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Effects of fresnel prisms on two clinical stereoscopic tests: An exploratory study

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Abstract

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An Exploratory Study

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INTRODUCTION

The following examination of stereoacuity through Fresnel prisms was suggested by Harold M. Haynes, O. D. The specific form of this problem was suggested by Professor Haynes[1], while discussing use of Fresnel prisms with stereo training.

In careful examination of available optometric literature, we found no reports on the effects of Fresnel prisms on stereoacuity. Reduced visual acuity has been reported by Flom, Weymouth, and Kahnerman [2] in Journal of American Optometric Society. Figure I graphically demonstrates visual acuity loss as a function of prism power.

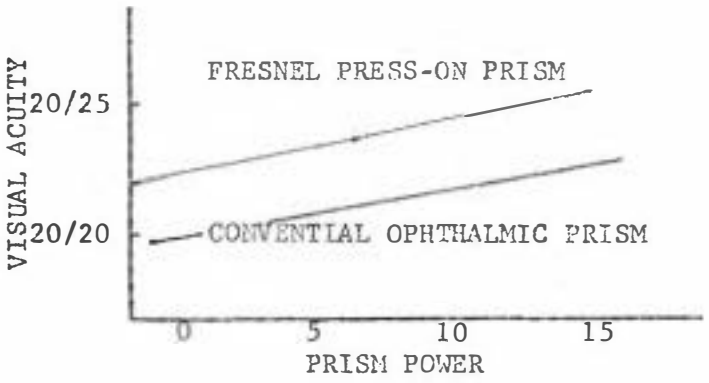

Figure I:

The figure illustrates acuity performances of prisms. Both OSG Press-On and Conventional prisms demonstrate clinically insignificant acuity decrement even for high powers. Conventional glass prisms had a 3.0 D. ocular curve and 2.1 mm. apex thickness. Fresnel prisms were pressed onto plano lenses with the same ocular curve and thickness. Visual acuity was measured psychometrically with Landolt Cs after a method described by Flom, Weymouth & Kahneman, J. Optical Soc. Am. 53 (9): 1026, 1963.[3]

Since the development of Fresnel prisms, the possibility of their use in orthoptics and visual training dictates the necessity for an investigation of their efforts on stereopsis and other stereoscopic performances.

PROBLEM:

This exploratory experiment was designed to study the immediate effects of wearing Fresnel prisms binocularly on stereoscopic seeing. The effects on stereoscopic seeing were measured by two clinical techniques: the Keystone Multi-Stereo test and the American Optical Space Eikonometer. The Multi-Stereo test is a stereoacuity test. The Space Eikonometer is not technically a stereoacuity test even though this stereo function is basic to it and can be derived as a threshold for the data obtained.

EXPERIMENTAL PROCEDURE:

Twelve male caucasian optometry students were selected as subjects for this experiment. Each subject who qualified, met the following visual standards: (1) uncorrected visual acuity in each eye of 20/20 or better at twenty feet; (2) a distance refraction between plano and plus one sphere (+1.00) with no more than .75 D. of astigmatism; and (3) steroacuity on the Multi-Stereo test in excess of 80% on the Keystone scale.

The experimental procedure was designed into three parts. Part I of the experiment was performed to determine the effects of Fresnel prisms on visual acuity. Part II of the experiment was performed to determine the effects of the several Fresnel prisms and prism-lense combinations on the Multi-Stereo test. Part III used the same lense schedule on the Space Eikonometer as was used with the Multi-Stereo test.

Part I involved testing visual acuity for each qualified subject monocularly and binocularly through plano trial case lenses and Fresnel prism of 6 pd. base verticle (BV) and 6 pd. of base lateral (BL), pressed on a plano trial case lens. All subjects when tested wore a trial frame for simple lense insertion and removal. After taking monocular and binocular visual acuity each subject was placed into one of four groups. The four groups were: (I) base right (BR) and base down (BD); (2) base left (BL) and BD; (3) BR and base up (BU); and (4) BL and BU. This grouping procedure was maintained throughout entire testing sequence. Table I shows the testing sequence of the four groups, the various prism powers, and prism-lense combinations used in Parts I, II, and III.

Table I:

	1	2	3	4	5	6	7
Group 1	plano	6^{Δ} BR	6^{Δ} BD	6^{Δ} = -1.00	12^{Δ} = -2.00	18^{Δ} = -3.00	plano
Group 2	plano	6^{Δ} BL	6^{Δ} BD	6^{Δ} = -1.00	12^{Δ} = -2.00	18^{Δ} = -3.00	plano
Group 3	plano	6^{Δ} BR	6^{Δ} BU	6^{Δ} = -1.00	12^{Δ} = -2.00	18^{Δ} = -3.00	plano
Group 4	plano	6^{Δ} BL	6^{Δ} BU	6^{Δ} = -1.00	12^{Δ} = -2.00	18^{Δ} = -3.00	plano

Testing sequence for each of the four groups of subjects.

The designated minus spheres were combined with the prisms to keep the stimulus to accommodation and convergence approximately equal. This was done to reduce the possibility of any decrement in stereoacuity as a function of exceeding the relative convergence or accommodation ranges. No control to measure the level of response of accommodation and convergences were used, other than the stereo task of the test.

