Brock Technique of Strabismus Training

INSTRUCTION MANUAL

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THE RATIONALE OF ORTHOPTIC TRAINING

1. Normal binocular vision develops in the child according to a definite pattern. (Gesell)
2. The natural (phylogenetic) order of development is from the undifferentiated to the particular, as from an indeterminate peripheral awareness of "something out there" to precise central fixation and resolution; from a vague. "Whereness" to discernment of depth differences of less than 1/4 inch at 20 feet (2 seconds of arc). That is, the order of the growth and refinement of the visual skills proceeds from the peripheral to the foveal.
3. The surrender of binocular skills proceeds in the reverse order in which they were acquired: first the foveal, last the peripheral.
4. In STRABISMUS the normal binocular skills have been lost and in many instances even basic binocular vision (normal correspondence) has been abandoned; reversions, characterized by constant or alternant or even simultaneous monocular vision, occur.
5. A sound corrective program follows the order of growth of normal binocular vision.

An orthoptic program based on the above classifications will fall into the following categories:

STAGE I. Establishment of normal correspondence.
STAGE II. Restoration of simultaneous perception.
STAGE III. Development of peripheral stereopsis.
STAGE IV. Development of macular stereopsis.

The Color Depth Strabismus Services as conceived by Dr. Brock has been redesigned to eliminate the necessity of projection of the slides. With the use of a light box, such as the Franzblau viewer (catalog #2195), the slides are easily presented to the patient and can be manipulated by the doctor or technician. At a reading distance the patient may work with the slides directly.

The slides themselves are of a size to easily be viewed from 10in. to 20 ft. They are interesting to youngsters, hold their attention, and arouse a desire to achieve.

Color Depth Strabismus Procedures

Dedicated
To the Memory of
Frederick W. Brock

And to his work in Strabismus Technique

DESCRIPTION OF COLOR-DEPTH STRABISMUS SLIDES

Slides

VD-BC-Consists of opposing arrows set perpendicular to each other with a horizontal scale running between them. VD slides are routinely used to find the most favorable viewing distance or favorable target separation. See procedure B Stage II for detailed instruction.

IA- A black rabbit with a carrot (carrot is red, top green). The rabbit is used as a gross central fixation target with rings IB and IC. The red carrot is seen through the green filter and the green top through the red filter. This arrangement provides a check on suppression.

I**B-**Ring, red
Diameter, 6 inch
IC-Ring, green
These rings are especially useful in developing peripheral stereopsis. May be used with following slides and slide combination: IA, 3A, 6BC, 9BC, and 10BC.

2A-Tree, black. Used with 2BC and 5BC as a central fixation target and plane of reference for stereoscopic judgments.

2B-Rabbits left one red, right one green. Show details.

2C-Rabbits left one green, right one red. In silhouette.
A highly effective means of eliciting stereopsis in the examination. Used for developing peripheral stereopsis. Suitable for developing quick and accurate stereo judgment. May be used with 2A, L and ¯ slides.

3A-Red bird and green lamb. Used as a check on suppression with 3BC and 4BC.

3B-Two interlocking rings, upper green, lower red.

3C-Two interlocking rings, upper red, lower green.
Useful in developing both gross and refined stereopsis. Rings may be combined to move in the same or opposite directions. Used with: 3A, 4A,L.

4A-Elephant and cat. Stereoscopic. Much used with 3BC, 4BC, 6BC,9BC, 10BC, as reference points for stereo judgment.

4B-Two dogs, upper green, lower red.

4C-Two dogs, upper red, lower green.
When slides are disparated, dogs move in opposite directions. Excellent for developing range and accuracy of stereopsis. Combine with: 3BC, 4A, 10BC, L.

5B-Green panda, red bear.

5C-Red panda, green bear.
Panda and bear move in opposite directions. Because of subject appeal to small children, especially effective in eliciting stereopsis in young patients. Useful in developing speed and accuracy of perception. Used with: 2A, 3A, 4A, and L.

6B-Red ring, green space ship.

6C-Green ring, red space ship.
Ships and rings move in opposite directions. Combine central and peripheral training. Used with IBC, 4A, and 9A.

8A-Black ring. Diameter, 50mm.
Used with: 9BC, 10BC for paramacular fusion and plane of reference in stereo training.

9A-Black ring. Diameter, 66mm.
Used for peripheral fusion and reference plane with: 3BC, 6BC, 9BC, 10BC.

9B-Red duck.

9C-Green duck.
Three-dimensional effect pronounced. Appealing to small children. Much used for eye-hand coordination training. Used with: IBC, 4A, 8A, 9A.

10B-Red engine.

10C-Green engine.
Boys like to drive an engine. Used with: IBC, 4A, 8A, 9A.

14B-Russian glacier, red.

14C-Russian glacier, green.
The dark, massive bulk and sharp contours of the foreground, silhouetted against the whiteness of the vast glacial fields covering the side of the towering mountain, together with the effect of great distances, enhanced by the "railroad track", produces a training situation having many possibilities. Used with: 2A, L, 14BC.

ÿ - Oblique white lines on red background. Used in suppression training in conjunction with almost any slide combinations desired.

L-Vertical row of black letters. A binocular fixation target. Demands precise bimacular fixation. Afford precise spatial judgments by orienting the individual letters with different objects in the scene. Used with: IBC, 2BC, 3BC, 4BC, 5BC, 14BC.

R-Red (ruby) plastic sheet. Used as a performance check on stereopsis and malingering.

Note: Scale on the small A slides, while used mostly for reference, can be read directly in Diopters at 16 inches.

Values are to be added or subtracted depending on the setting of the two moveables slides that is. Add values if slides are on either side of zero. If they are both on the same side of zero the values should be subtracted.

GENERAL

Where to begin training.

The majority of untrained strabismics can demonstrate peripheral stereopsis. In such cases training should begin with Stage III.

When there is a severe central suppression or alternation, it may be necessary to start with Stage II.

When normal correspondence is lacking, it will be necessary to begin with Stage I.

When to stop training.

When normal correspondence cannot be established. When a plateau is reached, discontinue temporarily. When no further progress seems possible, give extended vacation. When patient (and parents) fail to cooperate, discontinue until such a time as sufficient interest is shown.

STAGE I

String Test for Retinal Correspondence

1. Fit red color filter on right eye, green on the left. Let tester hold one end of a white string (about three feet long) to the bridge of his/her nose. The examiner grasps the other end of the string tautly and holds a small light source, a penlight, ophthalmoscope or retinoscope, against the string.

2. Testee is asked to fixate light and is urged to see two strings (physiological diplopia). When necessary, use sufficient vertical prism to produce diplopia.

3. Testee is to report the color of each string.
If the green string proceeds from the right eye and the red string from the left eye, correspondence is normal. If the red string proceeds from the right eye and the green string from the left eye, correspondence is not normal.

STAGE I

Common Visual Directions

Normal retinal correspondence is prerequisite to the correction of strabismus.

When the right and left images can be perceived as occupying the same place, the eyes are said to have **common visual directions** (Normal Correspondence). When the right and left images cannot be superimposed, although perceived simultaneously, normal retinal correspondence is absent.

The AFTER-IMAGE TEST is the most widely used means of determining correspondence. This test, which is concerned only with correspondence in the central field, is too well known to require description. The LID GLOW Technique described below is probably the most informative test for retinal correspondence. The BROCK COLOR-DEPTH SLIDES also contain much material for investigating and training the sensorial retinal relationship.

LID GLOW TECHNIQUE

1. Let the patient fixate a small black dot placed in the center of a light gray card held by him/her.
2. Flash a small light-retinoscope, ophthalmoscope or pencil flash light-against the closed lid of the deviating eye. Ask him/her where he/she sees the "glow" in relation to the black dot. It will be found to lie on the axis of the turned eye.
3. Instruct him/her to turn his/her head as he/she fixates the dot, until he/she sees the glow around the dot.

