POLAROID BAR VERGENCES
(PBV)

BRADLEY N. ZAJAC
FERRIS STATE COLLEGE OF OPTOMETRY

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# POLAROID BAR VERGENCES
## (PBV)

## PURPOSE

Polaroid Bar Vergences is a modified vergence test at near
utilizing the technique of the polaroid vis-a-vis (as originally
developed by J.R. Griffin) and a bar prism to determine near
point limits of BI and BO vergence movements.

The intent of this paper is twofold:

1) To investigate the relationship of standard near bar
   vergence testing with PBV utilizing an adult and
   pediatric clinic sample.

2) Utilization of the PBV in two vision screenings:
   a) to compare findings with the Modified Clinical
      Technique Pass/Fail criterion in the first
      vision screening

   b) to use in a second, larger screening, as a
      Pass/Fail screening tool criterion of near
      point vergence ranges.

## THE VIS-A-VIS TEST

Griffin's vis-a-vis technique was developed for the detection
of suppression and other binocular problems in which suppression
and other binocular problems may be involved including
anisometropia, anomalous correspondence, amblyopia and
microtropia.[1]

## VIS-A-VIS (CONT)

A brief summary of the recommended procedure for Griffin's vis-a-vis is as follows:[2]

1) The patient looks binocularly at the examiner from a distance of 50 cms and is asked which of the examiner's eyes he can see.

2) The patient is instructed to close either his right or left eye and report which of the examiner's eyes he can see. This test may be used for the perceptual testing of "laterality" and "directionality" in conjunction with suppression testing. Laterality refers to one's awareness of left and right body sidedness. When the patient closes his right eye (either a voluntary blink or with finger), determine if he demonstrates good laterality by knowing which eye or hand to use. In testing for directionality (egocentric localization), ask the patient to report which appears black to him with his right eye closed. Determine if he can accurately point ot the eye that appears to be black.

3) Have the patient open both eyes and report whether one of the examiner's eyes is blacked-out at any one moment. If both eyes are seen, suppression is assumed to be absent.

The modification of the above test to incorporate vergence testing at near is the procedure of PBV.

## BASIS OF PBV

PBV is based on the principle that crossed polaroids transmit very little light and appear "black". In the individual with normal binocularity, polaroid glasses worn by both examiner and patient will result in the patients perception of both examiner's eyes being open. If suppression occurs, crossed polaroids will result and one of the examiner's eyes will
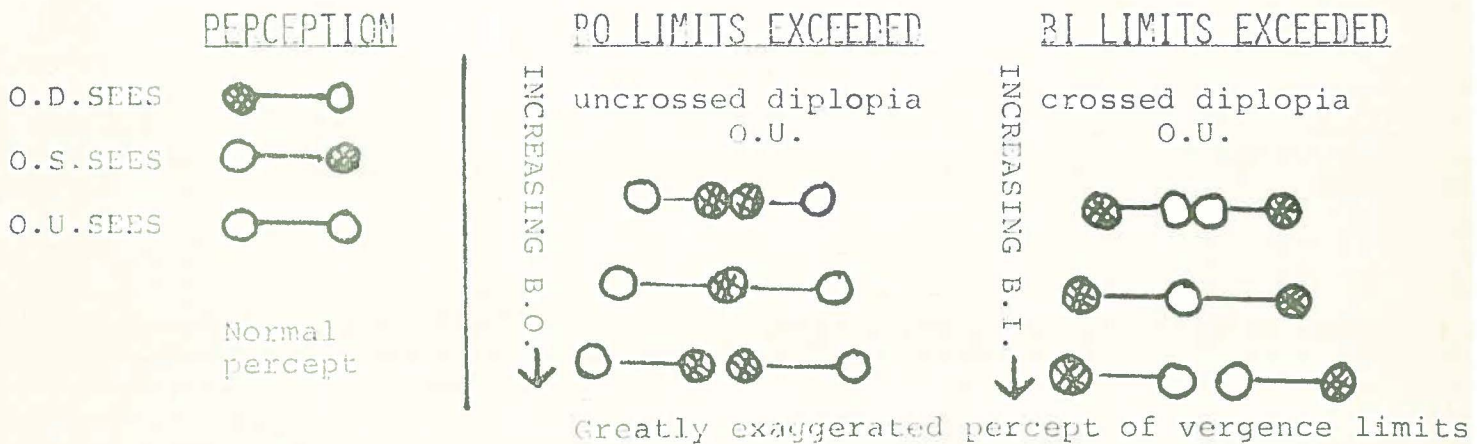
appear black : see fig. below



