CHAPTER 23

Interventions for Deficits in Vision and Other Sensory Functions

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Key Terms

Anesthesia
Paresthesia
Hypoesthesia
Hyperesthesia
Analgesia
Hypalgesia
Remedial treatment
Compensatory treatment
Vision
Visual perception
Visual acuity
Oculomotor control
Visual fields
Visual attention
Visual scanning
Pattern recognition
Visual memory
Visual cognition
Myopia
Hyperopia
Presbyopia
Astigmatism
Cataracts
Macular degeneration
Glaucoma
Hypertension
Diabetic retinopathy
Macular area
Age-related macular degeneration (ARM)
Ophthalmologist
Optometrist
Homonymous hemianopsia
Visual scanning
Hand trailing
Sighted guiding

Chapter Objectives

After studying this chapter, the student or practitioner will be able to do the following:

1. Discuss the functional effects of sensory loss or dysfunction.
2. Describe the complementary roles of the occupational therapist and the occupational therapy assistant in the treatment of sensory dysfunction.
3. Give examples of strategies taught in a program of compensation for sensory loss for clients with central nervous system lesions and peripheral nervous system lesions.
4. List guidelines for clients with peripheral nervous system dysfunction who lack protective sensation.
5. Describe the role of the occupational therapist and occupational therapy assistant in educating clients and family members on the effects of sensory dysfunction.
6. Describe some remedial techniques used for clients with peripheral nervous system dysfunction.
7. Describe the process of recovery from peripheral nerve dysfunction.
8. Discuss in general terms the process of organizing and processing visual perception.
9. Explain the importance of the client's visual history.
10. Identify the roles of the ophthalmologist and optometrist and how they work with the occupational therapist practitioner.
11. Place visual functions within a hierarchy.
12. Describe the functional effects of common visual conditions and diseases.
13. Identify some remedial strategies used for treatment of visual dysfunction.
14. Identify and describe compensatory strategies for clients with visual dysfunction.
15. Contrast the adaptive and the remedial approaches in treatment of perceptual dysfunction.
16. Identify and explain the six categories of perceptual dysfunction.

Impairments in client factors (body functions and body structures) may affect functional performance.[2] Engagement in occupation relies on the abilities to see, hear, feel, smell, taste, and balance; to organize sensations into meaningful representations of the world; and to plan and sequence responses.[2] The occupational therapist is trained to assess all areas of occupation within each client's context[2] and establish a treatment plan to address all problem areas. The occupational therapy assistant (OTA) participates in client treatment under the direct supervision of the occupational therapist. The extent of the OTA's role depends on many factors: experience, service competency, and the nature of the impairment. The OTA should be aware of deficit areas in considering the approach to clients with sensory dysfunction.

Recognizing the OTA's important and variable role in the treatment of client factors, this chapter presents some techniques the OTA might employ at entry level. The chapter also introduces interventions that only the more experienced OTA practitioner, who has acquired service competency under qualified supervision, would provide.

This chapter has two sections: sensation and vision. Each section examines the treatment of that client factor, and each may be studied separately. However, the OTA will need to integrate considerable information from this chapter and from Chapter 24 to provide effective interventions in complex cases, such as the case study of Mr. J.

Interventions for Sensory Dysfunction

The sensory receptors receive information from the person's internal structures and the environment and send it to the brain for interpretation. When sensation is normal, this process works quickly and smoothly and is often not consciously perceived. Sensation is important for learning, motor performance, and protection.[8] Persons are often unaware of the importance of sensation until it is impaired or absent. When sensation is abnormal, the process of receiving information can be slowed and disorganized.

Sensation can be divided into the somatosensory and special sensory systems.[20] The somatosensory component involves the primary senses (i.e., tactile, deep pressure, pain, proprioception, kinesthesia) and the cortical senses (i.e., two-point discrimination, stereognosis).[20] The special sensory system includes vision, hearing, smell, taste, and balance.[20]

CASE STUDY

Mr. J.

Mr. J. is a 58-year-old man diagnosed with multiple sclerosis 10 years ago. He recently was discharged from the acute care medical floor of the hospital to a home-based rehabilitation program after a recent exacerbation. At discharge, symptoms included blurred vision, numbness and mild spasticity of all extremities, mild intention tremors of the right-dominant side and moderate intention tremors of the left side, overall weakness, and limited endurance. Mr. J. is married and has two sons, ages 9 and 11. Mrs. J. works outside the home as a nurse consultant for an insurance company. Mr. J. did not receive any occupational therapy (OT) services prior to leaving the hospital. The referral for home services was for evaluation and treatment once a week. The occupational therapist completed an evaluation at home. The J. family lives in a one-floor ranch-style home especially designed for Mr. J. and his functional and mobility needs.

The occupational profile showed that before his most recent flare-up Mr. J. was responsible for his own activities of daily living. He prepared breakfast and dinner for his family, worked as a website designer about 16 to 20 hours a week from his home office, volunteered for church by updating the church website monthly from home, played board games or computer games with his sons, and occasionally read computer magazines and fiction. Mrs. J. performs the majority of household tasks. The children help with some of the chores. Other family members provide assistance in tasks such as lawn care, home maintenance, home repair, and transportation. In the analysis of occupational performance after Mr. J's most recent hospitalization, the occupational therapist noted that Mr. J. feeds himself but spills his food and drink, washes his face and hands, partially dresses himself, and performs functional mobility independently. He toilets himself but requires assistance with showering despite having a walk-in shower with built in seat, grab bars, and shower hose. Mr. J. requires assistance for fasteners and to put on his socks and shoes. He requires much more time to perform all of the above activities of daily living and can no longer stand while performing any tasks. The only instrumental activity of daily living he performs is heating up a prepared lunch and "watching" his sons when they return home from school. Prior to his hospitalization he could walk short distances with forearm crutches, but he currently uses an electric scooter for all mobility.

Regarding performance skills, Mr. J. showed reduced attention and concentration, blurred vision with corrective lenses, double vision, lack of protective sensation of left hand, impaired memory, impaired body scheme, and visual agnosia. The client can stay up out of bed for about 60 minutes and then has to rest in bed for about 2 hours. He currently gets up twice a day. Mr. J. stated that he values all of his life roles and would like to be able to prepare meals, play games with his children, read, volunteer for his church, and return to work within 1 to 2 months. Mrs. J. has already returned to work because she has no more vacation days to use. The client is receiving physical therapy in the home once a week for reduction of tone, strengthening, and functional mobility. Numerous examples of OT treatment intervention and activities provided by the OTA are discussed throughout this chapter.

Sensory dysfunction severe enough to require treatment affects function and can make performing basic activities of daily living (ADL) difficult and lead to injury. Mr. J., described in the case study, is at higher risk for developing pressure sores, which can result from being positioned in one place too long. Mr. J. has numbness and weakness of all extremities and spends more time lying down than he did prior to before his hospitalization. The occupational therapy (OT) practitioner will educate him on the importance of weight-shifting every 30 minutes when sitting and changing position every 2 hours while lying in bed.

OT can improve the performance of persons with sensory changes or loss by teaching compensatory strategies and by facilitating recovery (in some clients) of absent sensory function. The roles of the occupational therapist and the OTA in this area are complementary. The occupational therapist evaluates, plans treatment, and carries out remedial programs; the OTA teaches compensatory techniques and may assist in remedial treatment.

Sensory dysfunction can result from damage to or diseases of the central nervous system (CNS), peripheral nervous system (PNS), or cranial nerves. The CNS includes the brain and the spinal cord, whereas the PNS includes all other neurons lying outside of the innermost lining of the brain and spinal cord. Sensory dysfunction of CNS origin can be more generalized and cause sensory changes that affect the entire body, as occur with multiple sclerosis (MS). CNS lesions may affect the entire contralateral (opposite to brain hemisphere) side of the body as a result of a cerebrovascular accident (CVA, stroke) or traumatic brain injury. Sensory changes that affect the PNS and cranial nerves are specific to the affected nerves. For example, palsy of cranial nerve III, the oculomotor nerve, may cause drooping of the eyelid, thus blocking vision. The spinal nerves innervate specific areas of the skin called dermatomes. Lesions can cause dulled or absent sensation in affected areas.

Some of the terms associated with sensory dysfunction are **anesthesia** (complete loss of sensation), **paresthesia** (abnormal sensation such as tingling or crawling), **hypoesthesia** or hypesthesia (decreased or dulled sensation or hyposensitivity), **hyperesthesia** (increased tactile sensitivity or hypersensitivity), **analgesia** (complete loss of pain sensation), and **hypalgesia** or hypoalgesia (diminished pain sensation).[10] Clients with hyposensivity are at higher risk for injury because the protective sensation is lacking, as in Mr. J.'s case. Clients with hypersensitivity may find touch so painful that they avoid it.

