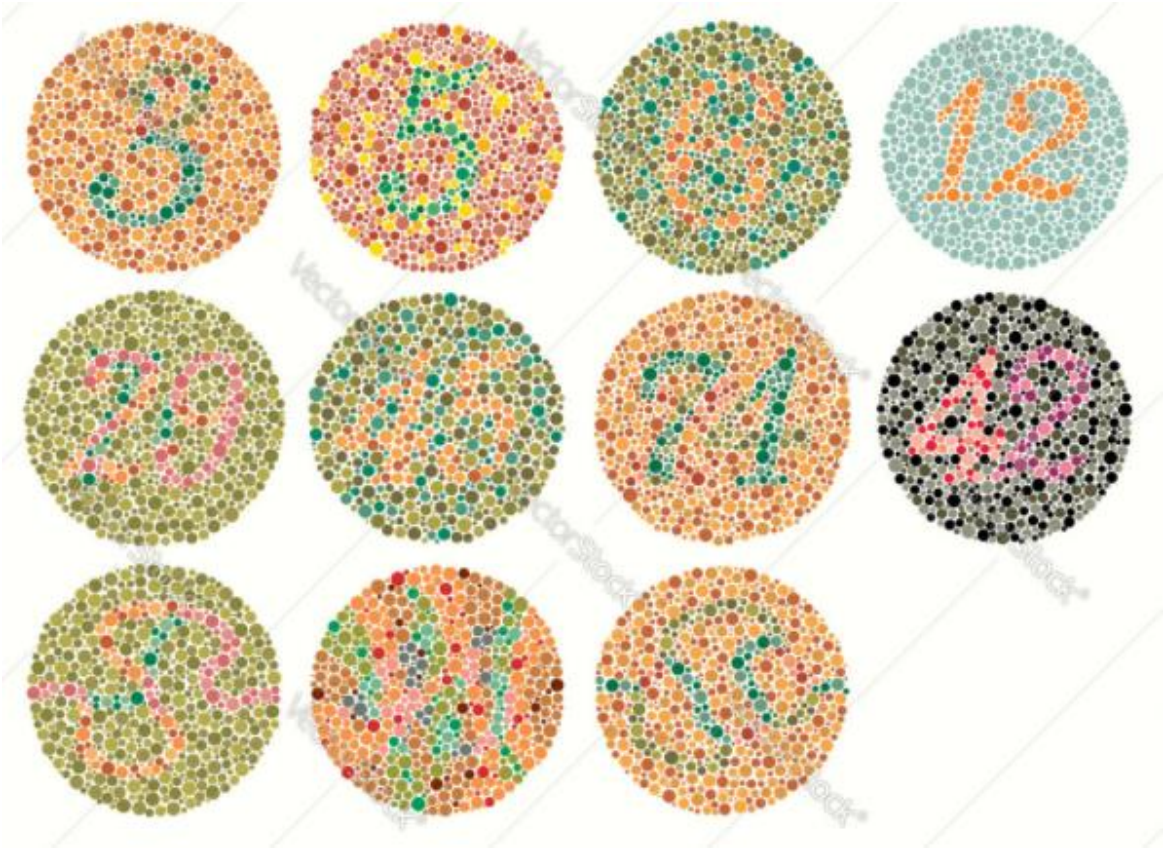
Cone Isolation Contrast Sensitivity

The future of color vision testing

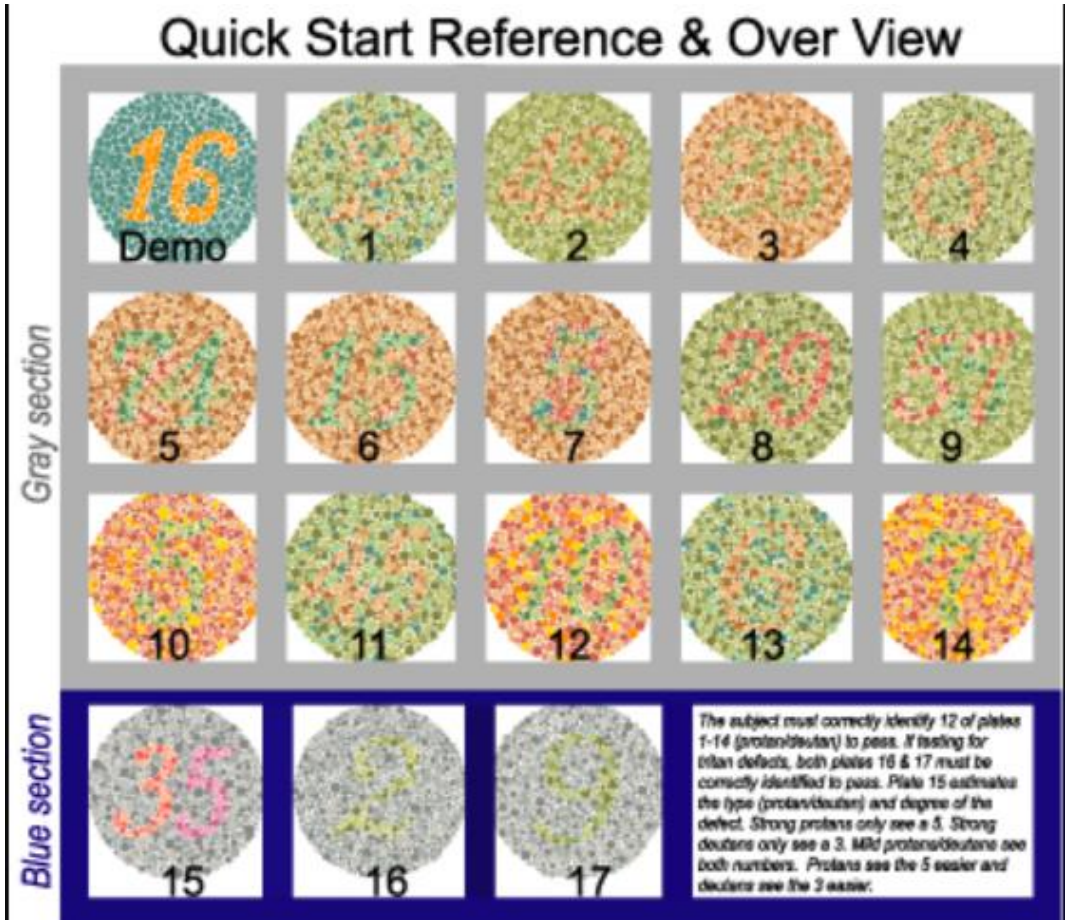
PAUL HARRIS

Nothing to disclose

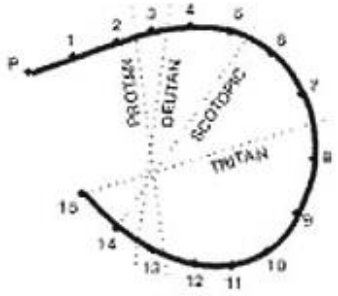
Ishihara



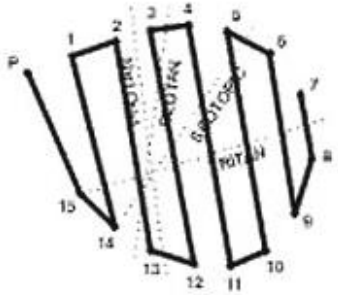
Dvorine


Quick Start Reference & Over View
Gray section
Blue section
Demo
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
The subject must correctly identify 12 of plates 1-14 (protan/deutan) to pass. If testing for tritan defects, both plates 16 & 17 must be correctly identified to pass. Plate 15 estimates the type (protan/deutan) and degree of the defect. Strong protans only see a 5. Strong deutans only see a 3. Mild protan/deutans see both numbers. Protans see the 5 easier and deutans see the 3 easier.