EXAMINEE

O.D.

O.S.

invisible

invisible

O.S.

O.D.

EXAMINER

visible

visible
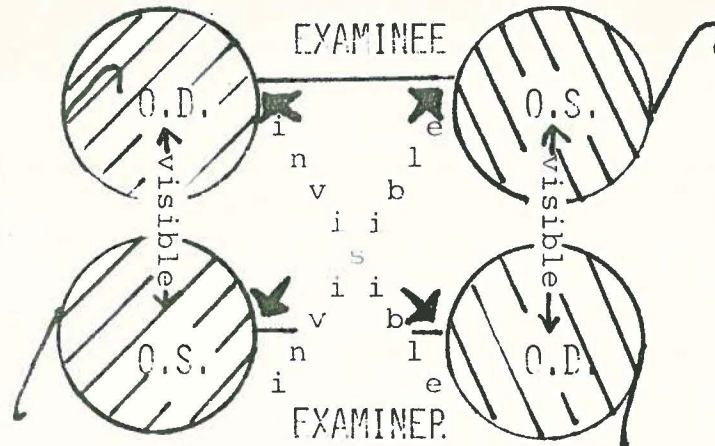
(Fig. from Griffin)[3]

In the individual with normal binocularity and no suppression,
both examiner's eyes are seen as open and no "black" is seen.
There are crossed polaroids in this situation (patients OD
cannot see examiners OD and patients OS cannot see examiner's
OS) but fusion of both images allows the perception of both
eyes seen as open.

If, however, a vergence demand is now placed of the patients
visual system, a limit of fusion ability is reached and the
patient will no longer fuse; diplopia results and is
subjectively reported as seeing "black", or as a "black eye"
(see figure below)

PERCEPTION

O.D.SEES

O.S.SEES

O.U.SEES

Normal
percept

BO LIMITS EXCEEDED

INCREASING B.O.

uncrossed diplopia
O.U.

BI LIMITS EXCEEDED

INCREASING B.I.

crossed diplopia
O.U.

Greatly exaggerated percept of vergence limits



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When the vergence demand is then reduced, a point where
fusion is re-established occurs and the "black" dissappears.
This is the basis for recording the BREAK/RECOVERY value
for PBV as described in the procedure section.

## PRELIMINARY PROCEDURE FOR PBV

The patient is seated directly in front of the examiner.
Polaroid glasses are worn (over current glasses if any) by
both examiner and patient. The sequence utilized for this
study is outlined as follows:

1) Examiner holds his hand over patients right eye and
   states: "I have a black eye now - tell me which one
   is black?".
       Correct response: examiners right eye is visible
                         and examiner's left eye appears
                         black.

2) Examiner holds his hand over patient's left eye and asks:
   "Now which eye is black?".
       Correct response: examiner's left eye is visible
                         and examiner's right eye is black.

3) Both eyes are exposed and the patient is asked:
   "Which eye is black now?".
       Correct response: both eyes are open

4) Examiner should further test for simultaneous perception
   by asking  "Do you see both of my eyes at the same time?"
                 "Do one of my eyes appear black - even for a second?
                 "Do you see any black?".

5) A further check of simultaneous perception may be
   quickly assesed by the examiner closing one eye or the
   other and asking the patient which of the examiner's
   eyes is closed. Ask the patient to point to whichever
   examiner's eye is closed.

