5

Introduction and General Concepts

This chapter provides detailed information and guidelines for vision therapy, and Chapters 6 to 8 describe a select group of vision therapy procedures for the treatment of vergence, accommodative, and ocular motility disorders. There are hundreds of vision therapy techniques in use by optometrists, and manuals describing a wide variety of instrumentation and procedures are available.[1,2] In our opinion, presentation of a vast array of procedures tends to make vision therapy appear overly complicated. We believe that this may discourage optometrists from becoming involved in vision therapy.

In Chapters 6 to 8, we present a select group of procedures and instruments. Our primary emphasis is on presentation of the principles underlying the vision therapy techniques we have selected. An understanding of this small group of vision therapy procedures will enable an optometrist to successfully treat the vast majority of accommodative, ocular motility, and nonstrabismic binocular vision disorders and achieve success rates consistent with those discussed in the literature.[3-12] In addition, the principles discussed for these vision therapy techniques are common to all procedures. Therefore, an appreciation of the key issues and principles in this chapter will allow the clinician to understand almost any other procedure and will permit growth as the practitioner gains experience and confidence.

It is not unusual for us to hear students and clinicians unfamiliar with vision therapy ask the question, “What do I do with it?” regarding vision therapy equipment. Therefore, one of the primary objectives of the following four chapters is to provide a detailed description of how to actually use the vision therapy equipment described. We have provided a detailed sequence of therapy procedures to perform with the specific instruments described. We are well aware that there are other ways to use this instrumentation, but our goal is to present a starting point for clinicians, who then can expand their utilization of this equipment as they gain experience in the area of vision therapy.

Categorization of Vision Therapy Instrumentation and Procedures

Binocular vision therapy procedures have traditionally been subdivided into two broad categories. The first category, referred to as *instrument training*, includes all techniques in which the patient is required to look directly into an instrument. With instrument training, movement of the patient is restricted, and it may be difficult to see the patient’s eyes. These conditions are generally described as being less natural or more artificial than other forms of therapy. The most common example of instrument training is the use of a stereoscopic-type device.

The second category, called *free space training*, involves techniques in which the patient is in a less restricted environment, more movement is possible, and it is easier to observe the patient’s eyes. This type of vision therapy more closely approximates normal seeing conditions and is considered less artificial than instrument training.

Upon careful analysis of this division, several problems become apparent. The first difficulty is the lack of precise criteria for placing a particular procedure in either category. For example, although the Aperture Rule, illustrated in Figure 5.1, is generally considered a free space technique, a patient using this device clearly has to position himself or herself directly against the device and look into the instrument. The same is true of the double mirror stereoscope shown in Figure 5.2. Although these two devices do not use lenses or prisms, they clearly resemble “instrument” devices such as the stereoscope shown in Figure 5.3. Another problem is how to categorize anaglyphic and Polaroid filter procedures. Are these techniques truly “free space,” or do the filters constitute an interference and alteration in the normal visual environment?

■ **Figure 5.1** The Aperture Rule.

■ **Figure 5.2** Double mirror stereoscope.

■ **Figure 5.3** Bernell-O-Scope stereoscope.

We believe that the "free space" versus "instrument" dichotomy is an artificial division that leaves too many devices and procedures without a clear fit into either category. We recommend a classification of vision therapy instrumentation and techniques that is based to a greater extent on the type of equipment being used. This classification is as follows:

1. Anaglyphs and Polaroid filters
2. Lenses, prisms, and mirrors
3. Septa and apertures
4. Paper, pencil, and miscellaneous tasks
5. Stereoscopes
6. Afterimages, entoptic phenomena, and electrophysiologic techniques.

This classification system is used throughout Chapters 6 to 8 as common vision therapy techniques are described. Table 5.1 lists many of the various instruments and procedures that fall into these six different categories.

Table 5.1 CLASSIFICATION OF VISION THERAPY INSTRUMENTATION AND PROCEDURES

1. Stereoscopes
Brewster stereoscopes
Wheatstone stereoscopes
Haploscopes
Cheiroscopes
2. Anaglyphs and Polaroid filters
Tranaglyphs
Vectograms
Bar readers
TV trainer
Computer programs using red/blue or red/green glasses
3. Lenses, prisms, and mirrors
Flip lenses
Loose lenses
Flip prisms
Loose prisms
Prism bars
Handheld mirrors
4. Septa and apertures
Aperture Rule
Remy separator
Tasks based on Turville test
5. Paper, pencil, and miscellaneous tasks
Lifesaver cards
Free space cards
Eccentric circles
Barrel card, three-dot card
Brock string
Computer techniques
Hart chart and other miscellaneous charts
Letter tracking
Tracing
6. Afterimages, entoptic phenomena, and electrophysiologic techniques
Devices for creating afterimages
Maxwell spot
Haidinger brush
Auditory biofeedback

The concept of natural versus artificial training conditions, however, is a useful one that we emphasize throughout this text. There is a general consensus that vision therapy procedures that approximate normal seeing conditions tend to be more effective in achieving the desired objectives of vision therapy.