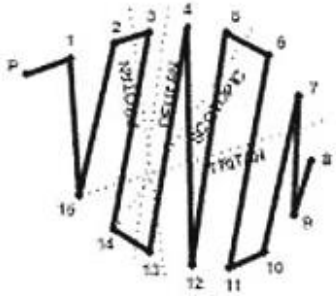
D15 Standard and Desaturated



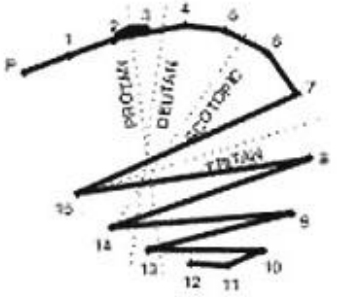
Normal



Protan



Deutan

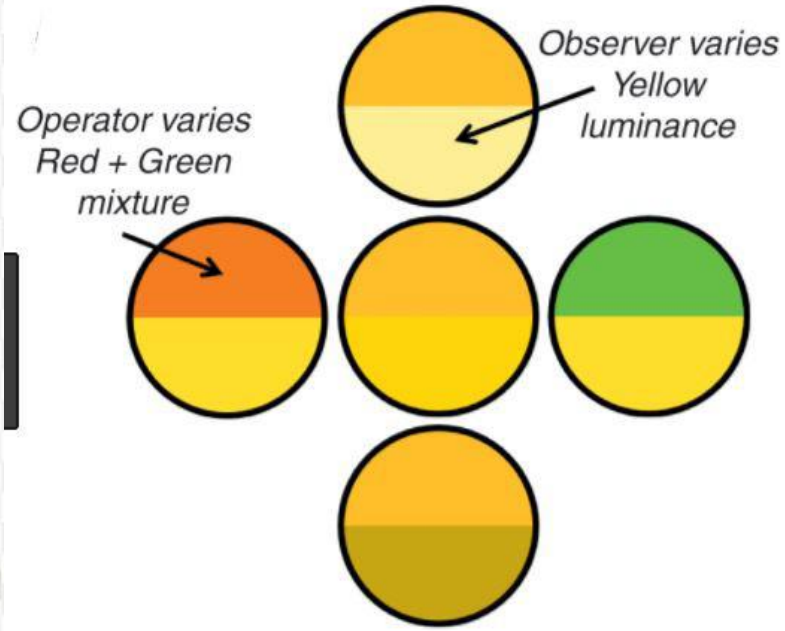


Tritan

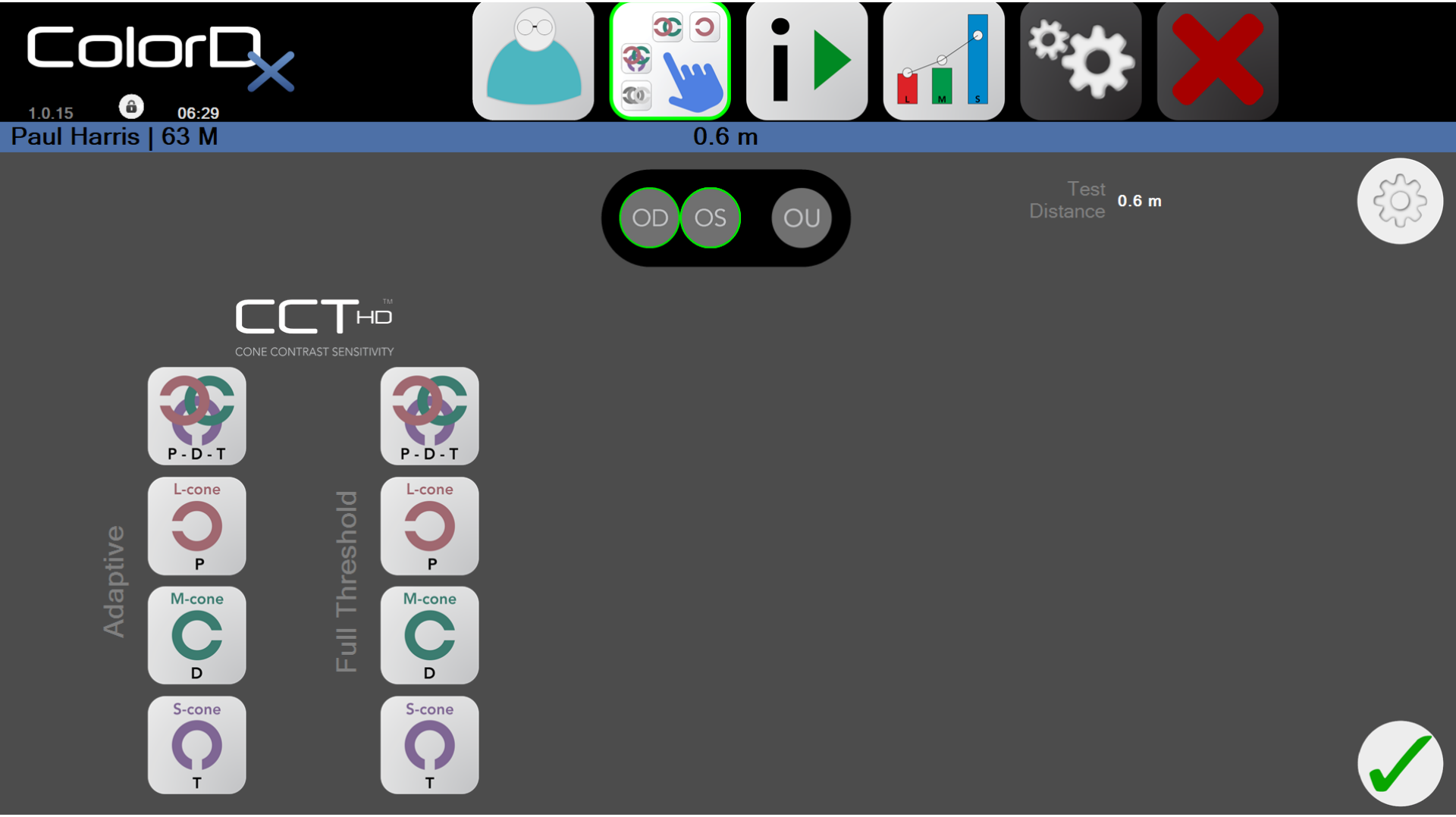
Rod monochromasy

Farnsworth 100 Hue

Oculus Anomaloscope



Computer based color vision testing


ColorDx
1.0.15
06:29
Paul Harris | 63 M
0.6 m
OD
OS
OU
Test Distance
0.6 m
CCT HD
CONE CONTRAST SENSITIVITY
Adaptive
Full Threshold
P - D - T
L-cone
P
M-cone
D
S-cone
T
P - D - T
L-cone
P
M-cone
D
S-cone
T

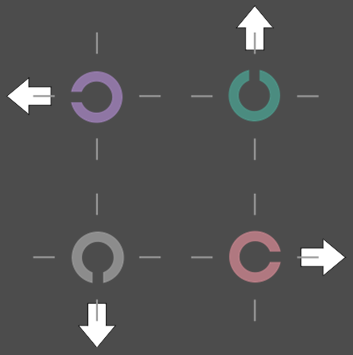
ColorDx

1.0.15 06:30

Paul Harris | 63 M | 0.6 m | L-M-S | OD - OS

Instructions

A **letter "C" shape** is shown briefly in one of four **directions** and may be one or more colors.



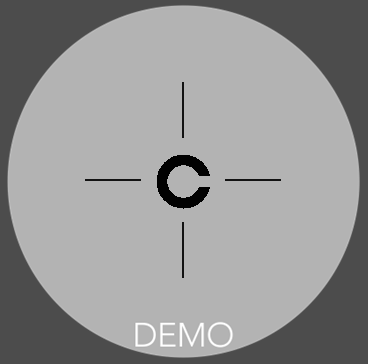
Use the **arrows to match the direction** of the opening of the "C". A high tone indicates "correct" a low tone indicates "wrong", then the next shape is displayed.

The test calculates the limit of what you can see. When the shape fades to be difficult and then purposely impossible to see, **make your best guess**.

The test ends after several wrong answers and the times to answer are recorded ...try to **answer as quickly as practical**.

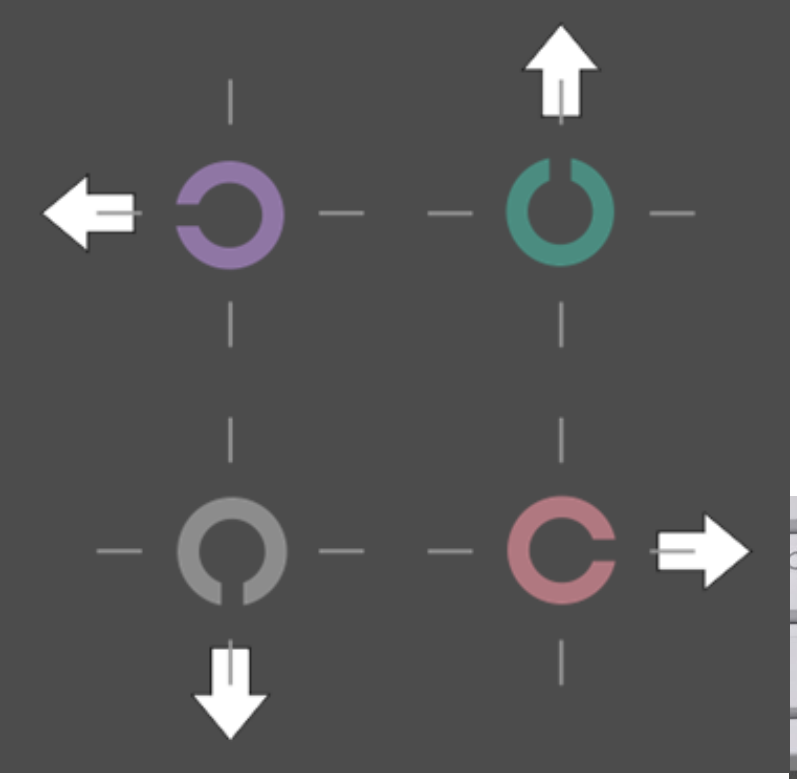
Start the test by selecting ✓ or with long press of any arrow button

use arrows to match direction of opening of "C"



OD

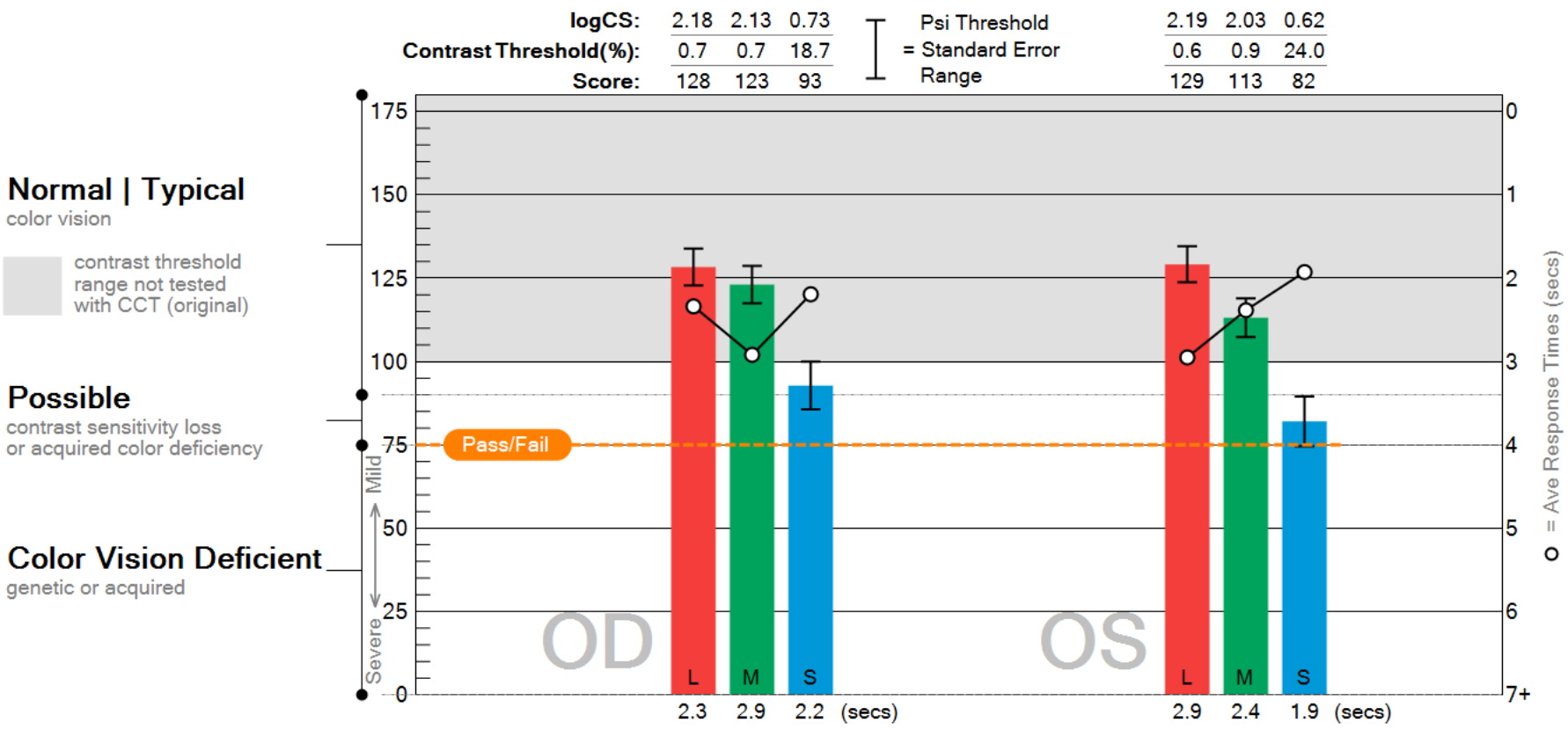
✓




Shift
Ctrl
KONAN MEDICAL

Video of Cone Isolation Contrast Sensitivity Stimuli

Data from video



Some Cases

Train engineer's vision problems led to deadly Oklahoma wreck, NTSB rules

BY CHRIS CASTEEL ccasteel@opubco.com • Published: June 18, 2013 12:00 AM CDT • *Updated: June 18, 2013 8:07 PM CDT*

WASHINGTON — Two years before his failing vision likely contributed to a fatal crash in the Oklahoma Panhandle, freight train engineer Dan Hall told one of his eye doctors that he was having trouble distinguishing the color of train signals.

Hall and his conductor, Brian Stone, were killed, as was John Hall, the engineer on the other train; the two engineers were not related. Juan Zurita, the conductor on the westbound train, leapt off just before impact.

The National Transportation Safety Board investigated the crash for nearly a year and determined Tuesday that the probable causes were Dan Hall's vision problems and Stone's failure to provide the backup assistance required of a conductor.

Subject TB

5th generation working for U.P. in family – 18 months from retirement.