The patient with no constant or alternating suppression will have passed the procedure up to this point. Examiner is now ready to proceed with PBV only if all correct responses have been given; an incorrect response indicates suppression and consists of not seeing both eyes open at the same time, or a constant awareness of "black" or a "black eye". This is essentially the vis-a-vis test.

## PROCEDURE FOR PBV

Examiner takes a bar prism and begins with BI findings. Procedure for this study is outlined as follows:

BI  Increasing BI is applied and patient is asked:
   "Tell me when you see 'black', even for just a
   second - watch my eyes very carefully".

   Continue adding prism if response after 3 seconds is
   no appearance of "black".

   Record first finding where patient percieves
   consistant "black".

   Now decrease BI until patient reports both eyes are
   seen as open without any "black".

   Record finding.

BO  Repeat verbal instructions above and record as above
   utilizing BO prism instead of BI.

As with any vergence testing, encouragment to "Watch carefully" and "Try to make them (eyes) come together" should be given.

Findings recorded are:  PBV  BI  BREAK/RECOVERY

                             BO  BREAK/RECOVERY

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## DATA FOR PBV

Data utilizing the PBV technique was determined from a

clinic population and a vision screening population.

This data follows in  section 1 and section 2, respectively.


SECTION ONE

> Standard bar vergences at near were taken in addition to
> PBV in 15 adult patients and 8 pediatric patients during
> the course of a general optometric examination. The
> criterion for all patients in this group was:
>
> 1) No strabismus
> 2) BVA of 20/20 or better
> 3) CT no greater than 6 p.d. eso or exophoria at near
> 4) Adult observers age 20-30. No presbyopia.


SECTION TWO

> Data from vision screenings involving youngsters enrolling
> in June Brown's LET'S READ program in Detroit. A Modified
> Clinical technique consisting of VA's, CT, retinoscopy
> and ophthalmoscopy was utilized. PBV's were taken in
> the first screening on a random sample (time restraints
> precluded PBV on all students).
>
> The second vision screening expected a turnout of several
> hundred youngsters, and based on experience from the
> first screening, it was decided to modify the PBV test
> to a screening procedure by utilizing only a 6 p.d. BI
> and BO hand held prism. Pass = simultaneous perception
> of both eyes with 6.p.d. BI or BO. Fail = perception
> of black with either 6 p.d. BI or BO (selection of 6 p.d.
> level as Pass/Fail was based on first vision screening
> data). In this manner, the test is essentially a vis-a-vis
> test with the added benifit of screening for possible
> suppression vergence anomalies.

# DATA FOR PBV: SECTION ONE

| SUBJECT | AGE | M/F | BAR VERGENCES | BI BREAK/REC.<br>BO BREAK/REC. | PBV | BI BREAK/REC.<br>BO BREAK/REC. |
|---------|-----|-----|---------------|-------------------------------|-----|-------------------------------|
| S.B. | 21 | M | 14/25/12<br>16/35/30 | | | 20/8<br>40+/− |
| M.T. | 33 | M | 10/16/14<br>18/30/25 | | | 18/16<br>30/25 |
| M.P. | 26 | M | −/8/6<br>−/40+/− | | | 16/12<br>40+/− |
| J.R. | 37 | M | 12/16/14<br>14/35/25 | | | 16/12<br>35/25 |
| A.T. | 26 | M | 10/12/10<br>10/35/20 | | | 14/10<br>40/30 |
| L.Z. | 21 | F | 10/25/20<br>10/40+/− | | | 20/14<br>30/25 |
| D.R. | 29 | F | −/12/10<br>−/14/12 | | | 10/8<br>30/25 |
| P.T. | 26 | F | 14/18/16<br>14/40+/− | | | 18/12<br>30/16 |
| D.D. | 26 | M | 25/35/20<br>18/40+/− | | | 20/14<br>40+/− |
| J.D. | 20 | M | 4/16/14<br>4/30/16 | | | 12/10<br>20/18 |
| K.G. | 27 | M | −/35/25<br>−/25/20 | | | 20/18<br>20/18 |
| B.Z. | 27 | M | 20/30/25<br>20/40+/− | | | 25/20<br>40+/− |
| J.D. | 27 | M | −/20/16<br>−/30/25 | | | 20/18<br>25/20 |
| C.M. | 21 | F | 10/20/16<br>20/30/25 | | | 16/14<br>25/20 |
| J.M. | 32 | M | 8/12/10<br>16/20/16 | | | 8/6<br>12/10 |
| M.R. | 6 | M | −/14/12<br>−/20/18 | | | 14/12<br>25/20 |
| E.S. | 7 | M | 14/18/12<br>20/25/12 | | | 18/14<br>12/8 |
| B.S. | 7 | M | 16/20/14<br>20/25/14 | | | 10/8<br>18/8 |
| R.S. | 9 | F | −/12/10<br>−/25/20 | | | 10/8<br>30/25 |
| T.M. | 7 | M | −/14/10<br>−/25/20 | | | 12/10<br>25/20 |
| K.O. | 7 | F | −/18/16<br>−/25/20 | | | 14/12<br>25/20 |
| L.J. | 8 | F | −/14/12<br>10/20/18 | | | 12/10<br>25/20 |
| B.C. | 6 | M | −/8/6<br>−/12/10 | | | 8/6<br>14/12 |

