

# POLARIZED VERSUS ANAGLYPHIC MATERIALS

For  
Suppression  
Control  
in  
Binocular  
Accommodative  
Facility  
Testing

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## Abstract

The use of suppression control is essential in binocular accommodative facility testing. This study was designed to investigate accommodative facility performance comparing the use of Polarized material versus anaglyphic material (red-green). Both devices are commonly used to monitor for suppression in the clinical setting. Seventy-five subjects performed one-minute binocular accommodative facility tests with both anaglyphic and Polaroid systems. Statistical analysis showed a significantly higher result (1.933 cycles per minute) when the Polaroid filters were used. The results show the need for further study to develop independent sets of normed values when different methods of suppression control are utilized.

## Key Words

accommodative facility, anaglyph, anti-suppression, binocular accommodative facility testing, Polaroid, bar reading units

Accommodative facility testing is useful in the evaluation of the efficiency of nearpoint visual skills. The lens flipper method is a commonly accepted clinical procedure for the assessment of the visual system's ability to efficiently alter its state of accommodation. As reported by Burge,<sup>1</sup> the use of anti-suppression techniques during binocular accommodative facility testing is necessary to avoid erroneous interpretation of test results. Red-green anaglyph glasses or crossed-Polarized glasses<sup>2</sup> with the corresponding bar reading units are two common anti-suppression control methods used by practitioners (see Figure 1).

Siderov and Johnston<sup>3</sup> explored the effects of varying the test parameters in binocular accommodative facility testing with respect to target size, test distance, test duration, and accommodative demand. However, varying the methods of control for suppression was not investigated. Bogdanovich, et al<sup>4</sup> studied the

properties of anaglyphic materials and found significant differences in retinal illuminance between the green and red lenses, which they stated can affect suppression tendencies. They recommended increased use of Polarized lenses, with which each eye would receive equal retinal illuminance. No study published to date has compared the outcomes of testing with both anaglyphic and Polarized filters. It is our hypothesis that a statistically significant intra-subject variability exists when measurements of accommodative facility are compared using these two methods of anti-suppression control.

## Methods

Ninety one optometry students between 21 and 32 years of age volunteered to participate in the experiment. Informed consent was obtained from all subjects before testing began. Eighty subjects passed a screening protocol consisting of visual acuity corrected to at least 20/20 in each eye at both distance and near, stereoacuity of at least 30 seconds of arc, monocular nearpoint of accommodation of at least 5 D in each eye, with no greater than 2 D difference between the eyes, distance horizontal phoria between 3 eso and 5 exo, vertical phoria of 1/2Δ or less, normal color vision, and no evidence of ocular pathology. Seventy five out of 80 subjects completed the two sessions as required for inclusion in the study. Of



Figure 1.

**Table 1.**  
**Demographic of Test Sample**

Subjects	Gender	Age
N = 75	F-35, M-40	Average: 24.69 years
		Standard Deviation: 2.20 years
		Range: 21-32 years

these, 35 were female (46.7%) and 40 were male (53.3%). The mean age was 24.69 years old (see Table 1).

In order to most accurately simulate actual clinical conditions, 10 pairs of Stereo Vision System's anaglyph filter glasses<sup>a</sup> and 10 pairs of Stereo Optical's crossed Polarized filter glasses<sup>b</sup> were randomly selected and sampled to determine an average percent light transmittance value. The percent transmission for each lens was tested with an illuminance probe optometer (UDT Model 61)<sup>c</sup> (see Table 2). An average value for each was obtained and a pair of glasses most closely matching these values was selected. For the anaglyph filter glasses, the average transmittance of the red lens was 15.42% and of the green lens 7.77%. The right Polarized filter lens had an average transmittance of 33.95% and the left lens 37.32%.