DVA uncorrected: OD 20/12 OS 20/12

NVA uncorrected: OD 20/16 OS 20/16

Binocular Balance: +0.50 OU to 20/20

BVA (Manifest): plan OU to 20/12

Peli-Robson CS: OD 3.2% OS 2.5% OU 3.2%

Linear Sine Wave Grating CS:

- 6 cycles per degree OD 0.8% OS 0.8% OU 0.5%
- 12 cycles per degree OD 1.0% OS 0.6% OU 0.6%
- 18 cycles per degree OD 1.6% OS 1.6% OU 1.6%

Bulls Eye CS

- Mesopic:18 cpd 12.5% 12 cpd 3.2% 6 cpd 1.8% 3 cpd 0.63% 1.5 cpd 0.63%
- Photopic: 18 cpd 2% 12 cpd 0.63% 6 cpd 0.63% 3 cpd 0.5% 1.5 cpd 0.63%

Stereo

- Randot Stereo: 20 seconds of arc
- Random Dot 3: 12.5 seconds of arc
- Distance Stereo – Chart 2020: 20 seconds of arc

Visual Fields

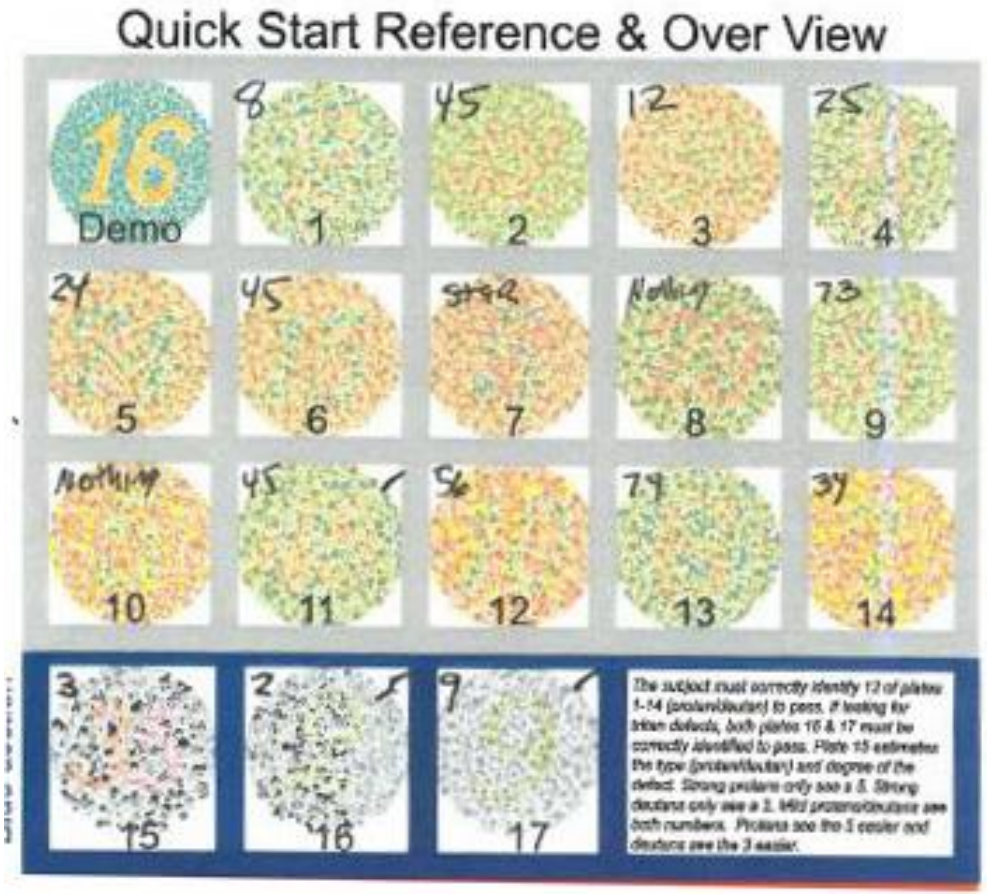
- 24-2 all normal
- 30-2 all normal
- Goldmann all normal

Color Testing

HRR ColorDx (formerly Color Vision Made Easy – Waggoner): 7 of 9 errors

D15 regular and desaturated OD and OS separately, all 4 trials perfectly in order.

Dvorine – look right



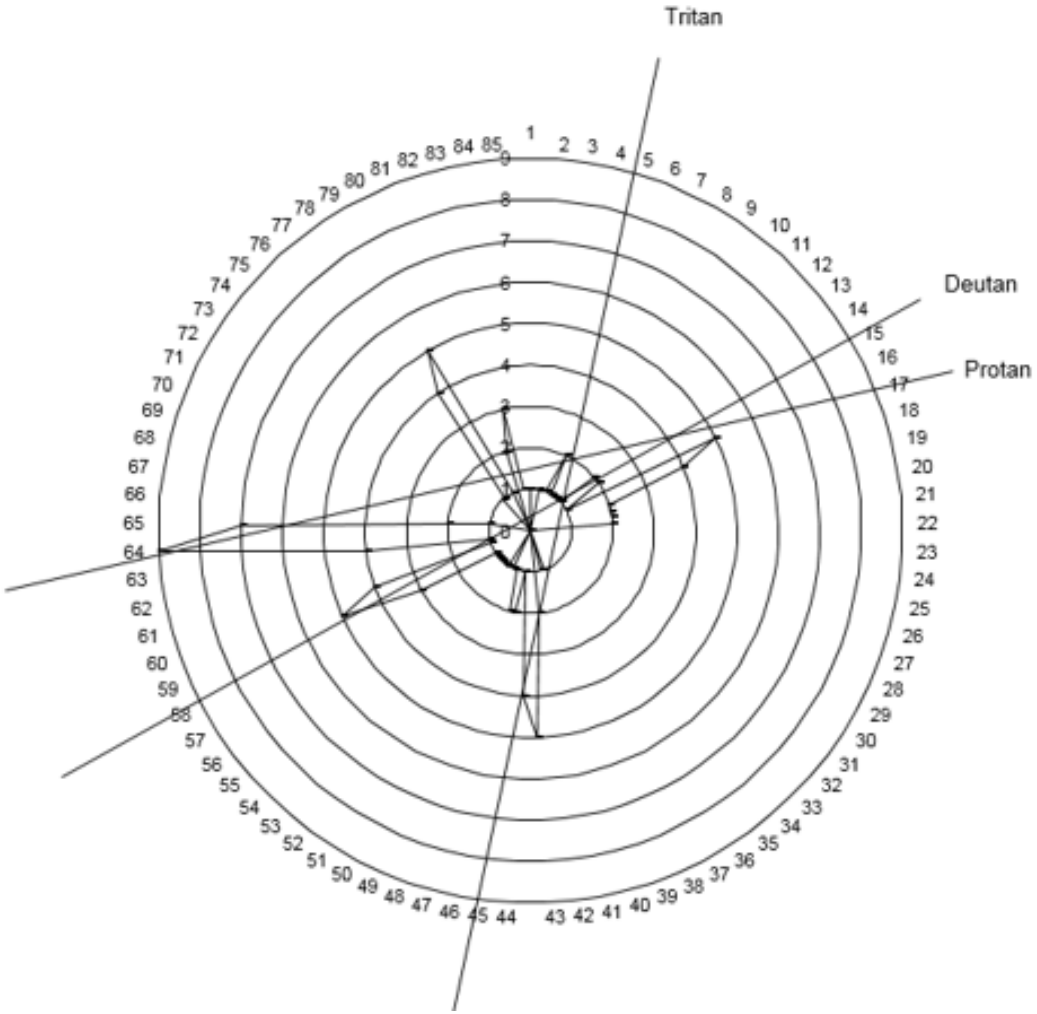
COLOR

Plate sequence	Number on Plate	Subject's Response	
		Pass	Fail
		Demonstration Plate	
1	48	✓	
2	67	✓	
3	38		33
4	92		95
5	70		75
6	95	✓	
7	26	✓	
8	2	✓	
9	74		46
10	62		19
11	4		2
12	28		23
13	46	✓	
14	7	✓	
15	39		35

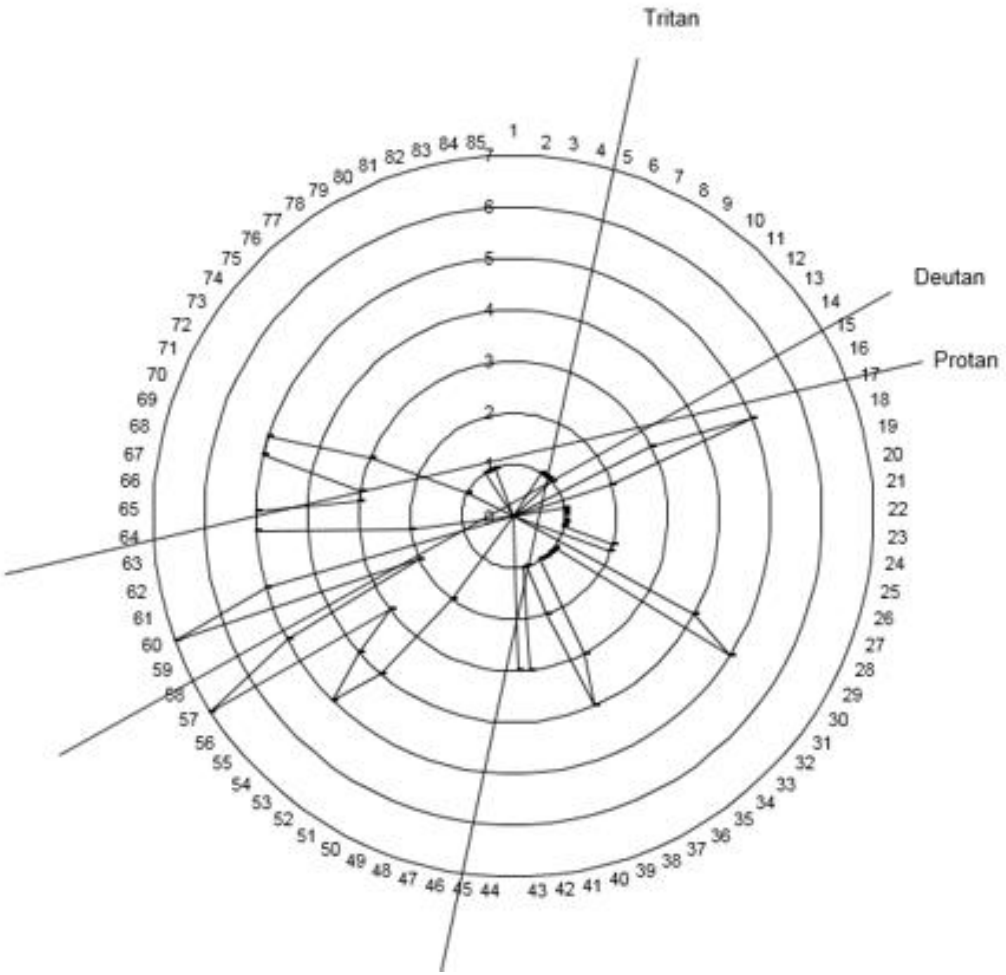
79
65
37
8

Number of Plate	Normal Person	Person with Red-Green Deficiencies			
1	12	12			
2	8	3			
3	6	5			
4	29	70			
5	57	35			
6	5	2			
7	3	5			
8	15	17			
9	74	21			
10	2	×			
11	6	×			
12	97	×			
13	45	×			
14	5	×			
15	7	×			
16	16	×			
17	73	×			
18	×	5			
19	×	2			
20	×	45			
21	×	73			
		Protan		Deutan	
		Strong	Mild	Strong	Mild
22	26	6	(2)6	2	2(6)
23	42	2	(4)2	4	4(2)
24	35	5	(3)5	3	3(5)
25	96	6	(9)6	9	9(6)