• = Adult Data
x = Pediatric Data

**BI Bar Vergences BREAK**
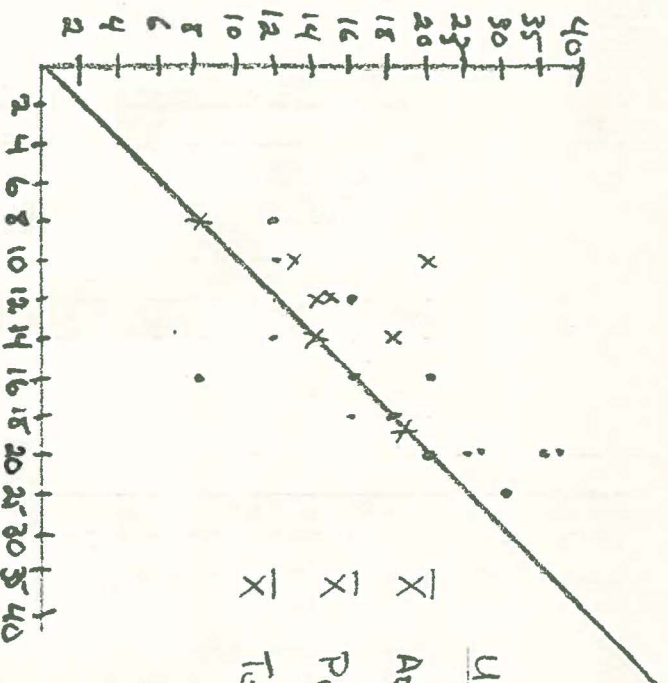
PBV BI BREAK

Unit of Deviation*

$X$ : Adults $\frac{22}{15} \cong 1.5$

$X$ : Ped $\frac{10}{8} \cong 1.3$

$\bar{X}$ : Total $\frac{32}{23} = 1.4$

• = Adult
x = Pediatric Data

**BI Bar Vergences RECOVERY**
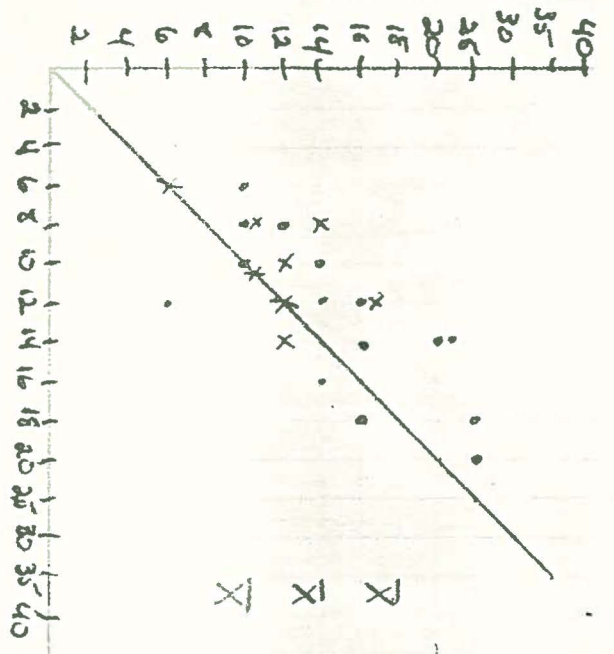
PBV BI RECOVERY

Unit of Deviation*

$X$ : Adults $\frac{25}{15} \cong 1.7$

$X$ : Peds $\frac{8}{8} \cong 1$

$\bar{X}$ : Total $\frac{33}{23} \cong 1.4$
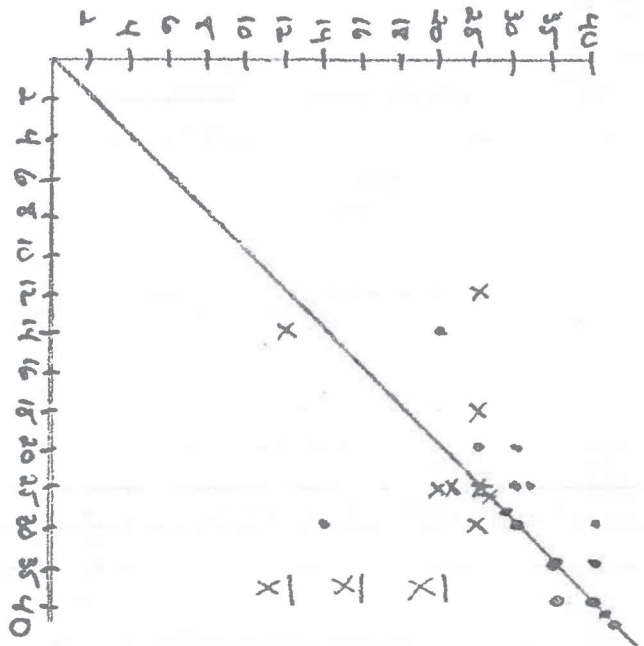
