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Positive fusional reserve changes associated with the magnitude of lens power prescribed

David S. Crist
Pacific University

Kirk L. Smick
Pacific University

James A. Soumbeniotis
Pacific University

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Abstract

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POSITIVE FUSIONAL RESERVE CHANGES
ASSOCIATED WITH THE MAGNITUDE
OF LENS POWER PRESCRIBED

by

David S. Crist,

Kirk L. Smick, and

James A. Soumbeniotis

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Faculty member in charge:
Professor Carol B. Pratt, O.D., Ph.D.

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Positive Fusional Reserve Changes Associated With The Magnitude Of Lens Power Prescribed

Introduction:

What is the effect of plus on the base out duction findings at near? This is a question that Optometrists have been pondering for many years, and during this time, many different ideas have emerged which have been applied clinically both successfully and unsuccessfully. This question has also been the origin of many new testing sequences and ideas contributing to the present knowledge of clinical Optometry.

In many instances the consideration of the accommodative findings in nearpoint prescriptions have overshadowed considerations of what the effects of the nearpoint lens on the ductions and phorias will be. This study attempts to determine the presence of any predictable effects on the nearpoint base out ductions (16B) as a result of plus relative to the nearpoint crosscylinder findings.

Definition of Terms:

For the purpose of clarification some of the frequently used terms in this study should be defined. The total nearpoint (TNP) lens refers to the total amount of lens power in use at the nearpoint. The "P" factor, devised by Dr. C.B. Pratt of Pacific University in 1956, "allows us to convert a number of clinical tests into a common number indicating the refractive status with higher reliability than a single finding, or a single finding repeated three to five times under usual clinical conditions of measurements. A highly reliable zero or starting point for scaling or measuring accommodation is determined by calculating "P". The "P" factor avoids the error of averaging various refractive tests together directly forcing us to decide which distance tests to call the 'refractive error' (4, 7, 7a,)."[1] All tests listed below are integral parts of the Optometric Extension Program's analytical examination.[2] The 13B is the nearpoint lateral phoria through the control lens. The 14B is the binocular nearpoint crosscylinder test. The 14B net is determined by taking into account the accommodation associated with convergent-accommodation. The lag of accommodation is determined in the following manner: 15B exophoria/6 x 2/3, or 15B exo/9. The net is equal to the 14B finding less the lag. The 15B is the lateral phoria taken through the gross 14B lens. The 16B sequence is the nearpoint base out duction involving the Break and Recovery points.

Background and Theory:

From the earliest available literature discussing case analysis, it can be seen that Optometry has recognized the significance of the duction tests in determining lens prescriptions. Most practitioners have noted that when the duction tests were low, relative to certain established standards, the patient's subjective complaints were numerous. Fortunately, according to Morgan, the ductions are one of the most amendable functions of visual training.[4] "Thirty years ago the various schools of of Optometry were teaching various rules regarding when to apply partial lens correction, none of which were entirely satisfactory."[5] It is hoped that this study will shed some light on when certain clinical maneuvers regarding the application of plus may be performed. From the results of this study, the clinician can make some generalized, but fairly accurate, conclusions as to when to prescribe relative amounts of plus in relation to the 14B Net. The analysis of these procedures and our findings will follow in a later section.

Dr. Carol B. Pratt, Pacific University, considers the base out duction (stimulating convergence) to be the more significant of the nearpoint ductions, since the eyes must converge to fixate a near object. Thus, tests investigating the facility of the convergence functions or act are relatively more important in analysis of the near point visual pattern.[6] Several other authors, in deciding when training is necessary, also seem to place special emphasis on this particular finding.

In traditional clinical optometric practice, the application of plus lens power (especially at the near point) results in an increase in the BI prism findings. This is presumably due to the relaxation of the accommodation (response of), and an associated relaxation of convergence due to accommodative convergence. Conversely, application of minus lens power increases the base-out prism findings, due to accommodative stimulation, (increase in Accommodative response) and the increased convergence due to accommodative-convergence.

Selection of Data:

The data used in this study was collected from the files of Pacific University Optometric Clinic. The following findings were recorded from each case record: "P" factor, 13B phoria, 14B, 15B phoria, 14B net, TNP lens, 16B(break and recovery), and VT(yes or no). For each individual, findings were recorded from two examinations (separated by a least 10 months) for purposes of comparison. The following criteria were applied to the records in order to reduce the number of variables: 1) The 16B duction had to be relatively low (in relation to the 17B finding); 2) the anisometrophia could not be in excess of .50D; 3) the cylinder found in either eye could not be in excess of .50D; 4) no tropia (in reference to the cover test) could be present; 5) the age of the individual had to fall between 12 - 38 years of age; 6) the analytical amplitude (19) had to have a net value of at least 5.00D; and 7) no pathalogical conditions could be present.

Introduction to the Analysis:

In the statistical analysis, the break and recovery of 16B were considered separately. The individuals were grouped into three divisions for purposes of comparison: 1) a TNP lens in excess of .37 more plus than the 14B net; 2) a TNP lens within .37 of the 14B net; and 3) a TNP lens in excess of .37 less plus than the 14B net.

The relative increase or decrease in the ductional magnitude between the two examinations was considered, since our purpose, as orginally stated, was to evaluate the effect of the near point prescription on the 16B ductions.

The statistical analysis follows as represented by the following graphs and statistical values.