After each subject completed the patterned testing procedure on the Mult-Stereo, he was transferred to the American Optical Space Eikonometer, where the same controls and prism settings were utilized.

Quantifying the data on the Space Eikonometer in our original experimental design was by the "method of limits". The method was rejected due to many subjects being unable to come to a point of alignment. This was due to the large variances in the visual display of the instrument with the introduction of the Fresnel prisms. The method then incorporated for measuring the magnification of axis 90, axis 80 and declination was qualatative description of the control setting and a subjective change to correct the observed differences of the visual display. The order of description and subjective change was first axis 90 (x90), then axis 180 (x180) and then declination. It is important to note, that before each prism setting, the original plano

control values were restored x90, x180 and declination - and the subject was instructed to give a subjective report of the visual display.

DESCRIPTION OF EQUIPMENT:

Stereoscope: The Multi-Stereo test instrument was the Visual Survey Telebinocular, model #46B. It is made by the Keystone View Company, Meadville, Pennsylvania.

American Optical Space Eikonometer: "The instrument is small and compact; it occupies a table space of only 7 x 10 inches; figure 30 shows a photograph of it:

> The Eikonometer provides for the measurement of three quantities:
>
> 1. The horizontal (x90) image size difference.
> 2. The vertical (x80) image size difference.
> 3. The declination error in degree, that is, the difference between the apparent angular deviation of the vertical line for each eye. A declination error exists when there are meridional image differences in oblique meridians.

The eikonic target (figure 31) consists of Kodachrome transparencies, one for each eye, so designed as to give rise to three-dimensional impression of five vertical lines and an oblique cross in space. Projection lenses of about +6.00 D. power are used to project the image of the test target to a distance of about 10 feet from the eye.

The magnification unit (figure 32) before the right eye is the x90 unit, that is, it controls the magnification in the horizontal meridian. The variable unit before the left eye is the x180 unit; it controls the magnification in the vertical meridian. The declination unit consists of a matched pair of meridional size lenses, one before each eye, so mounted that they can be rotated by equal but opposite amounts. With these lenses the declination error is measured by introducing an equal declination in the

opposite direction, without introducing any size difference in the horizontal or vertical meridian."[4]

Lenses: The Fresnel prisms were applied to biconcave plastic trial lenses of -1.00 D., -2.00 D., and -3.00 D. all with a center thickness of 2.0 mm.

RESULTS

Visual Acuity

The loss of visual acuity was found to be consistant with the findings of Flom, Weymouth, and Kahnerman.[5] Each subject showed an average decriment of about one line of acuity letters.

Table II:

Group I	P1	6$^{\Delta}$ BR	6$^{\Delta}$ BD
M. T.	20/15 20/15	20/20^{-2} 20/20^{-2}	20/20^{-2} 20/20^{-2}
H. D.	20/15 20/15	20/20 20/20	20/20 20/20
R. W.	20/15 20/15	20/20 20/20	20/20 20/20
Group II	**P1**	**6 BL**	**6 BD**
K. A.	20/10 20/10	20/20 20/20	20/20 20/20
M. R.	20/15 20/15	20/25 20/20	20/25 20/20
J. F.	20/15 20/15	20/25 20/20	20/20 20/20
Group III	**P1**	**6 BR**	**6 BU**
B. G.	20/15 20/15	20/20 20/20	20/20 20/20
L. F.	20/15 20/25	20/20 20/30	20/15 20/25
K. H.	20/15 20/15	20/20 20/20	20/20 20/20
Group IV	**P1**	**6 BL**	**6 BU**
G. H.	20/15 20/15	20/20 20/20	20/20 20/20
R. P.	20/15 20/15	20/20 20/20	20/20 20/20
J. P.	20/20 20/20	20/25 20/25	20/25 20/25

Chart II shows the change of visual acuity with the introduction of the Fresnel prisms of various magnitudes and directions.

Multi-Stereo

The data was first analyzed, for the Multi-Stereo test, by disregarding magnitudes of change and sorted on the basis of same (S), lowered (L) and higher (H) stereoacuity. Table III shows the results of this analysis. In comparison of the two plano control lenses on the pre-test and post-test conditions a possible practice effect from the continued exposure of the stereo cards was demonstrated. Six subjects maintained a constant response, five subjects showed an increase in stereoacuity while one decreased in his stereoacuity performance.

Comparing the six (6) prism diopters of vertical prism (BD and BU settings) with the plano lense controls, we found with the first plano control that three scored the same stereoacuity, eight showed a loss of stereoacuity and one demonstrated an improvement. Comparing with the second plano control, four mainatined the same stereoacuity, seven declined in stereoacuity and one showed an improvement. On the BL and BR prism settings combined with the first spheres, four remained the same, seven decreased and one improved in stereoacuity. The second plano control with BL and BR prism, two remained constant, eight demonstrated a loss and one improved in stereoacuity. Table III results of stereoacuity with each lense-prism combinations.

