5-1-1962

A comparison of the prism dissociation and the alternate occulsion techniques for taking the near unfused cross-cylinder test

Donald R. Davidson
Pacific University

Herbert H. Moore
Pacific University

Recommended Citation
https://commons.pacificu.edu/opt/233

This Thesis is brought to you for free and open access by the Theses, Dissertations and Capstone Projects at CommonKnowledge. It has been accepted for inclusion in College of Optometry by an authorized administrator of CommonKnowledge. For more information, please contact CommonKnowledge@pacificu.edu.
A comparison of the prism dissociation and the alternate occlusion techniques for taking the near unfused cross-cylinder test

Abstract
The purpose of this study was a comparison of two techniques, prism dissociation and alternate occlusion, for taking the Unfused Cross-Cylinder Test at Near (#14A) to determine statistically if the two techniques may be freely interchanged in the routine clinical examination.

Degree Type
Thesis

Rights
Terms of use for work posted in CommonKnowledge.
Copyright and terms of use

If you have downloaded this document directly from the web or from CommonKnowledge, see the “Rights” section on the previous page for the terms of use.

If you have received this document through an interlibrary loan/document delivery service, the following terms of use apply:

Copyright in this work is held by the author(s). You may download or print any portion of this document for personal use only, or for any use that is allowed by fair use (Title 17, §107 U.S.C.). Except for personal or fair use, you or your borrowing library may not reproduce, remix, republish, post, transmit, or distribute this document, or any portion thereof, without the permission of the copyright owner. [Note: If this document is licensed under a Creative Commons license (see “Rights” on the previous page) which allows broader usage rights, your use is governed by the terms of that license.]

Inquiries regarding further use of these materials should be addressed to: CommonKnowledge Rights, Pacific University Library, 2043 College Way, Forest Grove, OR 97116, (503) 352-7209. Email inquiries may be directed to: copyright@pacificu.edu

This thesis is available at CommonKnowledge: https://commons.pacificu.edu/opt/233
A COMPARISON OF THE PRISM DISSOCIATION AND THE
ALTERNATE OCCLUSION TECHNIQUES FOR TAKING THE
NEAR UNFUSED CROSS-CYLINDER TEST

Clinical Year Thesis

By
Donald R. Davidson
and
Herbert H. Moore

1 May 1962
ACKNOWLEDGMENTS

We express our appreciation to Dr. D. T. Jans, Professor of Optometry, for his guidance and interest in our project; and to Dr. J. R. Pierce, Instructor in Psychological Statistics, for his helpful suggestions regarding statistical procedures.

We also wish to thank those who so willingly co-operated with us by serving as subjects for this study.

D. R. D.

H. H. M.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>1</td>
</tr>
<tr>
<td>Apparatus and Procedure</td>
<td>2</td>
</tr>
<tr>
<td>Organization of the Data</td>
<td>5</td>
</tr>
<tr>
<td>Discussion and Conclusions</td>
<td>12</td>
</tr>
<tr>
<td>Summary</td>
<td>15</td>
</tr>
<tr>
<td>Appendix</td>
<td>16</td>
</tr>
</tbody>
</table>
PURPOSE

The purpose of this study was a comparison of two techniques, prism dissociation and alternate occlusion, for taking the Unfused Cross-Cylinder Test at Near (#14A) to determine statistically if the two techniques may be freely interchanged in the routine clinical examination.
APPARATUS AND PROCEDURE

Each test consisted of two phases: a prism dissociation phase and an alternate occlusion phase. The sequence of phases and the examiner for each phase were alternated in order to minimize any effects of sequence or examiner on the results of the study. This alternation was as follows:

Test #1 - P,D  AO,M
2 - AO,M  P,D
3 - P,M  AO,D
4 - AO,D  P,M
5 - P,D  AO,M

Etc.

where P = prism dissociation phase
AO = alternate occlusion phase
D = Davidson (examiner)
M = Moore (examiner)

The subject's habitual distance prescription was worn for each test. Since this was not a study of the #14A value per se, but of the difference in values found between the two techniques, it was felt that this procedure would provide a constant control without the necessity of doing a complete subjective routine at far.