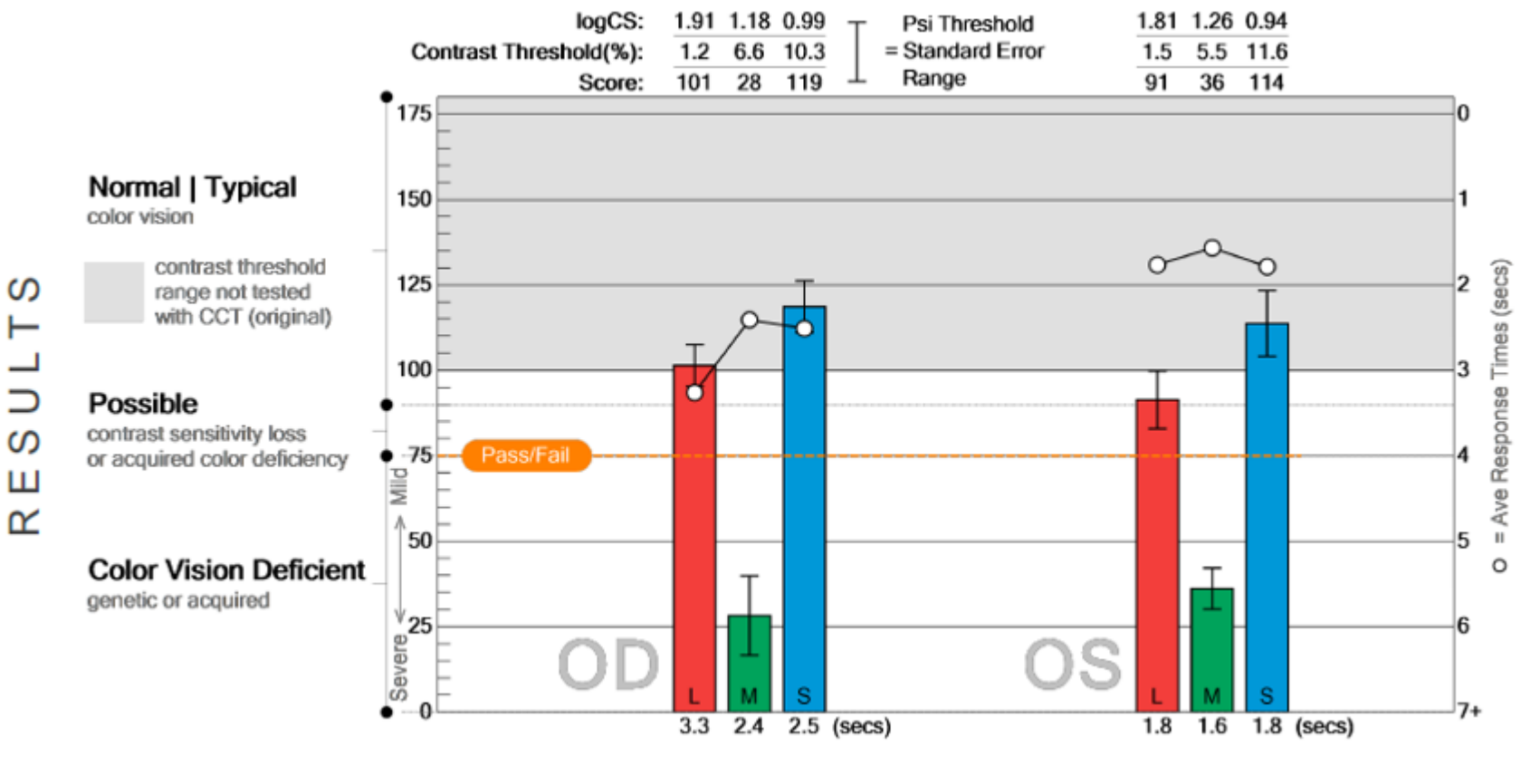
Farnsworth-Munsell 100 Hue Test



Farnsworth-Munsell 100 Hue Test



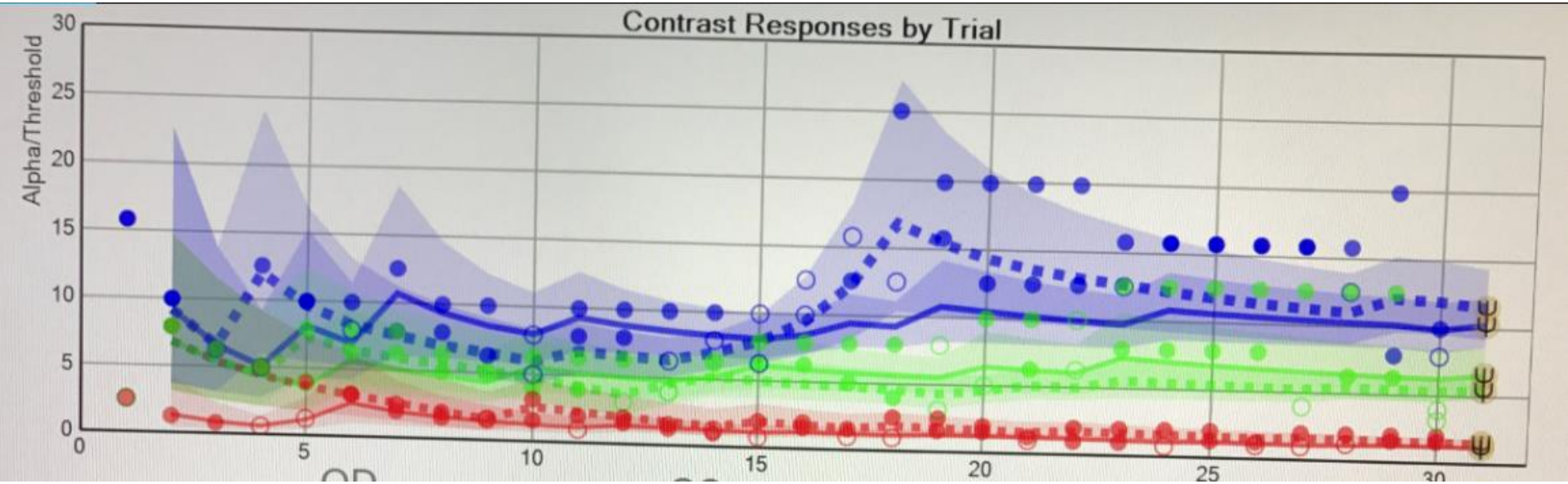
Severe Deutan



DATA

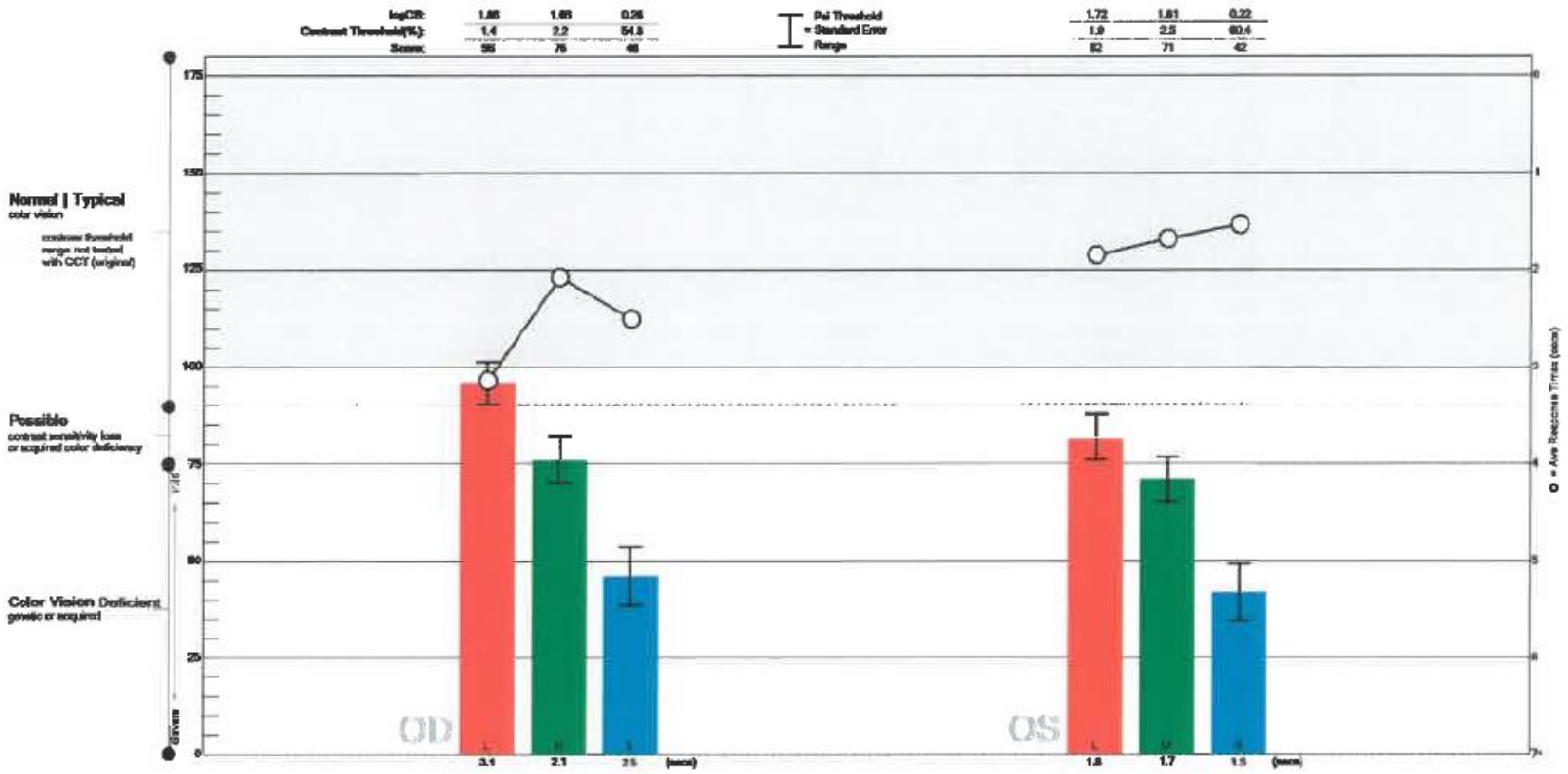
Estimated Psi

	Cone	Threshold	Error	Trials	Ave Time	Score	Category[1]
OD	Red L	1.2%	4.1%	30	3.3	101	Normal
	Green M	6.6%	1.7%	30	2.4	28	Severe (Deutan)
	Blue S	10.3%	2.4%	30	2.5	119	Normal
OS	Red L	1.5%	3.7%	30	1.8	91	Normal
	Green M	5.5%	4.0%	30	1.6	36	Severe (Deutan)
	Blue S	11.6%	1.8%	30	1.8	114	Normal



A Dental Professor
Research in: color for reconstruction

RESULTS



E.P. 29-yo female

Experiencing loss of vision in OS with pain which lasts for several hours.

