

EFFECT of LENS POWER on BINOCULAR LENS FLIPPER ACCOMMODATIVE FACILITY RATES

- Rebecca Loerzel, O.D.^a
- Lyn Tran, O.D.^a
- David A. Goss, O.D., Ph.D.^a

a. School of Optometry, Indiana University,
Bloomington, IN 47405

Abstract

Lens flipper accommodative facility is usually determined with +/-2.00 D lenses, although some practitioners use other powers. This study was performed to determine the magnitude of difference in flipper rates found with different lens powers. Fifty young adult subjects were evaluated with +/-1.00 D, +/-1.50 D, and +/-2.00 D lens flippers at a testing distance of 40cm. Mean results of 18.8, 15.6, and 11.6 cycles per minute, respectively, were found. Consequently, the norms established for +/-2.00D flippers are inappropriate for other lens powers.

Key Words

accommodation, accommodative facility, flipper rates

Introduction

Accommodative facility testing is an important component when evaluating the accommodative and binocular vision status of a patient.¹⁻⁷ Lens flipper accommodative facility is usually performed with powers of +2 and -2 D.⁸ However, because not all practitioners do their testing with these powers it is important to determine the effect different lens flipper powers have when testing accommodative facility. Siderov and Johnston⁹ found faster flipper rates with +1.00/-1.00 D lenses than with +2.00/-2.00 D lenses on 20 young adult subjects. This paper presents flipper rates in a larger sample of young adults for flippers with three different power levels.

Subjects

Fifty subjects, 32 females and 18 males, were tested. The subjects ranged in age from 21 to 35 years, with a mean age of 25.6 years. They all were either students, faculty or staff at the Indiana University School of Optometry. Mean spherical equivalent refractive errors of the subjects were -2.94 D in the right eye and -3.05 D in the left eye. Subjects were required to have best corrected visual acuity of at least 20/30 in each eye at both 6 m and 40 cm, stereopsis of at least 40 seconds of arc, no history of strabismus, amblyopia, nor a previous diagnosis of accommodative insufficiency, accommo-

dative infacility, convergence excess, convergence insufficiency, divergence excess, or divergence insufficiency. In addition, subjects were not taking any medications known to affect accommodation nor were they documented to have any disease conditions known to affect accommodative function. Each subject had received a complete eye and vision examination at the School's clinics during the previous three years and these records were used to determine eligibility. If the clinic chart was missing any of the necessary information, testing was performed to verify whether the subject met the inclusion criteria. Six potential subjects were excluded based on the exclusion criteria.

Methods

During testing subjects wore their habitual prescriptions and held a reduced Snellen chart at 40 cm from the spectacle plane. They viewed the 20/30 row of letters. Lighting consisted of a fluorescent ceiling light and the incandescent stand light turned on the high setting. The subject was instructed to say "clear" or "now" each time the line looked clear and single, at which time the lenses were flipped by the examiner to the other side. Testing continued for one minute. All testing was performed binocularly. Because a subject inclusion criterion was good stereopsis, no suppression check was used. The examiner counted the number of lens flips and divided by two to obtain the number of cycles per minute (cpm).

Three flipper lens powers were used: +1.00/-1.00 D, +1.50/-1.50 D, and +2.00/-2.00 D. The first subject was tested in the order +/-1, +/-1.5, +/-2, the second subject in the order +/-2, +/-1, +/-1.5, the third subject in the order +/-1.5, +/-2, +/-1, then the fourth in the same order as the first, fifth in the same order as the second, and so on. The same examiner handled the lens flipper and counted the number of flips for all testing.

Results

Summary statistics for flipper rates are given in Table 1. Frequency distributions are shown in Figures 1-3. The mean flipper rate for the +/-1.00 D flippers was 18.8 cpm. Mean rate for the +/-1.50 D flippers was 15.6 cpm, and the mean rate for the +/-2.00 D lenses was 11.6 cpm. Thus a change in +/-0.50 D in lens flipper power resulted in a change of 3 to 4 cpm in flipper rate. The standard deviations for all three lens conditions were 3.4 to 3.5 cpm.

