

# Welcome

## Visual Clarity Measurement for the 21<sup>st</sup> Century

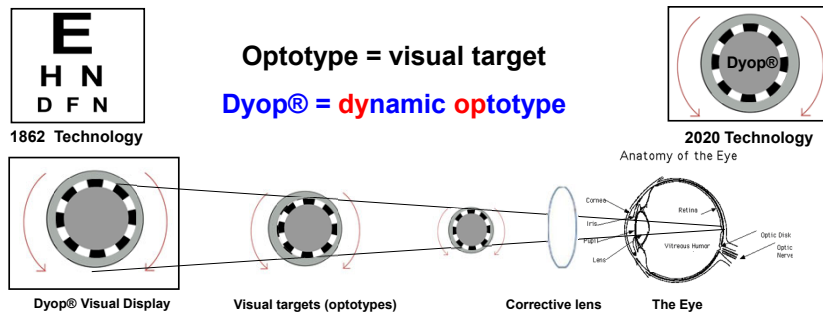


2021-07-11

1

1

## How a Dyop® Vision Test Works



The **Dyop®** ring spinning gaps/segments provide a **strobic stimulus** to the photoreceptors using **resolution** acuity rather than the inherently imprecise and inconsistent **recognition** acuity of letter-based tests. The **Dyop** acuity endpoint is the **smallest Dyop diameter** where a person can detect the **Dyop** as spinning.

Rather than guessing letters, the **Dyop** response question is: “Can you still clearly detect the direction of the spinning **Dyop**?” as the spinning **Dyop** gets smaller. The **Dyop 20/20** or **6/6** acuity endpoint is **7.6 arc minutes in diameter** which is equivalent to the **Snellen 5** arc minutes acuity endpoint letter height.

2

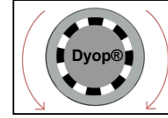
2

## How a Dyop® Vision Test Works



1862 Technology

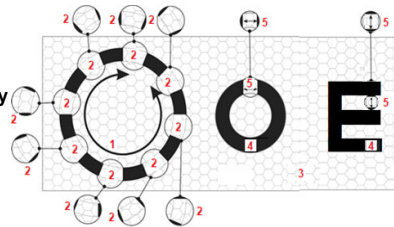
Optotype = visual target  
**Dyop® = dynamic optotype**



2020 Technology

### Dyop® components:

- 1** – visual angular velocity or strobic contrast response
- 2** – a moving segment visual arc-area dynamically stimulating retina cells with motion
- 3** – retinal cells
- 4** – an example of a static historical optotype
- 5** – a static minimum angle of resolution of a historical optotype



### A Dyop® test:

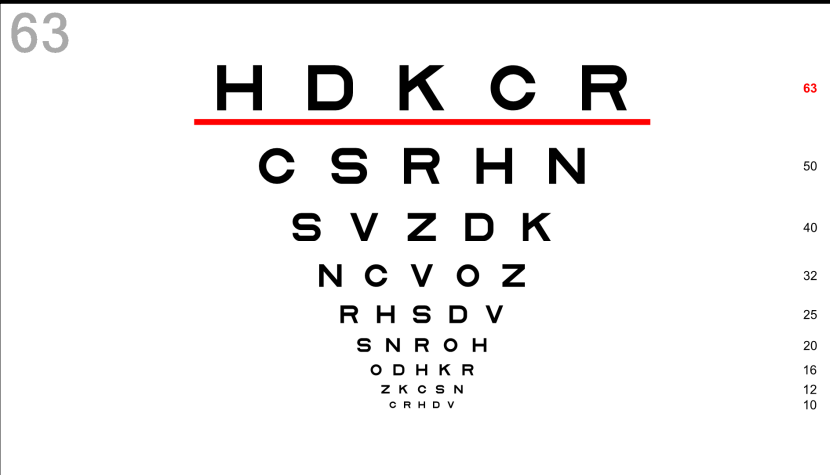
- is six times more precise than static image testing,
- has one/sixth the variance of static image testing,
- is three times as efficient, avoids overminusing,
- minimizes fixation, minimizes decision fatigue, and
- does not require patient literacy.

3

3

## Initial Chart2020 Sloan test

Chart2020 uses peripheral roll-over icons to access its multiple tests

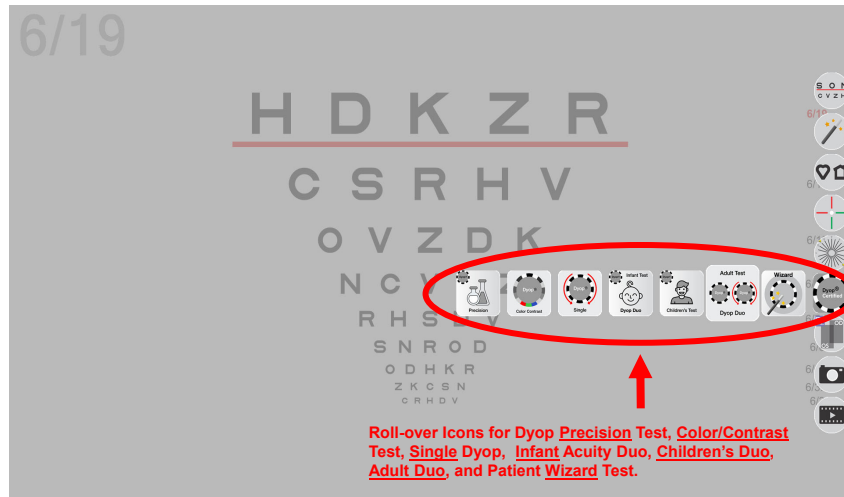


4

4

## Select the Roll-over Dyop Icons

The Chart2020 peripheral **RIGHT** margin icons to access the **Dyop®** tests.

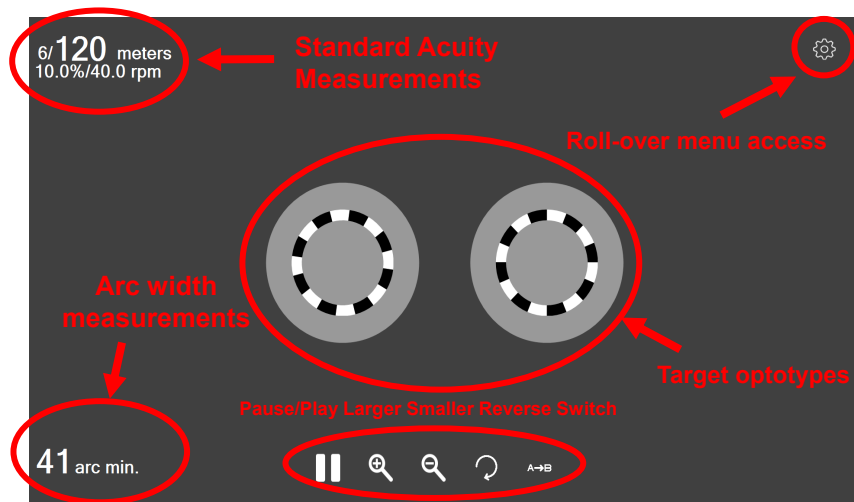


5

5

## Dyop® Screen Controls

The initial Dyop® screen has simple controls & a simple display.



Only **ONE** Dyop of the duo should be spinning

6

6

# Dyop® Screen Icons

## Roll-over Dyop® Menu Icons shows additional Control Options

6/ 120 meters  
10.0%/40.0 rpm

41 arc min.

Roll-over Menu Icons

Help Menu

Dyop Size  
Larger = scroll up or up arrow  
Smaller = scroll down or down arrow

Rotation Control  
F = reverse direction  
R = Start/Stop Dyop

Left key - rotate left target  
Right key - rotate right target  
End - play / pause

F - change notation to feet  
C - change notation to Decimal  
M - change notation to Meters  
L - change notation to Lighter

Home - Scroll Basic Colors

I - Increase Contrast  
N - Decrease Contrast

W - Patient Test Wizard  
U - Adult Due Test  
C - Child's Due Test  
S - Single Dyop Test  
C - Contrast Mode  
P - Precision mode

K - Hide Numbers

Home - Cycle Colors of Dyop  
5.2,3.4 = change size step  
5.5,7.0,8 = change step size

Roll-over Icons for Test Settings, Test Help, Global Help, Help for the Remote, Keyboard, Mouse, and Research Data Entry

7

# Dyop® Test Selection Icons

## Roll-over Dyop® Menu Icons shows additional Control Options

6/ 120 meters  
10.0%/40.0 rpm

41 arc min.

Roll-over Icons for Dyop Test Options

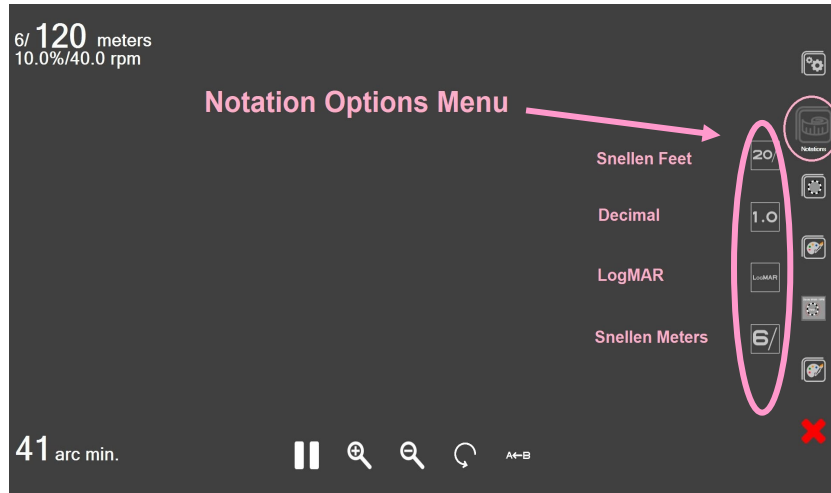
Roll-over Icons for Dyop test options

8

4

## Feet, Metric, LogMar, Decimal Settings

### Dyop Notation Icon Settings



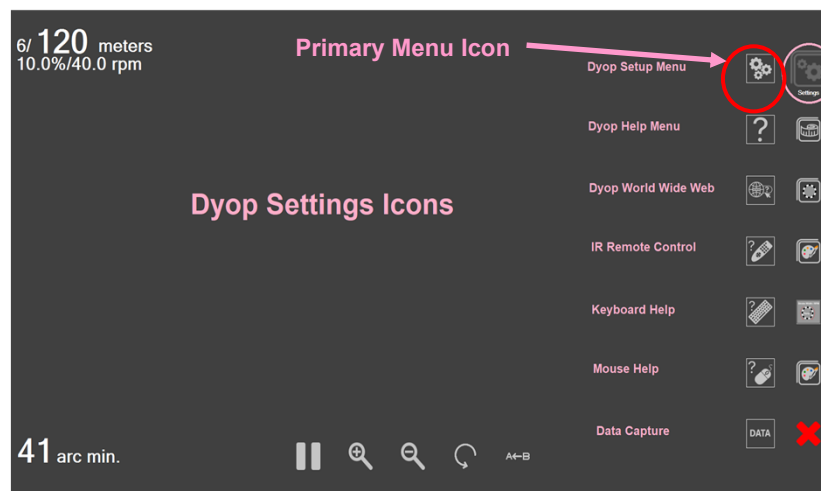
Options for Dyop test measurement formats

9

9

## Dyop® Setup Menu Access Icon

Go to the **Settings Menu** for proper Initial Calibration



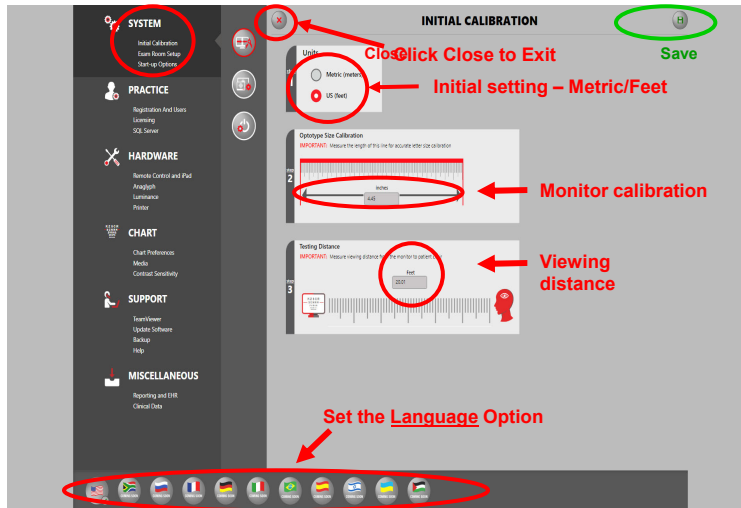
Simple roll-over **Settings Menu** access or **Press F-10**