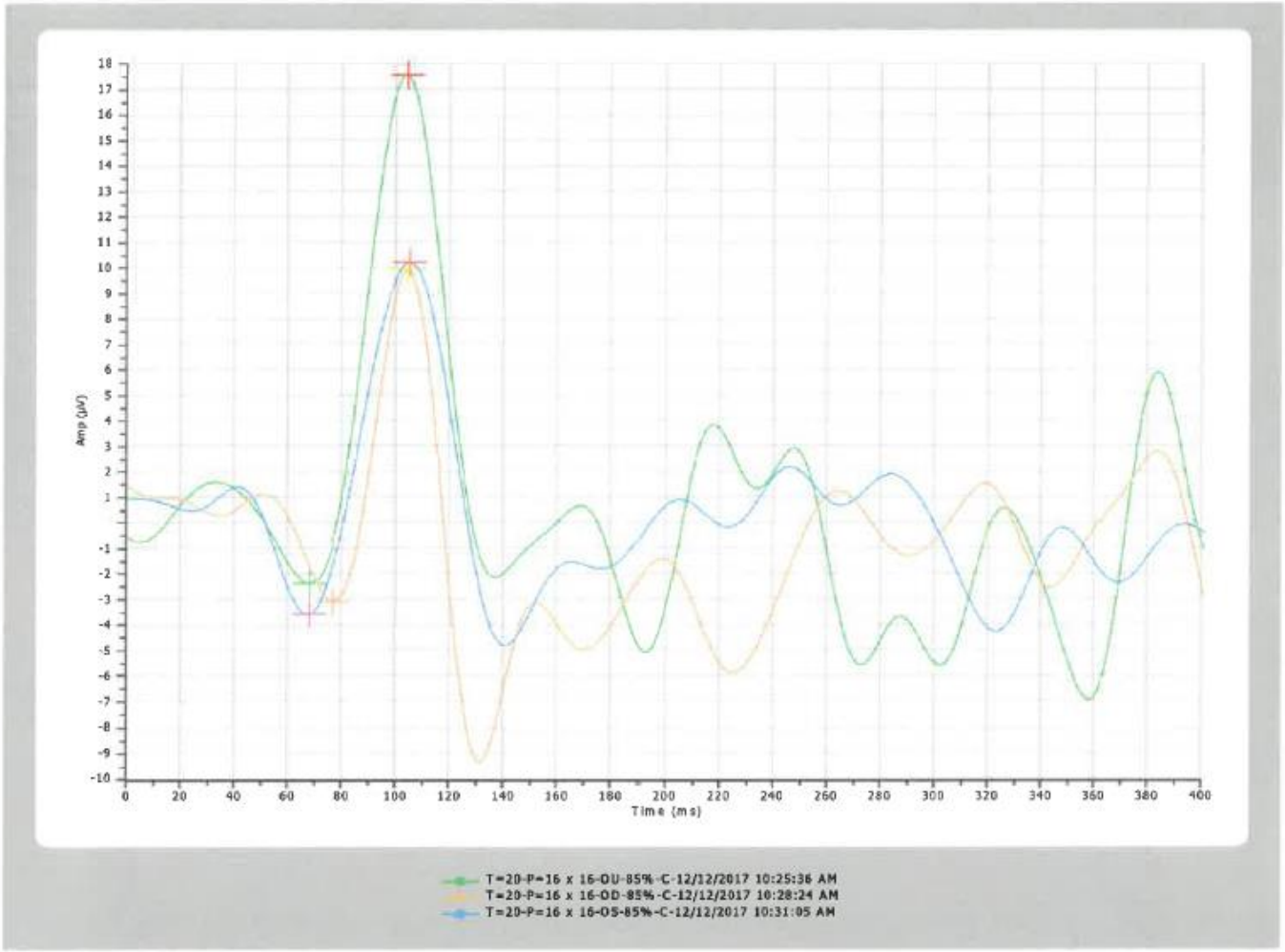
DVA OD 20/25 OS 20/25 OU 20/20

NVA OD 20/40 OS 20/30 OU 20/25

Binocular Balance: OD +0.50 -0.25 165 OS +0.50 20/20 OD, OS, OU

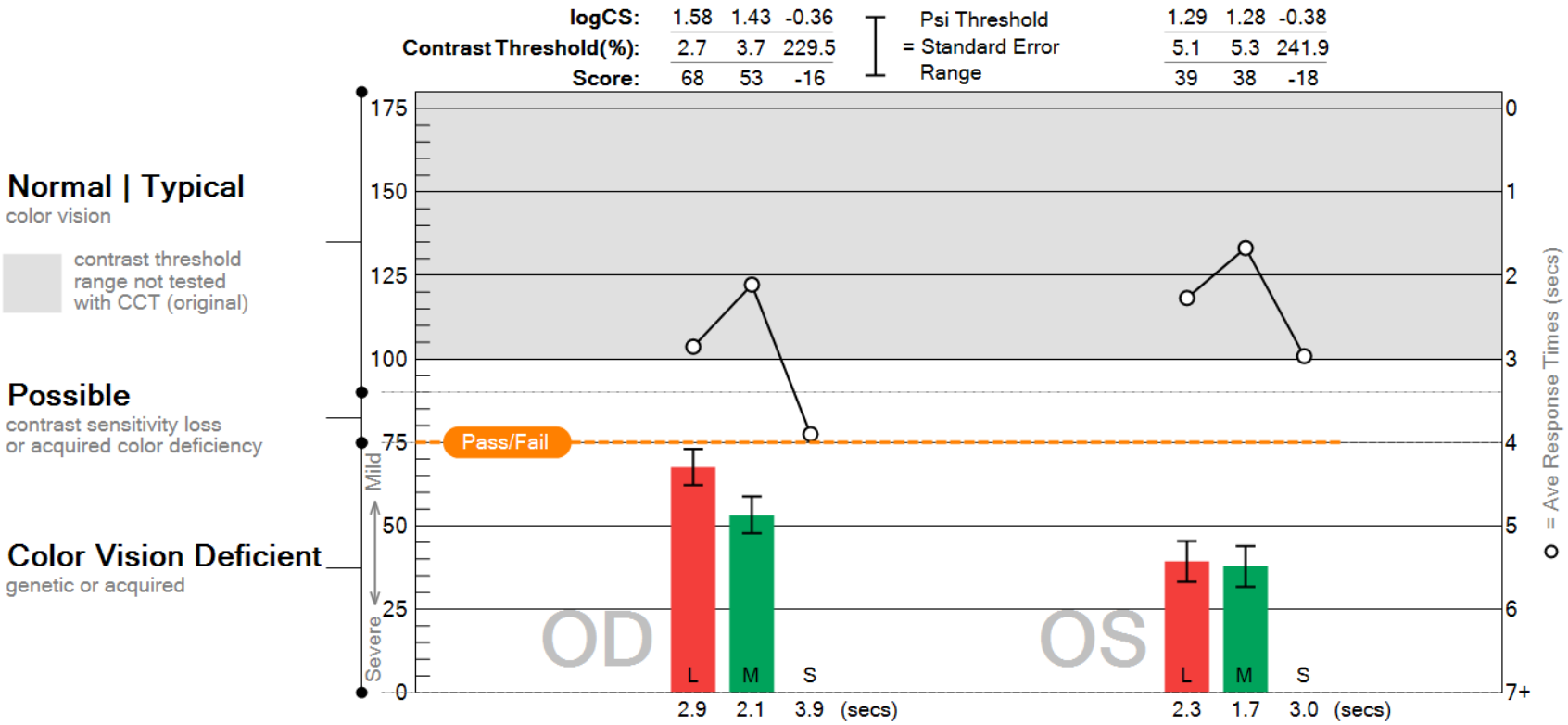
PRA: -3.50 NRA: +2.50

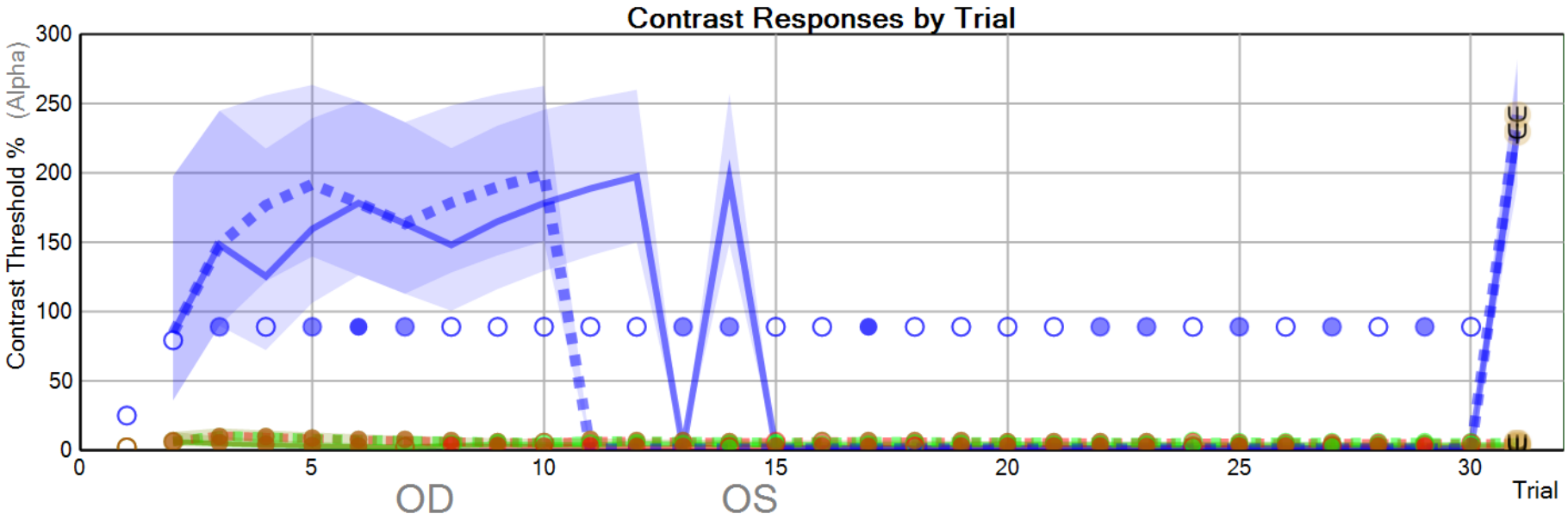
VEP's: 5 check sizes, OD, OS, OU all normal with binocular summation and no latency differences and no overall delay.