Table III:

	Plano [1] 6△BU&BD	6△BL&BR	6△BO= -1.00	12△BO= -2.00	18△BO= -3.00
S	3	4	1	0	1
L	8	7	10	10	10
H	1	1	1	2	1
	Plano[2]				
S	4	2	1	1	0
L	7	8	10	11	12
H	1	1	0	0	0

Key:

S - Same stereoacuity (no change)
L - Lowered stereoacuity
H - Higher stereoacuity

Table IV of Histograms demonstrate the changes in findings as a function of increase in prism power. One must note the definite trend of scores moving to the left, which is the decrease in stereoacuity. Compared to the two plano control histograms and an average control histogram (plano[1] and plano[2]/2), a definite pattern shifted toward the left indicating reduced stereoacuity is decernable.

To quantify the exact amount of loss in stereoacuity, both a mean and median were calculated for each lense-prism test setting. The plano lens conditions before and after the prism sequence were averaged to establish a change to show the percentage difference. The calculations for stereoacuity loss: plano[1] & plano[2]/2 - stereoacuity (score/lense-prism setting) = stereoacuity loss. The mean and median loss in stereoacuity are shown in Table V. Table V again depicts the continued loss of stereoacuity throughout the entire sequence of testing.

Table IV

Distribution of stereoacuity scores for each condition. The score is shown on the horizontal axis and frequency is on the vertical axis.

Table V:

	6Δ BD/BU	6Δ BL/BR	6Δ BO=-1.00	12Δ BO=-2.00	18Δ BO=-3.00
Range	0-40%	0-45%	0-45%	0-50%	0-55%
Median	5%	5%	12.5%	15%	22.5%
Mean	8%	10%	12.9%	16.6%	25.8%

Table V shows the range, mean and median loss of stereoacuity as measured with the Multi-Stereo test using the manufacturer's scoring percentages.

Space Eikonometer:

The two plano control lens conditions (conditions 1 and 7 of Table 1) were first compared to see if a possible practice effect was apparent. Inspection of Table VI indicates that the x180 and declination were affected by the intervening response to the prisms.

Table VI:

	x90	x180	Declination
S	5	1	2
I	3	4	1
D	4	7	9

Table VI shows frequency of improvement or disruption of stereofield.

Analysis of axis 180 and declination change seems to indicate some type of short term disruption after the test lenses were introduced to the subjects.

Analysis of the effects of the test prism-lens combinations were quantitatively scored on the basis of a simple Same (S), reduced aniseikonia (I), and degraded or increased aniseikonia (D). Table VII indicates a definite disruption or general worsen of performance of the subjects when the test lenses were introduced in the test sequence.

Table VII:

Average $\frac{P_1 + P_2}{2}$ x90:

	6^{Δ} BV	6^{Δ} BL	6^{Δ} BV= -1.00	12^{Δ} BV= -2.00	18^{Δ} = -3.00
S	1		2		
I		3	1	1	1
D	11	9	9	11	11

Average $\frac{P_1 \ TP_2}{2}$ x180:

	6^{Δ} BV	6^{Δ} BL	6^{Δ} Bv= -1.00	12^{Δ} BV= -2.00	18^{Δ} = -3.00
S			1		3
I	3	2	1		
D	9	10	10	12	9

Average $\frac{P_1 + P_2}{2}$ Declination:

	6^{Δ} BV	6^{Δ} BL	6^{Δ} Bv= -1.00	12^{Δ} BV= -2.00	18^{Δ} = -3.00
S		1			
I	1	2	1	1	1
D	11	9	11	11	11

Table VII KEY:

S = Same
I = Reduced Aniseikonia
D = Degraded Aniseikonia

BV = Base Vertical
BL = Base Lateral

A quantification of the amount of loss in performance as a function of the different prism powers was found to be very difficult with the current experimental data. Since the Eikonometer deals in both minification and magnification, we plotted out in histogram form the change of each subject. No consistent pattern of change between subjects for the several lenses was found. A constant pattern for some individual subjects was found. Dispersion of the data from zero, or the original mean setting, was clearly present.

Discussion of Results:

The data clearly indicates that stereoscopic responses were degraded by the prism lens combinations used. Such degrading may have important consequences relative to prescribing Fresnel prisms in strabismus and other ocular dysfunctions.

Even though usual clinical care was used in insertion and removing, the several lenses in the trial frame, the dispersion of the data suggests that small rotational errors of the prisms may have occured. This is suspected because several subjects discussed a proximal and distal curved distortion of the "X" in the Space Eikonometer. Other physical variables may have contributed as well. These additional variables would indicate inadequate control of lens to instrument distance, trial case lens thickness, degree of adhearance of the prism to the glass surface, distortion of the plastic prism in mounting and similar variables.

The data clearly indicates that much more rigorous experimental control needs to be used before we can explain the degrading of stereo performance.

In addition to more rigorous experimental design in future studies, we suggest the following experiments need undertaken:

1. Determine whether significant adaptation of stereo performance would occur as a function of wearing various Fresnel prisms.

2. A comparative study of glass ophthalmic prisms and Fresnel prisms would be of practical clinical significance.

3. Effects of reduced visual acuity in magnitudes equivalent to the effects of Fresnel prisms should be studied by "fogging lenses", luminance and contrast variations and similar methods of degrading the proximinal stimulus.