Because sensory changes or loss may have a significant effect on the patient's ability to function and to achieve fulfillment in everyday activities, the occupational therapist and OTA must promote sensory recovery or reeducation to the extent possible and teach safety precautions and compensatory techniques.

Treatment Guidelines

Before evaluation of sensory dysfunction can begin, the occupational therapist must know and understand the diagnosis, the cause of the sensory impairments, the prognosis for return of sensation, and the current progression of recovery. The results of the occupational therapist's sensory evaluation guide all treatment planning. Information from review of the client's chart and the evaluation will suggest whether the treatment approach should be remedial, compensatory, or both.

Remedial treatment aims to change the sensory response itself and to restore more normal sensory function. This objective is possible only with certain clients with reversible conditions (usually PNS). Candidates for sensory reeducation programming should understand the purpose of the training. They also should be able to learn and practice the techniques and incorporate the affected part in daily occupations.[8,16]

Compensatory treatment involves using strategies for adjusting and adapting to sensory changes or losses. Such strategies include precautions to avoid injury, using other senses to obtain information, and environmental modifications. The OTA would teach Mr. J. (and his family) how to adapt the environment to compensate for blurred vision by increasing contrast (placing reflective tape on edges of tables, counters, etc.), adding proper lighting, and spacing objects in the home to allow for easier mobility and access. The OTA might suggest that Mr. J. use a magnifying mirror to see his face clearly when washing and an electric razor with a strap to help keep the tool on his hand. For his computing needs, Mr. J. might consider an enlarged keyboard with tremor-dampening keys (and mouse control or alternatives) and highlighted letters as well as a larger monitor screen with enlarged font (print) and high contrast. These adjustments are only a few of the possible compensatory strategies.

This section now considers treatment approaches for the two major types of sensory dysfunction: CNS and PNS.

Central Nervous System Dysfunction

Effects of Sensory Changes

CNS damage can occur from trauma to the brain, from conditions such as CVA and from diseases such as MS or Parkinson's disease (PD). Resulting sensory changes or losses will diminish function. The inclination to move is based on how well sensory information is received and interpreted by the brain. Persons with poor sensation have little urge to move; those with dulled sensation, such as Mr. J., have even less urge to move. Attempted movement may be clumsy or uncoordinated, even when muscle recovery is good. An example is trying to walk on a leg that has "fallen asleep." Although the leg muscles are still working, the sensation has changed, and the movements are awkward. Clients with sensory dysfunction are at much higher risk for injury, especially if they have cognitive deficits such as impulsivity, reduced safety awareness, or impaired memory. Such clients will require supervision for all tasks, so as to prevent injury.

Sensory dysfunction can create functional difficulties in some or all of the areas of occupation. Appetite may diminish because of changes in smell and taste. Loss of visual fields may result in bumping into door frames. Clients may cease attending concerts because of hearing loss. Reduced tactile sensation may result in inability to feel the zipper pull when dressing or failure to notice that a brace is too tight, which could cause pressure sores of the lower leg. Hands may become frostbitten

because of cold exposure. The client may stop playing piano because of an inability to feel the keys with one hand and the pedals with one foot. Severe chronic pain may prevent the client from working. Sensory dysfunction may worsen the effects of other deficits such as loss of motor control, reduced coordination, or left unilateral neglect.

In our case study, Mr. J. has shown impairments in ADL, instrumental activities of daily living (IADL), work, play, leisure, and social participation. These impairments result from several deficits, including sensory dysfunction. He requires assistance in self-care, can perform only minimal caregiver and home management chores, has suspended his work role, has reduced play and leisure roles, and has experienced social isolation from spending most of his time in bed due to fatigue.

Client Education

Sensory recovery is a slow process that may stop at any time. Many clients may not have awareness of their sensory dysfunction and the effect on function. Because safety is primary, the clinician must teach clients and family members or significant others about the sensory changes and how to protect the affected body parts while performing all tasks. The first step is to instruct the client to increase self-awareness by recognizing symptoms and self-monitoring. Therapy aims to increase the client's vigilance about safety issues. The clinician reinforces safety factors throughout all self-care training sessions. For example, Mr. J. can be taught to check the water temperature with an unaffected body part such as an elbow before washing his face. The clinician's repeated verbal, visual, and tactile cueing may be needed. The client should have many opportunities to practice skills and use them in daily tasks. The client with the goal of returning to performing home management should demonstrate very good judgment, safety awareness, and visual compensation.[31] If the client cannot self-monitor because of cognitive dysfunction such as inattention, reduced self-awareness, impaired memory, or poor judgment, the client will require constant supervision. The OT practitioner would teach the caregiver(s) how to modify the environment to help the client function safely despite sensory dysfunction.

Remedial Treatment

The purpose of remedial treatment or sensory reeducation is to promote recovery of dulled or absent sensation via appropriate sensory input. Sensory reeducation may also reduce sensory hypersensitivity and allow sensory desensitization through graded sensory input. Individuals with hypersensitivity overreact to "normal" sensations, such as touch, light, and sounds, finding them unpleasant or noxious. Health care practitioners who are not well trained can injure clients. The occupational therapist determines which clients with sensory dysfunction are candidates for remedial treatment and designs the planning and implementation of that treatment. The OTA might participate in treatment by providing specific sensory input as instructed, under close supervision until service competency is well established.

The occupational therapist performs sensory reeducation treatment techniques to provide graded repeated sensory stimulation in the clinic or home. Some of the elements of a sensory reeducation program can be found in Box 23-1. The OTA would not generally be providing these treatments.

Box 23-1

Elements of a Sensory Reeducation Program for Deficits of Central Nervous System Origin

Object identification—The therapist presents objects so that the patient can see and hear the object while feeling it. The therapist begins with larger and more texturally distinct objects. Later, vision is occluded, but the patient is allowed to hear the object being felt. Finally, the client is asked to identify the object through touch only, without vision or auditory information.

Counting and discriminating objects—The client is asked to count out a specific number of objects, from a larger group. Next, discrimination of unlike objects (sponge ball and wooden cube) is added. The next gradation may include increasingly difficult touch discrimination tasks (differentiating different sizes, textures, shapes, etc.).

Compensatory Treatment

Compensatory strategies help the client maximize safe performance in occupation by working around problems associated with sensory deficits.

Callahan[8] proposed guidelines for clients who lack protective sensation of the hand. The following is a modification of those suggestions, applicable to clients with PNS dysfunction:

- Avoid exposure of the involved area to heat, cold, and sharp objects.
- When holding a tool or object, be conscious not to apply more force than necessary.
- The smaller the handle, the less the distribution of pressure over gripping surfaces. Adapt small handles by building up the handle or using a different tool whenever possible.
- Avoid tasks that require use of one tool for extended periods, especially if the hand cannot adapt by changing the manner of grip.
- Change tools frequently at work to avoid too much friction, and rest affected areas.
- Observe the skin for signs of stress (redness, edema, warmth) from excessive force or repetitive pressure, and rest the hand if these signs occur.
- To keep skin soft and pliant, follow a daily routine of skin care as recommended by the physician.

Other examples of compensation include (1) using the unaffected hand to perform household management tasks such as cooking, eating, and ironing; (2) using vision to observe movement and positioning of body parts such as looking behind to visually locate the commode seat; (3) testing bath water with the less affected hand or a water thermometer; (4) using adaptive devices such as the one-handed cutting board to avoid cutting the affected hand;[36] (5) not using appliances while preparing meals; (6) enlisting the aid of caregivers to prepare hot meals or to check for pressure sores in places that

the client cannot see or feel; and (7) leaving the affected painful areas uncovered.

Peripheral Nervous System Dysfunction

Effects of Sensory Changes

Peripheral nerve injury (PNI) may affect the nerve fibers and/or the nerve cell body.[7] Nerve fiber damage usually results from reduced circulation and is the mildest and the most temporary form of PNI.[20] Complete recovery occurs within 3 months.[20] When the myelin (the outer coating of the nerve that insulates the axon) is damaged, regeneration occurs at a rate of about 8 mm per day.[20] The most severe injury involves the nerve cell body and results from penetrating wounds, crushing, or stretching.[20] Cell body regrowth is slow—about 1 mm per day[7]—and because several of the branches from the nerve trunks can be over 1 meter in length, recovery may take several months to a year. Clinicians should always be aware of the type of peripheral nerve damage and the expected recovery period. During recovery, clients often experience increased sensitivity of the affected parts and may be tactilely defensive. Therefore they may protect sensitive areas and avoid using the affected part in bilateral functional tasks.