		T=20-P=16 x 16-OU-85%-C-12/12/2017 10:25:36 AM	T=20-P=16 x 16-OD-85%-C-12/12/2017 10:28:24 AM	T=20-P=16 x 16-OS-85%-C-12/12/2017 10:31:05 AM
Left Cursor	Lat	68.4 ms	77.1 ms	68.4 ms
	Amp	-2.37 uV	-3.10 uV	-3.59 uV
Right Cursor	Lat	**104.5 ms**	**104.5 ms**	**105.5 ms**
	Amp	17.58 uV	9.94 uV	10.22 uV
Delta	Lat	36.1 ms	27.3 ms	37.1 ms
	Amp	**19.95 uV**	**13.05 uV**	**13.81 uV**

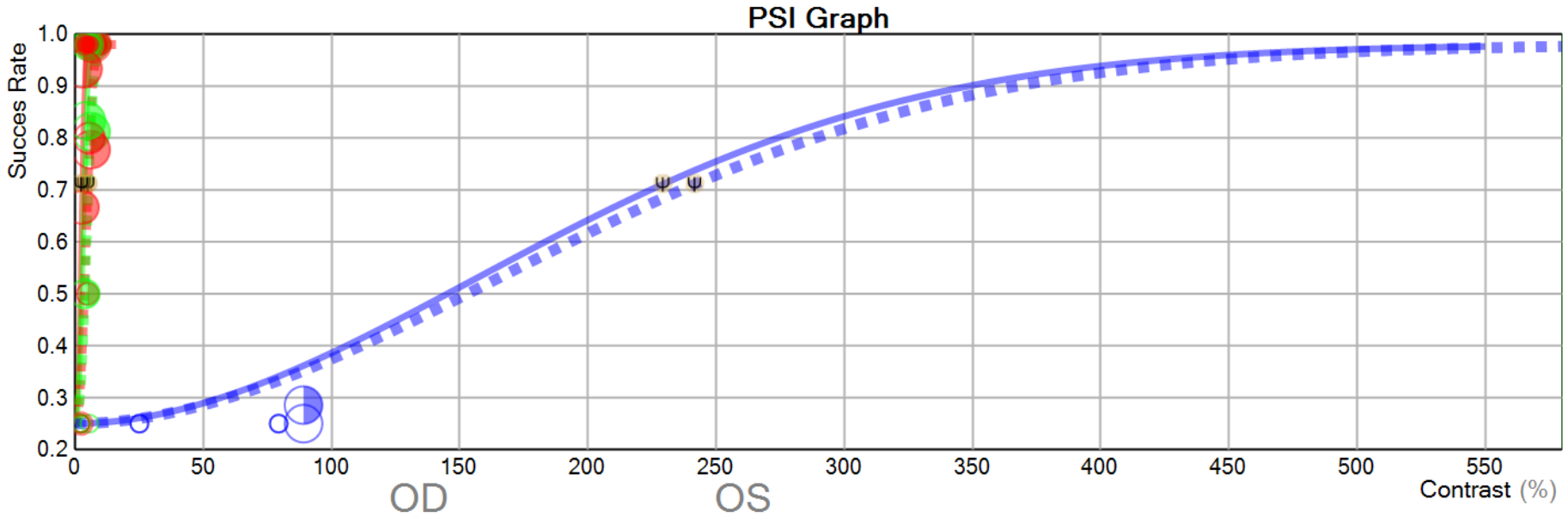
Houston we have a problem!





Cone	L	M	S	L	M	S
Reaction time (secs)	2.9	2.1	3.9	2.3	1.7	3.0
Contrast Threshold % (Alpha)	2.66	3.69	229.51	5.09	5.27	241.89
Standard Error (Alpha)	0.66	0.93	84.86	1.44	1.48	75.32

☑ Show responses ☑ Show range



Cone	L	M	S	L	M	S
Reaction time (secs)	2.9	2.1	3.9	2.3	1.7	3.0
Contrast Threshold % (Alpha)	2.66	3.69	229.51	5.09	5.27	241.89
Standard Error (Alpha)	0.66	0.93	84.86	1.44	1.48	75.32

☑ Show responses

B.C. 61-yo female

HTN since 1985, high cholesterol

1st exam at SCO: 10/27/17

DVA with Rx: OD 20/15 OS 20/15 OU 20/15

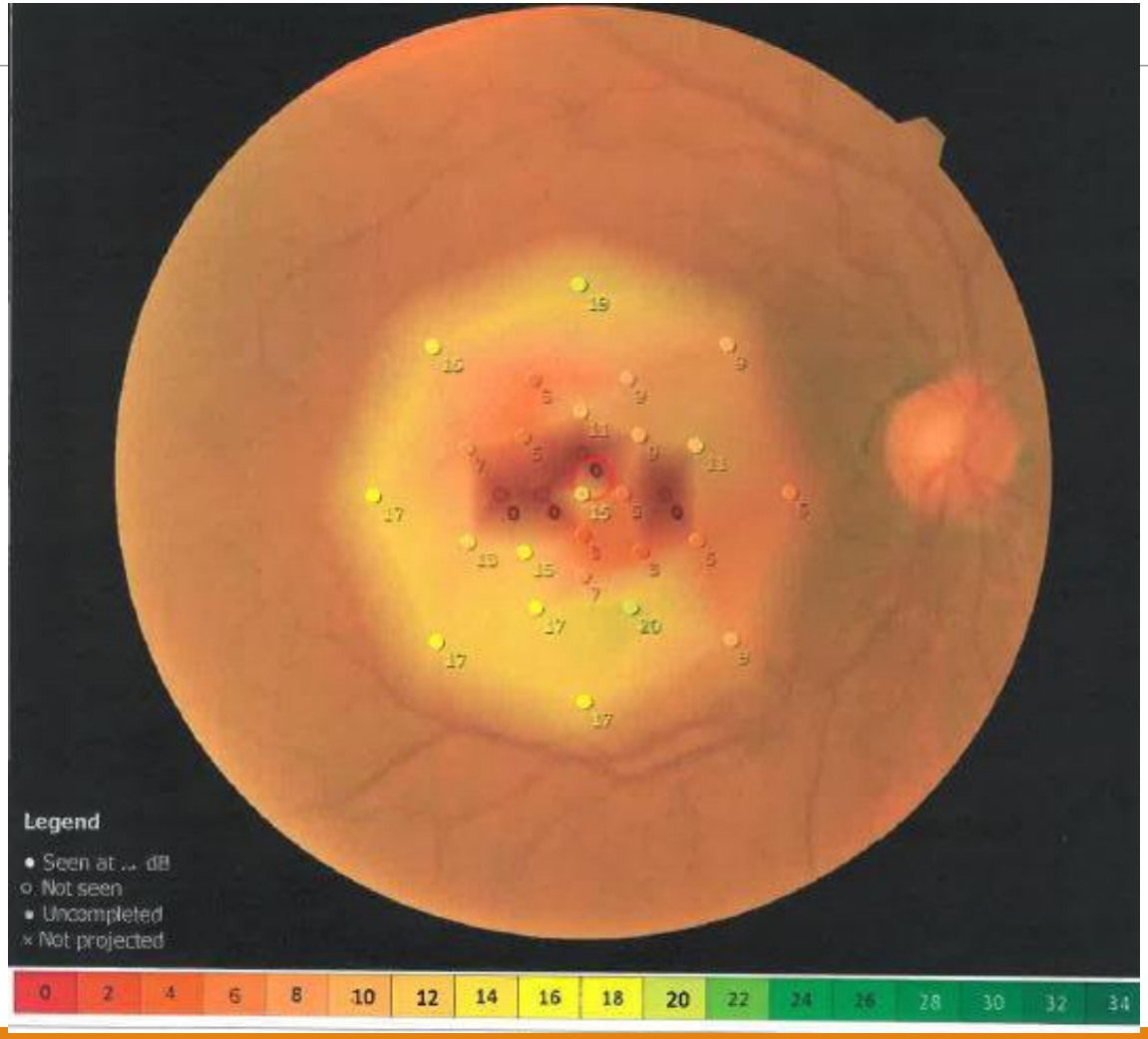
NVA with Rx: OD 20/20 OS 20/25 OU 20/25

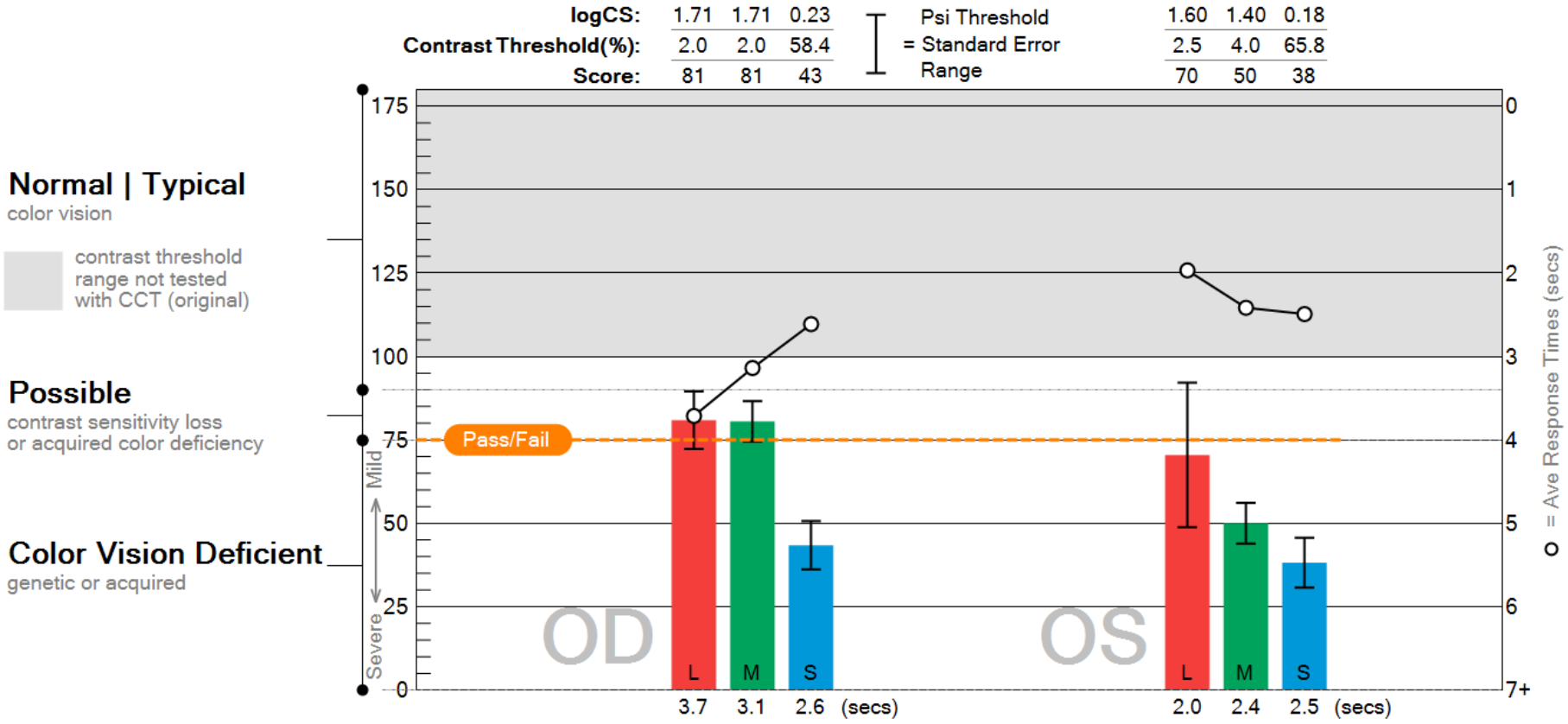
Binocular Balance: OD +0.25 -0.50 x 59 OS +0.25 20/20 all