4. Induced effects from mounting lenses on the toric surface of conventional lenses.

SUMMARY

Stereoscopic measurements were measured using the Multi-Stereo test and the Space Eikonometer with and without various magnitudes of Fresnel Press-On plastic prisms. Decrements in stereoscopic performance were generally observed under all conditions. The magnitude and direction of the induced effects are not readily explained by the present data.

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3. Borish, Irving M. Clinical Refraction The Professional Press, Inc. 1970, p. 1086.

4. Bannon, Robert E. Clinical Manual on Aniseikonia, American Optical Instrument Division, 1954. p. 14-15.

APPENDIX

APPENDIX

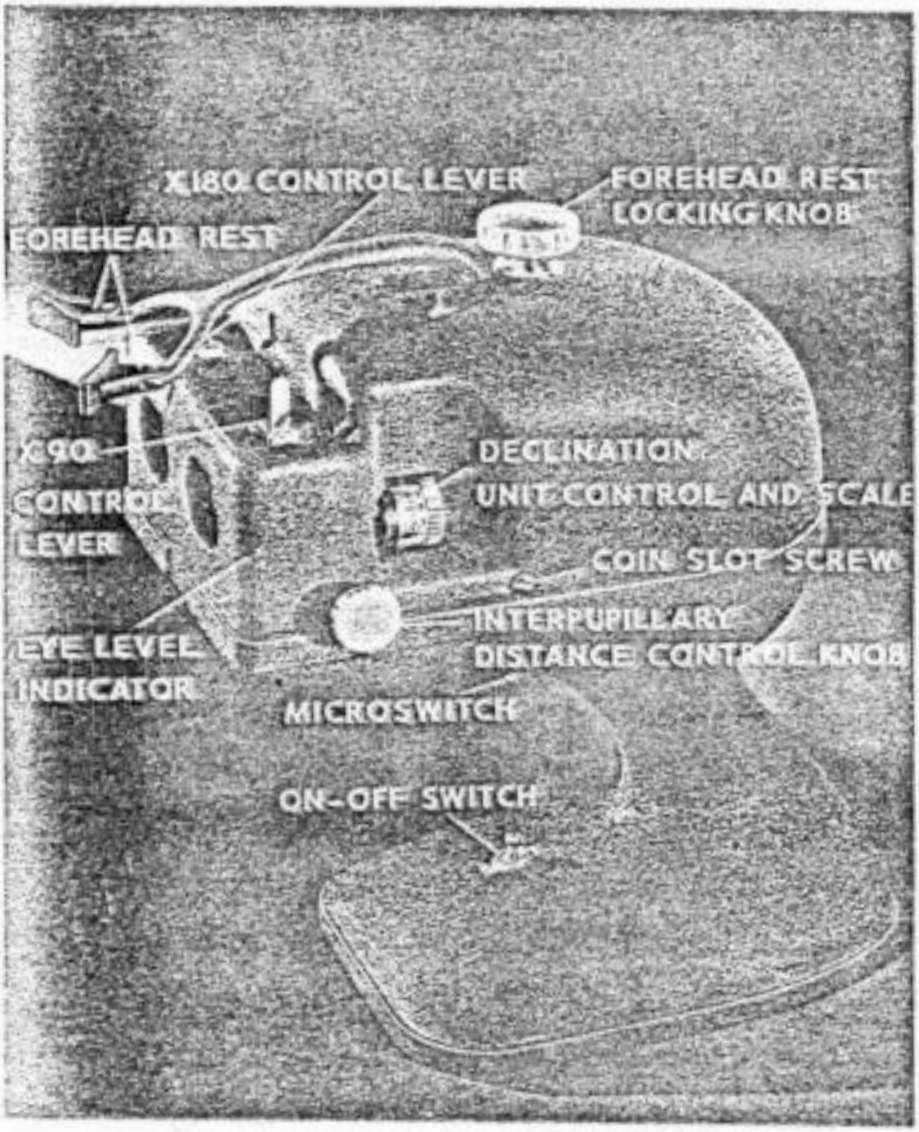

FIG. 10: OFFICE MODEL SPACE EIKONOMETER

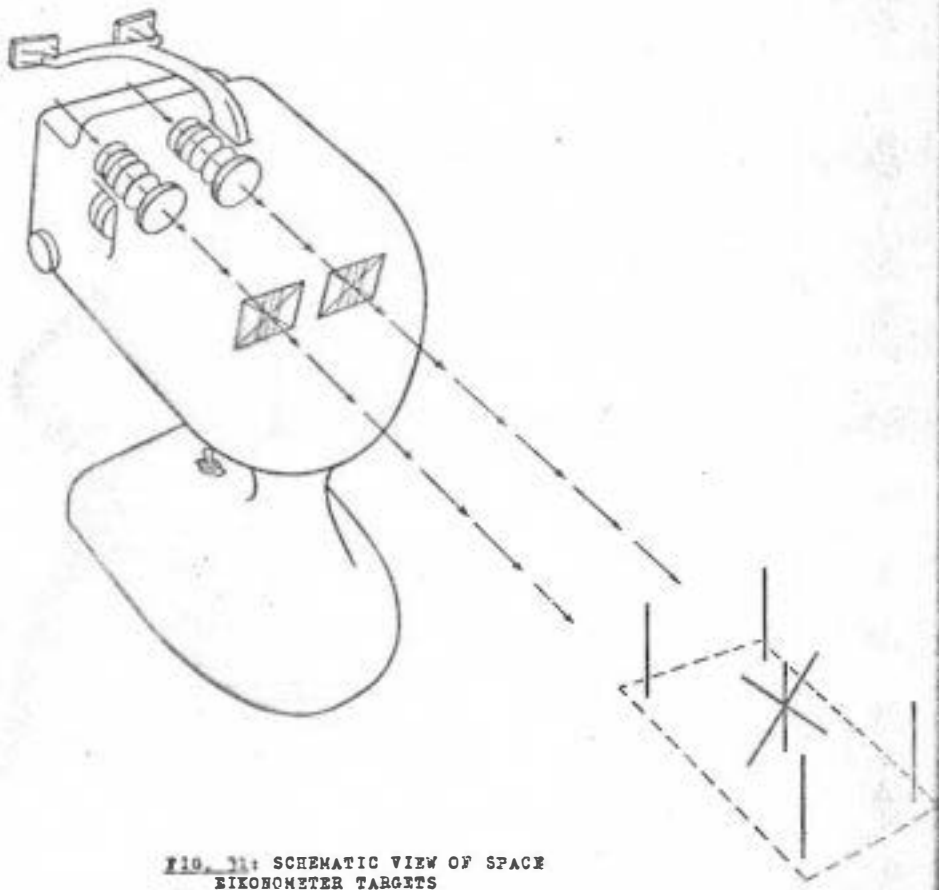

FIG. 31: SCHEMATIC VIEW OF SPACE EIKONOMETER TARGETS

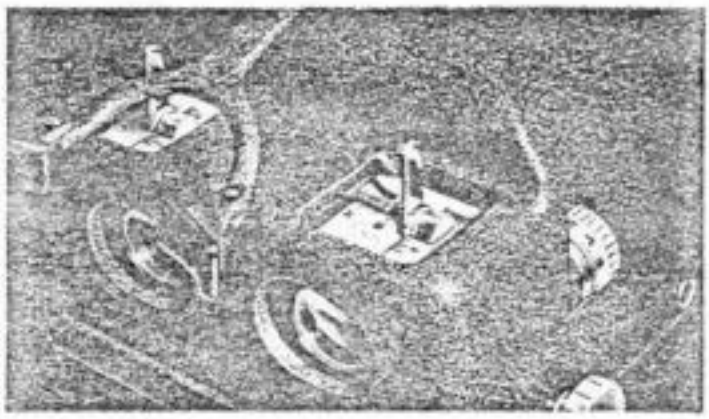