10

10

## Dyop® Setup Menu Screen

Enter the calibration line size and viewing distance  
Select **Save** and then **Close** when changes are complete

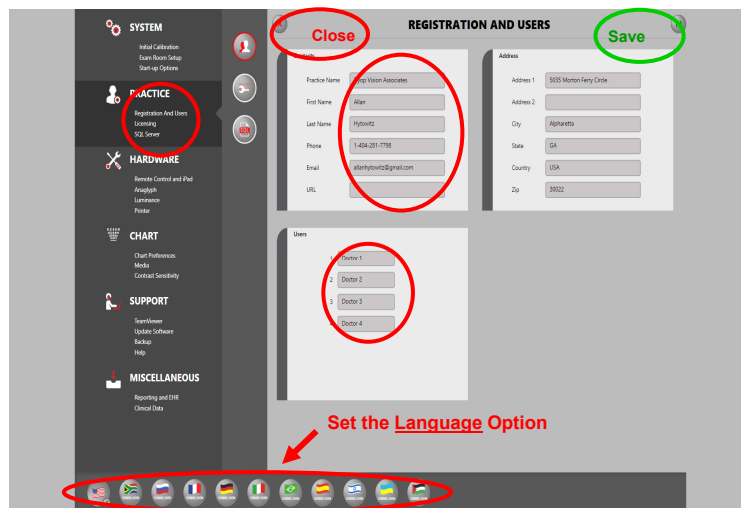


11

11

## Dyop® Setup Menu Screen

Enter the Office and Practice information.  
Select **Save** and then **Close** when changes are complete



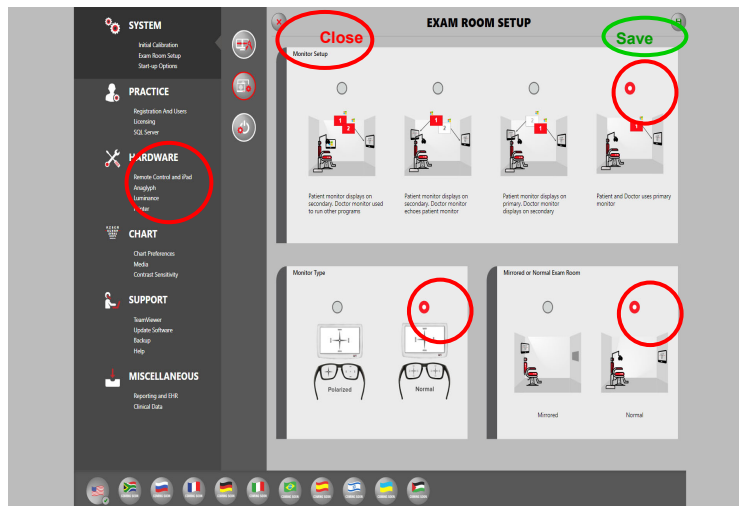
12

**Save and Close** to Exit the Setup and Return to the

12

## Dyop® Setup Screen

Chose the Examination Lane viewing Configuration  
Select **Save** and then **Close** when changes are complete

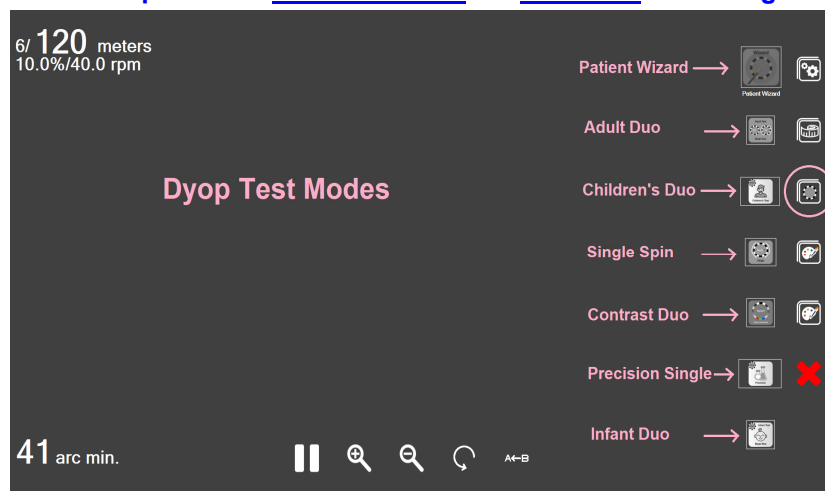


13

13

## Dyop Acuity Test Modes

Choose Patient Wizard, Adult Duo, Children's Duo, or Single Test  
Also options for Color/Contrast and Precision Screening



The Wizard can also be accessed via Keystroke "W"

14

14

## Patient Wizard - Adult Test

Options	Dyop Vision Test	
Patient	Firstname Lastname (30 years old)	<a href="#">Change Patient</a>
Test Eye	<a href="#">Right</a> <a href="#">Left</a> <a href="#">Both</a>	
Test	6.1 Meters	
Dyop Color	Basic Acuity	
Luminance	<input type="radio"/> Normal <input checked="" type="radio"/> 85 cd/m2	
Test Type	Adult Test <small>Is the Dyop spinning? No - Press the UP arrow (for LARGER) Yes - Press the DOWN arrow (for SMALLER)</small>	
	<input type="checkbox"/> Show Labels    Press Enter Or Down Arrow on Keyboard or Remote to start the test. <input type="checkbox"/> Enable Timer	
	<a href="#">EXIT</a>	<a href="#">START</a>

CHART 2020		Dyop Vision Screening Test	
Dyop Vision - 2020-02-17		Tel: 888-555-1212	
John Doe	29	2/18/2020   7:23 AM	10.0.50
patient name	age	date/time	version
Adult Test	Male	20200217	6/27/2019
method	gender	patient ID	calibration info
5.8 Meters	Low	Basic Acuity	Refer
distance	Luminance	Test Date	Result

Right VA	Left VA
6/12	6/14
7 seconds	13 seconds

Both
6/12
11 seconds

Notes: both eye

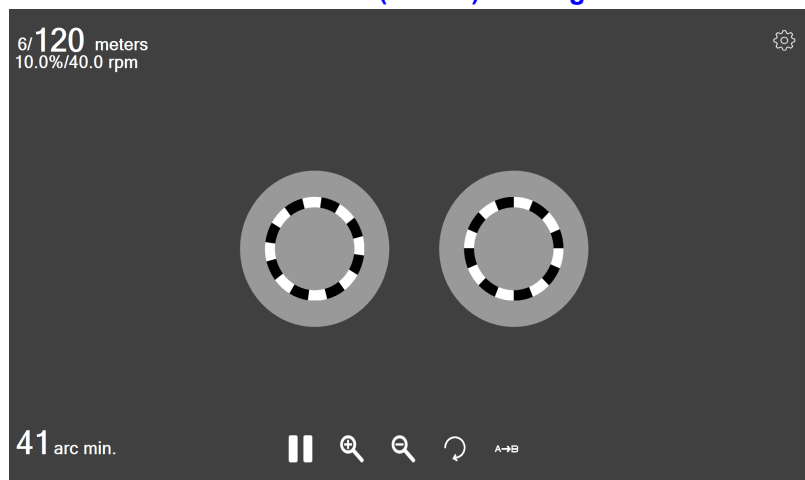
The Dyop Wizard Adult Duo rapidly determines the acuity endpoint.  
The Wizard can also be accessed via Keystroke "W"

15

15

## Patient Adult Duo Test

Dyop® Adult Duo Test – 41 arc minutes = 6/120 meters  
For use at 6 meters (20 feet) viewing distance



**Acuity question:** "Which (Dyop) segmented ring is spinning?  
(Left or Right?) Is it spinning clockwise or anti-clockwise?"

16

16



## The Wizard Creates a Test Report

**CHART 2020** Dyop Vision Screening Test

Dyop Vision - 2020-02-17 Tel: 888-555-1212

John Doe patient name 29 2/19/2020 | 7:23 AM 10.9.50 version

Adult Test Male 20200217 6/27/2019 calibration info

method 5.8 Meters patient ID LOW Basic Acuity

distance Luminance Dyop Color Refer Result

Right VA Left VA

6/12 6/14

7 seconds 13 seconds

Both

6/12

11 seconds

Notes: both eye

**SHEMESH HEALTH SOLUTIONS**

The Wizard rapidly determines the acuity endpoint.

17

17

## Basic Color Screening Patient Test

Best done at a 3 meter (10 foot) viewing distance.

**Options** Dyop Vision Test

Patient John Doe, Jr. (13 years old) Change Patient

Test Eye Right Left Both

Test 3 Meters

Dyop Color Basic Acuity

Luminance Normal 85 cd/m2

Test Type Basic Color Test

Which Dyop is Spinning?  
Right - Right Dyop  
Left - Left Dyop  
Up - Does Know Which is Spinning  
Down - Missed Dyop Spinner

Color Or Down Arrow on  
and or Remote to start the test.

**START**

**CHART 2020** Dyop Vision Screening Test

Dyop Vision 2020-03-25 Tel: 888-555-1212

John Doe patient name 13 3/25/2020 | 3:05 PM 10.9.80 version

Children's Test Male 20200325 6/27/2019 calibration info

method 3 Meters patient ID High Basic Color Screening Monitor not calibrated

distance Luminance Dyop Color Refer Result

Both Eyes - Dyop Basic Color Screening

Dyop	Basic Acuity	Blue/Black	Green/White
Color	8	17	13
Arc Min	6/6	6/23	6/15

Notes:

**SHEMESH HEALTH SOLUTIONS**

The Wizard rapidly determines the acuity endpoint.

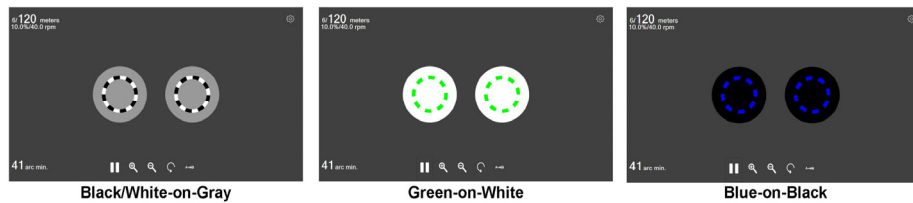
18

18

## Basic Color Screening

Black/White-on-Gray  
versus Blue/Black  
versus Green/White

The three acuity tests are done sequentially as binocular tests and can rapidly screen for color abnormalities which may be indicative of potential symptoms of dyslexia, migraines and epilepsy.



**Acuity question:** “Which (Dyop) segmented ring is spinning?  
(Left or Right?) Is it spinning clockwise or anti-clockwise?”

19

19

## Advanced Color Screening Test

Options
Dyop Vision Test

Patient
Firstname Lastname (30 years old)
Change Patient

Test Eye
Right Left Both

Test
6.1 Meters

Dyop Color
Basic Acuity

Luminance
Normal 85 cd/m2

Test Type
Advanced Color Test
Adult Test
Children's Test
Single Spin
Basic Color Test
Advanced Color Test

Which Dyop is Spinning?  
Right - Right Dyop  
Left - Left Dyop  
Up - Don't Know Which is Spinning  
Down - Make Dyop Smaller  
Enter Or Down Arrow on  
rd or Remote to start the test.

START

CHART 2020
Dyop Vision Screening Test

Dyop Vision - 2020-03-03
Tel: 866-555-1212

John Doe
30
3/3/2020
1:31 PM
10.9.50

Adult Test
Male
6/27/2019

6.1 Meters
High
Advanced Color Test
Green Deficient

Both Eyes - Advanced Color Test Options

Dyop	Color	Basic Acuity	Blue/Black	Green/White	Blue/Gray	Green/Gray	Amber/Gray	Red/Gray
Color	Basic Acuity	Blue/Black	Green/White	Blue/Gray	Green/Gray	Amber/Gray	Red/Gray	
Acuity	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
Score	6.1	6.1	6.1	6.1	6.1	6.1	6.1	

Notes: TEST 1

SHAMESH HEALTH SOLUTIONS

The Wizard rapidly determines the acuity endpoint.