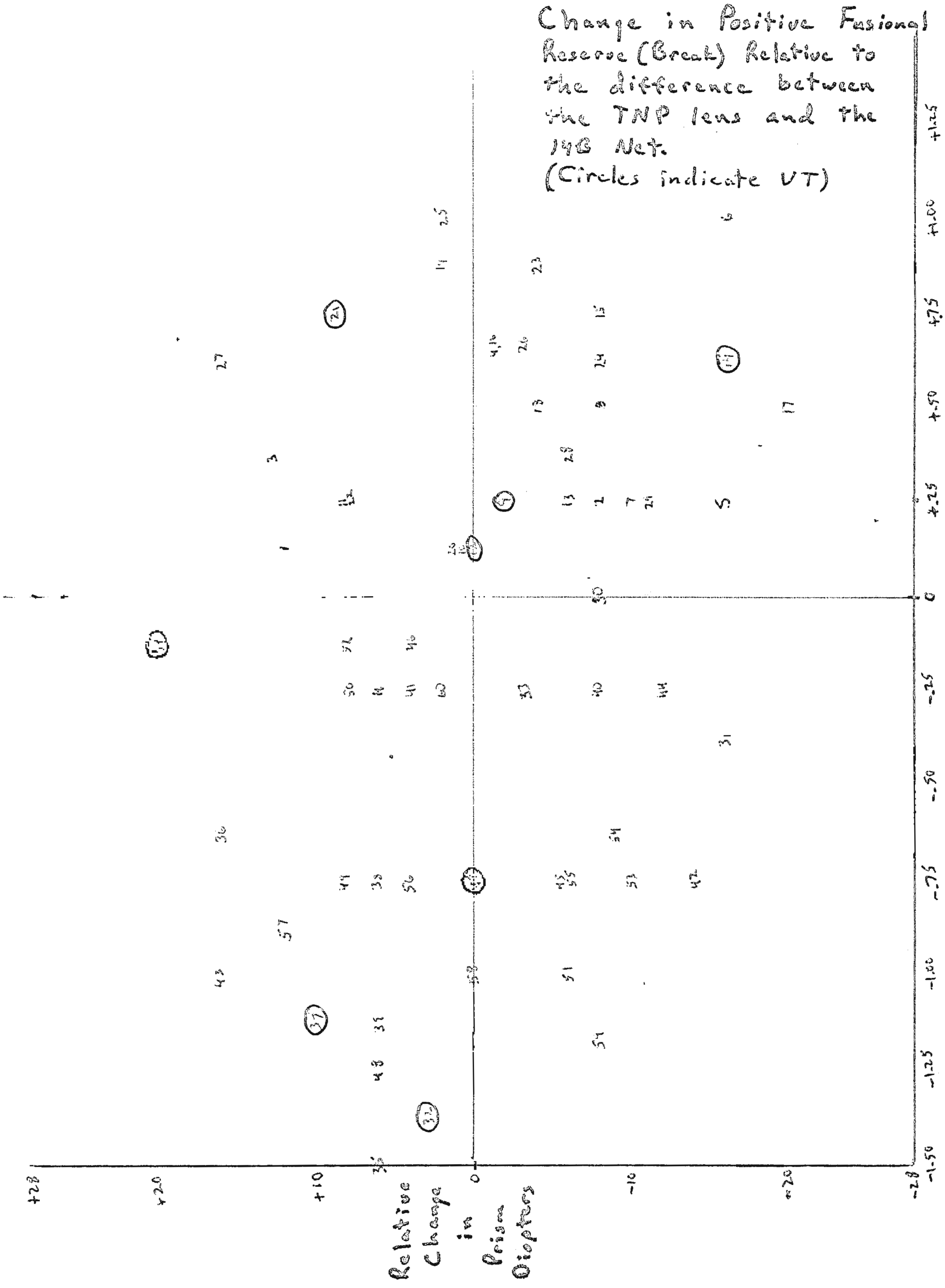
ate	Name	"P"	13B	14B	15B	14B NET	TNP	Difference (TNP−14BN)	16B (B)	16B (R)	Difference	VT?
/63 /66	J. A.	−4.50 −6.00	5x0 6x0	−3.50 −4.75	10x0 7x0	−4.37 −5.50	−4.25	+.12	6 16	4 2 14 4	+12/+10 −2	No (1)
/63 /64	B. A.	−1.50 −1.62	ø 2x0	−.50 −1.25	ø 6x0	−.50 −1.87	−.25	+.25	38 30	23 15 23 7	−8/0 +8	No (2)
/61 /62	C. A.	+.25 −.12	8x0 ø	+2.25 +1.75	17x0 6x0	+.37 +1.25	+.75	+.37	15 25	4 11 15 10	+13/+14 +1	No (3)
/64 /65	J. A.	−.87 −2.00	4 esc 6 esc	+.25 −.50	6x0 9x0	−.37 −1.50	+.25	+.62	26 25	2 14 6 19	−1/+4 −5	No (4)
/55 /57	M. A.	+.87 +.50	14x0 10x0	+2.25 +2.25	14x0 10x0	+.75 +1.25	+1.00	+.25	28 12	7 21 2 5	−16/−3 +13	No (5)
/58 /60	R. A.	−.37 −.62	1x0 2x0	−.25 +.75	2 esc 6x0	−.25 pl	+.75	+1.00	24 8	2 22 2 6	−16/0 +16	No (6)
/60 /64	F. A.	−.75 −1.00	14x0 11x0	−.25 pl	11x0 16x0	−1.25 −1.62	−1.00	+.25	22 12	3 19 2 10	−10/−1 +9	No (7)
/57 /58	R. A.	−.75 −1.50	4x0 ø	pl −1.00	ø ø	pl −1.00	+.50	+.50	32 24	12 20 5 19	−8/−7 +1	No (8)
/63 /65	K. B.	−1.87 −3.25	3 esc 11 esc	−.50 −2.50	3x0 3x0	−.75 −2.87	−.50	+.25	32 30	8 24 20 10	−2/+12 +14	Yes (9)
61 62	R. B.	+.25 +.25	4x0 5 esc	+1.50 +.75	6x0 ø	+.87 +.75	+1.00	+.12	16 17	4 12 9 8	+1/+5 +4	No (10)
60 61	A. B.	+.25 +.75	4x0 3x0	+2.25 +1.75	9x0 4½ x0	+1.25 +1.25	+1.50	+.25	22 30	4 18 4 26	+8/0 −8	No (11)
63 63	S. B.	+.87 +1.00	16x0 10x0	+2.75 +2.50	16x0 17x0	+1.12 +.87	+1.25	+.12	24 24	1 23 10 14	0/+9 +9	Yes (12)
/62 /63	F. B.	pl +.12	2 esc ½ esc	+1.25 +1.25	4x0 8x0	+.75 +.37	+1.00	+.25	30 24	8 22 5 19	−6/−3 +3	No (13)
61 64	W. C.	−1.12 −1.62	ø 3 esc	−.25 −.50	3x0 7x0	−.62 −1.25	pl	+.62	34 18	28 6 4 14	−16/−24 −8	Yes (4) (14)