Success indicates that correspondence is normal; failure indicates non-correspondence.

Interpretation

Under the condition of the test the response become highly significant of the existing cortical organization of vision.

(a) The glow, experienced through the closed lid, is diffused and consequently is not seen as coming from any specific direction. Hence the report that it lies to the right or to the left of the dot indicates the mental direction assigned to the stimuli receives from the turned eye.
(b) If by turning the head the dot can be brought within the glow, it means that "in principle", at least, the mind retains the kind of relatedness known as fusion or common visual directions.
(c) If on the other hand the glow and the dost seem to evade each other, no matter where he/she turns his/her head, it can be said that the eyes act as independent visual mechanisms. In other words, the eyes do not have common visual directions.

Actually, the individual has developecd two separate visual systems integrated in a kind of "binocular" vision, in that both are used simultaneously and the monocular fields are neatly joined at the midline.

COMPARISION OF VISUAL DIRECTIONS
IN NORMAL CORRESPONDENCE AND PANORAMIC VISION

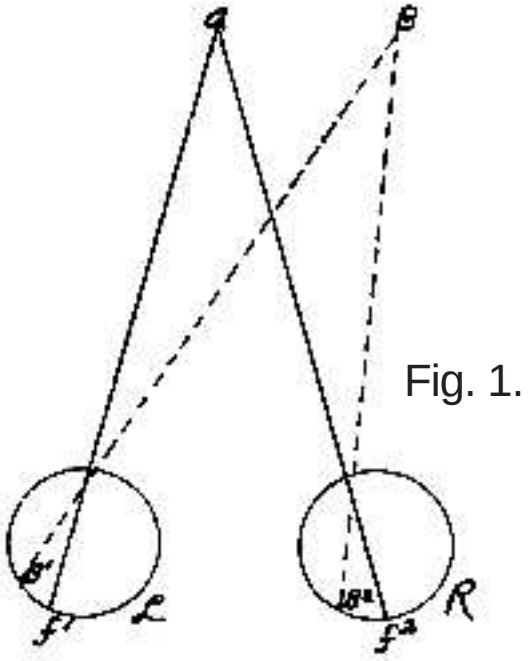

Fig. 1.

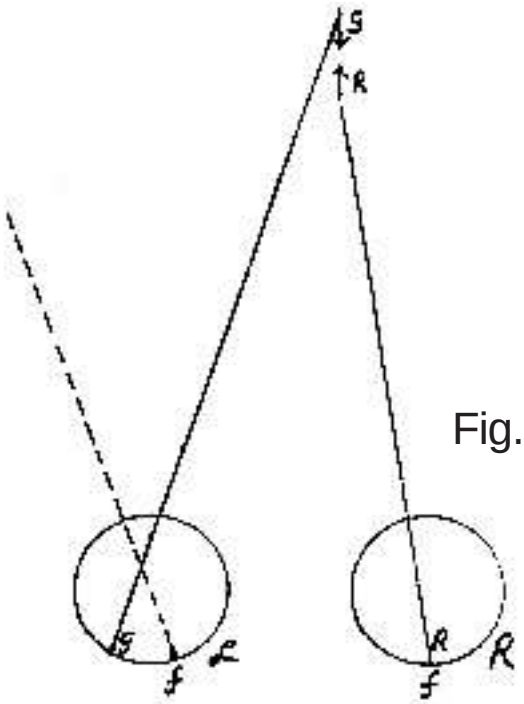

Fig. 2.

Fig. I illustrates how the visual direction of an object not foveally fixated is determined.

A is the binocular fixation object. Hence the images of F-1 and F-2 fall on the respective foveas. Since B is situated to the right of A, B-1 falls on the temporal retina of the left eye and B-2 on the nasal retina of the right eye. In common experience, when the images of B so fall, B will be perceived in the above relation to A, that is, to the right of A.

Fig.2. The VD slide is used to demonstrate the principle involved in Procedures B, Stage I. The green arrow (G) corresponds to the green panda and the red arrow (R) to the red bear. The green filter is before the right eye.

The VD slide is used because the arrows correspond to the diplopic images in the familiar vertical prism dissociation test.

Fig 2 shows the retinal position of the image of the green arrow (G) in the non-fixating exotropic eye. Since the left eye is turned to the left of G the image falls on the temporal retina and in accordance with common experience (see explanation, Fig.1) will be perceived to the right of R. This is known as "crossed" diplopia. As will be readily deduced, the opposite situation obtains in esotropia; here the diplopic images are "uncrossed". **The above explanation is valid only when retinal correspondence is normal.**

If normal correspondence is not present (panoramic vision), the arrow will be seen in vertical alignment or the green arrow somewhat to the left of the red arrow, in exotropia. In **esotropia** the arrows will be in vertical alignment or the green arrow responses are referred to in the literature as "paradoxical" diplopia, i.e. contradictory to those received when correspondence is normal. The analysis is presented in Stage I, Procedures A, Step 3 and the second paragraph on the following page (procedure B).

Applying the above explanation to the panda and the bear (5B), it is obvious that in left exotropia the panda will be seen as to the left of the bear regardless of the actual positions of the two animals, because in common experience anything seen via the left eye must of necessity be in the left field. Needless to say, the same condition obtains in right exotropia. In esotropia the panda will be seen to the **right** of the bear because the field of the left eye lies to the right of that of the right eye.

VIEWING DISTANCE

The viewing distance is usually near the crossing point of the eyes.

To attain binocularity, compensating lenses or prisms are sometimes indicated in early stages of training: plus and/or base out prism in esotropia, minus and/or base in prism in exotropia.

Table below will show crossing point when the angle of squint is known.

Angle in Degrees:	Crossing point in inches:
10	13
20	6.5
25	5
30	4
35	3.5
40	3
45	2.5

STAGE I

Procedure A: Testing and Training

Purpose: To elicit the LUSTER phenomenon.

Note: Color fusion indicates that normal correspondence is not entirely lost.

Instrumentation: Franzblau Projection Box Viewer.

Slides: None

Viewing distance: VD slide will indicate.

Color Filters: Green over dominant eye.

In right esotropia the patient should be instructed to look to the **right** side of the field, **in left esotropia**, to the **left** side.

In exotropias, the above instructions are reversed.

Let trainee cover and uncover, with his/her hand, the eye wearing red filter, and report whether he/she sees any changes in the green color. If the report is negative, let him/her cover and uncover the dominant eye. Covering and uncovering one eye enables the patient, who does not have normal correspondence, to tolerate binocularity for short intervals.

If no fusion of colors has taken place, try:
a. Changing the viewing distance.
b. Rapidly turning viewers light off and on.

Interpretation of unsuccessful response:
1. If the color seen by the non-dominant eye is not perceived when both eyes are uncovered, suppression is probably total.
2. Alternating strabismus is indicated when the colors are seen in rapid sequence. True alternation should not be confused with retinal rivalry. In alternating strabismus, the shifts from one color to the other are abrupt and usually follow each other in fairly quick succession. In retinal rivalry, the changes are gradual-one color receding slowly as the other advances.
3. Normal correspondence is lacking when the field is half red and half green. The "half red and half green" phenomenon indicates that the right and left visual fields are perceived independently, but simultaneously, i.e. vision has become panoramic. When this condition exists, correction of the strabismus by orthoptics will prove exceedingly difficult.

Begin with Procedure B and Lid Glow Technique.

Procedure B

When vision has become panoramic, binocularity may sometimes be aroused by reversing the fields and then showing the subject that his/her visual directions do not correspond with reality.