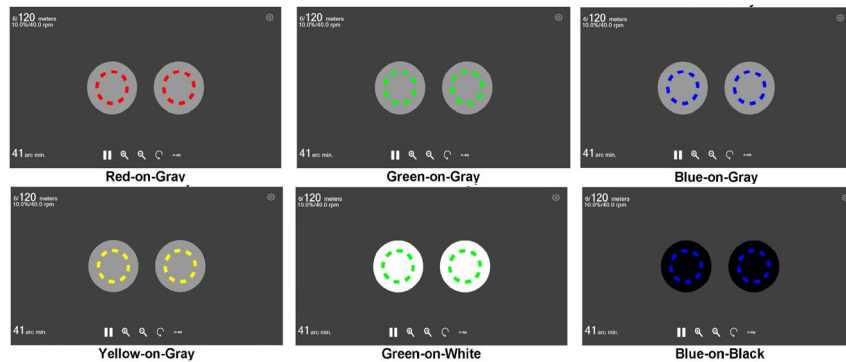
20

20

## Advanced Color Screening Test

### Dyop® Color Acuity Measurement

Color tests are done sequentially as a binocular test.



**Acuity question:** “Which (Dyop) segmented ring is spinning?  
(Left or Right?) Is it spinning clockwise or anti-clockwise?”

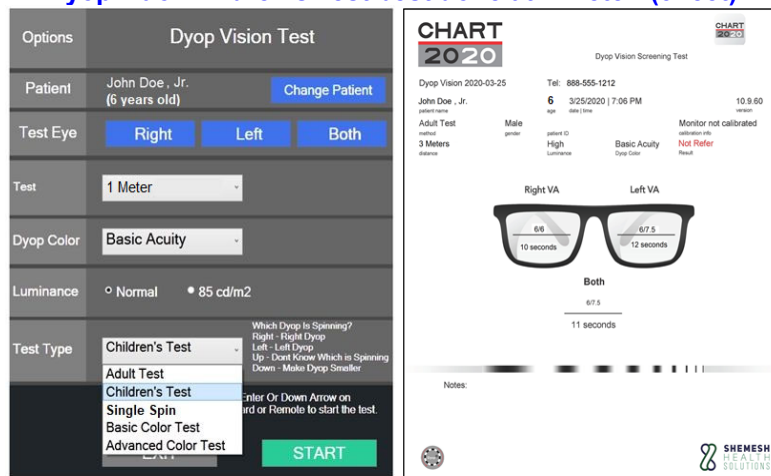
21

21

## Patient Children’s Test – Basic Acuity

### Dyop Duo Children’s Acuity Detection

Dyop Duo Children’s Test best done at 1 meter (3 feet).



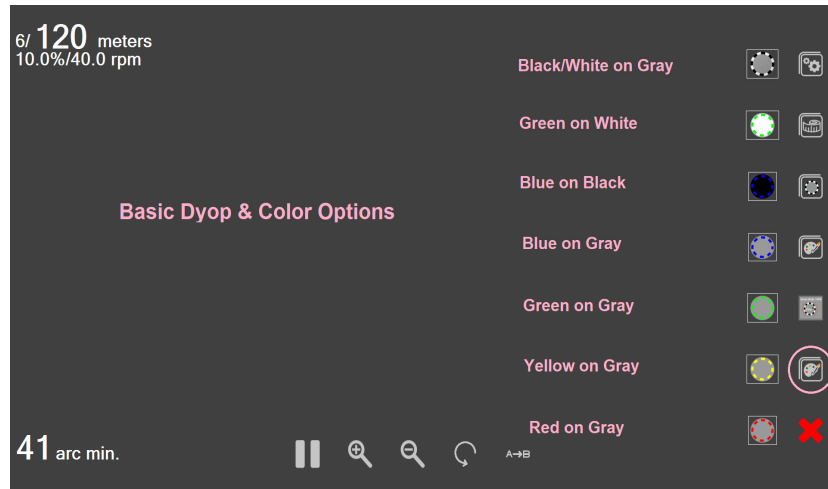
The Wizard rapidly determines the acuity endpoint.

22

22

## Color Acuity Options

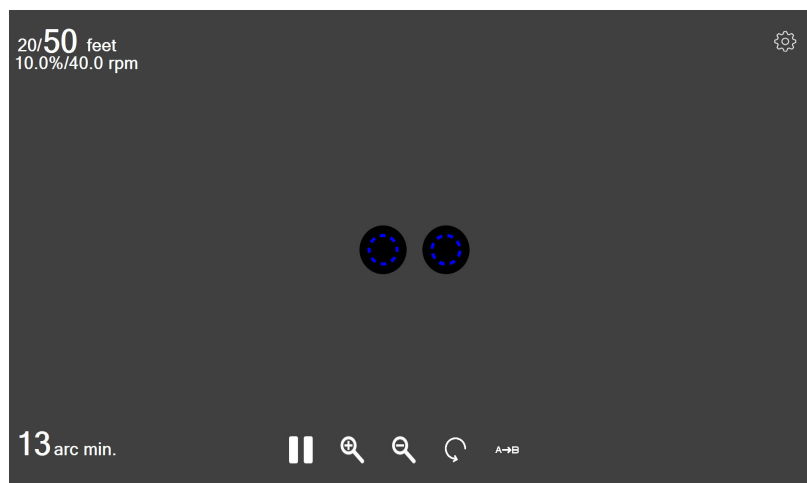
Dyop® Color Acuity Options – Red, Green, Blue, & Yellow



23

## Blue/Black Acuity Group Screening

Dyop® Genetic Color/Contrast Blue/Black Screening  
Pressing the Home Key scrolls through the color options

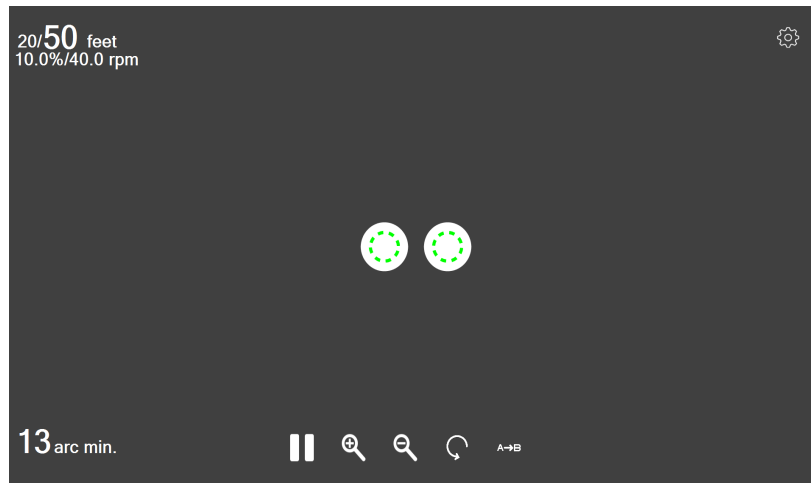


**Acuity question:** “Which (Dyop) segmented ring is spinning? (Left or Right?) Is it spinning clockwise or anti-clockwise?”

24

## Green/White Group Screening

Dyop® Genetic Color/Contrast Green/White Screening

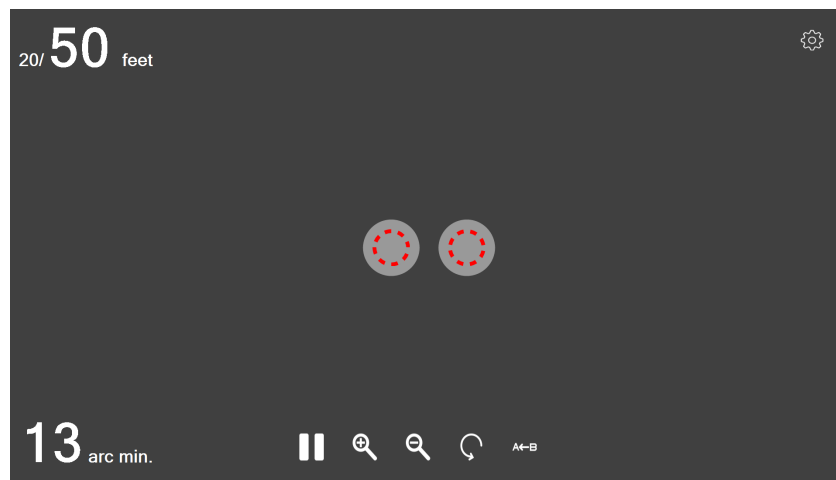


**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?"

25

## Red/Gray Color Acuity

Precise Red Acuity Measurement

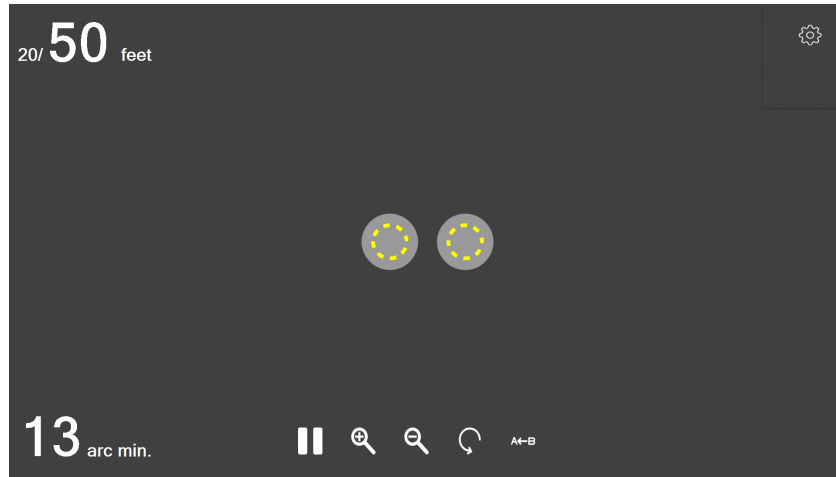


**Acuity question:** "Which (Dyop) segmented ring is spinning? (Left or Right?) Is it spinning clockwise or anti-clockwise?"

26

## Yellow Color Acuity

Precise Yellow Acuity Measurement

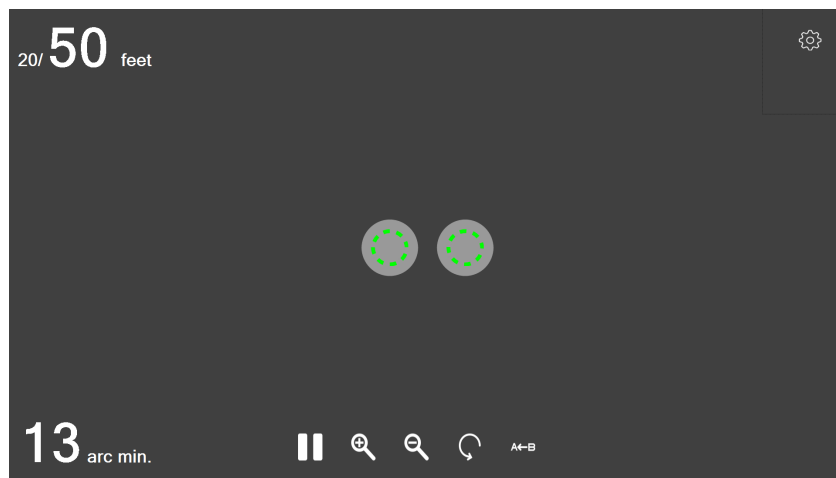


**Acuity question:** “Which (Dyop) segmented ring is spinning? (Left or Right?) Is it spinning clockwise or anti-clockwise?” 27

27

## Green/Gray Color Acuity

Precise Green Acuity Measurement

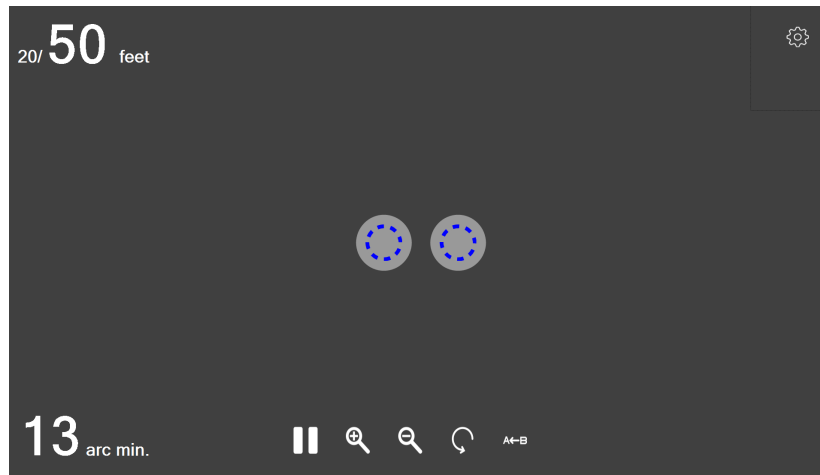


**Acuity question:** “Which (Dyop) segmented ring is spinning? (Left or Right?) Is it spinning clockwise or anti-clockwise?” 28