	+/-1.00	+/-1.50	+/-2.00
Mean	18.8	15.6	11.6
Median	20.0	15.5	11.5
Standard deviation	3.5	3.4	3.4
Range	12.5 – 27.5	7.5 – 21.5	5.5 – 18.5

Discussion

Average flipper rates reported in the literature have varied from study to study because of differences in testing methods, lens powers, and study samples.^{3,4,7,8} This study shows that in our sample of young adults, a change in lens flipper power of +/-0.50 D results in a change in mean flipper rate of 3 to 4 cpm.

Other testing variables that can affect flipper rates include test distance, letter size, presence or absence of a suppression

control, and whether the examiner or patient flips the lenses. The mean flipper rates in the present study were higher than in some previous studies,^{3,4,7,8} perhaps due to the exclusion criteria relating to accommodation and vergence function used in this study.

Another variable that affects flipper rates is patient age. A possible way of alleviating the effect of age is the use of an amplitude-scaled accommodative facility test for adults.^{10,11} Wick et al.¹¹ tested a group of 23 to 37 year old adults with standard +/-2.00 D flippers at 40 cm target distance. They then compared the flipper rates with those of an amplitude scaled test for the same subjects, where the lens power was 30% of the amplitude (rounded to the nearest 0.25 D) and the target distance represented 45% of the amplitude (rounded to the nearest 0.5 cm). They found that the amplitude scaled test provided a significantly better means to distinguish between symptomatic and

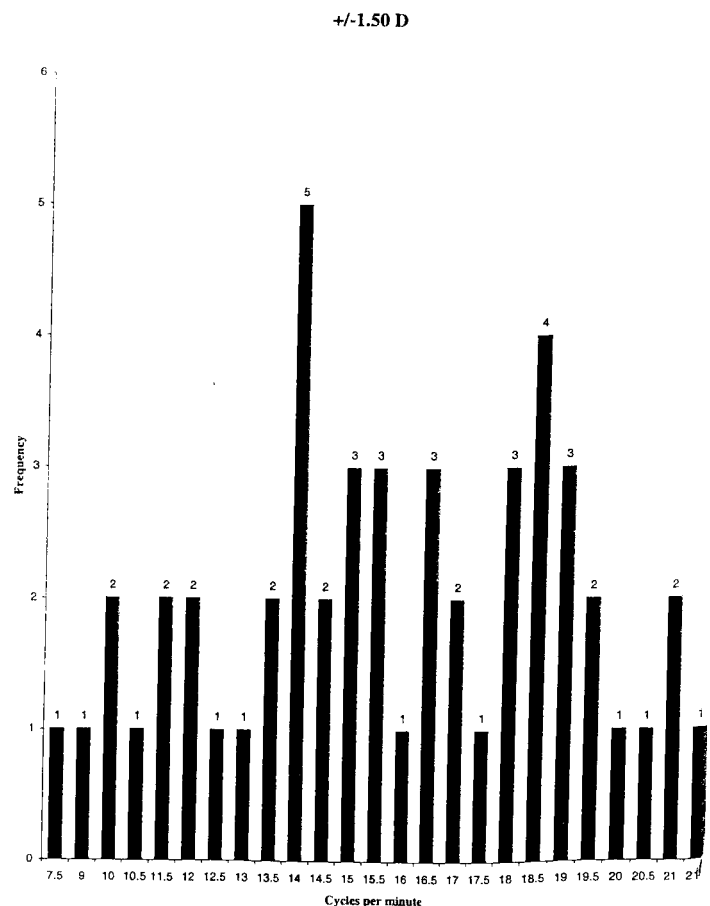
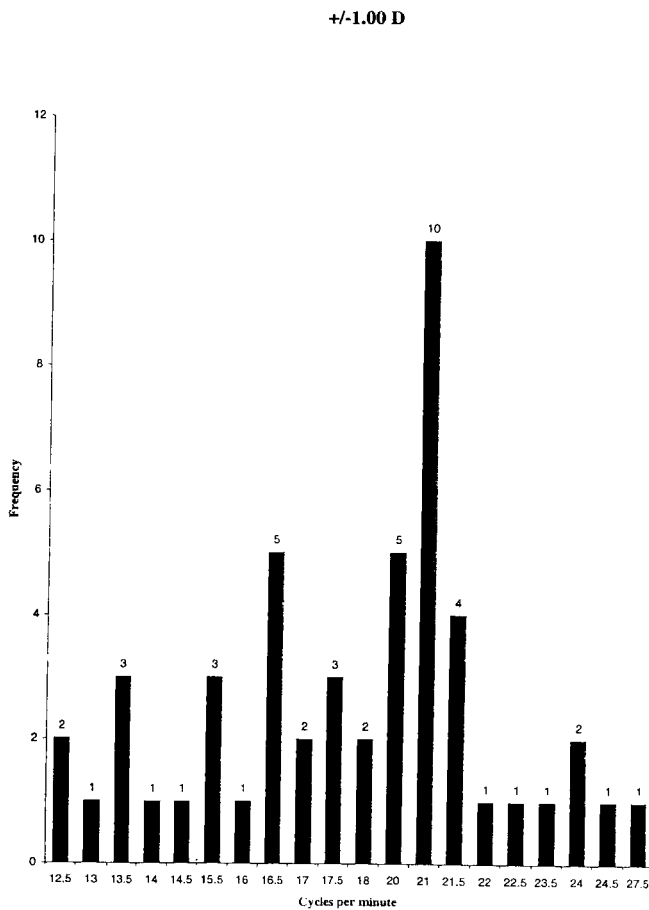