Similarly, the bar reading units,<sup>a</sup> both anaglyph and Polaroid types, were tested for the transmittance through each strip. In order to take into account possible variations in the percent transmission readings based on the positioning of the filter strips, measurements were taken at three different positions across each strip: center, extreme right, and extreme left. For the red filter strip, transmittance measurements varied from 12.3 - 13.0% over the probe, and for the green strip, 8.9 - 9.2%. Likewise, the transmittance of the right Polaroid strip varied from 7.3 - 11.7%, and the left Polaroid strip from 9.1 - 10.2%. For the study one pair of both anaglyph and Polaroid filter lenses and bar reading units were selected that most closely matched the mean values for transmittance in each sample (individual data for the anaglyph and Polaroid strips are available upon request).

The original 80 subjects who passed the screening were alternately assigned to two test groups. Habitual corrections were worn during testing. Group 1 subjects, consisting of 41 members, were tested with Polaroid filters as their first anti-suppression control, while Group 2 subjects,

**Table 2.**  
**Transmittance of Filters (in percentages)**

Glasses	Red Filter	Green Filter	Polaroid Right Lens	Left Lens
1	15.00	8.20	33.80	37.5
2	15.40	7.80	33.70	37.2
3	15.40	8.10	33.70	37.4
4	15.20	8.10	32.20	36.9
5	15.70	7.80	34.60	37.5
6	14.90	7.60	33.90	37.1
7	15.70	7.60	34.50	37.4
8	15.60	7.30	34.10	37.5
9	15.70	7.60	34.70	37.4
10	15.60	7.60	34.30	37.3
Average	15.42	7.77	33.95	37.32
Standard Dev.	0.30	0.29	0.72	0.20
Used	15.40	7.60	33.70	37

with 39 members, used anaglyph filters as their first control. Binocular accommodative facility testing via the Flipper Bar Method as described by Daum<sup>5</sup> was utilized. A 20/30 single letter rock card<sup>a</sup> was mounted on a Franzblau red-rock holder<sup>a</sup> with a 40 cm string attached, which the subject held to the nose (Figures 2 and 3).

The Franzblau holder, with the unit unplugged and thus not retro-illuminated, was used only to provide a stable surface in order to maintain a constant working distance and to allow the subject to slightly adjust the angle of gaze to eliminate glare. The procedure was explained to the subject and a brief training trial of not more than one cycle was demonstrated. A one-minute accommodative facility test, using +/- 2.00 D lenses was performed and the results recorded in cycles per minute. After at least one week had passed, 75 of the 80 subjects returned to be tested again, with those assigned to Group 1 (now 38 subjects) using the anaglyph filters for anti-suppression control and Group 2 (now 37 subjects) using the Polaroid filters. Lighting was controlled throughout the experiment.

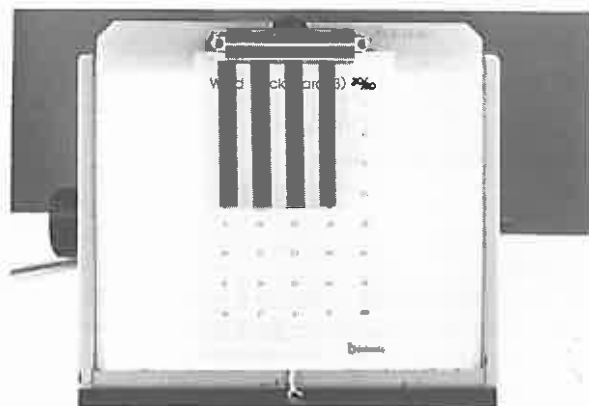


Figure 2.

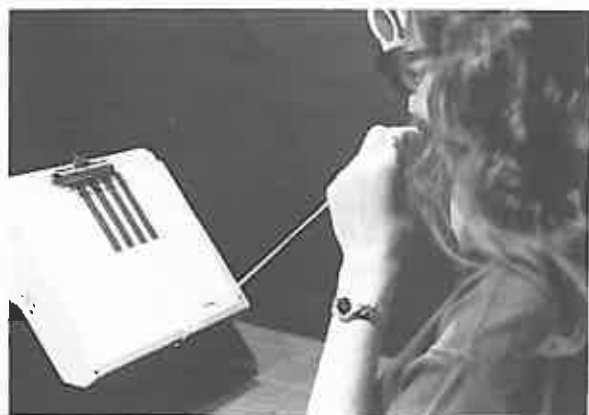


Figure 3.