FIG. 32: OPTICAL UNITS OF OFFICE MODEL SPACE EIKONOMETER

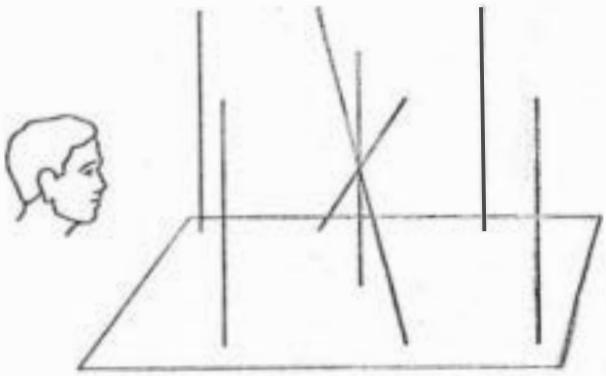

FIG. 33: SPACE EIKONOMETER TARGET WITH HORIZONTAL (AXIS 90) SIZE DIFFERENCE

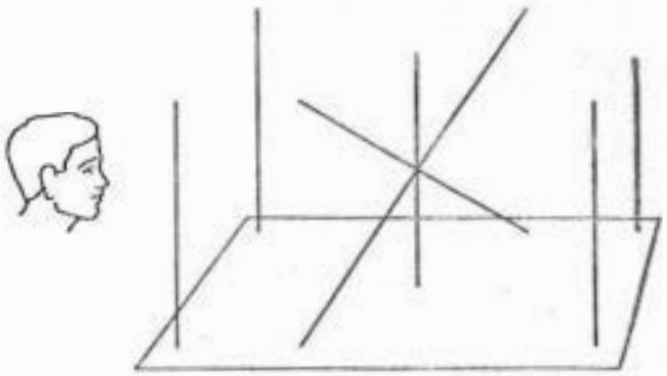

FIG. 34: SPACE EIKONOMETER TARGET WITH VERTICAL (AXIS 180) SIZE DIFFERENCE

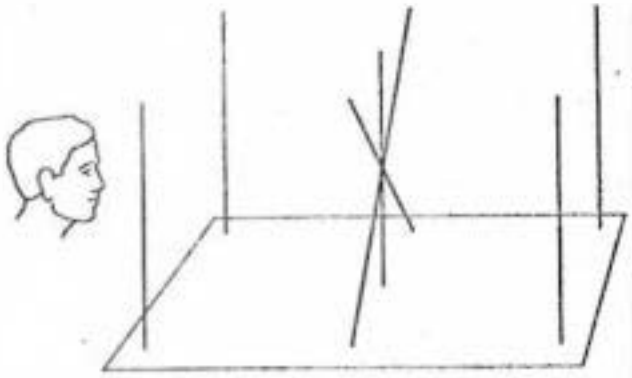

FIG. 36: SPACE EIKONOMETER TARGET WITH NO SIZE REFERENCE

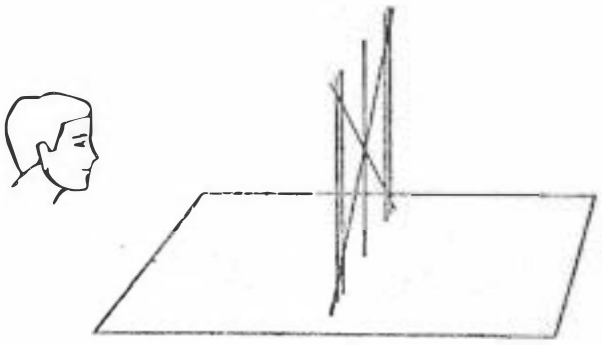

FIG. 37: NO STEREOPSIS

NAME MT AGE 25 SEX M

PL

6°R 6°BD

V.A. OD 20/15 20/20⁻¹ 20/20⁻²

OS 20/15 20/20⁻² 20/20

pl	6°BR	6°BD	6=-1.00	12=-2.00	18=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100
			Space Ikonometry			
X90	.50B	3.5B LEFT CLOSER	.50B EVEN	1.5B LEFT CLOSER	1.25B EVEN	3.25B LEFT CLOSER	.50B
X180	.25B	1.75B LEFT CLOSER	1.25B EVEN	1.75B EVEN	.50B RIGHT CLOSER	2.25R LEFT CLOSER	0
Declin-ation	.1B	.8B BOTTOM CLOSER	1.25B TOP CLOSER	.5B BOTTOM CLOSER	.8B BOTTOM CLOSER	.9B BOTTOM CLOSER	.4B

NAME H.D. AGE 25 SEX M