28

## Blue/Gray Color Acuity

Precise Blue Acuity Measurement



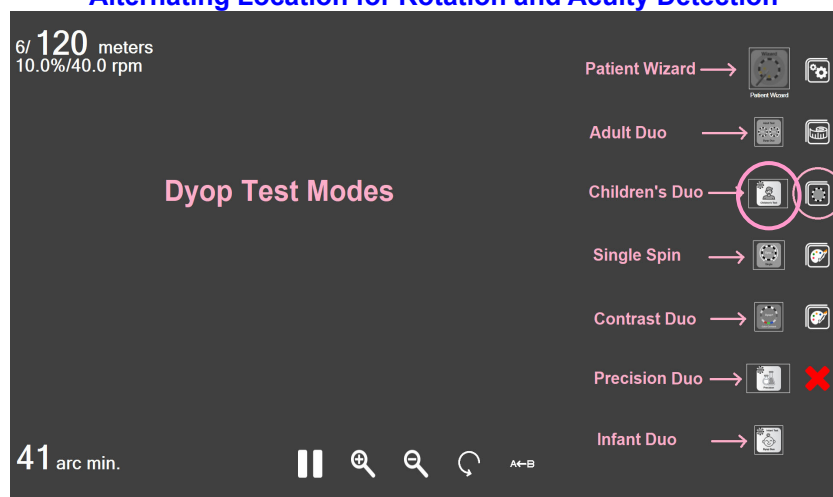
**Acuity question:** “Which (Dyop) segmented ring is spinning? (Left or Right?) Is it spinning clockwise or anti-clockwise?” 29

29

## Dyop Children's Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance

Alternating Location for Rotation and Acuity Detection

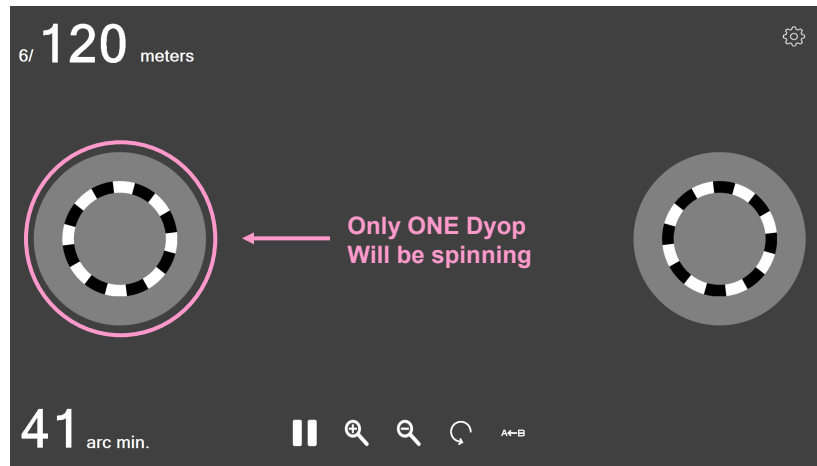


**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller. 30

30

## Basic Dyop Children's Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Maximum Children's Acuity Detection – 6/120 Metric



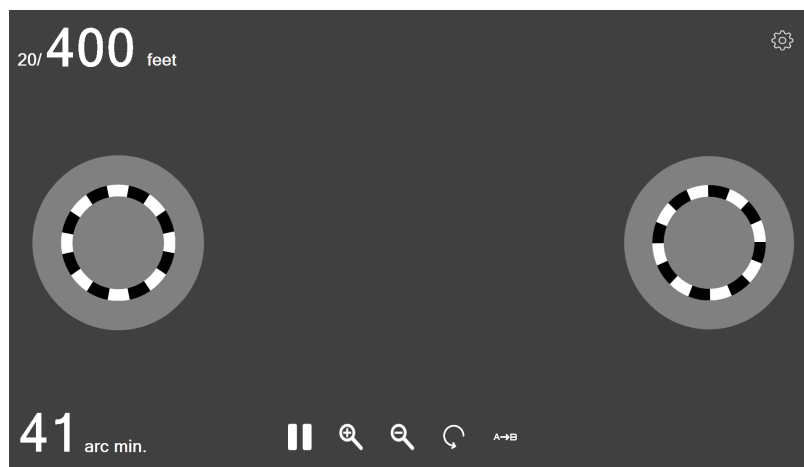
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

31

31

## Dyop Children's Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Maximum Children's Acuity Detection – 20/400 Snellen



**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

32

32



## Dyop Children's Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Alternating Location for Rotation and Acuity Detection



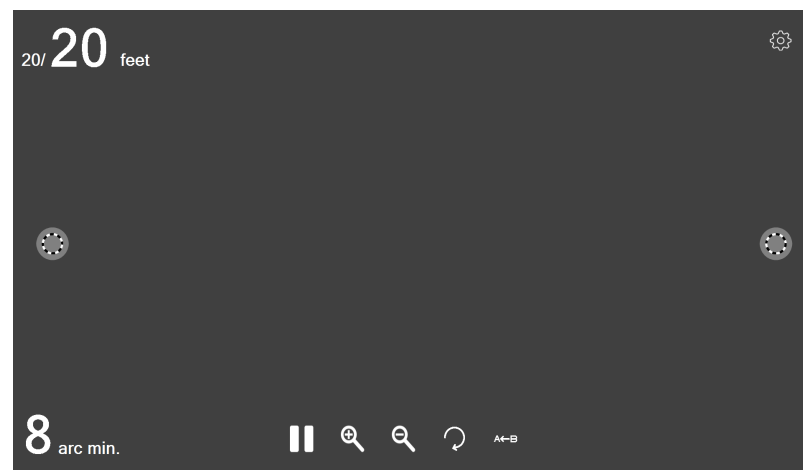
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

33

33

## Dyop Children's Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Alternating Location for Rotation and Acuity Detection



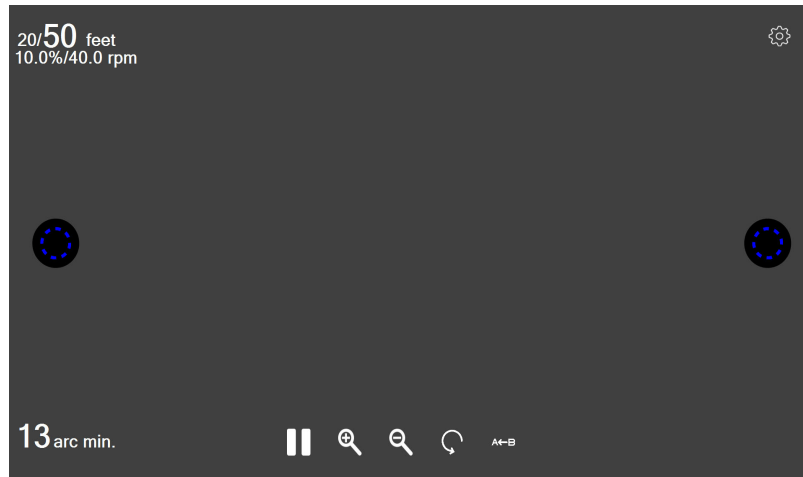
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

34

34

## Children's Acuity – Blue/Black Acuity

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Allows for Color perception diagnostics



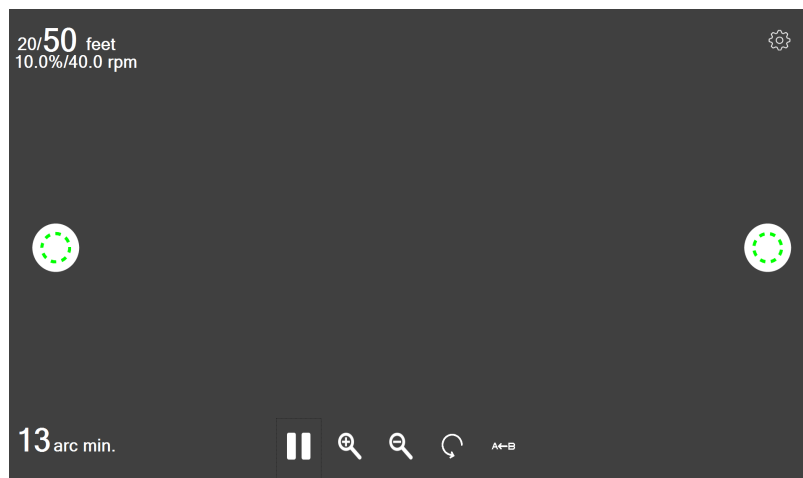
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

35

35

## Children's Acuity – Green/White

For Children age 1 and older at 1 meter (3 foot) viewing distance  
Allows for Color perception diagnostics



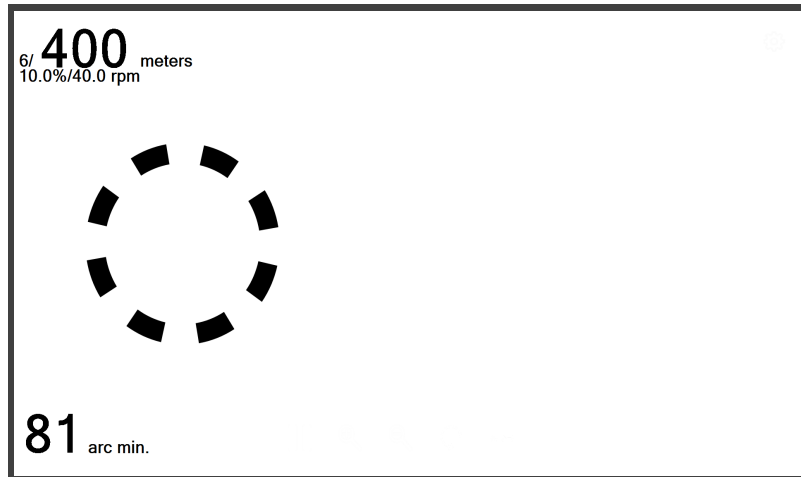
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

36

36

## Dyop Infant Acuity – 81 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



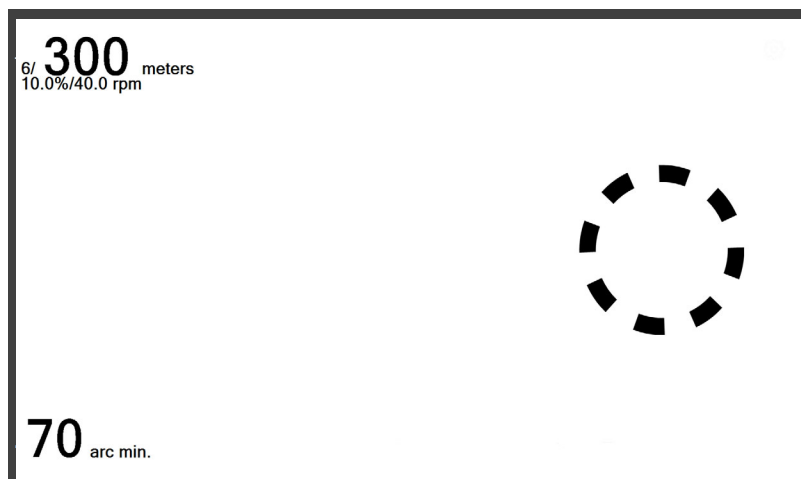
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

37

37

## Dyop Infant Acuity – 70 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



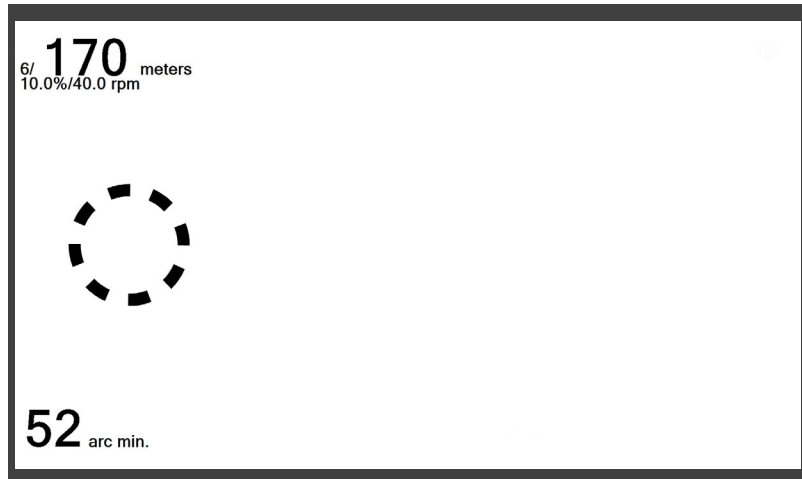
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

