Dyop Basics

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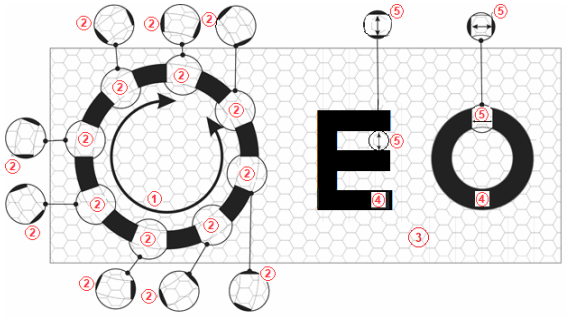
www.dyopvision.com

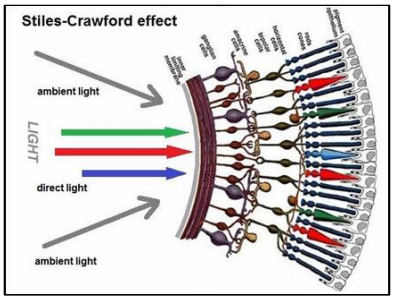
Vision is a dynamic and autonomic process, rather than a static process. That need for an automatic focal adjustment allows us to accommodate changes in the location and distance of a visual target. That automatic focal adjustment is essential for human survival to enable us to eat rather than be eaten. What facilitates that change is the kinetic and vibratory stimulus of the visual saccades, which constantly refresh the photoreceptors in the back of the eye. The retina and the photoreceptors function as the equivalent to a biological circuit board. Much like the pixelated scanning lines on your computer monitor which refresh the computer's visual image to keep it from burning into the monitor's screen, the saccades keep the biological image from burning out the response of the photoreceptors.

A **Dyop®** (short for **dy**namic **op**totype) is a spinning segmented ring that uses **resolution acuity** as a visual target (optotype). The **alternating** spinning Dyop gaps/segments provide a constantly refreshed **stationary strobic stimulus** to the retina. As that strobic stimulus area of the equally sized Dyop spinning gaps/segments become smaller (as the ring diameter becomes smaller), the Dyop **gap stimulus area** becomes too small (sub-acuity) for the photoreceptors to detect motion. The smallest spinning Dyop diameter where spinning motion is detected serves as a precise benchmark for acuity and refractions, and enables the quantitative measure of vision in color. Instead of a spinning ring (the direction of spin being irrelevant), with Dyop sub-acuity you see a blurred and almost solid ring. Measuring acuity with a Dyop also does not require patient literacy and may even be used to measure acuity in children as young as one year (or younger).

"Classic" static Snellen-type letter-based tests use culturally dependent **recognition acuity** to measure vision by having the subject identify rows of incrementally smaller letters until the "gaps" within the letters make those letters too small to recognize. A Dyop uses the physiological response of **resolution acuity** to measure acuity. The smallest stimulus gap, or Minimum **AREA** of Resolution (**MAR**), of the Snellen test is defined as **1.0 arc minutes squared,** versus **t**he Dyop stimulus **MAR** which is **0.54 arc minutes squared.** That difference in **stimulus area/gap** for a Dyop is about half the area of the classic Snellen stimulus. The disparity between the Dyop **MAR** and the Snellen **MAR** correlates to a Dyop having a linear increase in size with increased diopters of blur versus and the Snellen test increases in size with a logarithmic ratio. Letter-based tests (**recognition acuity)** tend to also measure acuity primarily in black and white even though most people see in color, and acuity tends to be regulated by color perception. Static-letter visual targets induce fixation and photoreceptor fatigue, are inherently imprecise, and may contribute to visual stress such as "Computer Vision Syndrome" and refractions that are overminused (excess compensation as to the optical correction for the refractive error).



Dyop Spinning Ring Components

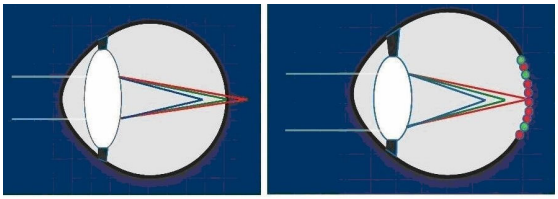


Stiles-Crawford Effect
Direct light has a higher stimulus effect

Item 1 – the visual angular movement/velocity for the strobic contrast response
Item 2 – a moving segmented visual **arc/area (MAR)** for dynamically stimulating retina cells with motion
Item 3 – retinal cell clusters
Item 4 – examples of static historical optotypes
Item 5 – the static minimum angle/arc/**area (MAR)** of resolution of a historical optotype

That dynamic stimulus also allows the photoreceptors to regulate acuity. The location of the photoreceptors at the back of the retina creates a hypersensitivity to emitted light such as that from electronic devices (**Stiles-Crawford Effect**). The photoreceptors ratio is about 100 photoreceptors to every optic nerve fiber, however, the Dyop **MAR** correlates to a cluster of 20 photoreceptors. That indicates that the "motion" of light across the photoreceptors allows adjacent clusters to sense the direction and dominant color of that stimulus. When a group of about 5 clusters (100 photoreceptors) is sufficiently stimulated, the optic nerve fiber associated with those clusters sends a signal to the brain indicating color, stimulus direction, and assists in regulating the lens response via chromatic triangulation (**Blue IN FRONT** of the retina, **Green ON** the retina, and **Red BEHIND** the retina). That detection of motion by photoreceptors clusters helps explain "optical illusions" such as the retrograde motion of speeding hubcaps.

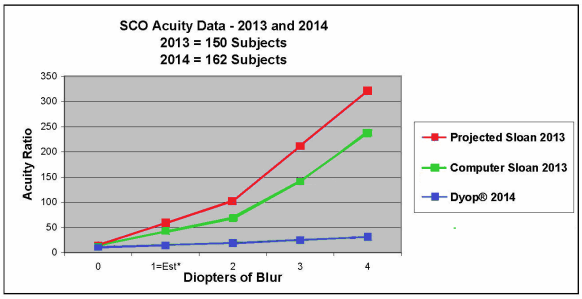
Individuals with a 75% Red and 20% Green photoreceptors have greater near-vision stress.



Green Focused Vision (GFV)
50% Red and 45% Green photoreceptors

Red Focused Vision (RFV)
75% Red and 20% Green photoreceptors

The net effect the stimulus difference is that a Dyop is **six times as precise** as a Snellen test with **one-sixth the variance** and **twice the efficiency** as to both acuity measurement (10 to 20 seconds per eye) and refractions (60 to 90 seconds per eye) versus a Snellen test.



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

Static optotypes add acuity overminus and are inherently imprecise and inconsistent.