A Greens' Refractor was used throughout the testing procedures. The Refractor was adjusted to each subject's near (16 inches) p. d.

To achieve a uniform preset before each phase, the subject was instructed to read aloud the .62m paragraph of a standard near-point reading card placed
at 16 inches on the reading rod for one minute before each phase of the test. The instrument light was directed on the card giving approximately 25 f.c. of illumination on the card.

After the preset period a +2.00\(\text{D}\) lens was added to the subject's habitual prescription by inserting a +2.00 retinoscopy lens in the phoropter. The cross-cylinders (± .50\(\text{D}\)) were placed with + axes at 180\(^\circ\). A 25mm cross-grid with the lines at 180\(^\circ\) and 90\(^\circ\) was placed at the 16 inch distance on the reading rod. The instrument light was directed toward the ceiling and wall behind the chair giving approximately 5 f.c. of illumination on the target.

In the prism dissociation phase, dissociation was obtained by using 3\(\Delta\) - 4\(\Delta\) BU before one eye and 3\(\Delta\) - 4\(\Delta\) 20\(^\circ\) before the other eye.\(^2\) In the alternate occlusion phase, dissociation was obtained by occluding alternately with a paddle occluder.

The subject was then asked: "Which lines are blacker and more distinct, the vertical or the horizontal?"

If the horizontal lines were reported as being blacker, more plus was added until the vertical lines were reported

---

1. The exact amount of vertical prism needed for dissociation varied from subject to subject.
as being blacker before each eye. The plus before each eye was alternately reduced by \(0.25 \text{D}\) steps until equality was reported. This value was then recorded as the finding. In the case of reversal from the vertical to horizontal, the next higher \(0.12 \text{D}\) (in plus) was recorded as the finding.\(^3\)

While the tempo of lens changing varied from subject to subject, the tempo for the two phases for the same subject was kept constant so that the elapsed time for each phase would be as nearly equal as possible.

\(^3\) See Appendix I for example of prepared data form.
ORGANIZATION OF THE DATA

Forty-three subjects with an age range of 21-35 were tested. Two of the 43 were eliminated from the analysis because they were not wearing their habitual distance prescriptions and one was eliminated because of an error in examination procedure. This left 40 subjects giving a total of 80 paired monocular values for analysis.

Table No. I lists the paired values in order from the highest plus value of the prism dissociation phase to the lowest plus value (minus) of the prism dissociation phase. The prism dissociation values are listed in the X column and the alternate occlusion values are listed in the Y column.

Graph No. 1 shows the frequency distribution of the prism dissociation values and Graph No. 2 shows the frequency distribution of the alternate occlusion values. Graph No. 3 is a scatter diagram of the values.

The formulae used in the statistical analysis are given on page 10.

On page 11 the statistical results are given.
Table No. 1, Values of Prism Dissociation Findings (X) and Alternate Occlusion Findings (Y)