In panoramic vision, the direction in which each eye sees is independently related to the body position. If, for example, the left eye is exotropic, whatever is perceived via that eye is ipso facto assumed to be located to the left of the midline or to the left of that which is seen via the right eye. Consequently, if a situation is arranged where an object seen by the left eye is placed to the right of that which is seen by the right eye, the subject will still perceives the object belonging to the left eye as being to the left.

Now if he/she places his/her left index finger on the object seen by the left eye and the right index finger on the object seen by the right eye, he/she discover that he/she is locating the "left" object to the right and the "right" object to the left-from the fact that his/her hands have crossed. Since this is contrary to the visually perceived directions of the respective objects, a condition has been created which calls for reorientation.

Testing

1. Place green filter over right eye, with slide 5B on viewer (panda will be to the left). Ask "To which side of the bear do you see the panda, right or left?" pointing, the fingers will locate the objects in direction opposite to where they are perceived visually. He/she discovers the contradiction when he/she finds that the hands crossed in the process. He/she comes to the astounding conclusion that one of the senses has deceived him/her.

2. Remove color filters and let him/her see for him/herself that his/her eyes have played him/her false. Unbelievable as it is, he/she must accept the incontrovertible fact. To him/her that is an intolerable situation, which must be corrected. The first, and most important, step toward restoring normal correspondence has been taken. Success will depend on the determination and persistence of the trainee and the skill of the technician.

The following individuals slides and combination may be utilized as illustrated in the above procedure, to teach the necessary intersensory coordination: 2B or 2C, 4B or 4C, 5B or 5C (the following combination should be disparated to various separations, crossed or uncrossed as the situation demands) 10B-9C, 10C-9B.

Procedure C

1. Illuminate Viewer. Place patient as far from screen as possible but not more than 20ft. Fit color filters.

2. Find the amount of prism required to produce vertical diplopia. Let patient hold prism or prisms.

If normal correspondence is absent, the images will usually be very nearly in vertical alignment, regardless of the angle of squint.

3. Introduce lateral prism (15 diopters or more), in addition to the vertical prism.

If normal correspondence is absent, no amount of lateral prism will cause the images to shift.

4. Let patient walk slowly toward the screen (vertical prism in place) and attempt to bring the images into superimposition.

> If monocularity perception is dominant, the images will shift laterally because of the lack of common visual directions. It should be remembered that the aversion to fusion might not extend to the peripheral areas. Let patient come within 3ft. of the screen (see Table No.2 for angle subtended at different distances).
>
> If even partial superimposition cannot be achieved at close range, the indication is that normal correspondence has been completely abandoned, that vision is panoramic.

Try Procedure D.

Procedure D

Purpose: To attain superimposition of **figure**, seen by one eye, upon **ground**, seen by theother eye.

Illuminate Viewer. Translucent and place ¯ slide (used as "ground").

Slides: Place ¯ (used as "ground") on viewer with any one of the slides listed below (used as "figures"): IC, 6C, 9C, and 10C. (14C is more difficult than the others listed and should be used last).

Viewing Distance: Place the patient close enough so that both lines of gaze fall well within the lighted area.

Color Filters: Red on non-dominant eye.

Instruct patient to attempt to see the figure surrounded by oblique lines.

If he cannot achieve, no matter how close he/she comes to the screen, raise filters and let him/her see that lines surround the figure.

Then let him/her place a pointer on the figure and with the other hand trace the lines all around and across the finger.

As he/she traces, lower filters and urge him/her to continue to see the lines around and over the figure.

Kinesthetic reinforcement is a powerful corrective.

In some instance rapidly turning on and off the viewer light is effective.

The establishment of common visual directions or correspondence requires patience and persistence. Do not continue, however, to the point where patient feels frustrated or has decided that he/she simply cannot do it.

Make the exercise a game.

Change targets (C slides) frequently to maintain interest.

If achievement is slow, make sure that he/she can do the Lid Glow and the Mirror exerices (see Mirror Technique Stage II). What these can be managed readily, Procedure D should not prove very difficult.

IMPORTANT. Sometimes during every training session of STAGE I try for peripheral stereopsis (STAGE III). Patient may pleasantly surprise you by suddenly "remembering" his/her innate stereoscopic ability. What that day comes, you should both celebrate.

STAGE II

Purpose: To establish simultaneous perception (eliminate suppression) when normal retinal correspondence is present.

Normal binocular vision may be present in the peripheral areas when suppression exists centrally. Aversion to fusion is peculiarly a macular phenomenon, which seldom extends to the whole field. This is

shown by the fact that the strabismic will often demonstrate peripheral stereopsis when he/she cannot simultaneously perceive centrally located dissimilar images such as the bird and the cage. It is important to find areas where stereopsis is still present, because the most effective method of eliminating suppression is to extend such fusion areas.

As soon as peripheral stereopsis can be evoked, the exercise under STAGE III should be employed to the fullest extent. **At that point, the exercises under STAGE II become supplementary.** They should be used in conjunction with stereoscopic training whenever they promote simultaneous awareness in areas where stereopsis has not yet been elicited.

Nearly all strabismics with normal correspondence will show peripheral, and often even central, stereopsis under appropriate testing conditions, prior to any training whatever. **Therefore, STAGE II may in many cases be bypassed.**

Mirror Testing Technique

The purpose is to bring about superimposition of right and left images of familiar but dissimilar objects.

The "magic" of seeing one thing with one eye and something else with the other eye and being able to move them around at will, is the kind of game that appeals to the imagination of a small child.

Make the test **fun**.

1) Place the child near a window, at right angle to it, so that the turned eye is on the side of the window. Let him/her hold a small mirror before deviating eye and against the side of his/her nose. Instruct him/her to angle it so that he/she sees the window reflected in it.
2) Let him/her hold a small light (seen only by the dominant eye) in his/her other hand and as he/she looks at the window reflected in the mirror, tell him/her to put the light in the "window". To do this he/she will need to turn the mirror so that it will be at right angles to the axis of the deviating eye.

If he/she has difficulty in seeing the window and the light at the same time, let him/her hold the mirror in front of the dominant eye. Now if he/she keeps the light moving, say in small circles, he/she should be able to see the window and the light at the same time and finally superimposed.

Repeat the above procedure with various objects in the room, advancing from large and undifferentiated objects to smaller objects having clearly defined but dissimilar contours until he/she can superimpose "anything".

Ingenuity is required in carrying out this kind of training. Let the child suggest things he/she would like to put on top of each other. If the game were played outdoors, perhaps he/she would like to put an "automobile" on top of a house. Or catch his/her dog in the mirror and have him/her "fly" over the trees. This can be even be fun for the parent whose privilege it will be to assist with the training at home, once the ability to perform at all has been established.

STAGE II

Procedure A
Use Procedure D, STAGE I. This procedure, which was used to establish normal correspondence, is also equally well suited to the radically different, but simpler, problem of establishing simultaneous perception.

Procedure B
Color filters: Green filter over dominant eye, before slides are inserted.

Slides: Slide 4A with 3A or 3C, 4C, 6C, 9C, 10C, and slide ¯ are used in this procedure.

Finding the viewing distance:
Insert slide VD. Ascertain that both arrows are seen. Ask the patient to approach the screen (or NV) until the arrows are in approximate alignment.

> **In esotropia** when the viewing distance is very short, accommodation may be stimulated sufficiently to reflexly increase the angle of squint. In that case, plus may be added or combined with base out prism, as a temporary measure.
>
> **In exotropia**, where the "crossing point" is behind the patient, it may be necessary to use sufficient minus to stimulate convergence reflexly and/or base in prism.

Place Slides 4A, 4B, ÿ on viewer and ask: "What animals do you see?" "Do you see any lines?" "Where?"

If red-dog or lines are not seen, use pointer or flashing. Let patient trace lines.