CATEGORY 1: ANAGLYPHS AND POLAROID FILTERS

Anaglyphs and Polaroids are filters that block out light from a portion of the target being viewed so that one part is visible by one eye and one part is visible by the other eye. These techniques are widely used for heterophoria patients.

Advantages

Anaglyphs (red/green targets) and Polaroids allow good control of stimulus parameters. A wide variety of targets, including second-degree, third-degree, central, peripheral, accommodative, and nonaccommodative targets, are available. These techniques work well with shallow to moderate suppression, and can be used to train both jump (phasic) or smooth (tonic) vergence. Because the patient does not have to look into an instrument, these procedures more closely resemble normal seeing conditions than instrument-type devices.

Disadvantages

Young children may lose interest, and it is important to use a variety of targets to maintain interest. The primary disadvantage of Polaroid techniques is high expense. They are approximately 10 times as expensive as anaglyphs. Another problem associated with Polaroids is that if the patient tilts his or her head, both targets can be seen by one eye. This would allow the patient to see both targets even if he or she is suppressing. Although anaglyphs are less expensive, these filters (particularly the red) are darker than Polaroids and may precipitate suppression.[1] A potential disadvantage associated with both anaglyphs and Polaroids is that if there is rapid alternate suppression, it may be difficult to determine whether suppression is present.

CATEGORY 2: LENSES, PRISMS, AND MIRRORS

Lenses change the accommodative and vergence demand, whereas prisms and mirrors change the direction of light. Lenses, prisms, and mirrors are often used in conjunction with anaglyphs and Polaroids and are among the most widely used procedures for heterophoria patients. These procedures are useful for antisuppression training and fusional vergence, as well as accommodative and ocular motility therapy.

Advantages

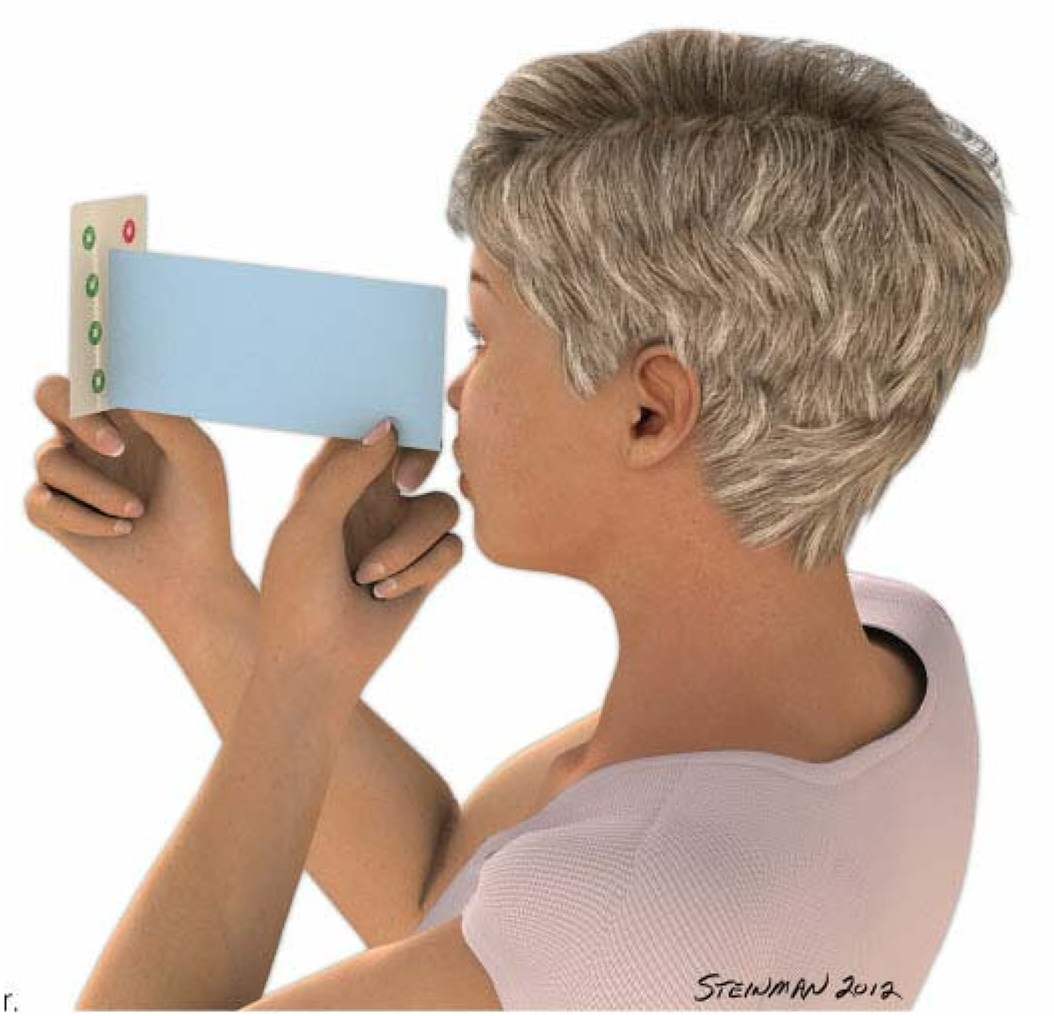
Lenses are very effective for accommodative therapy. These devices also allow the clinician to increase or decrease the level of demand of all binocular and accommodative techniques. They can be used to train both smooth (tonic) and jump (phasic) vergence.