PL

		6△BO	6△BR
V.A.	OD 20/25	20/20	20/20
	OS 20/15	20/20	20/20

pl	6△BO	6△BR	6△=-1.00	12△=-2.00	18△=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100
			Space Ekonometry			
X90	1.0 B	1.0 R RIGHT CLOSER	.5B EVEN	1.0 R RIGHT CLOSER	2.0 R RIGHT CLOSER	3.0 R RIGHT CLOSER	1.5 R
X180	1.0 B	1.0 B EVEN	0 EVEN	.25 B EVEN	1.5 B LEFT CLOSER	1.0 B EVEN	1.0 B
Declin-ation	0 .5B	.5 B BOTTOM CLOSER	0 EVEN	1.4 R TOP CLOSER	1.4 B BOTTOM CLOSER	1.0 B BOTTOM CLOSER	1.25 B

NAME R. W. AGE 29 SEX M

		6'BR	6'BD	6'BD
V.A.	OD	20/15	20/20	20/20
	OS	20/25	20/20	20/20

pl	6'BR	6'BD	6'=-1.00	12'=-2.00	18'=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100

(92.5)

Space Eikonometry

X90	0	1.5B LEFT CLOSER	2.5B LEFT CLOSER	1.0R EVEN	1.5R RIGHT CLOSER	12.5R EVEN	2.0B
X180	1.5B	5.0R LEFT CLOSER	1.0R EVEN	1.5R LEFT CLOSER	1.5R LEFT CLOSER	2.5R LEFT CLOSER	2.0B
Declin-ation	.4B	1.0B BOTTOM CLOSER	1.0B BOTTOM CLOSER	.8B EVEN	.3B EVEN	.9B BOTTOM CLOSER	1.1B