38

38

## Dyop Infant Acuity – 52 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



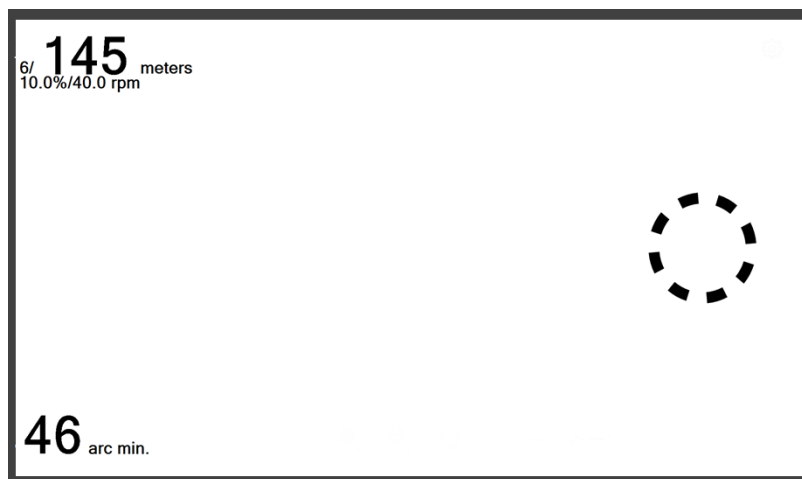
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

39

39

## Dyop Infant Acuity

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

40

40

## Dyop Infant Acuity – 35 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



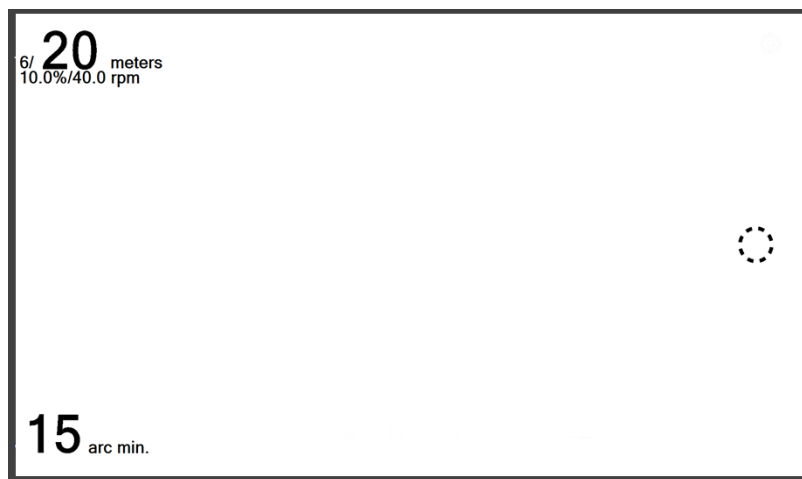
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

41

41

## Dyop Infant Acuity – 15 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

42

42

## Dyop Infant Acuity – 10 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

43

43

## Dyop Infant Acuity – 8 arc minutes

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



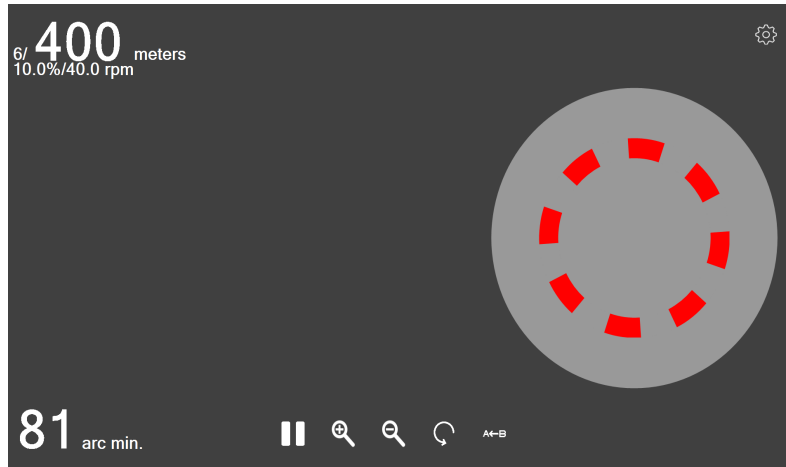
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

44

44

## Dyop Infant Acuity - Red

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



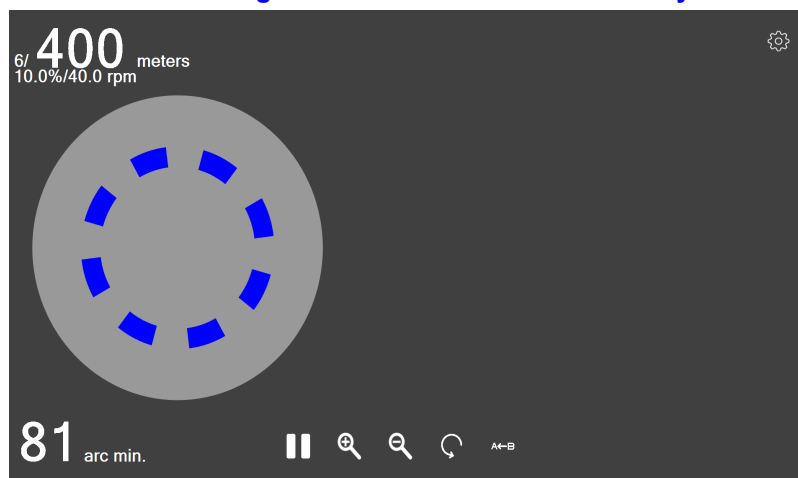
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

45

45

## Dyop Infant Acuity - Blue

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



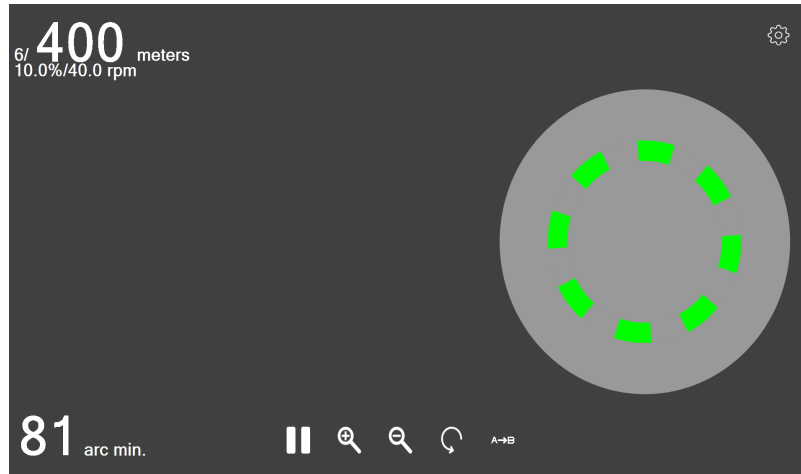
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

46

46

## Dyop Infant Acuity – Green

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



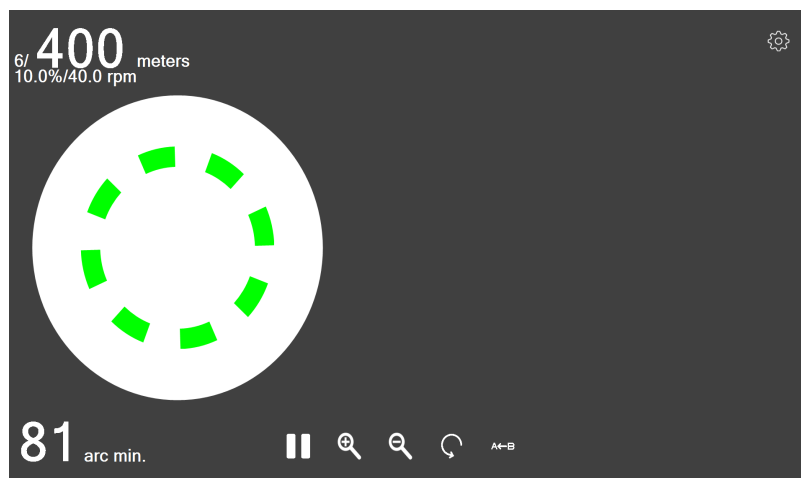
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

47

47

## Dyop Infant Acuity - Balanced Red Ratio\*

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



\*Better acuity with Blue/Black than with Green/White

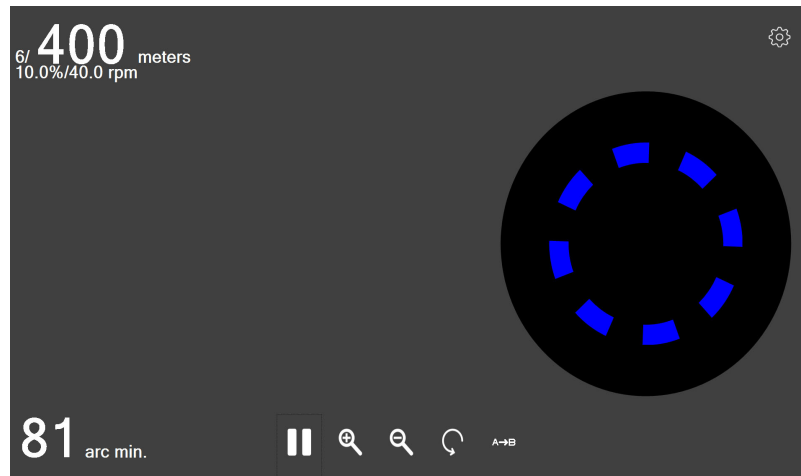
48

48



## Dyop Infant Acuity – High Red Ratio\*

For Children age 1 month to 12 months at 1 meter (3 foot) viewing distance. Alternating Location for Rotation and Acuity Detection



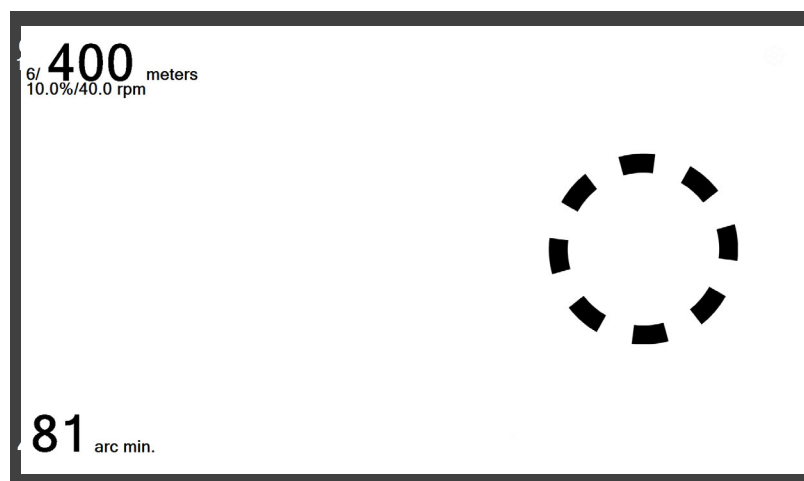
\*Better acuity with Blue/Black than with Green/White

49

49

## Dyop Infant Acuity – 81 arc minutes

Exit the Infant Test by pressing any of the Dyop Test keystrokes, "A" (Adult), "U" (Children), "S" (Single Dyop), "C" (Contrast), "P" (Precision)



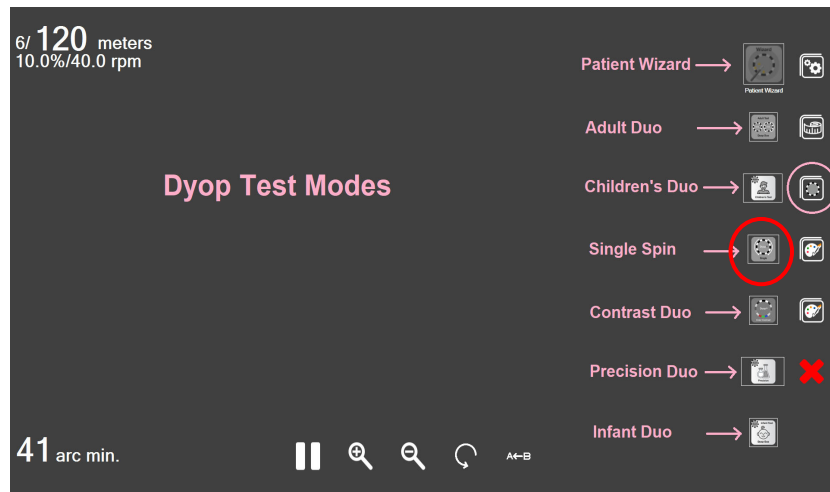
**NO Questions.** Instead watch the infant's head and eyes to detect which ring they see spinning as the rings get smaller.

