The phoric response in the nine cardinal fields of gaze

Arthur Dramen  
*Pacific University*

Stanley S. Berman  
*Pacific University*

Arnold Dickes  
*Pacific University*

---

**Recommended Citation**  
https://commons.pacificu.edu/opt/189
The phoric response in the nine cardinal fields of gaze

Abstract
The phoric response in the nine cardinal fields of gaze

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/189
THE PHORIC RESPONSE IN THE NINE CARDINAL FIELDS OF GAZE

A Thesis
Presented to
The Faculty of the College of Optometry
Pacific University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Optometry

by
Arthur Dramen
Stanley S. Berman
and
Arnold Dickes
INTRODUCTION

The purpose of this experiment was twofold.

1. A continuation of the investigation of "The Phoric Response in the Nine Cardinal Fields of Gaze", presented to the faculty of the College of Optometry of Pacific University, January, 1955. This was done by the accumulation of further data to determine if a lower phoria reading was found in position #3 and #4.

2. To determine if the lower phoria readings found on position #3 and #4 were due to the properties of the optical system used or due to the functional qualities of the human organism.

The conclusions drawn by Edwin Ward and Keith Arnold were; there is a definite difference in the phoria pattern in the different positions of gaze with a pronounced increase in the exophoria in the superior central position over all the other positions in the nine cardinal positions of gaze. The three lower positions (from left to right) of the nine cardinal positions were found to be in less exophoria than the other positions.

EQUIPMENT

1. Nine field board, 24" x 30", with illuminated slits, 1/2" x 3/8", of opaque glass with fixation letters, 3/32" x 3/16", on each. This is shown on drawing #1.
2. Adjustable chin rest.

3. Adjustable table for nine field board.

4. One 10 diopter prism, 50mm round.

5. One 15 diopter rotary prism, 50mm round.

6. Phorometer stand with head modified to hold prisms.

Drawing #2 shows the angular separation of positions from #1 position in degrees at a working distance of 30 inches.

PROCEDURE

The prism equipment as used by Ward and Arnold was as follows:

O.D. Rotary measuring prism with the measuring handle in an upright position at axis 90°.

O.S. Vertical dissociating prism 3 U.

To ascertain the validity of the optical system of the aforementioned experiment, the dissociating and measuring prisms were completely reversed as follows:

O.D. Vertical dissociating prism 3 D.

O.S. Rotary measuring prism with the measuring handle directed downward at axis 270°.

Ten fifth year optometry students were used as subjects. Each subject was seated before the board with chin on chin rest, adjusted to a height so that the #1 position on the board was on a horizontal line perpendicular to the face plane with the primary position of gaze centered on the fixation letter. The subject was instructed to fixate the letter on the upper illuminated slit when dissociated.
A series of phoria readings were taken on each subject twice per day for ten days. A series consists of the following:

- One reading from extreme base in position on the rotary prism.
- One reading from extreme base out position on the rotary prism.
- These were taken on each of the nine positions with an additional reading taken at the #1 position which was labeled on the data as #1A.

The number of each position is shown on drawing #1 and the series of readings were taken in this sequence.

RESULTS

The raw data of the ten subjects is on file in the Visual Training Laboratory at Pacific University.

Table #1

Averages of the findings in each of the ten positions for the ten subjects.

Table #2

Sigma of each of the ten positions for the ten subjects.

Table #3

Average sigma of each of the ten subjects and the average sigma for the group.

Table #4

Mean of the group averages of each position.

Graph 1

Shows the average differences from the average of position #1 for the group.
Graph II to XI inclusive

Shows the difference from position #1 of the other nine positions for each ten subjects. Graph II is of the subject whose average sigma is nearest to the group average sigma.

Graph I

Shows positions #2, #8 to be higher in exophoria than position #1.

Shows positions #3, #4, #5, #6, #7, and #9 to be less exophoric than #1 position.

Shows position #1A to be equal to #1 in exophoria.

Graph XI

Shows less exophoria in position #2 than on position #1.

Graphs II, III, IV, V, VI, VII, IX, X

Shows the phoria readings on the #2 position is higher in exophoria than that on #1 position. This is also indicated by the group averages,

Graph I.

Graphs II and VIII

Shows phoria reading on #3 position to be the same as #1 position.

Graphs III, IV, V, VI, VII, and IX

Shows the phoria reading in #3 position to be less exophoric than the phoria reading on #1 position, which is also indicated by group Graph #1.
Graphs II to XI Inclusive

Shows phoria reading on #4 position to be less exophoric than phoria reading on #1 position which is also shown on the group Graph I.

Graphs III, IV, and IX

Shows a phoria reading on #5 position to be more exophoria than the phoria reading on position #1. Graphs II, V, VI, VII, VIII

Shows a phoria reading of less exophoria on position #5 than the phoria reading on position #1. This is also shown on group Graph I.