Disadvantages

Young children may lose interest, and it is important to use a variety of targets to maintain interest.

CATEGORY 3: SEPTA AND APERTURES

A *septum* is a dividing wall that separates the view of each eye in normal space so that one eye sees one portion of a target whereas the other eye sees another. An example is the Remy separator (Fig. 5.4). An *aperture* is an opening or window that separates the views of each eye so that one eye sees one portion of the target whereas the other sees another part. The Aperture Rule (Fig. 5.1) is a popular vision therapy technique based on the use of an aperture.



■ **Figure 5.4** Remy separator.

Advantages

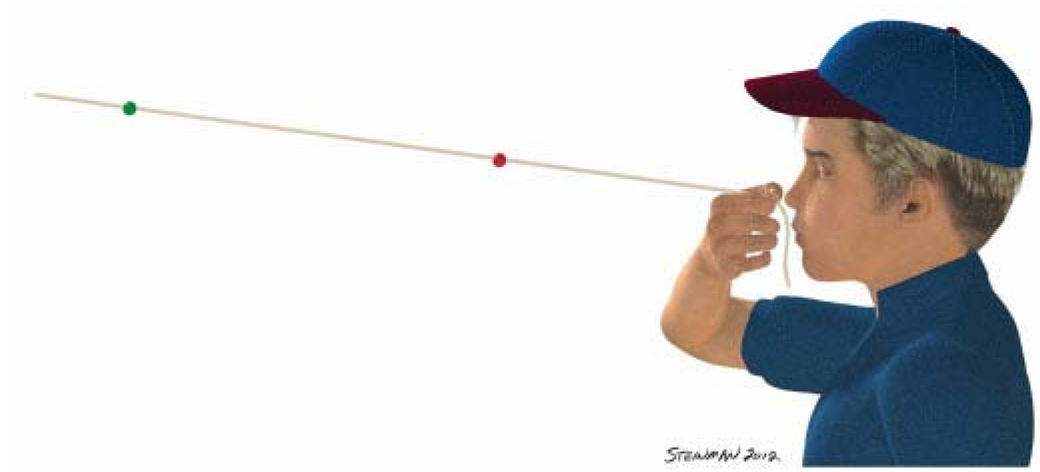
A moderate variety of targets is available, and more targets can be made by the clinician. Apertures and septa work well to treat patients with shallow to moderate suppression.

Disadvantages

It is sometimes difficult to keep a young child's interest with these techniques. Head position is also important with apertures and septa, and the child must sit still and maintain the prescribed head position. The demand of the target cannot be set at zero, forcing the patient to make an initial fusional vergence movement. Because of this, apertures and septa are generally used after anaglyphs, Polaroids, and lenses, prisms, and mirrors.

CATEGORY 4: PAPER, PENCIL, AND MISCELLANEOUS TASKS

This category includes training techniques that are printed on paper and designed to train vergence, accommodation, and accurate eye movements. Many of the eye movement tasks are also useful for suppression training when combined with anaglyphs. Another type of technique included in this category is the Brock string (Fig. 5.5), which is a string with beads that is used to take advantage of physiologic diplopia.



■ **Figure 5.5** Brock string.

Advantages

These techniques are generally the least expensive therapy procedures. A sufficient variety of targets are available, and the techniques work well with shallow to moderate suppression. These techniques work especially well for convergence therapy.

Disadvantages

It is difficult to maintain interest in young children.

CATEGORY 5: STEREOSCOPES

Stereoscopes are designed on the principle of dividing physical space into two separate areas of visual space, each of which is visible to only one eye. This is accomplished by dissociating the eyes mechanically with a septum (Brewster stereoscopes, Fig. 5.3) or by using two separate viewing tubes or mirrors (Wheatstone stereoscopes, Fig. 5.2). In addition, stereoscopes use lenses and prisms (Brewster stereoscopes) or mirrors (Wheatstone stereoscopes) to allow one to test and train at different simulated distances. In most cases, vision therapy for heterophoric patients can be successfully completed without the use of stereoscopes. Instrument training is useful, however, under the following circumstances:

- **If a patient is experiencing difficulty fusing with techniques from other categories.** Some patients respond better initially to instrument training techniques that present stimuli under less natural seeing conditions. Although this is unusual and not totally predictable, it is worthwhile to try stereoscopic procedures when a patient is not responding well to free space techniques.
- **After a patient has successfully completed the nonstereoscopic techniques described in** Chapters 6 to 8 **that are more natural.** It is often useful to perform some training with stereoscopes at this point, because such training allows considerable flexibility with the type of target used and the distance at which therapy can occur. With conditions such as divergence excess, the most difficult task is a first-degree target at a distance setting. Stereoscopes are well designed to deliver this type of stimulus.
- **To provide variety, which is an important consideration in vision therapy.** The use of stereoscopes is another way to improve fusional ranges and facility. A particularly useful technique, only available with stereoscopes, is called tromboning. Tromboning can be performed with Brewster-type stereoscopes and is a procedure in which a target is moved toward and then away from the patient. The unique aspect of this technique is that as the target is moved toward the patient, he or she must accommodate to maintain clarity and diverge to maintain fusion. As a target is moved away, the patient must relax accommodation and converge. This, of course, is opposite to what occurs in the normal seeing environment and this is why this procedure is valuable.

Advantages

The primary strengths of this approach for nonstrabismic binocular anomalies are the ability to present a large variety of targets at distance and intermediate settings and the ability to select first-, second-, and third-degree targets. Stereoscopes can be effective even in cases of deep suppression.

Disadvantages

The artificial nature of the tasks involved in instrument training is a disadvantage of this approach. Questions have been raised about the transfer of improvements in binocular vision from the instrument to situations outside the instrument.[1]

Stereoscopes are the most expensive vision therapy techniques, and they can be heavy and bulky. As a result, many varieties are more appropriate for in-office therapy than home therapy.

CATEGORY 6: AFTERIMAGES, ENTOPTIC PHENOMENA, AND ELECTROPHYSIOLOGIC TECHNIQUES

Techniques in this category are used in the treatment of amblyopia, eccentric fixation, anomalous correspondence, constant strabismus, and nystagmus. Because these topics fall outside the scope of this text, we do not describe the majority of these procedures. Examples of therapy techniques included in this category are devices for creating afterimages, the Maxwell spot, the Haidinger brush, and auditory biofeedback. Afterimages are used occasionally in the treatment of ocular motor dysfunction, and we describe these procedures.

General Principles and Guidelines for Vision Therapy

Before describing the various categories of vision therapy procedures, it is important to understand that there are general principles and guidelines that apply to all vision therapy techniques, as well as specific principles and guidelines for binocular vision, ocular motility, and accommodative techniques. Vision therapy is similar in many ways to other types of therapy that involve learning and education. If we look at other types of learning, it becomes clear that there are specific guidelines to facilitate learning and success. Because vision therapy can be considered a form of learning and education, similar principles and guidelines must be used to achieve success. The following guidelines have been derived from basic learning theory.

Before beginning vision therapy, follow sequential management considerations (Chapter 3). When developing the vision therapy program, always consider amblyopia and suppression therapy before beginning fusional vergence therapy.

- **Determine a level at which the patient can perform easily.** Working on this level makes it easier for the patient to become aware of the important feedback cues, strategies, and objectives involved in vision therapy, and also builds confidence and motivation.
- **Be aware of frustration level.** Signs of frustration include general nervous and muscular tension, hesitant performance, and possibly a desire to avoid the task.
- **Use positive reinforcement.** The patient should be rewarded for attempting a task, even if it is not successfully completed. Reinforcers can be verbal praise, tokens that can be exchanged for prizes, or participation in a task that the patient enjoys. Feldman[13] has described, in detail, the various principles of behavior modification applied to optometric vision therapy. It is a valuable reference for clinicians involved with vision therapy.
- **Maintain an effective training level.** Start at an initial level at which the task is easy and gradually increase the level of difficulty, being very careful to watch for signs of frustration. Vision training should be success oriented, that is, build on what the patient can do successfully, as opposed to giving tasks that are too difficult.
- **Emphasize to the patient that changes must occur within his or her own visual system.** Birnbaum,[14] in defining some of the critical concepts of which the vision therapist must be aware, goes beyond *what* should be done and concentrates on *how* vision therapy should be performed and the role of the vision therapist. This role, according to Birnbaum, is to carefully arrange conditions for learning to occur. His view parallels ours, stressing the use of learning theory principles. More important, and perhaps the key to vision therapy, is teaching the patient to internalize changes in visual function, as opposed to just achieving certain criteria for specific techniques. Often, as patients go through a vision therapy program, they gain the impression that it is the instrumentation, lenses, or prism that effect the change in their visual system. Unless told otherwise, a patient may believe that these external items are the keys to their success in vision therapy.