50

50

## Single Dyop Test

Acuity ranges from 6/2 (20/4) to 6/600 (20/2000) in seven steps

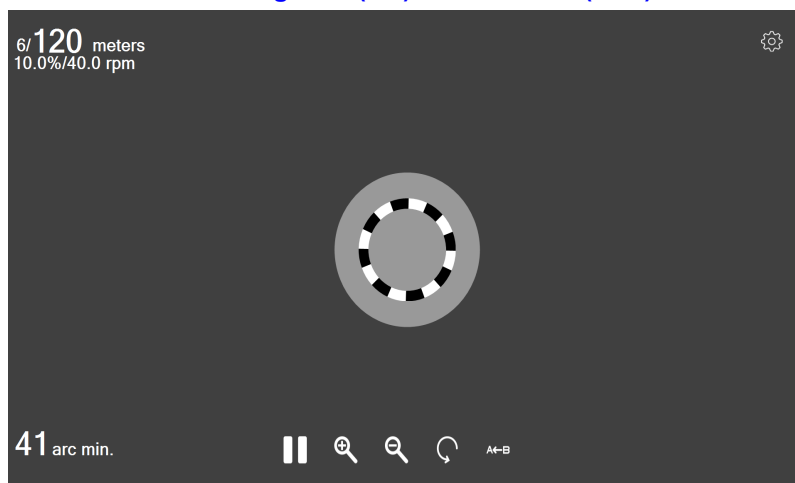


51

51

## Single Dyop Test

Dyop® – 41 arc minutes = 6/120 meters = 20/400 feet  
also in LogMAR (1.3) and Decimal (0.05)



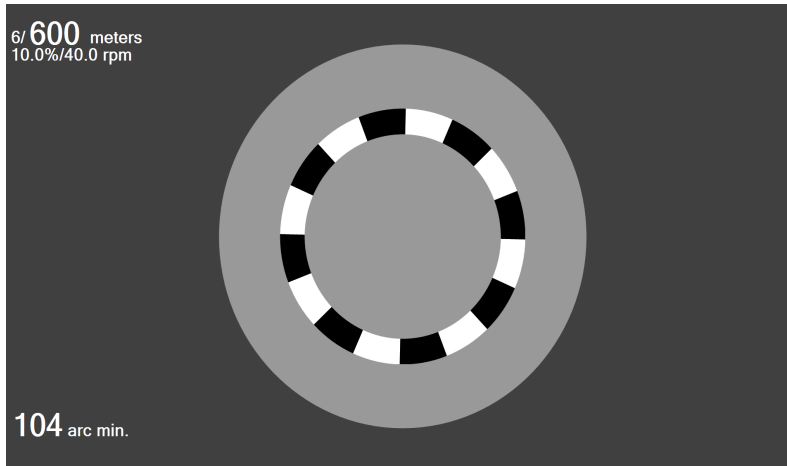
**Acuity question:** “Is the segmented (Dyop) ring spinning?  
(Yes or No?) Is it spinning clockwise or anti-clockwise?”

52

52

## Maximum Dyop Arc Width

Dyop® Acuity Maximum Value – Metric 6/600 or Sloan 20/2000  
also in LogMAR (2.0) and Decimal (0.01)

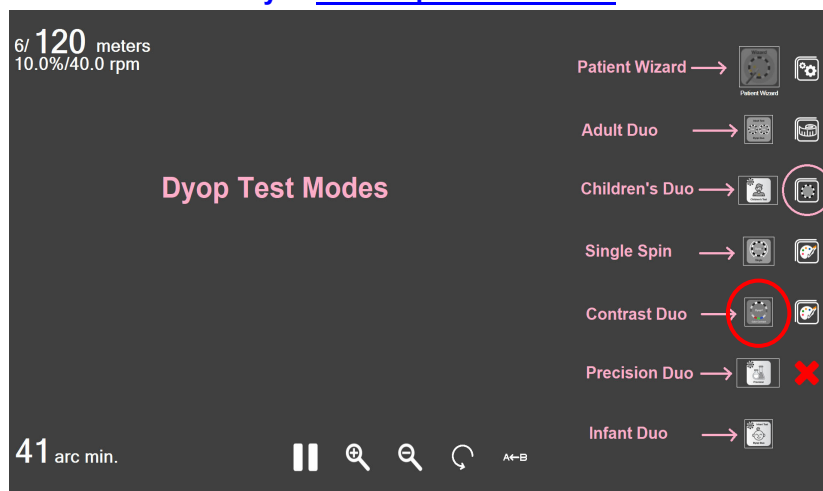


**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?" 53

53

## Dyop Color/Contrast Mode

Keystroke "C" for Color/Contrast  
Acuity in 0.02 diopter increments

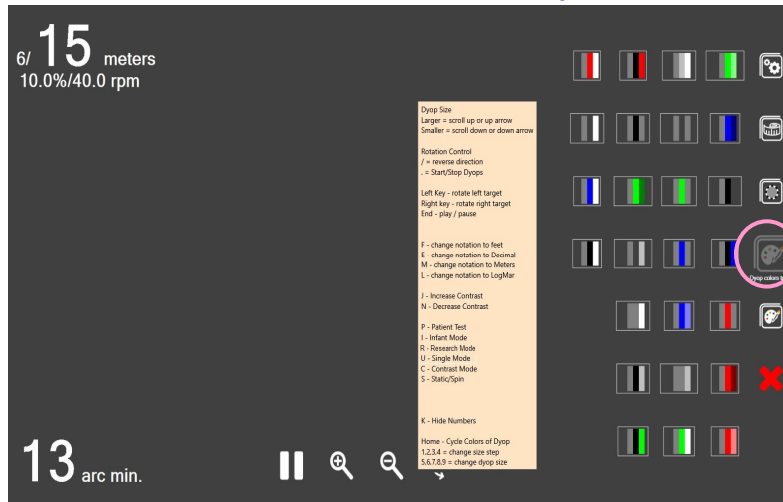


**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?" 54

54

## Dyop Color/Contrast Mode

Predefined for Color/Contrast options

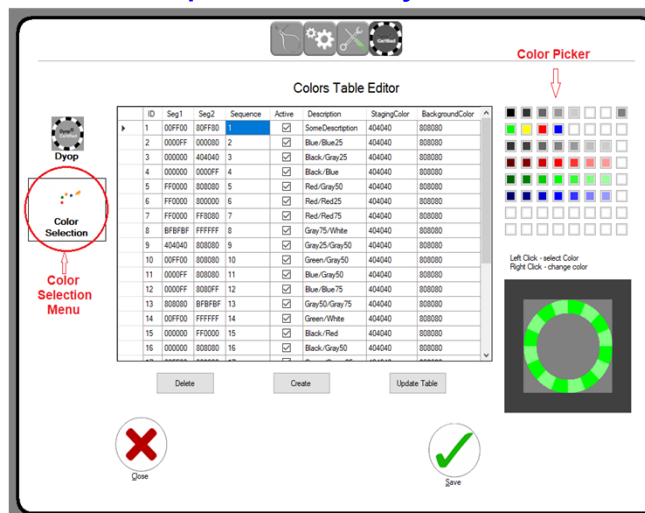


Access the Contrast Menu via **Shift F-10** or the **Color/Contrast Icon** 55

55

## Dyop Color/Contrast Mode

Color/Contrast permutations may also be customized



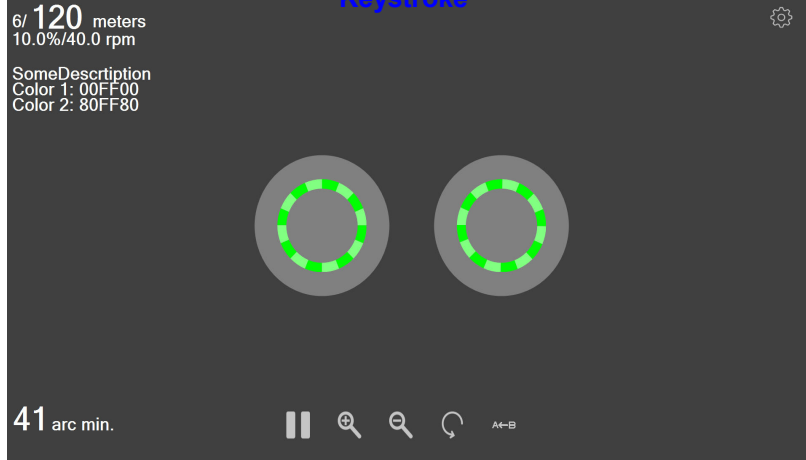
Access the Contrast Menu via **Shift F-10** or the **Color/Contrast Icon** 56

56

## Dyop Color/Contrast Mode

Color/Contrast permutations may also be customized  
Options advanced by the N Keystroke or reversed by the J

Keystroke



**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?"

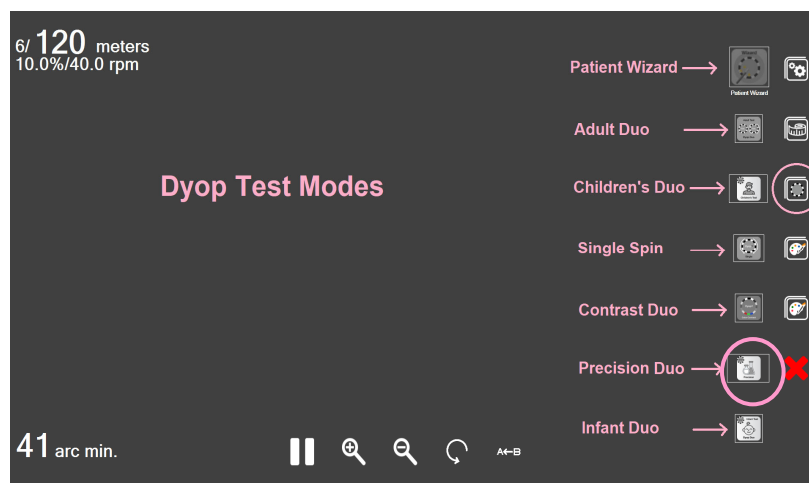
57

57

## Dyop Precision Modes

Keystroke "P" for Precision

Acuity in 0.02 diopter increments



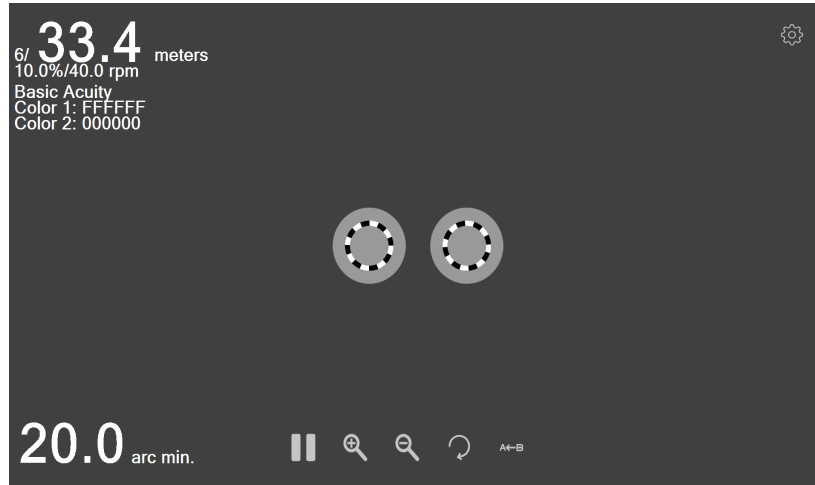
**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?"