Date	Name	"P"	13B	14B	15B	14B NET	TNP	Difference (TNP-14BN)	16B (B)	16B (R)	Difference	VT?
/60 /63	DJ	+.37 +.50	5x0 ø	+1.00 +2.50	5x0 12x0	+.50 +1.12	+1.25	[illegible]	24 16	10 1 10 6	0/0 +1	No (15)
3/64 /66	GJ	+.62 +.62	1x0 4x0	+2.00 +2.00	8x0 8x0	+0.12 +0.37	+.25	[illegible]	21 20	12 9 10 6	-1/.4 +1	No (16)
/59 /61	KJ	-.50 -.37	3x0 4x0	+1.00 +.75	4x0 4x0	+.50 +.25	+1.00	[illegible]	36 16	12 10	-20/.2 +18	No (17)
/60 /63	TJ	+.25 +.50	6x0 8x0	+1.37 +2.50	10x0 12x0	+.25 +1.12	+.75	+ .50	26 22	5 +1 4	-4/-1 +3	No (18)
/65 /65	SL	-1.37 -1.25	3x0 3x0	+.50 -.25	12x0 6x0	-1.37 -.87	-.50	+ .87	30 32	24 6 18	+2/-6 -8	No (19)
/64 /65	SM	-2.25 -2.00	ø 3x0	-1.25 -1.50	3x0 3x0	-1.62 -1.50	-1.50	+ .12	27 28	15 14 +1	+1/-1 -2	No (20)
/61 /62	RM	-3.50 -3.50	2x0 ø	-2.00 -2.75	5x0 6x0	-2.37 -2.87	-1.62	1.25	15 24	3 +2 12 12	+9/+9 0	Yes (21)
/59 /60	PM	-2.00 -2.00	2x0 ø	-1.25 -.75	1x0 6x0	-1.25 -1.25	-1.00	+ .25	20 28	8 12 16 12	+8/+8 0	No (22)
/64 /66	LM	+.25 +.37	4x0 3x0	pl +1.00	6x0 4x0	-.37 +.50	+.50	+ .87	24 20	8 16 8 12	-4/0 +4	No (23)
/61 /63	RC	+3.00 +2.00	3x0 5x0	+2.75 +4.00	3x0 10x0	+2.37 +2.87	+3.00	+ .62	20 12	12 1	-8/-11 -3	No (24)
/64 /65	DR	-1.00 -.75	3x0 3x0	+.25 +.75	7x0 9x0	-.25 -.25	+.75	+1.00	14 16	6 5 10 6	+2/+4 +2	No (25)
/62 /64	HR	-.25 pl	7x0 ø	+.75 +.25	6x0 2x0	+.12 pl	+.75	+.62	24 21	6 18 12 9	-3/+6 +9	No (26)
/61 /64	LT	+.50 +.75	14x0 17x0	+2.00 +1.75	18x0 19x0	+.37 pl	+1.00	+ .62	16 32	12 4 10 22	+16/-2 -18	No (27)
/63 /64	RT	pl -.50	4x0 3x0	+1.25 +.25	6x0 2x0	-.37 pl	pl	+ .37	23 17	5 18 10 7	-6/+5 +11	No ⑥ (28)

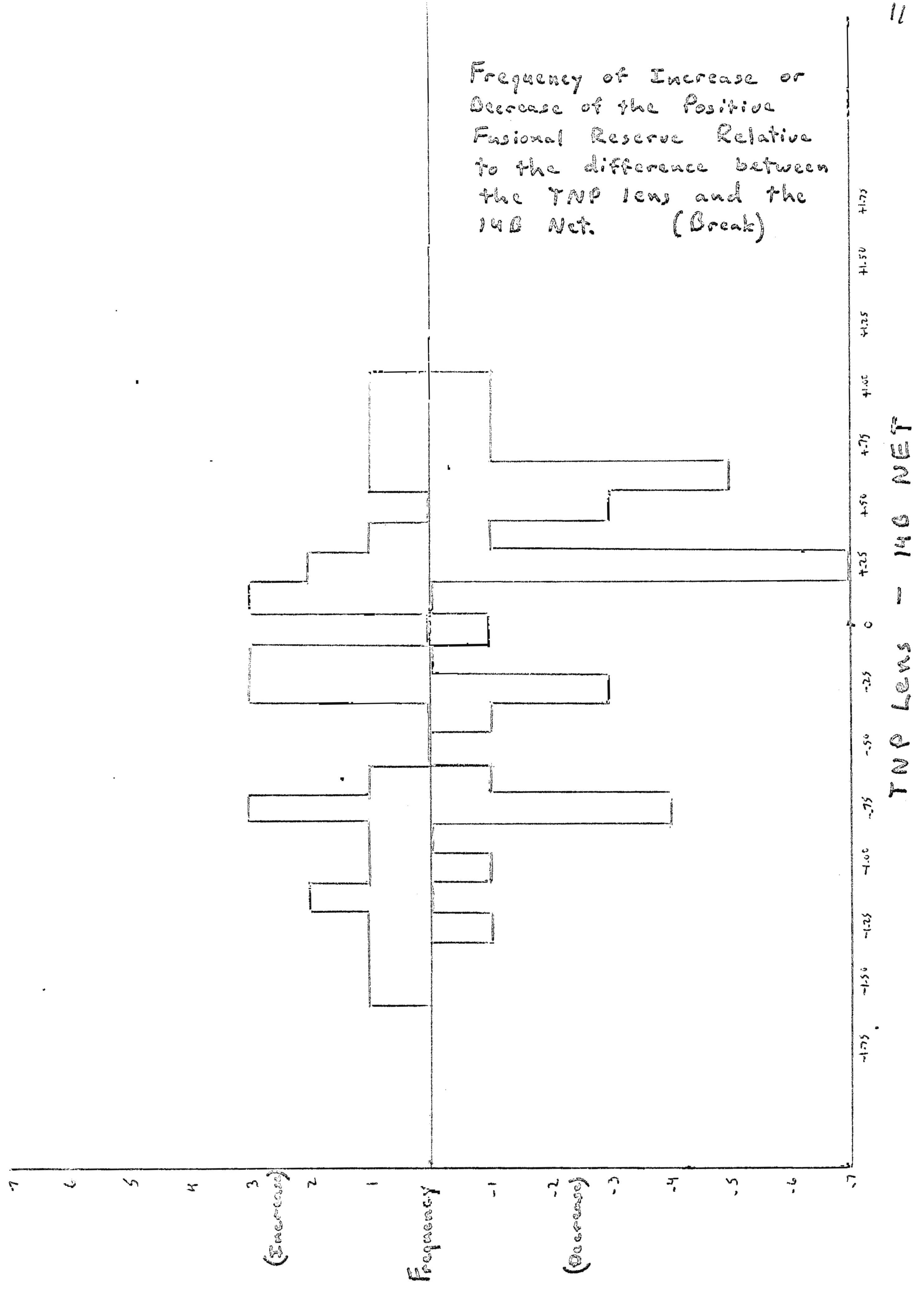
Date	Name	½P	13B	14B	15B	14B NET	TNP	Difference (TNP-14B NET)	16B (A)	16B (B)	Difference	VT?
/63 /65	JT	-1.75 -1.25	1x0 4x0	-.25 +.75	4x0 2x0	-.75 -1.00	-.50	+.25	24 13	2 19 9 0	-11/+4 +15	No (29)
/63 /66	DM	+2.00 +2.25	14x0 8x0	+3.50 +3.25	13x0 11x0	+2.00 +2.00	+2.00	0	36 28	3 33 ø 0	-8/+5 +13	No (30)
/60 /61	KA	+.37 +.37	1 [illegible] 3x0	+1.75 +1.75	1x0 10x0	+1.62 +.75	+1.25	-.37	28 12	6 22 6 6	-16/0 +16	No (31)
/59 /61	GA	-1.25 -.75	2 [illegible] ø	+1.00 +.22	8x0 7x0	+.12 -.50	-1.25	-1.37	10 13	7 3 8 5	+3/+1 -2	Yes (32)
/62 /63	DA	+2.50 +2.62	4x0 6x0	+3.00 +2.75	4x0 3x0	+2.50 +2.37	+2.25	-.25	18 15	2 16 4 11	-3/+2 +5	No (33)
/63 /64	JA	+.75 +.50	15x0 13x0	+2.75 +1.25	20x0 15x0	+1.12 -.37	+1.00	-.12	4 24	3 7 6 18	+20/+9 -11	Yes (34)
/63 /65	JA	-3.00 -2.75	4x0 8x0	-1.00 -3.50	5x0 8x0	-1.50 -4.37	-3.00	-1.50	18 24	14 4 12 12	+6/+2 -8	No (35)
/63 /64	PA	-1.12 -1.00	6x0 2 [illegible]	+.23 -.25	6x ø	-.37 -.25	-1.00	-.62	16 32	5 11 16 16	+16/+11 -5	No (36)
/63 /65	DB	+1.75 +2.25	4x0 6x0	+3.50 +4.50	7x0 7x0	+2.62 +3.75	+1.50	-1.12	32 12	8 24 34 8	+10/+26 -16	Yes (37)
/62 /65	RB	+.75 +.62	5 [illegible] 5x0	+2.25 +1.75	2x0 9x0	+2.00 +.75	+1.25	-.75	4 10	6 4 5 5	+6/+5 -1	No (38)
/62 /63	CC	+1.62 +1.50	2 [illegible] 2x0	+3.00 +2.00	3x0 3x0	+2.62 +1.62	+1.50	-1.12	16 24	12 6 13 11	+6/+1 -5	No (39)
/64 /66	CC	-2.37 -2.50	ø 2x0	-1.50 -1.25	5x0 3x0	-2.00 -1.62	-2.25	-.25	29 21	22 7 15 6	-8/-7 +1	No (40)
/62 /63	EJ	+.62 +.62	1x0 4x0	+2.00 +2.00	4x0 4x0	+1.50 +1.50	+1.25	-.25	17 21	1 16 8 13	+4/+7 +3	No (41)
/64 /65	BM	-2.00 -2.50	5 [illegible] 2 [illegible]	-.50 -.75	4x0 5x0	-1.00 -1.25	-1.75	-.75	22 c	10 12 5	-14/-2 +12	No [illegible]

