Why Snellen Testing is Making People Blinder

Allan Hytowitz, Allan@dyop.org

Abstract

While investigating the astigmatic (peripheral) zones of my progressive lenses, I discovered that a spinning segmented ring, now known as the Dyop® (pronounced "di-op," short for dynamic optotype), provides a unique means of measuring visual clarity. The Dyop becomes noticeably blurred when the eyes are moved sideways without corresponding head or eyeglass movement. Multiple comparative refractions have documented that Dyop usage is up to six times more precise than Snellen testing, up to eight times more consistent, and up to more than three times as efficient for acuity and refraction measurement. Dyop color permutations can measure acuity in color as a diagnostic and potential for therapy for symptoms of dyslexia, migraines, and epilepsy. Dyop testing does not require patient literacy so that it can be used to measure acuity in children and infants as young as 14 weeks of age. Further analysis revealed that the ratio of the Dyop ring's diameter to the viewing distance is linear, unlike the logarithmic relationship used in Snellen and Sloan charts that underpins the LogMAR system.

Through testing, I determined that a Dyop's acuity endpoint corresponds to a White-gap stimulus area (Minimum Area of Resolution, MAR) of 0.54 arcminutes squared, compared to the traditional Snellen MAR of 1.0 arcminutes squared. Additionally, refractions using a Dyop consistently showed a difference of approximately (minus) –0.50 diopters compared to Snellen/Sloan measurements. This systematic overminus in Snellen/Sloan results likely contributes to visual fatigue, reduced comfort, and diminished literacy outcomes.

A Dyop's precision, adaptability for color-based testing, and suitability for both clinical and remote use make it a compelling alternative to static optotypes, with potential applications in detecting dyslexia, early-stage glaucoma, and other vision-related conditions.

Keywords: Snellen chart, Dynamic optotype, Visual acuity, Dyop test, Motion detection, Vision screening.

Introduction

The journey into vision science didn't begin in a university lecture hall or an optometry clinic. It started with a pair of glasses that utterly changed my reading experience, improving clarity and easing strain in a way that made me question why my previous prescription was so abhorrent [1]. That realization led me to uncover a critical yet often overlooked truth: visual acuity tools may be flawed, not because the eyes themselves are faulty, but because our methods of testing them are incomplete.

The **Snellen chart**, introduced by Herman Snellen in 1862, has been the standard for gauging visual acuity for over 160 years. It presents static, high-contrast letters in decreasing sizes and relies on identifying the smallest one a person can read. It was simple, familiar, and deeply embedded in clinical practice [2]. Its strength is in its simplicity, but that is also its greatest weakness.

From our observations and literature, we learned that letter-based tests like Snellen measure more than light refraction. They measure literacy, memory, and familiarity with the alphabet [3,4]. Someone might "pass" simply because they recognized the symbols, not because of clear vision. This limitation is especially important with children, non-literate populations, and individuals with neurological differences such as dyslexia or visual stress [5,6].

Another flaw experienced firsthand: Snellen's reliance on static images and bright white backgrounds can disguise subtle refractive errors, worsen glare sensitivity, and do not assess temporal visual processing, which is essential for real-world visual tasks.

That is an advantage of the **Dyop** concept of a spinning segmented ring where the acuity question is: *"Can you see the motion of the ring?"* Unlike letter charts, the Dyop shifts the test from literacy-dependent recognition to pure visual function, engaging the visual system's spatial-temporal processing and minimizing cognitive bias. This paper will explore the inherent flaws of the Snellen chart, despite its historical importance, which is not an accurate or equitable measure of vision, and how a Dyop's dynamic approach could offer precise, efficient, and accessible visual assessments for diverse populations [7].

Vision Self-Tests verify the mechanics of vision http://www.dyop.net/documents/Acuity_Self_Tests.pdf

- **Chromatic Triangulation demonstration**: Close one eye and look around. You will still perceive depth perception and relative distance to your visual target, suggesting acuity is regulated by the retina and **not** the brain as a binocular image.
- **Excess minus power test**: If you wear glasses, push them about 0.5 inches forward away from your face. If the text appears clearer, your lenses are likely overminused by 0.25 to 0.50 diopters, enough to reduce cognition and potentially reduce your IQ by 10 or more points.
- **Overstimulation test**: Stare at a White light bulb briefly, then close your eyes. You'll likely see a White afterimage. The same hyper-stimulus from computer-based Snellen tests using bright White contrast damages the foveal photoreceptors' perception and refresh rate.