58

58

## Dyop Precision Mode

Precise Emmetrope Acuity in 0.02 diopter increments  
Precise Acuity in Snellen feet measurements



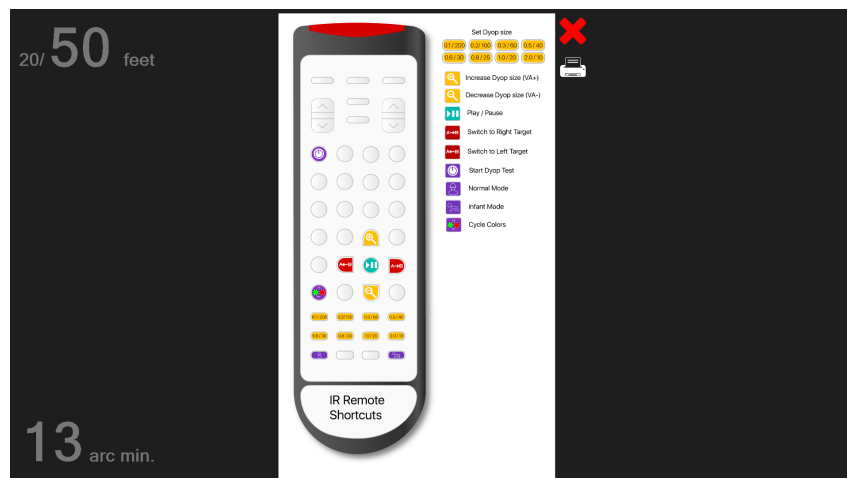
**Acuity question:** "What is the smallest spinning ring you can clearly detect as spinning? Is it spinning clockwise or anti-clockwise?"

59

59

## Dyop® Remote Help

Dyop® Remote Help - Access via the control menu



**Simple button controls.**

60

60

## Dyop® Keyboard Help

Dyop® Keyboard Help - Access via the control menu



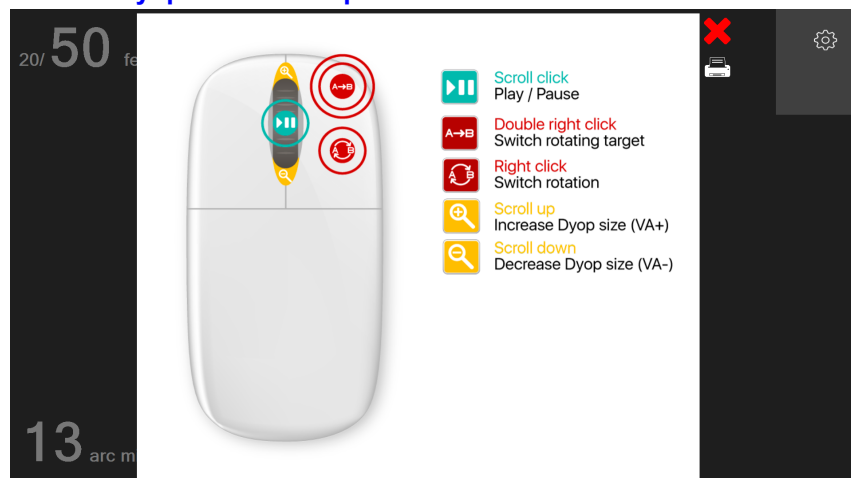
**Simple keyboard controls.**

61

61

## Dyop® Mouse Help

Dyop® Mouse Help - Access via the control menu



**Primary mouse functions.**

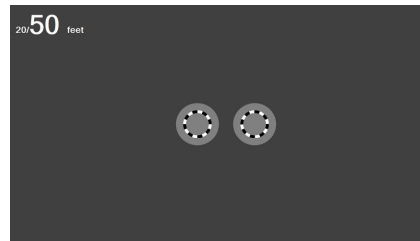
62

62

## Dyop® Dual Screen Mode

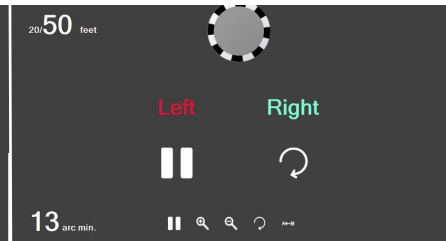
Allows the doctor to run the test without clueing the patient as to the answers.

Patient Screen



What the patient sees.

Doctor Screen



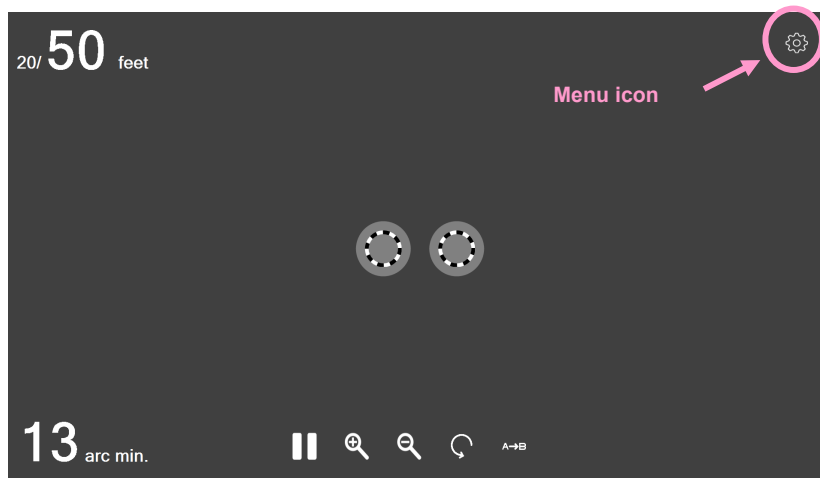
What the refractionist sees.

63

63

## To Exit - go to the Menu Icon

Roll-over the Dyop® Control Icon to **Exit** the Dyop® test



Click the **Control** Icon to display the **Menu** Icons.

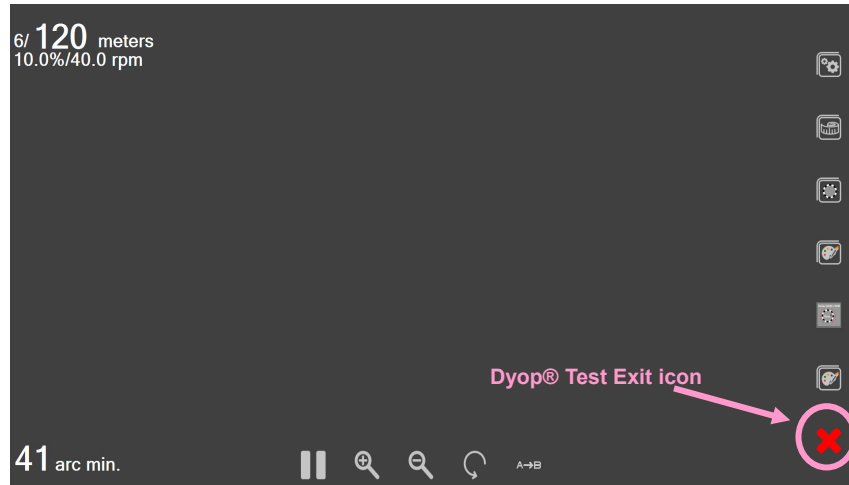
64

64



## Select the Dyop® Exit Icon

Select the Dyop® X (Exit) Icon to Exit the Dyop® test



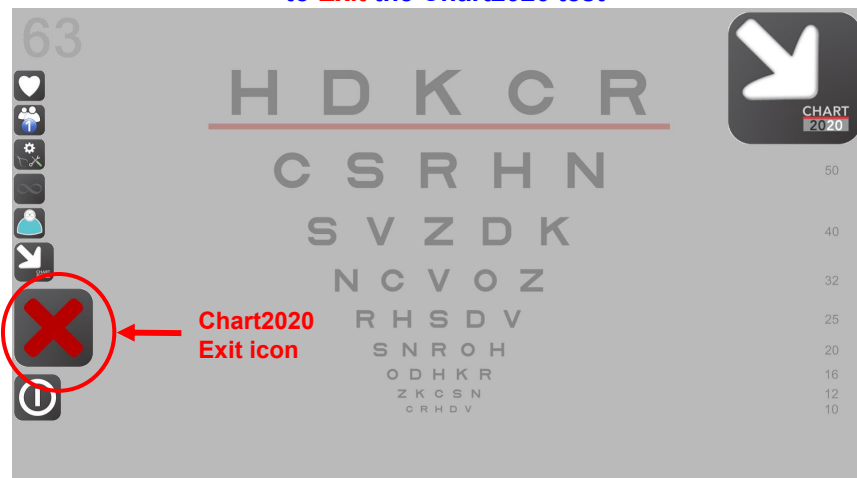
Click the Exit Icon to quit the Dyop test.

65

65

## Select the Chart2020 Exit Icon

Select the Rollover Chart2020 X (Exit) Icon to Exit the Chart2020 test



Click the Exit Icon to quit Chart2020.

66

66

# Is the 1862 Snellen Test Making 21<sup>st</sup> Century People Blinder?

## Snellen/Sloan versus Dyop Acuity

SCO Acuity Data - 2013 and 2014  
Dyop® versus Sloan (Snellen) ratios

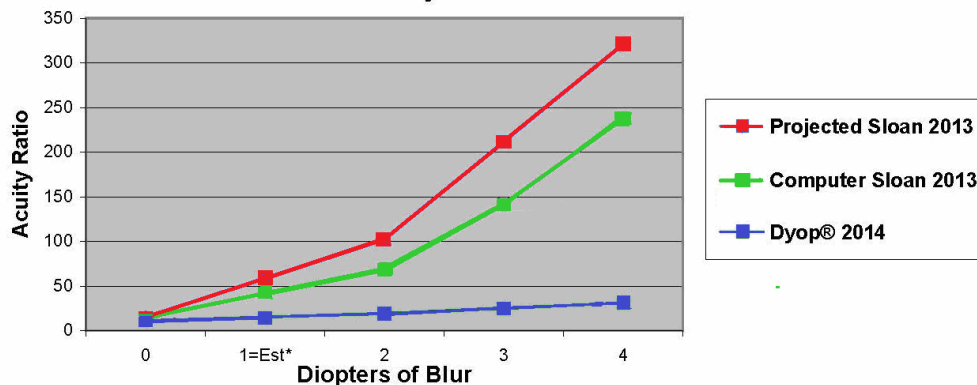
Diopters of Blur	0	1=Est*	2	3	4
Projected Sloan 2013 **	14.9	58.5	102.0	211.6	320.9
Computer Sloan 2013 **	14.8	41.6	68.4	141.8	238.1
Dyop® 2014 ***	10.8	15.0	19.2	24.8	31.1

\* NOTE: values for 1 diopter of blur are an averaged estimate

\*\* NOTE: Sloan 20/20 optotypes have a 5.0 arc minute width which is an 8.8 mm height at a 20 foot viewing distance  
2013 Computerized Sloan test had 0.25 diopter line increments

\*\*\* NOTE: Dyop 20/20 optotypes have a 7.6 arc minute diameter which is an 13.5 mm diameter at a 20 foot viewing distance

SCO Acuity Data - 2013 and 2014  
2013 = 150 Subjects  
2014 = 162 Subjects



## Reduced Dyop® Variance

Study Condition	Variance
Projected Sloan (2013)	0.282
Sloan Letters (2013)	0.233
Dyop - Doublet (2014)	0.035

Summary of the variance in the test conditions over the two years of the study.

**Acuity Study - Dr. Paul Harris, SCO**

# Dyop® Refraction Procedure

2021-07-11

A Dyop® (short for **dynamic optotype**) is a segmented ring visual target whose spinning gaps/segments create a **strobic stimulus** of the photoreceptors of the retina. The detection of spinning is a result of a Dyop using **Resonance Acuity**, much like the visual equivalent of a tuning fork. The spinning Dyop acuity endpoint is the **smallest angular diameter (arc width) of the Dyop ring where the direction of spin is detected** (with the actual clockwise or anti-clockwise direction of spin being irrelevant). A **sub-acuity Dyop** has gap/segments which are blurred or "twinkle" rather than having a clear **spinning direction**. The spinning Dyop **resonates** with the saccade induce vibrations of the photoreceptors to facilitate its being used measuring acuity and refractions.

To properly ensure monitor calibration and patient viewing distance, use the **Chart2020 Setup Menu** before using the tests. The **Upper Left Corner** Dyop test screen displays the corresponding options for **Sloan feet**, or **LogMAR**, or **Decimal**, or **Metric** values. Use a Mouse Scroll Wheel, IR controller, screen indicators icons, or the Keyboard Arrows to adjust the Dyop diameter(s). The **Lower Left Corner** Dyop test screen displays the **Dyop arc minute (am) diameter**. The use of Dyop Arc Minutes is a more precise measure of acuity than Snellen feet or meters. At each step, try to reduce the Dyop diameter as much as possible. The refraction sequence is initial Sphere, Axis, and Cylinder, readjust the Sphere, and then readjust the Cylinder.