PNS dysfunction can result from diseases, such as diabetes; injury, such as carpal tunnel syndrome; entrapment, such as spinal stenosis; and ischemia, such as thoracic outlet syndrome.[20] Damage can occur in one set of nerves or in several, depending on the cause. Symptoms of PNI include muscle weakness, hyperesthesia, hypoesthesia, lack of sensation, pain, muscle atrophy, loss of the ability to perspire, and changes in the quality of the skin and nails innervated by the affected nerves.[20] Skin changes can cause dry skin, which may be more easily injured.

If the patient has no open wounds or infection, early treatment of hypersensitivity is best—before sensory reeducation begins.[33] However, desensitization is most often done in hand and burn rehabilitation, which require advanced education and experience. Specific details of desensitization programs are beyond the scope of this chapter and the OTA's usual service competencies. A service-competent occupational therapist would use desensitization, a graded program including massage, and tapping or rolling over the affected areas with textures as tolerated by the client. This method aims to raise the nerve's pain threshold.[2,33]

Client Education

The occupational therapist has the primary role in educating the client, family or significant others by reinforcing information provided by the physician about recovery from PNI. The occupational therapist and the OTA act as a team, the OTA reinforcing what the occupational therapist has explained. The OTA has a more direct role during treatment involving ADL training; he or she explains the benefits of using the affected parts as one way to help reduce hypersensitivity.[4] Use of affected parts may help clients reduce pain and increase comfort with movement. Clients usually perform better when they are in control and can move the affected body parts on their own with their unaffected arm (in contrast to having someone else help them move). The OTA can also teach the client how to instruct others to help him/her move without causing discomfort. If cognitive dysfunction prevents the client from learning how to protect the affected part and perform functional tasks safely, the clinician will recommend that the caregiver(s) provide constant supervision. In this situation, the occupational therapist teaches the caregiver(s) how to modify the environment to help the client function safely.

Compensatory Treatment

In addition to increasing the client's awareness of the specific sensory deficits associated with PNS dysfunction, safety is the first and major focus of compensatory training for clients who lack protective sensation. It may be a better choice for the client to avoid using the affected limb during functional activities that are potentially unsafe, especially if the person is impulsive, inattentive, or lacks safety awareness.

Remedial Treatment

Remedial treatment or sensory reeducation is introduced after desensitization treatment is completed.[41] The program begins with teaching the client how to use sensation.[41] When nerves in the hand are repaired or recover after injury, the messages to the brain are altered. The new pattern of neural impulses may be so different that the brain fails to identify the sensory stimulus, and the client may incorrectly interpret the sensory information. Sensory reeducation instructs the client how to reinterpret the sensory impulses reaching the consciousness. Sensory reeducation enhances the patient's potential for functional recovery after nerve injury.[13,44] Although the occupational therapist generally provides sensory reeducation, the OTA with proven advanced proficiency could provide it under the occupational therapist's direct supervision. Box 23-2 shows some of the elements of a sensory reeducation program for deficits originating in PNI. The OTA may assist, under close supervision, by incorporating specific techniques into activities that simulate those of the patient's occupational roles.[8,13]

Summary of Interventions for Sensory Dysfunction

The skin receptors and sensory organs send information from the environment to the brain through the peripheral and spinal nerves and the spinal cord. Sensation provides information to the brain about the external environment necessary to guide purposeful and effective motor action. Sensory dysfunction disrupts the link between sensation and movement. The clinician should be aware of the type and extent of sensory dysfunction and expected recovery. Lack of protective sensation can increase the client's risk for injury to the affected part. OT practitioners can help improve the daily lives of persons with sensory impairments by maximizing safe, functional use of the affected extremity and providing remedial and compensatory treatments. Sensory reeducation and remediation require advanced training and should not be performed by the entry-level OTA.

Box 23-2

Elements of a Sensory Reeducation Program for Deficits of Peripheral Nervous System Origin[8,13,44]

Graded stimulation—First with client's eyes open, then with eyes closed, stimuli are graded to match recovery of different kinds of sensation during nerve regeneration. For example, the clinician moves an object such as a pencil eraser up and down the affected area to enhance sensation of moving touch. As this sense recovers, the clinician introduces constant touch, then gentle pressure.

Localization of stimuli—The client is asked to identify where the affected part is being touched by the eraser.

Tactile discrimination, visual and tactile integration—A graded series of tasks, beginning with identification of large familiar household objects and progressing to objects with finer and more subtle differences, is presented. The client works with vision occluded but can open the eyes if he or she cannot identify the item through touch. The client is asked to compare the sensation with how the object feels in the unaffected hand. This description helps the client to integrate visual and tactile information using both sides of the body.

Stimulation of motor recovery—Manipulation of the training objects contributes to motor recovery by combining movement with sensation. The task can be graded by asking the client to locate items buried in rice or sand, while using touch only.

Frequent training—Training is done in two to four 10-minute sessions a day.[72]

Practice and client education—The client is encouraged to practice assigned reeducation techniques four times a day for at least 5 minutes each but is directed not to stimulate one hand with the other because this stimulation would send two sets of sensory stimuli to the brain.[14,19]

Treatment of Vision Deficits and Visual-Perceptual Dysfunction

Understanding and using visual information requires vision and visual perception. **Vision** refers to the reception of sensory information through the visual receptors. **Visual perception** is the process by which information from vision receptors is integrated with information from the other senses and interpreted by the brain. This process requires the brain to combine information from all of the senses: visual, proprioceptive (pressure), kinesthetic (sense of movement), tactile (touch), vestibular (balance and equilibrium), olfactory (smell), and auditory (hearing). In adapting to the environment, the brain puts together the separate pieces of sensory information it receives, integrating them to form a visual image of the environment. Because sensory information coming into the CNS is constantly changing, the picture, likewise, is dynamic and constantly changing as well. A person's decision on how to respond to a situation changes moment by moment with alterations in the person's sensory context (experience). Clients with altered vision or perception may require more time to make decisions or may make decisions based on erroneous information.

In the case study, Mr. J. has the visual problems of blurred and double vision and the perceptual problems of impaired body scheme and visual agnosia (inability to recognize objects by sight). Visual, physical, and cognitive problems increase Mr. J.'s performance time for ADL. To address visual problems, the OTA could incorporate compensatory strategies into ADL training. For example, when working on upper body bathing, the clinician could spread out the supplies, increasing contrast by placing a white washcloth on a dark countertop or towel and using colored soap. The client is encouraged to perform the task in the same sequence each time while identifying each body part in front of a mirror to improve body scheme awareness. The OTA could limit the number of items used, arrange to keep items in the same place at all times, and apply large-print waterproof labels to address visual agnosia.

Visual acuity—how clearly the human eye can discriminate detail and contrast—can be affected by nearsightedness, farsightedness, presbyopia, astigmatism, eye diseases, trauma to the eye, or CNS dysfunction. In the United States, over 30 million adults over 40 are nearsighted, and over 11 and a half million are farsighted.[11] Corrective lenses are usually required for near-sightedness and far-sightedness. The OT practitioner should be aware of the client's preexisting visual acuity and of whether the client wears corrective lenses. If so, the occupational therapist should know the type of lenses.

Nearsightedness, farsightedness, and astigmatism often are easily corrected with prescription corrective lenses (i.e., eyeglasses or contact lenses). As adults age, they typically require corrective lenses to read because of presbyopia or farsightedness associated with age-related changes of the lens. Clients who require correction for both nearsightedness and farsightedness wear bifocal lenses, which correct both problems within the same lens. Occasionally some clients choose to wear contact lenses for distance viewing and reading glasses for near viewing or may wear two different contact lenses, one for distance and one for near. Other clients may need to wear only one contact lens for distance and can read without correction with the other eye. Some clients require trifocal lenses, which include a midrange distance. The lens of the eyeglasses may show a distinct demarcation of the different corrections within the glass lenses or may be unnoticeable, as with transition lenses.