Current Dyop Test formats:

1. An online Cloud Dyop (at **www.cloud-dyop.com**) which does NOT need computer installation.
2. A Windows format requiring an installation on a Windows computer.
   http://www.dyop.net/documents/Dyop_Application_Request.pdf
3. An iPad Dyop test using an iPhone as an image controller.
   https://apps.apple.com/us/app/dyop-vision-test/id1300193573

Key Advantages of the Cloud Dyop:

1. Scalable Global Access – Works on any device with an internet connection, allowing eye care professionals in both developed and emerging markets to conduct standardized, high-precision visual assessments.
2. Subscription Revenue Model – The system supports a $20 monthly subscription for professional users, with potential global adoption across 100 million annual eye exams in the U.S. alone.
3. Low-Cost Screening for Mass Deployment – The Cloud Dyop's rapid test cycle (<10 seconds per trial) and literacy independence make it ideal for community screening and telehealth programs.
4. Upgradeable Features – Planned enhancements include:

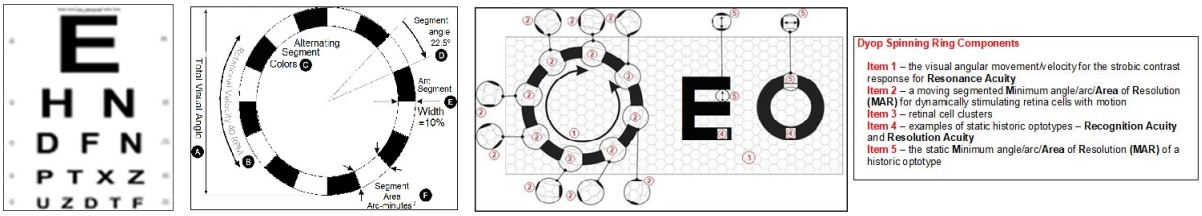
- Child and Infant Dyop formats with wider-separated targets for use with eye-tracking systems
  https://www.dyop.net/documents/Dyop_Infant_Acuity_Measurement_Poster.pdf
- Color-based Dyop testing for dyslexia, migraine, epilepsy, and glaucoma screening
  www.coloracuity.com
- The Adjustable Oval Dyop, enabling remote refractions without phoropters or trial lenses.
  https://www.dyop.net/documents/Measuring_Visual_Cylinder_and_Axis_with_a_Dyop.pdf
  https://www.dyop.net/documents/Subjective_Measurement_of_Cylinder_Powe_and_Axis.pdf
- Integration Potential – The platform can be seamlessly embedded into existing tele-optometry systems, school screening programs, and government health initiatives.

Commercial Opportunity

The global vision care market exceeds $75 billion annually, with over 2.5 billion people requiring visual correction. Snellen's limitations, combined with the Dyop's precision, create a clear commercial opportunity for disruption. At a modest $20/month professional subscription, the Cloud Dyop could generate millions in annual recurring revenue, while improving diagnostic outcomes worldwide. Moreover, its educational and humanitarian potential is substantial. With literacy-independent formats and infant screening capability, Dyop testing supports equitable access to eye care in low-resource settings.

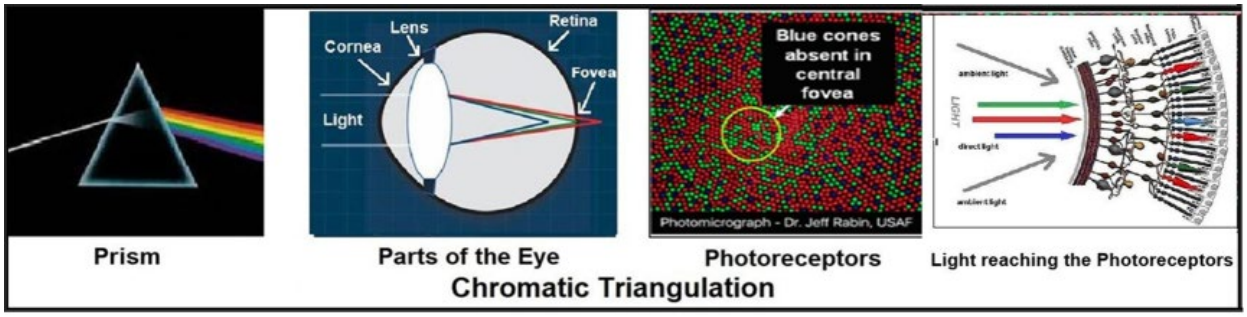
The four Vision SCIENCE Discoveries due to the use of the Dyop test:

1. The Snellen test, as a benchmark for acuity and refractions, is inherently imprecise, inconsistent, and inefficient due to its reliance on identifying (or guessing) three of the five letters per line in the final steps of the test [8]. Nearing 20/20 acuity (or 6/6 in the metric world), the rows become five letters of decreasing size. Except we don't "see" the letters or "see" the Black areas. Instead, we perceive the irregular White areas around culturally dependent Black shapes (e.g., letters) which do **NOT** stimulate your photoreceptors. With Snellen testing we see only White, which is a combination of the computer pixel **Red**, **Green**, and **Blue** light stimuli.



2. We discovered that the use of a spinning Black/White segmented ring optotype (now called a Dyop® - pronounced "di-op" and short for dynamic optotype) could be used for an optotype for acuity and refractions. I discovered that the optimal Dyop rotation speed was 40 rpm, with an optimum 10% ring stroke width [9]. This specific Dyop gaps size and motion is crucial to acuity precision. The Snellen gap AREA (such as the spacing in the "E" or the gap in the "C") is nearly twice the size of the Dyop's stimulus gap AREA. The Dyop optimum rotation rate matches the optimum photoreceptor refresh rate, thus making strobic Dyop optotypes significantly more precise than static optotypes [10].

3. The optimal Dyop rotation speed of 40 rpm matches the refresh rate of the retina fovea's photoreceptors which in turn relay their signals to neuroganglia cells in front of the retina. The neuroganglia sends its composite signal to the cilia to control the shape of the lens as well as a composite signal to the brain (via the optic nerve) where the image is stored and interpreted. Contrary to conventional belief, acuity is **NOT** regulated by the brain but by the foveal photoreceptors through a process called **Chromatic Triangulation** which allows the shape of the lens to adjust the focal depth colors of **Red**, **Green**, and **Blue** and the response of the color receptive photoreceptors in the fovea [11,12].



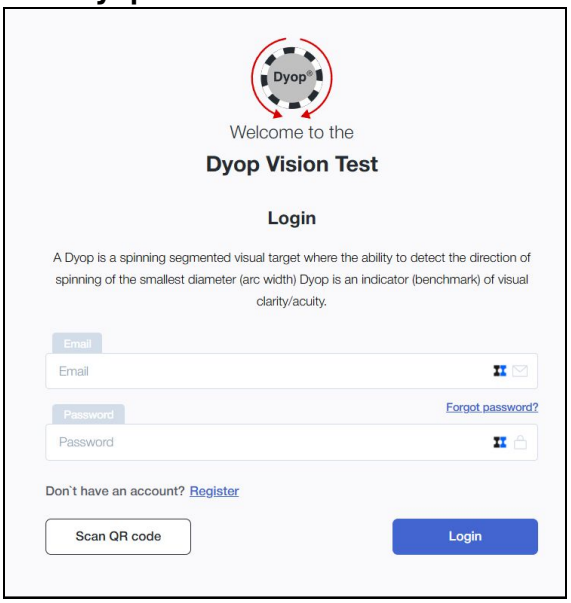
4. Vision testing that utilizes (static) **White gaps** around Snellen letters or shapes depletes the foveal photoreceptors' response and refresh rate, promoting a preference for excess minus power in prescriptions. That in turn contributes to eyeball elongation and increasing myopia. A Dyop test, with White gaps and Black segments on a Gray background, demonstrates how, as the Black/White Dyop shrinks in diameter, the White area becomes too small to sufficiently stimulate the fovea, causing the motion perception to vanish. At a **sub-acuity threshold**, the spinning Dyop ring appears to be a static undifferentiated Gray ring [13].