The following table illustrates the relationship to the **Unaided Dyop Acuity (UDA)** endpoint to the corresponding diopters of blur.

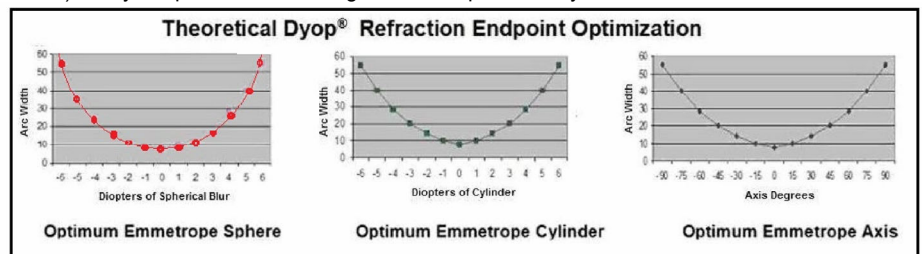
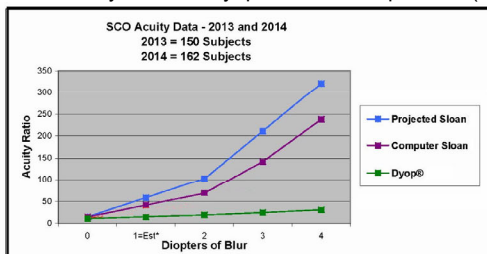
**UDA = initial Unaided Dyop Acuity** (arc minutes) **ECV** = Emmetropia Comparison Value (arc minutes) **IRS** = Initial Refraction Setting (diopters)  
**UDA arc minutes minus 8 arc minutes = ECV arc minutes** **ECV arc minutes divided by 6 = IRS in diopters (+/-) Rounded to 0.125 diopters**

Snellen/Sloan ratio = 20 / XX	2000	1300	1000	800	650	550	475	400	350	300	250	220	200	170	150	130	110	100
Metric ratio = 6 / XX	600	400	300	240	200	170	145	120	100	90	75	67	60	50	45	40	34	30
Unaided Dyop Acuity arc min = UDA	104	81	70	62	57	52	47	41	39	35	32	30	28	25	24	22	21	20
Emmetropia Comparison Value arc min = ECV	96	73	62	54	49	44	39	33	31	27	24	22	20	17	16	14	13	12
Initial Refraction Setting (+/-) = IRS diopters	16	12.125	10.375	9	8.125	7.375	6.375	5.5	5.25	4.5	4	3.5	3.25	3	2.5	2.25	2.25	2
Snellen/Sloan ratio = 20 / XX	90	80	75	70	65	60	50	45	40	32	25	20	18	15	10	6		
Metric ratio = 6 / XX	27	25	23	21	20	18	15	14	12	9.5	7.5	6	5.5	4.5	4	2		
Unaided Dyop Acuity arc min = UDA	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4		
Emmetropia Comparison Value arc min = ECV	11	10	9	8	7	6	5	4	3	2	1	0	-1	-2	-3	-4		
Initial Refraction Setting (+/-) = IRS diopters	1.75	1.62	1.5	1.25	1.25	1	1	0.75	0.5	0.375	0.25	0	-0.25	-0.375	-0.5	-0.75		

## Dyop refraction steps:

1. If you **HAVE access to an autorefractor** or retinoscope, use those initial values for sphere, cylinder, and axis and **proceed to step 3**.
2. If you **DO NOT** have an autorefractor or retinoscope, determine the **Unaided Dyop Acuity (UDA)** as the smallest diameter Dyop arc width detected as spinning. Check for false positives by alternating the Dyop spin direction and location. Subtracting 8 arc minutes from the **UDA** determines the **Emmetropia Comparison Value (ECV)**. The **ECV** value, when divided by six, determines the **Initial Refraction Setting (IRS)** in diopters. The appropriate **IRS** diopters of sphere (either + or -) **will make the Dyop appear clearer**. An **incorrect** (– or +) sphere will make the Dyop blurrier.
3. With the correct initial (– or +) **IRS** diopter spherical lens in place, **verify the axis** by adding - 0.50 diopters or more of cylinder. Rotate that cylinder lens to determine the maximum Dyop clarity (via reduced blur) as the **optimum Axis setting**.
4. Reduce the Dyop diameter for the **IRS sphere** with the optimum Axis to where the Dyop is still detected as spinning to avoid the preference for an under-plused refraction (especially as preferred by a hyperope).
5. With the **IRS Sphere** and the optimum **Axis** setting, adjust the cylinder in 0.25 diopter increments (either – or + based on the initial findings) to determine if the spinning Dyop becomes clearer. If the Dyop becomes blurrier, reverse the selection to remove or add 0.25 diopters of **Cylinder** to find the optimum **Cylinder** setting.
6. With the optimum **Cylinder** (and **Axis**) determined, again **reduce the Dyop diameter to the smallest arc width** where the direction of spinning can be detected. Then incrementally adjust the Sphere with either (-) 0.25 diopters (myope) or (+) 0.25 diopters (hyperope) to determine if the spinning Dyop becomes clearer or blurrier. If the spinning Dyop becomes blurrier, adjust the sphere by either (-) 0.25 diopters (myope) or (+) 0.25 diopters (hyperope) to make the spinning as clear as possible. Refine (validate) the **Cylinder** by adjusting in increments of 0.25 or 0.125 diopters of **Cylinder** and (+/-) 0.25 or 0.125 diopters of **Sphere** to optimize the Dyop values and reduce the Dyop arc width diameter where spinning is still detected.
7. The refraction endpoint will be the optimum setting for sphere, cylinder, and axis for the **smallest Dyop arc minute diameter** where the direction of spin can be detected. Note that a **STATIC** Dyop will seem to get "clearer" with an overminus. When you **overminus a myope OR overplus a hyperope** the **SPINNING Dyop will get less clear**. You want spin direction detection of the **SPINNING Dyop** to be as clear as possible.
8. Record the **Dyop Best Visual Acuity (DBVA)** in arc minutes or as the **Snellen ratio** or **Metric ratio**. Repeat the process for **each eye and binocularly**. With practice, it should be possible to have a **Dyop refraction completed in 90 seconds** or less per eye, but with the increased precision and consistency of a Dyop versus the use of a static optotypes.

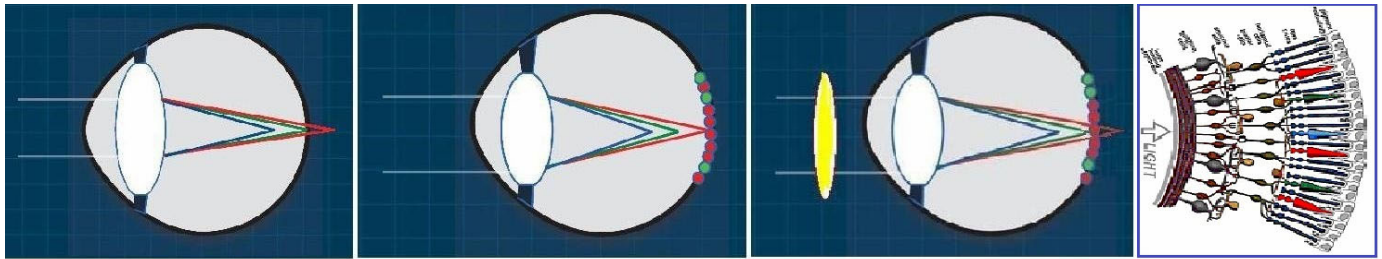
The **optimum emmetropia Dyop** equivalent to Snellen 20/20 (6/6) acuity has an angular arc width of **7.6 arc minutes**, a 10% stroke width, and spins at 40 revolutions per minute. The stimulus gap of that optimum Dyop correlates to a visual stimulus **AREA** of **0.54 arc minutes squared** (the Minimum **AREA** of Resolution or **MAR**) versus the traditional Snellen/Sloan/Landolt visual stimulus **AREA** of 1.0 arc minute squared. The smaller Dyop **MAR** results in its being significantly more precise than the Snellen **MAR**, and having a linear, rather than a logarithmic, increase in size with increasing blur. That linearity allows a Dyop to have an "optimum" (minimum) acuity endpoint for measuring refractive sphere, or cylinder, or axis.



The linear Dyop ratio of increased diameter to increased spherical blur allows for a relatively simple, yet precise determination, for refractions. An emmetropia **Dyop** comparable to **Snellen 20/20 (6/6)** has zero sphere, zero cylinder, and zero axis. The difference from that optimum emmetropia Dyop, with a (rounded) diameter of 8 arc minutes, correlate to an increase of **one diopter of power**, either plus OR minus for every **6 arc minutes** in diameter. **Dyop Refraction Terminology:** The **UDA** in arc minutes (am) is the smallest **Dyop** diameter where spinning can clearly be detected. The **ECV** is calculated by **subtracting 8** (the rounded initial am value) from the **UDA arc minute (am) value**. The **IRS +/-** in diopters is a linear equivalent to the **ECV**. **Divide the ECV by 6** to calculate the **IRS**, and then **round that IRS** value to the nearest quarter of a diopter. Using **Optometry nomenclature**, the **IRS** diopter value will be **plus (+)** for a hyperope and **minus (-)** for a myope. Confirm the correct +/- **IRS** setting because an **incorrect plus (+)** or **minus (-)** **IRS** lens will make the spinning Dyop blurrier (less visible) rather than clearer. Typically start with the **right eye** then the **left eye** followed by a **binocular** refraction. The formula for spherical lens power is **IRS (diopters of blur) = ECV/6 = (UDA-8)/6**.

**Examples:** A **UDA** of 14 arc minutes corresponds to an **ECV** of 6 arc minutes and 1 diopter of **IRS** sphere, as either plus (+) or minus (-). A **UDA** of 26 arc minutes will be an **ECV** of 18 arc minutes and three diopters of **IRS** sphere. **Reducing the Dyop diameter to sub-acuity (where Dyop spinning is NOT detected)** is equivalent to adding blur to the Snellen test or selecting a smaller size acuity line to test for false positives.

**Dyop® Color Acuity Response Form**  
 Contact [Allan@Dyop.org](mailto:Allan@Dyop.org) for access to the experimental test



**Green-Focused Vision**  
 GFV - 50% red / 45% green / 5% blue

**Red-Focused Vision**  
 RFV - 75% red / 20% green / 5% blue

**Chromatic Modulation**  
 RFV - 75% red / 20% green / 5% blue

**Photoreceptors**

Color	Hex	RGB
Gray	999999	153.153.153

Color	Hex	RGB
Black	000000	0.0.0
White	FFFFFF	255.255.255

Color	Hex	RGB
Blue	0000FF	0.0.255
Green	00FF00	0.255.0

Color	Hex	RGB
Amber	FFFF00	255.255.0
Red	FF0000	255.0.0

The smallest Dyop® arc width whose direction of spin is detected is the Acuity Endpoint for that color combination.

Subject Name: \_\_\_\_\_ Viewing Distance: \_\_\_\_\_ Test Date: \_\_\_\_\_

OD/OS/OU: \_\_\_\_\_

Device: \_\_\_\_\_

Dyop							
Color/Contrast	Basic Acuity	Blue/Gray	Green/Gray	Amber/Gray	Red/Gray	Green/White	Blue/Black
Arc Width							
Snellen - Feet							
Snellen - Meters							

Subject Name: \_\_\_\_\_ Viewing Distance: \_\_\_\_\_ Test Date: \_\_\_\_\_

OD/OS/OU: \_\_\_\_\_

Device: \_\_\_\_\_

Dyop							
Color/Contrast	Basic Acuity	Blue/Gray	Green/Gray	Amber/Gray	Red/Gray	Green/White	Blue/Black
Arc Width							
Snellen - Feet							
Snellen - Meters							

Subject Name: \_\_\_\_\_ Viewing Distance: \_\_\_\_\_ Test Date: \_\_\_\_\_

OD/OS/OU: \_\_\_\_\_

Device: \_\_\_\_\_

Dyop							
Color/Contrast	Basic Acuity	Blue/Gray	Green/Gray	Amber/Gray	Red/Gray	Green/White	Blue/Black
Arc Width							
Snellen - Feet							
Snellen - Meters							