Do not continue too long with any combination of slides. Variety adds interest.

Also ask: Which is closer to you, the elephant or the cat?"...the elephant or the upper dog?"

> At every opportunity explore the possibility of eliciting peripheral stereopsis.

Remember, if correspondence is normal and perception simultaneous (not alternating), stereopsis can nearly always be evoked immediately.

Procedure C
Color filters: Red filter on dominant eye, before slide is exposed.

Slides: IA

Viewing distance: Crossing point

i. If he/she cannot see carrot, let him/her use pointer.
ii. When carrot is seen, alter viewing distance, if necessary, to bring carrot top over the carrot.
When the angle of squint is not constant, some fluctuations are to be expected.
iii. Add slide IB. Patient should see carrot and the ring. When successful,
iv. Add IC and disparate slides slightly to bring the ring out in front.
Ask: "Are the rabbit and the ring the same distance from you?"

To stimulate the stereo reflex, move ring in and out with quick, short lateral movements of the slides.

The building of strong peripheral stereopsis is the first order of business in the correction of strabismus, because of this powerful binocular attraction of corresponding peripheral areas. Furthermore, angular extent of Panum's areas in the peripheral allows for much more retinal slip than is permissible at the fovea, without producing diplopia. Consequently, fusion is usually obtained much more easily peripherally than centrally.

EXPERIMENTAL EVIDENCE OF THE INNATENESS OF STEREOSCOPIC VISION

Slides: 1A, 1B, 1C.

1) Observer wears red color filter over right eye, green over the left eye. He/she remains at a constant viewing distance and maintain fixation of the rabbit.
2) a. When the Red ring is disparated to the right of the green ring (crossed disparity) the perceived ring approaches the observer and becomes **progressively smaller**.
b.When the red ring is disparated to the left (uncrossed disparity), the perceived ring recedes and becomes **progressively larger**.

These size changes contradict common experience but are characteristically accepted without question.

Considerations

The size of the projected rings did not change. The observer remained at the same distance from the rings and maintained fixation on the rabbit. Therefore, no changes in the size of the retinal images or the angle of convergence or accommodation occurred.

In common experience, these components undergo greater or lesser changes, when the distance of the object of regard is altered. Since here they remained constant, they could furnish only **contradictory** evidence of changes in localization. Nevertheless, the non-stereoscopic clues are rejected and the stereoscopic clues accepted, without question.

Two questions present themselves:

Why does the phenomenal ring undergo any change in size, when the retinal image has not changed?

Why are the sizes changes contrary to common experience?

The suggested answers point to the innate character of stereoscopic perception.

In common experience we do not consciously interpret retinal image size changes with any degree of accuracy. Nevertheless, when an object is brought closer we, at least, never experience a reduction in perceived size, nor when it is moved farther away, does it seem to get larger. Again, why does everyone who has normal binocular vision accept automatically the contradictory size changes that accompany the three-dimensional ring movements?

Suggested Explanation

The sensation of having the images remain the same size while they move across the retinas as though the object had moved closer or farther away creates a dilemma. The **monocular** evidence of image size indicates that the ring **has not** moved; the **binocular** evidence of **disparity** answers that the ring **has** moved.

This cannot be. The organism can take no effective action until these contradictions are reconciled. The solution? The monocular evidence is brought into agreement with the binocular, assuming that the ring has shrunk or expanded. This decision is un-deliberated and instantaneous. There is no mental debate concerning how an object may be made to shrink or expand, simply by moving it closer or farther away.

The evidence for the primacy of stereoscopic binocular vision could hardly be stronger.

Application

Why all this attention to the innate character of normal binocular vision? Because of the bearing it has on the possibility of restoring binocular vision by orthoptic means.

If normal binocular vision is innate, the problem becomes essentially one of reintegration. The rationale of the orthoptic program will be to evoke and integrate the visual skills that constitute normal human vision.

Purpose: To develop stereoscopic perception in the peripheral field.

Rationale: The extrinsic muscles are fully developed at birth and extreme convergence may be maintained for several seconds at six months. But the foveas are structurally undeveloped at birth; at six months the visual acuity is 20/200 or less and does not reach 20/20 for nearly five years. Since foveal fixation must wait for foveal acuity, it follows that binocular vision develops peripherally several years before precise bifoveal fixation is possible. This may explain why so many young strabismics will demonstrate peripheral stereopsis prior to any training, although they are not capable of putting the bird in the cage.

It seems remarkable that strabismic training has not generally followed the developmental order but has insisted upon forcing the establishment of central bifixation before awakening the more primitive binocular functions, because:

1) Peripheral stereopsis can be induced with comparatively little difficulty in practically all strabismics who do not have panoramic vision, i.e. those who do not see the screen half red and half green.

2) The establishment of peripheral fusion furnished support for precise coordination in the central areas. Burian's experiments showed that even the vertical displacement of the monocular peripheral stimulus was sufficient to break central fusion. How potent must peripheral fusion be in inducing and maintaining central fusion?

3) The early stages of training should be concerned with functions that do not require precise coordination. Fusion is usually obtained with less difficulty in the periphery than at the fovea because the sensitivity to diplopia varies inversely as the size of Panum's area.

BASIC PROCEDURE

Disparate, peripheral targets are combined with central stationary targets that do not require precise bifixation.

The viewing distance used depends to some extent on the angle deviation. As a rule, the viewing distance should not exceed the distance at which the lines of gaze cross (crossing point), i.e. the greater the deviation, the smaller the image.

PRISM EFFECT AT GIVEN DISTANCES WHEN DISPARITY IS 30MM.

I. Equivalent prism effect when given amounts of plus is added binocularly (1.00D is assumed to be equal to 4 prism diopters, on the basis of an average AC/A ratio of 1:4).

II. Total prism effect.

I	II	III
Dist. Prism	**Plus. Prism**	**Total Prism**
40"------3	1.00------4	7
32"------4	1.25------5	9
26"------5	1.50------6	11
20"------6	2.00------8	14
16"------8	2.50------10	18
13"------9	3.00------12	21
10"------12	4.00------16	28
8"--------15	5.00------20	35
6"--------20	6.00------24	44

When image is closer than plane of regard, the effect is base-out. When image is beyond plaen of regard, the effect is base-in.

If more BI stimulation is desired than is available by disparating the slides, add minus. Calculate effect of minus as above.

If patient's AC/A ratio is known, it should be used in calculating prism effect induced by lens.

APPROACH METHOD

Preset targets IBC with 90mm separation

Instruct trainee to (1) black away until he/she can fuse targets, (2) walk forward until he/she experience diplopia, (3) back away to point of recovery, (4) repeat 2 and 3. Every effort should be made to maintain fusion and to recover it. Do not continue to point of visible fatigue or lowered performance.

Viewing Distance	**Prism Diopters**
20'	1.5
16'	1.8
14'5"	2.3
12'	2.5
10'	3
8'	3.5
7'	4
6'	5
5'	6
4'	7
3'5"	8
36"	10
30"	12
24"	15
20"	18
16"	22

The following tables show which areas of the retinas are being stimulated, given the diameter of the target and the viewing distance (VD). The approximate horizontal dimensions of Panum's area are appended to Table No.1.

Table No.1

Ratio diameter to VD	Arc degrees subtended	Panum's arc minutes subtended	
1:1	**54**	**48**	
1:2	**27**	**24**	**Peripheral Stage III**
1:3	**18**	**16**	
1:4	**14**	**12**	
1:5	**11**	**10**	
1:6	**9**	**8**	
1:7	**8**	**7**	
1:8	**7**	**7**	
1:9	**6**	**7**	
1:10	**5**	**6**	
1:14	**4**	**6**	**Macular Stage IV**
1:18	**3**	**6**	
1:27	**2**	**6**	
1:54	**1**	**6**	

Table No.2

Angles subtended by 10" wide light box.