Figure 1. Frequency distribution of flipper rates (cpm) with +/- 1.00 D lenses.

Figure 2. Frequency distribution of flipper rates (cpm) with +/- 1.50 D lenses.

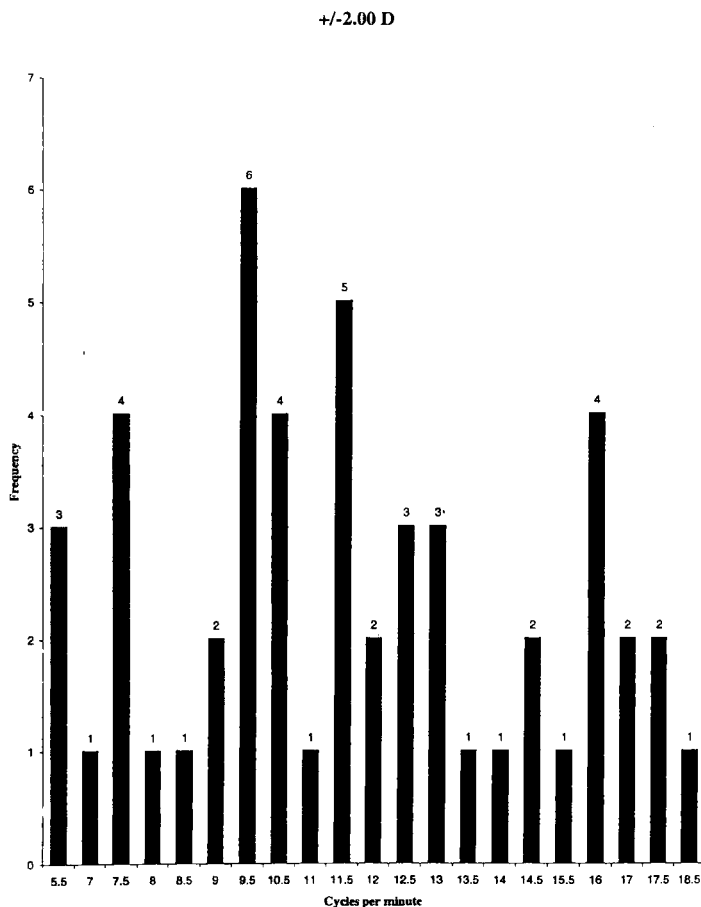


Figure 3. Frequency distribution of flipper rates (cpm) with +/- 2.00 D lenses.

asymptomatic subjects than the standard test.