Many modifications—such as ultraviolet protection tinting, lightweight lenses and frames, lenses that stay light indoors and darken in the sunlight, glareproofing, and so on—are available. A recent development is laser surgery that may

free the patient from need for any corrective lenses. However, everyone should wear sunglasses when outside to protect the retinas from the damaging ultraviolet rays of the sun. During evaluation, the occupational therapist investigates the client's visual history, including the presence of visual symptoms, whether corrective lenses are used and for what purpose, the age the client began wearing glasses and for what purpose, age of current glasses and their condition, date of the last professional vision examination by a vision specialist, name of the vision specialist, the presence of eye diseases, and any history of eye injury or eye surgery. The occupational therapist then assesses visual functions, including visual acuity, oculomotor control, and visual field testing. All clients who wear or who need corrective lenses should have current eyeglasses or contact lenses that provide optimal corrected vision. It is not unusual for clients to have lost their glasses, attend therapy wearing outdated glasses, or have ill-fitting glasses or ones that require repairs. The occupational therapist shares his or her findings with the client and may consult with the client's physician to request a referral for a complete vision examination. The client may require a current vision examination to update a prescription

The OT practitioner needs to consider vision problems, including recommendations and devices recommended by the optometrist, in treatment planning for every client. The practitioner would assist the client in using his or her eyeglasses appropriately (e.g., wearing them to all therapy sessions as indicated and removing reading glasses during dressing training when they are unnecessary). Reminders such as signs in a client's room or notes in the client's daily planner or memory notebook would inform others that the client should always have his or her glasses. The clinician also includes eyewear use and care in therapy. Clients may need to practice putting on and taking off their glasses, cleaning them, putting them in and out of their case, etc. For clients who tend to misplace or lose their eyeglasses, a headband can secure the glasses and prevent loss. Clients gain more from visual-perceptual training when their vision has been corrected.

Damage to the brain can impair visual-perceptual functioning. Damage to the peripheral and central mechanisms may alter a person's ability to process visual information and integrate it. The effect on functional performance depends on the extent of visual and perceptual dysfunction and the skills required for the person to accomplish life roles.

Visual Perception Organization and Processing

Visual-perceptual skills are organized in a hierarchy of levels that work together (Figure 23-1).[38] The ability to use visual-perceptual skills to adapt to the environment depends on the interaction of all of these skills at all levels.

One should read Figure 23-1 from the bottom. First, at the foundation level, the brain must receive clear, concise visual information from the environment. The three *primary visual functions* at this basic level are visual acuity, oculomotor control, and the visual fields.

Visual acuity ensures that the visual information sent to the brain is sharp, clear, and accurate. **Oculomotor control** occurs with effective coordination of eye movements by the eye muscles. The **visual fields** represent reception of complete visual information in the environment in all areas. These primary visual functions act together so humans can

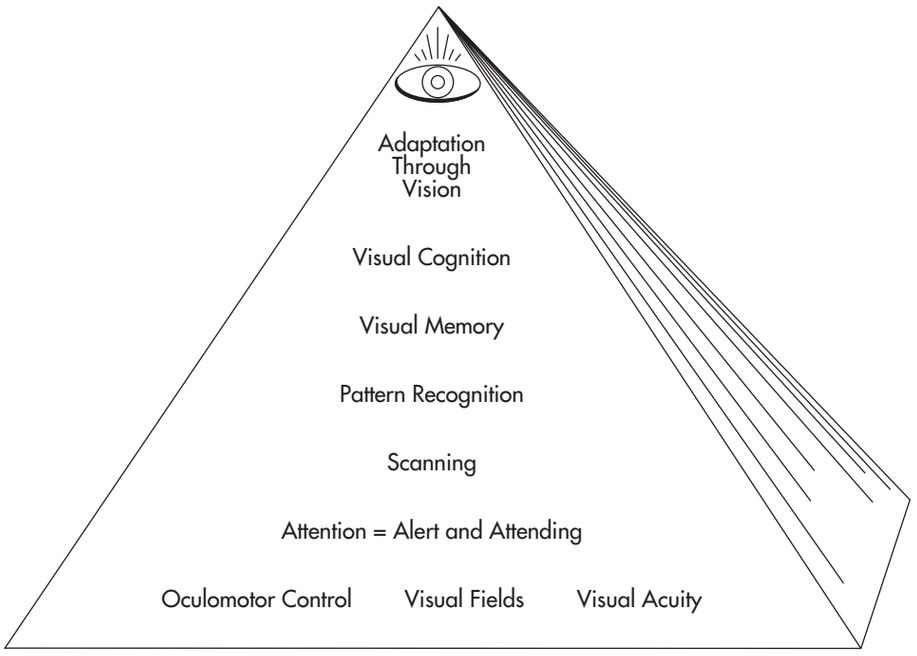

Figure 23-1 Hierarchy of visual perceptual skill development in the central nervous system. (Courtesy Josephine C Moore. From Warren M: A hierarchical model for evaluation and treatment of visual perceptual dysfunction in adult acquired brain injury. Part I, *Am J Occup Ther* 47:42, 1993.)

focus on and follow moving targets in the environment. These functions also provide the basis for all higher-level skills. In the case study, Mr. J. has blurred vision, thus indicating reduced visual acuity. Mr. J. also has double vision that may indicate eye misalignment or eye coordination deficits.

Visual attention, the next level in the hierarchy, involves fixating gaze on an image for as long as required, and shifting to other objects as needed. When processing speed is reduced, the client must attend visually long enough to process all of the information. Mr. J. has reduced attention and concentration, suggesting that he has reduced visual attention as well.

Visual scanning consists of shifting attention from one vision target to another in smooth succession so that the person continues to see the image clearly no matter how much the eyes move. Scanning allows a person to focus vision gaze on a chosen object on the area of the retina with the greatest ability to process detail, even when the eyes, the head, or the object is moving.

Pattern recognition is the ability to identify the important features of objects and the environment and to use these features to distinguish an object from its surroundings[23] and objects from each other.

Visual memory is the next skill level in the hierarchy. The brain must be able to create and retain a mental image of the observed object in the mind's eye and store a visual image temporarily in short-term memory. The brain processes visual information in working short-term memory to produce a response. The brain also must be able to store the image in long-term memory and then remember the information from a selection of choices (recognition) or retrieve it from memory (recall), when needed. The difficulties with attention, concentration, and visual problems that Mr. J. has demonstrated would interfere with memory, which is also impaired.

The highest skill in the hierarchy is **visual cognition**, the ability to manipulate visual information mentally, understand the mental image, and integrate it with other sensory information, using all the other skills described in the hierarchy. Visual cognition serves as a foundation for all learning (i.e., reading, writing, mathematics, and the majority of vocational and avocational pursuits).

Although different areas of the brain have different responsibilities in processing visual information, all areas work together to make sense of what is seen.[25,26] The brain works most efficiently only when all systems work together. Any central or peripheral damage of the visual components can cause dysfunction, a breakdown of the organization of visual processing, and reduced functional performance.

Because of the unity of the hierarchy, a disruption of skill function at one level will affect the entire structure. If an eye or brain injury disturbs a lower level skill, the skills above it will also be compromised. Evaluation of vision function requires an understanding of the function of vision at each skill level, which is the responsibility of the occupational therapist. Treatment for visual dysfunction focuses first at the level that has been disrupted. The following information is provided to prepare the OTA to assist in treatment, with supervision by the occupational therapist.

Deficits in Primary Visual Functions

Visual Acuity

Visual acuity is more than just the ability to read a line on the letter chart. It represents a complex interaction between the optical system, which focuses light at the back of the eye on the retina, and the CNS processing, which transforms that light into the visual images seen.

The first stage of CNS visual processing begins at the retina, where the sensory receptors of the eye or photoreceptors respond to specific visual information in the environment and activate only when that stimulus occurs. The retinal field contains an estimated almost 1 million discretely coded photoreceptors that send detailed information on the spatial components of objects to the CNS for visual processing. This neural specificity enables the CNS to detect minute differences between patterns. Thus, for example, a person can tell a "b" from a "d" and a tangerine from an orange.[12]

For the retina to resolve spatial information, visual images must be focused precisely. A defect in the optical system can cause the images to be poorly focused on the retina.[12] The optical system consists of the cornea, lens, and optic media.

The four most common optical defects reducing acuity are myopia (nearsightedness), hyperopia (farsightedness), presbyopia (farsightedness associated with aging), and astigmatism (variations in curvature of the cornea). In **myopia** the image of an object is focused at a point in front of the retina and is blurred when it reaches the retina. Myopia is corrected by placing a concave lens in front of the eye. In **hyperopia** the image comes into focus behind the retina, causing it to remain out of focus on the retina.[12] **Presbyopia** is caused by age-related changes or reduced elasticity of the lens of the eye. It occurs for many adults over the age of 40 years and eventually affects most adults. Hyperopia and presbyopia are corrected by placing a convex lens in front of the eye. Persons with myopia, hyperopia, or presbyopia require a bifocal lens, which contains correction for each problem.

In **astigmatism**, light cannot be focused clearly because the cornea is not totally spherical but instead is more spoon-shaped. It results in a blurring of the image and is corrected by placing a cylindrical lens in front of the eye,[12] either in eyeglasses or in contact lenses.

The clinician may see clients with conditions or diseases that affect vision, such as **cataracts, macular degeneration, glaucoma,** and **hypertension** or **diabetic retinopathy**. Preexisting vision conditions, which previously may have minimally affected visual function, may be a bigger factor in cases of neurological dysfunction, such as with a CVA or traumatic brain injury.