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th></th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.50</td>
<td>2.25</td>
<td>41</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>2</td>
<td>2.12</td>
<td>2.00</td>
<td>42</td>
<td>1.00</td>
<td>1.50</td>
</tr>
<tr>
<td>3</td>
<td>2.00</td>
<td>2.00</td>
<td>43</td>
<td>1.00</td>
<td>1.37</td>
</tr>
<tr>
<td>4</td>
<td>2.00</td>
<td>1.87</td>
<td>44</td>
<td>1.00</td>
<td>1.25</td>
</tr>
<tr>
<td>5</td>
<td>1.87</td>
<td>1.87</td>
<td>45</td>
<td>1.00</td>
<td>1.25</td>
</tr>
<tr>
<td>6</td>
<td>1.87</td>
<td>1.87</td>
<td>46</td>
<td>1.00</td>
<td>1.12</td>
</tr>
<tr>
<td>7</td>
<td>1.87</td>
<td>1.87</td>
<td>47</td>
<td>1.00</td>
<td>1.12</td>
</tr>
<tr>
<td>8</td>
<td>1.87</td>
<td>1.62</td>
<td>48</td>
<td>1.00</td>
<td>1.12</td>
</tr>
<tr>
<td>9</td>
<td>1.87</td>
<td>1.62</td>
<td>49</td>
<td>1.00</td>
<td>.75</td>
</tr>
<tr>
<td>10</td>
<td>1.75</td>
<td>2.00</td>
<td>50</td>
<td>1.87</td>
<td>1.12</td>
</tr>
<tr>
<td>11</td>
<td>1.75</td>
<td>1.87</td>
<td>51</td>
<td>1.87</td>
<td>1.12</td>
</tr>
<tr>
<td>12</td>
<td>1.75</td>
<td>1.62</td>
<td>52</td>
<td>1.87</td>
<td>.87</td>
</tr>
<tr>
<td>13</td>
<td>1.75</td>
<td>1.50</td>
<td>53</td>
<td>1.87</td>
<td>.87</td>
</tr>
<tr>
<td>14</td>
<td>1.75</td>
<td>1.50</td>
<td>54</td>
<td>1.87</td>
<td>.25</td>
</tr>
<tr>
<td>15</td>
<td>1.62</td>
<td>1.87</td>
<td>55</td>
<td>.75</td>
<td>1.50</td>
</tr>
<tr>
<td>16</td>
<td>1.62</td>
<td>1.87</td>
<td>56</td>
<td>.75</td>
<td>1.25</td>
</tr>
<tr>
<td>17</td>
<td>1.62</td>
<td>1.62</td>
<td>57</td>
<td>.75</td>
<td>1.00</td>
</tr>
<tr>
<td>18</td>
<td>1.62</td>
<td>1.62</td>
<td>58</td>
<td>.75</td>
<td>1.00</td>
</tr>
<tr>
<td>19</td>
<td>1.62</td>
<td>1.62</td>
<td>59</td>
<td>.75</td>
<td>1.00</td>
</tr>
<tr>
<td>20</td>
<td>1.50</td>
<td>2.00</td>
<td>60</td>
<td>.75</td>
<td>1.00</td>
</tr>
<tr>
<td>21</td>
<td>1.50</td>
<td>1.62</td>
<td>61</td>
<td>.75</td>
<td>.87</td>
</tr>
<tr>
<td>22</td>
<td>1.50</td>
<td>1.62</td>
<td>62</td>
<td>.75</td>
<td>.87</td>
</tr>
<tr>
<td>23</td>
<td>1.50</td>
<td>1.50</td>
<td>63</td>
<td>.75</td>
<td>.50</td>
</tr>
<tr>
<td>24</td>
<td>1.50</td>
<td>1.50</td>
<td>64</td>
<td>.62</td>
<td>1.87</td>
</tr>
<tr>
<td>25</td>
<td>1.50</td>
<td>1.25</td>
<td>65</td>
<td>.62</td>
<td>1.12</td>
</tr>
<tr>
<td>26</td>
<td>1.50</td>
<td>1.25</td>
<td>66</td>
<td>.62</td>
<td>1.00</td>
</tr>
<tr>
<td>27</td>
<td>1.37</td>
<td>1.62</td>
<td>67</td>
<td>.62</td>
<td>1.00</td>
</tr>
<tr>
<td>28</td>
<td>1.37</td>
<td>1.62</td>
<td>68</td>
<td>.62</td>
<td>1.00</td>
</tr>
<tr>
<td>29</td>
<td>1.25</td>
<td>1.75</td>
<td>69</td>
<td>.62</td>
<td>p1</td>
</tr>
<tr>
<td>30</td>
<td>1.25</td>
<td>1.50</td>
<td>70</td>
<td>.50</td>
<td>1.00</td>
</tr>
<tr>
<td>31</td>
<td>1.25</td>
<td>1.50</td>
<td>71</td>
<td>.50</td>
<td>.75</td>
</tr>
<tr>
<td>32</td>
<td>1.25</td>
<td>1.50</td>
<td>72</td>
<td>.37</td>
<td>.87</td>
</tr>
<tr>
<td>33</td>
<td>1.25</td>
<td>1.25</td>
<td>73</td>
<td>.37</td>
<td>.87</td>
</tr>
<tr>
<td>34</td>
<td>1.25</td>
<td>1.25</td>
<td>74</td>
<td>.37</td>
<td>.87</td>
</tr>
<tr>
<td>35</td>
<td>1.25</td>
<td>1.25</td>
<td>75</td>
<td>.37</td>
<td>.87</td>
</tr>
<tr>
<td>36</td>
<td>1.12</td>
<td>1.75</td>
<td>76</td>
<td>.37</td>
<td>.62</td>
</tr>
<tr>
<td>37</td>
<td>1.12</td>
<td>1.12</td>
<td>77</td>
<td>.25</td>
<td>.50</td>
</tr>
<tr>
<td>38</td>
<td>1.12</td>
<td>1.12</td>
<td>78</td>
<td>.25</td>
<td>.25</td>
</tr>
<tr>
<td>39</td>
<td>1.12</td>
<td>1.12</td>
<td>79</td>
<td>.12</td>
<td>+.37</td>
</tr>
<tr>
<td>40</td>
<td>1.12</td>
<td>.87</td>
<td>80</td>
<td>-.37</td>
<td>.87</td>
</tr>
</tbody>
</table>
Graph No. 1