Standard clinical lighting giving target luminance levels of 100-110 cd/m<sup>2</sup> (as measured by the portable photometer) was used.

## Results

Of the 91 students screened, 80 passed the screening and were present for the first testing session. Five failed to return for the

**Table 3.**  
**Performance of Group 1.**

Subject - Group 1		Polaroid (1st)	
		Polaroid (cpm)	Red/green(cpm)
N = 38	Average	6.09	4.47
	Std. Deviation	3.69	3.33

**Table 4.**  
**Performance of Group 2.**

Subject - Group 2		Red/Green (1st)	
		Red/green(cpm)	Polaroid (cpm)
N = 37	Average	4.18	6.43
	Std. Deviation	2.97	3.60

second test period, but this was incidental to the study. The data collected from the 75 subjects completing both sessions is displayed in Tables 3 and 4.

In order to establish that the differences observed in testing with red-green and Polaroid filters was significant, statistical analysis was performed. The t-test was used to compare subjects' cycles per minute performance(s). The results obtained from 75 subjects do indeed suggest a significant difference between the methods of anti-suppression control used and the performance levels obtained (Mean Difference = -1.933,  $T = 7.064$ ,  $DF = 74$ ,  $p < .0005$ ). These findings support the suggestion of Bogdanovich et al<sup>4</sup> encouraging the use of Polarized filters in anti-suppression control.

McKenzie et al<sup>6</sup> studied the effects of accommodative facility testing reliability as it relates to a learning curve. It was determined that a significant increase from the initial to the subsequent testing periods was found only in those subjects who initially obtained lower than normed average values (11 cpm monocularly, 8 cpm binocularly). The present study attempted to control for such a learning curve by testing half of the subjects with the Polaroid filters and half with the anaglyph filters at the onset of testing, and the opposite method at the second visit. Independent t-tests performed to examine this effect support there was no learning curve effect. (Anaglyph: Mean Difference = -0.298,  $T = -0.409$ ,  $DF = 73$ ,  $p = 0.6838$ ; Polaroid: Mean Difference = -0.340,  $T = 0.404$ ,  $DF = 73$ ,  $p = 0.6871$ .)

### Discussion

When compared to the anaglyph method of suppression control, testing with the Polarized method resulted in a 1.933 cycles per minute increase in binocular accommodative facility. Due to the

statistical significance of this finding ( $p .0005$ ), it is the opinion of the authors that current anaglyphic and Polarized methods cannot be used interchangeably when examining accommodative facility performance against standardized norms. Further testing to establish specific norms for each testing method is necessary to more accurately diagnose facility deficiencies.

Due to the inherent light transmittance differences between the red and green filter lenses, there is some uncertainty in assessing decreased performance with the anaglyph lenses. A decrease in performance may be caused by the patient truly having inefficient facility of accommodation or by the testing method. It appears that the Polaroid method, because of the lesser variability in transmittance, gives a cleaner method of testing because it minimizes the potential for suppression. It is our recommendation that the Polarized method be used to eliminate this uncertainty and provide a more reliable measurement of binocular accommodative facility.

Although not anticipated at the outset of our study, our subjects demonstrated a lower than expected facility performance when compared to the currently accepted standardized norms. This may be related to the increased level of nearpoint activity encountered among optometry students as compared to the general population, but is worthy of further consideration.

The currently accepted standardized norms were obtained, using the Modified Bernell Acuity Suppression Slide (VO/9 - also Polaroid).<sup>a</sup> Clinically, however, the Polaroid filter lenses and bar reading unit combination is more commonly used. We would suggest a comparison study to explore the possibility that a significant difference between these two methods of suppression control also exists.

### Sources

- a. Bernell Corporation, 750 Lincolnway East, P.O. Box 4637, South Bend, IN 46634-4637
  - b. Stereo Optical Company, 3529 North Kenton Ave., Chicago, IL 60641
  - c. UDT Illumination Probe Model 61 Photometer, United Detector Technologies, 3939 Landmark Street, Culver, CA
- The authors and their families have no financial interest regarding the instrumentation used in this paper.

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