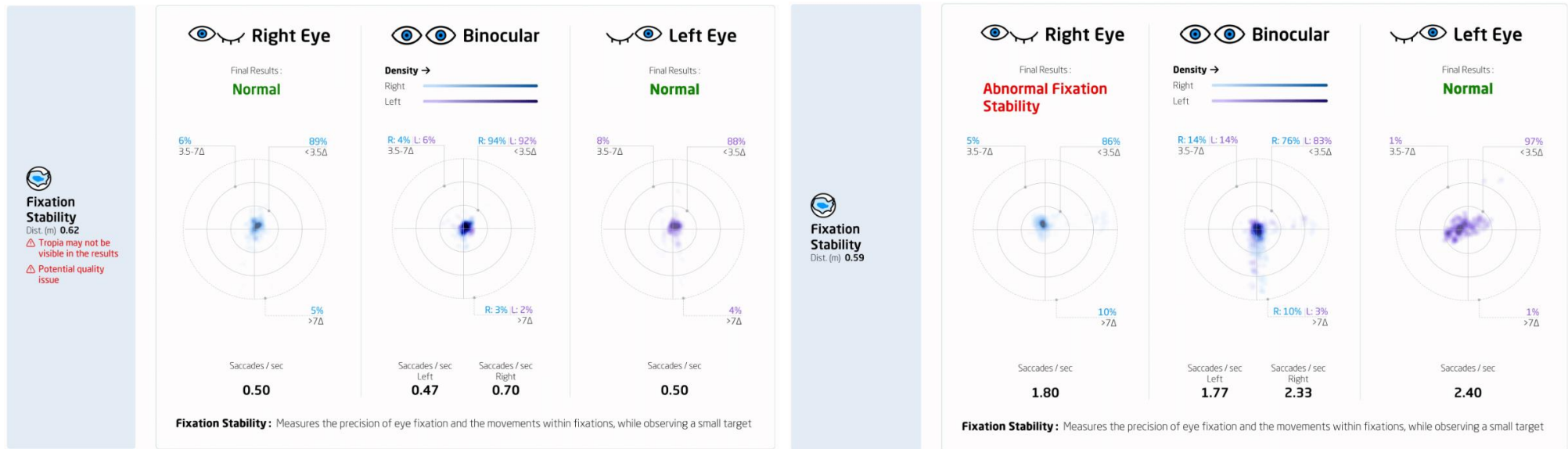
- Indication for potential binocular issue (phoria, attention, etc.) will be reported under the test name.
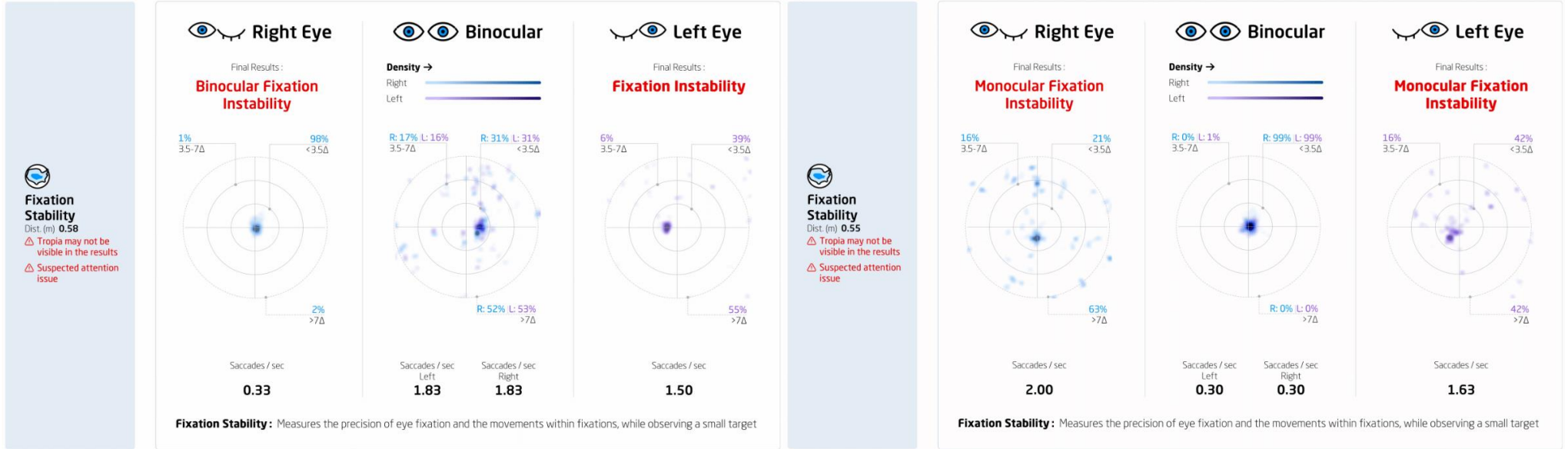
Main Test: Extraocular Motility

