EFFECT OF NEAR STIMULUS

ON THE DISTANCE ROCK TEST

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INTRODUCTION

Accommodative infacility is one of the most common problems encountered by non-presbyopes. The literature is abundant with reports of accommodative infacility being the cause or the result of oculomotor disturbances and reduced visual functioning. It is well documented that vision therapy directed toward improving accommodative facility can be beneficial to the patient in terms of reduced symptoms and improved visual performance.

Historically, two methods have been used to assess accommodative facility: flip-lens accommodative rock and distance accommodative rock. While similar in nature, it is important to recognize that these methods employ different stimulus conditions and require different types of responses. Flip-lens accommodative rock uses a fixed target at a fixed distance. The change in accommodative stimulus is produced by changing lenses in front of the eyes. This causes the subject to change his amount of accommodation and also to adjust the amount of positive or negative fusional vergence, because the convergence demand has not changed. Distance rock, on the other hand, is performed by having the subject change accommodation and convergence from a distance target to a near target using the physiologically normal accommodation and vergence demand pattern. Each target will be imaged on the retina at all times, the target of regard being clear, the other blurred. It is felt that this situation produces a task much more comparable to that of the normal environment.

PURPOSE

The purpose of this study is to further investigate the distance rock test. Specifically, it is to determine if the near accommodative stimulus, or testing distance, is significant in a clinical distance rock test. "Clinical" is used here to imply that the test is administered quickly and with the use of standard exam room equipment.

METHODS

Twenty randomly chosen non-presbyopic patients of the Ferris State College of Optometry clinic were used as subjects. The age range was 13-30 years, with all subjects having vision corrected to 20/20 and no symptomatic accommodative dysfunction.

Testing was performed under binocular conditions in a standard exam room with the subjects wearing their habitual correction. The distance target was a single row of Project-O-Chart™ 20/20 letters. The near target was a block of reduced Snellen letters (Hart Chart), with each letter measuring 0.9 mm. in height. Ten cycles of near-far fixations were timed with a standard Timex wristwatch. The ten cycles were counted by counting the number of fixations made. One cycle consisted of a shift from distance to near and back to distance.

The accommodative stimulus was varied by changing the distance at which the near target was held. Three distances were chosen: 1) the distance corresponding to 2/3 of the subject's measured binocular amplitude of accommodation, 2) the distance corresponding to 1/2 of the subject's measured binocular amplitude of accommodation, and 3) the subject's preferred working distance. The sequence of the test distances was varied in order to eliminate the effects of fatigue or practice.

Standard instructions to the subjects were as follows: "Hold this card this far from your eyes and directly below the distance chart (demonstrated). You will be concerned with only the first letter of each chart. Begin by looking at the first letter of the distance chart. When I say 'go,' change your focus to the first letter on the card. When that is clear, change your focus back to the first letter on the distance chart. When that is clear, change your focus back to the first letter on the card. Keep doing this until I say 'stop.' I will be timing you and watching your eyes."

Because there are many techniques that can be employed in conducting the distance rock test, a discussion of the procedures used here is in order. The decision to conduct the test binocularly rather than monocularly was made simply because people in the real world change focus binocularly, not monocularly. Also, by conducting the test binocularly, we are not isolating accommodation from convergence. This is important because in reality accommodative facility is a measure of changes in accommodation and convergence operating on the physically-determined demand line.

The choice of the three testing distances was somewhat arbitrary. The only criteria considered was to keep the accommodative demand out of the non-linear range of accommodation, as reported by Shirachi, et al[1].

Perhaps the greatest variability in technique lies in knowing when the subject has cleared the letters. The technique used here simply has the subject change focus when he has cleared the letters. It can be argued that under silent reading conditions some people will change focus without actually clearing the letters. An alternative would be to have the subject read successive letters on the charts. However, this can bring contamination from verbal processing time and also introduce a series of saccades in searching for the next letter of the sequence. Another possibility is to have the subject respond "clear" when he has cleared the letters. Again, this introduces verbal processing time and may establish a rhythmical response pattern due to auditory feedback. Each method has its drawbacks, as any subjective testing does, and the choice of methods becomes somewhat arbitrary.

RESULTS

Raw data, along with means and standard deviations for the ten cycles are presented in Table 1. These results were then analyzed using a t-test at the 0.05 significance level, as presented in Table 2.