Date	Name	"P"	13B	14B	15B	14B NET	TNP	Difference (TNP-14B NET)	16B (B)	16B (R)	Difference	UT?	
2/63 1/66	DM	+2.00 +3.50	4 cc Ø	+.75 +1.75	Ø 2x0	+.75 +1.87	+.75	-1.00	14 25	9 5 15 10	+14/+9 -5	No	(43
10/59 2/62	LM	-.50 -.50	Ø 7x0	+.50 +.50	2x0 4x0	+.25 pl	pl	-.25	23 11	24 1 8 3	-12/-16 -4	No	(44
4/64 7/65	OM	-1.25 -1.25	5x0 6x0	pl -1.00	5x0 5x0	-.50 -2.00	-1.25	-.75	22 16	8 14 10 6	-6/+2 +8	No	(45
10/61 10/62	MM	pl +.12	4x0 6x0	+.75 +2.00	6x0 6x0	+.12 +.62	pl	-.12	15 19	6 9 4 15	+4/-2 -6	No	(4
9/58 9/59	SM	-1.25 -1.00	5x0 8x0	+.25 +.75	5x0 6x0	-.25 -1.50	-1.00	-.75	12 12	4 8 7 5	0/+3 +3	Yes	(4
8/58 1/59	JM	+.50 pl	4x0 6x0	+1.75 +2.00	4x0 7x0	+1.25 +1.25	pl	-1.25	16 22	8 8 6 16	+6/-2 -8	No	(4
7/65 9/66	PM	-.50 -.50	13 cc 8x0	+.75 +1.00	2 cc 12x0	+.75 -.37	pl	-.75	32 44	13 19 20 24	+8/+7 -5	No	(49
1/65 1/66	MM	+.50 +.50	5 cc Ø	+1.00 +1.75	2 cc 3x0	+1.00 +1.25	+.75	-.25	16 24	8 8 3 21	+8/-5 -13	No	(50
3/63 1/64	DM	pl pl	3 cc 4x0	+1.00 +.25	4x0 4x0	+1.00 -.25	pl	-1.00	18 12	6 12 4 8	-6/-2 +4	No	(51
1/61 1/62	RR	+.50 +.25	4x0 5x0	+1.50 +1.50	6x0 8x0	+.87 +1.00	+.75	-.12	14 22	13 1 16 6	+8/+3 -5	No	(52
1/65 1/66	ER	-2.25 -2.50	6 cc 3 cc	-1.50 -1.75	2 cc 2x0	-1.50 -1.87	-2.25	-.75	32 22	24 8 9 13	-10/-15 -5	No	(53
1/64 1/66	RR	+.50 +.50	3x0 4x0	+1.00 +.50	3x0 6x0	+.62 -.12	pl	-.62	21 17	6 15 6 6	-9/0 +9	No	(54
1/62 1/63	CR	+.50 +.75	2x0 4x0	+2.[illegible] +1.25	6x0 6x0	+1.50 +.50	+.75	-.75	22 16	9 13 8 8	-6/-1 +5	No	(55
1/63 1/64	DR	+1.25 +1.00	3x0 3x0	+2.25 +1.25	6x0 3x0	+1.50 +.87	+.75	-.75	16 20	4 12 6 14	+4/+2 -2	No (8)	(5