HISTOGRAM SHOWING THE FREQUENCY DISTRIBUTION OF 80 14A FINDINGS—PRISM DISSOCIATION
Graph No. 2

Histogram showing the frequency distribution of 80 I4A findings — alternate occlusion
Graph No. 3

SCATTER DIAGRAM FOR THE VALUES OF 14A BY PRISM DISSOCIATION AND ALTERNATE OCCLUSION
Formulae

Mean ($X$ and $Y$):$^4$

$$X = \frac{\Sigma X}{n}, \quad Y = \frac{\Sigma Y}{n}$$

where $X$ = prism dissociation values
$Y$ = alternate occlusion values
$n$ = number of values

Correlation Coefficient ($r$):$^5$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \Sigma y^2}}$$

where $x = X - \bar{X}$
$y = Y - \bar{Y}$

Standard Error of Estimate of $y$ from $x$ ($s_{Y|x}$):$^6$

$$s_{Y|x} = \sqrt{\frac{(\Sigma xy)^2}{\Sigma x^2 n^2 - \Sigma x^2 n^2}}$$

$r$ to $z$ transformation of Fisher:$^7$

$$z = 1.1513 \log_{10} \frac{1 + r}{1 - r}, \quad \sigma_z = \frac{1}{\sqrt{n - 3}}$$

Confidence limits for $r = z \pm 2.58\%$ transformed back to $r$'s from Table C.$^8$

t test for significance$^9$

$$t = \frac{r'}{\sqrt{1 - r'^2}} \sqrt{n - 2}$$

where $r'$ = lower of the $r$ values from $z$ to $r$ transformation.

$^5$ Ibid., p. 72.
$^6$ Ibid., pp. 80 & 81.
$^8$ Ibid., p. 349.
$^9$ Edwards, Statistical Analysis, p. 166.
Statistical Results

Mean of prism dissociation values = 1.117^D.
Mean of alternate occlusion values = 1.277^D.
Difference of the means = the mean of the
difference = .160^D.

By examining the scatter diagram, we see that
the values yield a fairly linear plot allowing the
use of the correlation coefficient rather than the
correlation ratio.

Correlation coefficient = .786.
Standard error of estimate = .306^D.
The standard error of estimate corresponds to
the standard deviation with respect to the mean of
the differences.