Corneal opacities such as cataracts and conditions that cloud the lens can also reduce the quality of the image projected onto the retina. Over 20 million adults over 40 have cataracts, which are caused by aging, diabetes mellitus, trauma, chronic steroid medication use, ultraviolet light exposure,[5] and heredity. Cataracts affect one or both eyes and first develop in middle age or later. Cataracts involve a gradual, painless loss of vision,[5] as if the person is seeing through

plastic wrap. Cataracts also cause significant difficulty tolerating glare.[5] Treatment involves thick lenses (because of severely reduced visual acuity) or surgical removal of the affected lenses with an intraocular implant.[5]

The health and integrity of the retina also influence the image quality sent on to the CNS. The **macular area** of the retina is particularly critical for identification of visual detail. Unfortunately, this structure is also vulnerable to several diseases that destroy its function, including age-related macular degeneration and systemic diseases (e.g., diabetic retinopathy, hypertension).

Age-related macular degeneration (ARM) affects over 9 million adults over age 40 years[11] and is the leading cause of loss of vision for older adults.[6] Central visual loss is gradual and painless,[5] but peripheral vision stays intact. Central visual acuity is often 20/200 and is considered legally blind.[5] Macular damage also significantly reduces the ability to distinguish visual details such as variations in colors, pattern frequency, and contrast.[17] Accurate identification of patterns and objects becomes difficult because the CNS does not receive sufficient information to identify main features. For example, human faces have little contrast between the features—that is, the nose is the same color as the forehead, cheeks, and chin, and eye and hair color blend with skin tones. For this reason, clients with macular loss almost universally have difficulty identifying faces, even of close friends and family members. They must rely on other characteristics of the person, such as height, weight, hair color, clothing preferences, and voice, to identify him or her. Approximately one in four people over age 80 years has a vision impairment that affects the retina significantly enough that the individual cannot read standard size print.[17]

Glaucoma is caused by increased pressure within the eye, pinching the optic nerve. Over 2 million adult Americans have been diagnosed with glaucoma, and two million more adults have undiagnosed glaucoma.[11] A gradual loss of peripheral or side vision occurs, whereas central vision remains intact.

Hypertension, or high blood pressure, can cause hypertensive retinopathy due to arteriosclerosis (hardening of the arteries) of the retinal blood vessels.[7] The process of gradual loss of visual acuity in hypertensive retinopathy is identical to that of diabetic retinopathy, a common complication of diabetes. In diabetic retinopathy, dilation and breakdown and leakage of blood from retinal vessels[11] cause retinal damage. Laser surgery can be effective in treating the condition.[11]

Myopia, hyperopia, presbyopia, cataracts, diabetic neuropathy, and other conditions that cause refractive errors generally can be corrected by lenses or surgery. Glaucoma is treated with medication. Services are provided by a vision specialist, such as an **ophthalmologist** or an **optometrist**.

Treatment Strategies for Visual Acuity

Reduced ability to see contrast or color and the loss of central or peripheral vision cannot be resolved by prescribing a pair of lenses. Instead, the OT practitioner actively teaches the client compensatory strategies and helps him or her adapt the environment. Three factors can be manipulated to make the environment more user-friendly to the individual with reduced acuity: background contrast, illumination, and background pattern.[15]

The key to using contrast effectively is first to identify the critical items needed for orientation or identification in the environment and then to increase their *contrast* with surrounding features (e.g., by placing a light-colored object on a dark background). Using a dark blue or black plate—not colors usually associated with food—could help Mr. J. see his food more easily because of the increased contrast.

Increasing the intensity of available light for better *illumination* enables objects and environmental features to be seen more clearly and reduces the need for high contrast between objects. For example, facial features can be identified more easily if the person's face is fully illuminated. The challenge in providing light is to increase illumination without increasing glare. Natural and white lighting provide the best sources of high illumination with minimal glare and are recommended over standard fluorescent lighting for both room and reading illumination.

In addition to reducing glare, minimizing shadows is also important. The use of single bulb or recessed "can" lighting in hallways and rooms should be avoided; instead, long panels of fluorescent lights should be used. For reading, direct "white" (pure) lighting in the form of desk lamps or natural lighting provides the best illumination.

Patterned backgrounds have the effect of camouflaging objects lying on them. Even people with excellent vision have trouble locating an earring back or a small screw on a patterned carpet. Solid colors should be used for background surfaces such as bedspreads, bed sheets, placemats, dishes, countertops, rugs, towels, carpets, and furniture coverings.

Clutter in an environment causes the same problems as pattern. A person who has difficulty identifying objects will perform better when asked to scan a kitchen shelf with a few orderly items rather than one with dozens of items. The same is true of closets, drawers, sewing baskets, desks, bookshelves, countertops, and clinic areas.

Oculomotor Control

The process by which the eye muscles control eye movements is oculomotor control. Oculomotor skills include alignment, range of motion, speed, and coordination. Deficits in oculomotor control can cause severe problems. To maintain a single visual image, the eyes must always line up evenly and move together. If the muscles of one eye are paretic (weakened), the eye may drift toward one side of the eye socket (i.e., drift either in or out). When the movement of one eye does not match that of the other, the person sees a double image. This condition is known as diplopia, or double vision.[27] To eliminate the double image, the patient often holds the head in a position that reduces the need to use the paretic muscle (usually in the same direction as the weak muscle) or closes one eye. If the range of motion is affected, the person may not be able to move his or her eyes in all planes as quickly, causing difficulty with using the eyes together in a coordinated manner. Dysmetric eye movement, in which the eye undershoots or overshoots a target, may also be observed.[3,24]

These disturbances in the control of the eye muscles affect functional performance. Visual images may appear blurred or doubled, and the client may have difficulty focusing at different distances from the body, with impaired depth perception. Compensating for double vision by closing one eye can further reduce depth perception. Deficits in oculomotor control create significant visual stress for the client, reducing attention and concentration and endurance for activities. In response to this increased visual stress, the person may complain of headaches, eye pain, eye strain, or neck strain. The client may be slower in scanning the environment, taking in visual information, and responding to the environment. In response, the client may become frustrated, agitated, and less cooperative in therapy. Treatment for oculomotor dysfunction should be coordinated by the occupational therapist with the guidance of vision specialists.[18,27]

Visual Fields

Numerous visual field deficits, some of which can limit the client's independence and functional mobility within the environment, exist. **Homonymous hemianopsia** (or hemanopsia), the loss of visual field in the corresponding right or left half in each eye, is the most common visual impairment observed after a CVA.[45] The OTA should observe the client with CVA for signs of a visual field deficit, including (1) changing head position when asked to view objects placed in a certain plane; (2) consistently bumping into objects on one side; (3) misplacing objects in one field; and (4) making consistent errors in reading. Such observations should be reported to the occupational therapist.

Clients with visual field deficits experience changes in several areas of performance that affect their ability to complete daily activities safely and effectively. The most significant change occurs in the area of **visual scanning.** Instead of spontaneously adopting a wider scanning strategy, turning the head farther to see around the blind field, clients tend to narrow their scope of scanning.[42] They adopt a more protective strategy, turning the head very little; limiting their scanning to areas immediately adjacent to the body; and concentrating more on sensory input from the tactile, proprioceptive, and vestibular senses. This strategy for field loss occurs because the brain fills in (perceptually completes) any portion of the visual field that is missing, thus providing the viewer with the illusion of seeing a complete visual scene.[34] The person experiencing visual field loss is not immediately aware of the absence of vision and experiences it only through interaction with the environment.[24] The person may run into walls or other obstacles when navigating in the environment and may not be able to find items or see people within the blind field.

Clients with field loss are not aware of the boundary between the seeing and nonseeing field. Instead, they (incorrectly) perceive a complete visual scene in which objects always seem to be appearing, disappearing, and reappearing without warning. Uncertainty regarding the accuracy of visual input on the affected side causes the person to adopt a protective strategy that is more midline- and body-centered.[28] Clients are less aware of objects and the environment because they have reduced the space in their world to that immediately in front of themselves. The midline fixation creates problems in activities such as walking (moving) in a changing (moving) environment such as a shopping mall, which requires scanning and awareness of a wider environment.

If the central and particularly the macular portion of the visual field is affected, the client tends to miss or misidentify detail when viewing objects. Reading presents the greatest challenge and frustration for the client.[45] Words can often be guessed from context. Inaccurate reading of numbers is the more functionally limiting problem because numbers appear without context. Because Mr. J.'s visual problems would interfere with his ability to perform one of his favorite pastimes, reading, the OT clinician might suggest large-print books, books online in larger font, and perhaps audiobooks.