Birnbaum[14] stresses that "the patient must be made aware that the changes actually occur internally, within the visual system, and not externally in the instruments and paraphernalia utilized in vision therapy." To accomplish this objective, the language used in communication between the optometrist and patient is critical. Birnbaum provides several excellent examples, including the following scenario. When performing a fusional vergence technique, the clinician might say, "Try to keep the picture single." The problem with this instructional set is that although the patient is asked to try, the instructions are given in terms of what happens to the targets rather than what changes the patient must make internally to achieve the desired result. Birnbaum suggests the following as being a preferable instructional set:

> Explain to the patient that if the picture is double, it is because he or she is looking too far or too close in space. In order to make it single, the patient needs to look nearer or farther; the patient needs to make adjustments in himself or herself, in where he or she is pointing his or her eyes in space, and then the picture will become single.

The underlying important concept is that it is not just the specific technique that leads to success in vision therapy. Rather, the key factor is to get the patient to take responsibility for creating internal change.

- **Make the patient aware of the goals of vision therapy.** The patient must know why he or she is in vision therapy. The patient should be able to explain what his or her problem is, how it affects performance, and the goals of vision therapy. This is true for children as well as adults. Even with a young child, the therapist should try to establish some understanding on the part of the child about what is wrong with his or her eyes and why vision therapy is necessary. For each therapy technique, the child should be able to explain what he or she needs to do to accomplish the desired task.
- **Set realistic therapy objectives and maintain flexibility with these objectives or endpoints.** With all therapy techniques, there are certain general objectives that we expect to achieve before we proceed to the next procedure. In this text, we call these objectives *endpoints*. For instance, in Chapter 6, we recommend ending the tranaglyph procedure when the patient can fuse to about 30 base-out, and ending accommodative facility when the patient can complete 12 cpm of accommodative facility with +2.00/−2.00 lenses using a 20/30 target.

  It is important to understand that these endpoints are only guidelines and that flexibility and clinical judgment are ultimately just as important in deciding when to move on to another procedure. The objective of vision therapy is to solve the patient's problems as quickly as possible. If a patient can only achieve 25 base-out with the tranaglyph procedure in spite of sufficient effort, it makes sense to move on and try another technique.

- **Use vision therapy techniques that provide feedback to the patient.** All therapy and teaching progresses more effectively when feedback about performance is available to the student or patient. The various feedback mechanisms used in vision therapy include the following:
    - Diplopia
    - Blur
    - Suppression
    - Luster
    - Kinesthetic awareness
    - Small in, large out (SILO) response
    - Float
    - Localization
    - Parallax.

FEEDBACK MECHANISMS USED IN VISION THERAPY (VIDEO 5.1)

Diplopia

Diplopia is a powerful feedback cue and relatively easy to explain to a patient. If a patient experiences diplopia during a therapy procedure, he or she receives immediate feedback that he or she is not aligning his or her eyes appropriately. It is important to try to provide the patient with methods of overcoming diplopia. These methods are discussed later.

Blur (Video 5.1)

Explain to the patient that blur represents feedback that the focusing system is either overfocusing or underfocusing. As the patient gains control over the accommodative system, he or she should be able to make the necessary changes in accommodation to overcome blur.

Suppression (Video 5.2)

Suppression is also an easy feedback mechanism to demonstrate and explain to patients. Virtually all binocular vision therapy procedures contain elements in the targets that can be used to monitor suppression. For example, there is often a letter “R” and a letter “L” printed on vergence therapy techniques. The “R” is seen only by the right eye and the “L” only by the left eye. If one of these letters is not seen by the patient, he or she receives feedback about suppression. Other techniques use different stimuli, such as a dot, cross, or a vertical or horizontal line, to help monitor suppression. In all cases, the clinician should identify what the suppression cues are for a given therapy technique and utilize these cues to make the patient aware of suppression.

Luster

Luster is the perception of the combination of colors seen when the patient is asked to fuse targets of different colors. Sometimes patients also report a shimmering effect when they fuse targets of different colors. Vision therapy procedures using red and green targets lead to the perception of luster. The clinician should make the patient aware that the fused image is a mixture of the two colors. The absence of luster is clinically significant. For example, if the patient sees only red or only green, it is one indication that he or she may be suppressing.

Kinesthetic Awareness (Video 5.3)

A common theme throughout all vision therapy techniques for accommodation and binocular vision is stressing an awareness of the sensation of accommodating or converging. We want the patient to be able to feel the difference between stimulating and relaxing accommodation and the difference between converging and diverging. When performing any technique, ask the patient to explain what he or she is feeling. “Does it feel like you are straining or relaxing your eyes? Does it feel like you are looking close and crossing your eyes or looking far and relaxing your eyes?” Therapy will often progress considerably faster if the patient is able to develop this awareness.