Fig. 1: Plot of BI Bar Vergences vs. PBV BI
* See Analysis of Data for Discussion of Unit of Deviat...

• = ADULT DATA
x = PEDIATRIC DATA

BO Bar Vergences Break

PBV BO BREAK

UNIT OF DEVIATION*

x Adults $\frac{18}{15}$ = 1.2

x Ped $\frac{9}{8}$ = 1.1

x Total $\frac{27}{23}$ = 1.2

• = Adults Data
x = Pediatric Data

BO Bar Vergences Recovery
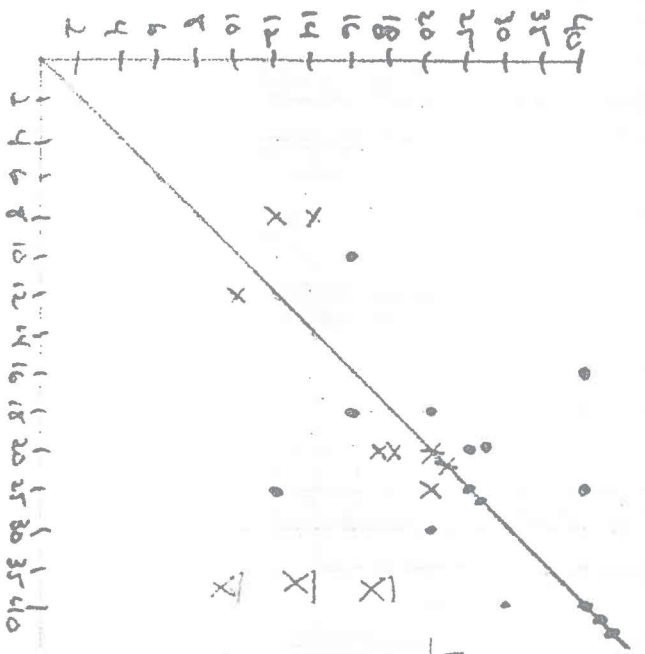
PBV BO Recovery

UNIT OF DEVIATION*

x Adult $\frac{25}{15}$ = 1.7

x̄ Ped $\frac{9}{8}$ = 1.1

x̄ Total $\frac{34}{23}$ = 1.5

Fig 2: Plot of BO Bar Vergences vs PBV BO

*See Analysis of Data for...