Date	Name	"p"	13B	14B	15B	14B NET	TNP	Difference (TNP-14BN)	16B (B)	16B (R)	Difference	UT ?
4/62 2/64	ER	-.25 pl	2x0 2 eso	+1.50 +1.50	6x0 8x0	+.87 +.62	[illegible]	-.87	20 32	[illegible] 20 17	-6 / +6	No (57)
10/65 10/66	LR	+1.00 +.50	Ø 4x0	+2.25 +1.50	4x0 11x0	+1.75 +1.12	+.75	-1.00	16 16	8 8 9 7	0 / +1 +1	No (58)
2/64 2/66	SR	-1.25 -2.50	7x0 5x0	+1.50 -.75	8x0 9x0	+.75 -1.50	-2.00	-1.25	30 22	16 +14 16 +6	-8 / 0 +8	No (59)
/50 /62	BT	-.25 pl.	5 eso 5x0	+.50 +.25	Ø 5x	+.50 -.37	+.25	-.23	24 26	10 14 17 9	+2 / +7 +5	No (60)


Change in Positive Fusional Reserve (Break) Relative to the difference between the TNP lens and the 14B Net.
(Circles indicate VT)
TNP LENS − 14B · NET
Relative Change in Prism Diopters
+28
+20
+10
0
-10
-20
-28
-1.50
-1.25
-1.00
-.75
-.50
-.25
0
+.25
+.50
+.75
+1.00
+1.25

Frequency of Increase or Decrease of the Positive Fusional Reserve Relative to the difference between the TNP lens and the 14B Net. (Break)



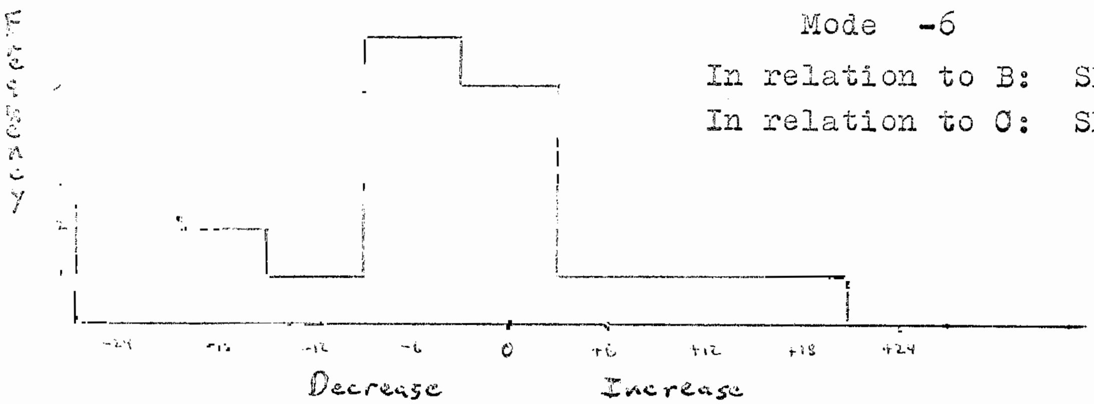
Frequency of Increase or Decrease of the Positive Fusional Reserve (Break)

A) TNP .37 to 1.50 over the 14B Net

N 16
Mean -2.56
Median -2
Mode -6

Range +16 to -20
s 8.65
PE 5.76
$s_{\bar{x}}$ 2.2

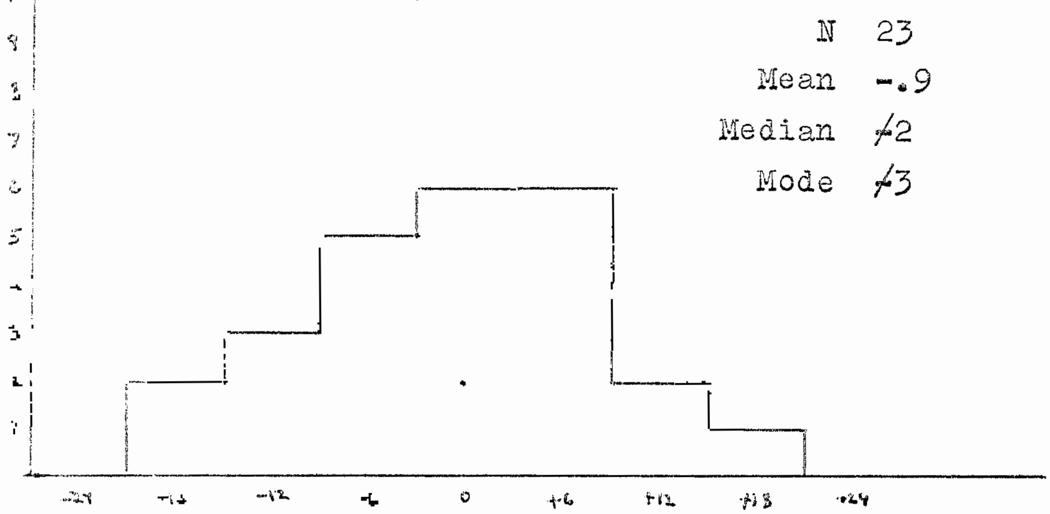
In relation to B: SED 2.97 t .56
In relation to C: SED 2.91 t 1.17