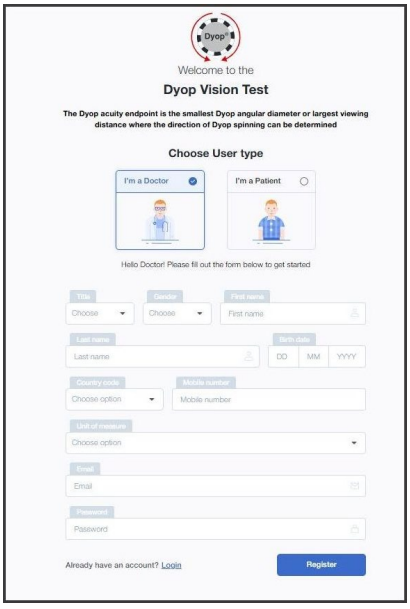
Typical Dyop Test Formats

Dyop Professional Cloud Acuity Test

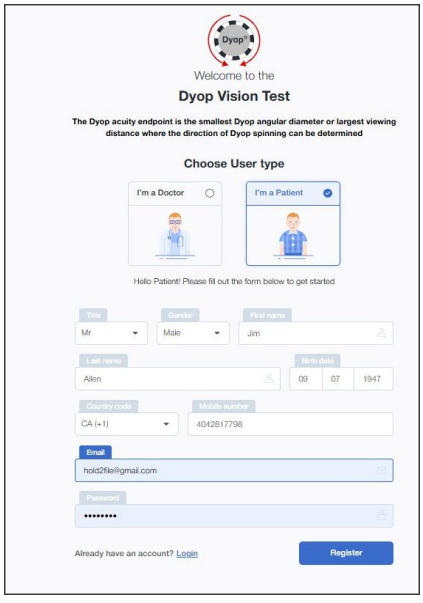
A Cloud version of the Dyop test is available at www.Cloud-Dyop.com at no charge and with no need for having to do a computer installation. The Cloud Dyop has the same precision, consistency, efficiency and accuracy (+/- 0.04 diopters) as the Windows Dyop Clinical test.

Dyop Cloud Welcome Screen

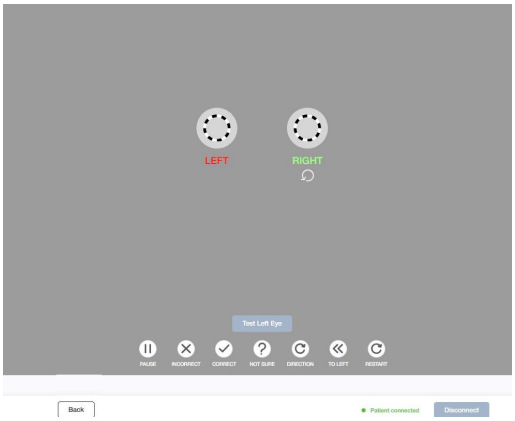




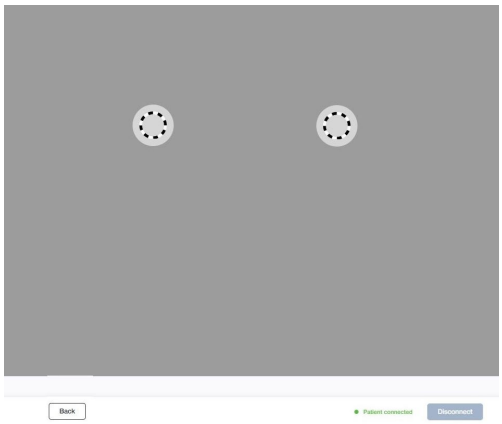
Doctor Registration



Patient Registration



Doctor Response Screen



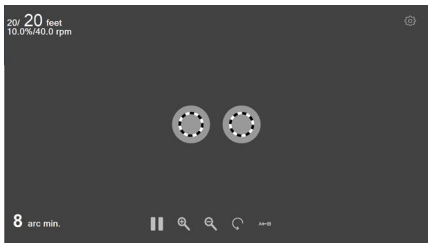
Patient Observations

Dyop Windows Professional Test

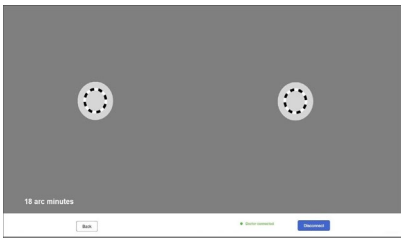
http://www.dyop.net/documents/Dyop_Application_Request.pdf