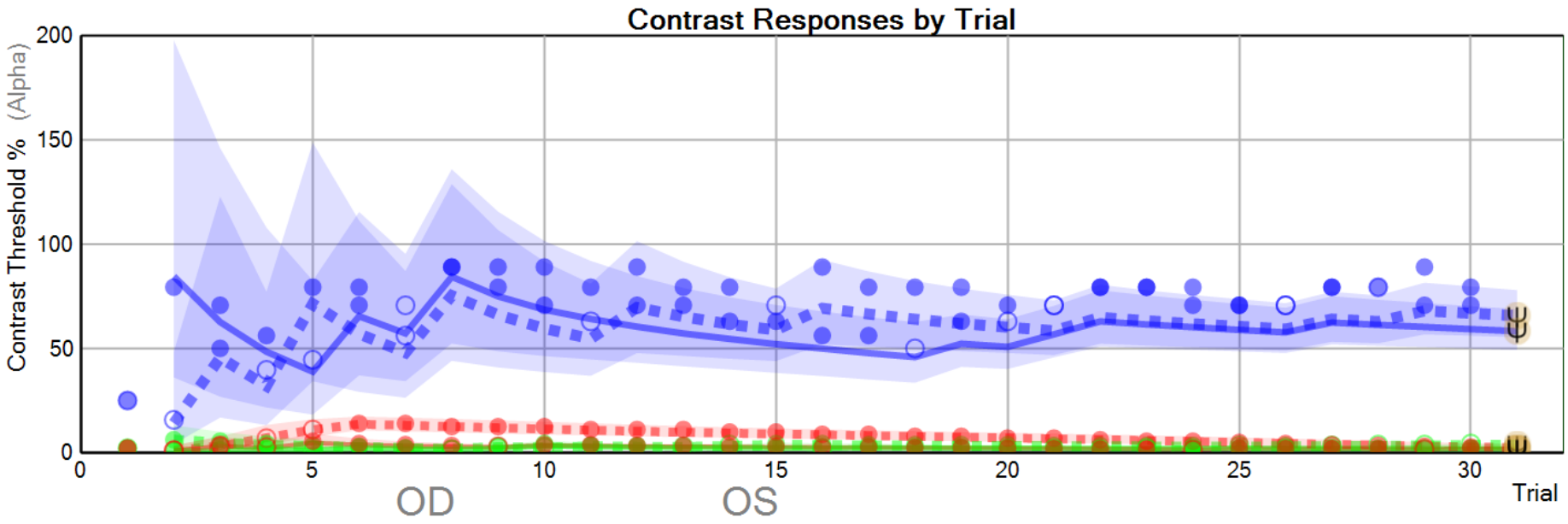
Brought back for DFE 11/16/17

- Scattered punched out lesions OU
- Pigmentary changes throughout
- CD OD .35/.35 OS .65/.65
- 24-2 OD ok - possible arcuate superior OS

Nidek Micro-Perimeter




logCS: 1.71 1.71 0.23
Contrast Threshold(%): 2.0 2.0 58.4
Score: 81 81 43
Psi Threshold
= Standard Error
Range
1.60 1.40 0.18
2.5 4.0 65.8
70 50 38
Normal | Typical
color vision
contrast threshold range not tested with CCT (original)
Possible
contrast sensitivity loss or acquired color deficiency
Color Vision Deficient
genetic or acquired
175
150
125
100
75
50
25
0
Mild
Severe
Pass/Fail
OD
OS
L
M
S
3.7 3.1 2.6 (secs)
2.0 2.4 2.5 (secs)
0
1
2
3
4
5
6
7+
= Ave Response Times (secs)



Cone	L	M	S	L	M	S
Reaction time (secs)	3.7	3.1	2.6	2.0	2.4	2.5
Contrast Threshold % (Alpha)	1.95	1.97	58.35	2.48	3.98	65.78
Standard Error (Alpha)	0.78	0.55	19.54	2.58	1.12	22.62

☑ Show responses ☑ Show range

58-yo male

9/7/17 sent in by outside OD

Type 2 diabetic – elevated A1C in June 7.3% - on steroid for pneumonia – BP 140/88

DVA with Rx: OD 20/15-3 OS 20/15-1 OU 20/15-2

NVA with Rx: 20/25+ all

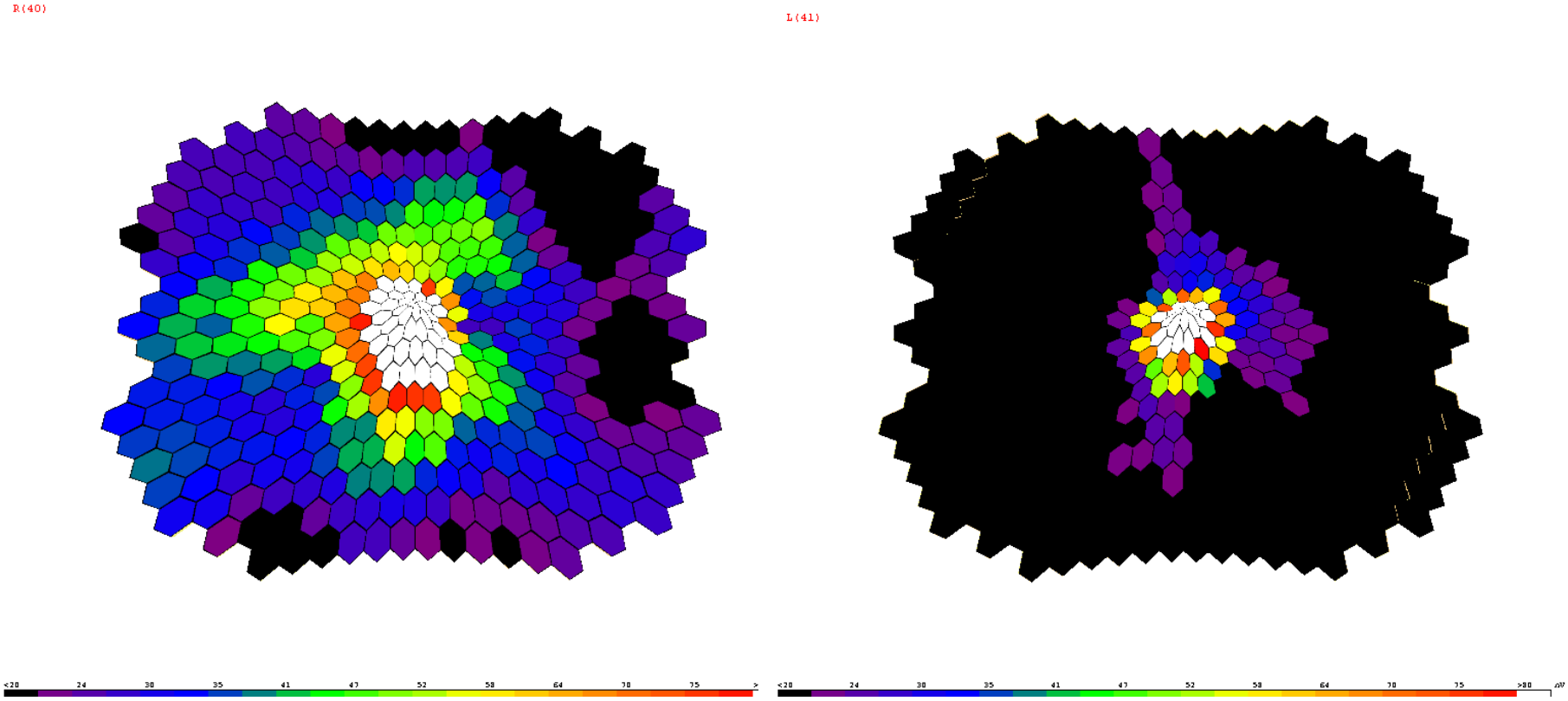
ASEG – nothing interesting

PSEG OD shows Drusen scattered but not in OS.

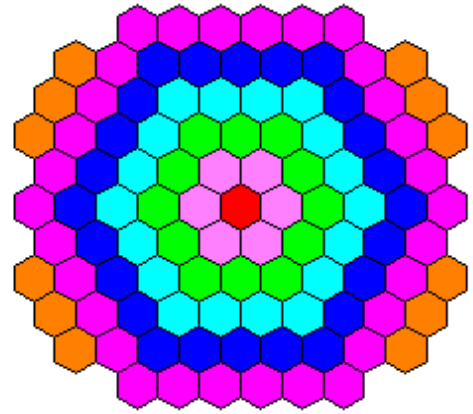
NOTES: OD appears like intermediate AMD. 2nd opinion by another doctor: Could be CACD but very asymmetric. Spectralis shows choroidal irregularity and Drusen affecting the RPE layer.