## ANALYSIS OF DATA: SECTION ONE

All measurements of near vergences were made with a standard large prism bar (28x30mm) with 1-2-4-6-8-10-12-14-16-18-20-25-30-35-40 p.d. steps.

A plot of BI bar vergences vs. PBV BI for the adult sample, pediatric sample and combined sample as well as the BO comparisons are found in figures 1 and 2. Analysis of section one data is found in table 1.

In analyzing the PBV data, the term 'unit of deviation' is defined as follows:

'     Unit of deviation = the number of step prism jumps the
                          PBV reading differs from the **bar vergence**
                          reading

          e.g.: Bar vergence reading = 16
                PBV reading          = 14     =one unit deviation

This 'unit of deviation' was chosen in an attempt to correlate the PBV findings with standard bar vergence findings. Because standard bar vergence findings are taken in a step-function manner, the plots of figs.1 and 2 have the corresponding jump prism steps along both axes.

In using this criterion for comparison, and arbitrarily selecting those total correlations which fall within 2 units of deviation (i.e. PBV and standard bar vergences agree within 2 prism jumps), 83% of the BI findings correlate while 70% of the BO findings correlate.

## ANALYSIS OF DATA: SECTION ONE (CONT)

| UNITS OF DEVIATION OF PBV FROM STANDARD BAR VERGENCES | | %ADULTS | %PED. | %TOTAL |
|---|---|---|---|---|
| BI   BREAK | 0 | 20% | 38% | 28% |
| | 1 | 40% | 38% | 39% |
| | 2 | 20% | 12% | 17% |
| | 3 | 13% | 0% | 9% |
| | 3+ | 7% | 12% | 9% |
| BI   Recovery | 0 | 7% | 38% | 18% |
| | 1 | 40% | 38% | 39% |
| | 2 | 33% | 12% | 26% |
| | 3 | 20% | 12% | 17% |
| | 3+ | 0% | 0% | 0% |
| BO   Break | 0 | 40% | 25% | 35% |
| | 1 | 33% | 50% | 39% |
| | 2 | 13% | 12% | 13% |
| | 3 | 7% | 0% | 4% |
| | 3+ | 7% | 12% | 9% |
| BO Recovery | 0 | 33% | 25% | 30% |
| | 1 | 27% | 50% | 35% |
| | 2 | 13% | 12% | 13% |
| | 3 | 13% | 12% | 13% |
| | 3+ | 13% | 0% | 9% |

| Total BI correlation | %ADULTS | %PED. | %TOTAL |
|---|---|---|---|
| No deviation | 13% | 38% | 22% |
| Within 1 unit | 53% | 75% | 61% |
| Within 2 units | 80% | 88% | 83% |
| Within 3 units | 97% | 94% | 96% |

| Total BO Correlation | | | |
|---|---|---|---|
| No deviation | 37% | 25% | 33% |
| Within 1 unit | 60% | 75% | 65% |
| Within 2 units | 73% | 88% | 70% |
| Within 3 units | 90% | 94% | 94% |

## ANALYSIS OF DATA: SECTION ONE (CONT)

It is interesting that a higher percentage of BI findings correlate than BO findings. Standard bar vergence testing utilized a high-contrast accommodative target (a near point acuity chart mounted on a small wooden tongue depressor) while the PBV required the patient to watch the examiners eyes for the appearance of "black". PBV offers a lower contrast and therefore lower accommodative demand than does the standard bar vergence method. For this reason, one would expect PBV not to exactly correlate with the standard bar vergence findings. BI findings seem to correlate better than BO findings because the BI limits of divergence are influenced to a lesser degree by accommodation than the BO limits. The accommodative/convergence relationship plays a greater part in maintaining singleness (albeit blurred vision) at near with the BO limits of convergence. Because the PBV provides less of an accommodative demand, one would expect a lower PBV BO finding than standard bar vergence testing.