Dyop Professional Acuity Test

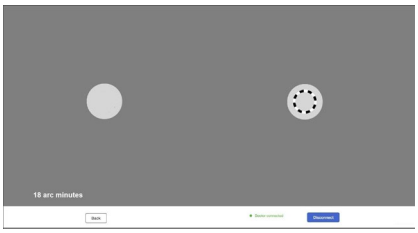
Dyop Professional Acuity Test



Dyop Professional Infant Test

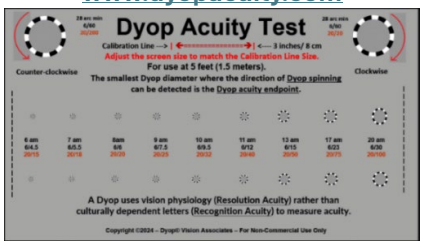


Dyop Professional Infant Test



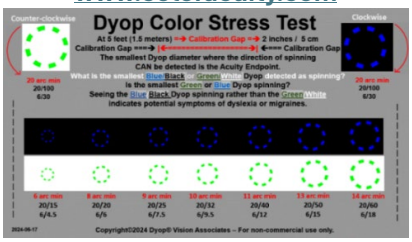
Dyop Acuity Screening Test

www.dyopacuity.com



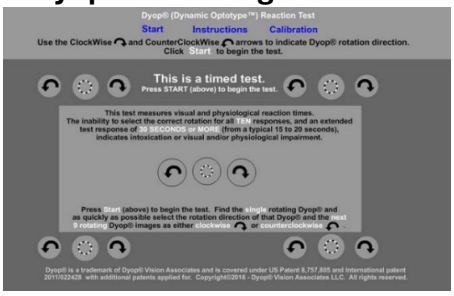
Dyop Visual Stress Screening

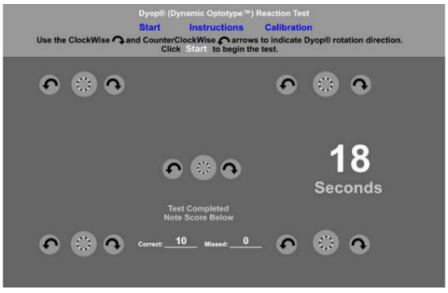
www.coloracuity.com



Dyop Online Cognition Test

www.DyopCognition.com

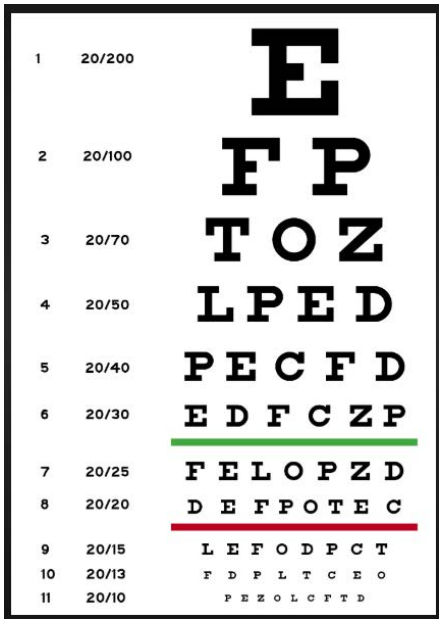




Early identification of children with reading difficulties, especially those from difficult home environments, can prevent social and educational marginalization. In extreme cases, these unmet challenges can contribute to school violence. The **Dyop visual stress (dyslexia) color screening test** may help identify students needing intervention and support. The timed **Cognition Screening Test** may enable early diagnosis of perception difficulties associated with symptoms of Alzheimer's, Parkinson's, PTSD, marijuana intoxication, or concussion injuries.

Fifteen years after the initial Dyop discovery, I learned that I had cataracts in both eyes which explained the loss of cognition and depression during the previous three years [14]. However, after the cataracts were removed, I began experiencing headaches and mental fatigue when looking at my computer monitor. Reducing the screen brightness and contrast from 100% to 50% eliminated those headache symptoms, highlighting the damage caused by the high-contrast White background screens inherent in Snellen testing. Without the Curse of my cataracts, I may never have uncovered the blessings of understanding Snellen's 21st-century harm as a factor in the **Global Epidemic of Myopia**.

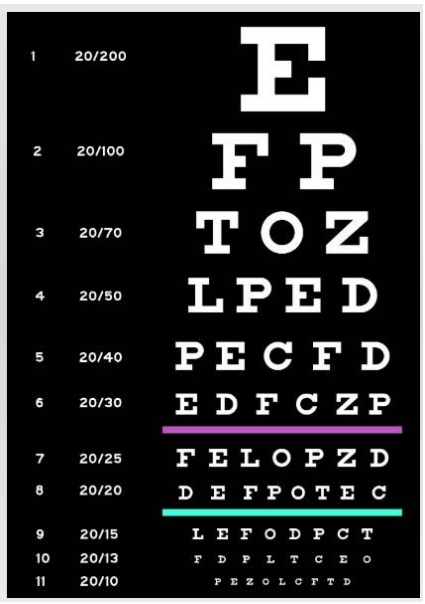
It now is stunning to realize how "good" a guess it was to set the Black letters on a White background to a 50% brightness and 50% contrast level.