Table 1

Raw Data, Means, and Standard Deviations

Subject	Age	Amplitude	Time in seconds for 10 cycles		
			@2/3 Amp.	@1/2 Amp.	@Preferred
1.	19	16	19	19	20
2.	19	20	16	15	24
3.	13	20	25	25	20
4.	17	11	15	12	15
5.	21	11	22	25	22
6.	15	25	23	23	27
7.	24	10	35	25	25
8.	25	12	28	25	16
9.	21	20	20	20	22
10.	21	15	26	22	20
11.	22	14	21	20	22
12.	30	20	26	26	24
13.	13	14	28	20	25
14.	18	12	25	19	20
15.	20	12	25	20	15
16.	20	20	15	20	28
17.	30	14	15	15	25
18.	21	17	23	20	18
19.	21	11	23	20	18
20.	20	15	21	22	20
Mean	20.5	15.5	22.7	20.8	21.3
S.D.	4.5	4.2	5.1	3.7	3.8

Table 2

t-Tests at 0.05 Significance Level

H_o: $u_x - u_y = 0$

H_A: $u_x - u_y \neq 0$

t-Test	Mean Difference	Critical t	Calculated t	Accept H_o?
1/2 Amp. 2/3 Amp.	1.90	± 2.09	2.38	No
1/2 Amp. vs. Preferred	0.55	± 2.09	0.49	Yes
2/3 Amp. vs. Preferred	1.35	± 2.09	0.91	Yes

Examination of the statistics reveals that there is no difference in performance of the distance rock test when holding the near target at 1/2 of the amplitude as compared to holding it at the preferred working distance. Also, there is no difference in performance when holding the near target at 2/3 of the amplitude as compared to holding it at the preferred working distance. There is, however, a statistically significant difference in performance when holding the near target at 1/2 of the amplitude as compared to holding it at 2/3 of the amplitude. This seems somewhat inconsistent and will be discussed later.

It is interesting to note the relationship between the subjects' ages and amplitudes of accommodation. Using simple bivariate correlation and regression, a Pearson r of only -0.19 was calculated. This was hardly expected and certainly does not agree with previous studies of age-amplitude relationships as compiled by Borish[2]. However, closer examination of the raw data reveals that this is not a normal age distribution, but rather a leptokurtic distribution because of the large number of subjects in the 19-21 age range. The effect is that normal individual variations among this age group masks the true age-amplitude relationship.

DISCUSSION

The three nearpoint test distances can be ranked in order of accommodative demand. The 2/3 amplitude distance would require the greatest accommodative effort, the 1/2 amplitude distance would require a moderate effort, and the preferred working distance, assumed to be around 40 cms., would require the least accommodative effort. Now, restating the results of the statistical analysis, there was no difference in performance when using the greatest effort versus the least effort, and no difference in performance when using moderate effort versus the least effort, but there was a difference when using the greatest effort versus moderate effort. This is illogical because if there was a difference, we would expect it to be between the performance using the greatest effort and performance using the least effort. A possible explanation for this is that the statistical analysis is more precise than the data itself. Recalling that the measurements were made with a standard wristwatch, it is quite possible to introduce measurement error of one or two seconds. Therefore, what is statistically significant may in fact be clinically insignificant.

Haynes[3], in a similar study on distance rock, found the mean cycles/min. to be 29, which converts to 20.7 seconds for ten cycles. This figure is combined with the results of this study and presented in Table 3.

Table 3

Norms for 10 Cycles of Distance Rock (in seconds)

@2/3 Amplitude	22.7
@1/2 Amplitude	20.8
@Preferred working distance	21.3
@40 centimeters	20.7

Although the mean times listed in Table 3 are not statistically equal, they may be considered clinically equal. That is, when conducting the distance rock test in a clinical situation, it makes very little difference whether the response time for ten cycles is 20.8 seconds, 22.7 seconds, or somewhere in between. Also, because these mean times can be considered "clinically equal," it appears to make little difference where the near target is held, as long as it is held between the preferred working distance and 2/3 of the accommodative amplitude.

CONCLUSION

This study used three nearpoint test distances to evaluate the effect of accommodative stimulus on the distance rock test. Statistical analysis proved somewhat inconclusive, but it is felt that clinically it makes little difference where the near target is held, provided it does not exceed 2/3 of the subject's amplitude of accommodation.

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