NAME K A AGE 21 SEX M

PL

V.A.		6°BD	6°BL
	OD	20/20	20/20
	OS	20/20	20/20

pl	6°BD	6°BL	6°=-1.00	12°=-2.00	18°=-3.00	pl
			Multi-Stereo			
S1						
1-2	2 45	2 45	2 45	2 45	2 45	2 45
2-3	3 50	3 50	3 50	3 50	3 50	3 50
3-4	3 50	3 50	3 50	3 50	3 50	3 50
4-5	5 55	5 55	5 55	5 55	5 55	5 55
5-6	5 55	5 55	5 55	5 55	5 55	5 55
6-7	6 60	6 60	6 60	6 60	6 60	6 60
7-8	8 60	8 60	8 60	8 60	8 60	8 60
8-9	9 65	9 65	9 65	9 65	9 65	9 65
9-10	9 70	9 70	9 70	9 70	9 70	9 70
10-11	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2	2 75	2 75	2 75	2 75	2 75	2 75
2-3	3 80	3 80	3 80	3 80	3 80	3 80
3-4	3 80	3 80	3 80	3 80	3 80	3 80
4-5	4 85	4 85	4 85	4 85	4 85	4 85
5-6	6 85	6 85	6 85	6 85	6 85	6 85
6-7	6 90	6 90	6 90	6 90	6 90	6 90
7-8	8 90	8 90	8 90	8 90	8 90	8 90
8-9	9 95	9 95	9 95	9 95	9 95	9 95
9-10	9 95	9 95	9 95	9 95	9 95	9 95
10-11	10 100	10 100	10 100	10 100	10 100	10 100
			Space Ekonometry			
X90	.5B .25B	3.5B LEFT CLOSER	2.0R RIGHT CLOSER	.75R EVEN	3.25R RIGHT CLOSER	1.75R RIGHT CLOSER	0
X180	.5B .00	2.5B RIGHT CLOSER	1.5B RIGHT CLOSER	2.0B RIGHT CLOSER	3.5B RIGHT CLOSER	1.0B EVEN	1.75B
Declin-ation	.2B .0B	1.1B EVEN	1.1R EVEN	1.2R EVEN	1.3B EVEN	1.1B TOP CLOSER	1.0B

NAME M R AGE 24 SEX M

	PL	6^BD	6^BI
V.A. OD	20/15	20/25	20/25
V.A. OS	20/15	20/20	20/20

pl	6^BD	6^BI	6=-1.00	12=-2.00	18=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100

92.5

Space Ikonometry

X90	0	2.75R RIGHT CLOSER	2.5R RIGHT CLOSER	1.5R EVEN	1.75R EVEN	2.0R EVEN	0
X180	1.5B	2.5B EVEN	3.0B LEFT CLOSER	2.25B EVEN	2.0B EVEN	2.5B EVEN	1.25B
Declination	1.5B	.7B TOP CLOSER	.8R EVEN	.7B EVEN	.6B EVEN	.5R EVEN	.6B

NAME V. F AGE 32 SEX M

	PL	6^BD	6^BI
V.A. OD	20/15	20/20	20/25
V.A. OS	20/15	20/20	20/20

pl	6^BD	6^BI	6△=-1.00	12△=-2.00	18△=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55.	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-109 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 1170	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-909 95	9 95	9 95	9 95	9 95	9 95	9 95
9-109 95	9 95	9 95	9 95	9 95	9 95	9 95
10-1110100	10 100	10 100	10 100	10 100	10 100	10 100
			Space Eikonometry			
X90	0	3R RIGHT CLOSER.	2R RIGHT CLOSER	0 EVEN	1,5R EVEN	1,5R EVEN	0
X180	1.75B 1.5B	2,75B EVEN	3.5B LEFT CLOSER	2.0B EVEN	2,0B EVEN	2.25R EVEN	1.25B
Declin-ation	.4B	.7B TOP CLOSER	.6R ABOUT SAME	.5B EVEN	.5B EVEN	.5R BOTTOM CLOSER	.3B

NAME B.C. AGE 22 SEX M

	FL	6°BU	6°BR
V.A. OD	20/15	20/20	20/20
V.A. OS	20/15	20/20	20/20

Multi-Stereo

pl	6°BU	6°BR	6°=-1.00	12°=-2.00	18°=-3.00	pl
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100

(95)

Space Eikonometry

X90	1.0 B	3.0R RIGHT CLOSER	0 EVEN	3.0 B LEFT CLOSER	3.0 B LEFT CLOSER	2.0 B LEFT CLOSER	2.0 B
X180	0	4.5R LEFT CLOSER	1.0 B RIGHT CLOSER	1.25R EVEN	2.5 B RIGHT CLOSER	3.5 R LEFT CLOSER	1.5 B
Declination	1 R	1.0 R EVEN	1.0 R EVEN	1.5 B EVEN	1.4 R EVEN	1.4 R EVEN	1.2 R

NAME I. F. AGE 28 SEX M

	PL	6°BO	6°BR
V.A. OD	20/15	20/15	20/20
V.A. OS	20/25	20/25	20/30

Multi-Stereo

pl	6°BO	6°BR	6°=-1.00	12°=-2.00	18°=-3.00	pl
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-109 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 1170	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-909 95	9 95	9 95	9 95	9 95	9 95	9 95
9-109 95	9 95	9 95	9 95	9 95	9 95	9 95
10-1110100	10 100	10 100	10 100	10 100	10 100	10 100

Space Eikonometry

X90	1.0 B .75	1.5 R RIGHT CLOSER	.5 R LEFT CLOSER	0 EVEN	2.5 R LEFT CLOSER	4.0 R LEFT CLOSER	2.5 R
X180	1.0 B 1.75	1.5 R LEFT CLOSER	2.0 B RIGHT CLOSER	2.0 B RIGHT CLOSER	2.5 B LEFT CLOSER	3.0 B LEFT CLOSER	2.5 B
Declination	0	.9 B EVEN	1.5 B TOP CLOSER	1.5 B TOP CLOSER	1.5 B TOP CLOSER	1.5 B TOP CLOSER	1.5 B