Graphs II, VIII, and IX

Shows a phoria reading on #6 position to be more exophoric than position #1. Graphs III and VI

Shows the phoria reading on #6 position equal to the readings on #1, position.

Graphs IV, V, VII, X and XI

Shows less exophoria on the #6 position than found on the #1 position. This is also shown on Graph I.

Graph IX

Shows position #7 to be equal to position #1. Graphs III, IV, V, VI, VII, VIII, X, and XI

Shows less exophoria in position #7 than found in position #1. This is also shown on group Graph I.
Graph IV

Shows the phoria reading of position #8 to be equal to that found on #1.

Graphs II, III, VI, VII, VIII, IX, X and XI

Shows the phoria readings of #8 position to be more exophoric than the phoria reading for the #1 position. This is also found on group Graph I.

Graph II, VI, IX

Shows the #9 position phoria to be more exophoria than the phoria reading on #1 position.

Graphs II, IV, V, VII, VIII, X and XI

Shows the phoria reading to be less exophoria than the phoria reading on the #1 position. This is also shown on group graph I.

Graphs II and X.

Shows the phoria reading on position #1A to be less exophoric than the phoria reading on #1 position.

Graph XI

Shows phoria reading on position #1A to be equal to the phoria reading on #1 position. This is shown on group Graph I.

Graphs III, IV, V, VI, VII, VIII, and IX

Shows the phoria reading in position #1A to be more exophoric than reading found on #1 position.
SUMMARY

On group Graph I it can be seen that the phoric response on positions #3 and #4 were lowest in exophoria with position #4 as the lowest. The sequence of the phoria responses from least to most exophoria was as follows:
Positions -- #4, 3, 9, 7, 5, 6, 1, 8, and 2.

CONCLUSIONS

The results of the data of this experiment substantiated those found in E. Ward and K. Arnold's experiment.

The phoria pattern in the different positions of gaze, showed a marked decrease as the position of gaze was depressed, with the exception of the #5 position.

Since, these results bear out the results of E. Ward and K. Arnold, and the optical system had been reversed, it can be concluded that the lower phoric responses in the above mentioned positions are attributed to the functional qualities of the human organism.

PROBLEMS

To further substantiate the validity of the findings, a similar experiment should be performed with the subject wearing red-green goggles. The
phoric responses should also be calculated from measurements taken on a tangent screen.

2. To determine whether or not the phorias in the nine fields are significantly altered in persons with binocular difficulty.

3. To determine if changes in illumination will manifest itself in the results of aforementioned experiment.

4. To determine if the variables such as distance and target size will modify the results if changed.
Drawing #1 - not to scale

Board Dimensions and Fixation slits Numbered in their order of sequence.
An angular separation of positions from position #1, in degrees at working distance of 30".
### Table 1

**Average Phoria in Each Position**

<table>
<thead>
<tr>
<th>Subj</th>
<th>*1</th>
<th>*2</th>
<th>*3</th>
<th>*4</th>
<th>*5</th>
<th>*6</th>
<th>*7</th>
<th>*8</th>
<th>*9</th>
<th>*10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>545.00</td>
<td>565.00</td>
<td>570.00</td>
<td>575.00</td>
<td>580.00</td>
<td>585.00</td>
<td>590.00</td>
<td>595.00</td>
<td>600.00</td>
<td>605.00</td>
</tr>
<tr>
<td>2</td>
<td>555.00</td>
<td>560.00</td>
<td>565.00</td>
<td>570.00</td>
<td>575.00</td>
<td>580.00</td>
<td>585.00</td>
<td>590.00</td>
<td>595.00</td>
<td>600.00</td>
</tr>
<tr>
<td>3</td>
<td>565.00</td>
<td>570.00</td>
<td>575.00</td>
<td>580.00</td>
<td>585.00</td>
<td>590.00</td>
<td>595.00</td>
<td>600.00</td>
<td>605.00</td>
<td>610.00</td>
</tr>
<tr>
<td>4</td>
<td>575.00</td>
<td>580.00</td>
<td>585.00</td>
<td>590.00</td>
<td>595.00</td>
<td>600.00</td>
<td>605.00</td>
<td>610.00</td>
<td>615.00</td>
<td>620.00</td>
</tr>
<tr>
<td>5</td>
<td>585.00</td>
<td>590.00</td>
<td>595.00</td>
<td>600.00</td>
<td>605.00</td>
<td>610.00</td>
<td>615.00</td>
<td>620.00</td>
<td>625.00</td>
<td>630.00</td>
</tr>
</tbody>
</table>