Even though PBV does not exactly correlate with standard bar vergences (and one would not expect them to as mentioned above), the relationship between bar vergence BREAK/RECOVERY values and those obtained with the PBV technique agree sufficiently to be considered a technique in testing limits of vergence fusion at near as an alternative method.

# DATA FOR PBV: SECTION TWO (1ST SCREENING)

| P/F | SEC. FAILED | AGE | M/F | PBV BI | PBV BO |
|-----|-------------|-----|-----|--------|--------|
| F | Acuity | 6 | F | 8/6 | 16/14 |
| F | Acuity Ret. | 10 | M | 8/6 | 8/6 |
| P | | 11 | M | 10/8 | 16/14 |
| P | | 11 | M | 12/10 | 14/12 |
| P | | 12 | M | 18/16 | 25/20 |
| P | | 7 | M | 4/2 | 4/2 |
| P | | 15 | M | 16/14 | 35/30 |
| F | Acuity Ret. | 7 | F | 6/4 | 6/4 |
| P | | 9 | F | 10/8 | 10/8 |
| P | | 10 | M | 14/2 | 4/2 |
| P | | 10 | M | 10/8 | 25/20 |
| F | Acuity Ret. | 7 | M | 6/4 | 6/4 |
| P | | 11 | M | 14/12 | 18/16 |
| P | | 5 | M | 10/8 | 12/10 |

## SUMMARY OF DATA

| | MCT | X PBV BI B/R | X PBV BO B/R |
|--------|-----|--------------|--------------|
| PASSED | 10 | 12/9 | 16/13 |
| FAILED | 4 | 7/5 | 9/7 |

Seven additional youngsters did not pass the initial requirements
for the preliminary procedure of PBV. They passed the MCT
but were unable to give PBV results because of impression
of suppression or lack of understanding the test itself.

| MCT P/F | SEC. FAILED | AGE | M/F | PBV P/F |
|---------|-------------|-----|-----|---------|
| P | | 6 | M | F BI |
| P | | 4 | F | F Did not understand |
| P | | 12 | M | P |
| F | Ret.ATR | 14 | F | P |
| P | | 13 | M | P |
| P | | 8 | F | P |
| P | | 13 | M | P |
| P | | 8 | F | P |
| P | | 11 | M | F BO |
| P | | 4 | M | Unattentive |
| P | | 8 | F | P |
| P | | 8 | F | P |
| P | | 6 | F | P |
| P | | 5 | F | P |
| P | | 4 | F | F BI |
| P | | 3 | F | Did not understand |
| P | | 7 | M | F BO |
| F | AC:Strab. | 12 | M | F Suppression |
| F | Acuity | 5 | F | F BI and BO |
| P | | 6 | F | P |
| P | | 8 | F | P |
| F | Ret.ATR | 6 | F | P |
| F | Acuity | 9 | M | F BI and BO |
| P | | 11 | M | P |
| P | | 6 | M | P |
| P | | 12 | M | P |
| P | | 7 | M | F BI |
| P | | 11 | M | P |
| P | | 9 | M | P |
| F | Ac.Ret. | 12 | M | P |
| P | | 12 | M | F BI |
| P | | 12 | F | P |
| P | | 10 | F | P |
| P | | 5 | F | P |
| P | | 9 | M | P |
| P | | 8 | F | F BI |
| P | | 6 | F | F Bi and BO |
| F | Acuity,Ret. | 14 | M | P |
| F | Acuity,Ret. | 5 | M | P |
| P | | 7 | F | P |
| P | | 6 | F | P |
| P | | 8 | F | F BI |
| P | | 7 | M | F Suppression |
| P | | 10 | M | P |
| P | | 9 | M | P |
| P | | 9 | F | P |
| P | | 9 | F | P |
| P | | 9 | M | P |
| P | | 7 | F | P |
| P | | 7 | F | F BI |
| P | | 12 | F | P |
| P | | 7 | M | P |