Depending on the size of the visual field loss and the side on which the loss occurs, the client may experience difficulty guiding the hand in writing and other near-vision tasks such as cutting. The top envelope in Figure 23-2 illustrates the handwriting of a client with right visual field loss. In attempting to address the envelope, the client would lose sight of the hand in the hemianopsic field on the right side and subsequently begin to drift downward on that side. The bottom envelope in Figure 23-2 illustrates the client's performance after training.

As part of the evaluation process, the occupational therapist would identify the presence of visual field deficits and recommend complete testing by a vision specialist, such as an optometrist or ophthalmologist, who has the expertise to specifically diagnose visual field cuts.

Treatment Strategies

In providing treatment for clients with visual field deficits, education and a combination of strategies are used. First the clinician works with the client to increase awareness of the dysfunction and effect on functional performance. Remedial strategies focus on increasing the speed, scope, and effectiveness of the scanning pattern. The client must learn as quickly as possible to turn the head to compensate for the limitation in field. Activities may include games such as catch with a ball or volleyball with a balloon.

Visual field deficits can affect all functional areas but have a primary effect on driving, reading, and writing. Driving is a complex skill that involves the interaction of physical, cognitive, emotional, and visual abilities.[37] A client's ability to resume driving safely requires a specialized evaluation completed by qualified personnel (see Chapter 16). Clients with field deficits experience difficulty primarily in three aspects of driving: (1) changing lanes; (2) merging on and off roadways; and (3) monitoring traffic in multilane situations. The extent of the difficulties depends on the size of the field deficit, the client's awareness of the problem, and the client's demonstrated ability to compensate for the deficit. The occupational therapist focuses on increasing scanning speed and scope and teaching the patient specific strategies to handle the three traffic situations.

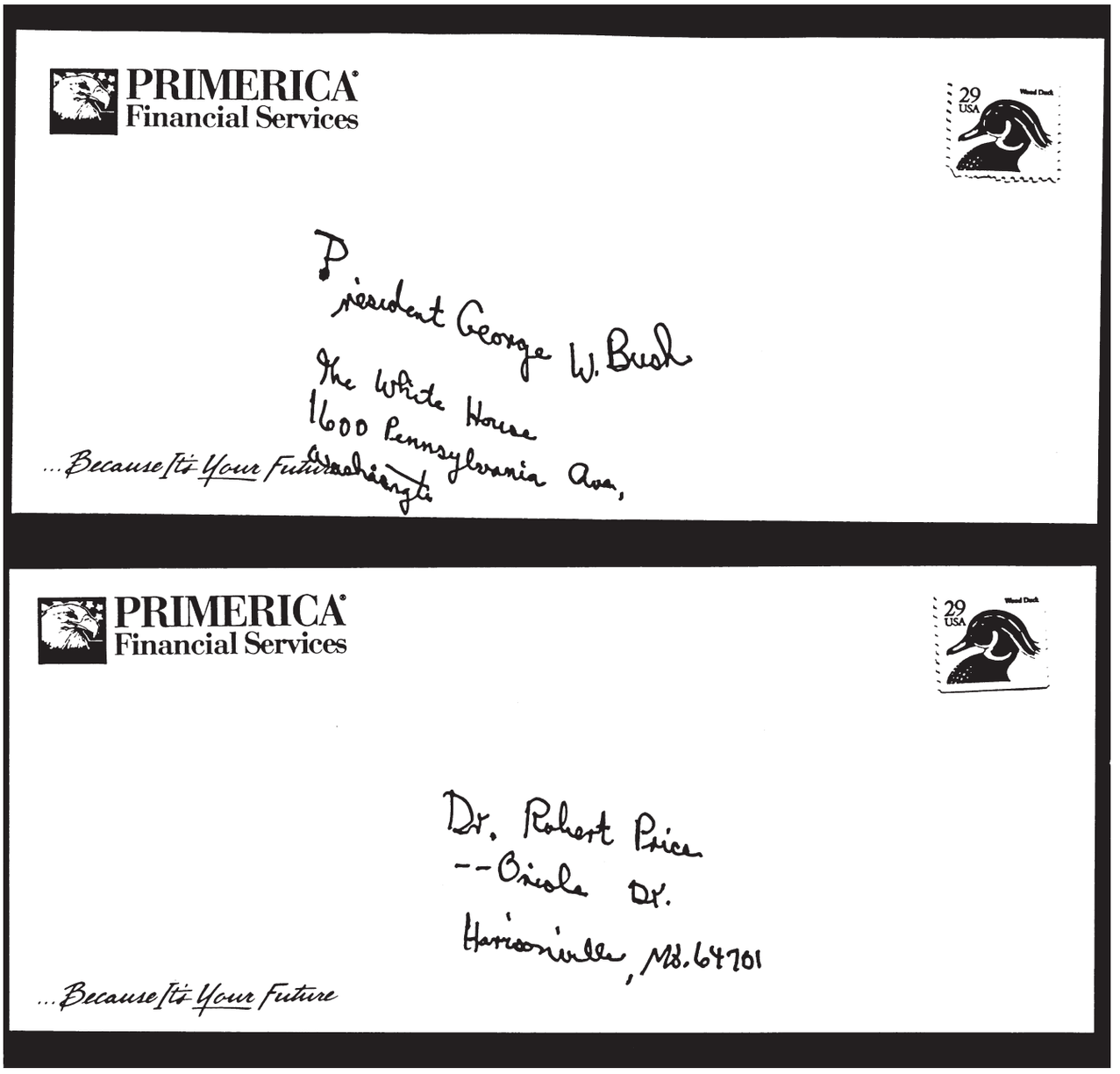

Figure 23-2 Handwriting completed by a patient with right-sided hemianopsia (hemanopia). Upper drawing depicts typical slant as pen moves into hemianopic field. Lower drawing shows improvement after training. (From Warren M: Visuospatial skills: assessment and intervention strategies. In Royeen CB, editor: *AOTA self-study series: cognitive rehabilitation*, Rockville, MD, 1994, American Occupational Therapy Association.)

Difficulties in reading occur in locating and maintaining the correct line of print and accurately identifying words and numbers.[45] Clients with left visual field deficit typically do not move their eyes to the far left-hand margin of the reading material to begin a new line of text. Drawing a thick red line down the side of the left-hand margin provides the client with an "anchor" to find the left margin.[42] The same technique used on the right margin assists clients with right visual field loss, who are often uncertain whether they have reached the end of a line of print. The clinician teaches the client to move his or her eyes until he or she finds the red line to avoid missing any of the written material. If the client has difficulty staying on the line or moving down to the correct line, a ruler or card can be held under the line of print. These techniques can be employed when the patient is required to read a bill, financial statement, recipe, or cooking instructions. The client can also check off each line to help keep his or her place.

To learn how to stay on the line when writing, the OT practitioner teaches the client to watch the pen tip and maintain visual fixation as the hand moves across the page and

into the area of visual field loss. Activities that require the client to trace lines toward the side of the field loss are effective in reestablishing the eye-hand connection. Contrast in writing can be heightened by using black felt-tip pens and boldly lined paper. Devices that offer feedback, such as a talking pen, also work well to train the client to monitor the pen tip while writing.

The clinician can enhance functional performance by modifying the client's visual environment. Adding color and contrast to the key structures in the environment needed for orientation (door frames, furniture, stair edges, etc.) assists the client in locating these structures. Reduction of pattern in the environment by decluttering it and using solid-colored objects can enhance the client's ability to locate items. For functional mobility in the community, the clinician instructs the client to walk in noncongested well-defined areas (e.g., grocery stores with shelving in high contrast with the floor).

Deficits in Central Nervous System Visual Skills

Visual Attention and Scanning

Visual attention can be divided into two categories: (1) focal or selective visual attention; and (2) ambient or peripheral visual attention.[23] *Focal or selective attention* is used for object recognition and identification and enables persons to discriminate visual details accurately, such as differences between letters and numbers. It contributes greatly to learning. *Ambient or peripheral attention* allows people to detect and locate items in the environment. It relies on input from the peripheral visual field and mostly attends to moving objects. To have a fully functional and efficient visual system, the two modes of visual attention must work together.

Injury to the brain can disrupt normal scanning strategy. Visual scanning deficits associated with right-sided brain injury are characterized by an avoidance in shifting the eye toward the left half of the visual space.[9,15,22] The avoidance creates an asymmetrical scanning pattern. Instead of starting the scanning pattern on the left side of a visual array, where most adults do, individuals with right-sided brain injuries tend to begin on the right side of the array and stay on the right side. The person misses both detail and configuration in viewing objects on the left side and may fail to note some visual information needed to make accurate identification and decisions.