Saccades

The appearance of an object in the periphery of the visual field attracts attention, and the eye turns toward the object to fixate on the object with the fovea where the VA is maximal. The rapid eye movement between fixations is called a saccade. Saccades normally fall short of a target, and correction of the eye position occurs with a secondary smaller corrective saccade.

Pursuits
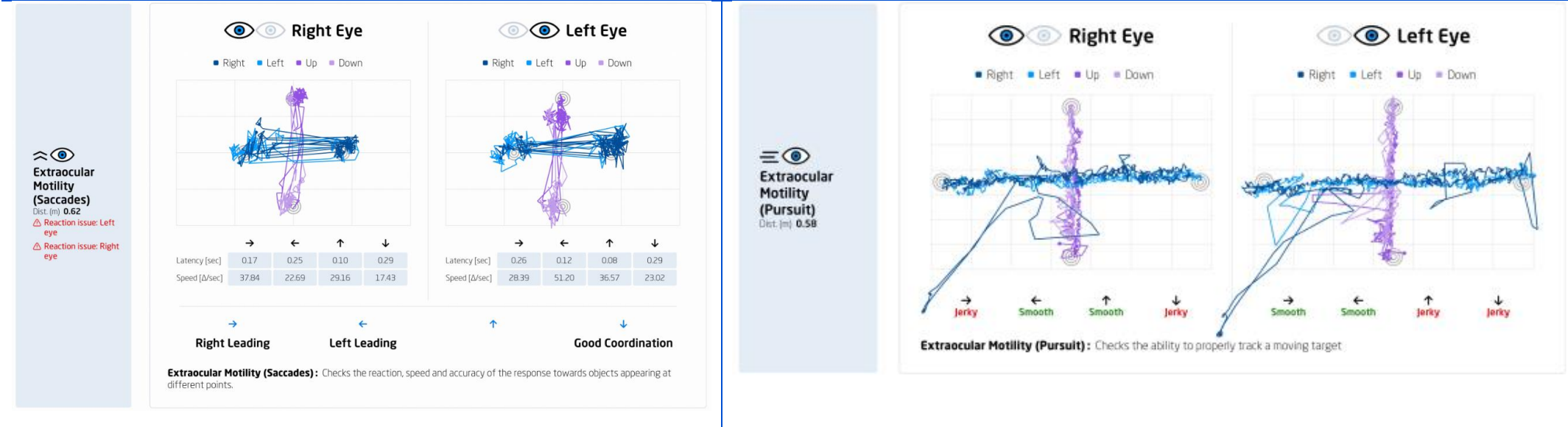
Smooth pursuit movements are made when tracking a moving object. The function of the pursuit system is to match eye velocity to target velocity.

Output (+ measurement units)

- Graphs for each tested eye (Right, Left).
- Average latency (seconds).
- Average saccade speed (diopters/ second).
- Coordination between eyes issue - for each path type (right-left up-down).
- Reaction issues - reaction time varies between the first step of saccades and the second step.
- When correlation is not unambiguous (i.e. not good but we also did not identify a leading eye with certainty) no results will appear under the arrow.
- Arrows represent the saccadic movement direction.
- Testing distance from screen (meters).

- Graphs for each tested eye (Right, Left).
- Type of tracking for each path type (right-left up-down) (smooth/ jerky) (textual result, colored if abnormal).
- Vergence issues- distance between the eyes is increasing during the movements.
- Testing distance from screen (meters).

Graphic results