B) TNP within .37(+,-) of the 14B Net

N 23
Mean -.9
Median +2
Mode +3

Range +20 to -16
s 9.76
PE 6.5
$s_{\bar{x}}$ 2

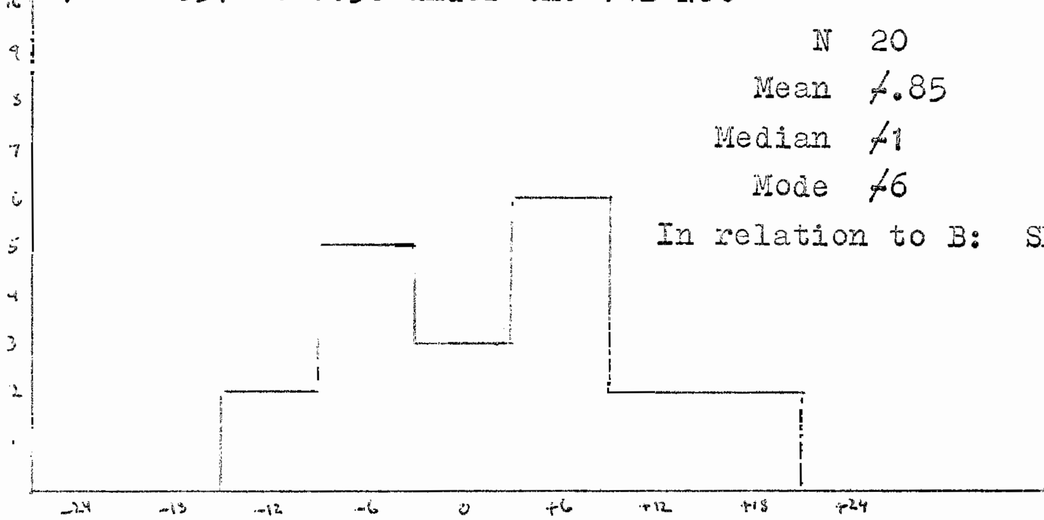


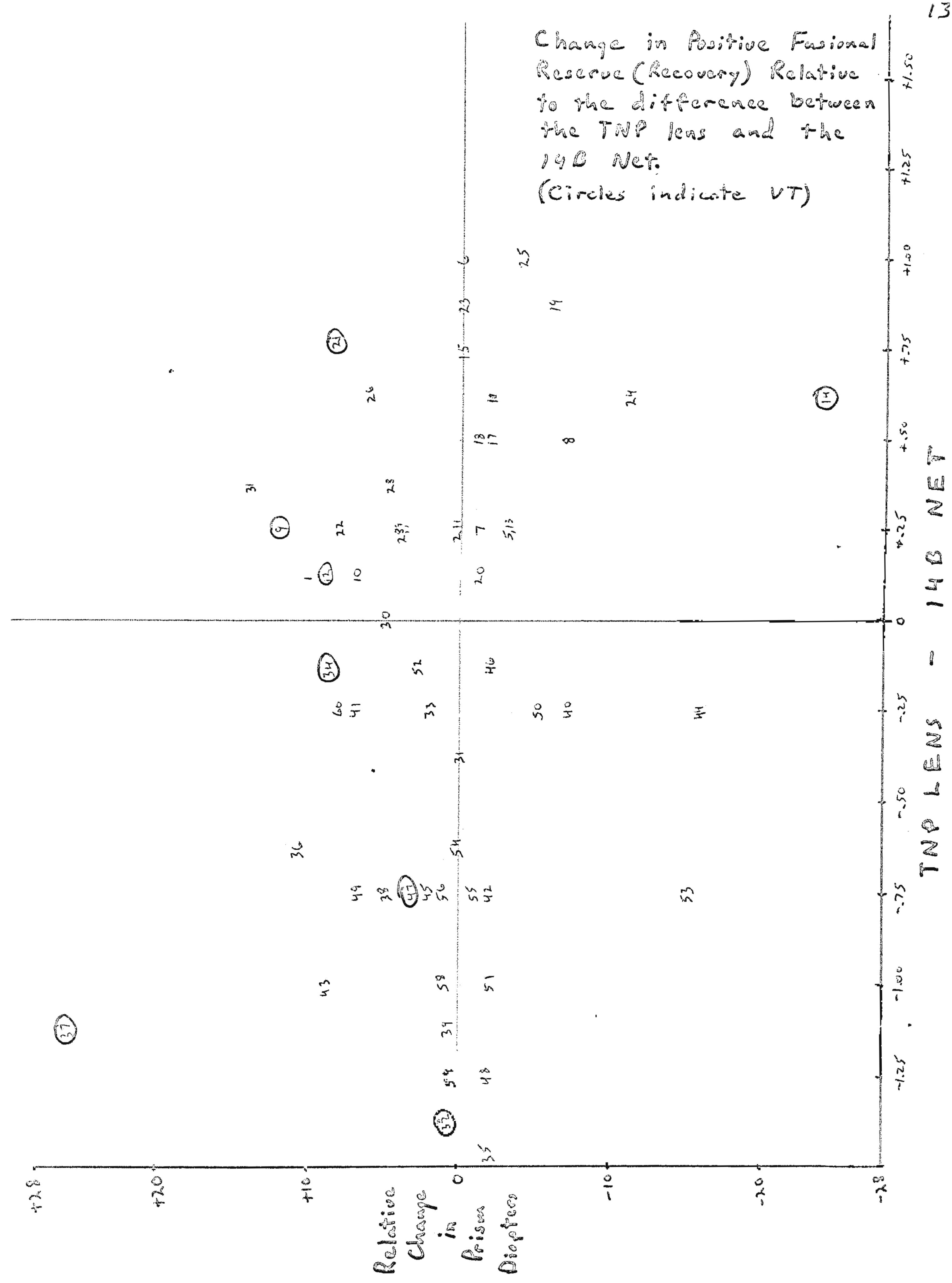
C) TNP .37 to 1.50 under the 14B Net

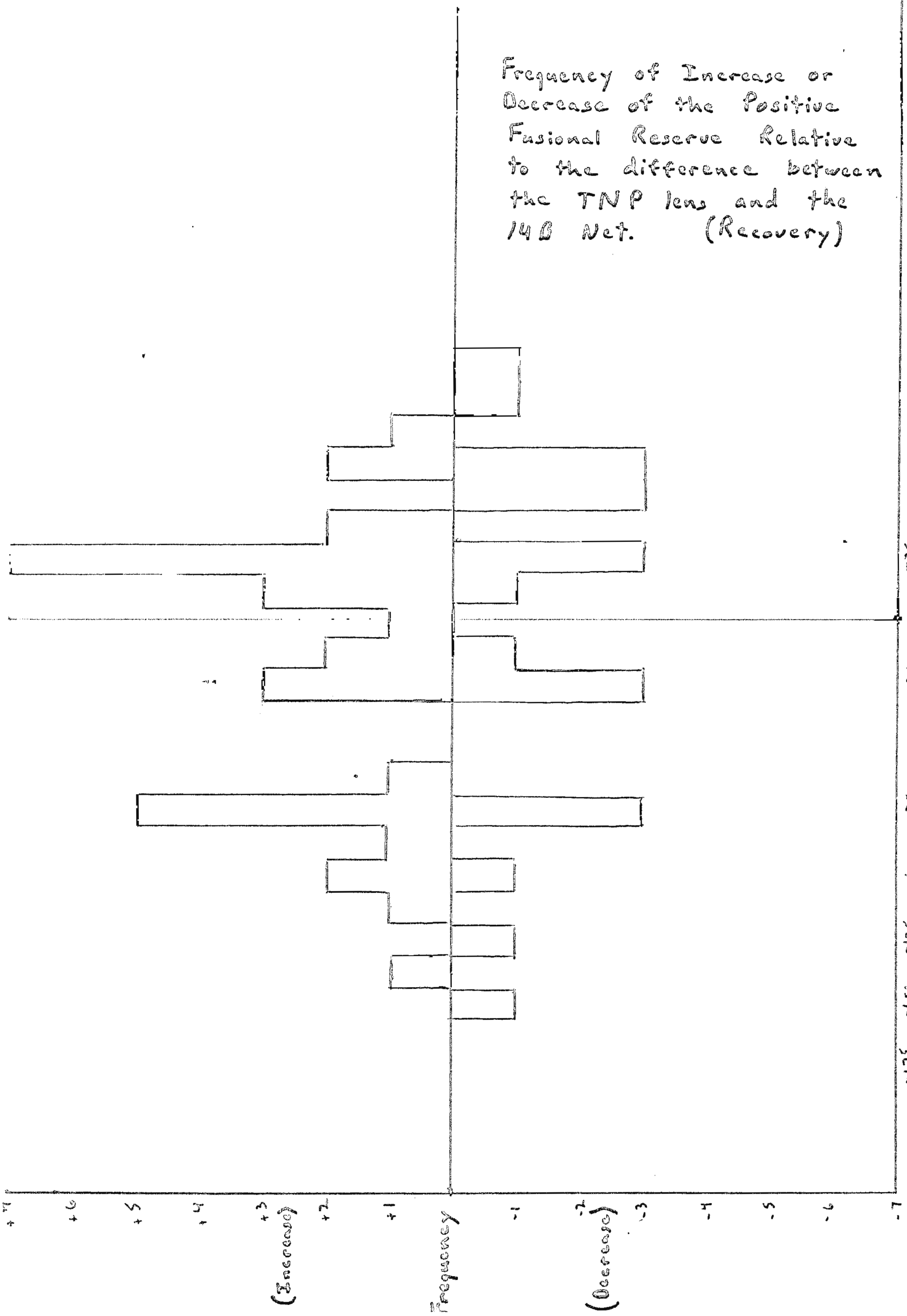
N 20
Mean +.85
Median +1
Mode +6

Range +16 to -14
s 8.6
PE 5.7
$s_{\bar{x}}$ 1.9

In relation to B: SED 2.76 t .63

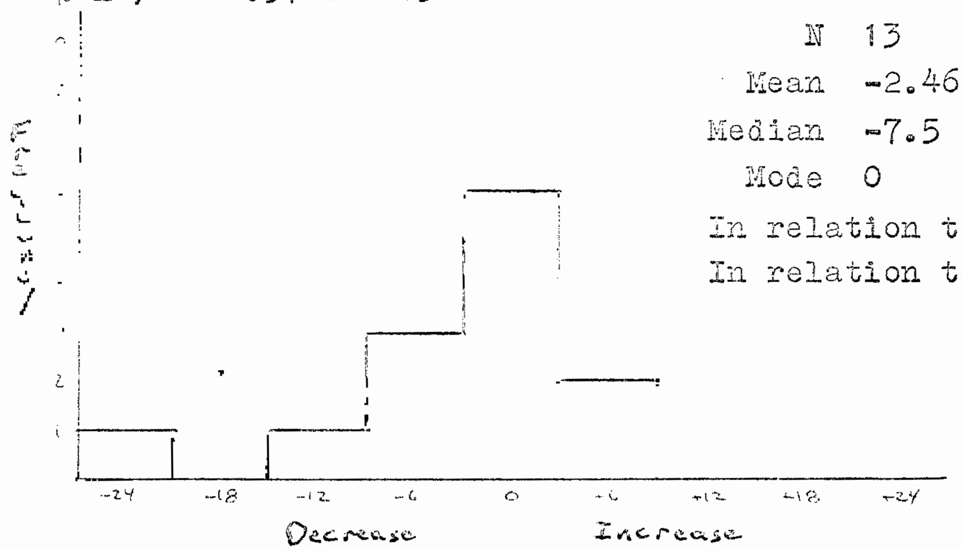



Change in Positive Fusional Reserve (Recovery) Relative to the difference between the TNP lens and the 14B Net.
(Circles indicate VT)