Perhaps the most commonly used norms for lens flipper accommodative facility are those from Zellers et al.⁸ Their norms were derived with 18 to 30-year-old subjects using +/-2.00 D flippers and fixation at 40 cm on a polarized acuity target to monitor suppression. Passing rates on their norms are 11 cpm or better on monocular lens flippers and 8 cpm or better on binocular lens flippers.

In a study of 10 to 30-year-old subjects, García et al.⁵ found that accommodation or vergence dysfunction was often present when a patient failed to meet these norms. Because García et al.⁵ published all their data, additional data analysis, including calculation of sensitivity and specificity, was possible. (The sensitivity of a test is the proportion of persons with a condition that are correctly identified by that test as being outside the normal range on the test. The specificity of a test is the proportion of persons without the condi-

tion in question who are found to be normal by the test.) Sensitivity and specificity can be used to find the best cut-off values on a given test to detect a condition. The reanalysis of the García et al.⁵ data was performed to determine how well accommodative facility detected accommodation or vergence dysfunction. Sensitivity increased to 91.7% and specificity increased to 91.7% when the failure criteria were altered to monocular rate less than 11 cpm, or binocular rate less than 10 cpm, or monocular rate minus binocular rate greater than 4 cpm.⁶

Flipper failure rates recommended in the literature should be applied only when testing conditions are the same as those under which those rates were derived. Even then experienced clinicians may want to adjust those rates based on long-term personal observations.

Conclusions

Fifty young adults with normal binocular vision performed binocular lens flip-

per testing with +/-1.00, +/-1.50, and +/-2.00 D lens powers. Mean rates of 18.8, 15.6, and 11.6 cpm, respectively, were obtained. Thus, a change in lens flipper powers of +/-0.50 D resulted in a change in mean flipper rate of 3 to 4 cpm. Lens flipper norms are dependent upon lens power and other testing variables.

References

- Hennessey D, Iosue RA, Rouse MW. Relation of symptoms to accommodative infacility of school aged children. *Am J Optom Physiol Opt* 1984;61:177-83.
- Levine S, Ciuffreda KJ, Selenow A, Flax N. Clinical assessment of accommodative facility in symptomatic and asymptomatic individuals. *J Am Optom Assoc* 1985;56:286-90.
- Cooper J. Accommodative dysfunction. In: Amos JF, ed. *Diagnosis and Management in Vision Care*. Boston: Butterworth-Heinemann, 1987:431-59.
- Daum KM. Accommodative facility. In: Eskridge JB, Amos JF, Bartlett JD, eds. *Clinical Procedures in Optometry*. Philadelphia: Lippincott, 1991:687-97.
- García A, Cacho P, Lara F, Megias R. The relation between accommodative facility and general binocular dysfunction. *Ophthal Physiol Opt* 2000;20:98-104.
- Goss DA. The relation between accommodative facility and general binocular dysfunction. *Ophthal Physiol Opt* 2001;21:484-85.
- Wick B, Yothers TL, Jiang B-C, Morse SE. Clinical testing of accommodative facility: Part I. A critical appraisal of the literature. *Optom* 2002;73:11-23.
- Zellers JA, Albert TL, Rouse MW. A review of the literature and a normative study of accommodative facility. *J Am Optom Assoc* 1984;55:31-37.
- Siderov J, Johnston AW. The importance of test parameters in the clinical assessment of accommodative facility. *Optom Vis Sci* 1990;67:551-57.
- Yothers T, Wick B, Morse SE. Clinical testing of accommodative facility: Part II. Development of an amplitude-scaled test. *Optom* 2002;73:91-102.
- Wick B, Gall R, Yothers T. Clinical testing of accommodative facility: Part III. Masked assessment of the relation between visual symptoms and binocular test results in school children and adults. *Optom* 2002;73:173-81.

Corresponding author:
David A. Goss, O.D., Ph.D., FAAO,
FCOVD
School of Optometry
Indiana University
Bloomington, IN 47405
Date accepted for publication:
December 4, 2002