Visual inattention associated with right-sided brain injuries is often labeled *visual neglect, left unilateral spatial neglect*, or *hemi-inattention*.[19] Although *neglect* is often used to describe inattention to visual space occurring after left or right hemisphere lesions, research indicates that the condition occurs only with right-sided brain injuries.[22,34] Neglect is often confused with visual field deficits. Although both conditions may cause the client to miss visual information, they are distinctly different and do not have the same effect on the client's performance. When a visual field deficit occurs, the client attempts to compensate for the loss by engaging visual attention.[23] The client directs eye movements toward the side of the vision loss in an attempt to gather visual information from that side. Because of the field deficit, however, the client may not move the eyes far enough to see the needed visual information and thus misses visual information on that side. This performance may create a false impression of hemi-inattention or neglect.

In contrast, the client with true hemi-inattention or neglect has lost the attentional CNS mechanisms that drive the search for visual information. The inattentive client makes no attempt to search for information on the left side of the visual space; no eye movements or head turning are observed toward the left side.[23]

The client with both visual field deficits and neglect misses visual information on the left side because of the field deficit and has no means to compensate for it by directing attention toward the left side. The presence of a visual field deficit exaggerates the inattentive behavior observed in the patient with neglect.[21,43]

Research has shown that in normal adults, scanning is consistently completed in an organized, systematic, and efficient pattern.[9,18,29,40] The type of scanning pattern used depends on the demands of the task. In reading, a left-to-right and top-to-bottom rectilinear strategy is used. In scanning an open array (e.g., a room), a circular, left-to-right strategy is generally employed, with the eye following either a clockwise or a counterclockwise pattern.

Pattern Recognition

When a person does not thoroughly and efficiently scan for objects in the environment, decreased pattern recognition results. Clients with right-sided brain injury may fail to recognize an object or pattern because they do not perceive or "see" it. Clients with left-sided brain injuries may be aware of objects but have difficulty identifying them.[14,32] Mr. J. has visual agnosia (inability to recognize and name objects), thus suggesting that he has left-sided brain involvement.

Visual Memory

Visual memory depends on accurate pattern recognition. When an important aspect of an object is overlooked, the brain generates an inaccurate representation. If the representation is not accurate, the CNS may not recognize the object or may misidentify it. When this occurs, the CNS has difficulty establishing a visual memory of the object. Mr. J. has demonstrated memory problems in conjunction with deficits in attention, concentration, and visual function. Therefore he probably would have difficulty remembering ADL sequences and would benefit from large-print signs (visual cues) posted in several places.

Because humans do not store information through vision alone, information stored in memory can be retrieved through other sensory channels. If a person does not recognize an object by looking at it, the person can pick it up and feel it or can ask someone to explain what it is. Thus a patient with a visual deficit that results in inaccurate pattern recognition can still function reasonably well in ADL provided a variety of sensory information is available. However, as discussed earlier, function is likely to be impaired in the three daily living

skills that rely almost exclusively on vision for performance (reading, writing, and driving). Given Mr. J's problems, the OT practitioner addresses reading, writing, and functional mobility (instead of driving, which is contraindicated). Incoordination and sensory dysfunction would affect handwriting. Mr. J may benefit from using a weighted marker pen, which is easier to hold and requires less pressure, to practice writing, perhaps beginning with his signature, needed for daily functioning.

Visual Cognition

Visual cognition is the final product of the integration of all the foundation skills—visual attention, visual scanning, pattern recognition, and memory. Any deficit in these lower-level skills reduces the person's ability to apply these skills cognitively to function and adapt to the environmental demands.

Deficits in visual cognition result in problems identifying the spatial properties of objects and mentally manipulating these properties in thought. Many terms are used to describe the deficits that occur in visual cognition. They include *spatial agnosia, alexia, impaired visual closure, spatial relations,* and *figure-ground discrimination*. Assessment of visual cognition is done by the occupational therapist;[39] the OTA provides treatment under supervision with guidelines directed by the occupational therapist.

Clients with brain injury or disease demonstrate three changes in selective attention: (1) an inability to attend to the critical features and variables among objects; (2) a tendency to restrict scanning to objects only on the unaffected side; and (3) an inability to assign structure in scanning an unstructured array.[29,30] These changes cause clients to commit errors in viewing and manipulating complex visual information. In dressing training, Mr. J. could participate in a graded dressing program, beginning with the aspects he can perform without assistance and progressing to aspects in which he requires minimal assistance. Because of visual impairments, incoordination, and sensory deficits, he would not be a candidate for using a buttonhook to fasten buttons but would benefit more from wearing loose-fitting pullover shirts, adapting the shirt closure with a Velcro strip with buttons sewn on the outside to look like a buttoned shirt. The occupational therapist limits ADL training time to just over his attention span to reduce frustration and fatigue and gradually increases the time.

Treatment Strategies

Treatment of CNS visual-perceptual deficits is aimed at teaching the client to take in visual information in a consistent, systematic, and organized manner. Clients with inattention caused by right-sided brain injuries learn to reorganize their scanning pattern by beginning scanning in the impaired space (or left side) first.[42] Two scanning strategies are taught: a left-to-right rectilinear pattern for reading and a left-to-right circular pattern for scanning an unstructured array. Any therapeutic activity chosen to reestablish an organized scanning pattern is more effective if the patient is required to physically manipulate the objects scanned. Research has shown that a stronger mental representation of a visual image is formed if what is seen is verified by tactile exploration.[11] The OTA can incorporate the training of systematic scanning into ADL and other interactive tasks such as games (e.g., solitaire card games, dominoes, ball games, jigsaw puzzles, and checkers).

Clients with left-sided brain injuries benefit from engaging in activities that emphasize conscious attention to detail and careful review and comparison of objects. These include any type of matching or sorting activity, such as laundry, form boards, puzzles, or dominoes.

To improve the client's ability to scan, every activity should require the person to scan as broad a visual space as possible. The working field should be large enough to require the client either to turn the head or to change body positions to accomplish the task. Some smaller spaces, such as a closet in which the client looks for clothing, do not require adaptation. Activities and games can be enlarged to require head turning for scanning; one example is playing tic-tac-toe on a chalkboard, with the letters at least 5″ tall.

To improve selective attention, the OTA teaches clients to study objects consciously, emphasizing items placed in the impaired space. Matching activities that require discrimination of subtle details are especially effective. Treatment may begin by using pairs of common objects, such as toothbrushes, combs, etc., which may be easier to match because they are familiar. Also effective are games such as Concentration, Connect Four, checkers, Scrabble, dominoes, and 300- to 500-piece puzzles, word or number search workbooks, crossword puzzles, and crafts such as mosaic tiles. The OT practitioner encourages the client to doublecheck his or her work to ensure that critical details are not missed. Success in regaining selective attention is related to the client's ability to learn and employ a conscious strategy to compensate for the deficits created by inattention.

According to Toglia,[35] clients with brain injury may overestimate their abilities, believing them unaffected by injury. Without a real understanding of their limitations, clients may not be able to understand fully the purpose of compensatory strategies. Overestimation of ability may contribute to reduced safety awareness, necessitating constant supervision for safety. To increase insight, Abreu and Toglia[1] advocate teaching clients how to monitor and control performance by learning to recognize and correct for errors. The clinician gives the client immediate feedback about performance and points out problems. The client is taught self-monitoring techniques such as activity prediction, in which the client predicts how successfully an activity will be performed and identifies aspects of the activity in which errors are likely to occur. The client then compares actual performance with predicted performance. Employing this technique helps the client become aware and anticipate how the deficit will affect functional performance.

A final treatment guideline is to practice the skill within context to ensure carryover to functional activities. Research has shown that brain-injured clients generally do not transfer

skills spontaneously from one learning situation to the next. The OT practitioner therefore must have the client apply the learned strategy to different ADL contexts. Mr. J. could use the strategy of initiating organized search when selecting and gathering his supplies for upper body bathing or searching for items in a refrigerator or on a shelf. Repetition and practice in a variety of circumstances help the client generalize the skill and transfer it to new situations. Independent-living apartments, simulated work areas, and kitchens within the clinic may be used regularly in treatment. However, real-life situations, preferably in the community environment, are most likely to help the client develop insight into abilities and learn compensation for limitations. Cafeterias, gift shops, and office areas within the health care facility, and streets, fast-food restaurants, and shops near the facility can be used to expose the client to more realistic and demanding visual environments.

Vision Loss: Compensatory Techniques for Activities of Daily Living

Performing ADL may be overwhelming for the person with a new vision loss. Clients should be encouraged to use the remaining senses (hearing, taste, touch, smell) to gather and filter information. The occupational therapist or OTA teaches safety techniques first, breaking each activity into small parts and organizing all materials before beginning each activity. Starred items (*) could be incorporated into Mr. J.'s OT treatment program.