TNP LENS - 14B NET
+1.50
+1.25
+1.00
+.75
+.50
+.25
0
-.25
-.50
-.75
-1.00
-1.25
Relative Change in Prism Diopters
+28
+20
+10
0
-10
-20
-28


Frequency of Increase or Decrease of the Positive Fusional Reserve Relative to the difference between the TNP lens and the 14B Net. (Recovery)
TNP Lens - 14B NET
+1.75 +1.50 +1.25 +1.00 +.75 +.50 +.25 -.25 -.50 -.75 -1.00 -1.25 -1.50 -1.75
+7 +6 +5 +4 +3 +2 +1 -1 -2 -3 -4 -5 -6 -7
(Increase)
Frequency
(Decrease)

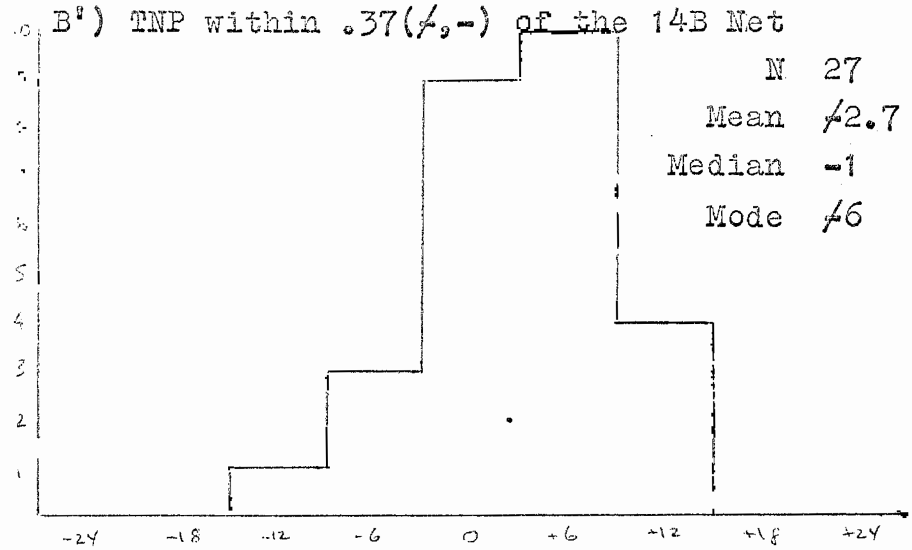
Frequency of Increase or Decrease of the Positive Fusional Reserve (Recovery)