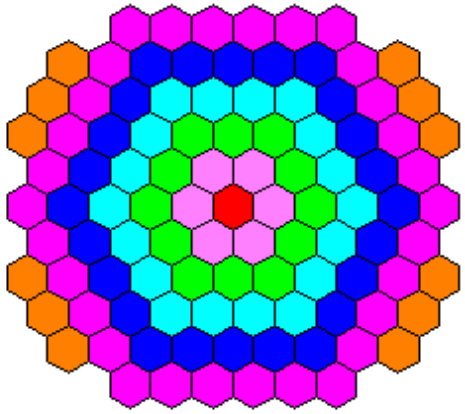
Multi focal ERG

OD OS



mfERG Ring Analysis



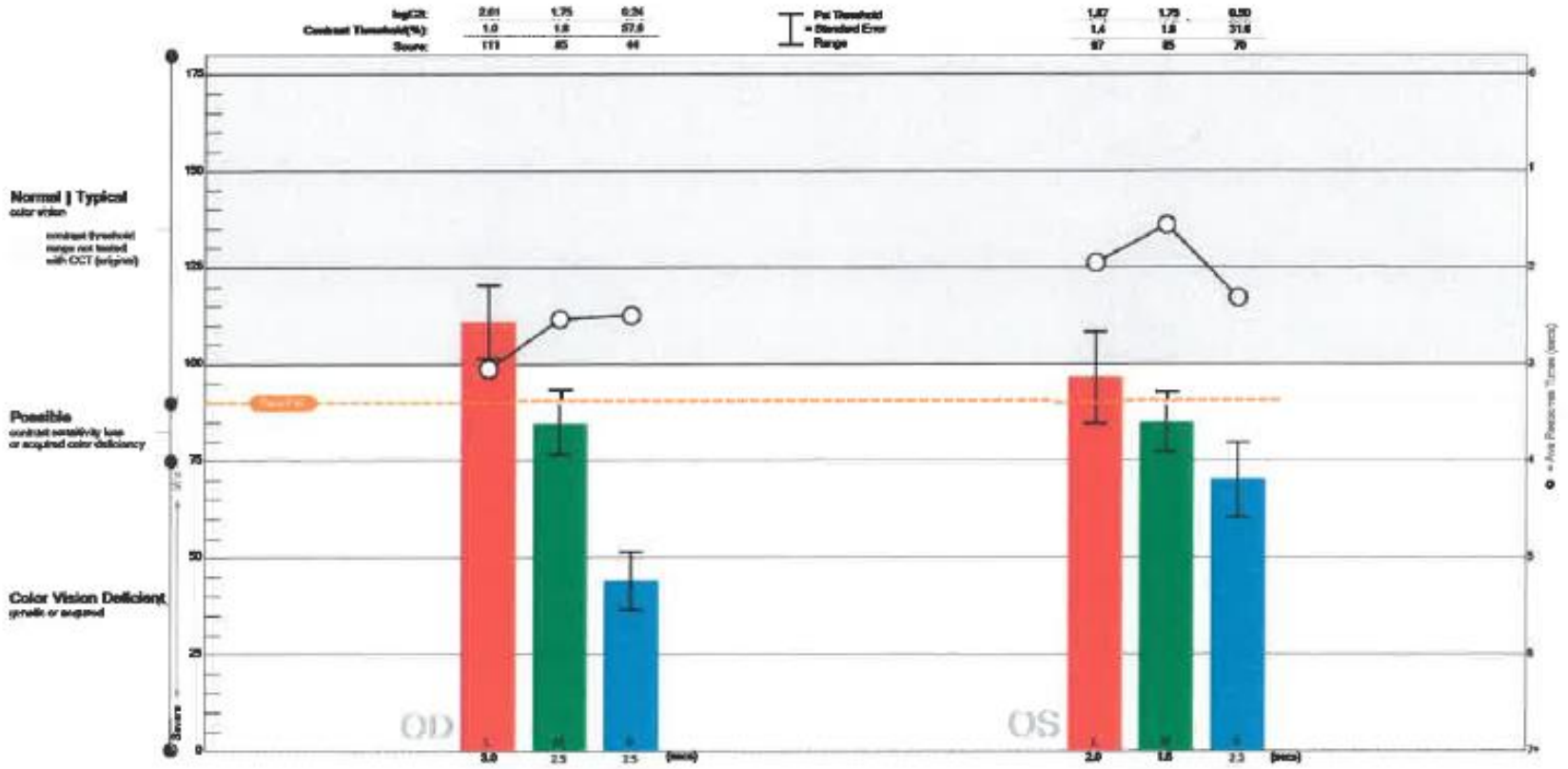


N1(nV/deg2)	P1(nV/deg2)	Diff(nV/deg2)
-36.76	52.04	88.81
4.57	10.65	6.08
-3.03	6.34	9.37
-1.89	3.35	5.24
-1.37	2.56	3.93
-0.22	2.45	2.67
-1.88	2.57	4.46

N1(nV/deg2)	P1(nV/deg2)	Diff(nV/deg2)
-20.42	28.00	48.42
-6.37	4.82	11.18
-2.14	4.00	6.14
-0.14	4.11	4.25
-2.42	2.10	4.52
-1.23	1.36	2.59
-2.61	2.40	5.01

ColorDx Results

RESULTS



Data

DATA

CCT HD™

	Cone	Psi Threshold	Trials	Ave Time	Score	Category[1]
OD	Red L	1.0%	30	3.0	111	Normal
	Green M	1.8%	30	2.5	85	Possible (Deutan)
	Blue S	57.6%	30	2.5	44	Color Deficient (Tritan)
OS	Red L	1.4%	30	2.0	97	Normal
	Green M	1.8%	30	1.6	85	Possible (Deutan)
	Blue S	31.6%	30	2.3	70	Color Deficient (Tritan)

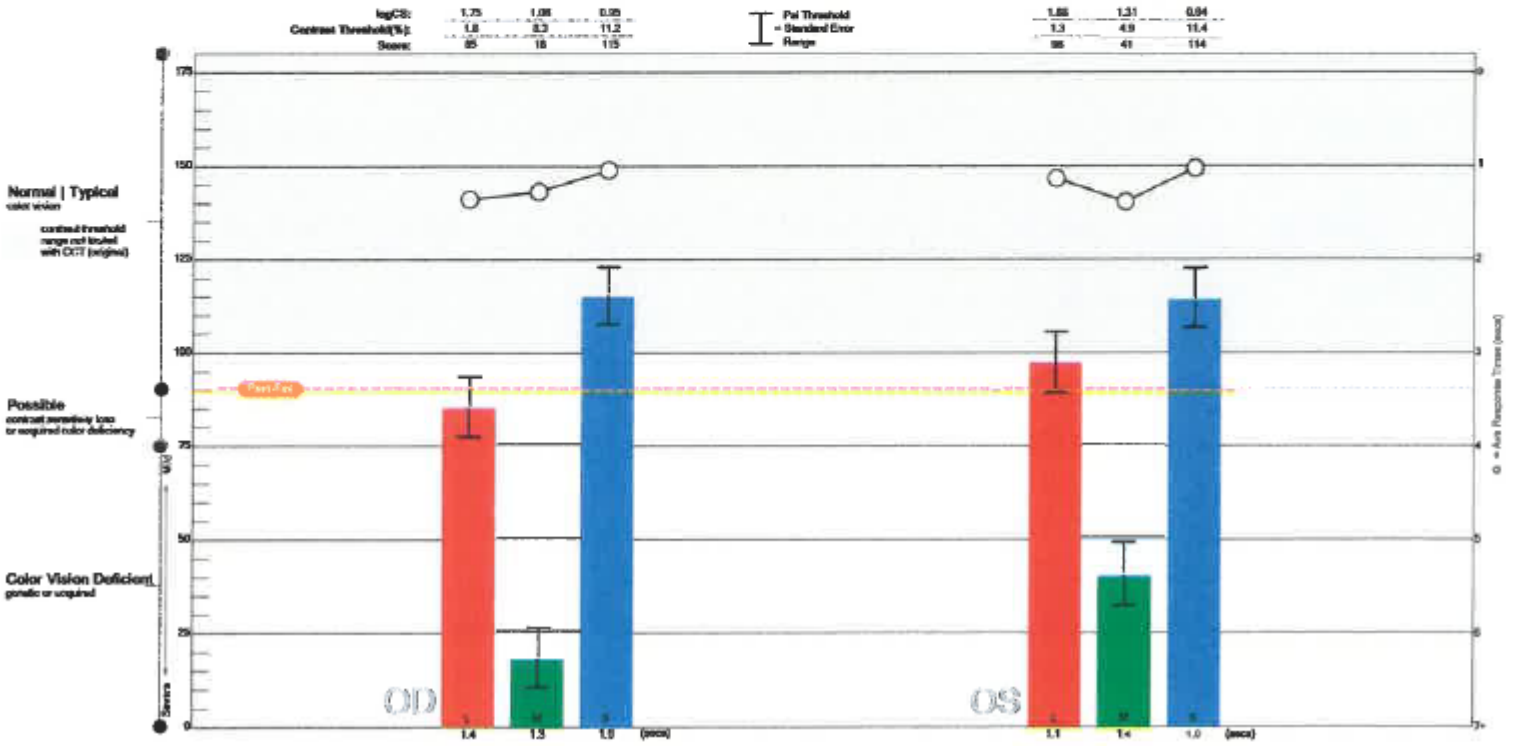
How about some vanilla color deficiencies?

DATA

	Cone	Psi Threshold	Trials	Ave Time	Score	Category[1]
OD	Red L	1.8%	30	1.4	85	Possible
	Green M	8.3%	30	1.3	18	Color Deficient
	Blue S	11.2%	30	1.0	115	Normal
OS	Red L	1.3%	30	1.1	98	Normal
	Green M	4.9%	30	1.4	41	Color Deficient
	Blue S	11.4%	30	1.0	114	Normal

[1]Cut-off criteria are physician-selected from custom, or user input score method ranges and corresponding assigned categories.

RESULTS

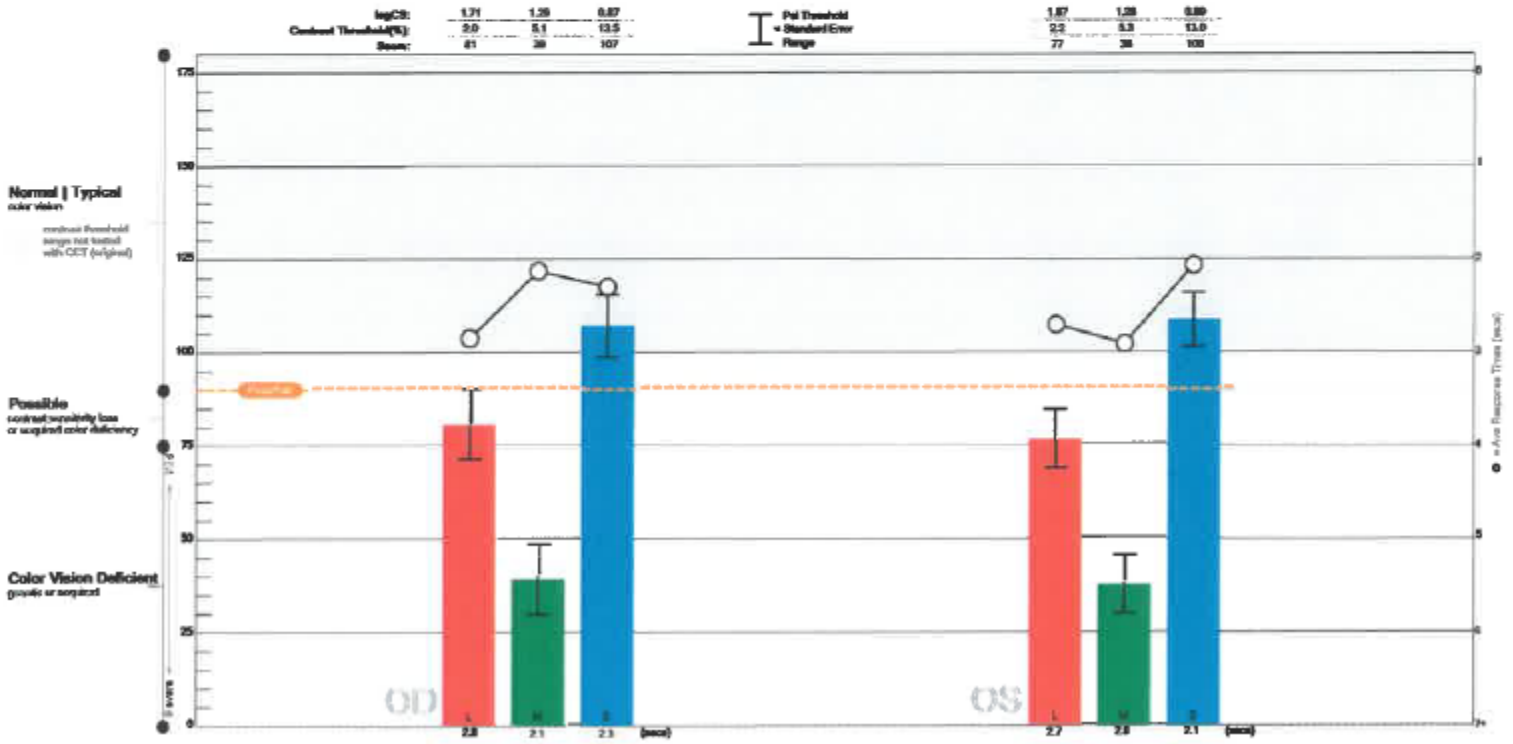


DATA

	Cone	Psi Threshold	Trials	Ave Time	Score	Category[1]
OD	Red L	2.0%	30	2.8	81	Possible
	Green M	5.1%	30	2.1	39	Color Deficient
	Blue S	13.5%	30	2.3	107	Normal
OS	Red L	2.2%	30	2.7	77	Possible
	Green M	5.3%	30	2.9	38	Color Deficient
	Blue S	13.0%	30	2.1	109	Normal

[1]Cut-off criteria are physician-selected from custom, or user input score method ranges and corresponding assigned categories.

RESULTS



Billing and Diagnosis Codes

Extended Color Testing: 92283 approximately $65

Deutan H53.53

Protan H53.54

Tritan H53.55

Questions & Answers

Paul Harris, OD
Professor, Southern College of Optometry
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