NAME K.H. AGE 22 SEX M

	PL	6°BU	6°BR
V.A. OD	20/15	20/20	20/20
V.A. OS	20/15	20/20	20/20

Multi-Stereo

pl	6°BU	6°BR	6°=-1.00	12°=-2.00	18°=-3.00	pl
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 100	10 100	10 100	10 100	10 100	10 100	10 100

Space Eikonometry

X90	0	4.0 R LEFT CLOSER	2.5 B RIGHT CLOSER	2.0 R LEFT CLOSER	2.0 R LEFT CLOSER	1.25 R EVEN	0
X180	0 .15 B	4.0 R RIGHT CLOSER	2.0 B LEFT CLOSER	2.0 B LEFT CLOSER	3.0 B LEFT CLOSER	2.0 R RIGHT CLOSER	1.5 B
Declin-ation	1.2 B .3	.7 B EVEN	1.4 R BOTTOM CLOSER	1.0 B EVEN	1.5 R BOTTOM CLOSER	1.0 B EVEN	1.5 R

NAME G H AGE 24 SEX M

	RL	6^ BO	6^ BL
V.A. OD	20/15	20/20	20/20
V.A. OS	20/15	20/20	20/20

Multi-Stereo

pl	6^ BO	6^ BL	6= -1.00	12= -2.00	18= -3.00	pl
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100

Space Ikonometry

X90	.5 B	.5 B LEFT CLOSER	0 EVEN	.5 B LEFT CLOSER	.75 B EVEN	1.0 B LEFT CLOSER	.25 B
X180	.25 B	.25 B LEFT CLOSER	.25 B EVEN	.25 B EVEN	.25 B EVEN	0 EVEN	0
Declination	.1 B	.4 B EVEN	.2 B EVEN	.3 B TOP CLOSER	.3 B TOP CLOSER	.1 B TOP CLOSER	.3 B

NAME R.P AGE 27 SEX M

PL 6△BI 6△BU 6△BU

V.A. OD 20/15 20/20 20/20

OS 20/15? ? 20/20 20/20

pl	6△BI	6△BU	6▭=-1.00 Multi-Stereo	12△=-2.00	18△=-3.00	pl.
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100

Space Ikonometry

X90	0 .75R	1.0R RIGHT CLOSER	1.5R RIGHT CLOSER	1.5B LEFT CLOSER	1.5R EVEN	3.0R RIGHT CLOSER	1.5R
X180	1.0B	1.5B EVEN	1.0B LEFT CLOSER	3.0B LEFT CLOSER	3.0B LEFT CLOSER	2.0B LEFT CLOSER	1.5B
Declin -ation	0	1.5B EVEN	.5R EVEN	1.0B TOP CLOSER	1.5B TOP CLOSER	1.4B TOP CLOSER	.1B

(90)

NAME JA AGE 26 SEX M

	PL	6°BO	6°BI
V.A. OD	20/20	20/20	20/25
V.A. OS	20/20	20/25	20/25

pl	6°BO	6°BI	6°=-1.00	12°=-2.00	18°=-3.00	pl
			Multi-Stereo			
S1						
1-2 2 45	2 45	2 45	2 45	2 45	2 45	2 45
2-3 3 50	3 50	3 50	3 50	3 50	3 50	3 50
3-4 3 50	3 50	3 50	3 50	3 50	3 50	3 50
4-5 5 55	5 55	5 55	5 55	5 55	5 55	5 55
5-6 5 55	5 55	5 55	5 55	5 55	5 55	5 55
6-7 6 60	6 60	6 60	6 60	6 60	6 60	6 60
7-8 8 60	8 60	8 60	8 60	8 60	8 60	8 60
8-9 9 65	9 65	9 65	9 65	9 65	9 65	9 65
9-10 9 70	9 70	9 70	9 70	9 70	9 70	9 70
10-11 11 70	11 70	11 70	11 70	11 70	11 70	11 70
S2						
1-2 2 75	2 75	2 75	2 75	2 75	2 75	2 75
2-3 3 80	3 80	3 80	3 80	3 80	3 80	3 80
3-4 3 80	3 80	3 80	3 80	3 80	3 80	3 80
4-5 4 85	4 85	4 85	4 85	4 85	4 85	4 85
5-6 6 85	6 85	6 85	6 85	6 85	6 85	6 85
6-7 6 90	6 90	6 90	6 90	6 90	6 90	6 90
7-8 8 90	8 90	8 90	8 90	8 90	8 90	8 90
8-9 9 95	9 95	9 95	9 95	9 95	9 95	9 95
9-10 9 95	9 95	9 95	9 95	9 95	9 95	9 95
10-11 10 100	10 100	10 100	10 100	10 100	10 100	10 100
			Space Eikonometry			
X90	0	1.0R RIGHT CLOSER	1.5R RIGHT CLOSER	1.75B LEFT CLOSER	1BR EVEN	1.5R RIGHT CLOSER	0
X180	.25B	.75R EVEN	.5B EVEN	3.0B LEFT CLOSER	2.75B LEFT CLOSER	2.5oB LEFT CLOSER	.5R
Declin -ation	0	.3R EVEN	.4B EVEN	1.5B TOP CLOSER	1.5A TOP CLOSER	1.3B TOP CLOSER	.2B