## SUMMARY OF DATA

RESULTS OF VISION SCREENING PERFORMED APRIL 25, 1981

MCT                                          PBV (6 P.D. BI AND BO)

%PASSED   85 ———— %PASSED ———————— 68
                  ———— %FAILED ———————— 32

MCT                                          PBV (6 P.D. BI AND BO)

%FAILED   15 ———— %PASSED ———————— 63
                  ———— %FAILED ———————— 37

## ANALYSIS OF DATA: SECTION TWO

The above data was taken from a randon sample of 52 youngsters
of approximately 200 youngsters screened. Time restrictions
did not permit sampling all children.

From the results above, of the 85% of the children who passed
the screening, 32% failed the PBV. The parents of these
children were advised to have their childs eyes examined
if they felt their child was not performing adequately in the
reading program.

## ANALYSIS OF DATA: SECTION TWO (CONT.)

It should also be noted that of the 15% who failed the MCT, 63% passed the PBV. This is reflective of the fact that most of the MCT failures were because of decreased distance acuity as a result of myopia greater than 0.50D (the criterion used in this MCT).

It is relatively significant that fully one-third of those children who passed the MCT failed to pass a small vergence demand of 6 p.d. utilizing the 'modified' PBV. Vergence testing in a screening situation can be combined with a suppression test as was done in this screening quite easily, and add another test to the optometric armamentarian.

Although the PBV technique has not undergone extensive clinical testing, it is felt that PBV represents a valid testing procedure for near point vergence analysis, as performed in this report.

## DISCUSSION

The basis of the PBV is a subjective awareness of "black"
or a "black eye" when convergence or divergence can no longer
maintain a fused image. Diplopia is experienced, crossed
polaroids occur, and "black"is perceived. Recovery is indicated
when fusion is re-established and binocular vision with
no diplopia is maintained.

The relationship between bar vergence BREAK/RECOVERY values
and those obtained with the PBV technique agree sufficiently
to be considered a technique in testing limits of vergence
fusion at near which are comparible to bar vergence values.

Although low bar vergence or low PBV findings are not
diagnostic of a particular vergence anomaly, findings below
expecteds do contribute to the distinct possibility of a
vergence anomaly.

One source of expected values for near vergences is as follows:[4]

         BI to blur                14
         BI to BREAK/RECOVERY      22/18 Minimum

         BO to blur                15
         BO to BREAK/RECOVERY      21/15 Minimum

The above data is based on Risley Prism findings which are
typically higher than the step-wise jump introduction of
vergence demand utilizing the bar prism. It is often found

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clinically that the BLUR finding is absent when using the bar prism. For this reason, it is felt that the PBV provides data which is comparable to the standard near bar vergences, and as such can be utilized in the vergence testing of patients in clinical and screening procedures.

The PBV can be performed with a cooperative patient in about 1-2 minutes, but only if there is normal binocularity and no suppression. In this light, PBV findings can be used as a quick clinical technique. In the case of vision screenings, it is recommended that the examiner limit polaroid testing to a check of the response for suppression (as per the via-a-vis) and to screen BI and BO vergence responses with one hand held prism (e.g. 6,8,10 p.d. prism). This procedure can be easily accomplished in less than 30 seconds which is quite feasible in a vision screening situation.

## SUMMARY

The usefulness of the PBV test is that it is a quick, novel and interesting test especially for children. Binocular testing in young children utilizing "...ductions with Risley Prisms and phoropter at nearpoint are valuable tests in older children, but findings in youngsters may be variable, quite unreliable..."[5] As a clinical technique, the procedure of PBV offers the examiner a good clinical and screening technique for detecting possible binocular dysfunctions including suppression vergence anomalies.

# FOOTNOTES

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