[Normal Snellen –](#)
Black letters on White background

% Contrast	Max Viewing Distance- Feet	Max Viewing Distance- Feet
%Brightness	Snellen White Background	Snellen Black Background
100	20	27
90	21	27
80	22	27
70	22	37
60	23	26
50	24	24
40	21	22
30	20	20
20	16	18

Maximum Viewing Letter Comprehension Versus percent brightness/contrast

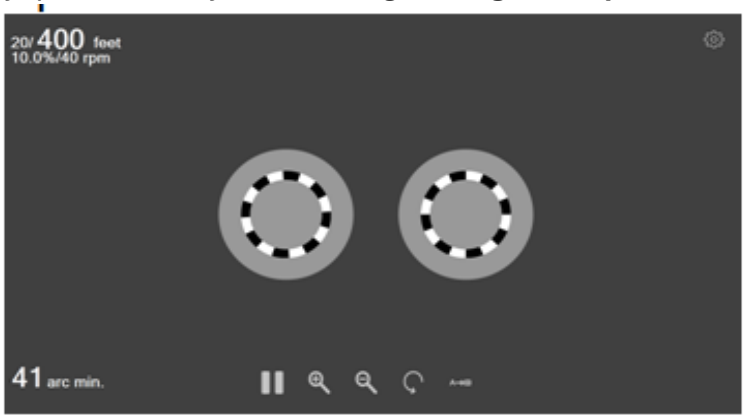


[Reverse Snellen –](#)
White letters on Black background

The main impediment with Snellen type testing isn't just its imprecision or temporary eye fatigue. While innovative in 1862, Snellen's chart overlooked that we perceive the white spaces shaping black letters, rather than the letters themselves. The high contrast White areas versus the Black letters on my computer screen were unintentionally inducing dyslexia as an outdated technology due to the lack of awareness by the optical profession of the disparity caused by replacing reflected light with computer-generated emitted light.

The **modern-day vision damage** stems from computerized Snellen testing. It's not just the inaccuracy of the Snellen gaps but the **bright, dominant White backgrounds** of digital displays, often comprising 90% of the screen area, that over stimulates the photoreceptors, similar to briefly looking at a light bulb leaves a residual image when you close your eyes.

The **light Gray Dyop target ring background** was chosen so that as the spinning Dyop ring shrinks, the Black/White contrast fades into a seemingly Gray, static ring. The dark gray Dyop test stage was chosen to as to NOT distract from the spinning Black/White spinning Dyop rings. But it turns out that the **White screen backgrounds of modern computerized Snellen tests** play a significant role in overminusing prescriptions, inducing myopia, and likely contributing to the **global epidemic of myopia** [15].



Without the curse of my cataracts, I may never have uncovered the blessings of understanding Snellen's 21st-century harm. The high contrast White areas versus the Black letters on my screen were unintentionally inducing dyslexia as an outdated technology due to the lack of awareness by the optical profession.

Moving Forward

We are working on simplifying the Dyop explanation for non-scientists [16]. Your feedback is welcome and would be greatly appreciated.
The **www.dyop.org** website offers complimentary screening tests primarily for use by teachers and parents:

- A 10-second **acuity screening test = www.dyopacuity.com**
- A 5-second **dyslexia screening test = www.coloracuity.com**
- A timed **cognition screening test = www.dyopcognition.com**

Future Cloud Dyop enhancements:
I am expecting that the Cloud Dyop (www.cloud-dyop.com) will become the dominant global standard for acuity and refraction measurement. The consumer, teacher, and parent applications for the Cloud Dyop test will remain free to use. I am expecting that the software developer (Inmost.pro) will be able to modify the Cloud test for optimum Dyop Clinical use
(with +/- 0.04 diopter clinical precision) **to include the following format enhancements:**

- A wider separation of the Dyop target rings (at a1/4 and 3/4 screen separation) to facilitate use of an **eye tracking system for the combined Adult/Child format.**
- An **Infant Acuity** format with two target rings (at a1/4 and 3/4 screen separation) but only one spinning Dyop taking advantage of the inherent infant preference for motion detection. https://www.dyop.net/documents/Dyop_Infant_Acuity_Measurement_Poster.pdf
- **Color acuity testing** for potential diagnosis of symptoms of dyslexia, migraines, and epilepsy.
- An **Adjustable Oval Dyop** which can be used to measure acuity on a two-dimensional surface.

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