A') TNP .37 to 1.50 over the 14B Net



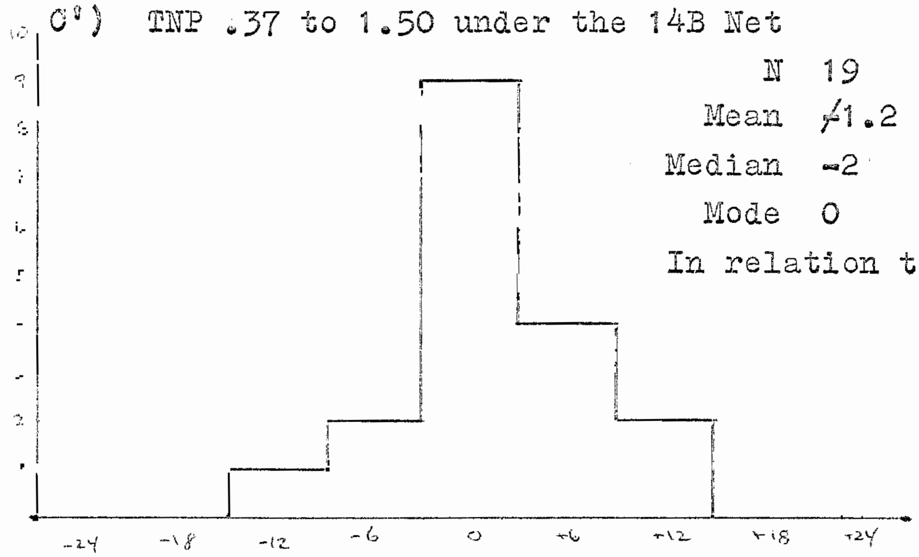
N	13	Range	≠9 to -24		
Mean	-2.46	s	7.81		
Median	-7.5	PE	5.2		
Mode	0	$s_{\bar{X}}$	2.5		
In relation to B':		SED	2.82	t	1.83
In relation to C':		SED	2.77	t	1.32

B') TNP within .37(≠,-) of the 14B Net



N	27	Range	≠14 to -16
Mean	≠2.7	s	6.45
Median	-1	PE	4.3
Mode	≠6	$s_{\bar{X}}$	1.3

C') TNP .37 to 1.50 under the 14B Net



N	19	Range	≠11 to -15		
Mean	≠1.2	s	5.21		
Median	-2	PE	3.47		
Mode	0	$s_{\bar{X}}$	1.2		
In relation to B':		SED	1.77	t	.84

Discussion:

In considering our statistical results, there is a strong indication that the 16B Break is lowered when plus in excess of the 14B Net is worn (a mean decrease of 2.56p.d.). We found that the wearing of plus less than the 14B Net resulted in an increase of the 16B Net (a mean increase of .85p.d.). Those individuals wearing within .37 of the 14B Net show a decrease in the Break (a mean decrease of .90p.d.). In regard to the recovery, the individuals wearing excessive plus (over the 14B Net) showed a decrease in the 16B Recovery (a mean decrease of 2.46p.d.). Significantly, those who wore plus equal to or less than the 14B Net exhibited substantial increases in the values of the Recovery (mean increase of 2.7.p.d. and 1.2p.d. respectively).

Statistical tests of significance do not indicate that our results are significant to the 90th degree, but do indicate very definite trends toward the above results. We can assume that our measures of central tendency would not change appreciably if there were more individuals included in the study. Certain tests of significance, however, notably the standard error of the mean ($s_{\bar{x}}$) and the standard error of the difference (SED) would be decreased if the population (N) were larger. This strongly indicates that while we have failed to obtain mathematical statistical significance, we have obtained strong and significant trends.

Hull and Yaeger (1959) studied the affect of visual training combined with lens therapy on the 16B finding.

Their results indicate that, on a long range basis, the value of the 16B finding is neither decidedly increased nor decreased, although a slight increase in indicated.[7] This may be due to the tendency of the convergence functions (including 16B) to be changed most easily by visual training. In our study, a total of eight individuals had had visual training combined with lens therapy. In regard to the Break, the finding was increased in four cases, showed no change in two cases, and was decreased in two cases. Seven out of the eight showed an increase in the 16B Recovery. Although the number of patients with visual training in our study was too small for a sub-study, there are indications that both the Break and Recovery might be increased, regardless of lens power prescribed, when visual training is utilized. This supposition is consistant with the results obtained by Hull and Yaeger.

In clinical application, not only the immediate effects of the lens power upon the convergence should be considered, but also the long range effects. Our results indicate that plus in excess of the 14B Net tends to lower the 16B (both Break and Recovery). For those patients who require plus at the near point, consideration should be given to whether or not the proposed lens might in fact have long range deleterious effects upon the convergence system. If so, would this be desireable in light of the existing status of the convergence reserve? Therefore, in certain instances, near point plus application should be accompanied by considerations of additional treatment such as prism application and/or visual training.

Conclusion:

In conclusion, the authors found trends in relation to near point prescriptions which might be applicable clinically. In general, for patients with relatively low 16B findings, plus exceeding the 14B Net has a tendency to decrease the 16B finding, on a long range basis. Conversely, plus equal to or less than the near net has a tendency to increase the 16B finding.

Footnotes

1. Pratt, Dr. Carol B., Calculation of the 'P' Factor. A Lecture Supplement, Pacific University, 1965. Pg. 1.

2. Lesser, S. K., O. D., F. A. A. O., Introduction to Modern Analytical Optometry. Optometric Extension Program Foundation, Inc., Duncan, Oklahoma, 1965. pg. 20.

3. Jang Dr. Detleff, Lecture - Theory of Optometry. Pacific University, 1966.

4. Borish, Irvin M., O. D., D. O. S., F. A. A. O., Clinical Refraction. 2nd Edition. The Professional Press, Inc., 5 N. Wabash Ave., Chicago 2, Ill., 1954. pg. 400.

5. Manas, Leo, M. A., O. D., Visual Analysis. 3rd Edition. The Professional Press, Inc., 5 N. Wabash Ave., Chicago 2, Ill., 1965. pg. 173.

6. Pratt, Dr. Carol B., Lecture - Dr. Pratt's Studies and Research. Pacific University, 1967.

7. Hull, R. C., and Yaeger, R. E., A Compilation of Forty 10-16B Low Cases As Taken From The P. U. Files. Thesis, Pacific University, 1959.

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1. Borish, Irvin M., O.D., D.O.S., F.A.A.O., Clinical Refraction. 2nd Edition. The Professional Press, Inc., 5 N. Wabash, Chicago 2, Ill., 1964.

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4. Lesser, S.K., O.D., F.A.A.O., Introduction to Modern Analytical Optometry. Optometric Extension Program Foundation, Inc., Duncan, Oklahoma, 1965.

5. Manas, Leo, M.A., O.D., Visual Analysis. 3rd Edition. The Professional Press, Inc., 5 N. Wabash Ave., Chicago 2, Ill., 1965.

6. Pratt, Dr. Carol B., Calculation of the 'P' Factor. A Lecture Supplement, Pacific University, 1965.

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