SILO Response

SILO Response Associated with Vergence (Video 5.4)

SILO is an acronym for “small in, large out.” It refers to the fact that as a patient is asked to maintain fusion while divergence or convergence demand is varied, he or she will experience perceptual changes. Specifically, as the convergence demand is increased and the patient maintains fusion, the target may appear to become smaller and move closer or in toward the patient. This is the “SI” of the acronym SILO (small and in). Conversely, as the divergence demand is increased and the patient maintains fusion, the target may appear to become larger and move farther away or out. This is the “LO” of the acronym (large and out).

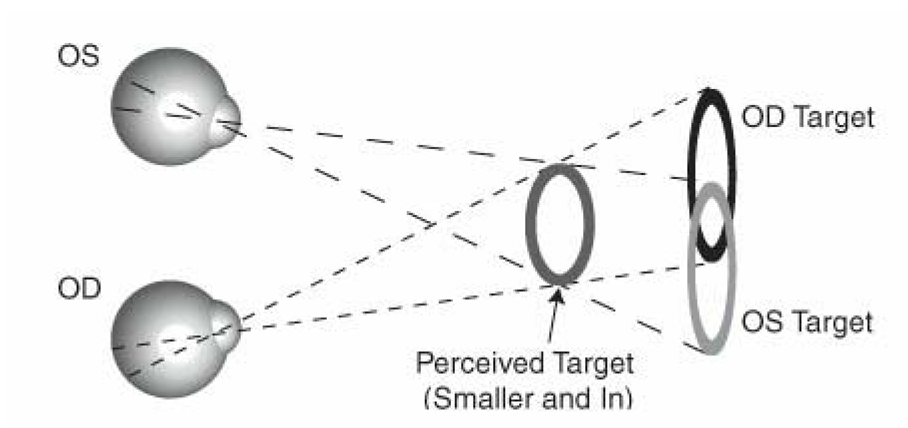
The underlying basis for the SILO phenomenon is size constancy. Leibowitz et al[15] and Leibowitz and Moore[16] studied the role of accommodation and convergence in the size constancy phenomenon, and their findings offer one explanation for the SILO phenomenon. The authors noted that as one's gaze shifts from a far to a near object, accommodative and convergence changes must occur for the observer to maintain clear single vision. They found that the initiation of these accommodative and convergence movements is coupled with an expectation that this action will be accompanied by an alteration in retinal image size. Anticipating such a change, the patient corrects for it and thereby maintains size constancy.

According to this theory, when an observer accommodates and converges as an object approaches, the retinal image size increases. The perceptual system therefore must make a correction to maintain size constancy and shrink the size of the image. As an object is moved farther away, the retinal image size decreases and the perceptual system must expand the image. With the vision therapy techniques under consideration here, the important difference is that the retinal image size is never changing while accommodative and convergence changes occur. Therefore, the shrinkage adjustment of the perceptual size constancy system normally associated with convergence and accommodation leads to a perception that the object is becoming smaller. Similarly, the normal expansion adjustment associated with a relaxation of accommodation leads to a perception that the object is becoming larger with divergence techniques. Thus, the perceived size change is directly related to accommodative and vergence changes.

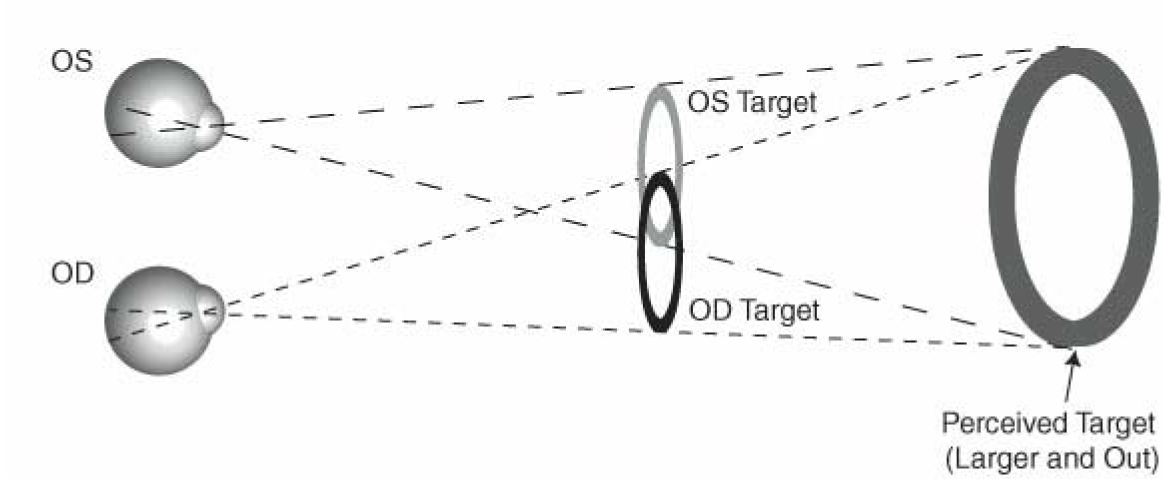
In regard to the apparent distance changes, subjects give variable responses. Some report that the object becomes smaller as it moves closer (SILO). Others report that the image becomes smaller and moves farther away or out (SOLI: small out, large in). These different responses can be explained if we assume that individuals use different cues for distance perception. The first possibility is that an individual uses vergence as a cue for his perception of distance. This person perceives the object to be moving closer because he is converging and he "knows," from previous experience, that when he does so, it means he is looking at an object moving closer. Conversely, when the person diverges, he "knows," from prior experience, that the object must be moving away.