Confidence limits for r = .645 - .875.
t (using the lower limit of r) = 23.6.
The confidence limits for r gives information as
to the value of r which may be expected on subsequent
tests using the same techniques. The lower value gives
a more realistic basis for the t test than does the r
given above. The t test is a test to determine the
probability of obtaining the results of the testing
procedures by chance—less than .001 in this case.
DISCUSSION AND CONCLUSIONS

This study was conducted on the premise that the prism dissociation and alternate occlusion techniques for taking the Unfused Cross-Cylinder Test at Near would show no significant difference in values. It was assumed that if no significant difference between the values for the two techniques was found, the techniques could be freely interchanged in the routine clinical examination.

The prism dissociation technique is outlined by Borish and by Lesser. Lesser states that "some men prefer to take it (#14A) monocularly". Skeffington reports that either method may be used, but that "the dissociation procedure is standard practice" (referring to prism dissociation).

In the opinion of the authors of this paper, the correlation coefficient is too low to allow free substitution of one procedure for the other. Peters and Van Voorhis point out that when $r = .80$, there remains 60 per cent of guess in a prediction based on $r$. Even where $r = .95,$

10 Borish, Clinical Refraction, p. 333.
there still remains 31 per cent of the element of chance in prediction. The correlation coefficient should .90 or greater in order to predict the values for one technique from the values obtained by the other technique with any degree of certainty.

A wide range of individual differences between the two techniques was obtained. Examination of the data14 shows that the greatest difference is 1.50D. The mean difference is less than .25D, however. The standard error of estimate is .306, which means that Y (alternate occlusion values) could be predicted from X (prism dissociation values) within ± .306D 68 times out of 100 and within ± .612D 95 times out of 100. It would seem that our accuracy of prediction for the alternate occlusion method is rather poor -- within a range of approximately .62D 68 per cent of the time and within a range of approximately 1.25D 95 per cent of the time.

It must be pointed out that the value of the standard error of estimate may be questioned in this analysis. The use of the standard error assumes normal distributions and neither of the groups of values in this study are normally distributed. The prism dissociation frequency distribution is more nearly normal than is the alternate occlusion frequency distribution.

14 See Table I, page 6
The t test indicates that the probability of obtaining our statistical results by chance is less than .001. By this test the results are highly significant in their meaning.

In general, then, statistical evaluation of the data indicates that the two techniques as administered in this study should not be substituted.

No appreciable difference in subject response to the two methods was observed. The alternate occlusion technique was somewhat easier to administer due to the elimination of any reference to a lower or upper cross.

Further work recommended in this field is a study of the repeatability on test-retest for the two methods. Another fruitful area of investigation would be a study of the prism dissociation method as outlined by Lesser using the lateral, B.I. prism of #13b compared to the prism dissociation method used in this study where the phoric status was disregarded.

15 Lesser, Introduction to Modern Analytical Optometry, p. 12.
SUMMARY

This study was a comparison of the prism dissociation technique and the alternate occlusion technique for taking the Unfused Cross-Cylinder Test at Near to determine if the two techniques may be freely interchanged in the routine clinical examination.

Eighty pairs of monocular values were evaluated statistically. The statistical evaluation indicates that the two techniques as administered in this study should not be substituted.

No appreciable difference in subject response to the two methods was observed.

Further study should be carried out to determine the reliability of the two methods.
APPENDIX I

Prepared Data Form
Number:  
Name:  
Age:  

Date:  

14A, Prism Dissociation: OD OS  
14A, Alternate Occlusion: OD OS  
Sequence of Testing: P AO  
Examiner each test: D M  
Comments:  

Number:  
Name:  
Age:  

Date:  

14A, Prism Dissociation: OD OS  
14A, Alternate Occlusion: OD OS  
Sequence of Testing: P AO  
Examiner each test: D M  
Comments:  

Number:  
Name:  
Age:  

Date:  

14A, Prism Dissociation: OD OS  
14A, Alternate Occlusion: OD OS  
Sequence of Testing: P AO  
Examiner each test: D M  
Comments:  