Distance. Inches	Arc degree	
12	**45**	
16	**35**	
18	**31**	
24	**24**	**Peripheral**
30	**19**	
36	**16**	
48	**12**	
60	**10**	
72	**8**	
84	**7**	
96	**6**	
108	**5.3**	

Table No.3
Angle Subtended by
IBC and 9A

Dist. Inches	Arc Degrees	
6	**54**	
8	**36**	
12	**27**	**Peripheral Stage III**
16	**18**	
18	**16**	
24	**12**	
32	**9**	
36	**8**	
40	**7**	
48	**6**	
60	**5**	
72	**4**	**Macular Stage IV**
96	**3**	
144	**2**	

Table No.4
Angle Subtended by 120mm target

Dist. Inches	Arc Degrees	
2	**100**	
3	**76**	
4	**61**	
5	**50**	
6	**58**	**Peripheral Stage III**
7	**37**	
8	**32**	
9	**29**	
10	**27**	
12	**22**	
13	**55**	
15	**18**	
18	**15**	
24	**11**	
36	**7**	
48	**6**	
60	**5**	**Macular Stage IV**
72	**4**	
96	**3**	
144	**2**	

Table No.5
30mm target

Dist. Inches	Arc Degree	
2	33	
3	22	
4	16	
5	13	**Peripheral Stage III**
6	11	
7	9	
8	8	
9	7	
11	6	
13	5	
16	4	
22	3	**Macular Stage IV**
33	2	
36	1	

Table No.6
10mm target

Dist. Inches	Arc Degree	
2	72	
3	52	**Peripheral Stage III**
4	40	
5	32	
6	28	
8	21	
12	14	
24	7	
36	5	**Macular Stage IV**
48	4	
72	2	
120	1.4	

PERFORMANCE TESTS

The orthoptist should be thoroughly familiar with the Performance Tests described below in order that she/he may use the appropriate test in a given situation.

Check on the trainee's performance should be made frequently throughout the entire course of training.

Performance Test No.1:

Let the patient hold the R (Ruby), slide in both hands, just below the line of gaze. While the rings are in motion, let him/her raise the slide and look through the "red window", in reporting which way the ring moves. If he/she reports a change from "in and out" to "sidewise" under repeated test, his/her observations are reliable.

This test should be used frequently during the course of training. Children are anxious to please. They will give you the correct answer, if you give them any hint as to what it is. They soon learn which way the ring should move, from the sidewise movements of the rings. From then on, they may give the correct answer without even seeing binocularly. This is known as "faking".

Performance Test No.2:

Instead of having the patient use the R slide as described above, casually hold the green filter of a pair of spectacles in front of the eye wearing the red filter, or vice versa. If he/she still reports that the ring is moving in and out, he/she is faking.

Performance Test No.3:

Slide 5B & 5C on viewer

Red filter over right eye. Move slides right and left of 0, as patient reports the direction of movement:

a) If Teddy moves from left to right, there is left suppression.
b) If Panda moves from left to right, there is right suppression.
c) If Teddy and Panda move in-and-out, stereopsis is present.

When (c) is reported, let the patient raise and lower the R slide in front of his/her eyes and report what changes occur.

If he/she is seeing binocularly, he/she will report that the in-and-out movement has ceased and that one of the animals is moving sidewise, when he/she looks through the ruby slide.

Immediately when the R slide is lowered, he/she should report the in-and-out movement.

It is important that the respective changes be quickly recognized. The manner in which the report is made is revealing, in regard to the level of integration of the binocular skills achieved at this time.

Performance Test No.4:
Place 9B and 10B on viewer. As you move the slides back and forth, let patient report what happens:

If he/she reports in-and-out movements, he/she is faking. Give him/her a pointer and ask him/her to touch the "nearer" picture. If he/she claims to do so in front of the NV, training will have to be discontinued for the present, for lack of interest.

Before giving him/her a "vacation", try challenging him/her with, "It looks like you can't do it right!" If he/she protests that he/she can, repeat the test. If he/she now achieves, proceed to the next exercise.

Performance Test No.5:
Purpose: To determine accuracy of stereoscopic perception.

1. Before seating patient place slides 8A, 9B & 9C on viewer.
   Disparate slides as follows:
      For PD of 55mm or less: 6mm left of zero or 1 1/2 on scale.
      For PD of more than 55mm: 7mm left of zero or 1 3/4 on scale.
   Cover slides with a card. Fit red filter over right eye of patient.

2. Seat patient within easy reach of viewer and within his/her binocular range. Lift card and ask:
   "Is Duck right in the ring or behind it or in front of it?"
   If the patient seems uncertain or guessing, proceed with caution, watching the patient's reaction carefully.

3. Move slides to the same setting on the opposite side of zero.
   Ask: "What is the Duck doing?"
      Unless he/she sees the Duck moving toward him/herself, stereopsis is lacking.
   "Is he coming straight out at you?"
   The report should be that the Duck is coming out obliquely. Let patient point with his/her finger to indicate the direction of the movement.

4. Let him/her lift 8A slide from the viewer and hold it in both hands. Instruct him/her to hold the ring right around the duck-not in front, not behind. The table below shows the proper distance of ring from viewer at different scale settings:

For PD of 52mm		**Ring at**
Scale Setting:	1.5	1/10 Viewing Distance
	1.75	1/8
	3.25	1/5
	4.25	1/4
For PD of 61mm		**Ring at**
Scale Setting:	1.75	1/10 Viewing Distance
	2.25	1/8
	3.75	1/5
	6	1/4

Interpretations:
If the patient has learned to judge where objects are in space, he/she will readily place the ring at the proper distance.

If he/she uncertain as to where to hold the ring, stereopsis is deficient.

If he/she holds the ring at some distance clearly at variance with the calculated distance, he/she is faking.

5. Disparate slides slowly back and forth. Instruct him/her to keep the Duck centered in the ring. This will show whether he/she recognizes the angle at which the Duck travels.

STAGE III

Procedure A
Make sure that the size of the projected image on the screen is correct for the angle of squint, and that the patient is placed at the proper viewing distance (see Table I). Use VD slide to obtain viewing distance.
1. Place Slide IA on viewer. (Use no color filters in this step.) Ask:
   "What is the rabbit looking at?"
   "What is on top of the carrot?"
2. Fit color filters. Ask:
   "What is the rabbit looking at now?"

   (If the carrot is missing when red filter is on the right eye, the left eye is suppressing; if the top of carrot is missing, the right eye is suppressing. Moving a pointer quickly over the suppressed area is particularly effective in arousing perception. Flashing the viewer light is frequently effective).

   If the top is not directly above the carrot, change viewing distance. It may not be possible to bring the carrot and the top into close alignment because they shift continuously in relation to each other, i.e. the angle of deviation changes. In such cases try to find the midpoint of the shift. Fluctuation in the angle of squint is considered a favorable prognostic sign.

3. While the patient closes his/her eyes, add IB and IC to viewers.

Superimpose the rings exactly.

Disparate rings slowly to right and left of zero by not more than the width of a ring (until edges of red and green rings just touch). Ask:

"What is the ring doing?"
"Which way is it moving?"

When one eye suppresses, the ring will move sidewise. The suppressing eye will be indicated by the disappearance of the carrot or the carrot top. Also, when there is suppression, the lateral movement may be interpreted as being **toward** or **away from** the rabbit (closer to his/her head or tail). To avoid misinterpreting the child's answers, have him/her point in the direction in which he/she sees the ring moving.

It should be remembered that small children often transfer their own identity to an animal, such as the rabbit. Thus, when they say that the ring is moving toward them, they may mean that it is moving toward the rabbit.