Those who do not use vergence as a cue to perceive distance probably use apparent size as a cue. An individual using apparent size as a cue would be expected to report SOLI. For example, as the person converges using a vectogram target, he/she will perceive the target becoming smaller, based on Leibowitz's study. Because the target is becoming smaller, the person perceives the target as moving out or farther away. The person perceives things this way because, from previous experience, as a target becomes smaller, it generally means it is moving away.

There is also a geometric explanation for the SILO phenomenon. Figures 5.6 and 5.7 illustrate the expected response for a convergence and divergence demand in fusional vergence therapy technique. In Figure 5.6, the right eye is viewing the left target, and the left eye is viewing the right target. The visual axes cross between the patient's eyes and the targets and represent the location in space at which the patient perceives the fused target. Thus, the target will appear to move closer, or in. The illustration also demonstrates that the fused target would appear to be smaller than either of the real targets. Figure 5.7 is a geometric explanation for a patient's perception of larger and out during a divergence task. In this illustration, the right eye is viewing the right target, and the left eye the left target. The fused image is perceived where the visual axes cross, which is beyond the plane of the targets. The fused target is therefore perceived as farther away and, as Figure 5.7 illustrates, larger.



■ **Figure 5.6** Geometric explanation for the "small in, large out" phenomenon. The illustration demonstrates that the fused target would appear to be smaller and closer than either of the real targets during a base-out fusion technique. OD, oculus dextrus; OS, oculus sinister.



■ **Figure 5.7** Geometric explanation for the "small in, large out" phenomenon. The illustration demonstrates that the fused target would appear to be larger and farther away during a base-in fusion technique. OD, oculus dextrus; OS, oculus sinister.

SILO Response Associated with Lenses (Video 5.5)

When an individual accommodates through plus or minus lenses, perceptual changes in the apparent size and distance of the object occur similar to those described earlier. The reasons for these perceived changes, however, must be different, because with lenses the retinal image size *does* change, whereas with vergence the retinal image size remains constant. Minus lenses cause minification of the retinal image, and plus lenses cause magnification.

A possible explanation for perceptual changes that occur with lenses is that minus lenses minify the retinal image and cause the response of "smaller," whereas plus lenses magnify the retinal image and lead to the response of "larger." Based on the perceived change in size, the patient reasons "the target is smaller; therefore, it must be farther away" with minus lenses and "the target is larger; therefore, it must be closer." This would be a SOLI response and is actually the expected finding with lenses.

Clinical Relevance of SILO Response

It is apparent from the literature and clinical experience that SILO is not the only normal or expected response to vergence or accommodative techniques. This is particularly true with lenses.

A response of SOLI is not necessarily an indication of a binocular or accommodative problem. Rather, it is a reflection of the individual's perceptual style and attention to visual stimuli. Whereas the appreciation of the object becoming smaller with convergence demand and minus and becoming larger with divergence and plus seems to be almost universal, the perception of the distance change is by no means predictable. From clinical experience, we have found that adults are more likely to respond with SOLI than SILO. A possible explanation for this is that adults are more likely to respond with what they "know" should occur as a target becomes smaller and to report that the object must be moving away from them. Children tend to be less rigid in their perceptions and will respond with what they see: the object is becoming smaller and moving closer.

It is important to remember that the main value of the SILO phenomenon is to provide feedback to the patient about his or her performance. As long as a consistent pattern can be established, the feedback is useful. Thus, if a patient consistently feels that with increasing convergence demand the target appears to become smaller and move away, this will still represent a useful feedback technique for this patient.

It is desirable, however, to spend some time initially with the patient to try to make him or her more aware of what he or she is seeing and try to elicit a SILO response. A SILO response is desirable because it helps the therapist create an awareness on the part of the patient of what is occurring during the therapy procedure. For example, if we are performing a convergence technique, it is helpful to establish that the patient must cross his or her eyes and look closer as the targets are separated. If the patient perceives that the target is becoming smaller and moving closer, this reinforces the concept of looking closer and crossing the eyes. If a patient experiences SILO, the therapist can say the following: "Do you see how the target appears to become closer and smaller as we separate the targets? This is feedback for you about what your eyes are doing during this task. The target looks like it is moving closer to you because you are looking closer as the task becomes more difficult." If a SILO response cannot be elicited, the clinician has to use other feedback cues to establish the concept of looking close.