Eating

The newly vision-impaired individual may be concerned about whether his or her eating behaviors will be socially acceptable. Lack of confidence may lead the person to avoid social situations that involve eating and to restrict eating to finger foods. Initially, self-feeding with finger foods is acceptable but should progress to eating food with utensils.*

General Suggestions

The client should learn the following:

1. Establish a point of reference with an object at the table, such as a dinner plate. From this object, the placement of other objects can be determined. Using the plate as a "clock" can help clients learn a frame of reference to recall the location of items.
2. Place the plate on a contrasting colored placemat.*
3. When necessary, ask others what is on the plate and where the food is located. Ask others to cut meat and pour liquids as needed.*
4. If meat is on the plate, it should be placed at the 6-o'clock position, where cutting will be easier.
5. Always maintain tactile contact with the table.*
6. Bend forward while eating (if there are no feeding problems) so that any food falling from the fork will land on the plate.
7. Estimate the weight, temperature, and texture of the food from the way it feels on the fork or spoon before placing it in the mouth.
8. Use a "pusher" (e.g., piece of bread or roll) to stabilize food so that the fork will pick it up.

Exploring Contents of a Plate

1. Depending on other factors, use of a spoon is recommended for all self-feeding.*
2. Hold fork with the tines turned downward.
3. Insert fork into food starting with the 12-o'clock position and working around the plate clockwise.
4. Identify food by texture and smell before placing it in the mouth.*

Cutting Food with a Knife and Fork

1. Locate knife and turn cutting edge downward toward the table. Hold knife in the right hand.
2. Hold knife in the right hand with index finger firmly along the handle and thumb by the side of the handle.
3. Hold fork in the left hand with the tines turned downward to the table and the index finger along the top surface of the handle.
4. Use knife to locate food (preferably placed at the 6-o'clock position) to be cut.
5. Place fork about 1 inch (2.5 cm) from the outer edge of the food to be cut, and cut bite-sized pieces by placing knife against the back of fork's tines and sawing back and forth firmly and slowly.

Simple Food Preparation

A large tray should be used to prepare foods; it should be a different color than the dishes, cups, and utensils. This strategy keeps all items together, minimizes the area to be cleaned, and makes carrying items to the sink easier.*

Pouring Cold Liquids

1. Use a thermal cup with a lid with spout or cutout and straw for all liquids.*
2. Use a tall glass and center the container of liquid over the glass.
3. Before pouring, place the glass in the sink or a bowl to catch spills.
4. To estimate the level of the liquid as the glass fills, place the index finger (up to the first joint) over the lip of the glass.
5. Note changes in weight, temperature, and sound as glass is being filled.

Opening a Container of Milk

1. Locate the seam of the milk carton. The side that should be opened is directly opposite this seam. Milk cartons are easier to open when taken directly from the refrigerator when the wax is stiffer.
2. Alternatively, locate the two indented lines on the top of the milk carton. These lines indicate that this is the side to be opened.

Buttering a Piece of Bread

1. Use softened tub butter or margarine that is made easier to spread.

2. Use fingers or the feel of the knife's weight to determine the amount of butter on the knife.
3. Place bread either in the palm of the hand or on a plate. Spread the butter from the top right-hand corner to the lower right-hand corner. Then turn the bread 90° counterclockwise and repeat the procedure.

Making a Sandwich

1. Apply sandwich spreads in same manner as for butter.
2. Use presliced cold cuts.
3. Cut a sandwich safely by first placing the thumb and index finger on either side of the bread so that an arch is formed. Then place the knife under the fingers in the center of the arch and cut the bread.

Mobility and Safe Travel

Most significantly vision-impaired persons receive training in techniques of orientation and mobility. This is a specialized program, with separate training, available to interested OTAs. However, all OT practitioners should understand the basics of **hand trailing** and **sighted guiding**, techniques that can be used with the client inside and outside the home.

Hand Trailing

This technique involves the use of the hands to trail along a smooth, stationery object in a straight line, such as a wall or table edge.

1. Use the arm closest to the smooth trailing surface.
2. Person should hold the arm straight but not rigid, extending down in a diagonal.
3. The hand should lightly touch the trailing surface.

Sighted Guiding

The following is the recommended technique for a sighted person to guide a vision-impaired person when they are traveling together.

1. Guides should always ask the vision impaired client to take their arm.
2. The client grasps the guide's arm lightly but firmly above the elbow, with thumb outside and fingers wrapped to inside of arm.
3. The guide holds arm relaxed, with elbow bent.
4. The client stands at side of the guide, who walks in front with the client following a half step behind to ensure safety.
5. The guide should try to set a comfortable pace. If the client's grip tightens or if the client pulls back, slow down.

Protective Techniques for Safe Functional Mobility

These protective techniques are used to warn the vision-impaired person of unexpected and potentially harmful objects. These techniques are used most often in unfamiliar areas or in areas that may have been changed by others (e.g., repositioning of furniture). The two techniques given may be used separately or together.

Upper Body Protection (Upper Chest, Head)

For upper body protection the clinician teaches the client to do the following:

1. Bend forearm across the chest and touch the opposite shoulder.
2. Move hand forward so that it is about 12 inches (30 cm) from the shoulder, with the palm facing outward and the fingers held loosely.

Lower Body Protection

For lower body protection the clinician teaches the client to do the following:

1. Extend one arm forward and downward, placing it about 12 inches (30 cm) in front of the opposite thigh.
2. Turn palm to face the body, with fingers pointing toward the feet.

Telling Time

Low-vision aids such as magnifying glasses and telescopes may be used to view watches or clocks. Special timepieces with Braille, talking features, and large numbers with contrasting background colors can be obtained from the American Foundation for the Blind. However, the client will require training with any new device; therefore the OT practitioner should be familiar with low-vision aids. The occupational therapist may recommend the devices, and the OTA with service competency could perform the training.

Money Identification

The ability to manage money independently is a very important functional skill.

Bills

The denomination of U.S. currency cannot be identified without assistance. The person must be told the denominations and then can use a system of folding, such as the following:

1. Singles should remain flat in the wallet.
2. Fives can be folded in half horizontally.
3. Tens can be folded in half vertically.
4. Twenties can be folded in half twice.

Coins

Coins can be identified through stereognosis, as follows:

1. Quarters are large and have rough edges.
2. Dimes are small and thin and have rough edges.
3. Nickels are thicker and wider than dimes and have smooth edges.
4. Pennies are smaller and thinner than nickels and have smooth edges.

Clothing Identification

Various methods may be used to mark clothing to assist in color matching, such as the following:

1. Safety pins (e.g., one for red, two for green) may be attached to the label. Alternatively, French knots or iron-on patches may be used. Braille labels from the American Foundation for the Blind are also available.

2. Texture or identifying marks (e.g., fasteners, trimmings) may be used to identify certain garments.
3. Small dots of clear nail polish simulating Braille letters can be applied on the inside of the heel of shoes to identify color.

Summary

A variety of structures in the eye and the brain are responsible for the processing of visual information. Whether a deficit in visual processing requires therapeutic intervention depends on the patient's lifestyle and whether the visual deficit prevents successful engagement in ADL.

OT evaluation and treatment of visual perception are based on a hierarchy of skill levels that are so interrelated that a skill function cannot be disrupted at one level without negatively affecting all perceptual processing. Intervention focuses on increasing the accuracy and organization of the sensory input into the system by remediating skills, adapting the environment, and teaching clients compensatory strategies to minimize the effect of deficits on functional performance. In addition, the experienced OTA might teach compensatory techniques to persons with vision loss to maximize functional performance and mobility.

Selected Reading Guide Questions

1. Compare and contrast the roles of the occupational therapist and the OTA in the treatment of clients with problems in performance skills and body functions.
2. Contrast remedial and compensatory treatment.
3. Give four examples of compensatory strategies used to prevent injury in the client with sensory loss from a CNS lesion.
4. Describe some remedial treatments used for clients with sensory loss.
5. List some safety precautions used for clients with sensory loss in the hand.
6. Contrast vision and visual perception.
7. Describe what happens to the eye that lacks oculomotor control and describe what happens to vision as a consequence.
8. List three environmental factors that can be changed to help the client with a deficit in visual acuity.
9. Describe the typical strategy of a client with a visual field loss and explain how the occupational therapist directs the client to compensate.
10. Contrast the effects of a visual field loss with the effects of true hemi-inattention.
11. Name the three areas of selective attention that typically are changed in the client with brain injury.
12. Describe the scanning pattern used to train clients with right-sided brain injuries to compensate for inattention.
13. Describe compensatory strategies for the client with visual loss in the areas of eating, food preparation, mobility, telling time, and identifying money and clothing.

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