"Which is closer to you, the rabbit or the ring?"

In many instances, the ring will not "float" until the child touches the rabbit with his/her finger or a pointer. Enlist eye-hand coordination frequently during the course of the training.
4. If the answers to the above questions are correct, check on reliability, using Performance Test No.2.

Motivation: Do not continue very long at a time with any one procedure or set of slides, particularly if the patient is not achieving.

Rating Performance: In the early stages of training, the child's performance should be rated "Good or Poor" on the basis of the honestly of his/her report of what he/she thinks he/she saw, not on the basis of success.

Every response, whether desirable or undesirable, is of value, because the clues it afford as to his/her powers of observation and reliability. This is especially true in the case of small children.

Procedure B
1) Use slides VD to check viewing distance.
Place slide 2A, 2B and 2C on viewer
2) Disparate slides slightly to each side of zero.

Suggested questions:

"What are the rabbits doing?"..."Are they running past the tree?"..."Which way is the top rabbit going?" (Let him indicated direction by pointing)..."Which rabbit is closer to you?"..."Is the lower rabbit behind or in front of the tree?"..."Which is the Mamma rabbit and which is the Baby rabbit?"

In the early stages of training, some strabismics will report that the rabbit gets bigger as it comes closer, instead of when it goes back. It is best not to make any comment to them about this, at least for time being. Usually they will perceive size changes correctly when binocularity has become well established.

The above, and similar questions should be asked with the slides at various positions.

If the patient has any difficulty getting depth effects, have him/her place pointer against the tree between the rabbits.

3) Repeat steps 1 and 2 with 5B and 5C instead of 2B and 2C.
4) Use Reliability Test No.1 or No.2.

Procedure C
Slides: 3A, 3B, 3C.

1) Use slide VD to check viewing distance
Put 3A and 3B on viewer. Set on zero. Use no color filters in this step.
"Look at the rings, the bird and the bunny, remember where they are, and close your eyes."
2) While the eyes are closed, fit color filters with green over the non-dominant eye.
"Now open your eyes. Are the rings, the bird and the bunny where you remember them"?

If the rings are not seen in approximately the same position as without color filters, change viewing distance accordingly.

Watch for suppression. The bird, bunny and rings should all be seen at the same time.
3) Add 3C to viewer.

Disparate to crossed and uncrossed positions, back and forth, no farther than the width of a ring.

"Are the rings the same?"

Size differences may be seen before the to and fro shift of the rings becomes evident. Perception of size changes is evidence that stereopsis is present.

"Are the rings the same distance from you?" Once the size change is perceived, it should be possible for the patient to recognize the to and fro movements of the rings.
4) When the rings-move to and fro, let the patient report:
a. The directions in which the rings move.
b. When the rings touch each other. (This requires precise depth judgment).
c. Where each ring is, in relation to the bird or to the bunny.
5) As you disparate rings back and forth, instruct him/her to push his/her pointer through whichever ring is nearer to him/her.

The promptness with which he/she recognize when one ring goes behind the viewing surface and the other comes forward, will be seen from the precision with which he/she shifts the pointer from one ring to the other.

NOTE. If he/she insists that he/she can follow a ring when it is behind the screen, he/she is faking. If he/she now also fails on exercises where he/she previously succeeded, discontinue training for the day. Perhaps a short vacation is indicated.

One must continually be on the alert for "fake" responses because most children are anxious to please and will give the correct answer if they can get a clue to what is expected, either from the lateral movements of the targets or from the tone of voice or the manner in which a question is asked. Children are much more observing than we expect them to be. It takes a "smart" technician "outsmart" a smart child!

6) Reverse 3C to bring one red ring directly about the other. This brings the green rings into a similar alignment. The four rings now form a square. If each pair of red and green rings is fused, two rings will appear to float several inches out in front (actually 2/5 of the viewing distance).

Disparate the slides, and let the patient push his/her pointer through the rings to get the feeling of depth. Let him/her follow the rings with his/her fingers as they move nearer to him/her and away from him/her.

Procedure D

Most of the following combinations include four slides:

A	B	C	D	
	8A	1B	IC	
6B	6C	1B	IC	Superimpose the slides in Column A &B exactly, vertically and horizontally. Change combination frequently.
9B	9C	1B	IC	
10B	10C	1B	IC	

The objectives and techniques used with these slide combinations are the same as in Procedures A, B, and C, with the addition of Activity #5 given below:

Activity #5:

1. Let patient extend both hands, palms facing each other, fingers out-stretched, the tips of the middle fingers touching the viewer about one inch away from the edge of the ring at 9 o'clock and 3 o'clock.
2. Disparate rings slighty from 0 on the scale so as to bring the ring out in front, being careful not to cause diplopia or loss of stereopsis. Ask: "Where is the ring?"

Judgments as to whether the ring is closer than, even with, or farther away than the center target should be given as promptly as possible. Hesitant answers indicate guessing.

If he/she does not see the target between his/her hands, return to some previously successful procedure.

"Can you bring your finger tips out even with the ring?"

This is a test of stereo accuracy and therefore of the ring.

3. Disparate slides slowly back and forth. Instruct him/her to follow ring with tip of his/her fingers. Notice particularly how promptly he/she notices when the ring has moved beyond his/her reach, i.e. on or behind the viewer, or when it moves out in front again.

This is also a good reliability test. If he/she is faking, this test should catch him/her.

4. Let him/her hold slide 9A in both hands. Instruct him/her to keep the ring around the moving target.

STAGE IV

Objectives:
1. Develop a high degree of binocular organization in the macular and foveal areas.
2. Develop speed and accuracy of stereopsis perception.
3. Extend the binocular range to all usable distances.
4. Facilitate transfer of acquired skills to everyday seeing.

Habitual use of the binocular skills is of course the ultimate goal. Its realization is one of the most serious problems connected with the effective correction of strabismus. Limitation inherent in the training technique may be a factor. It is not sufficient that the child can perform in the straight-ahead direction. He/she should be able to maintain normal binocular vision in all directions-right, left, up, and down-and under various stimuli conditions. Certainly, the more nearly the conditions under which learning takes place simulate the everyday enviroment, the more positive should the transfer be.

The activities described below are important factors in reaching the present objectives. They should be systematically employed as indicated under the different procedures in STAGE IV.

Activity #1: Increase viewing distance slowly so long as he/she can maintain stereopsis.

Activity #2: Place the patient beyond his/her stereo range, then let him/her walk forward until depth perception is recovered.

NOTE. This method also measures the recovery point of his/her binocular (fusion) range at Far Point. It is an excellent test of progress as well as a significant training procedure.

Activity #3: While the patient closes his/her eyes, change the stereo effect. Then see how quickly and accurately he/she can recover stereopsis.

Activity #4: As the patient maintains stereopsis, let him/her turn head slightly: right, left, up, down, clockwise, counterclockwise.

Response control: During the activity, change the stereo effect and question him/her as to what he/she sees.

Activity #5: Eye-hand coordination, including use of pointers.

The hands and fingers provide a yardstick for determining how far from his/her person the ring is situated.

Eyes and hands must find things in the same place. Only when the eyes learn to perceive things to be where the hands would find them, does stereoscopic perception of space become important to the individual. Only then may he/she extend his/her "grasp" far beyond the length of his/her arms with assurance.

Activity #6: Flash exposure: Blink Viewer light. Particularly effective in increasing speed and accuracy of stereo perception. It is an excellent means of determining reliability. When used for the latter purpose, change the stereo effect between flashes.

Maximum stereo perception requires appreciation of unbelievably small differences in parallactic angles, even of the order of two seconds of arc or less. This means that the individual may recognize disparity differences a small as 1/500 of one millimeter. Appreciation of differences so minute is dependent on highly integrated central binocular vision.