Float

Float refers to the perception that a target is floating closer or farther away as the demand is changed from convergence to divergence during vergence therapy. With convergence, the target should appear to float closer, and with divergence, farther away. This perception is actually part of the SILO phenomenon. As discussed previously, not all patients see the target moving closer with convergence or farther with divergence. If this response can be elicited, it becomes a very helpful feedback cue that can be used by the therapist to establish the concept of looking closer during convergence and farther during divergence therapy.

Localization (Video 5.6)

Localization is one of the more valuable feedback cues available for vergence therapy. It refers to the ability of the patient to point to where the target appears to be when fusion occurs and is based on the concept of physiologic diplopia. Figure 5.6 illustrates the concept of localization. In Figure 5.8, the patient is working with a quoit vectogram and is fusing with a convergence demand. The visual axes cross before the targets, and the patient should perceive the target as smaller and closer. The patient is now asked to pick up a pointer and point to where he or she sees the target floating. The objective is for the patient to point to the target and perceive one target and one pointer.

■ **Figure 5.8** A patient working with a quoit vectogram is fusing with a convergence demand. The patient points to where she sees the target.

If the patient places the pointer in the general area of where his or her visual axes cross, he or she will perceive one target and one pointer. If the patient points closer or farther away than the intersection of his or her visual axes, he or she will report diplopia of either the target or the pointer. The importance of localization is that it allows the patient to develop an understanding of what changes must occur within his or her visual system to accomplish the therapy task. If the patient can localize the target, he or she will begin to understand that when the targets are separated to create a convergence demand, he or she must look closer and cross his or her eyes to maintain single vision and fusion. We cannot overemphasize the importance of the patient developing this understanding of what changes he or she must make to accomplish a particular task.

Often when a patient is first asked to try to localize during convergence therapy, he or she experiences difficulty. At first, the patient may tend to point to the actual plane of the target, rather than the intersection of the visual axes. It is useful to state, “We both know that the targets are back there, but what I want you to do is to try to get the feeling of where you are looking and where the target is floating.”

If the patient continues to have problems localizing, the next step is to make him or her aware of the concept of physiologic diplopia and to use this phenomenon to get the patient started. The explanation we use with patients is as follows: “The way the visual system works is that whatever object we are directly viewing is seen as one, while all other objects are seen as double.” It is then useful to demonstrate this by having the patient look at a pointer while you hold another object in the background. Have the patient experiment with this concept for several minutes until he or she is comfortable with this idea and is satisfied that he or she can experience physiologic diplopia. Demonstrate that when the more distant object (seen as two) is moved closer to the fixation object, it will also be seen singly when it is in approximately the same position in space. If the patient now understands the concept that we experience single vision if we point to where the eyes are looking, the idea can be applied to vision therapy techniques.

For example, assume the patient is fusing a quoit vectogram using positive fusional vergence (PFV). We ask the patient to localize and point to where he or she perceives the quoit. The patient, however, points too far away and experiences diplopia. If the patient understands the concept of physiologic diplopia, we would say the following:

> This time I want you to hold the pointer at the slides and look directly at the pointer. Do not try to keep the ropes single. If you look at the pointer, while you do so, you will see two ropes in the background. Now slowly move the pointer toward yourself, always looking directly at the pointer and being aware of the two ropes. As you do this, you will notice that, as you move the pointer toward yourself, the two ropes appear to move closer to one another. Continue moving the pointer toward yourself very slowly and you will notice that, at some distance, you will see one pointer and one set of ropes. This is where you must look to

accomplish this task. Do you feel yourself looking closer? Try to get the feel of where you have to look. Can you now understand where you have to look to see one rope? Can you see that the rope is floating closer?

Generally the patient is unable to simply pick up the pointer and immediately localize correctly. However, with repetition, most patients will soon understand what they must do visually during convergence therapy. Once they grasp this concept, the rest of the therapy is simplified.

Localization is a very powerful feedback cue for convergence therapy. With divergence therapy, it is more difficult to use, but it can still be an important aid to therapy. The primary difficulty with divergence is that as the fusional vergence demand increases, the object floats farther away from the patient and the patient can no longer point to it because it is too far away to physically reach with a pointer. Another problem is that depending on the target being used, the patient must visualize an object moving farther away, passing through an opaque background. For example, if we are using a vectogram such as quoits with the Polachrome illuminated trainer (Fig. 5.9), the patient would be asked to visualize the rope floating behind the white stand. The ability of people to visualize varies greatly, and an inability to do so interferes with the use of localization for divergence therapy.

■ **Figure 5.9** Quoit vectogram setup in the Polachrome illuminated trainer.

This second problem is rather simple to overcome and merely involves selecting targets that are printed on clear plastic, such as vectograms, tranaglyphs, free space circles, and eccentric circles (Fig. 5.10). In addition, if the targets are to be placed in a holder, the holder should also be transparent, like the one illustrated in Figure 5.10.