### Sigma for Each Position

<table>
<thead>
<tr>
<th>Subj</th>
<th>*1</th>
<th>*2</th>
<th>*3</th>
<th>*4</th>
<th>*5</th>
<th>*6</th>
<th>*7</th>
<th>*8</th>
<th>*9</th>
<th>*10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.65</td>
<td>0.57</td>
<td>0.76</td>
<td>0.53</td>
<td>0.72</td>
<td>0.42</td>
<td>0.87</td>
<td>0.63</td>
<td>0.87</td>
<td>0.49</td>
</tr>
<tr>
<td>2</td>
<td>0.60</td>
<td>0.57</td>
<td>0.76</td>
<td>0.53</td>
<td>0.72</td>
<td>0.42</td>
<td>0.87</td>
<td>0.63</td>
<td>0.87</td>
<td>0.49</td>
</tr>
<tr>
<td>3</td>
<td>0.46</td>
<td>0.57</td>
<td>0.76</td>
<td>0.53</td>
<td>0.72</td>
<td>0.42</td>
<td>0.87</td>
<td>0.63</td>
<td>0.87</td>
<td>0.49</td>
</tr>
<tr>
<td>4</td>
<td>0.35</td>
<td>0.33</td>
<td>0.36</td>
<td>0.33</td>
<td>0.36</td>
<td>0.33</td>
<td>0.36</td>
<td>0.33</td>
<td>0.36</td>
<td>0.33</td>
</tr>
<tr>
<td>5</td>
<td>0.45</td>
<td>0.40</td>
<td>0.50</td>
<td>0.60</td>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
<td>1.00</td>
<td>1.10</td>
<td>1.20</td>
</tr>
<tr>
<td>6</td>
<td>0.16</td>
<td>0.18</td>
<td>0.19</td>
<td>0.20</td>
<td>0.21</td>
<td>0.22</td>
<td>0.23</td>
<td>0.24</td>
<td>0.25</td>
<td>0.26</td>
</tr>
<tr>
<td>7</td>
<td>0.54</td>
<td>0.41</td>
<td>0.58</td>
<td>0.70</td>
<td>0.82</td>
<td>0.94</td>
<td>1.06</td>
<td>1.18</td>
<td>1.30</td>
<td>1.42</td>
</tr>
<tr>
<td>8</td>
<td>0.69</td>
<td>0.56</td>
<td>0.73</td>
<td>0.90</td>
<td>1.07</td>
<td>1.24</td>
<td>1.41</td>
<td>1.58</td>
<td>1.75</td>
<td>1.92</td>
</tr>
<tr>
<td>9</td>
<td>0.87</td>
<td>0.72</td>
<td>0.57</td>
<td>0.42</td>
<td>0.33</td>
<td>0.23</td>
<td>0.13</td>
<td>0.03</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>10</td>
<td>0.98</td>
<td>0.83</td>
<td>0.75</td>
<td>0.65</td>
<td>0.57</td>
<td>0.49</td>
<td>0.41</td>
<td>0.33</td>
<td>0.25</td>
<td>0.18</td>
</tr>
</tbody>
</table>
Table #3

Average sigma for each subject

<table>
<thead>
<tr>
<th>Subject</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ave.</td>
<td>.62</td>
<td>1.10</td>
<td>1.35</td>
<td>1.25</td>
<td>.47</td>
<td>.86</td>
<td>1.59</td>
<td>1.36</td>
<td>.81</td>
<td>.82</td>
</tr>
</tbody>
</table>

Average sigma for the group = 1.02

Table #4

Mean average for group in each position

<table>
<thead>
<tr>
<th>Position</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Ave.</td>
<td>2.87x0</td>
<td>3.78x0</td>
<td>1.60x0</td>
<td>.36x0</td>
<td>2.30x0</td>
<td>2.50x0</td>
<td>2.69x0</td>
<td>3.58x0</td>
<td>1.85x0</td>
<td>2.87x0</td>
</tr>
</tbody>
</table>
Group Graph I

Difference from position 0, in degrees

Group Average z-score = .96

Mean response for ten subjects
Graph # II

D. difference from position of #1 at 3 minutes

Group average C 1000

implies $a = 5$
Graph III

Difference from Position #1 in Drophers

Subject #3: 5.18
DIFFERENCE FROM POS. FROM 7 IN CHAPTERS
SUBJEC T IV: $T = 11.5$
Graph V

Difference from position #1 in Dipters

Subject #5, $\Delta = -$47
Graph VII

Difference from position #1 in Droplets
Subject #7 ε = 0.69
Graph VIII

Omissions from position #1 in diaphysis

Subject #8 Average t = 1.36
Graph IX

Difference from position in chapters

Subject #9 Average = .81
Graph II

Difference from predicted-simulated
Subject #1 Average $r = .62$