Only when the organism has discovered the advantages of normal binocular vision and has practiced the requisite binocular skills until they are used habitually, may we expect that the strabismic habits will fall into disuse.

DIFFERENTIAL PERFORMANCE TESTS

To be used when desired to check progress.

Place 14B & 14C on viewer-care should be exercised in inserting the slides. If the horizontal bears of the "ladder" are out of line vertically, fusion will be difficult, if not impossible.

Slide 14B slightly left of zero.

1. "Look at the rock with the people on it. Do you see a colored cross on the rock? Is it a good cross?"

This is a leading question designed to catch the faker, who always reports that he/she sees a perfect cross. Only those who have excellent binocular vision will have a perfect cross.

Those for who binocular vision is still difficult will report suppression of one or the other line at times, or partially intersecting lines that shift against each other, or lines that do not intersect, but are close together.

In any case, proceed as follows:

2. Point to the ladder and ask:

"Does that look like a ladder, or like a railroad track?"...
"Can you touch the far end of the track with the tip of your pointer?"

He/she cannot do this, because the far end of the track lies beyond the plane of the screen. If he/she claims that he/she is touching it, he/she is not getting the stereoscopic effect, but may be making an honest monocular response.

3. Test for faking:

Disparate slides so that the ladder is entirely behind the plane of the screen. Say: "Now the ladder is away out in front, isn't it?"

If he agrees, ask him:

"Can you touch the different rungs in the ladder with your pointer?"

If he/she pretends to point to the rungs out in front of the screen, he/she is faking. When the patient is faking, training will have to be discontinued until he/she matures somewhat. In that case, monthly checks should be made to assess changes in attitude.

If his/her answers have been correct up to this point, proceed:

4. Add L slide

Disparate slides to different positions and let trainee report which rung of the ladder the column of letters is aligned with.

If the answers are correct, he/she is ready for training in a stereoscope.

STAGE IV

Procedure A
Place 1A, 1B, and 1C on viewer

Check viewing distance.

Use Activities #1, #2, and #3, especially.

Use Reliability Test #2

Record ratio of diameter of target to viewing distance.

Procedure B
Place 2A, (2B or 5B) on viewer.

1. Continue with Stage III, Procedure B, in conjunction with Activities #1, #4, and #5 in Stage IV.

The effort the child puts forth depends very much on you. Does your voice and manner challenge him/her to do his/her best? Do you make the work a game? Are you and he/she a team?

IMPORTANT: See to it that during each session the child accomplishes something new; that he/she knows that he/she has succeeded. The "success habit" is a potent weapon in the attack upon strabismic seeing.

Record accomplishments.

Procedure C
Basic procedure: To maintain **peripheral fusion** of black ring and develop stereoscopic appreciation in the central field.

Use slide combinations of 9A-9BC, 9A-6BC, and 9A-10BC. Change slides often to maintain interest.

Illustrative procedure:
Place 9A, 9B, and 9C on viewer.

1. Disparate duck behind viewer and ask: "Is the duck **closer** to **you** than the ring, **even with it** or behind it?" If uncertain at first, move duck to a greater distance.
2. Give patient a pointer and instruct him/her to touch the duck's beak as soon as the duck moves out in front of the viewer. This is a test of the accuracy of his/her stereo judgment.
3. Disparate slides slightly to each side of the zero and have him/her continue to point to some designated part of the duck.
4. Bring the duck out in front of the ring and instruct him/her to touch:
The ring at 3 o'clock.
The tip of the upper part of the beak.
The ring at 12 o'clock.
The tip of the lower part of the beak.
The ring at 6 o'clock.
The duck's right eye.
The sureness and promptness with which he/she points indicates how well he/she is organized spatially.
5. Use also Activities #1,2,3,4,6 in conjunction with disparation of slides.

A modification of Procedure C
Remove 9A slide and add 1B and 1C to viewer.

Instead of the peripheral target remaining in the plane of the viewer, it may now be placed at any desired position by disparating 1C. The relative position of the central and peripheral targets may be altered in several ways:

A. Both may be situated in front or behind the viewer, or
B. One in front, the other behind, or
C. One on the viewer, the other in front or behind

Use all the different Activities for lengthening the fusion range, increasing speed and accuracy of stereo perception.

Record performances, especially increases in binocular range and speed of stereo perception.

Procedure E
Place slide L on viewer. Add slide 4A off center so that the elephant's trunk falls between the letters A and S. (This brings the cat to the extreme right of the field.) Add slide 5B and 5C.

View with red filter on right eye.

It will be seen that the above arrangement affords many opportunities for stereo judgments, as between:

The bear and the elephant,
The bear and the letter,
The bear and the panda,
The bear and the cat,
The elephant and the cat,
The different animals and the letters

1. Depth judgments should be made at different disparity settings and with the slides in motion, in conjunction with Activities #1,3,5,6.

These Activities are the specific methods for transferring the acquired skills to everyday use.

Note. Reverse color filters and ask whether the three-dimensional effect of the bear and panda undergoes any change. If not noticed at first, repeat. The technique is an excellent check on stereopsis.

Replace 5BC with 4BC (place elephant to the left.) Repeat above procedure.

Procedure E affords an almost unlimited number of opportunities for the development of normal binocular vision. It should be used again and again.

Procedure F
Place 4A-L-4B and 4C on viewer (L should be midway between dogs)

Red filter over right eye.

1. Let patient report the relative distances of the different animals, to each other and the line of letters.

The promptness and certainty of his/her answers should be noted.

2. Disparate slides slightly to the right and the left of zero, and at each position have patient make depth judgments.
3. At different disparations, use all six Activities, laying stress on increasing viewing distance and quickness of stereo perception.

Procedure G
Place L slide, 14B, and 14C on viewer.

The technician should wear color filters when testing accuracy of patient's stereopsis.

1. Set slides. Ask:

"How many rungs are there in the ladder?"

"Which rung, counting from the back, is the letter S near?"

S will be exactly in the plane where the red and green ladders cross, as seen without color filters.

2. While the slides are disparated slightly to the left and right of zero, let patient make judgments as to the location of the various letters in relation to the rungs of the ladder and persons in the scene. Be careful to avoid producing diplopia of the letters.
3. Let patient observe a designated letter as the slides are disparated to the left of zero. The letter will appear to recede. Have him/her report when the letter touches the ground and what it then seems to do. Do not suggest the answer.

If space judgment is acute, the letter will first move sideways and then double.

He is not likely to notice these effects until binocular vision is well integrated.

AMBLYOPIA

Procedure A
Place 1A on Viewers.

1. Green filter over amblyopic eye. Ask: "What do you see in front to the rabbit?"

If he/she is not certain, let him/her move a pointer over the suppressed area. If this is not effective, occlude the good eye and as he/she moves the pointer in front of the carrot, remove occluder and encourage him/her to continue to see the carrot. When he/she sees the carrot, continue: add 1B, 1C and ÿ on viewer.

2. Set slide 1B 1 scale setting left of zero when the right eye is amblyopic, 1 scale setting right of zero when the left eye is amblyopic.

"What do you see?"

If at first he/she does not see both the rabbit and the oblique lines, cover the eyes in turn and determine whether he/she now sees both. When he/she does:

3. "Can you point to the object which is the farthest from you?"

(The ring is farthest back)

If he/she points to the ring, have him/her close his/her eyes and set slide to the opposite side of zero.

"What object is nearest to you?"

If the answer is incorrect, disparate slides and ask:

"Do you see anything moving?"

If no motion is reported, the amblyopic eye is suppressing. Repeat from the beginning or go to Procedure B.

Procedure B

Place 1A, 1B, and 1C on viewer. Turn off viewer light.

1. Place red filter over amblyopic eye. Give patient a red penlight.

Remove the lens from the penlight (should be type having a recessed lens) and insert small piece of red cellophane. Replace lens.

He/she is to look at the rabbit's head and see the red light behind the head. When he/she achieves, disparate slides slightly back and forth to the right and left of zero and have him/her identify the motion of the ring.

Special attention should be given to the direction of the ring movement. If the ring moves to and fro and also obliquely, the amblyopic eye is functioning. Patient should be encouraged to make every effort to see the ring moving straight away from him/her.

2. At later sessions attempt to extend the viewing distance.

Procedure C

In right amblyopia

Esotropia: Place ÿ slide and 2C on viewer. Lights Off.
Exotropia: Place ÿ slide and 2B on viewer. Lights Off.

In left amblyopia

Esotropia: Place ÿ slide and 2B on viewer. Lights Off.
Exotropia: Place ÿ and 2C on viewer.

1. Patient wears no color filters. Ask:

"Can you place the red light between the rabbits?"

After he/she can do so, ask him/her to remember where the rabbits are, particulary how far apart they are. Now fit color filters, with red over the amblyopic eye. Have him/her continue to point the light.

2. "What do you see?"

If the light and one rabbit are missing, it means that the amblyopic eye is suppressing. If the light and one rabbit are seen, the good eye is suppressing. In either case, try having the patient place a pointer upon missing part.

3. If both rabbits and the reflected light are seen, ask:

"Are the rabbits the same distance apart as before?"

If they appear in a different position, correct the viewing distance.

4. Add remaining No.2 slide. Set slightly to the right or left of zero.

"Do you still see the light between the rabbits?"...

"Are the rabbits the same distance from you?"

If, No:

"Does one rabbit seem bigger than the other?"

With small children this question may be changed to

"Can you tell me which is the daddy bunny and which is the baby bunny?"

If the size difference is correctly reported, good binocularity is indicated. If the size is not recognized, ask him/her to touch the bunny which seems to be out in front. If the child can do so correctly, disparate slides to the opposite side of zero while his/her eyes are closed and repeat question. If again the answer is correct, proceed to Procedure D.

Additional exercise
Place 2A and ÿ slide on viewer, lights off. Place red filter over amblyopic eye. Ascertain whether patient sees two trees, in which case change viewing distance until he/she fuses.

The patient is to point the red penlight in the left top corner of the field and trace the oblique lines, one by one, until he/she reaches the lower right hand corner. Each line should be traced as accurately as possible.

Procedure D
Place 4B, 3B and 3C on viewer.

1. Place B slides slightly to right of zero. Red filter over good eye. Viewing distance: per VD slide.

2. "What do you see"?

If he/she sees two rings but only one dog, he/she is suppressing.

If he/she sees four rings, change viewing distance until fusion is obtained.

3. When he/she sees two rings and two dogs, ask:

"Can you poke your pointer through the upper ring?"...The lower ring?"

If he/she reports that he/she cannot reach the (furthest) ring, have him/her close his/her eyes.

4. Superimpose rings exactly.

"Which ring can you poke the pointer through now?"

If he/she says he/she cannot poke it through either one, the exercise has been successfully completed.

Procedure E
Place 4B, 3B and 3C on viewer.

In right amblyopia reverse 3C so that the red rings are above each other to the right of the green rings.

In left amblyopia reverse 3B so that the red rings are directly above each other to the left of the green rings.

Red filter over amblyopic eye. Viewing distance: per VD slide.

1. "What do you see?"

If he/she sees two rings but only one dog, one eye is suppressing.
Let him/her point in the area of the missing dog.
If he/she sees four rings, alter viewing distance until fusion takes places.

2. "Can you put your pointer through either ring?"

He/she is able to put the pointer through either one or through both at the same time.

3. Disparate rings slightly to the right and left of zero, back and forth. Ask:

"Which ring seems nearer to you?"...
"Which ring seems larger?"...
"Which way do the rings move?"

It is important that the rings should be seen to shrink in size when coming closer and become larger when receding. SEE EXPERIMENTAL EVIDENCE OF THE INNATENESS OF STEREOSCOPIC VISION.

Procedure F

Picture tracing: This exercise is a form of chiroscopic drawing. No fusion stimulus is provided and no depth judgments required. The good eye provides detail vision but direct fixation is demanding of the amblyopic eye.

Selection of slides:

In right amblyopia with esotropia and left amblyopia with exotropia, use only 4B.

In left amblyopia with esotropia and right amblyopia with exotropia, use only 4C.

1. Place patient at VD range and fit red filter over amblyopic eye, viewer off, ask:

"How many dogs do you see?"

If only one dog is seen, let him/her place a pointer in area of missing dog. Short, quick movements of the pointer may be helpful. It does not matter about the relative positions of the dogs, so long as he/she sees both within the lighted field.

2. Let him/her place the red (pen) light half way **between** the dogs, then **on** the dog seen by the good eye and by the poor eye, in that order.

If he cannot place the light on the dog seen by the amblyopic eye, because the light disappears, or he/she finds it impossible to place it directly upon the dog, that is he/she sees it to one side or the other, there is a large suppression area.

If he/she is unable to place the light on the dog, have him/her rotate the light around the dog in smaller and smaller circles until he/she finally succeeds.

3. Next have him/her place the light on various parts of the dog's anatomy: the right eye, the left eye, the right ear, the left ear, the tail. Finally have him/her trace the outline of the dog with the light, taking care that the light just touches the body.

Procedure G
Place ÿ slide 9A, 5B and 5C on viewer.

For right amblyopia. In left amblyopia, reverse 5B so that red teddy is to the left of green panda and reverse 5C so that red panda is to the right of green teddy.

1. Place red filter over amblyopic eye. Set slides at zero. Seat patient at VD range. Ask:

"Do you see the slanting white lines?"

2. When lines are seen, disparate slides slightly to each side of zero. Ask:

"What are the teddy and panda doing?"

When they are reported as moving in and out, particular attention should be given to when they pass the black ring.

Control: Have patient hold ruby (R) slide with both hands. While the teddy and panda are moving in and out, let him/her raise R slide in front of both eyes. Since the ruby slide blanks out the good eye, stereopsis is lost and the animals should appear to move sideways. If he/she still reports that they are moving in and out, he/she is faking.

3. At subsequent sessions let patient lengthen the viewing distance until he/she notices a similar shift, from in and out to sideways. That distance establishes the length of his/her fusion range.

Procedure H
Place slide 6C on viewer, light off.

1. Place patient at the far end of his/her fusion range, as determined in Procedure G. Place red filter over amblyopic eye. Ask:

"When you look at the space ship, do you see a very dim or dark ring?"

If only a dim ring is seen, the amblyopic eye is suppressing. Let him/her move closer until a dark ring appears. If necessary, let him/her trace the outline of the ring.

If he/she sees both the dim ring and the dark ring, let him/her move to the position where they become one or are brought as close together as possible.

2. When he/she see the space ship within, or partly within, the dark ring, let him/her trace the ring with the red penlight while he/she makes every attempt to keep the ship within the ring.

This is an excellent posturing exercise and should be used repeatedly. Let him/her choose the best position for tracing.

3. Remove 6C and insert 6B. Let him/her find the viewing distance where he/she can see the ship within the ring. If he/she complains that the ship fades out when he/she tried to place it in the center of the ring, postpone this step.
4. When successful in Step 3, find furthest distance at which the ship is within the ring. Add 6C. Viewer lights on. Disparate slides to different position off zero and expose by flashing viewer light. Make certain, first that the patient is within his/her stereo range. Slowly increase viewing distance.
5. Also use tracing technique, using red penlight. Use ÿ , see Procedure F. Also slides: 8B, 9B, and 10B.

Training may be continued with Procedures under STAGE III and IV.

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